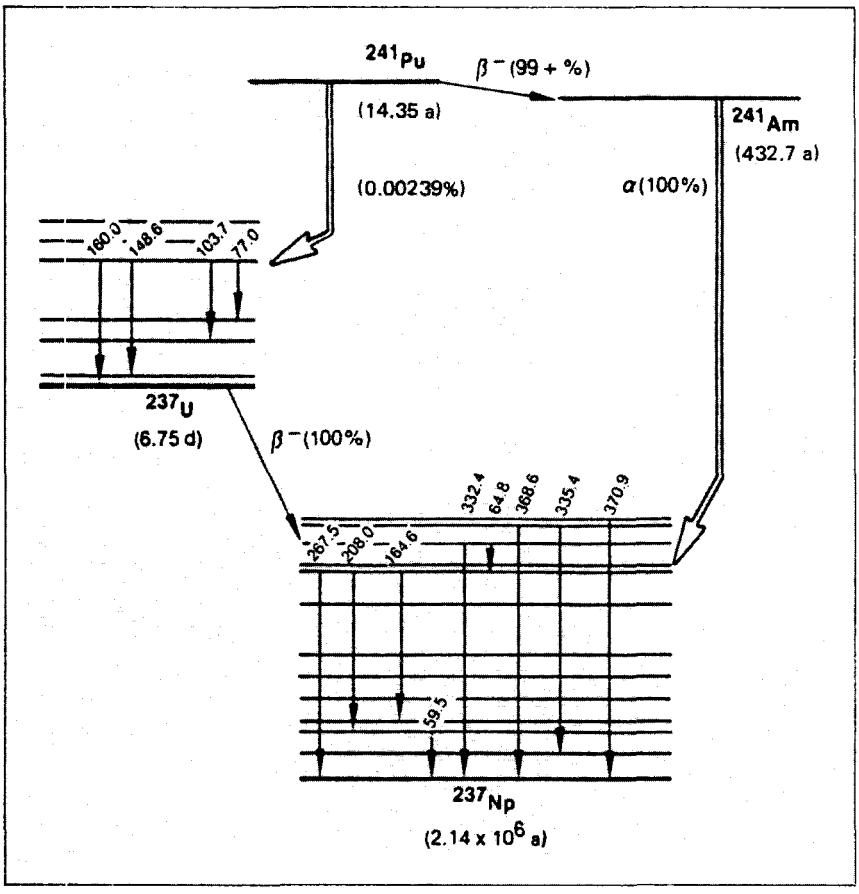

TECHNICAL REPORTS SERIES No. 261

Decay Data of the Transactinium Nuclides

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1986

DECAY DATA
OF THE TRANSACTINIUM NUCLIDES

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FOREWORD

This report summarizes the work performed by participants in the IAEA Co-ordinated Research Programme (CRP) on the measurement and evaluation of transactinium isotope nuclear decay data which was carried out from 1978 until 1985. The specific objectives of this project were to improve the quality and accuracy of heavy element and actinide decay data in order to:

- assess more accurately the effects of these data on the thermal and fast reactor fuel cycles
- aid in the evaluation of nuclear waste management procedures
- provide more reliable data for nuclear safeguards
- extend the knowledge of actinide decay characteristics required in scientific research.

Within the framework of an international co-operative effort, the CRP participants performed a number of highly precise measurements and systematic in-depth evaluations of the required data. They have also contributed to the development of methodology and measurement techniques, and stimulated a number of measurements and evaluations at laboratories not directly involved in the IAEA project.

The results of the work undertaken by the CRP are presented in Parts 2 and 3 of this book. Part 2 takes the form of data tabulations with specific reference to the measurements and evaluations performed by the CRP participants and the data which they recommend; these consist of listings of recommended half-lives and branching fractions, gamma ray transition energies and emission probabilities, and alpha radiation energies and emission probabilities. A complete set of recommended heavy nuclide decay data is given in Part 3, including data that originate from sources other than the CRP.

CONTENTS

Part 1

ASSESSMENT AND STATUS OF REQUIREMENTS

1.1. INTRODUCTION

Transactinium nuclides are important in the nuclear fuel cycles of both thermal and fast reactors, and have found increasing applications in other fields. Traditionally, the measurement of decay data for these nuclides has been motivated mainly by their relevance to fundamental low energy nuclear physics. Extensive measurement efforts have also been developed over the past thirty years in response to the increasing need of the nuclear technology community for accurate data. This has resulted in a large amount of detailed data on the decay properties of these nuclei. However, the existence of this extensive body of information does not necessarily mean that the decay data needs for any given application are satisfied. A proper assessment of the adequacy of the existing data base for a given application requires a careful examination of this information in terms of the specific needs of the user.

1.2. ORIGIN AND BACKGROUND

The IAEA, in co-operation with the Nuclear Energy Agency of the OECD, convened in 1975 an Advisory Group Meeting on Transactinium Isotope Nuclear Data (TND), at the Kernforschungszentrum Karlsruhe [1]. This meeting brought together users and measurers to review the requirements and status of the nuclear data for transactinium nuclides relevant to fission reactor research and technology. One of the areas specifically addressed at this meeting was the status of the decay data for these nuclides. A substantial part of the data then available did not meet the requirements specified by the users. More specifically, it was recognized that the accuracy of many of these data was not adequate to satisfy a number of needs in such areas of reactor technology as safeguards, fuel assay, mass determination and standards. In response to this situation, the 1975 TND meeting recommended that the IAEA implement an international programme to improve the status of these data. This recommendation was accepted by the IAEA, and a co-ordinated research programme (CRP) was established in 1977 to review, measure and evaluate the required transactinium isotope decay data.

1.3. COMPOSITION OF THE CRP

Five groups experienced in decay data measurements agreed to participate in the work of this CRP. Their representatives met for the first time at IAEA

Headquarters in Vienna in April 1978 [2]. Subsequent meetings of this representative group were held annually up to 1984 [3–8].

The five laboratories which participated formally in this CRP by performing the required measurements and evaluations are:

UKAEA Atomic Energy Research Establishment (AERE), Harwell, United Kingdom (represented by A.J. Fudge)

Central Bureau for Nuclear Measurements (CBNM), Geel, Belgium (represented by R. Vaninbroukx)

Idaho National Engineering Laboratory (INEL), Idaho Falls, Idaho, USA (represented by C.W. Reich)

Japan Atomic Energy Research Institute (JAERI), Tokai-Mura, Japan (represented by H. Okashita, and previously by H. Umezawa)

Laboratoire de Métrologie des Rayonnements Ionisants (LMRI), Gif-sur-Yvette, France (represented by J. Legrand, with the participation of N. Coursol, F. Lagoutine and G. Malet).

A.L. Nichols of UKAEA Atomic Energy Establishment Winfrith (AEEW), UK, has participated in most of the meetings of the CRP and has been actively involved in its work. In addition, K. Debertin of the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Federal Republic of Germany, W.B. Ewbank of the Oak Ridge National Laboratory (ORNL), USA, and V.M. Kulakov of the Kurchatov Atomic Energy Institute, USSR, provided helpful input to some of the meetings. The programme was co-ordinated by A. Lorenz of the IAEA Nuclear Data Section.

At the same time, other laboratories in Japan, the UK and the USA have been engaged in measurements relevant to the objectives of the CRP. In response to specific requests, I. Ahmad of Argonne National Laboratory has carried out accurate alpha particle emission probability measurements on several actinide nuclides. Valuable input to the CRP has also been provided by the US Half-Life Evaluation Committee, which was set up several years prior to the inception of the CRP to deal with the problem of the poor status of the half-life data for the important Pu nuclides (^{239}Pu, ^{240}Pu and ^{241}Pu).

1.4. IDENTIFICATION OF THE REQUIREMENTS

The decay data requirements identified at the 1975 TND meeting at Karlsruhe were used to plan the initial work of the CRP, and a measurement programme was drawn up and started in 1978. At a second IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, held at Cadarache in 1979 [9], the original requirements were extensively reviewed and several modifications were made. In some cases, the required accuracies had been achieved and the related data requests were regarded as having been satisfied. However, additional data needs were

identified and increased accuracy requirements were specified. In a number of cases the requested accuracies exceeded the capability of current experimental techniques. A third IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data was held at Uppsala in May 1984 [10]; it provided an opportunity to make another assessment of the status of the data. A summary of the present status of the data is presented in Table I. This also gives an overview of the requirements which were identified at the three Advisory Group Meetings.

1.5. OBJECTIVES OF THE CRP

The objectives of the CRP were to

- assess the status of the existing data
- identify the data discrepancies and unfulfilled requirements
- encourage measurements to meet the requirements
- evaluate the data

and ultimately to arrive at a final set of decay data for the transactinium nuclides which would satisfy the required accuracies.

To achieve these objectives, the status of the existing data was reviewed annually, priorities were assigned, on-going measurements were co-ordinated and new ones initiated. Considerable emphasis was put on co-operation among the participating laboratories and on the intercomparison of the results. The CRP participants concentrated specifically on the measurement and evaluation of total and partial half-lives, and alpha particle and gamma ray emission probabilities, these being the broad categories of decay data emphasized at the Karlsruhe Advisory Group Meeting in 1975.

1.6. ACHIEVEMENTS OF THE CRP

1.6.1. Measurements

On the basis of their broad experience in decay data measurements, the CRP participants have critically evaluated the experimental feasibility of achieving the requested data accuracies. Their access to and familiarity with several national decay data files has enabled them to unify the information from a number of sources and prepare a list of evaluated data that reflects their status accurately.

One significant aspect of the CRP programme was to have a number of the quantities measured independently by several of the participating laboratories. The evaluation of the results to produce a single recommended value for each quantity (for example, P_γ values for ^{235}U) was considered to be an especially important task for which the CRP participants were uniquely qualified.

Text cont. on p. 12.

TABLE I. TRANSACTINIUM ISOTOPE DECAY DATA: REQUIREMENTS, STATUS AND CRP ACTIVITIES

The laboratories which have contributed to the IAEA Co-ordinated Research Programme for the Measurement and Evaluation of Transactinium Isotope Decay Data are referred to by their abbreviations: AEEW – UKAEA Atomic Energy Establishment at Winfrith, AERE – UKAEA Atomic Energy Research Establishment at Harwell, CBNM – CEC Central Bureau for Nuclear Measurements at Geel, Belgium, INEL – Idaho National Engineering Laboratory, Idaho Falls, USA, JAERI – Japan Atomic Energy Research Institute, Tokai-Mura, LMRI – CEA Laboratoire de Métrologie des Rayonnements Ionisants, Saclay, France. The label '+' refers to measurements or evaluations performed by laboratories that have contributed indirectly to the IAEA Co-ordinated Research Programme.

(a) Uncertainties for alpha, gamma and X-ray emission probabilities: the required and achieved accuracies apply to the major transitions only. The stated uncertainties correspond to 1σ confidence levels.
(b) The listed requirements represent those for the more prominent transitions from all the members of the decay chain of these nuclides.
(c) The beta emission probabilities are inferred from the gamma emission probabilities.
(d) P_X refers to L-X-ray emission probabilities.

Nuclide	Data type	Accuracy (%) (a) Required	Achieved	Needs	CRP activities Measurements	Evaluations	Comments
Th-228	$T_{1/2}$	1	0.1	Decay chain calculations (includes daughters)	–	CBNM	
	P_γ	2 (b)	2–5		CBNM, INEL	CBNM, LMRI	
Th-229	$T_{1/2}$	1	2	Mass determination in U-233 chain	–	–	CRP participants believe that the achieved accuracy of the half-life is adequate
	P_γ	2 (b)	1–3		INEL, +	INEL	
Th-230	$T_{1/2}$	1	0.4	Marine dating	+	+	

Th-232	$T_{1/2}$	not requested	0.4	Includes daughters	–	+	
	P_γ	not requested			–		
Th-233	$T_{1/2}$	1	0.5	Thorium cycle-	–	–	P_β and P_γ requirements
	P_β	2	unknown	decay heat	–	–	are not satisfied.
	P_γ	2	unknown		AERE	–	AERE measurement of P_γ planned
Pa-231	$T_{1/2}$	1	0.3	Non-destructive assay	–	–	
	P_α	2	2–7		–	AEEW	
	P_γ	2	2–5		AERE	AEEW	
Pa-233	$T_{1/2}$	1	0.4	Decay heat and mass	–	–	
	P_β	2	unknown	determination	–	–	Requirement for P_β is
	P_γ	2	1		AERE, CBNM, INEL	INEL	not satisfied
U-232	$T_{1/2}$	1	0.7	Shielding calculations (includes daughters)	AERE, +	+	$T_{1/2}$ requires confirmation. AERE measurement is
	P_α	2	1		–	–	planned
	P_γ	2	1–2		AERE, CBNM, INEL, +	CBNM	

TABLE I (cont.)

Nuclide	Data type	Accuracy (%) (a) Required	Achieved	Needs	CRP activities Measurements	Evaluations	Comments
U-233	$T_{1/2}$	0.5	0.1		+	+	
	$T_{1/2}$ (SF)	not requested		Thorium fuel cycle	+	–	
	P_α	2	1–2	and environmental	+	INEL	
	P_γ	2	1–2	studies	AERE, INEL	INEL	AERE measurement planned
	P_X (d)	5	unknown		–	–	P_X requirement not satisfied
U-234	$T_{1/2}$	0.3	0.1		+	AEEW	
	$T_{1/2}$ (SF)	not requested		Mass determination	+	–	
	P_α	1	0.03–1	and non-destructive	CBNM, JAERI, +	AEEW	
	P_γ	2	1–2	assay	CBNM	AEEW	
U-235	$T_{1/2}$	0.5	0.1		–	+	
	$T_{1/2}$ (SF)	not requested		Mass determination	+	–	The required accuracy of
	P_α	3	5–12	and non-destructive	–	–	3% for P_α is unlikely
	P_γ	1	1	assay	AERE, CBNM, INEL, +	CBNM	to be achieved
U-236	$T_{1/2}$	1	0.1		–	+	
	$T_{1/2}$ (SF)	not requested	3	Mass determination	+	–	
	P_α	3	5–15	and non-destructive	–	–	P_α and P_γ requirements
	P_γ	3	10	assay	–	–	are not satisfied
U-237	P_γ	1	2–3	Non-destructive assay of Pu	AERE, INEL	LMRI	AERE measurement of P_γ in progress

U-238	$T_{1/2}$	1	0.1	Mass determination	–	+	Required accuracies for
	$T_{1/2}$ (SF)	2	1.2	and non-destructive	+	+	P_α, P_γ and P_X are
	P_α	3	5–20	assay; $T_{1/2}$ (SF) for	–	–	unlikely to be achieved.
	P_γ	3	13	geochronology;	AERE, +	–	AERE measurement of
	P_X (d)	3	unknown	P_X for environmental studies	–	–	P_γ planned
U-239	$T_{1/2}$	1	0.2		–	AEEW	
	P_β	2	2–20	Decay heat	+	AEEW	P_β requirement is not
	P_γ	2	2		+	AEEW	satisfied
Np-236	$T_{1/2}$	5	10		+	–	$T_{1/2}$ and P_β requirements
	Branching ratio	5	2	U-232 production	–	–	not satisfied
	P_β	2	unknown		–	–	
	P_γ	2	2		–	–	
Np-236m	$T_{1/2}$	5	2		–	–	
	Branching ratio	5	2	U-232 production	–	–	
Np-237	$T_{1/2}$	0.5	0.5		AERE/CBNM	–	Confirmatory measurement
	P_α	1	20	Environmental studies	CBNM	–	of $T_{1/2}$ is definitely
	P_γ	1	1–2	and mass	AERE, CBNM, +	INEL	required. New $T_{1/2}$ results
	P_X (d)	2	unknown	determination			are expected from AERE and CBNM in 1985. P_α and P_X requirements are not satisfied. Measurement of P_α is planned by CBNM

TABLE I (cont.)

Nuclide	Data type	Accuracy (%) (a) Required	Achieved	Needs	CRP activities Measurements	Evaluations	Comments
Np-238	$T_{1/2}$	2	0.1	Activation analysis of	–	–	
	P_γ	2	5	Np-237 and Am-242m determination	–	–	P_γ requirement is not satisfied
Np-239	$T_{1/2}$	1	0.2	Decay heat and	–	–	
	P_β	2	(c)	detector calibration	–	–	
	P_γ	1	1–2	standard	CBNM, +	CBNM	
Pu-236	$T_{1/2}$	1	3.0		–	+	$T_{1/2}$, P_α and P_γ
	P_α	2	1–3	U-232 production	–	–	requirements are not
	P_γ	3	30		–	–	satisfied
Pu-237	$T_{1/2}$	not requested	0.1		+	CBNM	
	P_X (d)	2	unknown	Environmental studies	–	–	P_X requirement is not satisfied
Pu-238	$T_{1/2}$	0.5	0.3		+	+	
	$T_{1/2}$ (SF)	2	4	Mass determination	–	+	$T_{1/2}$ (SF) requirement is
	P_α	1	<1	and non-destructive	CBNM, +	LMRI	not satisfied.
	P_γ	1	1–2	assay; P_X for detector calibration	CBNM, INEL, LMRI	LMRI	LMRI measurement of P_γ planned
	P_X (d)	2	2–3		–	–	

Pu-239	$T_{1/2}$	0.5	0.1		AERE, CBNM, +	CBNM	
	P_α	1	1–2	Mass determination,	+	JAERI	
	P_γ	1	<1	non-destructive	INEL, LMRI, +	JAERI	
	P_X(d)	3	3	assay and environ-	–	–	
				mental studies			
Pu-240	$T_{1/2}$	0.5	0.1		+	CBNM/LMRI	
	$T_{1/2}$ (SF)	2	3	Mass determination,	CBNM	+	$T_{1/2}$ (SF) requirement is
	P_α	1	1–2	non-destructive assay	+	LMRI	not satisfied.
	P_γ	1	1–2	and environmental	INEL, LMRI	LMRI	P_γ measurement planned
	P_X (d)	3	3	studies; $T_{1/2}$ (SF)	–	–	by LMRI
				for waste management			
Pu-241	$T_{1/2}$	0.5	0.7	Mass determination	AERE, CBNM, +	CBNM	$T_{1/2}$ requirement is not
	$T_{1/2}$ (α)	1	0.8	and non-destructive	CBNM	–	satisfied (measurements in
	P_γ	1	1–2	assay	INEL, +	LMRI	progress)
Pu-242	$T_{1/2}$	1	0.3	Mass determination,	+	+	
	$T_{1/2}$ (SF)	5	1.5	non-destructive assay	–	+	
	P_α	5	<1	and environmental	–	–	
	P_γ	5	2–5	studies	CBNM	–	P_X requirement is not
	P_X (d)	3	unknown		–	–	satisfied
Am-241	$T_{1/2}$	0.2	0.1	Non-destructive assay	–	CBNM	
	P_α	not requested	1–2	and low energy gamma	+	CBNM	
	P_γ	0.5–1	1–10	emission standard.	CBNM, LMRI	CBNM	CBNM measurement of P_γ
	P_X(d)	2	3	0.5% accuracy	–	–	in progress. P_X requirement
				requested for 59.5 keV			not satisfied
				gamma emission			
				probability			

TABLE I (cont.)

Nuclide	Data type	Accuracy (%) (a) Required	Achieved	Needs	CRP activities Measurements	Evaluations	Comments
Am-242	$T_{1/2}$	1	0.1	Cm-244 production and	–	y –	
	Branching ratio	1	1	Am mass determination	–	–	
Am-242m	$T_{1/2}$	1	1.4	Cm-244 production	+	AEEW	$T_{1/2}$ requires confirmatory measurement. P_X requirements not satisfied
	Branching ratio	1	0.03	and Am mass determination	–	AEEW	
	P_X (d)	3	unknown		–	–	
Am-243	$T_{1/2}$	1	0.2	Mass determination,	+	CBNM	
	P_α	1	unknown	long term storage and	–	CBNM	P_α, P_γ and P_X requirements are not satisfied
	P_γ	1	2	environmental studies	CBNM, +	CBNM	
	P_X(d)	2	unknown		–	–	
Cm-242	$T_{1/2}$	0.2	0.04		AERE, JAERI, +	JAERI	
	$T_{1/2}$ (SF)	5	2	Non-destructive	JAERI, +	JAERI	
	P_γ	5	4–20	assay	–	–	
Cm-243	$T_{1/2}$	1	0.3		–	+	
	P_α	5	1–3	Non-destructive	–	–	
	P_γ	5	2–10	assay and environ-	–	–	
	P_X(d)	5	unknown	mental studies	–	–	P_X requirement is not satisfied

Cm-244	$T_{1/2}$	1	0.3		–	+	
	$T_{1/2}$ (SF)	3	0.4		–	+	
	P_α	3	<1	Non-destructive assay	+	LMRI	
	P_γ	3	2–10	and environmental	–	LMRI	P_γ requirement is not
	P_X (d)	3	3	studies	–	–	satisfied
Cm-245	$T_{1/2}$	1	1	Long term storage and	+	+	
	P_α	5	0.5–2	environmental studies	–	–	
	P_γ	5	10		–	–	$\bar{P}_\gamma$ and $\bar{P}_X$ requirements
	P_X (d)	5	unknown		–	–	are not satisfied
Cm-246	$T_{1/2}$	1	2	Long term storage and	–	+	$T_{1/2}$, P_α, P_γ and P_X
	P_α	3	1–5	environmental studies	–	–	requirements are not
	P_γ	3	unknown		–	–	satisfied
	P_X (d)	3	unknown		–	–	
Cm-248	$T_{1/2}$	2	1	Long term storage and	–	+	
	P_α	3	<1	environmental studies	–	–	P_γ and P_X requirements
	P_γ	3	unknown		–	–	are not satisfied
	P_X (d)	3	unknown		–	–	
Cf-250	$T_{1/2}$	0.2	0.7	Impurity in Cf-252	–	–	$T_{1/2}$ and $T_{1/2}$ (SF)
	$T_{1/2}$ (SF)	2	4	neutron standard	–	–	requirements are not satisfied
Cf-252	$T_{1/2}$	0.2	0.3	Neutron standard	LMRI	INEL	$T_{1/2}$ requirement is not
	$T_{1/2}$ (SF)	1	0.3		–	+	satisfied; discrepancies exist among measured half-lives

The accuracies requested for many of the data were quite high, especially the gamma ray emission probabilities. This presented challenging experimental problems. Nevertheless, during the seven years of the CRP, some of these problems have been solved. A considerable amount of data has been produced with the required accuracy (at least for the prominent transitions, which are usually the ones of most interest to the user). Thus, the CRP has not only helped improve the existing capabilities of the participating laboratories but has also encouraged the development of such capabilities at other laboratories. Together with the systematic production of highly accurately measured decay data, this interaction among laboratories represents one of the more significant long term effects of the work of the CRP.

In comparing the measurements of gamma ray emission probabilities performed by the participating laboratories, it became evident that the individual results depended to a considerable extent on the calibration of the gamma ray detectors. In order to achieve some form of unity among the calibration data of the CRP laboratories, the IAEA compiled a provisional list of gamma ray emission probabilities and half-lives for all nuclides used as standards. This compilation represents an initial step towards a common base of reference standard data, and was published in report form in 1983 [11]. The data for these nuclides were selected from the most recent available evaluations.

In view of the importance of reference standards for the calibration of detectors used in the measurement of gamma ray emission probabilities, the CRP participants at the 1984 TND meeting re-emphasized the need for a common data base for these nuclides that should be used by all nuclear data measurement laboratories. It was recommended that an evaluation of the decay data be carried out for the most commonly used calibration nuclides and their gamma ray transitions in order to create an acceptable data base.

1.6.2. Evaluations

The CRP also evaluated specific decay data of the transactinium nuclides in order to arrive at a consistent set of recommended values. During the first two years, this effort was restricted mainly to the preparation of half-life values for 40 nuclides, ranging from ^{228}Th to ^{253}Es. In later years, this list was updated and expanded to incorporate nuclides with $Z < 90$ that were members of the decay chains of the transactinium nuclides. The most recently issued half-life list contains information on total and partial half-lives for 125 nuclides [12]. Substantial information has been obtained from:

- the current mass-chain evaluations published in Nuclear Data Sheets [13] (which uses the Evaluated Nuclear Structure Data File as a source file);
- the Actinide Decay Data File of the Idaho National Engineering Laboratory [14](which serves as the source file for the decay data incorporated into the Actinide File of ENDF/B); and

– the UK Chemical Nuclear Data Committee Heavy Element Decay Data File [15] (evaluated at AEEW).

In a number of cases, data have been supplemented or replaced by values measured or evaluated by members of the CRP and by other groups and individuals.

More recently, part of this effort has been directed towards the preparation of provisional lists of recommended values for alpha particle and gamma ray emission probabilities [12]. Values given in these lists were based generally on data published in Nuclear Data Sheets, supplemented by values from the Table of Isotopes [16] when appropriate. These values represented the current status of the published evaluated data. The provisional lists contained alpha particle transition probability data for 24 nuclides ranging from ^{228}Th to ^{252}Cf, and gamma ray emission probability data for 26 nuclides from ^{228}Th to ^{246}Cm. These provisional lists have now been superseded by the data presented in Part 3 of this report.

1.6.3. Consideration of uncertainties

The CRP participants established the following guidelines for the assignment of uncertainties:

(a) That the total uncertainty be based on a 1σ random error plus one-third the linear sum of the systematic errors based on a statistical confidence level of 68.3%;
(b) That an uncertainty assigned to a mean value should not be smaller than the smallest uncertainty of the values used to calculate the mean;
(c) For those nuclides that are sufficiently long lived that their half-lives cannot be simply determined by following their decay, the half-lives are generally determined through the measurement of two quantities, namely the number of atoms in the sample and the sample activity; since the CRP participants believe that both these quantities cannot be determined reliably with accuracies better than 0.1%, they have assigned a minimum uncertainty of 0.1% to these half-life values.

1.7. CONTENT OF FINAL REPORT

This report represents the culmination of a series of detailed measurements and evaluations carried out under the auspices of the CRP. In a number of instances, the data incorporated in this report differ from those in other publications or files. To understand the significance of such differences, it is important to remember that the data in this report have been subdivided into three general

categories that are based upon the extent of CRP measurement and evaluation involvement:

- *the first category* consists of new decay data generated by the activities of the CRP and evaluated in conjunction with other independent measurements;
- *the second category* includes data for which new measurements have resulted in a change of the earlier value, or where a re-evaluation of previously existing data indicated that changes are appropriate;
- *the third category* involves data that have been adopted from existing national data files or publications with little or no additional evaluation by the CRP.

The data evaluation effort of the CRP has been directed primarily towards the first two categories mentioned above. No particular importance should be attached to differences between values listed in the third category and those available in existing files or publications of evaluated decay data. However, the CRP participants believe that the values in these first two categories represent significant improvements in the data. Consequently, it is hoped that users and evaluators of transactinium nuclide decay data will regard any differences between the CRP-evaluated values in these two categories and those previously available as important, and will incorporate these changes into their own data files.

1.8. SUMMARY AND CONCLUSION

During its existence, the CRP has highlighted various data requirements and succeeded in satisfying many of them. The achievements are summarized in the tables contained in this report; and they are believed to represent a significant improvement in the quality of specific decay data for the transactinium nuclides.

Although the situation has improved considerably since the Karslruhe and Cadarache Advisory Group Meetings, several of the identified decay data needs remain unsatisfied. For some of them the required accuracies are questionable. For others it will be difficult, or even impossible, to achieve the required accuracies with the present experimental capabilities.

The CRP has accomplished a number of its goals. It has:

(a) Evaluated the accuracy requirements for decay data established by the users at the Karlsruhe, Cadarache and Uppsala Advisory Group Meetings and has grouped them into three general categories: (a) those which are satisfied by presently available data; (b) those which lie beyond the capabilities of present measurement techniques; (c) those not satisfied but which are achievable with present experimental capabilities;
(b) Assessed the status of the existing data in the light of these requirements, and maintained an awareness of new measurements;
(c) Identified and co-ordinated existing measurement expertise in order to acquire the required data; and

(d) Prepared a report which presents a critical evaluation of the data and summarizes their current status.

Despite the large body of new and accurate decay data that has been produced by the laboratories which have participated in the CRP, much remains to be done. A number of the accuracy requirements have not been met, and it is hoped that this fact will encourage other groups or individuals interested in transactinium nuclide decay data measurements to become involved in producing highly accurate data in response to these identified needs.

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Part 2

DATA MEASURED AND EVALUATED BY THE CRP

This part of the report contains the results of measurements performed by members of the CRP. These data and other relevant experimental results have been evaluated to produce the recommended values of heavy element decay data. Half-lives, gamma ray emission probabilities and alpha particle emission probabilities are listed separately for each radionuclide considered by the CRP. Source references for these evaluations are also given.

As described above, uncertainties have been treated as 1σ values in the calculation of weighted means. Since the same calibration nuclides may have been used by the other measurers, the uncertainties of the individual gamma ray emission probabilities may be partially correlated. Therefore, the adopted uncertainty of the weighted mean value of a set of such measurements has been taken to be no less than that of the most accurate individual value. It is also important to note that the basis upon which detectors were calibrated and the meaning of the quoted uncertainties were not always made clear in some of the other measurements included in these evaluations. However, these data have been considered in the evaluations and suitable judgements have been made by the evaluators when appropriate.

NOTE

Uncertainties: The uncertainty in any number is sometimes given one space after the number in italics:

4.623 *3* means 4.623 ± 0.003
3.75 *11* means 3.75 ± 0.11

I. HALF-LIFE

^{229}Th

Recommended value: 7340 ± 160 a

This value was adopted from the Nuclear Date Sheets [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by C.W. Reich (INEL, Idaho Falls, USA).

A. Recommended values[a]

E_γ (keV)[b]	Emission probability (P_γ) (Photons per decay of ^{229}Th)
31.10 31.50 31.57	0.0245 ± 0.0006
40.10 (^{225}Ra)	0.300 ± 0.007
42.3 42.82	0.00199 ± 0.00006
43.99	0.00762 ± 0.00017
56.52	0.00312 ± 0.00007
94.73 [c]	0.00465 ± 0.00008
107.11	0.00809 ± 0.00013
110.33	0.00128 ± 0.00003
123.19 [c]	0.00197 ± 0.00003
124.55 124.65	0.01449 ± 0.00020
131.93	0.00327 ± 0.00005
136.99	0.01171 ± 0.00016
142.96	0.00401 ± 0.00006
147.64 148.15	0.01091 ± 0.00015
150.0 (^{225}Ac)	0.00796 ± 0.00011
154.34 [c]	0.00922 ± 0.00013
156.41	0.01237 ± 0.00018
179.76	0.00215 ± 0.00004
193.51	0.0441 ± 0.0006

E_γ (keV)[b]	Emission probability (P_γ) (Photons per decay of ^{229}Th)
204.69	0.00595 ± 0.00009
210.15 210.85	0.0318 ± 0.0004
218.1 (^{221}Fr) [d]	0.1157 ± 0.0015
292.8 (^{213}Bi)	0.00429 ± 0.00007
440.46 (^{213}Bi)	0.261 ± 0.003
465.4 (^{209}Tl)	0.02022 ± 0.00026
808.9 (^{213}Bi)	0.00292 ± 0.00012

Notes to Table A

[a] The listed P_γ values are for a ^{229}Th source in secular equilibrium with the members of its decay chain. Gamma rays arising from the decay of a nuclide other than ^{229}Th are labelled (in parentheses) by the parent nuclide.

[b] Nominal values only.

[c] Gamma ray peak contains a contribution from radiation emitted by a member of the ^{229}Th decay chain.

[d] Gamma ray peak contains a small contribution from ^{229}Th decay.

B. CRP measurements

The only CRP-based P_γ measurement is that carried out at INEL and reported in Ref. [2]. Since this is the only CRP-based measurement and since these data are given in II.C below, they are not additionally presented here.

C. Comparison with other measurements

E_γ (keV)[a]	CRP measurements[b]		Other measurements[b]			Recommended values[k]
	Helmer et al. (1985) [5]		Rattan et al. (1983) [3]	Dickens and McConnell (1981) [4]	Tret'yakov et al. (1970) [5]	
	Equilibrium source	Chemically purified source[e]	Chemically purified source	Equilibrium source[d]	Chemically purified source	(Equilibrium source data only)
31.10		0.0087 [e]	0.00896 *80*			
31.50	{ 0.0245 *6* [e]	0.0122	0.01692 *85*	0.0340 *8* [g]	{ 0.040	{ 0.0245 *6*
31.57		0.0007				
40.10 (^{225}Ra)	0.300 *7*	–	–	0.393 *12*		0.300 *7*
42.25	{ 0.00199 *6* [e]	0.0008 [e]	{ 0.00188 *10*	{ 0.00272 *11*		{ 0.00199 *6*
42.76		0.0017				
43.99	0.00762 *17*	0.0068 *3*	0.00604 *20*	–		0.00762 *17*
56.52	0.00312 *7*	0.0030 *2*	0.00246 *6*	0.00427 *15*		0.00312 *7*
94.73 [f]	0.00465 *8*	0.0027 *2*	0.00232 *6*	–		0.00465 *8*
107.11	0.00809 *13*	0.0083 *4*	0.00656 *9*	0.0095 *3*		0.00809 *13*
110.33	0.00128 *3*	0.00128 *13*	0.00107 *4*	–		0.00128 *3*
123.19 [f]	0.00197 *3*	0.00155 *7*	0.00120 *4*	–		0.00197 *3*
124.55	{ 0.01449 *20* [e]	0.0071 [e]	{ 0.01040 *12*	{ 0.0162 *5*	{ 0.036	0.01449 *20*
124.65		0.0076				
131.93	0.00327 *5*	0.00345 *13*	–	0.00433 *15*		0.00327 *5*
136.99	0.01171 *16*	0.0121 *3*	0.00904 *18*	0.0151 *5*	0.016	0.01171 *16*
142.96	0.00401 *6*	0.00416 *13*	0.00314 *6*	0.00532 *19*		0.00401 *6*

E_γ (keV)[a]	CRP measurements[b]		Other measurements[b]			Recommended values[k]
	Helmer et al. (1985) [5]		Rattan et al. (1983) [3]	Dickens and McConnell (1981) [4]	Tret'yakov et al. (1970) [5]	
	Equilibrium source	Chemically purified source[c]	Chemically purified source	Equilibrium source[d]	Chemically purified source	(Equilibrium source data only)
147.63	{ 0.01091 *15* [e]	0.0021 [e]	0.00183 *14*	{ 0.0126 *4*	{ 0.011	{ 0.01091 *15*
148.09		0.0091	0.00708 *17*			
150.0 (^{225}Ac)	0.00796 *11*	–	–	0.00981 *33* [j]		0.00796 *11*
154. 34 [f]	0.00922 *13*	0.0079 *2*	0.00612 *12*	0.0113 *4*	{ 0.022	0.00922 *13*
156.41	0.01237 *18*	0.0122 *3*	0.00972 *18*	0.0126 *4*		0.01237 *18*
172.93	–	–	0.00093 *6*	0.00130 *6*		–
179.76	0.00215 *4*	0.00203 *16*	0.00176 *5*	0.00262 *10*		0.00215 *4*
183.95	–	–	0.00188 *6*	0.00091 *9*		–
193.51	0.0441 *6*	0.0454 [h]	0.03769 *75*	0.0589 *18*	0.045	0.0441 *6*
204.69	0.00595 *9*	0.0061 *3*	0.00495 *12*	0.0075 *4*		0.00595 *9*
210.13	{0.0318 *4* [e]	0.0020 [e,h]	0.00210 *33*	{ 0.0400 *13*	{ 0.032	{ 0.0318 *4*
210.85		0.0285	0.02467 *63*			
218.1 (^{221}Fr) [i]	0.1157 *15*	–	0.00149 *37*	0.1344 *27*		0.1157 *15*
292.8 (^{213}Bi)	0.00429 *7*	–		0.00426 *24*		0.00429 *7*
440.46 (^{213}Bi)	0.261 *3*	–		0.274		0.261 *3*
465.4 (^{209}Tl)	0.02022 *26*	–		0.0214 *19*		0.02022 *26*
808.9 (^{213}Bi)	0.00292 *12*	–		0.00316 *7*		0.00292 *12*

Notes to Table C

[a] Nominal values only. Peaks resulting from the decay of a nuclide other than ^{229}Th are labelled by the respective parent nuclide.

[b] All P_γ values are expressed in units of photons per decay of ^{229}Th.

[c] These data are taken from a detailed study, to be published elsewhere, of the decay scheme of ^{229}Th, utilizing chemically purified sources. The gamma ray intensities resulting from this study are given here to assist in a comparison of data, such as those of Refs [3] and [5], taken using chemically purified source material, with data such as those in Ref. [4], from sources containing an equilibrium concentration of decay chain members.

[d] Listed uncertainties do not include an overall 4% uncertainty in the absolute normalization (see Ref. [4]).

[e] The results obtained for the relative intensities of the gamma rays making up a complex, and only partially resolved, peak such as this may depend on the resolution of the detector employed and the peak-fitting techniques used.

[f] Peak also contains a contribution from radiation emitted by a member of the decay chain.

[g] Includes contribution from a 31.60 keV gamma ray, listed as 'unassigned' in Ref. [4]. We are indebted to J.K. Dickens for bringing this to our attention.

[h] Normalization points. Normalization of the data from the chemically purified source studies to those from the 'equilibrium' source was done by requiring that the sum of the intensities of the 193 and 210 keV lines be the same in the two sets of data.

[i] This peak, due mostly to the ^{221}Fr decay, contains a small contribution from ^{229}Th decay.

[j] The listed uncertainty differs from that given in Ref. [4], possibly representing a typographical error in the latter.

[k] The *normalization* scales of the P_γ data reported in Refs [3] and [4] are clearly different. Furthermore, significant differences exist among some of the ratios of P_γ values as reported in these two studies. (These points have been discussed by Dickens (see Ref. [6]).) Although the fact that different source conditions were used in these two studies might account for some of these differences in P_γ ratios, it is clear that this cannot account for all of them. In this evaluation, we have chosen to adopt as 'recommended values' those reported in Ref. [2].

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I. HALF-LIFE

^{231}Th

Recommended value: **25.52 ± 0.01 h**

This value was adopted from the Nuclear Data Sheets [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_γ (keV)	P_γ
25.64	0.146 ± 0.003
58.57	0.0050 ± 0.0005
72.75	0.0026 ± 0.0002
81.23	0.0085 ± 0.0003
82.09	0.0037 ± 0.0002
84.21	0.0671 ± 0.0010
102.27	0.0040 ± 0.0002
124.91	0.00060 ± 0.00003
134.03	0.00025 ± 0.00005
135.66	0.00084 ± 0.00007
217.94	0.00037 ± 0.00001

E_γ (keV)	Vaninbroukx and Denecke (1982) [2]	Banham and Jones (1983) [3]	Helmer and Reich (1984) [4]
25.64	0.145 *3*	0.150 *10*	
58.57		0.0044 *4*	
72.75		0.0051 *5*	
81.23		0.0086 *3*	
82.09		0.0039 *2*	
84.21	0.066 *3*	0.0652 *13*	0.0684 *10*
102.27		0.0042 *2*	
124.91		0.00058 *8*	
134.03		0.00019 *9*	
135.66		0.00085 *15*	
217.94		0.00037 *1*	

C. Comparison with other measurements

^{231}Th

E_γ (keV)	CRP measurements			Other measurements			Evaluated values[c]
	Vaninbroukx and Denecke (1982) [2]	Banham and Jones (1983) [3]	Helmer and Reich (1984) [4]	Teoh (1973) [5][a]	Hornshøj et al. (1975) [6]	Baranov et al. (1977) [7][a]	
25.64	0.145 *3*	0.150 *10*			0.148 *10*	0.22 *1* [b]	0.146 *3*
58.57		0.0044 *4*			0.0048 *2*	0.0059 *3*	0.0050 *5* [d]
72.75		0.0051 *5* [b]		0.0025 *2*	0.00251 *15*	0.0027 *2*	0.0026 *2*
81.23		0.0086 *3*		0.0091 *6*	0.0089 *5*	0.0078 *4*	0.0085 *3*
82.09		0.0039 *2*		0.0046 *3*	0.0040 *3*	0.0031 *2*	0.0037 *2*
84.21	0.066 *3*	0.0652 *13*	0.0684 *10*		0.065 *4*		0.0671 *10*
102.27		0.0042 *2*		0.0046 *3*	0.0041 *3*	0.0036 *2*	0.0040 *2*
124.91		0.00058 *8*			0.00056 *3*	0.00068 *4*	0.00060 *3*
134.03		0.00019 *9*			0.00024 *1*	0.00038 *3*	0.00025 *5* [d]
135.66		0.00085 *15*			0.00078 *5*	0.0011 *1*	0.00084 *7*
217.94		0.00037 *1*			0.00040 *3*		0.00037 *1*

[a] The P_γ values have been calculated from the measured relative intensities using $P_\gamma = 0.0671 \pm 0.0010$ for the 84 keV reference line; a minimum uncertainty of 5% has been attributed to these values.

[b] These P_γ values, deviating by several times the quoted uncertainty from those of the other measurements, have not been considered in the calculation of the evaluated values.

[c] The evaluated values and uncertainties are based on weighted means calculated according to Topping [8].

[d] For consistency reasons, the quoted uncertainties have been increased for the calculation of the weighted mean and its uncertainty.

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I. HALF-LIFE

^{231}Pa

Recommended value: 32760 ± 110 a

This value was adopted from the Nuclear Data Sheets [1].

No CRP-related measurement or evaluation of the half-life has been carried out: the recommended value has been taken from the Evaluated Nuclear Structure Data File (ENSDF), the data base associated with the preparation of Nuclear Data Sheets.

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

A. Recommended values

E_γ (keV)	P_γ [a]
16.39 ± 0.02	0.0022 ± 0.0001
18.95 ± 0.02	0.00354 ± 0.00007 [b]
(23.6 ± 0.1)	0.000044 ± 0.000005 [c]
24.5 ± 0.1	0.000035 ± 0.000001 [d]
25.44 ± 0.06	0.00095 ± 0.00003 [e]
27.360 ± 0.020	0.111 ± 0.004 [f]
29.950 ± 0.020	0.00095 ± 0.00006
(31.5 ± 0.1)	0.000076 ± 0.000007 [g]
35.9 ± 0.1	0.00016 ± 0.00002
38.20 ± 0.03	0.00143 ± 0.00009
(39.9 ± 0.1)	g, h
42.3 ± 0.1	0.000054 ± 0.000010 [i]
44.17 ± 0.04	0.00056 ± 0.00007
46.370 ± 0.020	0.00223 ± 0.00006
50.98 ± 0.12	0.000014 ± 0.000004 [i]
52.71 ± 0.07	0.00090 ± 0.00011
54.59 ± 0.03	0.00077 ± 0.00006
56.9 ± 0.1	0.000048 ± 0.000006 [i]
57.19 ± 0.03	0.00040 ± 0.00003
60.5 ± 0.1	0.000055 ± 0.000009
63.64 ± 0.05	0.00046 ± 0.00003

E_γ (keV)	P_γ [a]
(70.57 ± 0.03)	0.000058 ± 0.000010 [g]
71.9 ± 0.1	0.000015 ± 0.000002 [i]
72.6 ± 0.1	0.000035 ± 0.000006 [i]
74.14 ± 0.03	0.00022 ± 0.00001
77.4 ± 0.1	0.00057 ± 0.00004
96.88 ± 0.05	0.00082 ± 0.00003
100.9 ± 0.1	0.00023 ± 0.00002
102.8 ± 0.1	0.00015 ± 0.00004
124.6 ± 0.1	0.000039 ± 0.000007
144.5 ± 0.1	0.00011 ± 0.00001
199.0 ± 0.1	0.000043 ± 0.000006
242.8 ± 0.2	0.00011 ± 0.00002
243.2 ± 0.1	0.00032 ± 0.00002
245.5 ± 0.1	0.000068 ± 0.000006
255.90 ± 0.04	0.00107 ± 0.00003
258.34 ± 0.03	0.0000099 ± 0.0000035
260.3 ± 0.1	0.00182 ± 0.00005
273.237 ± 0.117	0.00059 ± 0.00002
277.322 ± 0.013	0.00069 ± 0.00002
283.690 ± 0.013	0.0165 ± 0.0004
(286.6 ± 0.1)	0.000104 ± 0.000007 [g]
300.069 ± 0.008	0.0241 ± 0.0006
302.669 ± 0.006	0.0247 ± 0.0006 [j]
310.0 ± 0.1	0.000010 ± 0.000002
313.0 ± 0.1	0.00099 ± 0.00002
327.130 ± 0.188	0.00035 ± 0.00001
330.057 ± 0.015	0.0136 ± 0.0003
340.77 ± 0.07	0.00178 ± 0.00004
351.6 ± 0.1	0.000016 ± 0.000002 [i]
354.474 ± 0.075	0.00097 ± 0.00003
357.16 ± 0.07	0.00169 ± 0.00005
359.5 ± 0.1	0.000086 ± 0.000004
363.98 ± 0.09	0.000080 ± 0.000004
375.4 ± 0.2	0.000047 ± 0.000003
379.34 ± 0.08	0.00050 ± 0.00001

E_γ (keV)	P_γ [a]
384.9 ± 0.1	0.000039 ± 0.000004
387.13 ± 0.06	0.0000034 ± 0.0000010
391.76 ± 0.07	0.000068 ± 0.000003
395.73 ± 0.08	0.000025 ± 0.000002
398.33 ± 0.07	0.000096 ± 0.000004
407.829 ± 0.028	0.00036 ± 0.00001
410.75 ± 0.07	0.000017 ± 0.000002
435.1 ± 0.5	0.000030 ± 0.000002
438.12 ± 0.06	0.000046 ± 0.000003
438.8 ± 0.1	0.000013 ± 0.000003 [i]
486.827 ± 0.023	0.000015 ± 0.000002
490.6 ± 0.1	0.0000038 ± 0.0000011
501.2 ± 0.1	0.000007 ± 0.000002
509.6 ± 0.1	0.000003 ± 0.000001
516.4 ± 0.1	0.000015 ± 0.000002
535.4 ± 0.1	0.000006 ± 0.000001
546 ± 1	0.000008 ± 0.000001
571 ± 1	0.000003 ± 0.000001
582 ± 1	0.000003 ± 0.000001
610 ± 1	0.000005 ± 0.000001

Notes to Table A

[a] The emission probabilities have been assessed in conjunction with alpha decay data (Hummel [7] and Baranov et al. [8]) to produce a complex and comprehensive decay scheme to aid in the evaluation.

[b] Significant overlap between gamma ray and AcL-X-rays: emission probability calculated from the proposed decay scheme and alpha decay data.

[c] Gamma ray has not been observed: data have been derived from the proposed decay scheme.

[d] Observed gamma ray data are only approximate: data have been derived from the proposed decay scheme.

[e] Discrepancies between measurements: data have been derived from the proposed decay scheme.

[f] Unweighted CRP AERE data have been recommended.

[g] Not placed in the proposed decay scheme.

[h] Discrepancies between measurements: unable to recommend a value.

[i] Calculated using the weighted mean of the relative emission probability data and a normalization factor of 0.0165 *4*.

[j] Unresolved doublet: placed twice in the proposed decay scheme.

E_γ (keV)	Banham (1984) [9]	
	Relative[a] (to that of 283.65 keV)	Absolute[b] (photons per decay)
10.87 (AcLl)	108.0 *20*	–
12.63 (AcLα_1, α_2)	1725 *35*	–
14.08 (AcLη)	21.1 *8*	–
15.70 (AcLβ)	973 *19*	–
16.56	13.4 *5*	0.0022 *1*
18.39 (AcLγ_1)	184.6 *37*	–
18.95 (AcLγ_3, γ_6)	76.7 *15*	0.0126 *5* [d]
19.67 (AcLγ_4)	18.4 *7*	–
25.28	16.5 *9*	0.0027 *2*
27.35	673 *13*	0.111 *4*
29.96	5.63 *30*	0.00093 *6*
30.85[c]	–	–
38.19	8.59 *33*	0.00142 *8*
39.90	6.48 *30*	0.00107 *7*
44.15	2.7 *5*	0.00045 *9*
46.35	10.6 *7*	0.00175 *14*
52.71	5.4 *6*	0.00089 *11*
54.60	4.44 *32*	0.00073 *6*
56.82[c]	–	–
57.19	2.34 *15*	0.00039 *3*
60.47	0.29 *5*	0.000048 *9*
63.65	2.70 *9*	0.00045 *2*
70.57	0.30 *5*	0.000049 *9*
74.17	1.35 *5*	0.00022 *1*
77.34	3.45 *7*	0.00057 *2*
96.90	5.00 *10*	0.00082 *3*
100.91	1.38 *4*	0.00023 *1*
102.93 (AcKβ_1)	0.9 *2*	0.00015 *4* [d]
124.66	0.259 *24*	0.000043 *5*
144.49	0.69 *5*	0.00011 *1*
199.04	0.246 *29*	0.000041 *6*
242.50	0.70 *4*	0.00012 *1*
243.21	1.87 *4*	0.00031 *1*
245.56	0.382 *31*	0.000063 *6*
255.88	6.41 *6*	0.00106 *3*
258.26	0.06 *2*	0.0000099 *35*
260.23	10.97 *10*	0.00181 *5*
273.18	3.50 *4*	0.00058 *2*
277.10	4.12 *5*	0.00068 *2*
283.65	100.0 *8*	0.01649 *40*
286.62	0.632 *30*	0.000104 *7*

E_γ (keV)	Banham (1984) [9]	
	Relative[a] (to that of 283.65 keV)	Absolute[b] (photons per decay)
300.03	146.3 *13*	0.0241 *6*
302.63	149.6 *12*	0.0247 *6*
310.04	0.058 *12*	0.0000096 *21*
312.94	5.97 *5*	0.00098 *2*
327.16	2.22 *4*	0.000366 *13*
330.01	82.4 *7*	0.0136 *3*
340.77	10.80 *9*	0.00178 *4*
351.43	0.102 *4*	0.0000168 *9*
354.55	5.81 *6*	0.00096 *3*
357.11	10.14 *9*	0.00167 *4*
359.41	0.512 *14*	0.000084 *4*
363.91	0.488 *14*	0.000080 *4*
375.02	0.282 *15*	0.000047 *3*
379.26	3.03 *4*	0.000500 *15*
384.84	0.221 *12*	0.000036 *3*
387.11	0.018 *6*	0.0000030 *10*
391.75	0.408 *11*	0.000067 *3*
395.66	0.148 *10*	0.000024 *2*
398.26	0.574 *14*	0.000095 *4*
407.86	2.156 *24*	0.000356 *10*
410.72	0.099 *11*	0.000016 *2*
435.14	0.177 *10*	0.000029 *2*
438.07	0.283 *16*	0.000047 *3*
486.81	0.091 *9*	0.000015 *2*
491.65	0.023 *6*	0.0000038 *11*
501.22	0.053 *11*	0.0000087 *19*
516.13	0.093 *9*	0.000015 *2*
535.3	0.038 *7*	0.0000063 *13*
536.00	0.020 *7*	0.0000033 *12* [e]
546.33	0.056 *8*	0.0000092 *15*

Notes to Table B

[a] Claimed uncertainties have been adjusted when required to obey the following criteria:
(i) from 0 to 120 keV, P_γ uncertainty of approximately 2%;
(ii) above 120 keV, P_γ uncertainty of approximately 1% and not less than 0.3%;
(iii) in the region of 55 to 62 keV (Am-241 calibration), P_γ uncertainty can be as low as 0.5%.

[b] Absolute gamma ray emission probabilities calculated using an emission probability of 0.01649 *27* for the 283 keV gamma ray, a value re-assessed by Banham (1984) [9].

[c] These gamma rays were listed in the original publication (Banham and Jones (1983) [9] (CRP, AERE)), but they were not included in the re-assessment (Banham (1984) [9]).

[d] Gamma rays are postulated at these energies but there is considerable interference with AcK- and L-X-rays.

[e] Observation of this gamma ray is questionable, and it was not considered in the final evaluation.

C. Comparison with other measurements

Lange and Hagee (1968) [2][a]		Leang (1970) [3][b]		De Pinho et al. (1970) [4][c]		Teoh (1979) [5][d]		Börner et al. (1979) [6]	
E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ
10.9 *5* [f]	–	–	–	10.9 *1* [f]	~24	–	–	–	–
12.4 *5* [f]	–	12.7 [f]	–	12.65 *1* [f]	~470	–	–	–	–
–	–	–	–	14.1 *1* [f]	–	–	–	–	–
15.5 *5* [f]	–	15.7 [f]	–	15.7 [f]	~600	–	–	–	–
–	–	–	–	16.5 *1*	–	–	–	–	–
18.2 *5* [f]	–	18.4 [f]	–	18.5 [f]	~150	–	–	–	–
–	–	–	–	~19 [f]	–	–	–	–	–
–	–	–	–	24.5 *1*	~0.6	24.6 *5*	0.7 *3*	–	–
25.3 *5*	–	25.2 *2*	~19	25.54 *6*	~6	25.36 *8*	6.9 *10*	–	–
27.3 *5*	–	27.3 *2*	440 *180*	27.35 *2*	590 *30*	27.38 *2*	640 *50*	27.360 *20*	–
29.8 *5*	–	29.9 *2*	6.2 *26*	29.95 *2*	5.9 *8*	30.01 *3*	6.5 *5*	29.950 *20*	–
30.7 *5*	–	–	–	31.00 *5*	0.6 *2*	30.87 *4*	0.5 *1*	–	–
–	–	–	–	31.54 *5*	0.4 *1*	31.55 *5*	0.47 *4*	–	–
35.6 *5*	–	35.8 *3*	0.9 *4*	35.82 *3*	1.0 *2*	35.86 *4*	0.94 *5*	–	–
38.0 *5*	–	38.1 *2*	6.3 *26*	38.20 *2*	9.5 *14*	38.19 *2*	9.4 *5*	–	–
39.6 *5*	–	–	–	39.57 *4*	0.09 *5*	39.73 *3*	0.14 *10*	–	–
–	–	–	–	39.97 *2*	0.77 *15*	40.00 *3*	1.22 *6*	–	–
–	–	–	–	42.48 *5*	0.36 *8*	42.41 *4*	0.3 *1*	–	–
–	–	–	–	43.05 *5*	0.4 *1*	43.08 *4*	0.41 *11*	–	–

43.9 *5*	–	44.1 *2*	2.8 *13*	44.16 *2*	3.8 *6*	44.13 *2*	3.77 *40*	–	–
46.1 *5*	–	46.2 *2*	8.1 *35*	46.37 *2*	13.3 *8*	46.32 *2*	12.97 *64*	46.370 *20*	–
–	–	–	–	50.98 *5*	0.09 *4*	50.68 *6*	0.3 *1* [e]	–	–
52.4 *5*	–	52.6 *2*	3.8 *17*	52.74 *2*	5.4 *8*	52.66 *3*	4.85 *34*	–	–
54.8 *5*	–	54.5 *2*	3.8 *17*	54.61 *2*	5.1 *7*	54.56 *3*	4.33 *35*	–	–
–	–	–	–	56.76 *4*	0.36 *8*	56.79 *4*	0.27 *4*	–	–
–	–	57.0 *2*	1.9 *9*	57.19 *3*	2.5 *4*	57.19 *3*	2.54 *26*	–	–
59.4 *5*	–	60.2 *3*	0.19 *15*	60.50 *3*	0.41 *8*	60.47 *8*	0.3 *1*	–	–
63.3 *5*	–	63.5 *2*	1.9 *9*	63.67 *3*	3.2 *4*	63.60 *4*	2.7 *3*	–	–
–	–	–	–	70.50 *5*	0.41 *8*	70.45 *8*	0.6 *2*	–	–
–	–	–	–	71.9 *1*	0.12 *7*	71.9 *1*	0.1 *1*	–	–
–	–	–	–	72.5 *1*	0.24 *13*	72.78 *8*	0.2 *1*	–	–
–	–	74.1 *3*	1.3 *6*	74.18 *4*	1.6 *3*	74.08 *6*	1.24 *20*	–	–
77.1 *5*	–	77.2 *2*	2.5 *9*	77.36 *3*	4.3 *7*	77.30 *4*	4.31 *20*	–	–
87.5 *5* [f]	–	–	} 94 *30*	87.67 *2* [f]	36 *5*	–	–	–	–
90.7 *5* [f]	–	–		90.88 *2* [f]	61 *8*	–	–	–	–
–	–	96.7 *2*	4.1 *15*	96.88 *3*	5.6 *8*	96.80 *3*	5.62 *28*	–	–
–	–	100.5 *5*	0.75 *40*	100.92 *4*	2.0 *4*	100.77 *4*	1.66 *25*	–	–
–	–	–	–	102.7 *1* [f]	23 *3*	–	–	–	–
102.5 *5*	–	102.5 *4*	2.8 *13*	~103	~1	102.6 *5*	<0.8	–	–
106.0 *5* [f]	–	–	–	105.7 *1* [f]	6.8 *12*	–	–	–	–
–	–	124.4 *5*	0.13 *8*	124.6 *1*	0.29 *13*	124.56 *8*	0.29 *9*	–	–
–	–	144.4 *5*	0.25 *16*	144.5 *1*	0.77 *27*	144.33 *8*	0.64 *30*	–	–
–	–	198.7 *6*	0.06 *4*	199 *1*	0.36 *14*	198.89 *10*	0.23 *10*	–	–

Lange and Hagee (1968) [2][a]		Leang (1970) [3][b]		De Pinho et al. (1970) [4][c]		Teoh (1979) [5][d]		Börner et al. (1979) [6]	
E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ
–	–	–	–	–	–	230.0 *10*	0.10 *5*	–	–
–	–	–	–	242.2 *1*	0.53 *8*	242.16 *8*	0.5 *2*	–	–
243.0 *5*	5.7	242.9 *4*	2.5 *9*	243.0 *1*	2.2 *3*	243.15 *9*	2.97 *24*	–	–
–	–	245.3 *5*	0.44 *18*	245.4 *1*	0.47 *8*	245.77 *9*	0.48 *12*	–	–
–	–	–	–	246.0 *2*	<0.06	246.05 *9*	0.7 *2*	–	–
256.1 *5*	6.3	255.9 *3*	8.1 *22*	255.78 *7*	6.4 *7*	255.76 *8*	6.34 *41*	–	
–	–	–	–	258.4 *1*	0.15 *4*	258.54 *15*	0.15 *5*	–	
260.2 *5*	19	260.2 *3*	11 *3*	260.14 *8*	11.0 *12*	260.23 *8*	11.39 *57*	–	
273.5 *5*	0.27	273.2 *3*	4.4 *15*	273.08 *9*	3.7 *4*	273.15 *9*	3.48 *24*	273.237 *117*	–
277.7 *5*	0.065	277.2 *3*	5.0 *16*	276.99 *9*	4.3 *4*	277.10 *9*	3.88 *25*	277.322 *13*	–
283.9 *5*	100	283.7 *3*	100	283.56 *6*	100	283.65 *5*	100	283.690 *13*	–
–	–	–	–	286.55 *10*	0.59 *9*	286.60 *10*	0.8 *3*	–	–
300.5 *5*	} 230	300.1 *2*	144 *31*	299.94 *6*	144 *15*	300.02 *5*	149.6 *75*	300.069 *8*	–
303.2 *5*		302.7 *2*	144 *31*	302.52 *6*	149 *15*	302.65 *5*	140 *15*	302.669 *6*	–
–	–	–	–	310.0 *1*	0.09 *3*	310.0 *5*	0.07 *3*	–	–
313.0 *5*	4.1	312.9 *3*	6.9 *21*	312.88 *8*	6.0 *6*	312.94 *5*	7.05 *56*	–	–
–	–	318.1 *7*	0.125 *80*	–	–	–	–	–	–
–	–	327.2 *4*	2.5 *13*	327.02 *10*	1.9 *2*	327.26 *10*	2.27 *28*	327.130 *188*	–
330.2 *5*	34	330.0 *2*	81 *23*	329.89 *6*	83 *8*	330.06 *5*	81.9 *65*	330.057 *15*	–
341.0 *5*	3.7	340.8 *2*	10 *4*	340.61 *7*	10.5 *10*	340.77 *6*	10.9 *13*	–	–

–	–	–	–	351.4 *1*	0.22 *3*	351.6 *1*	0.15 *6*	–	–
–	–	354.6 *2*	6.3 *20*	354.38 *8*	6.0 *6*	354.57 *8*	5.07 *56*	354.474 *75*	–
356.6 *5*		357.2 *2*	9.4 *30*	356.96 *7*	11.0 *12*	357.21 *6*	9.67 *82*	–	–
–	4.5	358.6 *4*	0.38 *24*	359.25 *10*	0.57 *7*	359.57 *10*	0.41 *18*	–	–
364.2 *5*		363.9 *4*	0.38 *24*	363.74 *10*	0.47 *6*	363.93 *10*	0.42 *15*	–	–
–	–	374.9 *4*	0.19 *9*	374.9 *1*	0.29 *4*	375.01 *10*	0.24 *10*	–	–
379.5 *5*	0.65	379.2 *3*	2.5 *12*	379.09 *8*	3.1 *4*	379.41 *6*	2.89 *23*	–	–
–	–	384.8 *3*	0.13 *8*	384.7 *1*	0.26 *4*	384.7 *1*	0.18 *4*	–	–
–	–	–	–	387.0 *1*	0.030 *14*	–	–		–
392.5 *5*	0.70	391.7 *3*	0.31 *6*	391.5 *1*	0.43 *6*	391.67 *9*	0.52 *8*		–
–	–	395.7 *4*	0.06 *4*	395.5 *1*	0.17 *3*	395.49 *10*	0.11 *2*		–
398.4 *5*	0.075	398.1 *3*	0.44 *24*	398.10 *8*	0.59 *8*	398.19 *9*	0.49 *9*	–	–
408.1 *5*	0.34	407.7 *3*	1.3 *8*	407.71 *6*	2.3 *3*	407.80 *5*	2.13 *18*	407.829 *28*	–
410.5 *5*		410.3 *10*	0.06 *4*	410.5 *1*	0.12 *2*	410.1 *1*	0.19 *4*	–	–
–	–	–	–	–	–	427.0 *10*	0.04 *2*	–	–
–	–	434.9 *8*	0.13 *6*	435.1 *1*	0.21 *3*	435.0 *1*	0.12 *3*	–	–
437.9 *5*	0.048	437.9 *8*	0.25 *16*	437.9 *1*	0.26 *4*	438.10 *9*	0.20 *6*	–	–
–	–	–	–	438.7 *1*	0.095 *30*	438.8 *2*	0.07 *2*	–	–
487.2 *5*	<0.02	486.6 *10*	0.06 *4*	486.7 *3*	0.11 *3*	486.8 *10*	0.15 *2*	486.827 *23*	–
–	–	491 *2*	0.006	491.0 *6*	0.030	491.0 *10*	<0.04	–	–
–	–	501 *1*	0.013	501.6 *5*	0.036 *15*	501.0 *10*	0.05 *2*	–	–
512.2 *5*	<0.02	510 *1*	0.031	509 *1*	0.018 *7*	510.0 *10*	0.05 *2*	–	–

Lange and Hagee (1968) [2][a]		Leang (1970) [3][b]		De Pinho et al. (1970) [4][c]		Teoh (1979) [5][d]		Börner et al. (1979) [6]	
E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ
516.2 *5*	<0.02	516 *1*	0.050	516.2 *6*	0.08 *2*	516.1 *10*	0.06 *2*	–	–
–	–	535 *1*	0.031	535.3 *7*	0.030 *14*	–	–	–	–
–	–	–	–	–	–	536.6 *10*	0.05 *2*	–	–
–	–	546 *1*	0.025	546.6 *7*	0.036 *15*	546.6 *10*	0.04 *2*	–	–
–	–	571 *2*	0.019	572.1 *8*	0.030 *14*	571.0 *10*	0.04 *2*	–	–
–	–	583 *2*	0.019	–	–	–	–	–	–
–	–	609 *2*	0.031	–	–	–	–	–	–

Notes to Table C

[a] Emission probabilities are listed in terms of the complex 300.5–303.2 keV ray(s): these data have been adjusted to give emission probabilities relative to that of the 283.69 keV gamma ray. The data from this source have not been included in the final evaluation because of the large discrepancies when compared with the other published data.

[b] Emission probabilities are listed as absolute values (photons per 100 alpha decays): these data have been adjusted to give emission probabilities relative to that of the 283.69 keV gamma ray for comparison only.

[c] Emission probabilities are listed in terms of the 27.36 keV gamma ray: these data have been adjusted to give emission probabilities relative to that of the 283.69 keV gamma ray. Absolute gamma ray emission probabilities can be derived assuming an emission probability of 0.0169 *8* for the 283.69 keV gamma ray.

[d] Emission probabilities are listed relative to that of the 283.69 keV gamma ray. However, absolute gamma emission probabilities cannot be derived directly from this source, and these data have not been included in the final evaluation.

[e] Teoh [5] reported a relative emission probability of 0.08 *4* for the 51 keV gamma ray.

[f] AcK- and L-X-rays.

E_γ (keV)	CRP measurements	Other measurements		
	Banham (1984) [9]	Leang (1970) [3]	De Pinho et al. (1970) [4]	Evaluated values[a]
16.4	0.0022 *1*	–	–	0.0022 *1*
18.9	0.0126 *5*	–	–	b, c
24.5	–	–	~0.0001	c
25.4	0.0027 *2*	~0.003	~0.001	c
27.360	0.111 *4*	0.07 *2*	~0.1	0.109 *4* [c]
29.950	0.00093 *6*	0.0010 *3*	0.00099 *9*	0.00095 *6*
30.9	–	–	0.00010 *2*	d, e
31.5	–	–	0.00007 *2*	d
35.9	–	0.00015 *5*	0.00017 *2*	0.00016 *2*
38.2	0.00142 *8*	0.0010 *3*	0.00160 *16*	0.00143 *9*
39.9	0.00107 *7*	–	0.00013 *2*	d
42.3	–	–	0.00006 *1*	c
44.2	0.00045 *9*	0.00045 *15*	0.00065 *7*	0.00056 *7*
46.370	0.00175 *14*	0.0013 *4*	0.00224 *2*	0.00223 *6*
51.0	–	–	0.000015 *6*	c
52.7	0.00089 *11*	0.0006 *2*	0.00091 *9*	0.00090 *11*
54.6	0.00073 *6*	0.0006 *2*	0.00087 *8*	0.00077 *6*
56.9	–	–	0.00006 *1*	c
57.2	0.00039 *3*	0.0003 *1*	0.00042 *4*	0.00040 *3*
60.5	0.000048 *9*	0.00003 *2*	0.00007 *1*	0.000055 *9*
63.6	0.00045 *2*	0.0003 *1*	0.00054 *5*	0.00046 *3*
70.6	0.000049 *9*	–	0.00007 *1*	0.000058 *10*
71.9	–	–	0.00002 *1*	c
72.6	–	–	0.00004 *2*	c
74.1	0.00022 *1*	0.00020 *7*	0.00027 *3*	0.00022 *1*
77.4	0.00057 *2*	0.0004 *1*	0.00073 *8*	0.00057 *4*
96.9	0.00082 *3*	0.00065 *15*	0.00095 *10*	0.00082 *3*
100.9	0.00023 *1*	0.00012 *5*	0.00034 *5*	0.00023 *2*
102.8	0.00015 *4*	0.00044 *15*	~0.0002	0.00015 *4* [b]
124.6	0.000043 *5*	0.00002 *1*	0.00005 *2*	0.000039 *7*
144.5	0.00011 *1*	0.00004 *2*	0.00013 *4*	0.00011 *1*

E_γ (keV)	CRP measurements	Other measurements		
	Banham (1984) [9]	Leang (1970) [3]	De Pinho et al. (1970) [4]	Evaluated values[a]
199.0	0.000041 *6*	0.000010 *5*	0.00006 *2*	0.000043 *6*
242.8	0.00012 *1*	0.0004 *1*	0.00009 *1*	0.00011 *2*
243.2	0.00031 *1*		0.00037 *3*	0.00032 *2*
245.5	0.000063 *6*	0.00007 *2*	0.00008 *1*	0.000068 *6*
255.9	0.00106 *3*	0.0013 *2*	0.00109 *6*	0.00107 *3*
258.3	0.0000099 *35*	–	0.000025 *6*	0.0000099 *35*
260.3	0.00181 *5*	0.0018 *3*	0.00186 *11*	0.00182 *5*
273.237	0.00058 *2*	0.00070 *15*	0.00062 *3*	0.00059 *2*
277.322	0.00068 *2*	0.00080 *15*	0.00072 *4*	0.00069 *2*
283.690	0.01649 *40*	0.016 *2*	0.0169 *8*	0.0165 *4*
286.6	0.000104 *7*	–	0.00010 *1*	0.000104 *7*
300.069	0.0241 *6*	0.023 *2*	0.0244 *14*	0.0241 *6*
302.669	0.0247 *6*	0.023 *2*	0.0252 *14*	0.0247 *6*
310.0	0.0000096 *21*	–	0.000015 *5*	0.000010 *2*
313.0	0.00098 *2*	0.0011 *2*	0.00102 *6*	0.00099 *2*
327.130	0.000366 *13*	0.0004 *2*	0.00032 *2*	0.00035 *1*
330.057	0.0136 *3*	0.013 *2*	0.0140 *7*	0.0136 *3*
340.8	0.00178 *4*	0.0016 *4*	0.00178 *9*	0.00178 *4*
351.6	0.0000168 *9*	–	0.000038 *4*	c
354.474	0.00096 *3*	0.0010 *2*	0.00102 *6*	0.00097 *3*
357.2	0.00167 *4*	0.0015 *3*	0.00186 *11*	0.00169 *5*
359.5	0.000084 *4*	0.00006 *3*	0.000097 *8*	0.000086 *4*
364.0	0.000080 *4*	0.00006 *3*	0.000080 *7*	0.000080 *4*
375.4	0.000047 *3*	0.00003 *1*	0.000050 *4*	0.000047 *3*
379.3	0.000500 *15*	0.00040 *15*	0.00053 *4*	0.00050 *1*
384.9	0.000036 *3*	0.00002 *1*	0.000044 *4*	0.000039 *4*
387.1	0.0000030 *10*	–	0.000005 *2*	0.0000034 *10*
391.7	0.000067 *3*	0.00005 *2*	0.000073 *6*	0.000068 *3*
395.7	0.000024 *2*	0.000010 *5*	0.000028 *3*	0.000025 *2*
398.3	0.000095 *4*	0.00007 *3*	0.000100 *8*	0.000096 *4*
407.829	0.000356 *10*	0.0002 *1*	0.00039 *3*	0.00036 *1*

E_γ (keV)	CRP measurements	Other measurements		
	Banham (1984) [9]	Leang (1970) [3]	De Pinho et al. (1970) [4]	Evaluated values[a]
410.7	0.000016 *2*	0.000010 *5*	0.000020 *2*	0.000017 *2*
435.1	0.000029 *2*	0.00002 *1*	0.000036 *4*	0.000030 *2*
438.1	0.000047 *3*	0.00004 *2*	0.000044 *4*	0.000046 *3*
438.8	–	–	0.000016 *4*	c
486.827	0.000015 *2*	0.000010 *5*	0.000019 *4*	0.000015 *2*
490.6	0.0000038 *11*	0.000001	0.000005	0.0000038 *11*
501.2	0.0000087 *19*	0.000002	0.000006 *2*	0.000007 *2*
509.6	–	0.000005	0.000003 *1*	0.000003 *1*
516.4	0.000015 *2*	0.000008	0.000014 *3*	0.000015 *2*
535.4	0.0000063 *13*	0.000005	0.000005 *2*	0.000006 *1*
536.0	0.0000033 *12*	–	–	d, e
546	0.0000092 *15*	0.000004	0.000006 *2*	0.000008 *1*
571	–	0.000003	0.000005 *2*	0.000003 *1*
582	–	0.000003	–	0.000003 *1*
610	–	0.000005	–	0.000005 *1*

Notes to Table

[a] Recommended data are weighted mean values with 1σ standard deviation unless stated otherwise.

[b] Gamma rays are postulated to occur at these energies when a complete decay scheme is formulated, but there is significant interference with the AcK- and L-X-rays.

[c] Insufficient data to produce a reliable weighted mean value; final recommended data have been derived in conjunction with the proposed decay scheme which includes the alpha decay data of Hummel [7] and Baranov et al. [8].

[d] Data are inadequate or discrepant and a reliable weighted mean value cannot be derived.

[e] Detection viewed as questionable, and it was not considered in the final evaluation.

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

A. Recommended values

E_α (keV)[a]	P_α[b]
(4414 ± 2)	(0.000019 ± 0.000004)
4506 ± 1	0.000021 ± 0.000003)
(4531 ± 1)	(0.000007 ± 0.000002)
(4554 ± 1)	(0.00012 ± 0.00002)
(4559 ± 1)	(0.000010 ± 0.000002)
4567 ± 1	0.000054 ± 0.000005
4598 ± 1	0.00020 ± 0.00003
(4629 ± 1)	(0.00065 ± 0.00015)
4631.4 ± 0.8	0.00052 ± 0.00003
4640.7 ± 0.9	0.00077 ± 0.00003
4678.6 ± 0.9	0.0161 ± 0.0007
4710.7 ± 0.9	0.0100 ± 0.0007
4734.7 ± 0.8	0.0847 ± 0.0040
4792.4 ± 0.9	0.0006 ± 0.0001
4851.8 ± 0.9	0.014 ± 0.001
4934.4 ± 0.9	0.030 ± 0.004
4951.0 ± 0.9	0.229 ± 0.005
4976.0 ± 0.8	0.004 ± 0.001
4986.2 ± 0.8	0.014 ± 0.002
5013.5 ± 0.8	0.254 ± 0.005
5029.6 ± 0.8	0.20 ± 0.02
5032.2 ± 0.8	0.032 ± 0.003
5059.1 ± 0.8	0.110 ± 0.005

Notes to Table A

[a] Alpha energies have been calculated from Q_α of 5148.2 *8* keV and the level scheme of Ac-227.

[b] Recommended emission probability data have been derived from the proposed decay scheme in conjunction with the measurements of Hummel [7] and Baranov et al. [8].

B. CRP measurements

None.

C. Other measurements

E_α (keV)[a]	Hummel (1956) [7][b]	Baranov et al. (1961) [8][b]
4506 *1*	–	0.00003
4567 *1*	–	0.00008
4598 *1*	–	0.00015
4631.4 *8*	–	~0.001
4640.7 *9*	–	~0.001
4678.6 *9*	0.021	0.015
4710.7 *9*	0.014	~0.01
4734.7 *8*	0.11	0.084
4792.4 *9*	–	0.0004
4851.8 *9*	0.014	0.014
4899 *2*	–	0.00002
4934.4 *9*	0.028	0.030
4951.0 *9*	0.22	0.228
4976.0 *8*	} 0.023	0.004
4986.2 *8*		0.014
5013.5 *8*	0.24	0.254
5029.6 *8*	} 0.23	⩽0.20
5032.2 *8*		~0.025
5059.1 *8*	0.10	0.110

Notes to Table C

[a] Alpha energies have been calculated from Q_α of 5148.2 *8* keV and the nuclear level structure of Ac-227.

[b] There are no uncertainties identified with the published data, hence weighted mean values cannot be derived.

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I. HALF-LIFE

^{233}Pa

Recommended value: 27.0 ± 0.1 d

This value was adopted from the Nuclear Data Sheets [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by C.W. Reich (INEL, Idaho Falls, USA).

A. Recommended values

E_γ (keV)[a]	P_γ
28.54	0.0015 ± 0.0001
75.28	0.0132 ± 0.0004
86.59	0.0197 ± 0.0012
103.86	0.0087 ± 0.0003
248.50	0.00059 ± 0.00002
271.48	0.0032 ± 0.0001
300.12	0.0663 ± 0.0006
311.98	0.3863 ± 0.0039
340.50	0.0450 ± 0.0005
375.45	0.0068 ± 0.0001
398.62	0.0141 ± 0.0002
415.76	0.0174 ± 0.0002

Note to Table A

[a] Nominal values only.

E_γ (keV)	Vaninbroukx et al. (1984) [3]	Gehrke et al. (1979) [4]
28.54	0.0015 *1*	–
75.28	0.0130 *4*	0.0139 *8*
86.59	–	0.0197 *12*
103.86	0.0087 *3*	0.0087 *3*
248.50	0.0006 *1*	0.00059 *2*
271.48	0.0032 *1*	0.0033 *1*
300.12	0.0664 *6*	0.0662 *10*
311.98	0.3865 *39*	0.386 *5*
340.50	0.0452 *5*	0.0447 *6*
375.45	0.0069 *1*	0.0068 *1*
398.62	0.0143 *2*	0.0139 *2*
415.76	0.0174 *2*	0.0174 *2*

Note to Table B

[a] The P_γ values reported in Ref. [2] have also been measured by one of the laboratories participating in the work of the CRP. However, the efficiency calibration data upon which these values are based have subsequently been revised (M.F. Banham, private communication June 1984). Consequently, these values have not been included in this evaluation.

C. Comparison with other measurements

E_γ (keV)	CRP measurements		Other measurements				Evaluated values[b]
	Vaninbroukx et al. (1984) [3]	Gehrke et al. (1979) [4]	Poenitz and Smith (1978) [5]	Valkeapää et al. (1973)[a] [6]	Gunnink et al. (1969) [7]	Malmskog and Höjeberg (1967) [8]	
28.54	0.0015 *1*	–		0.00070 *8*			0.0015 *1*
75.28	0.0130 *4*	0.0139 *8*		0.0126 *8*	0.0068		0.0132 *4*
86.59	–	0.0197 *12*		0.0188 *23*	0.0186		0.0197 *12*
103.86	0.0087 *3*	0.0087 *3*		0.0074 *8*	0.0081		0.0087 *3*
248.50	0.0006 *1*	0.00059 *2*		0.000039 *12*	0.00075	0.0005 *2*	0.00059 *2*
271.48	0.0032 *1*	0.0033 *1*		0.0030 *3*	0.0033		0.0032 *1*
300.12	0.0664 *6*	0.0662 *10*		0.0664 *31*	0.0660		0.0663 *6*
311.98	0.3865 *39*	0.386 *5*	0.386 *15*	0.3863	0.380		0.3863 *39*
340.50	0.0452 *5*	0.0447 *6*		0.0452 *46*	0.0443		0.0450 *5*
375.45	0.0069 *1*	0.0068 *1*		0.0061 *12*	0.00655		0.0068 *1*
398.62	0.0143 *2*	0.0139 *2*		0.0129 *15*	0.0139		0.0141 *2*
415.76	0.0174 *2*	0.0174 *2*		0.0162 *15*	0.0172		0.0174 *2*

Notes to Table C

[a] Authors quote relative values only. Normalization of these data was accomplished by requiring P_γ (311.98) to be equal to 0.3863. Uncertainty in the normalization not included in the listed uncertainties.

[b] Values derived from a $1\sigma^2$ weighted average of the data from Refs [3–5] only. Since generally a common base of radionuclide decay data was used in the determination of the detector efficiency, the CRP-based P_γ values may not be completely independent. Consequently, the uncertainty in the weighted average is never quoted as being smaller than that of the most precise measurement.

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I. HALF-LIFE ^{232}U

Recommended value: 69.8 ± 0.5 a

This value was adopted from the 1984 review by N.E. Holden [1].

The uncertainty quoted by the evaluator corresponds to a 2σ confidence level; it has been reduced by a factor of two to correspond to the 1σ criterion adopted in this report.

II. EMISSION OF SELECTED GAMMA RAYS AT EQUILIBRIUM OF THE ^{232}U-^{208}Pb DECAY CHAIN

Evaluated by N. Coursol (LMRI, Saclay, France) and R. Vaninbroukx (CBNM, Geel, Belgium).

Nuclide	E_γ (keV)	P_γ per ^{232}U decay
^{232}U	57.78	0.00200 ± 0.00002
	129.08	$(6.82 \pm 0.04)\ 10^{-4}$
	270.2	$(3.16 \pm 0.05)\ 10^{-5}$
	327.9	$(2.83 \pm 0.06)\ 10^{-5}$
^{228}Th	84.40	0.0122 ± 0.0003
	131.62	0.00127 ± 0.00007
	166.37	0.00107 ± 0.00004
	215.94	0.0026 ± 0.0001
^{224}Ra	241.0	0.0405 ± 0.0004
^{220}Rn	549.7	0.00114 ± 0.00017
^{212}Pb	115.18	0.0060 ± 0.0002
	176.66	0.00052 ± 0.00006
	238.63	0.435 ± 0.004
	300.09	0.0325 ± 0.0004
$^{212}Bi(\alpha)$	39.86	0.0103 ± 0.0005
	288.07	0.0031 ± 0.0004
	327.96	0.00120 ± 0.00008
	452.83	0.0036 ± 0.0004
$^{212}Bi(\beta)$	727.18	0.0664 ± 0.0009
	785.42	0.0110 ± 0.0002
	893.39	0.00381 ± 0.00014
	1078.6	0.00574 ± 0.00015
	1620.6	0.0149 ± 0.0006
^{208}Ti	211.5	0.00066 ± 0.00005
	233.5	0.00104 ± 0.00008
	252.6	0.00290 ± 0.00004
	277.35	0.0230 ± 0.0002
	510.80	0.0820 ± 0.0010
	583.14	0.306 ± 0.002
	722.3	0.00094 ± 0.00009
	763.13	0.0068 ± 0.0002
	860.37	0.0450 ± 0.0004
	1093.1	0.0016 ± 0.0002
	2614.6	0.3588 ± 0.0006

Nuclide	E_γ (keV)	P_γ per ^{232}U decay		
		Vaninbroukx and Hansen (1983) [2][a]	Gehrke et al. (1984) [3][b]	Banham and McCrohon (1984) [4]
^{232}U	57.78		0.00200 *4*	0.001992 *12*
	129.08		0.000686 *7*	0.000681 *4*
	270.2			0.0000317 *2*
	327.9			0.0000284 *2*
^{228}Th	84.40		0.01248 *29*	
	131.62		0.00128 *15*	
	166.37		0.00107 *2*	
	215.94		0.00261 *3*	
^{224}Ra	241.0	0.0405 *9*	0.0417 *4*	
^{220}Rn	549.7		0.00130 *3*	
^{212}Pb	115.18		0.00593 *8*	
	176.66		0.00052 *6*	
	238.63	0.440 *6*	0.433 *4*	
	300.09	0.0322 *6*	0.0328 *4*	
$^{212}Bi(\alpha)$	39.86		0.0105 *4*	
	288.07		0.00337 *4*	
	327.96		0.00126 *6*	
	452.83		0.00363 *4*	
$^{212}Bi(\beta)$	727.18	0.0693 *18*	0.0658 *5*	
	785.42		0.01105 *13*	
	893.39		0.00382 *18*	
	1078.6		0.00565 *18*	
	1620.6		0.0149 *3*	
^{208}Tl	211.5		0.00070 *6*	
	233.5		0.00095 *12*	
	252.6		0.00291 *4*	
	277.35	0.0228 *4*	0.02304 *22*	
	510.80	0.0827 *14*	0.0821 *27*	
	583.14	0.308 *6*	0.3052 *17*	
	722.3		0.00095 *18*	
	763.13		0.00656 *7*	
	860.37		0.0451 *4*	
	1093.1		0.00160 *2*	
	2614.6		0.363 *5*	

Nuclide	E_γ (keV)	P_γ per ^{232}U decay				
		CRP measurements			Other measurements	
		Vaninbroukx and Hansen (1983) [2] [a]	Gehrke et al. (1984) [3] [b]	Banham and Mc Crohon (1984) [4]	Schupp et al. (1960) [5]	Bertolini et al. (1962) [6] [c]
^{232}U	57.78		0.00200 *4*	0.001992 *12*		
	129.08		0.000686 *7*	0.000681 *4*		
	270.2			0.0000317 *2*		
	327.9			0.0000284 *2*		
^{228}Th	84.40		0.01248 *29*			
	131.62		0.00128 *15*			
	166.37		0.00107 *2*			
	215.94		0.00261 *3*			
^{224}Ra	241.0	0.0405 *9*	0.0417 *4*			
^{220}Rn	549.7		0.00130 *3*			
^{212}Pb	115.18		0.00593 *8*			
	176.66		0.00052 *6*			
	238.63	0.440 *6*	0.433 *4*			
	300.09	0.0322 *6*	0.0328 *4*			
$^{212}Bi(\alpha)$	39.86		0.0105 *4*			
	288.07		0.00337 *4*			0.00278 *14*
	327.96		0.00126 *6*			0.00107 *8*
	452.83		0.00363 *4*			
$^{212}Bi(\beta)$	727.18	0.0693 *18*	0.0658 *5*		0.0711 *45*	
	785.42		0.01105 *13*		0.0109 *17*	
	893.39		0.00382 *18*		0.00423 *45*	
	1078.6		0.00565 *18*		0.00634 *51*	
	1620.6		0.0149 *3*		0.0180 *13*	
^{208}Tl	211.5		0.00070 *6*			
	233.5		0.00095 *12*			
	252.6		0.00291 *4*			
	277.35	0.0228 *4*	0.02304 *22*			
	510.80	0.0827 *14*	0.0821 *27*			
	583.14	0.308 *6*	0.3052 *17*			
	722.3		0.00095 *18*			
	763.13		0.00656 *7*			
	860.37		0.0451 *4*			
	1093.1		0.00160 *2*			
	2614.6		0.363 *5*			

Nuclide	E_γ (keV)	P_γ per ^{232}U decay				
		Other measurements				
		Péghaire (1969) [7]	Larsen and Jørgensen (1969) [8][d]	Aubin et al. (1969) [9][e]	Kortelahti et al. (1975) [10][e]	Kurcewicz et al. (1977) [11][f]
^{232}U	57.78					
	129.08					0.000669 *26*
	270.2					0.0000285 *12*
	327.9					0.0000253 *10*
^{228}Th	84.40	0.0121 *6*				
	131.62					0.00125 *7*
	166.37					0.00097 *6*
	215.94					0.00241 *14*
^{224}Ra	241.0	0.0395 *13*				
^{220}Rn	549.7					0.00097 *8*
^{212}Pb	115.18					
	176.66					
	238.63					
	300.09					
$^{212}Bi(\alpha)$	39.86					
	288.07					
	327.96					
	452.83					
$^{212}Bi(\beta)$	727.18					
	785.42					
	893.39					
	1078.6					
	1620.6					
^{208}Tl	211.5		0.0007 *2*		0.00061 *7*	
	233.5		0.0011 *2*		0.00111 *11*	
	252.6		0.0029 *4*		0.00287 *18*	
	277.35		0.0248 *18*		0.0244 *11*	
	510.80		0.083 *4*		0.078 *3*	
	583.14			0.307 *6*	0.308 *11*	
	722.3		0.0011 *4*		0.00073 *5*	
	763.13		0.0072 *7*		0.0059 *3*	
	860.37		0.047 *4*		0.0430 *14*	
	1093.1		0.0018 *4*		0.00133 *14*	
	2614.6					

Nuclide	E_γ (keV)	P_γ per ^{232}U decay				
		Other measurements				
		Avignone and Schmidt (1978) [12] [g]	Sadasivan and Raghunath (1982) [13] [h]	Schötzig and Debertin (1983) [14] [i]	Evaluated values [j]	Calculated values [k]
^{232}U	57.78				0.00199 *2* [l]	0.00204 *5*
	129.08				0.000682 *4*	
	270.2				0.0000316 *5*	
	327.9				0.0000283 *6*	
^{228}Th	84.40		0.019 *1*		0.0124 *3*	0.01195 *25*
	131.62		0.0017 *2*		0.00127 *7*	
	166.37		0.0013 *1*		0.00107 *4* [l]	
	215.94		0.0030 *2*		0.0026 *1* [l]	
^{224}Ra	241.0		0.039 *2*	0.0404 *17*	0.0412 *4*	0.0396 *4*
^{220}Rn	549.7				0.00114 *17* [m]	
^{212}Pb	115.18	0.0068 *7*	0.0071 *5*		0.0060 *2*	
	176.66				0.00052 *6*	
	238.63	0.500 *14*		0.435 *12*	0.435 *4*	
	300.09	0.0317 *11*	0.029 *2*	0.0327 *9*	0.0325 *4*	
$^{212}Bi(\alpha)$	39.86		0.009 *1*		0.0103 *5*	
	288.07	0.0035 *2*	0.0032 *3*	0.00274 *23*	0.0031 *4* [m]	
	327.96			0.00120 *8*	0.00120 *8* [l]	
	452.83	0.0040 *2*	0.0042 *5*	0.00256 *23*	0.0036 *4* [m]	
$^{212}Bi(\beta)$	727.18	0.0756 *29*	0.070 *4*	0.0656 *20*	0.0664 *9* [l]	
	785.42	0.0117 *6*	0.0101 *7*	0.0107 *5*	0.0110 *2* [l]	
	893.39		0.0050 *8*	0.00352 *36*	0.00381 *14*	
	1078.6			0.0058 *4*	0.00574 *15*	
	1620.6			0.0138 *8*	0.0149 *6*	
^{208}Tl	211.5				0.00066 *5*	
	233.5				0.00104 *8*	
	252.6	0.0022 *2*	0.0028 *3*		0.00290 *4*	
	277.35	0.0220 *7*	0.024 *1*		0.0230 *2*	
	510.80	0.0821 *25*	0.079 *4*		0.0820 *10*	
	583.14		0.303 *14*	0.306 *9*	0.306 *2*	
	722.3	0.00097 *7*			0.00094 *9* [m]	
	763.13	0.0066 *3*	0.007 *1*	0.0073 *5*	0.0068 *2* [m]	
	860.37	0.0500 *22*	0.042 *2*	0.0455 *12*	0.0450 *4*	
	1093.1				0.0016 *2* [m]	
	2614.6			0.356 *11*	0.361 *5*	0.3587 *6*

[a] The results from the measurements with a Ge(Li) detector have been recalculated using $P_\gamma = 0.306 \pm 0.002$ for the 583 keV reference ray.

[b] When no absolute emission probability values (see table in C) are given, the P_γ values have been calculated from the measured relative intensities (see table in B) using the authors' value of $P_\gamma = 0.3052 \pm 0.0017$ for the 583 keV ray. The measured relative value for the 328 keV ray from ^{212}Bi has been corrected for a 2.2% contribution by the 328 keV ray from ^{232}U. The absolute value for the 2615 keV ray in the table in C is a calculated figure and has not been considered in the table of measured values.

[c] The P_γ values have been recalculated using 0.3594 ± 0.0006 for the alpha decay branch of ^{212}Bi.

[d] The P_γ values have been calculated from the measured relative intensities using $P_\gamma = 0.306 \pm 0.002$ for the 583 keV ray.

[e] The P_γ value has been calculated from the measured relative intensities using $P_\gamma = 0.3588 \pm 0.0006$ for the 2615 keV reference ray.

[f] The P_γ values have been recalculated using $P_\gamma(58) = 0.00200 \pm 0.00002$ for ^{232}U, $P_\gamma(84) = 0.0122 \pm 0.0003$ for ^{228}Th and $P_\gamma(241) = 0.0405 \pm 0.0004$ for ^{224}Ra-^{220}Rn, respectively.

[g] The P_γ values have been normalized using $P_\gamma = 0.306 \pm 0.002$ for the 583 keV reference ray. The results for the 239, 253 and 860 keV rays, deviating by several times the quoted uncertainties from those of the other measurements, have not been considered in the calculation of the evaluated values.

[h] The P_γ values have been renormalized using $P_\gamma = 0.435 \pm 0.004$ for the 239 keV reference ray. The value for the 84 keV ray has not been considered in the calculation of the evaluated value.

[i] The P_γ values for the 277, 328, 583 and 727 keV rays have been obtained by applying corrections for the contributions of rays of ^{228}Ac of nearly the same energies. These contributions were calculated from the literature values given in the authors' Table 2.

[j] Generally, the evaluated values are, in accordance with Topping [15], deduced from the weighted means of the measured results. For consistency, the quoted uncertainties have been occasionally increased for the calculation of the weights (see too footnote l). For some low-intensity transitions, with a great spread of the experimental results, the evaluated values are the arithmetic means (see footnote m).

[k] These values were calculated from the well known transition probabilities $P_{tr} = P_\alpha$ (or P_β) $+ P_\gamma + P_{CE}$ feeding the considered level, taken from the literature [16–19] and the theoretical total internal-conversion coefficients (ICC), obtained by cubic spline interpolation or by extrapolation of the values tabulated by Rösel et al. [20]. Details are given in the table below. These calculated values are also considered for the calculation of the recommended values.

[l] The quoted uncertainties have been increased for the calculation of the means.

[m] Arithmetic means.

Nuclide	E_γ (keV)	Multipolarity	Transition probability (P_{tr})	Total ICC (α) [20]	$P_\gamma = P_{tr}/(1+\alpha)$
^{232}U	57.78	E_2	0.320 *4* [16]	156 *3*	0.00204 *5*
^{228}Th	84.40	E_2	0.270 *3* [17]	21.6 *4*	0.01195 *25*
^{224}Ra	241.0	E_2	0.0507 *5* [18]	0.279 *6*	0.0396 *4*
^{208}Tl	2614.6	E_3	0.3594 *6* [19] (α branch ^{212}Bi)	0.0019 *1*	0.3587 *6*

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Recommended value: $(1.592 \pm 0.002) \times 10^5$ a

This value was adopted from the 1984 review by N.E. Holden [1].

The listed uncertainty has the same value as that given by Holden [1], whose uncertainties are customarily quoted at the 2σ level. To convert Holden's uncertainty to the 1σ level would result in the ^{233}U half-life being given with an accuracy of $<0.1\%$. As discussed elsewhere in this report, the CRP participants feel that 0.1% is the *minimum* accuracy to which the half-lives of long lived actinide nuclides can be reliably determined. Consequently, we have retained Holden's listed uncertainty, which also represents – to one significant figure – this 0.1% lower limit.

Evaluated by C.W. Reich (INEL, Idaho Falls, USA).

A. Recommended values

E_γ (keV)[a]	Emission probability (P_γ) (photons per decay)
29.192 ± 0.001	0.000120 ± 0.000003 [c]
42.468 ± 0.002 [b]	0.000862 ± 0.000013 [c]
54.699 ± 0.001	0.000182 ± 0.000003
118.968 ± 0.002	0.0000406 ± 0.0000004
120.816 ± 0.001	0.0000332 ± 0.0000003
135.3	0.0000232 ± 0.0000002
146.345 ± 0.002	0.0000657 ± 0.0000006
164.522 ± 0.002	0.0000623 ± 0.0000005
208.171 ± 0.002	0.0000229 ± 0.0000003
245.345 ± 0.002	0.0000362 ± 0.0000003
291.354 ± 0.004	0.0000537 ± 0.0000005
317.2	0.0000776 ± 0.0000007
320.541 ± 0.005	0.0000290 ± 0.0000003

Notes to Table A

[a] Values reported in Ref. [2].

[b] Decay scheme studies indicate that this peak is a doublet.

[c] Gamma rays from members of the decay chain headed by ^{233}U can contribute to this peak.

B. CRP measurements

The only CRP-based measurements of the emission probabilities of the gamma-ray transitions from ^{233}U decay are those carried out at INEL [2]. Since these are included in II.C. (below) they are not listed separately here.

C. Comparison with other measurements

E_γ (keV)[a]	CRP measurements[b]	Other measurements[b]			Recommended values[f]
	Reich et al. (1984) [2]	Canty et al. (1977) [3][c]	Kroger and Reich (1976) [4][e]	Ahmad (1966) [5]	
29.192 *1*	12.0 *3*	6.46	12.0 *12*	10 *2*	12.0 *3*
42.468 *2*	86.2 *13*	57.24	62.0 *50*	77 *7*	86.2 *13*
54.699 *1*	18.2 *3*	13.3	15.0 *10*	14 *2*	18.2 *3*
118.968 *2*	4.06 *4*	3.01	3.7 *2*	4.7 *8*	4.06 *4*
120.816 *1*	3.32 *3*	1.95	3.10 *15*	3.2 *5*	3.32 *3*
135.3	2.32 *2*	2.06	2.30 *12*	2.9 *3*	2.32 *2*
146.345 *2*	6.57 *6*	5.96	6.40 *32*	8.0 *15*	6.57 *6*
164.522 *2*	6.23 *5*	6.31	6.2 *4*	7.8 *8*	6.23 *5*
208.171 *2*	2.29 *3*	2.37	2.40 *12*	2.7 *3*	2.29 *3*
245.345 *2*	3.62 *3*	3.77	3.8 *2*	4.2 *5*	3.62 *3*
291.354 *4*	5.37 *5*	5.46	5.5 *3*	6.7 *7*	5.37 *5*
317.2	7.76 *7*	7.76 [d]	8.0 *10*	9 *1*	7.76 *7*
320.541 *5*	2.90 *3*	2.87	3.0 *2*	3.2 *5*	2.90 *3*

Notes to Table C

[a] Gamma-ray energies are those reported in Ref. [2].

[b] All P_γ values are expressed in units of photons per 10^5 decays.

[c] Only relative values for the gamma ray intensities are given in Ref. [3]. The uncertainties in these relative data are stated to be <15%. The values shown here have, for purposes of comparison, been normalized to that of the 317.2 keV gamma ray.

[d] Normalization point.

[e] The listed uncertainty of P_γ (317.2) is that of the overall P_γ normalization. It has *not* been 'folded' into the other listed uncertainties, which are those of the relative intensities only.

[f] After consideration of the relatively large uncertainties in three of the sets of measurements and the large differences among some of the values reported in them, we have chosen to adopt for the recommended P_γ values those measured at INEL [2].

Evaluated by C.W. Reich.

A. Recommended values

Transition[a]	E_α (keV)[b]	P_α
α_0	4824	0.827 ± 0.003
α_{42}	4783	0.149 ± 0.002
α_{97}	4729	0.0185 ± 0.0005

Notes to Table A

[a] Subscript denotes the energy (in keV) of the daughter-nucleus level fed by the alpha transition.

[b] Nominal values only, taken from Ref. [6].

B. CRP measurements

None. However, the measurements reported by I. Ahmad [7] and included in III.C below were undertaken at the request of the CRP participants.

C. Comparison with other measurements

Transition	E_α(keV)	Ahmad (1984) [7]	Baranov et al. (1976) [8]	Recommended values[b]
α_0	4824	0.827 *3*	0.844 *5*	0.827 *3*
α_{42}	4783	0.149 *2*	0.132 *2*	0.149 *2*
α_{97}	4729	0.0185 *5*	0.0161 [a]	0.0185 *5*

Notes to Table C

[a] Value not given in Ref. [8]; it has been taken from Ref. [6].

[b] The differences in the two reported measurements appear to arise from systematic, rather than from statistical, causes. Consequently, we have not carried out a weighted average of the two data sets in order to arrive at a list of recommended values. We have chosen to adopt as the recommended values those of Ref. [7].

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Recommended value: $(2.457 \pm 0.003) \times 10^5$ a

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

Weighted mean with 1σ standard deviation.

Value (years)	Reference [e]
2.475 *24* X 10^5 [a]	Fleming et al. (1952) [1]
2.47 *3* X 10^5 [a]	White et al. (1965) [2]
2.439 *36* X 10^5 [a, b]	Meadows (1970) [3]
2.450 *6* X 10^5 [a]	de Bievre et al. (1972/1980) [4]
2.458 *6* X 10^5 [a]	Lounsbury and Durham (1972) [5]
2.459 *4* X 10^5 [a]	Geidel'man et al. (1980) [6]
2.457 *5* X 10^5 [a, c]	Poenitz and Meadows (1983) [7]
2.457 *5* X 10^5 [a, d]	Divadeenam and Stehn (1984) [8]
2.458 *5* X 10^5 [a, d]	Axton (1985) [9]

Notes to Table

[a] 1σ standard deviation has been estimated.

[b] Data in Ref. [7] imply that this value has been withdrawn, and it has not been considered in this evaluation.

[c] Determined from accurate mass assay of U-235 samples and absolute alpha decay rates.

[d] Derived from least squares fit of thermal data for selected fissile nuclei; the data from Ref. [8] were omitted from the evaluation on the basis that the same data sources were used to derive the least squares fit for Refs [8] and [9].

[e] An earlier evaluation by Holden [10] was based on the data from Refs [1–6] to give a recommended half-life of 2.454 *6* X 10^5 years with a 95% confidence limit; the most recent evaluation of Holden [11] was based on the data from Refs [1, 2] and [4–7] to give a recommended half-life of 2.456 *5* X 10^5 years with a 95% confidence limit.

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

A. Recommended values

E_γ (keV)	P_γ
53.20 ± 0.02	0.00123 ± 0.00002
120.90 ± 0.02	0.000342 ± 0.000005
454.95 ± 0.05	$(2.5 \pm 0.5) \times 10^{-7}$
508.20 ± 0.10	$(1.5 \pm 0.5) \times 10^{-7}$
581.7 ± 0.2	$(1.2 \pm 0.5) \times 10^{-7}$

B. CRP measurements

E_γ (keV)	P_γ Vaninbroukx et al. (1984) [20]
53.20	0.00124 *2*
120.88	0.000341 *4*

C. Comparison with other measurements

E_γ and P_γ from other sources

Bjørnholm et al. (1963) [12]		Ahmad (1966) [13]		Schmorak et al. (1972) [14]		Taylor (1973) [15]		Heath (1974) [16]	
E_γ (keV)	P_γ	E_γ (keV)	P_γ [a]	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ [a]
–	–	53.3 *2*	100	53.222 *19*	–	53.15 *3*	–	53.3 *1*	100 *5*
–	–	120.9 *2*	34 *4*	120.905 *12*	–	–	–	120.9 *1*	34.2 *18*
460	$4\ 1 \times 10^{-7}$	–	–	–	–	–	–	–	–
510		–	–	–	–	–	–	–	–
585	$1.2\ 5 \times 10^{-7}$	–	–	–	–	–	–	–	–

Note to Table C

[a] Relative gamma ray emission probabilities.

Comparison

E_γ (keV)	CRP measurements	Other measurements			Evaluated values[e] (from measurements)	Calculated values (from ICC and P_α data)
	Vaninbroukx et al. (1984) [20]	Bjørnholm et al. (1963) [12][c]	Ahmad (1966) [13][d]	Heath (1974) [16][d]		
53.20 *2* [a]	0.00124 *2*	–	0.00122 *3*	0.00122 *9*	0.00123 *2*	0.00122 *3*
120.90 *2* [a]	0.000341 *4*	–	0.00041 *6*	0.00042 *6*	0.000342 *5*	0.00033 *1*
454.95 *5* [b]	–	$2.5\ 5 \times 10^{-7}$	–	–	$2.5\ 5 \times 10^{-7}$	–
508.20 *10* [b]	–	$1.5\ 5 \times 10^{-7}$	–	–	$1.5\ 5 \times 10^{-7}$	–
581.7 *2* [b]	–	$1.2\ 5 \times 10^{-7}$	–	–	$1.2\ 5 \times 10^{-7}$	–

Notes to Table

[a] Gamma energies derived from weighted mean values of Refs [13–16].

[b] Accurate gamma energies derived from Pa-230 decay data.

[c] $P_\gamma(455)/P_\gamma(508) = 1.67$ from Pa-230 and Ac-230 decay data.

[d] Data renormalized so that $P(\gamma + ce) + P_\alpha(0) = 1.00$ with $P_\alpha(0) = 0.7137\ 2$.

[e] Recommended data are weighted mean values with 1σ standard deviation.

E_γ (keV)	Transition type	Theoretical internal conversion coefficients[a]				Calculated total transition probability (from ICC and P_γ data)
		α_K	α_L	α_{M+}	α_{tot}	
53.20	E2	–	170 *2*	63 *1*	233 *5*	0.288 *11*
120.90	E2	0.253 *3*	3.49 *4*	1.30 *1*	5.0 *1*	0.00205 *7*

Note to Table

[a] Theoretical internal conversion coefficients taken from F. Rösel et al., At. Data Nucl. Data Tables **21**, 4–5 (1978).

III. ALPHA PARTICLE EMISSION PROBABILITIES

A. Recommended values

E_α (keV)	P_α
4603.8 ± 0.9	0.00199 ± 0.00002
4722.6 ± 0.9	0.2842 ± 0.0002
4774.9 ± 0.8	0.7137 ± 0.0002

B. CRP measurements

Vaninbroukx et al. (1984) [20]		Okashita (1984) [21]	
E_α (keV)	P_α	E_α (keV)	P_α
4605	0.00206 *4*	4604.7	0.00209 *12*
4724	0.2842 *5*	4723.7	0.2846 *17*
4776	0.7138 *5*	4775.8	0.7134 *15*

C. Comparison with other measurements

E_α (keV)[a]	CRP measurements		Other measurements			Evaluated values
	Vaninbroukx et al. (1984) [20][b]	Okashita (1984) [21]	Baranov et al. (1960) [17][c]	Kocharov and Korolev (1961) [18][d]	Burns et al. (1984) [19][b]	
4603.8 *9*	0.00206 *4*	0.00209 *12*	<0.0037 *11*	0.003	0.001978 *12*	0.00199 *2*
4722.6 *9*	0.2842 *5*	0.2846 *17*	0.275 *15*	0.27	0.2843 *2*	0.2842 *2*
4774.9 *8*	0.7138 *5*	0.7134 *15*	0.725 *30*	0.73	0.7137 *2*	0.7137 *2*

Notes to Table C

[a] Alpha energies have not been measured by CRP laboratories; accurate energies have been calculated from Q_α of 4857.9 *8* keV and nuclear level scheme of Th-230.

[b] The extremely low uncertainties were accepted because of the great care taken to prepare samples, measure the alpha transitions and process the resulting spectra.

[c] Only an upper limit was placed on the 4604 keV alpha emission probability by Baranov et al. [17], and this value has not been used in the calculation of a weighted mean and the derivation of the recommended value.

[d] No uncertainties were reported by Kocharov and Korolev [18]: values of 0.27 *2* and 0.73 *2* have been assigned to the 4723 and 4775 keV alpha emission probabilities, respectively, and the 4604 keV alpha emission probability has not been used in calculating the weighted mean and recommended value.

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I. HALF-LIFE

^{235}U

Recommended value: $(7.037 \pm 0.007) \times 10^8$ a

This value was adopted from the 1984 review by Holden [1].

The quoted uncertainty, corresponding to the 2σ level, has been reduced to 0.1%, being the minimum value adopted by the CRP participants for half-lives of long lived nuclides.

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_γ (keV)	P_γ
41.96	0.0006 ± 0.0001
74.8	0.0006 ± 0.0001
109.16	0.0154 ± 0.0005
140.76	0.0022 ± 0.0002
143.76	0.1096 ± 0.0008
150.93	0.0008 ± 0.0001
163.33	0.0508 ± 0.0004
182.61	0.0034 ± 0.0002
185.72	0.572 ± 0.002
194.94	0.0063 ± 0.0001
198.90	0.0042 ± 0.0006
202.11	0.0108 ± 0.0002
205.31	0.0501 ± 0.0005
221.38	0.0012 ± 0.0001
233.50	0.00029 ± 0.00005
240.85	0.00075 ± 0.00006
246.84	0.00053 ± 0.00003

E_γ (keV)	Vaninbroukx and Denecke (1982) [2]	Banham and Jones (1983) [3]	Helmer and Reich (1984) [4]
41.96		0.0006 *1*	
74.8		0.0051 *5*	
109.16		0.0153 *5*	
140.76		0.00214 *15*	
143.76	0.109 *2*	0.107 *2*	0.1101 *8*
150.93		0.00066 *10*	
163.33	0.050 *1*	0.0497 *10*	0.0512 *4*
182.61		0.00339 *17*	
185.72	0.575 *9*	0.573 *6*	0.572 *5*
194.94		0.00626 *13*	
198.90		0.00047 *6*	
202.11		0.0108 *2*	
205.31	0.050 *2*	0.0505 *5*	0.0496 *5*
221.38		0.00114 *6*	
233.50		0.00029 *5*	
240.85		0.00076 *6*	
246.84		0.00053 *3*	

C. Comparison with other measurements

E_γ (keV)	CRP measurements			Other measurements			Evaluated values[c]
	Vaninbroukx and Denecke (1982) [2]	Banham and Jones (1983) [3]	Helmer and Reich (1984) [4]	Teoh et al. (1974) [5][a]	Vano et al. (1975) [6][a]	Olson (1983) [7]	
41.96		0.0006 *1*		0.0007 *3*			0.0006 *1*
74.8		0.0051 *5*[b]		0.0005 *1*	0.0007 *1*		0.0006 *1*
109.16		0.0153 *5*		0.018 *2*	0.015 *2*		0.0154 *5*
140.76		0.00214 *15*		0.0026 *3*	0.0022 *3*		0.0022 *2*
143.76	0.109 *2*	0.107 *2*	0.1101 *8*	0.112 *11*	0.111 *11*	0.1093 *15*	0.1096 *8*
150.93		0.00066 *10*		0.0008 *1*	0.00081 *10*		0.0008 *1*
163.33	0.050 *1*	0.0497 *10*	0.0512 *4*	0.050 *5*	0.051 *5*	0.0507 *8*	0.0508 *4*
182.61		0.00339 *17*		0.0042 *14*	0.0044 *9*		0.0034 *2*
185.72	0.575 *9*	0.573 *6*	0.572 *5*			0.561 *8*	0.572 *5*
194.94		0.00626 *13*		0.0061 *9*	0.0062 *6*		0.0063 *1*
198.90		0.00047 *6*		0.00046 *6*	0.00033 *5*		0.0042 *6*
202.11		0.0108 *2*		0.0108 *11*	0.0107 *10*		0.0108 *2*
205.31	0.050 *2*	0.0505 *5*	0.0496 *5*	0.049 *4*	0.050 *5*	0.0503 *9*	0.0501 *5*
221.38		0.00114 *6*		0.0012 *3*	0.0012 *1*		0.0012 *1*
233.50		0.00029 *5*		0.0003 *1*	0.0003 *1*		0.00029 *5*
240.85		0.00076 *6*		0.0006 *2*	0.0008 *2*		0.00075 *6*
246.84		0.00053 *3*		0.0005 *2*	0.0008 *2*		0.00053 *3*

Notes to Table C

[a] The P_γ values have been calculated from the measured relative intensities using $P_\gamma = 0.572 \pm 0.005$ for the 185 keV reference line.

[b] The value, deviating by a factor of about 10 from the results of the other measurements, has not been considered in the calculation of the evaluated value.

[c] The evaluated values and uncertainties are based on weighted means calculated according to Topping [8].

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I. HALF-LIFE

Recommended value: 6.75 ± 0.01 a

This value was adopted from the Nuclear Data Sheets [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_γ (keV)	P_γ
51.00	0.0045 ± 0.0006
59.54	0.345 ± 0.008
64.83	0.0131 ± 0.0003
164.58	0.0187 ± 0.0005
208.00	0.216 ± 0.005
221.73	0.000205 ± 0.000008
234.24	0.000205 ± 0.000008
267.54	0.00730 ± 0.00018
332.35	0.0121 ± 0.0003
335.40	0.00097 ± 0.00003
368.60	0.00042 ± 0.00002
370.93	0.00110 ± 0.00004

E_γ (keV)	Willmes et al. (1985) [2][a]	Helmer and Reich (1985) [3][a]	Banham (1984) [4][b]
51.00			
59.54			0.344 *9*
64.83	0.0130 *4*		0.0045 *6*
164.58	0.0188 *5*	0.0190 *5*	0.0188 *5*
208.00	0.216 *6*	0.216 *6*	*0.216* [e]
221.73			0.000203 *25*
234.24			0.000227 *40*
267.54	0.00722 *20*	0.00726 *33*	0.00733 *25*
332.35	0.0122 *3*		0.0120 *4*
335.40	0.00097 *3*		0.00093 *5*
368.60	0.00040 *3*		0.00042 *3*
370.93	0.00109 *4*		0.00111 *6*

	CRP measurements			Other measurements				
E_γ (keV)	Willmes et al. (1985) [2][a]	Helmer and Reich (1985) [3][a]	Banham (1984) [4][b]	Yamazaki and Hollander (1966) [5][b]	Cline (1971) [6][b]	Gunnink et al. (1976) [7][c]	Buchuev et al. (1982) [8]	Evaluated values[d]
51.00			0.0045 *6*	0.0021 *10*		0.00340 *14*		0.0045 *6*
59.54			0.344 *9*	0.335 *40*	0.334 (25)	0.345 *8*		0.345 *8*
64.83	0.0130 *4*		0.0133 *5*	0.0117 *16*	0.0121 *9*	0.0130 *3*		0.0131 *3*
164.58	0.0188 *5*	0.0190 *5*	0.0188 *5*	0.0183 *9*	0.0185 *14*	0.0184 *5*		0.0187 *5*
208.00	0.216 *6*	0.216 *6*	(0.216)[e]	(0.216)[e]	(0.216)[e]	0.217 *5*	0.215 *14*	0.216 *5*
221.73			0.000203 *25*	0.000203 *18*	0.000185 *14*	0.000212 *8*		0.000205 *8*
234.24			0.000227 *40*	0.000194 *18*	0.000278 *60*	0.000205 *8*		0.000205 *8*
267.54	0.00722 *20*	0.00726 *33*	0.00733 *25*	0.00711 *30*	0.00769 *60*	0.00740 *18*		0.00730 *18*
332.35	0.0122 *3*		0.0120 *4*	0.0120 *8*	0.0121 *9*	0.0121 *3*		0.0121 *3*
335.40	0.00097 *3*		0.00093 *5*	0.00095 *9*	0.00111 *9*	0.00097 *3*		0.00097 *3*
368.60	0.00040 *3*		0.00042 *3*	0.00046 *5*	0.00044 *3*	0.00043 *2*		0.00042 *2*
370.93	0.00109 *4*		0.00111 *6*	0.00111 *9*	0.00127 *10*	0.00110 *4*		0.00110 *4*

Notes to Table C

[a] The P_γ values have been recalculated from the ^{241}Pu decay data in the form $P_\alpha(^{241}Pu)$ times $P_\gamma(^{237}U)$.

[b] The relative values of each author are normalized to 0.216 at 208.00 keV as the weighted mean of data from Refs [2, 3, 7, 8].

[c] Uncertainties include a 2% detector efficiency uncertainty.

[d] The evaluated values are deduced from the weighted mean of the experimental data.

[e] Evaluator's normalization point. For reasons of consistency, the quoted uncertainty for the 234 keV ray in Ref. [6] has been increased by a factor of 3.

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Recommended value: 23.47 ± 0.05 min

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

Weighted mean with 1σ standard deviation.

Value (min)	Reference
23.54 *5*	Mitchell et al. (1943) [1]
23.5 *7*	Feather and Krishnan (1947) [2]
23.40 *5*	Hunt et al. (1969) [3]

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

A. Recommended values

E_γ (keV)	P_γ
31.131 ± 0.002	0.00068 ± 0.00010 [a]
43.533 ± 0.001	0.0416 ± 0.0011
74.664 ± 0.001	0.481 ± 0.010
86.72 ± 0.07	0.00052 ± 0.00006
117.7 ± 0.1	0.0013 ± 0.0004

Note to Table A

[a] Adjusted to produce complete and consistent decay scheme (see below).

B. CRP measurements

E_γ (keV)	P_γ Holloway et al. (1984) [4]
31.1	0.00065 *7*
43.5	0.0418 *13*
74.7	0.482 *10*
86.7	0.00052 *6*
117.8	0.0013 *4*

C. Comparison with other measurements

E_γ and P_γ from other sources

Blinowska et al. (1964) [5]		Yurova and Bushuev (1965) [6]		MacKenzie and Connor (1968) [7]		Cline and Tripp (1969) Schmorak (1983) [8]		Börner et al. (1979) [9]	
E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ	E_γ (keV)	P_γ [a]	E_γ (keV)	P_γ
31.142 *3*	–	–	–	–	–	–	–	31.131 *2*	–
43.531 *2*	0.041 *2*	–	–	43.5	~0.012	43.52 *4*	8.9 *3*	43.533 *1*	–
74.673 *2*	(0.51)	74	0.435 *30*	74.7	0.62 *9*	74.66 *2*	100	74.664 *1*	–
–	–	–	–	–	–	86.72 *7*	0.12	–	–
–	–	–	–	–	–	117.66 *3*	0.29	–	–

Note to Table C

[a] Relative gamma ray emission probabilities.

E_γ(keV)	CRP measurements	Other measurements				
	Holloway et al. (1984) [4]	Blinowska et al. (1964) [5]	Yurova and Bushuev (1965) [6][c]	MacKenzie and Connor (1968) [7][d]	Cline and Tripp (1969) Schmorak (1983) [8][e]	Evaluated values
31.131 *2*	0.00065 *7*	–	–	–	–	0.00065 *7*
43.533 *1*	0.0418 *13*	0.041 *2* [a]	–	~0.012	0.0445 *60*	0.0416 *11*
74.664 *1*	0.482 *10*	(0.51) [b]	0.47 *4*	0.62 *9*	0.50 *5*	0.481 *10*
86.72 *7*	0.00052 *6*	–	–	–	0.00060 *6*	0.00052 *6*
117.7 *1*	0.0013 *4*	–	–	–	0.00145 *15*	0.0013 *4*

Notes to Table

[a] The 1σ standard deviation for the 43.533 keV gamma emission probability has been estimated from the spectral data.

[b] The 74.664 keV gamma emission probability was calculated by Blinowska et al. from their proposed decay scheme: this derived value has not been used to calculate the weighted mean and recommended value.

[c] The emission probabilities of the Au-198 K-X-rays were used to calibrate the gamma spectrometer in the 72 keV region: a value of 0.0257 *7* gave an emission probability of 0.435 *30*. The latest estimate for the combined K-X-ray emission probability of Au-198 is 0.0280 *10*, and this gives a 74.664 keV gamma emission probability of 0.47 *4*.

[d] The 74.664 keV gamma emission probability was calculated by assuming a single transition from the 74.664 keV energy level to the ground state: this is incorrect, and a value of 0.48 *2* can be derived using transition probability data associated with the 43.533 keV gamma ray. The data from this biased recalculation have not been used to calculate the weighted mean and recommended values.

[e] Communicated privately to Artna-Cohen [8], but not published in the open literature with the necessary experimental detail: these data have not been used to calculate the weighted mean and recommended values. However, the emission probabilities of the 149 gamma rays listed by Artna-Cohen/Cline and Tripp have been used to produce a complex and comprehensive decay scheme to aid in the evaluation of the limited CRP data. Internal conversion coefficients measured by Engelkemeir (1969) [10] and Schmidt-Ott et al. (1972) [11] were used in this evaluation to calculate the multipolarities of important gamma transitions.

E_γ (keV)	Transition type	Theoretical internal conversion coefficients[a]				Calculated total transition probability (from ICC and P_γ data)
		α_K	α_L	α_{M+}	α_{tot}	
31.131[b]	M1 + E2	–	210 *10*	75 *5*	285 *15*	0.194 *40*
43.533	E1	–	0.87 *3*	0.29 *1*	1.16 *4*	0.090 *4*
74.664	E1	–	0.211 *6*	0.070 *2*	0.281 *8*	0.616 *17*
86.72	E1	–	0.142 *4*	0.048 *2*	0.190 *6*	0.00062 *7*
117.7	E1	–	0.064 *2*	0.024 *1*	0.088 *3*	0.0014 *4*

Notes to Table

[a] Theoretical internal conversion coefficients taken from F. Rösel et al., At. Data Nucl. Data Tables **21**, 4–5 (1978).

[b] The multipolarity of the $7/2^+ \rightarrow 5/2^+$ ground-state transition was calculated to have an admixture of 3% E2 by balancing the decay schemes for U-239 and Am-243: this consistency was best achieved by adjusting the 31.131 keV gamma emission probability to a recommended value of 0.00068 *10*.

III. BETA DECAY DATA

Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

Recommended values

E_β (keV)[a]	P_β[b]
1145.2 ± 2.5	0.018 ± 0.002
1188.2 ± 2.5	0.688 ± 0.014
1231.8 ± 2.5	0.102 ± 0.019
1262.9 ± 2.5	0.178 ± 0.029

Notes to Table

[a] Beta energies have been calculated from Q_β of 1262.9 *25* keV and the nuclear level structure of Np-239.

[b] Recommended emission probability data have been derived from the proposed decay scheme formed from the evaluated gamma ray emission probabilities and the high energy gamma ray measurements of Cline and Tripp [8].

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I. HALF-LIFE

^{237}Np

Recommended value: $(2.14 \pm 0.01) \times 10^6$ a

This value is based on the results of only one precise measurement, namely that of Brauer et al. [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by C.W. Reich (INEL, Idaho Falls, USA).

A. Recommended values

E_γ (keV)[a]	P_γ
29.37	0.153 ± 0.003
46.53	0.00106 ± 0.00006
57.15	0.00382 ± 0.00011
86.50	0.123 ± 0.002
88.04	0.00138 ± 0.00003
117.68	0.00173 ± 0.00003
131.04	0.00086 ± 0.00002
134.23	0.00071 ± 0.00002
143.21	0.00432 ± 0.00008
151.37	0.00234 ± 0.00004
155.22	0.00092 ± 0.00002
169.17	0.00071 ± 0.00001
195.09	0.00185 ± 0.00002
212.42	0.00151 ± 0.00002
238.0	0.00059 ± 0.00001

Note to Table A

[a] Nominal values only.

E_γ (keV)	Banham (1984) [2][a]	Vaninbroukx et al. (1984) [4]
29.37	0.154 *2*	0.1503 *40*
46.53	0.00104 *6*	0.0011 *1*
57.15	0.00373 *11*	0.0039 *1*
86.50	0.1220 *12*	0.1244 *33*
88.04	0.00138 *3*	0.0014 *1*
117.68	0.00175 *2*	0.00168 *5*
131.04	0.00086 *1*	–
134.23	0.00071 *1*	–
143.21	0.00430 *4*	0.00434 *10*
151.37	0.00236 *2*	0.00232 *6*
155.22	0.000917 *10*	–
169.17	0.000711 *7*	–
195.09	0.00184 *2*	0.00188 *5*
212.42	0.00150 *2*	0.00155 *5*
238.0	0.000586 *12*	–

Note to Table B

[a] The P_γ values previously reported by Banham and Fudge [3] have been modified somewhat owing to changes in their detector-efficiency curves resulting from the adoption of more recent values for the efficiency calibration standards. It is these modified P_γ values that are shown here.

C. Comparison with other measurements

E_γ(keV)[a]	CRP measurements		Other measurements				Recommended values[h]
	Banham (1984) [2]	Vaninbroukx et al. (1984) [4]	González et al. (1979) [5]	Skalsey and Connor (1976) [6]	Brown and Asaro (1969) [7]	Vara and Gaeta (1969) [8]	
29.37	0.154 *2*	0.1503 *40*	0.103 *10*	0.162 *9*	0.140 *20*	0.13	0.153 *3*
46.53	0.00104 *6*	0.0011 *1*	0.0010 *1*	0.0012 *2*	0.00140 *20*	0.001[e]	0.00106 *6*
57.15	0.00373 *11*	0.0039 *1*	0.0038 *4*	0.00433 *25*	0.00420 *38*	0.0006	0.00382 *11*
86.50	0.1220 *12*	0.1244 *33*	0.126[b]	0.123[c]	0.126[d]	0.13[f]	0.123 *2*
88.04	0.00138 *3*	0.0014 *1*	0.0012 *1*	0.0014 *4*	0.00160 *20*	–	0.00138 *3*
117.68	0.00175 *2*	0.00168 *5*	0.00151 *15*	0.00180 *12*	0.00170 *20*	–	0.00173 *3*
131.04	0.00086 *1*	–	0.00081 *8*	0.0010 *1*	0.00089 *9*	0.001	0.00086 *2*
134.23	0.00071 *1*	–	0.00063 *6*	0.00081 *16*	0.00071 *8*	0.001	0.00071 *2*
143.21	0.00430 *4*	0.00434 *10*	0.0041 *4*	0.00462 *28*	0.00420 *40*	0.004	0.00432 *8*
151.37	0.00236 *2*	0.00232 *6*	0.00227 *23*	0.00249 *16*	0.00249 *30*	0.001	0.00234 *4*
155.22	0.000917 *1*[i]	–	0.00087 *9*	0.00097 *7*	0.00097 *9*	–	0.00092 *2*
169.17	0.000711 *7*	–	0.00074 *7*	0.00082 *9*	0.00076 *8*	–	0.00071 *1*
195.09	0.00184 *2*	0.00188 *5*	0.0016 *2*	0.00169 *21*	0.00210 *20*	0.001	0.00185 *2*
212.42	0.00150 *2*	0.00155 *5*	0.00160 *16*	0.00166 *11*	0.00159 *20*	0.001	0.00151 *2*
238.0	0.000586 *12*	–	0.00063 *7*	0.00075 *9*	0.00068 *6*	0.0005[g]	0.00059 *1*

Notes to Table C (cont'd overleaf)

[a] Nominal values only.

[b] Normalization adopted by the authors of Ref. [5].

[c] Only relative values are reported in Ref. [6]. Normalization of these data has been accomplished by requiring that P_γ (86.50) = 0.123, the value being recommended in this evaluation. The uncertainty in this normalization is not included in the listed uncertainties.

[d] P_γ value determined by Browne and Asaro, from alpha/gamma coincidence measurements, as reported by private communication (1972) to Skalsey and Connor (see Ref. [6]).

[e] Includes contribution from three gamma ray peaks.

[f] Includes contribution from two peaks.

[g] Sum of the intensities of two listed gamma ray peaks.

[h] These recommended values have been derived from a $1/\sigma^2$ weighted average of the data from Refs [2] and [4] only. In including the values of Ref. [2], however, we have prior to the weighting modified the quoted uncertainties for the gamma rays below ~0.16 MeV so that the minimum uncertainty is in no case less than 2%. Since a common base of radionuclide decay data was used to determine the detector efficiencies in Refs. [2] and [4], the resultant P_γ values may not be completely independent. Consequently, the uncertainty in the weighted average of these two data sets is never quoted as being smaller than that of the most precise measurement.

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I. HALF-LIFE

^{239}Np

Recommended value: 56.52 ± 0.10 h

This value was adopted from the Nuclear Data Sheets [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_γ (keV)	P_γ
61.46	0.0129 ± 0.0002
106.12	0.272 ± 0.004
181.71	0.00081 ± 0.00004
209.75	0.0342 ± 0.0005
226.42	0.0028 ± 0.0002
228.18	0.1127 ± 0.0018
254.41	0.0011 ± 0.0001
272.84	0.00077 ± 0.00004
277.60	0.1438 ± 0.0021
285.46	0.0079 ± 0.0002
315.88	0.0160 ± 0.0003
334.31	0.0207 ± 0.0003

E_γ (keV)	Vaninbroukx et al. (1984) [2]
61.46	0.0129 ± 0.0002
106.12	0.2750 ± 0.0040
181.71	0.0007 ± 0.0001
209.75	0.0346 ± 0.0005
226.42	0.0028 ± 0.0002
228.18	0.1121 ± 0.0018
254.41	0.0012 ± 0.0001
272.84	0.0008 ± 0.0001
277.60	0.1438 ± 0.0021
285.46	0.0077 ± 0.0002
315.88	0.0160 ± 0.0003
334.31	0.0208 ± 0.0003

C. Comparison with other measurements

E_γ (keV)	CRP measurements	Other measurements					Evaluated values[a]
	Vaninbroukx et al. (1984) [2]	Ahmad and Wahlgren (1972) [3]	Yurova et al. (1974) [4]	Starozhukov et al. (1977) [5]	Mozhaev et al. (1979) [6]	Ahmad (1982) [7]	
61.46	0.0129 *2*					0.0129 *6*	0.0129 *2*
106.12	0.2750 *40*	0.278 *9*		0.266 *10*		0.264 *8*	0.272 *2*
181.71	0.0007 *1*	0.00075 *8*				0.00083 *4*	0.00081 *4*
209.75	0.0346 *5*	0.0342 *10*		0.0336 *14*		0.0330 *10*	0.0342 *5*
226.42	0.0028 *2*			0.0024 *3*		0.00290 *16*	0.0028 *2*
228.18	0.1121 *18*	0.114 *3*		0.1178 *44*		0.112 *3*	0.1127 *18*
254.41	0.0012 *1*	0.0011 *1*				0.00110 *6*	0.0011 *1*
272.84	0.0008 *1*	0.0008 *1*				0.00077 *4*	0.00077 *4*
277.60	0.1438 *21*	0.145 *4*	0.141 *4*	0.150 *5*	0.1430 *24*	0.145 *4*	0.1438 *21*
285.46	0.0077 *2*	0.0076 *2*		0.0093 *6*		0.00790 *25*	0.0079 *2*
315.88	0.0160 *3*	0.0152 *5*		0.0163 *7*		0.0160 *5*	0.0160 *3*
334.31	0.0208 *3*	0.0195 *7*		0.021 *1*		0.0206 *6*	0.0207 *3*

Note to Table C

[a] The evaluated values and uncertainties are based on weighted means calculated according to Topping [8].

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I. HALF-LIFE

Recommended value: 87.7 ± 0.3 a

This value was adopted from the 1984 review by N.E. Holden [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_γ (keV)	P_γ
43.498 ± 0.001	(3.95 ± 0.08) × 10^{-4}
99.853 ± 0.003	(7.35 ± 0.08) × 10^{-5}
152.720 ± 0.002	(9.37 ± 0.10) × 10^{-6}

B. CRP measurements

E_γ (keV)	Bortels et al. (1984) [3]	Helmer and Reich (1984) [2]
43.498 *1*	3.96 *10* × 10^{-4}	3.82 *8* × 10^{-4}
99.853 *3*	7.30 *11* × 10^{-5}	7.43 *8* × 10^{-5}
152.720 *2*	9.28 *14* × 10^{-6}	9.36 *10* × 10^{-6}

C. Comparison with other measurements

E_γ (keV)	CRP measurements		Other measurements			Evaluated values[b]	Calculated values[c]
	Bortels et al. (1984) [3]	Helmer and Reich (1984) [2]	Gunnink et al. (1976) [4][a]	Ovechkin et al. (1984) [5]	Umezava et al. (1976) [6]		
43.498	3.96 *10* X 10^{-4}	3.82 *8* X 10^{-4}	3.93 *8* X 10^{-4}		4.11 *8* X 10^{-4}	3.95 *8* X 10^{-4}	3.98 X 10^{-4}
99.853	7.30 *11* X 10^{-5}	7.43 *8* X 10^{-5}	7.24 *14* X 10^{-5}	6.31 *38* X 10^{-5}		7.35 *8* X 10^{-5}	7.48 X 10^{-5}
152.720	9.28 *14* X 10^{-6}	9.36 *10* X 10^{-6}	9.56 *20* X 10^{-6}	8.57 *40* X 10^{-6}		9.37 *10* X 10^{-6}	9.42 X 10^{-6}

Notes to Table C

[a] Uncertainties include a 2% efficiency uncertainty.

[b] The evaluated P_γ values represent the weighted mean of the data in Refs [2–4] and [6](i.e. those with the smallest quoted uncertainties).

[c] The calculated P_γ values are obtained from the P_α values reported in this evaluation and the ICC values calculated from Rösel's table.

E_γ (keV)	Multipolarity	Transition probability	Total ICC [7]	P_γ
43.498	E2	0.291 *1*	731 *15*	$3.98\ 8 \times 10^{-4}$
99.853	E2	0.00110 *3*	13.7 *3*	$7.48\ 35 \times 10^{-5}$
152.720	E2	$3.0\ 1 \times 10^{-5}$	2.185 *40*	$9.42\ 40 \times 10^{-6}$

III. SELECTED ALPHA EMISSION PROBABILITIES

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_α (keV)	P_α
5208.0	$(3.0 \pm 0.1) \times 10^{-5}$
5358.1	0.00102 ± 0.00002
5456.3	0.2884 ± 0.0006
5499.1	0.7104 ± 0.0006

B. CRP measurements

E_α (keV)	Bortels et al. (1984) [3]	Ahmad (1984)[a] [8]
5208.0	$3.0\ 1 \times 10^{-5}$	
5358.1	0.00105 *5*	0.00106 *3*
5456.3	0.2898 *10*	0.290 *1*
5499.1	0.7091 *10*	0.709 *1*

Note to Table B

[a] Work performed in response to requests from the CRP.

C. Comparison with other measurements

E_α(keV)	CRP measurements		Other measurements				
	Bortels et al. (1984) [3]	Ahmad (1984) [8]	Burns et al. (1984) [9]	Kondrat'ev et al. (1957) [10]	Soares et al. (1971) [11]	Baranov et al. (1970) [12]	Evaluated values[a]
5208.1	3.0 *1* X 10^{-5}						3.0 *1* X 10^{-5}
5358.1	0.00105 *5*	0.00106 *3*	0.001002 *17*	0.0013 *1*		0.00068	0.00102 *2*
5456.3	0.2898 *10*	0.290 *1*	0.2878 *4*	0.287 *12*	0.0293 *2*	0.278	0.2884 *6*
5499.1	0.7091 *10*	0.709 *1*	0.7111 *4*	0.711 *12*	0.707 *2*	0.722	0.7104 *6*

Note to Table C

[a] The evaluated P_α values have been derived from the weighted mean of the data in Refs [3, 8–11].

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I. HALF-LIFE

1. Total half-life

Recommended value: $(2.411 \pm 0.003) \times 10^4$ **a**

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium) [1].

The number of significant digits was reduced to four.

2. Spontaneous fission half-life

Recommended value: 5.5×10^{15} **a**

Based on a single measurement reported in 1952 [2].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by H. Okashita (JAERI, Tokai Mura, Japan)

A. Recommended values

E_γ(keV)[a]	Emission probability (P_γ) (photons/10^6 decays)
38.660 ± 0.002	105 ± 2
40.41 ± 0.05 [b]	1.62 ± 0.17
42.06 ± 0.03 [b]	1.65 ± 0.06
46.218 ± 0.010	7.37 ± 0.75
46.69 [b]	0.58 ± 0.04
51.624 ± 0.001	271 ± 5
56.825 ± 0.003	11.30 ± 0.25
123.62 ± 0.05 [b]	0.197 ± 0.021
124.51 ± 0.03 [b]	0.613 ± 0.022
125.21 ± 0.10 [b]	0.711 ± 0.020
129.296 ± 0.001	63.1 ± 0.6
141.657 ± 0.020 [b]	0.320 ± 0.0009
144.201 ± 0.003 [f]	3.035 ± 0.037 [d]
146.094 ± 0.006 [b]	1.190 ± 0.025

E_γ(keV)[a]	Emission probability (P_γ) (photons/10^6 decays)
161.482 ± 0.012	1.23 ± 0.02
171.393 ± 0.006	1.10 ± 0.02
179.220 ± 0.012	0.66 ± 0.01
188.23 ± 0.10[b]	0.109 ± 0.011
189.360 ± 0.010	0.83 ± 0.01
195.679 ± 0.008	1.07 ± 0.01
203.550 ± 0.005	5.69 ± 0.03
255.384 ± 0.015	0.80 ± 0.01
297.46 ± 0.03	0.498 ± 0.008
311.78 ± 0.04	0.258 ± 0.007
332.845 ± 0.005	4.94 ± 0.03
341.502 ± 0.019	0.662 ± 0.014
345.013 ± 0.004	5.56 ± 0.05
375.054 ± 0.003	15.54 ± 0.09
380.191 ± 0.006	3.05 ± 0.06
382.698 ± 0.016	2.59 ± 0.05
392.914 ± 0.014[e]	5.53 ± 0.12[e]
413.713 ± 0.005	14.66 ± 0.11
422.598 ± 0.019	1.22 ± 0.02
445.81 ± 0.10	0.088 ± 0.006
451.481 ± 0.010	1.894 ± 0.016
481.78 ± 0.12	0.046 ± 0.002
639.99 ± 0.10	0.087 ± 0.002
645.98 ± 0.03	0.152 ± 0.003
651.79 ± 0.10	0.066 ± 0.002
658.63 ± 0.15	0.097 ± 0.002
718.0 ± 0.5	0.028 ± 0.002
769.19 ± 0.04[c]	0.119 ± 0.002

Notes to Table A

[a] Energy values from Ref. [3], except for those values marked by superscripts b and c.
[b] Values reported in Ref. [7].
[c] Values reported in Ref. [4].
[d] This peak is a doublet according to Ref. [5].
[e] This peak is a doublet according to Ref. [7].
[f] The P_γ values at E_γ = 143.35 keV and E_γ = 144.201 keV of Ref. [5] are combined.

B. CRP measurements[b] ^{239}Pu

Recent measurements of the emission probabilities of the gamma ray transitions from ^{239}Pu decay other than CRP-based ones are those carried out by Gunnink [5]. The data used for evaluation are given in II. C.

E_γ(keV)[a]	Helmer et al. (1982) [3]	Despres (1980) [4]	Iwara et al. (1984) [6]
129.296 *1* [c]	64.1 *5*	62.3 *4*	64.8 *10*
143.350			
144.201 *3* [c]	3.07 *6* [e]	3.24 *15*	3.08 *8*
146.077			
161.482 *21* [c]	1.25 *3* [e]	1.25 *7*	1.24 *6*
171.396 *6* [c]	1.11 *3* [e]	1.05 *6*	1.10 *6*
179.220 *12* [c]	0.665 *20* [e]	0.65 *5*	0.65 *3*
189.360 *10* [c]	0.831 *15* [e]	0.830 [f]	0.827 *19*
195.679 *8* [c]	1.07 *2*	1.02 *7*	1.088 *25*
203.550 *5* [c]	5.68 *4*	5.57 *26*	5.80 *9*
255.384 *15* [c]	0.812 *20* [e]	0.79 *6*	0.794 *18*
297.46 *3* [c]	0.498 *13* [e]	0.48 *5*	0.496 *13*
332.845 *3* [c]	4.92 *4*	4.76 *20*	4.95 *7*
345.013 *4* [c]	5.54 *10* [e]	5.45 *19*	5.58 *7*
375.054 *3* [c]	15.47 *12*	15.5 *5*	15.65 *18*
413.713 *5* [c]	14.55 *9*	14.8 *5*	15.00 *18*
422.598 *19* [c]	1.200 *25* [e]	1.19 *9*	1.254 *18*
445.81 *10* [c]	0.115 *13* [e]	0.0908	0.085 *7*
451.481 *10* [c]	1.892 *22* [e]	1.92 *12*	1.899 *28*
481.78 *12* [c]	0.071 *6* [e]	0.0477 [g]	0.0448 *29*
639.99 *10*	0.103 *13* [e]	0.0867 [g]	0.092 *3*
645.98 *3* [c]	0.134 *13* [e]	0.155 [g]	0.153 *4*
651.79 *10* [c]	0.079 *10* [e]	0.0657 [g]	0.066 *3*
658.63 *15* [c]	0.079 *9* [e]	0.0991 [g]	0.097 *3*
718.0 *5* [c]	--	0.0296 [g]	0.0274 *23*
769.19 *4* [d]	--	0.125 [g]	0.121 *3*

C. Comparison with other measurements

E_γ (keV)[a]	*CRP* measurements[b]			*Other measurements*[b]	
	Helmer et al. (1982) [3]	Despres (1980) [4]	Iwara et al. (1984) [6]	Gunnink et al. (1976) [5][i]	Recommended values[j]
38.664				105 *11*	105 *11*
40.41				1.62 *17*	1.62 *17*
42.06				1.65 *6*	1.65 *6*
46.21				7.37 *75*	7.37 *75*
46.69				0.58 *4*	0.58 *4*
51.624 *1* [c]	271 *5*			270 *5*	271 *5*
56.838				11.30 *25*	11.30 *25*
123.62				0.197 *21*	0.197 *21*
124.51				0.613 *22*	0.613 *22*
125.21				0.711 *20*	0.711 *20*
129.296 *1* [c]	64.1 *5*	62.3 *4*	64.8 *10*	62.6 *13*	63.1 *6*
141.657				0.320 *9*	0.320 *9*
143.350				0.173 *8*	3.035 *37* [g]
144.201 *3* [c]	3.07 *6* [e]	3.24 *15*	3.08 *8*	2.83 *6*	
146.077				1.190 *25*	1.190 *25*
161.482 *21* [c]	1.25 *3* [e]	1.25 *7*	1.24 *6*	1.20 *3*	1.23 *2*
171.396 *6* [c]	1.11 *3* [e]	1.05 *6*	1.10 *6*	1.105 *24*	1.10 *2*
179.220 *12* [c]	0.665 *20* [e]	0.65 *5*	0.65 *3*	0.658 *15*	0.66 *1*

188.23				0.109 *11*	0.109 *11*
189.360 *10* [c]	0.831 *15* [e]	0.830 [f]	0.827 *19*	0.830 *23*	0.83 *1*
195.679 *8* [c]	1.07 *2*	1.02 *7*	1.088 *25*	1.064 *22*	1.07 *1*
203.550 *5* [c]	5.68 *4*	5.57 *26*	5.80 *9*	5.60 *11*	5.69 *3*
255.384 *15* [c]	0.812 *20* [e]	0.79 *6*	0.794 *18*	0.805 *23*	0.80 *1*
297.46 *3* [c]	0.498 *13* [c]	0.48 *5*	0.496 *13*	0.502 *14*	0.498 *8*
311.74				0.258 *7*	0.258 *7*
332.845 *3* [c]	4.92 *4*	4.76 *20*	4.95 *7*	5.06 *10*	4.94 *3*
341.510				0.662 *14*	0.662 *14*
345.013 *4* [c]	5.54 *10* [e]	5.45 *19*	5.58 *7*	5.59 *11*	5.56 *5*
375.054 *3* [c]	15.47 *12*	15.5 *5*	15.65 *18*	15.70 *31*	15.54 *9*
380.166				3.05 *6*	3.05 *6*
382.751				2.59 *5*	2.59 *5*
392.53 / 393.14 [h]				5.527 *12*	5.53 *12*
413.713 *5* [c]	14.55 *9*	14.8 *5*	15.00 *18*	14.89 *30*	14.66 *11*
422.598 *19* [c]	1.200 *25* [e]	1.19 *9*	1.254 *18*	1.193 *24*	1.22 *2*
445.81 *10* [c]	0.115 *13* [e]	0.0908	0.085 *7*	0.0870 *25*	0.088 *6*
451.481 *10* [c]	1.892 *22* [e]	1.92 *12*	1.899 *28*	1.89 *4*	1.894 *16*
481.78 *12* [c]	0.071 *6* [e]	0.0477 [g]	0.0448 *29*	0.0460 *10*	0.046 *2*
639.99 *10*	0.103 *13* [e]	0.0867 [g]	0.092 *3*	0.0820 *17*	0.087 *2*

E_γ(keV)[a]	CRP measurements[b]			Other measurements[b]	
	Helmer et al. (1982) [3]	Despres (1980) [4]	Iwara et al. (1984) [6]	Gunnink et al. (1976) [5][i]	Recommended values[j]
645.98 *3* [c]	0.134 *13* [e]	0.155 [g]	0.153 *4*	0.1489 *30*	0.152 *3*
651.79 *10* [c]	0.079 *10* [e]	0.0657 [g]	0.066 *3*	0.0655 *14*	0.066 *2*
658.63 *15* [c]	0.079 *9* [e]	0.0991 [g]	0.097 *3*	0.0969 *21*	0.097 *2*
718.0 *5* [c]	–	0.0296 [g]	0.0274 *23*	0.0274 *6*	0.028 *2*
769.19 *4* [d]	–	0.125 [g]	0.121 *3*	0.1120 *23*	0.119 *2*

Notes to Tables B and C

[a] Values reported in Ref. [5] except for those marked by superscripts c and d.

[b] All P_γ values are expressed in terms of photons per 10 decays.

[c] Values reported in Ref. [3].

[d] Value reported in Ref. [4].

[e] Evaluated from the reported relative emission data.

[f] Uncertainties are not reported but estimated to be equal to the highest uncertainty in the set.

[g] The P_γ values at E_γ = 143.35 keV and E_γ = 144.201 keV of Ref. [5] are combined.

[h] Average value of combined peaks taken as 392.914 ± 0.014.

[i] Uncertainty in detector efficiency (2%) was added to the uncertainties listed.

[j] Weighted mean method is applied to the sets of data recognized as one population and arithmetic mean method to the other sets after rejection of outlier.

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I. HALF-LIFE ^{240}Pu

Recommended value: 6563 ± 7 a

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium) and N. Coursol (LMRI, Saclay, France).

Measured values

Value in years	Reference
6500 ± 45 [a]	Inghram et al. (1951) [1]
6600 ± 100	Butler et al. (1956) [2]
6620 ± 50	Dokuchaev (1959) [3]
6537 ± 15 [b]	Oetting (1968) [4]
6569 ± 7 [c]	Jaffey et al. (1978) [5]
6574 ± 7 [c,d]	Beckman et al. (1984) [6]
6571 ± 9 [d]	Steinkruger et al. (1984) [7]
6552.2 ± 6.6 [c,e]	Lucas and Noyce (1984) [8]
6552.4 ± 6.6 [c]	Rudy et al. (1984) [9]
6563 ± 5	Weighted mean and standard error [f]

Since a minimum uncertainty of 0.1% is assumed for all long lived nuclides[c] the recommended value is (6563 ± 7) a.

Notes to Table

[a] The value has been recalculated on the basis of a ^{239}Pu half-life of 2.411×10^4 a.

[b] The quoted uncertainty has been increased by 5 a since apparently no measurements were made to demonstrate the absence of ^{238}Pu. The published value of 6524 a has been recalculated to 6537 a by Schmorak [10].

[c] According to one of the criteria adopted by the members of the CRP, a minimum uncertainty of 0.1% on the half-life of long lived nuclides has been attributed to all measured values [11].

[d] The quoted uncertainties, corresponding to a 95% confidence level, have been reduced by a factor of 2 in order to be comparable with the other quoted uncertainties.

[e] The quoted systematic uncertainty limit of 13.8 a is the linear sum of the estimated uncertainty limits. According to the criteria adopted by the CRP and as suggested by Grinberg et al. [12] for a 68% confidence level this value should be divided by 3.

[f] The weighted mean and its standard error has been calculated according to Topping [13]. The external error obtained for nine values, if they would be completely independent, is 4 a and the internal standard error 3 a. However, since all recent values from the USA are based on the same material, they are not completely independent. Hence a standard error of 5 a is assumed, being the 4 a (obtained external standard error) plus 1 a due to the uncertainty on the US sample mass determination, being 0.03% on the 95% confidence level [14] or 0.015% on a 68% confidence level.

Evaluated by N. Coursol (LMRI, Saclay, France).

A. Recommended values

E_γ (keV)	P_γ per ^{240}Pu decay
45.244	0.000447 ± 0.000007
104.234	0.0000714 ± 0.0000006
160.308	0.00000402 ± 0.00000004

B. CRP measurements

E_γ (keV)[a]	P_γ per ^{240}Pu decay	
	Helmer and Reich (1981) [15]	Morel et al. (1981) [16]
45.244 ± 0.002	0.000435 *9*	
104.234 ± 0.006	0.0000718 *7*	
160.308 ± 0.003	0.00000402 *4*	0.00000402 *7*

Note to Table B

[a] E_γ values from Ref. [1].

C. Comparison with other measurements

E_γ (keV)	CRP measurements		Other measurements			Evaluated values
	Helmer and Reich (1981) [15]	Morel et al. (1981) [16]	Umezawa et al. (1967) [17][a]	Ottmar et al. (1974) [18][b]	Gunnink et al. (1976) [19][c]	
45.244	0.000435 *9*		0.000461 *14*		0.000453 *9*	0.000447 *7*
104.234	0.0000718 *7*				0.0000698 *14*	0.0000714 *6*
160.308	0.00000402 *4*	0.00000402 *7*		0.00000408 *10*	0.00000402 *8*	0.00000402 *4*

Notes to Table C

[a] The quoted uncertainty has been recalculated on the basis of a 2% detector efficiency uncertainty and 1% from the sample isotopic composition.
[b] The P_γ value has been calculated from the measured relative intensity using P_γ values from Helmer.
[c] The quoted uncertainties have been recalculated to include a 2% detector efficiency uncertainty.

Evaluated by N. Coursol (LMRI, Saclay, France).

A. Recommended values

E_α (keV)	P_α per ^{240}Pu decay
4863.6	$(1.13 \pm 0.03) \times 10^{-5}$
5021.5	0.00089 ± 0.00002
5123.62	0.270 ± 0.005
5168.30	0.729 ± 0.005

B. CRP measurements

E_α (keV)	Ahmad (1984) [20]
5021.5	0.00090 *5*
5123.62	0.271 *1*
5168.30	0.728 *1*

C. Comparison with other measurements

	CRP measurements	Other measurements				
E_α (keV)	Ahmad (1984) [20]	Kondrat'ev et al. (1957) [21]	Schmorak et al. (1972) [22]	Baranov and Shatinskii (1977) [23]	Evaluated values[a]	Calculated values[b]
4863.6	–	–	0.000012 *3*	0.00001	0.000012 *3*	0.0000113 *3*
5021.5	0.00090 *5*	0.00096 *5*	0.00096 *5*	0.00096 *5*	0.00094 *3*	0.00087 *3*
5123.62	0.271 *1* [a]	(24.4)	(24)	0.2639 *21*	0.270 *3* [a]	0.270 *5*
5168.30	0.728 *1* [a]	(75.5)		0.7351 *36*	0.729 *3* [a]	0.729 *5*

Notes to Table C

[a] For consistency, the quoted uncertainties have been occasionally increased for the calculation of the weights.

[b] These values were calculated from the recommended P_γ values and the theoretical total internal conversion coefficients (ICC), obtained by cubic spline interpolation of the values tabulated by Rösel et al. [24]. Details are given in the following table. These calculated values are also considered for the calculation of the recommended values of P_α given in Table A.

Table of ICC for Z = 92, interpolated by cubic spline from tables of Rösel et al. [24].

E_γ (keV)	Multipolarity	Total ICC [10]
45.244	E2	603 *12*
104.234	E2	11.23 *24*
160.308	E2	1.80 *4*

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I. HALF-LIFE

^{241}Pu

Recommended value: 14.4 ± 0.1 a

This value was adopted from the 1984 review by N.E. Holden [1].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_γ (keV)	P_γ
59.54 [a]	$(8.29 \pm 0.05) \times 10^{-6}$
64.83 [a]	$(.0.315 \pm 0.003) \times 10^{-6}$
77.10	$(0.207 \pm 0.004) \times 10^{-6}$
103.68	$(1.02 \pm 0.02) \times 10^{-6}$
148.57	$(1.859 \pm 0.016) \times 10^{-6}$
160.00	$(0.0658 \pm 0.0009) \times 10^{-6}$
164.61 [a]	$(0.454 \pm 0.004) \times 10^{-6}$
208.00 [a]	$(5.20 \pm 0.05) \times 10^{-6}$
267.54 [a]	$(0.175 \pm 0.002) \times 10^{-6}$
332.36 [a]	$(0.292 \pm 0.003) \times 10^{-6}$
335.38 [a]	$(0.0235 \pm 0.0005) \times 10^{-6}$
368.59 [a]	$(0.0099 \pm 0.0004) \times 10^{-6}$
370.94 [a]	$(0.0264 \pm 0.0004) \times 10^{-6}$

Note to Table A

[a] Gamma transition for the decay from the daughter ^{237}U in equilibrium with ^{241}Pu.

E_γ (keV)	Helmer and Reich (1985) [2]	Willmes et al. (1985) [3]	Banham (1984) [4][a]
51.00			0.108 *12* X 10^{-6}
59.54			8.29 *5* X 10^{-6}
64.83		0.314 *3* X 10^{-6}	0.320 *5* X 10^{-6}
77.10	0.211 *5* X 10^{-6}	0.203 *4* X 10^{-6}	
103.68	1.02 *3* X 10^{-6}	1.032 *12* X 10^{-6}	
148.57	1.963 *17* X 10^{-6}	1.855 *16* X 10^{-6}	
160.00	0.0654 *9* X 10^{-6}	0.0651 *14* X 10^{-6}	
164.61	0.457 *4* X 10^{-6}	0.454 *4* X 10^{-6}	0.452 *4* X 10^{-6}
208.00	5.20 *5* X 10^{-6}	5.20 *5* X 10^{-6}	
267.54	0.175 *5* X 10^{-6}	0.1741 *17* X 10^{-6}	0.176 *3* X 10^{-6}
332.36		0.294 *3* X 10^{-6}	0.290 *3* X 10^{-6}
335.38		0.0233 *5* X 10^{-6}	0.0223 *8* X 10^{-6}
368.59		0.0096 *4* X 10^{-6}	0.0101 *6* X 10^{-6}
370.94		0.0263 *4* X 10^{-6}	0.0267 *8* X 10^{-6}

C. Comparison with other measurements

E_γ (keV)	CRP measurements			Other measurements			Evaluated values[d]
	Helmer and Reich (1985) [2]	Willmes et al. (1985) [3]	Banham (1984)[4] [a]	Ahmad et al. (1968) [5][b]	Gunnink et al. (1976) [6][c]	Umezawa et al. (1976) [7]	
51.00			0.108 *12* X 10^{-6}		0.0820 *35* X 10^{-6}		
59.54			8.29 *5* X 10^{-6}		8.31 *20* X 10^{-6}		8.29 *5* X 10^{-6}
64.83		0.314 *3* X 10^{-6}	0.320 *5* X 10^{-6}		0.313 *13* X 10^{-6}		0.315 *3* X 10^{-6}
77.10	0.211 *5* X 10^{-6}	0.203 *4* X 10^{-6}		0.176 *20* X 10^{-6}	0.222 *8* X 10^{-6}		0.207 *4* X 10^{-6}
103.68	1.02 *3* X 10^{-6}	1.032 *12* X 10^{-6}		1.09 *20* X 10^{-6}	1.01 *3* X 10^{-6}		1.02 *2* X 10^{-6}
148.57	1.863 *17* X 10^{-6}	1.855 *16* X 10^{-6}		2.17 *20* X 10^{-6}	1.87 *4* X 10^{-6}	1.91 *4* X 10^{-6}	1.859 *16* X 10^{-6}
160.00	0.0654 *9* X 10^{-6}	0.0651 *14* X 10^{-6}		0.077 *7* X 10^{-6}	0.0674 *13* X 10^{-6}		0.0658 *9* X 10^{-6}
164.61	0.457 *4* X 10^{-6}	0.454 *4* X 10^{-6}	0.452 *4* X 10^{-6}		0.443 *20* X 10^{-6}		0.454 *4* X 10^{-6}
208.00	5.20 *5* X 10^{-6}	5.20 *5* X 10^{-6}			5.23 *11* X 10^{-6}		5.20 *5* X 10^{-6}
267.54	0.175 *5* X 10^{-6}	0.1741 *17* X 10^{-6}	0.176 *3* X 10^{-6}		0.178 *8* X 10^{-6}		0.175 *2* X 10^{-6}
332.36		0.294 *3* X 10^{-6}	0.290 *3* X 10^{-6}		0.292 *9* X 10^{-6}		0.292 *3* X 10^{-6}
335.38		0.0233 *5* X 10^{-6}	0.0223 *8* X 10^{-6}		0.0238 *6* X 10^{-6}		0.0235 *5* X 10^{-6}
368.59		0.0096 *4* X 10^{-6}	0.0101 *6* X 10^{-6}		0.0103 *6* X 10^{-6}		0.0099 *4* X 10^{-6}
370.94		0.0263 *4* X 10^{-6}	0.0267 *8* X 10^{-6}		0.0266 *14* X 10^{-6}		0.0264 *4* X 10^{-6}

Notes to Tables B and C on page 118.

[a] The P_γ values have been calculated using the authors' values of the relative gamma ray intensities and $P_\gamma(208) = 5.20\ 5 \times 10^{-6}$ which represents the weighted mean of the data in Refs [2] and [3] (see table below).

[b] The original values of gamma ray emission probabilities have been renormalized using $2.41\ 4 \times 10^{-5}$ for ^{241}Pu alpha branching probability [8] (see table below).

[c] The P_γ values have been calculated using $2.41\ 4 \times 10^{-5}$ for ^{241}Pu alpha branching probability [8], and the original values of gamma ray emission probabilities associated with the ^{237}U β^--decay (see table on page 119).

[d] The evaluated values have been derived from the weighted mean of the data given in II.C.

Relative gamma ray intensities [4]

E_γ	I_γ
51.00	2.07 *22*
59.536	159.32 *60*
64.832	6.157 *79*
164.58	8.689 *41*
208.00	100.00 *31*
221.73	0.094 *10*
234.24	0.105 *16*
267.54	3.394 *29*
332.35	5.578 *46*
335.405	0.429 *13*
368.605	0.194 *11*
370.93	0.514 *14*

Gamma ray emission probabilities [5]

E_γ	Gamma ray per 100 ^{241}Pu alpha decays
76.9	0.73 *7*
103.5	4.5 *5*
148.5	9.0 *9*
160.0	0.32 *3*

E_γ	Gamma ray per ^{237}U β^--decay*
51.00	0.00340 *14*
59.54	0.345 *8*
64.83	0.0130 *3*
164.58	0.0184 *5*
208.00	0.217 *5*
267.54	0.00740 *19*
332.35	0.0121 *3*
335.40	0.000970 *29*
368.60	0.000429 *17*
370.93	0.001103 *38*

* Uncertainties include a 2% detector efficiency uncertainty.

III. SELECTED ALPHA EMISSION PROBABILITIES

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_α (keV)	P_α
4784	$(0.05 \pm 0.02) \times 10^{-6}$
4799	$(0.29 \pm 0.03) \times 10^{-6}$
4853.5	$(2.92 \pm 0.05) \times 10^{-6}$
4896.5	$(2.01 \pm 0.02) \times 10^{-5}$
4972	$(0.31 \pm 0.06) \times 10^{-6}$
4998	$(0.10 \pm 0.01) \times 10^{-6}$
5042	2.5×10^{-7}
5054	0.84×10^{-7}

None.

C. Tabulation of the data considered in the evaluation

E_α (keV)	Baranov et al. (1965) [9][a]		Ahmad et al. (1968) [5][a]		Evaluated values[b]
	α/100 ^{241}Pu alpha decays	P_α	α/100 ^{241}Pu alpha decays	P_α	
4784			0.2 *1*	0.05 *2* X 10^{-6}	0.05 *2* X 10^{-6}
4799			1.2 *1*	0.29 *3* X 10^{-6}	0.29 *3* X 10^{-6}
4853.5			12.1 *2*	2.92 *5* X 10^{-4}	2.92 *5* X 10^{-4}
4896.5			83.2 *5*	2.01 *2* X 10^{-3}	2.01 *2* X 10^{-3}
4972			1.3 *1*	0.31 *6* X 10^{-6}	0.31 *6* X 10^{-6}
4998			0.41 *5*	0.10 *1* X 10^{-6}	0.10 *1* X 10^{-6}
5042	1.02	2.5 X 10^{-6}			2.5 X 10^{-6}
5054	0.35	0.84 X 10^{-6}			0.84 X 10^{-6}

Notes to Table C

[a] The P_α values have been calculated using 2.41 X 10^{-5} for the alpha decay branching of ^{241}Pu and the authors' values of α per 100 ^{241}Pu alpha decays.

[b] Since only one measurement is reported for each transition, the P_α values obtained are taken as evaluated values.

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I. HALF-LIFE

^{242}Pu

Recommended value: $(3.735 \pm 0.011) \times 10^5$ a

This value was adopted from the 1984 review by N.E. Holden [1].

The uncertainty quoted by the evaluator corresponds to a 2σ confidence level; it has been reduced by a factor of two to correspond to the 1σ level adopted in this report.

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_γ (keV)	P_γ
44.92	$(3.73 \pm 0.07) \times 10^{-4}$
103.50	$(2.55 \pm 0.10) \times 10^{-5}$
158.80	$(3.0 \pm 0.2) \times 10^{-6}$

B. CRP measurements

E_γ (keV)	Vaninbroukx et al. (1984)[a] [2]
44.92	$(3.72 \pm 0.07) \times 10^{-4}$
103.50	$(2.63 \pm 0.09) \times 10^{-5}$
158.80	$(3.0 \pm 0.2) \times 10^{-6}$

C. Comparison with other measurements

	Emission probabilities X 10^3			
	CRP measurements	Other measurements		
E_γ (keV)	Vaninbroukx et al. (1984) [2][a]	Schmorak et al. (1972) [3][b]	Evaluated values[c]	Calculated values[d]
44.92	0.372 *7*		0.372 *7*	0.375 *8*
103.50	0.0263 *9*	0.081 *9*	0.0263 *9*	0.0237 *12*
158.80	0.0030 *2*	0.005 *2*	0.0030 *2*	

Notes to Tables B and C

[a] Only the measured values are given here. The final values adopted are deduced from these measured figures and from values calculated from our measured alpha particle emission probabilities and theoretical total internal conversion coefficients.

[b] The relative P_γ values deduced by Ellis and Haese [4] from the authors' unquoted I_γ measurements are normalized to P_γ 45 = (3.73 ± 0.07) X 10^{-4}. No information at all is given about the I_γ measurements and therefore the results have not been considered in the evaluation.

[c] Since only one measurement is considered, this column is only given for consistency.

[d] These values are calculated from the transition probabilities P_{tr} and the theoretical total internal conversion coefficients (ICC), obtained by cubic spline interpolation of the values tabulated by Rösel et al. [5]. Because of the absence of cross-over gamma transitions, P_{tr} is equal to the sum of the P_α values feeding the considered level and all higher levels. The evaluated P_α values from Table III.C have been used for the calculations. The alpha particle emission probability to the 158.8 keV level, although not observed in the alpha particle spectra, has to be added for balance reasons. A value of (8.6 ± 0.7) X 10^{-6} was adopted from Table III.A. Details are given in the following table. These calculated values are considered too for the calculation of the recommended values of Table II.A. These values are based on weighted means calculated in accordance with Topping [6].

Calculated P_γ values

E_γ (keV)	Multipolarity	Transition probability (P_{tr})	Total ICC [5] (α)	$P_\gamma = P_{tr}/(1+\alpha)$ X 10^3
44.92	E2	0.2353 *17*	626 *13*	0.375 *8*
103.50	E2	0.000299 *14*	11.61 *23*	0.0237 *12*
158.80	E2		1.86 *4*	

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_α (keV)	P_α
4598.5	$(8.6 \pm 0.7) \times 10^{-6}$
4754.6	$(3.07 \pm 0.14) \times 10^{-4}$
4856.0	0.2348 ± 0.0017
4900.6	0.7649 ± 0.0017

B. CRP measurements

E_α (keV)	Vaninbroukx et al. (1984)[a] [2]
4598.5	–
4754.6	0.000290 *14*
4856.0	0.2352 *17*
4900.6	0.7645 *17*

C. Comparison with other measurements

E_α (keV)	CRP measurements	Other measurements			Evaluated values[d]	Calculated values[e]
	Vaninbroukx et al. (1984) [2][a]	Asaro (1953) [7][b]	Hummel (1956) [8][b]	Baranov et al. (1976) [9][c]		
4598.5						$(8.6 \pm 0.7) \times 10^{-6}$
4756.6	0.000290 *14*				0.000290 *14*	0.000323 *13*
4856.0	0.2352 *17*	0.20 *6*	0.26 *4*	0.202 *20*	0.2350 *17*	0.2329 *60*
4900.6	0.7645 *17*	0.80 *6*	0.74 *4*	0.797 *20*	0.7647 *17*	0.7668 *60*

Notes to Tables B and C

[a] Only the measured values are given here. The final values adopted are deduced from these measured figures and from values calculated from our measured gamma ray emission probabilities and theoretical total internal conversion coefficients.

[b] No uncertainties are quoted by the authors. The uncertainties adopted here are estimated by the evaluator from the spectra shown in the papers.

[c] The uncertainties quoted by the authors for the P_α values of 0.202 and 0.797 are 0.011 and 0.027, respectively. Since for consistency both uncertainty figures should be the same, a mean uncertainty value of 0.020 was adopted.

[d] The evaluated values and uncertainties are based on weighted means calculated in accordance with Topping [6].

[e] These values are calculated from the gamma ray emission probabilities and the theoretical total ICC (see note d on p. 122). The experimental values of Table II.C are used for P_γ. The calculated emission value $P_\alpha = (1 + \alpha)P_\gamma$ minus the sum P_α to all higher levels. Details are given in the table opposite. These calculated values are also considered for the calculation of the recommended values of Table III.A.

Level in ^{238}U (keV)	Corresponding energies		Total ICC [5]	Experimental	Calculated
	E_α (keV)	E_γ (keV)	α	$P_\gamma \times 10^3$	P_α
307	4598.5	158.80	1.86 *4*	0.0030 *2*	$(8.6 \pm 0.7) \times 10^{-6}$
148	4754.6	103.50	11.61 *23*	0.0263 *9*	$(3.22 \pm 0.13) \times 10^{-4}$
45	4856.0	44.92	626 *13*	0.372 *7*	0.2329 ± 0.0060
0	4900.6				0.7668 ± 0.0060 [a]

Note to Table

[a] 1−Sum P_α to higher levels.

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Recommended value: 432.7 ± 0.5 a

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

Measured values

Value (in years)[a]	Reference
432.7 ± 0.7	Oetting and Gunn (1967) [1]
436.6 ± 3.0	Stone and Hulet (1968) [2]
433 ± 7	Brown and Propst (1968) [3]
426.3 ± 2.1	Jove and Robert (1972) [4]
432.8 ± 1.6 [b]	Polyukhov et al. (1974) [5]
432.5 ± 0.7 [c]	Strohm and Jordan (1974) [6]
435.0 ± 1.6 [d]	"
432.0 ± 0.7 [e]	Ramthun and Müller (1974) [7]
432.7 ± 0.5	Weighted mean[f]

Notes to Table

[a] The values measured before 1960 by Hall and Markin [8] and by Wallmann et al. [9], deviating by about 6% from the values quoted above, have been omitted on the basis of statistical considerations.

[b] The uncertainty quoted by the authors, corresponding to a 2σ confidence level, has been divided by two in order to be comparable to the other quoted uncertainties, all corresponding to a 1σ confidence level.

[c] Determined by measuring the power output by calorimetry.

[d] Determined by measuring the increase of the power output of a ^{241}Pu sample due to the ingrowth of ^{241}Am; the uncertainty quoted by the authors has been increased slightly to take into account a somewhat larger uncertainty in the ^{241}Pu decay constant than adopted by the authors.

[e] The uncertainty of 0.2 a quoted by the authors has been increased to 0.7 a, i.e. the uncertainty quoted by Oetting and Gunn for their measurements performed with the same method as used by Ramthun and Müller. The quoted individual uncertainties on the Am determination (weighing and impurities), on the power measurements, on Q(α) and on random effects are nearly the same for Refs [1] and [7]. The difference in the quoted overall uncertainties is only due to the different manner of summation of individual uncertainties: quadratic sum of one-third of the individual uncertainties by Ramthun and Müller and quadratic sum of the individual uncertainties by Oetting and Gunn. Furthermore, the result in Ref. [1] is based on 31 individual measurements on two large samples (6 and 15 g Am) using different calorimeters in two laboratories (Rocky Flats and Livermore), while Ramthun and Müller's result is based on 5 individual measurements on only one small sample (0.07 g), and the use of Student t-factors, depending on the degrees of freedom, would even make the result in [7] slightly less accurate than that of Ref. [1].

[f] The weighted mean and its uncertainty is calculated according to Topping [10].

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS ^{241}Am

Evaluated by W. Bambynek (CBNM, Geel, Belgium).

A. Recommended values

	Emission probability
E(keV)	$10^2 P_\gamma$
26.34	2.4 ± 0.1
33.20	0.12 ± 0.01
43.42	0.071 ± 0.010
59.54	35.9 ± 0.4
98.95	0.020 ± 0.001
102.97	0.0196 ± 0.0010
	$10^6 P_\gamma$
122.99	10 ± 1
125.29	41 ± 1
146.55	4.6 ± 0.2
164.60	0.72 ± 0.15
169.56	1.72 ± 0.15
208.00	7.9 ± 0.2
322.54	1.5 ± 0.1
332.35	1.5 ± 0.1
335.40	4.95 ± 0.10
368.60	2.2 ± 0.2
662.42	3.6 ± 0.2

B. CRP measurements

None.

C. Other measurements

Emission probability [a]

E^{b}(keV)	P_{γ} [c]	Magnusson (1957) [14]	W. Michaelis [g] (1965) [24]	W. Michaelis [g] (1966) [30]	Lederer et al. (1966) [43]	Günther and Parsignault (1967) [44] [e]	Kamoun et al. (1968) [31]	Péghaire (1969) [25]	Gehrke and Lokken (1971) [15] [d]	Faermann et al. (1971) [45] [d,h]	Watson and Li (1971) [16]	Campbell and McNelles (1974) [18]
26.35	10^{-2}	2.5 *2*							2.2 *2*	2.5 *2*	2.4 *1* [i]	2.4 *1*
33.20	10^{-3}	1.1 *1* [d]							1.0 *1*	1.29 *10*		
43.42	10^{-4}	7.3 *7*							5.7 *24*	6.4 *8*		
59.54	10^{-2}	35.9 *6* [h]						35.3 *6*				
98.95	10^{-4}	2.3 *3* [h]	1.9 *6*	1.9 *6*	1.9 *3*	2.1 *3*						
102.97	10^{-4}	1.9 *3* [h]	1.4 *5*	1.5 *5*	1.9 *3*	2.1 *3*	1.9 *9*					
122.99	10^{-5}		1.2 *3*	1.5 *5*		1.2 *3*	1.8 *5*					
125.29	10^{-5}		3.9 *9*	2.6 *6*	5 *2*		4.5 *5*					
146.55	10^{-6}			4.5 *11*	1.6 *7* [f]	4.2 *6*	1.6 *6* [f]					
164.60	10^{-6}			1.1 *4*	0.41 *23* [f]	0.85 *6*	0.25 *12* [f]					
169.56	10^{-6}		1.3 *5*	1.3 *4*	1.0 *5* [f]	1.67 *7*	0.85 *42* [f]					
208.00	10^{-6}		5.4 *10* [f]	5.7 *11* [f]	5.6 *16* [f]	7.6 *4*	5.61 *10* [f]					
322.54	10^{-6}			1.3 *3*	1.6 *5*	1.60 *8*	1.9 *9* [f]					
332.35	10^{-6}				1.8 *6*	2.2 *3*	1.4 *7*					
335.40	10^{-6}		4.4 *9*	4.4 *9*	5.7 *17*	5.2 *3*	5.7 *1*					
368.60	10^{-6}		2.7 *7*	1.9 *4*	2.8 *9*	3.2 *2* [f]	2.8 *14*					
662.42	10^{-6}		3.1 *7*	2.8 *9*	5.3 *13*	3.5 *2*	5.3 *13* [h]					

E^b (keV)	P_γ [c]	Chauhan et al. (1974) [17][g]	Legrand et al. (1975) [27]	Plch et al. (1976) [28]	Gunnink et al. (1976) [19][k]	Genoux-Lubain and Ardisson[g] (1978) [20]	Genoux-Lubain and Ardisson[g] (1978) [46]	LMRI (1978) [32]	Ovechkin (1978) [47]	Hutchinson and Mullen (1983) [29]	Debertin and Pessara (1983) [21]	Evaluated values[l,m]
26.35	10^{-2}	2.1 *1* [h]			2.45 *6*	2.54 *26*					2.41 *5*	2.4 *1*
33.20	10^{-3}	1.3 *1*			1.26 *8* [h]	1.06 *11*						1.2 *1*
43.42	10^{-4}	7.1 *10*				7.29 *73*						7.1 *1*
59.54	10^{-2}		36.3 *4* [j]	35.5 *3*						35.82 *12*		35.9 *4*
98.95	10^{-4}	2.5 *2* [h]			2.03 *4*	2.9 *2*						2.0 *1*
102.97	10^{-4}	2.3 *3*			1.95 *4*	2.5 *3* [h]						1.96 *10*
122.99	10^{-5}				1.00 *2*	2.4 *4* [f]	1.4 *4* [h]	1.08 *9*				1.0 *1*
125.29	10^{-5}				4.08 *8*	6.4 *7*	4.28 *50* [h]	4.17 *32*				4.1 *1*
146.55	10^{-6}				4.61 *10*		6.02 [f]	5.10 *32*				4.6 *2*
164.60	10^{-6}				0.67 *4* [h]		1.0 *4* [c,f]	0.71 *6*				0.72 *15*
169.56	10^{-6}				1.73 *4*		3.18 [f]	1.85 *11*				1.72 *15*
208.00	10^{-6}				7.91 *16*		15.8 [f]	7.95 *38*				7.9 *2*
322.54	10^{-6}				1.518 *32*		3.09 [f]	1.47 *7*				1.5 *1*
332.35	10^{-6}				1.49 *3*		3.35 [f]	1.48 *9*				1.5 *1*
335.40	10^{-6}				4.96 *10*		10.0 [f]	4.75 *21*				4.95 *10*
368.60	10^{-6}				2.17 *4*		4.41 [f]	2.08 *10*				2.2 *2*
662.42	10^{-6}				3.64 *7*		7.34 [f]	3.50 *17*	3.41 *25* [g]			3.6 *2*

Notes to Table C

[a] The data sets of Prohaska [22], Beling et al. [11], Jaffe et al. [12], Day [13] and McIsaac [23] were omitted as outliers according to Dixon's criterion [42]. The data of Cline et al. [26] were omitted because it is not clear whether these values are measured or compiled data.

[b] The energies are not evaluated. They are taken from the Nuclear Data Sheets [35].

[c] The figures in this column indicate the power of ten by which the figures of the table have to be multiplied.

[d] Deduced from relative intensity measurements using $P_\gamma(59.54) = 0.359\ 4$.

[e] Deduced from relative intensity measurements using $P_\gamma(125.29) = 4.1\ 1 \times 10^{-4}$.

[f] This value was rejected as an outlier according to Dixon's criterion [42].

[g] Recalculated from the emission probability quoted using $P_\gamma(59.54) = 0.359\ 4$.

[h] The uncertainty was (re)estimated by the evaluator.

[i] Deduced from intensity measurements relative to the $L_{\beta 1}$ X-ray line ($L_2 - M_4$) using $P_{L\beta} = 0.1946\ 46$ of Gallagher and Cipolla [41] for the total L_β emission probability.

[j] The uncertainty quoted by Legrand et al. [27] corresponds to a 2σ level. We have divided it by 2 to be comparable to the other uncertainties quoted.

[k] The uncertainties quoted by Gunnink et al. [19] are the statistical uncertainties in the measurement of the peak areas. They have been increased by 2% to allow for the uncertainty of the detector calibration.

[l] The recommended values have been deduced from the weighted means of the measured results. As weights, the squared reciprocals of the adjusted uncertainties were used. Usually the maximum of the internal and external errors has been assigned as uncertainty of the weighted means according to Topping [10]. However, owing to the great spread of the various results of some transitions, in some cases the evaluator has assigned greater uncertainties.

[m] Previous compilations or evaluations were published by Hansen et al. [33], Ellis [35], Kocher [34], Kholnov et al. [36], Blachot and Fiche [37], Reus and Westmeier [38] and Lorenz [39, 40].

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Evaluated by A.L. Nichols (UKAEA, AEE Winfrith).

I.1. Total half-life

Recommended value: 141 ± 2 a

Weighted mean with 1σ standard deviation.

Value (years)	Reference[e]
152 *7* [a,b]	Barnes et al. (1959) [1]
141.9 *17* [a,c]	Zelenkov et al. (1979) [2]
139.7 *18* [a,d]	Zelenkov et al. (1979) [2]

Notes to Table

[a] Quoted uncertainty estimated to be 1σ standard deviation.
[b] Derived from unpublished data and measured alpha half-life: recalculated, but includes erroneous identification of decay modes.
[c] In-growth of ^{242}Cm via ^{242}Am.
[d] Measurement of emission ratios of $^{242}Am^{m}$ and ^{242}Am.
[e] Exclusive consideration of 1979 measurements (see note b) results in a weighted mean half-life of 141 *1* years.

I.2. Alpha half-life

Recommended value: $(3.11 \pm 0.05) \times 10^{4}$ a

Weighted mean with 1σ standard deviation.

Value (years)	Reference
2.9 *2* X 10^{4} [a,b]	Barnes et al. (1959) [1]
3.12 *5* X 10^{4} [a]	Zelenkov et al. (1979) [2]

Notes to Table

[a] Quoted uncertainty estimated to be 1σ standard deviation.
[b] Recalculated from activity measurements using latest estimates of half-life data.

I.3. Spontaneous fission half-life $^{242}Am^{m}$

Recommended value: $(8.8 \pm 3.2) \times 10^{11}$ a

Value (years)	Reference
8.8 *32* $\times 10^{11}$ [a]	Caldwell et al. (1967) [3]

Note to Table

[a] Reported value of 9.5 *35* $\times 10^{11}$ years has been recalculated using latest values for the half-life of $^{242}Am^{m}$ and the branching fraction to ^{242}Cm.

I.4. Branching fractions

Alpha branching fraction: 0.0045 ± 0.0003.
Isomeric transition branching fraction: 0.9955 ± 0.0003.
Spontaneous fission branching fraction: $(1.6 \pm 0.6) \times 10^{-10}$.

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Recommended value: 7370 ± 15 a

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

Measured values

Value in years[a]	Reference
7292 ± 160	Barnes et al. (1959) [1]
7226 ± 100 [b]	Beadle et al. (1960) [2]
7370 ± 40 [c]	Brown and Propst (1968) [3]
7380 ± 17 [c,d]	Polyukhov et al. (1974) [4]
7360 ± 42	Aggarwal et al. (1980) [5]
7370 ± 15	Weighted mean and standard error[e]

Notes to Table

[a] The values measured before 1959 by Diamond et al. [6] and Wallmann et al. [7], deviating by about 9% from all other results, have been omitted. The values of Refs [1–5] are to a large extent based on measurements relative to the ^{241}Am half-life. When necessary, they have been recalculated on the basis that $T_{1/2}$ ^{241}Am is (432.7 ± 0.5) a.

[b] The uncertainty of 50 a quoted by the authors has been changed. The main quoted uncertainty of 1.4% is largely due to systematic effects and therefore division of this uncertainty by $\sqrt{n}$ is questionable.

[c] These results are the weighted mean values from measurements relative to $T_{1/2}$ ^{241}Am and from specific ^{243}Am determinations.

[d] The uncertainty quoted by the authors correponds to the 2σ confidence level and has been divided by two in order to be comparable to the other quoted uncertainties.

[e] The weighted mean and its uncertainty have been calculated according to Topping [8]. Since the results of the measurements relative to the ^{241}Am half-life are not independent, the number of independent results has been taken as three for the calculation of the standard error.

Evaluated by R. Vaninbroukx (CBNM, Geel, Belgium).

A. Recommended values

E_γ (keV)	P_γ
43.53	0.0593 ± 0.0013
74.67	0.682 ± 0.014
86.79	0.00338 ± 0.00007
142.18	0.0012 ± 0.0001

B. CRP measurements

E_γ (keV)	Vaninbroukx et al. (1984) [9]
43.53	0.0604 ± 0.0013
74.67	0.685 ± 0.015
86.79	0.0035 ± 0.0001
142.18	0.0013 ± 0.0001

C. Comparison with other measurements

^{243}Am

E_γ (keV)	CRP measurements	Other measurements								Evaluated values[c]
	Vaninbroukx et al. (1984) [9]	Asaro et al. (1960) [10]	Van Hise and Engelkemeir (1968) [11][a]	Aleksandrov et al. (1970) [12]	Ahmad and Wahlgren (1972) [13]	Starozhukov et al. (1977) [14]	Popov et al. (1979) [15]	Ahmad (1982) [16]	Holloway et al. (1983) [17][b]	
43.53	0.0604 *13*	0.04 *1*	0.053 *5*	0.05 *1*	0.055 *3*		0.053 *12*	0.0620 *30*	0.0587 *17*	0.0593 *13*
74.67	0.685 *15*	0.69 *3*	0.61 *6*	0.73 *1*	0.660 *30*	0.591 *40*	0.60 *4*	0.680 *20*	0.670 *12*	0.682 *14*
86.79	0.0035 *1*		0.0037 *4*					0.00340 *15*	0.00334 *6*	0.00338 *7*
142.18	0.0013 *1*		0.0013 *1*					0.00128 *6*	0.00105 *2*	0.0012 *1*

Notes to Table C

[a] The individual values are given by the authors without uncertainty quotation; from the explanations in the text, they can be estimated to be about 10%.

[b] The P_γ values have been re-evaluated by one of the authors (T.D. MacMahon, private communication, December 1984) using the calibration standards decay data from INDC(NDS)-145/GEI [18] for the recalculation of the detector efficiencies.

[c] The evaluated values and uncertainties are generally based on weighted means calculated according to Topping [8]. To the individual values given with one decimal place less than the others slightly smaller weights are attributed, since generally figures quoted with one digit more are the result of more careful error considerations. Further, as a general rule, minimum uncertainties of 2% were assumed for P_γ values from rays with energies below 100 keV.

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Total half-life

Evaluated by H. Okashita (JAERI, Tokai Mura, Japan).

Recommended value: 162.94 ± 0.06 d

This value coincides with that evaluated by Vaninbroukx in 1982 [1].

Values (days)[a]	Period of observation (days)	Reference
162.5 *2* [b]	300	Hanna et al. (1950) [2]
162.46 *32* [b]	210	Glover et al. (1954) [3]
163.0 *18* [c]	365	Hutchinson and White (1954) [4]
163.1 *4* [d]	1187	Flynn et al. (1965) [5]
163.2 *2* [c]	287	Kerrigan and Banick (1975) [6]
162.76 *8* [e]	260	Diamond et al. (1977) [7]
163.02 *18* [b]	308	Huan-Qiao et al. (1979) [8]
162.13 *225* [f]	237	Jadhav et al. (1980) [9]
161.35 *30* [d]	540	Usuda and Umezawa (1981) [10]
163.17 *11* [e]	250	Aggarwal et al. (1982) [11]
162.82 *26* [f]	208	Aggarwal et al. (1982) [11]
163.03 *16* [b]	490	Wiltshire et al. (1982) [12]

Notes to Table

[a] The uncertainties have been estimated when the authors have not made a systematic consideration of the error.
[b] Alpha spectrometry with low geometry proportional counter.
[c] Heat output by calorimetry.
[d] Alpha counting with 2π proportional counter.
[e] Alpha counting with intermediate geometry proportional counter.
[f] Alpha spectrometry with solid state detector.

Comment: The weighted mean of all the results is 162.90 days with an external standard error of ±0.10 and an internal one of ±0.05 days, showing no consistency of the individual values with their attributed weights. The recommended value was calculated after rejecting the outlying value of Ref. [10].

Evaluated by H. Okashita (JAERI, Tokai Mura, Japan).

Recommended value: $(7.05 \pm 0.09) \times 10^6$ **a**

Values (10^6 a)[a]	Reference
7.2 *2* [b]	Hanna et al. (1951) [13]
6.09 *18* [c]	Armani et al. (1967) [14]
7.46 *6* [d]	Huan-Qiao et al. (1979) [8]
7.15 *15* [d]	Raghuraman et al. (1982) [15]
6.89 *14* [d]	Usuda and Jaeri (1983) [16]

Notes to Table

[a] The uncertainties are those quoted by the authors.
[b] Fission fragment counting/ionization chamber.
[c] Fission neutron counting/LiI detector.
[d] Fission events recording/SSNTD.

Comment: The weighted mean of all results is 7.24×10^6 a with an external standard error of ± 0.19 and an internal one of $\pm 0.05 \times 10^6$ a. The recommended value was calculated after rejecting the two outermost data points.

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I. HALF-LIFE

^{244}Cm

Recommended value: 18.10 ± 0.05 a

This value was adopted from the 1984 review of N.E. Holden [1].

The uncertainty quoted by the evaluator corresponds to a 2σ confidence level; it has been reduced by a factor of two to correspond to the 1σ level adopted in this report.

II. EMISSION PROBABILITIES OF SELECTED GAMMA RAYS

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_γ (keV)	P_γ
42.82	$(2.48 \pm 0.06) \times 10^{-4}$
98.86	$(1.1 \pm 0.1) \times 10^{-5}$
152.63	0.99×10^{-5}

B. Tabulation of data considered in the evaluation

No CRP or CRP-related measurements of the P_γ were carried out. The listed values are obtained as described in the notes overleaf.

E_γ (keV)	Calculated values[a]	Calculated values[b]	Evaluated values[c]
42.82	$2.48\ 6 \times 10^{-4}$		$2.48\ 6 \times 10^{-4}$
98.86	$1.11\ 8 \times 10^{-5}$	$1.66\ 22 \times 10^{-5}$	$1.1\ 1 \times 10^{-5}$
152.63	0.99×10^{-5}	$1.02\ 5 \times 10^{-5}$	0.99×10^{-5}

[a] The calculated P_γ values are obtained from the P_α values reported in this evaluation and the ICC values calculated from Rösel's table (see below).

[b] The P_γ values have been calculated from the measured relative intensities using the adopted value of 2.48 *6* X 10^{-4} for the 42.8 keV ray (see below).

[c] The evaluated P_γ values are those derived from recommended P_α values.

E_γ (keV)	Multipolarity	Transition probability	Total ICC [2]	P_γ
42.82	E2	0.2300 *5*	928 *18*	2.48 *6* X 10^{-4}
98.96	E2	0.000200 *10*	17.0 *3*	1.11 *8* X 10^{-5}
152.63	E2	3.5 X 10^{-5}	2.54 *5*	0.99 X 10^{-5}

E_γ (keV)	Rel. intensity [3]	P_γ
42.82	100	2.48 *6* X 10^{-4}
98.86	6.7 *7*	1.66 *20* X 10^{-5}
152.63	4.1 *1*	1.02 *5* X 10^{-5}

III. SELECTED ALPHA EMISSION PROBABILITIES

Evaluated by F. Lagoutine (LMRI, Saclay, France).

A. Recommended values

E_α (keV)	P_α
5515.5	3.5 X 10^{-5}
5665.7	0.000163 ± 0.000007
5762.84	0.2300 ± 0.0005
5804.96	0.7698 ± 0.0005

B. CRP measurement

None.

E_α (keV)	Other measurements					Evaluated values[a]
	Burns et al. (1984) [4]	Hummel (1956) [5]	Asaro and Perlman (1984) [6]	Dzhelepov et al. (1963) [7]	Baranov et al. (1966)[8]	
5515.5			$3.6\ 3 \times 10^{-5}$	$3\ 1 \times 10^{-5}$	3.4×10^{-5}	3.5×10^{-5}
5665.7	0.000163 *7*	0.00017 *3*	0.00023 *2*	0.00021 *2*	0.0002	0.000163 *7*
5762.84	0.2300 *5*	0.233 *6*		0.238 *9*	0.236	0.2300 *5*
5804.96	0.7698 *5*	0.767 *6*		0.762 *20*	0.764	0.7698 *5*

Note to Table C

[a] The P_α value for the 5515.5 keV alpha transition simply represents the average of two values reported in Refs [6] and [8]. The uncertainties are not assigned because of the difficulty in the estimation of confidence level. For the other alpha transitions, the P_α values are those listed in III.B.

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Recommended value: 2.645 ± 0.008 a

Evaluated by J.R. Smith (INEL, Idaho Falls, USA).

This value was adopted from Ref. [1].

A. Tabulation of data considered in the evaluation

Half-life (years)	Reference and year
2.646 ± 0.004	[2] (1965)
2.621 ± 0.006	[3] (1969)
2.659 ± 0.010	[4] (1973)
2.628 ± 0.010	[5] (1974)
2.638 ± 0.007 [a]	[6] (1974)
2.637 ± 0.005	[7] (1976)
2.648 ± 0.002	[8] (1980)
2.653 ± 0.001	[8] (1980)
2.651 ± 0.003	[9] (1984)
2.639 ± 0.007	[10] (1982)
2.651 ± 0.003	[11] (1984)

Note to Table A

[a] Value subsequently withdrawn by author.

Comment: It is pointed out in Ref. [1] that there appears to be substantial support for half-life values near both 2.638 a and 2.651 a and that there is no apparent way at present to identify the cause of this discrepancy. Until such time as the present problems regarding the ^{252}Cf half-life can be resolved, use of the recommended value above is suggested. This value has been chosen simply to represent an average of these two values, with a quoted error sufficiently large to cover the range of uncertainty.

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Part 3

DATA RECOMMENDED BY THE CRP

The third section of this Report lists the values of decay parameters of heavy element radionuclides recommended by the CRP. The radionuclides included in these tabulations reflect the requirements which were identified at the three IAEA Advisory Group meetings on transactinium isotope nuclear data (Karlsruhe 1975, Cadarache 1979, and Uppsala 1984). These tabulations comprise data which have been measured and/or evaluated in the context of the CRP activities (included in Part 2 of this Report), as well as data that have been adopted with little or no additional evaluation from existing national data files or publications. To complete the data set produced for this report, the data which have resulted from the CRP effort have been complemented with the most recently evaluated data published in the Nuclear Data Sheets.

In the course of the assessment of the non-CRP data, in particular half-life data, situations were encountered in which CRP members had cause to question the recommended values. In those instances where changes were felt to be justified, CRP members made appropriate adjustments on the basis of criteria described above, or performed a detailed evaluation (see Part 2). It is important to note that such revisions were not based on CRP measurements, but were derived from consideration of other existing data.

DESCRIPTION OF TABLE ENTRIES

Decay mode	A	Alpha decay	IT	Isomeric transition
	B-	Beta decay	SF	Spontaneous fission
	EC	Electron capture	T	Total half-life
Units	MS	millisecond	H	Hour
	S	second	D	day
	M	minute	Y	year (= 365.2422 days)

Half-life data: the following criteria were adopted for the representation of the half-lives:

- seconds are used if half-life is longer than 100 milliseconds
- minutes are used if half-life is longer than 100 seconds
- hours are used if half-life is longer than 100 minutes
- days are used if half-life is longer than 100 hours
- years are used if half-life is longer than 500 days

Comments in the tables (given in right-hand column):

A – Half-life derived from branching fraction.
B – Branching fraction derived from half-life.
C – Total half-life as defined here equals partial half-life multiplied by branching fraction.
D – Complex peak; listed energy is nominal value only.
E – Peak contains contribution from member of the ^{229}Th decay chain.

Branching fractions: defined such that the total decay probability for all modes of decay is equal to 1.

Emission probabilities: all P_α and $P\gamma$ values are expressed as the absolute probability of an emission of an alpha particle or photon per decay.

Criteria used to include gamma lines in tabulations

- Lines with an uncertainty larger than 50% were omitted.
- In this tabulation of $E\gamma/P\gamma$, only gamma rays from parent nuclide decays are included. Gamma rays from radionuclides in equilibrium with their daughters are included in the individual evaluations given in Part 2.

References: list given at the end of Part 3.

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	HALF-LIFE UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY		HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY		BRANCHING FRACTION REFERENCE	COMMENT
80-HG-206	B-	M	(8.15	+- 0.10	)	WE7901					
81-TL-206	B-	M	(4.20	+- 0.02	)	WE7901					
81-TL-206M1	IT	M	(3.76	+- 0.04	)	WE7901					
81-TL-207	B-	M	(4.77	+- 0.03	)	NI8101					
81-TL-207M1	IT	S	(1.33	+- 0.11	)	NI8101					
81-TL-208	B-	M	(3.053	+- 0.004	)	NI8101					
81-TL-209	B-	M	(2.20	+- 0.07	)	NI8101					
81-TL-210	B-	M	(1.30	+- 0.03	)	HA8103					
82-PB-205	EC	Y	(1.52	+- 0.07	)E+7	SC8501					
82-PB-209	B-	H	(3.253	+- 0.014	)	NI8101					
82-PB-210	A	Y	(1.17	+- 0.18	)E+9	HA8103	(1.9	+- 0.3	)E-8	HA8103	A
82-PB-210	B-	Y	(22.3	+- 0.2	)	HA8103					
82-PB-211	B-	M	(36.1	+- 0.2	)	NI8101					
82-PB-212	B-	H	(10.64	+- 0.01	)	MA7901					
82-PB-214	B-	M	26.8			TO7703					
83-BI-210	A	Y	(1.04	+- 0.08	)E+4	HA8103	(1.32	+- 0.10	)E-6	HA8103	A
83-BI-210	B-	D	(5.013	+- 0.005	)	HA8103					
83-BI-210M1	A	Y	(3.0	+- 0.1	)E+6	HA8103					
83-BI-211	A	M	(2.17	+- 0.04	)	NI8101	(0.99727	+- 0.00004	)	NI8101	
83-BI-211	B-	H	(13.25	+- 0.28	)	NI8101	(0.00273	+- 0.00004	)	NI8101	A
83-BI-212	T	M	(60.55	+- 0.06	)	MA7901					C
83-BI-212	A	H	(2.808	+- 0.005	)	MA7901	(0.3594	+- 0.0006	)	MA7901	A
83-BI-212	B-	M	(94.52	+- 0.13	)	MA7901	(0.6406	+- 0.0006	)	MA7901	A
83-BI-212M1	T	M	25.			MA7901					C
83-BI-212M1	A	M	26.9			MA7901	0.93			MA7901	A
83-BI-212M1	B-	H	5.95			MA7901	0.07			MA7901	A
83-BI-212M2	B-	M	9.			MA7901					
83-BI-213	T	M	(45.59	+- 0.06	)	EL7902					C
83-BI-213	A	H	(35.2	+- 1.8	)	EL7902	(0.0216	+- 0.0011	)	EL7902	A
83-BI-213	B-	M	(46.60	+- 0.08	)	EL7902	(0.9784	+- 0.0011	)	EL7902	A
83-BI-214	A	D	(65.8	+- 3.4	)	NI8101	(0.00021	+- 0.00001	)	NI8101	A
83-BI-214	B-	M	(19.9	+- 0.4	)	NI8101	(0.99979	+- 0.00001	)	NI8101	

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	HALF-LIFE UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION REFERENCE	COMMENT
83-BI-215	B-	M	(7.4	+- 0.6)	NI8101				
84-PO-209	A	Y	(102.	+- 5.)	NI8101	(0.9974	+- 0.0001)	NI8101	
84-PO-209	EC	Y	(3.92	+- 0.24)E+4	NI8101	(0.0026	+- 0.0001)	NI8101	A
84-PO-210	A	D	(138.4	+- 0.2)	NI8101				
84-PO-211	A	S	(0.516	+- 0.003)	NI8101				
84-PO-211M1	A	S	(25.5	+- 0.3)	NI8101				
84-PO-212	A	MS	(0.298	+- 0.003)E-3	MA7901				
84-PO-212M1	A	S	(45.1	+- 0.6)	MA7901	(1.000	+- 0.015)	MA7901	
84-PO-213	A	MS	(4.2	+- 0.8)E-3	EL7902				
84-PO-214	A	MS	(0.165	+- 0.003)	NI8101				
84-PO-215	A	MS	(1.78	+- 0.01)	NI8101				
84-PO-215	B-	M	(7.	+- 4.)	NI8101	(4.	+- 2.)E-6	NI8101	A
84-PO-216	A	S	(0.15	+- 0.01)	NI8101				
84-PO-218	A	M	3.05		NI8101	0.9998		NI8101	
84-PO-218	B-	D	10.6		NI8101	0.0002		NI8101	A
85-AT-215	A	MS	(0.10	+- 0.02)	NI8101				
85-AT-217	A	MS	(32.3	+- 0.4)	EL7903	(0.99988	+- 0.00004)	EL7903	
85-AT-217	B-	M	(4.5	+- 1.5)	EL7903	(0.00012	+- 0.00004)	EL7903	A
85-AT-218	A	S	(1.6	+- 0.4)	NI8101	(0.999	+- 0.001)	NI8101	
85-AT-218	B-	M	(30.	+- 30.)	NI8101	(0.001	+- 0.001)	NI8101	A
85-AT-219	T	S	(54.	+- 6.)	NI8101				
85-AT-219	A	S	(56.	+- 6.)	NI8101	(0.97	+- 0.01)	NI8101	A
85-AT-219	B-	M	(30.	+- 10.)	NI8101	(0.03	+- 0.01)	NI8101	A
86-RN-217	A	MS	(0.54	+- 0.05)	EL7903				
86-RN-218	A	MS	(35.	+- 6.)	NI8101				
86-RN-219	A	S	(3.96	+- 0.05)	NI8101				
86-RN-220	A	S	(55.6	+- 0.1)	NI8101				
86-RN-222	A	D	(3.8235	+- 0.0003)	TO7704				
87-FR-221	A	M	(4.9	+- 0.2)	TO7902				
87-FR-223	A	D	(252.	+- 42.)	NI8101	(0.00006	+- 0.00001)	NI8101	A
87-FR-223	B-	M	(21.8	+- 0.4)	NI8101	(0.99994	+- 0.00001)	NI8101	
88-RA-223	A	D	(11.43	+- 0.02)	NI8101				

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY		HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY		BRANCHING FRACTION REFERENCE	COMMENT
88-RA-224	A	D	(3.66	+- 0.04	)	NI8101					
88-RA-225	B-	D	(14.8	+- 0.2	)	TO7902					
88-RA-226	A	Y	(1600.	+- 7.	)	NI8101					
88-RA-228	B-	Y	(5.75	+- 0.03	)	NI8101					
89-AC-225	A	D	(10.0	+- 0.1	)	TO7902					
89-AC-227	T	Y	(21.77	+- 0.03	)	NI8101					C
89-AC-227	A	Y	(1578.	+- 11.	)	NI8101	(0.0138	+- 0.0001	)	NI8101	A
89-AC-227	B-	Y	(22.07	+- 0.03	)	NI8101	(0.9862	+- 0.0001	)	NI8101	A
89-AC-228	B-	H	(6.15	+- 0.02	)	SK8501					
90-TH-227	A	D	(18.72	+- 0.02	)	NI8101					
90-TH-228	A	Y	(1.913	+- 0.002	)	VA8401					
90-TH-229	A	Y	(7340.	+- 160.	)	TO7801					
90-TH-230	A	Y	(7.538	+- 0.030	)E+4	EL8301					
90-TH-230	SF	Y	1.5E+17			EL8301	5.0E-13				B
90-TH-231	B-	H	(25.52	+- 0.01	)	SC8301					
90-TH-232	A	Y	(1.405	+- 0.006	)E+10	SC8201					
90-TH-232	SF	Y	1.E+21			LE7801	1.4E-11				B
90-TH-233	B-	M	(22.3	+- 0.1	)	EL7802					
90-TH-234	B-	D	(24.10	+- 0.03	)	EL8302					
90-TH-235	B-	M	(6.9	+- 0.2	)	SC8301					
91-PA-231	A	Y	(3.276	+- 0.011	)E+4	SC8301					
91-PA-231	SF	Y	1.1E+16			SC8301	3.0E-12				B
91-PA-232	B-	D	(1.31	+- 0.02	)	SC8201	1.000				
91-PA-232	EC	Y	(120.	+- 40.	)	NI8401	(3.	+- 1.	)E-5	NI8401	
91-PA-233	B-	D	(27.0	+- 0.1	)	EL7801					
91-PA-234	B-	H	(6.70	+- 0.05	)	EL8302					
91-PA-234M1	B-	M	(1.17	+- 0.03	)	EL8302	(0.9987	+- 0.0002	)	EL8302	
91-PA-234M1	IT	H	(15.	+- 2.	)	EL8302	(0.0013	+- 0.0002	)	EL8302	A
91-PA-235	B-	M	(24.1	+- 0.2	)	SC8301					

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION REFERENCE	COMMENT
92-U -232	A	Y	(69.8	+- 0.5)	HO8401				
92-U -232	SF	Y	(8.	+- 6.)E+13	HO8401	(0.9	+- 0.7)E-12		B
92-U -233	A	Y	(1.592	+- 0.002)E+5	HO8401				
92-U -233	SF	Y	> 2.7E+17		HO8401	< 5.9E-13			
92-U -234	A	Y	(2.457	+- 0.003)E+5	NI8401				
92-U -234	SF	Y	(1.42	+- 0.08)E+16	HO8401	(1.73	+- 0.10)E-11		B
92-U -235	A	Y	(7.037	+- 0.007)E+8	HO8401				
92-U -235	SF	Y	(9.8	+- 2.8)E+18	HO8401	(7.2	+- 2.1)E-11		B
92-U -235M1	IT	M	(26.	+- 2.)	NI8101				
92-U -236	A	Y	(2.342	+- 0.003)E+7	HO8401				
92-U -236	SF	Y	(2.43	+- 0.07)E+16	HO8401	(9.64	+- 0.03)E-10		B
92-U -237	B-	D	(6.75	+- 0.01)	EL7803				
92-U -238	A	Y	(4.468	+- 0.005)E+9	HO8401				
92-U -238	SF	Y	(8.2	+- 0.1)E+15	HO8401	(5.45	+- 0.07)E-7		B
92-U -239	B-	M	(23.47	+- 0.05)	NI8401				
92-U -240	B-	H	(14.1	+- 0.2)	NI8101				
93-NP-236	T	Y	(1.15	+- 0.12)E+5	GR8401				C
93-NP-236	B-	Y	(1.3	+- 0.3)E+6	SC8201	(0.089	+- 0.020)	SC8201	A
93-NP-236	EC	Y	(1.26	+- 0.03)E+5	SC8201	(0.911	+- 0.020)	SC8201	A
93-NP-236M1	T	H	(22.5	+- 0.4)	SC8201				C
93-NP-236M1	B-	H	(46.9	+- 1.3)	SC8201	(0.48	+- 0.01)	SC8201	A
93-NP-236M1	EC	H	(43.3	+- 1.1)	SC8201	(0.52	+- 0.01)	SC8201	A
93-NP-237	A	Y	(2.14	+- 0.01)E+6	BR6001				
93-NP-237	SF	Y	> 1.E+18		EL7803	< 2.E-12			B
93-NP-238	B-	H	(50.81	+- 0.05)	SH8301				
93-NP-239	B-	D	(2.355	+- 0.004)	SC8301				
93-NP-240	B-	M	(65.	+- 3.)	NI8101				
93-NP-240M1	B-	M	(7.4	+- 0.2)	NI8101	(0.9989	+- 0.0003)	NI8101	
93-NP-240M1	IT	D	(4.7	+- 1.3)	NI8101	(0.0011	+- 0.0003)	NI8101	A
93-NP-241	B-	M	(13.9	+- 0.2)	EL8501				
94-PU-236	A	Y	(2.9	+- 0.1)	HO8401				
94-PU-236	SF	Y	(3.4	+- 0.6)E+9	HO8401	(8.5	+- 1.5)E-10		B
94-PU-237	A	Y	(2.9	+- 0.3)E+3	EL7904	(0.000042	+- 0.000004)	EL7904	A
94-PU-237	EC	D	(45.17	+- 0.06)	VA8201	0.999958			

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	HALF-LIFE UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION REFERENCE	COMMENT
94-PU-238	A	Y	(87.7	+- 0.3)	HO8401				
94-PU-238	SF	Y	(4.7	+- 0.2)E+10	HO8401	(1.9	+- 0.1)E-9		B
94-PU-239	A	Y	(2.411	+- 0.003)E+4	VA8401				
94-PU-239	SF	Y	5.5E+15		HO8401	4.4E-12			B
94-PU-240	A	Y	(6563.	+- 7.)	VA8402				
94-PU-240	SF	Y	(1.16	+- 0.04)E+11	HO8401	(5.7	+- 0.1)E-8		B
94-PU-241	A	Y	(6.00	+- 0.05)E+5	VA8301	(2.39	+- 0.04)E-5		B
94-PU-241	B-	Y	(14.35	+- 0.10)	EL8501				
94-PU-242	A	Y	(3.735	+- 0.011)E+5	HO8401				
94-PU-242	SF	Y	(6.8	+- 0.1)E+10	HO8401	(5.49	+- 0.08)E-6		B
94-PU-243	B-	H	(4.956	+- 0.003)	EL8101				
94-PU-244	A	Y	(8.00	+- 0.09)E+7	HO8401	0.998806			
94-PU-244	SF	Y	(6.7	+- 0.3)E+10	HO8401	(0.0012	+- 0.0001)		B
94-PU-245	B-	H	(10.5	+- 0.1)	EL8102				
94-PU-246	B-	D	(10.85	+- 0.02)	SC8101				
95-AM-240	A	Y	(3.0	+- 1.1)E+3	NI8101	(1.9	+- 0.7)E-6	NI8101	A
95-AM-240	EC	H	(50.8	+- 0.3)	NI8101				
95-AM-241	A	Y	(432.7	+- 0.5)	VA8401				
95-AM-241	SF	Y	(1.147	+- 0.024)E+14	EL8501	(3.77	+- 0.08)E-12		A
95-AM-242	T	H	(16.02	+- 0.02)	SH8501				C
95-AM-242	B-	H	(19.37	+- 0.07)	SH8501	(0.827	+- 0.003)	SH8501	A
95-AM-242	EC	H	(92.6	+- 1.6)	SH8501	(0.173	+- 0.003)	SH8501	A
95-AM-242M1	A	Y	(3.11	+- 0.05)E+4	NI8401	(0.0045	+- 0.0003)		B
95-AM-242M1	SF	Y	(8.8	+- 3.2)E+11	NI8401	(1.6	+- 0.6)E-10		B
95-AM-242M1	IT	Y	(141.	+- 2.)	NI8401	(0.9955	+- 0.0003)		B
95-AM-243	A	Y	(7370.	+- 15.)	VA8401				
95-AM-243	SF	Y	(2.0	+- 0.5)E+14	HO8402	(3.7	+- 0.9)E-11		B
95-AM-244	B-	H	(10.1	+- 0.1)	CH8101				
95-AM-244M1	B-	M	26.		CH8101	(0.999639	+- 0.000007)	CH8101	
95-AM-244M1	EC	D	50.		CH8101	(0.000361	+- 0.000007)	CH8101	A
95-AM-245	B-	H	(2.05	+- 0.01)	EL8102				
95-AM-246	B-	M	(39.	+- 3.)	SC8101				
95-AM-246M1	B-	M	(25.0	+- 0.2)	SC8101				

RECOMMENDED HEAVY RADIONUCLIDE HALF-LIVES AND BRANCHING FRACTIONS

NUCLIDE	DECAY MODE	UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY		REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY		REFERENCE	COMMENT
96-CM-241	T	D	(32.8	+- 0.2	)	EL7801					
96-CM-241	A	Y	(8.98	+- 0.90	)	EL7801	(0.010	+- 0.001	)	EL7801	A
96-CM-241	EC	D	(33.1	+- 0.2	)	EL7801	(0.990	+- 0.001	)	EL7801	A
96-CM-242	A	D	(162.94	+- 0.06	)	OK8401					
96-CM-242	SF	Y	(7.05	+- 0.14	)E+6	OK8401	(6.33	+- 0.13	)E-8	OK8401	
96-CM-243	T	Y	(28.5	+- 0.2	)	EL8101					C
96-CM-243	A	Y	(28.6	+- 0.2	)	EL8101	(0.9976	+- 0.0003	)	EL8101	A
96-CM-243	EC	Y	(1.19	+- 0.15	)E+4	EL8101	(0.0024	+- 0.0003	)	EL8101	B
96-CM-244	A	Y	(18.10	+- 0.02	)	CH8101					
96-CM-244	SF	Y	(1.344	+- 0.007	)E+7	CH8101	(1.347	+- 0.007	)E-6		B
96-CM-245	A	Y	(8500.	+- 200.	)	HO8402					
96-CM-246	A	Y	(4.73	+- 0.15	)E+3	SC8102	0.9997			SC8102	
96-CM-246	SF	Y	(1.81	+- 0.06	)E+7	SC8102	(2.614	+- 0.005	)E-4	SC8102	B
96-CM-247	A	Y	(1.60	+- 0.05	)E+7	HO8402					
96-CM-248	T	Y	(3.40	+- 0.04	)E+5	SC8102					C
96-CM-248	A	Y	(3.71	+- 0.04	)E+5	SC8102	(0.9174	+- 0.0003	)	SC8102	A
96-CM-248	SF	Y	(4.12	+- 0.05	)E+6	SC8102	(0.0826	+- 0.0003	)	SC8102	B
96-CM-249	B-	M	(64.15	+- 0.03	)	SC8102					
97-BK-249	A	Y	(6.04	+- 0.35	)E+4	SC8102	(1.45	+- 0.08	)E-5	SC8102	A
97-BK-249	B-	D	(320.	+- 6.	)	SC8102					C
97-BK-249	SF	Y	(1.87	+- 0.09	)E+9	SC8102	(4.69	+- 0.24	)E-10	SC8102	B
97-BK-250	B-	H	(3.217	+- 0.005	)	SC8101					
98-CF-249	A	Y	(351.	+- 2.	)	SC8102					
98-CF-249	SF	Y	(6.8	+- 0.5	)E+10	SC8102	(5.2	+- 0.2	)E-9	SC8102	A
98-CF-250	A	Y	(13.08	+- 0.09	)	SC8101	(0.99923	+- 0.00003	)	SC8101	
98-CF-250	SF	Y	(1.70	+- 0.07	)E+4	SC8101	(0.00077	+- 0.00003	)	SC8101	A
98-CF-251	A	Y	(898.	+- 44.	)	SC8102					
98-CF-252	T	Y	(2.645	+- 0.008	)	SM8301					C
98-CF-252	A	Y	(2.73	+- 0.01	)	RE8401	(0.96908	+- 0.00008	)	RE8401	A
98-CF-252	SF	Y	(85.5	+- 0.3	)	RE8401	(0.03092	+- 0.00008	)	RE8401	A
98-CF-253	T	D	(17.81	+- 0.08	)	SC8102					C
98-CF-253	A	Y	(15.7	+- 2.0	)	SC8102	(0.0031	+- 0.0004	)	SC8102	A
98-CF-253	B-	D	(17.86	+- 0.08	)	SC8102	(0.9969	+- 0.0004	)	SC8102	A
99-ES-253	A	D	(20.47	+- 0.03	)	SC8102				SC8102	
99-ES-253	SF	Y	(6.4	+- 0.2	)E+5	SC8102	(8.7	+- 0.3	)E-8	SC8102	A

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILITIES

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILTIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (PHOTONS/DECAY) DATA	UNCERTAINTY	REFERENCE	COMMENT
81-TL-208	211.5	+- 0.6	LE7101	(0.00184	+- 0.00014)	CO8402	
81-TL-208	233.5	+- 0.8	LE7101	(0.0029	+- 0.0002)	CO8402	
81-TL-208	252.6	+- 0.3	LE7101	(0.00807	+- 0.00011)	CO8402	
81-TL-208	277.35	+- 0.06	LE7101	(0.0640	+- 0.0006)	CO8402	
81-TL-208	510.80	+- 0.08	LE7101	(0.228	+- 0.003)	CO8402	
81-TL-208	583.191	+- 0.002	HE7801	(0.851	+- 0.006)	CO8402	
81-TL-208	722.3	+- 1.0	LE7101	(0.0026	+- 0.0003)	CO8402	
81-TL-208	763.13	+- 0.08	LE7101	(0.0189	+- 0.0006)	CO8402	
81-TL-208	860.37	+- 0.08	LE7101	(0.1252	+- 0.0012)	CO8402	
81-TL-208	1093.1	+- 0.1	LE7101	(0.0045	+- 0.0006)	CO8402	
81-TL-208	2614.6	+- 0.1	LE7101	(0.9983	+- 0.0017)	CO8402	
82-PB-212	115.176	+- 0.007	MA7901	(0.0060	+- 0.0002)	CO8402	
82-PB-212	176.66	+- 0.05	MA7901	(0.00052	+- 0.00006)	CO8402	
82-PB-212	238.632	+- 0.002	HE7801	(0.435	+- 0.004)	CO8402	
82-PB-212	300.087	+- 0.010	MA7901	(0.0325	+- 0.0004)	CO8402	
83-BI-212	39.858	+- 0.004	MA7901	(0.0103	+- 0.0005)	CO8402	
83-BI-212	288.07	+- 0.07	MA7901	(0.0031	+- 0.0004)	CO8402	
83-BI-212	327.96	+- 0.10	MA7901	(0.00120	+- 0.00008)	CO8402	
83-BI-212	452.83	+- 0.10	MA7901	(0.0036	+- 0.0004)	CO8402	
83-BI-212	727.330	+- 0.009	HE7803	(0.0664	+- 0.0009)	CO8402	
83-BI-212	785.42	+- 0.06	MA7901	(0.0110	+- 0.0002)	CO8402	
83-BI-212	893.408	+- 0.005	HE7803	(0.00381	+- 0.00014)	CO8402	
83-BI-212	1078.62	+- 0.10	MA7901	(0.00574	+- 0.00015)	CO8402	
83-BI-212	1620.735	+- 0.010	HE7803	(0.0149	+- 0.0006)	CO8402	
86-RN-220	549.7	+- 0.5	EL7602	(0.00114	+- 0.00017)	CO8402	
88-RA-224	241.0	+- 0.1	EL7603	(0.0405	+- 0.0004)	CO8402	
90-TH-228	84.40	+- 0.05	HO7601	(0.0122	+- 0.0003)	CO8402	
90-TH-228	131.62	+- 0.20	HO7601	(0.00127	+- 0.00007)	CO8402	
90-TH-228	166.37	+- 0.20	HO7601	(0.00107	+- 0.00004)	CO8402	
90-TH-228	215.94	+- 0.08	HO7601	(0.0026	+- 0.0001)	CO8402	
90-TH-229	31.4	+- 0.2	RE8401	(0.0245	+- 0.0006)	RE8401	D
90-TH-229	42.7	+- 0.2	RE8401	(0.00199	+- 0.00006)	RE8401	D
90-TH-229	43.99	+- 0.01	RE8401	(0.00762	+- 0.00017)	RE8401	
90-TH-229	56.52	+- 0.01	RE8401	(0.00312	+- 0.00007)	RE8401	
90-TH-229	94.73	+- 0.02	RE8401	(0.00465	+- 0.00008)	RE8401	E
90-TH-229	107.11	+- 0.01	RE8401	(0.00809	+- 0.00013)	RE8401	
90-TH-229	110.33	+- 0.01	RE8401	(0.00128	+- 0.00003)	RE8401	
90-TH-229	123.19	+- 0.01	RE8401	(0.00197	+- 0.00003)	RE8401	E
90-TH-229	124.60	+- 0.05	RE8401	(0.01449	+- 0.00020)	RE8401	D
90-TH-229	131.93	+- 0.01	RE8401	(0.00327	+- 0.00005)	RE8401	
90-TH-229	136.990	+- 0.004	RE8401	(0.01171	+- 0.00016)	RE8401	
90-TH-229	142.96	+- 0.01	RE8401	(0.00401	+- 0.00006)	RE8401	
90-TH-229	148.0	+- 0.2	RE8401	(0.01091	+- 0.00015)	RE8401	D
90-TH-229	156.41	+- 0.01	RE8401	(0.01237	+- 0.00018)	RE8401	
90-TH-229	179.76	+- 0.01	RE8401	(0.00215	+- 0.00004)	RE8401	
90-TH-229	193.509	+- 0.004	RE8401	(0.0441	+- 0.0006)	RE8401	
90-TH-229	204.69	+- 0.01	RE8401	(0.00595	+- 0.00009)	RE8401	
90-TH-229	210.8	+- 0.1	RE8401	(0.0318	+- 0.0004)	RE8401	D
90-TH-230	67.672	+- 0.002	EL8301	(0.00376	+- 0.00043)	EL8301	
90-TH-230	143.872	+- 0.004	EL8301	(0.000486	+- 0.000051)	EL8301	
90-TH-230	186.053	+- 0.004	EL8301	(0.000088	+- 0.000009)	EL8301	
90-TH-230	253.729	+- 0.010	EL8301	(0.000111	+- 0.000012)	EL8301	
90-TH-231	25.64	+- 0.02	SC8301	(0.146	+- 0.003)	VA8401	
90-TH-231	58.570	+- 0.003	SC8301	(0.0050	+- 0.0005)	VA8401	
90-TH-231	72.751	+- 0.003	SC8301	(0.0026	+- 0.0002)	VA8401	
90-TH-231	81.228	+- 0.003	SC8301	(0.0085	+- 0.0003)	VA8401	
90-TH-231	82.087	+- 0.003	SC8301	(0.0037	+- 0.0002)	VA8401	
90-TH-231	84.214	+- 0.003	SC8301	(0.0671	+- 0.0010)	VA8401	
90-TH-231	102.270	+- 0.003	SC8301	(0.0040	+- 0.0002)	VA8401	
90-TH-231	124.914	+- 0.017	SC8301	(0.00060	+- 0.00003)	VA8401	
90-TH-231	134.03	+- 0.02	SC8301	(0.00025	+- 0.00005)	VA8401	
90-TH-231	135.664	+- 0.011	SC8301	(0.00084	+- 0.00007)	VA8401	
90-TH-231	217.94	+- 0.03	SC8301	(0.00037	+- 0.00001)	VA8401	
90-TH-232	59.	+- 1.	SC8201	0.0019		SC8201	
90-TH-232	126.	+- 5.	SC8201	0.00043		SC8201	
90-TH-233	29.36	+- 0.04	EL7802	0.025		EL7802	
90-TH-233	86.50	+- 0.05	EL7802	0.027		EL7802	
90-TH-233	88.0	+- 0.2	EL7802	0.003		EL7802	
90-TH-233	94.68	+- 0.05	EL7802	0.008		EL7802	
90-TH-233	162.5	+- 0.1	EL7802	0.0032		EL7802	
90-TH-233	169.1	+- 0.2	EL7802	0.0034		EL7802	
90-TH-233	170.7	+- 0.3	EL7802	0.0013		EL7802	
90-TH-233	190.54	+- 0.08	EL7802	0.0013		EL7802	
90-TH-233	194.90	+- 0.05	EL7802	0.0016		EL7802	
90-TH-233	359.9	+- 0.2	EL7802	0.0012		EL7802	
90-TH-233	441.0	+- 0.3	EL7802	0.0023		EL7802	
90-TH-233	447.7	+- 0.3	EL7802	0.0015		EL7802	
90-TH-233	459.2	+- 0.2	EL7802	0.014		EL7802	
90-TH-233	490.8	+- 0.3	EL7802	0.0017		EL7802	
90-TH-233	499.0	+- 0.3	EL7802	0.0021		EL7802	
90-TH-233	595.2	+- 0.2	EL7802	0.0016		EL7802	
90-TH-233	669.8	+- 0.2	EL7802	0.0068		EL7802	
90-TH-233	764.4	+- 0.4	EL7802	0.0012		EL7802	
90-TH-233	890.1	+- 0.5	EL7802	0.0014		EL7802	

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILTIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (PHOTONS/DECAY) DATA	UNCERTAINTY		REFERENCE	COMMENT
90-TH-234	63.29	+- 0.02	EL8302	(0.0447	+- 0.0088	)	EL8302	
90-TH-234	83.30	+- 0.05	EL8302	(0.00073	+- 0.00015	)	EL8302	
90-TH-234	92.38	+- 0.01	EL8302	(0.0260	+- 0.0053	)	EL8302	
90-TH-234	92.80	+- 0.02	EL8302	(0.0256	+- 0.0052	)	EL8302	
90-TH-234	112.81	+- 0.05	EL8302	(0.00256	+- 0.00054	)	EL8302	
91-PA-231	16.39	+- 0.02	NI8401	(0.0022	+- 0.0001	)	NI8401	
91-PA-231	18.95	+- 0.02	NI8401	(0.00354	+- 0.00007	)	NI8401	
91-PA-231	25.44	+- 0.06	NI8401	(0.00095	+- 0.00003	)	NI8401	
91-PA-231	27.360	+- 0.020	NI8401	(0.111	+- 0.004	)	NI8401	
91-PA-231	29.950	+- 0.020	NI8401	(0.00095	+- 0.00006	)	NI8401	
91-PA-231	35.9	+- 0.1	NI8401	(0.00016	+- 0.00002	)	NI8401	
91-PA-231	38.20	+- 0.03	NI8401	(0.00143	+- 0.00009	)	NI8401	
91-PA-231	44.17	+- 0.04	NI8401	(0.00056	+- 0.00007	)	NI8401	
91-PA-231	46.370	+- 0.020	NI8401	(0.00223	+- 0.00006	)	NI8401	
91-PA-231	52.71	+- 0.07	NI8401	(0.00090	+- 0.00011	)	NI8401	
91-PA-231	54.59	+- 0.03	NI8401	(0.00077	+- 0.00006	)	NI8401	
91-PA-231	57.19	+- 0.03	NI8401	(0.00040	+- 0.00003	)	NI8401	
91-PA-231	63.64	+- 0.05	NI8401	(0.00046	+- 0.00003	)	NI8401	
91-PA-231	74.14	+- 0.03	NI8401	(0.00022	+- 0.00001	)	NI8401	
91-PA-231	77.4	+- 0.1	NI8401	(0.00057	+- 0.00004	)	NI8401	
91-PA-231	96.88	+- 0.05	NI8401	(0.00082	+- 0.00003	)	NI8401	
91-PA-231	100.9	+- 0.1	NI8401	(0.00023	+- 0.00002	)	NI8401	
91-PA-231	102.8	+- 0.1	NI8401	(0.00015	+- 0.00004	)	NI8401	
91-PA-231	144.5	+- 0.1	NI8401	(0.00011	+- 0.00001	)	NI8401	
91-PA-231	242.8	+- 0.2	NI8401	(0.00011	+- 0.00002	)	NI8401	
91-PA-231	243.2	+- 0.1	NI8401	(0.00032	+- 0.00002	)	NI8401	
91-PA-231	255.90	+- 0.04	NI8401	(0.00107	+- 0.00003	)	NI8401	
91-PA-231	260.3	+- 0.1	NI8401	(0.00182	+- 0.00005	)	NI8401	
91-PA-231	273.237	+- 0.117	NI8401	(0.00059	+- 0.00002	)	NI8401	
91-PA-231	277.322	+- 0.013	NI8401	(0.00069	+- 0.00002	)	NI8401	
91-PA-231	283.690	+- 0.013	NI8401	(0.0165	+- 0.0004	)	NI8401	
91-PA-231	300.069	+- 0.008	NI8401	(0.0241	+- 0.0006	)	NI8401	
91-PA-231	302.669	+- 0.006	NI8401	(0.0247	+- 0.0006	)	NI8401	
91-PA-231	313.0	+- 0.1	NI8401	(0.00099	+- 0.00002	)	NI8401	
91-PA-231	327.130	+- 0.188	NI8401	(0.00035	+- 0.00001	)	NI8401	
91-PA-231	330.057	+- 0.015	NI8401	(0.0136	+- 0.0003	)	NI8401	
91-PA-231	340.77	+- 0.07	NI8401	(0.00178	+- 0.00004	)	NI8401	
91-PA-231	354.474	+- 0.075	NI8401	(0.00097	+- 0.00003	)	NI8401	
91-PA-231	357.16	+- 0.07	NI8401	(0.00169	+- 0.00005	)	NI8401	
91-PA-231	379.34	+- 0.08	NI8401	(0.00050	+- 0.00001	)	NI8401	
91-PA-231	407.829	+- 0.028	NI8401	(0.00036	+- 0.00001	)	NI8401	
91-PA-233	28.54	+- 0.05	EL7802	(0.0015	+- 0.0001	)	RE8401	
91-PA-233	75.28	+- 0.01	EL7802	(0.0132	+- 0.0004	)	RE8401	
91-PA-233	86.59	+- 0.01	EL7802	(0.0197	+- 0.0012	)	RE8401	
91-PA-233	103.86	+- 0.02	EL7802	(0.0087	+- 0.0003	)	RE8401	
91-PA-233	248.5	+- 0.5	EL7802	(0.00059	+- 0.00002	)	RE8401	
91-PA-233	271.48	+- 0.08	EL7802	(0.0032	+- 0.0001	)	RE8401	
91-PA-233	300.12	+- 0.03	EL7802	(0.0663	+- 0.0006	)	RE8401	
91-PA-233	311.98	+- 0.03	EL7802	(0.3863	+- 0.0039	)	RE8401	
91-PA-233	340.50	+- 0.04	EL7802	(0.0450	+- 0.0005	)	RE8401	
91-PA-233	375.45	+- 0.04	EL7802	(0.0068	+- 0.0001	)	RE8401	
91-PA-233	398.62	+- 0.08	EL7802	(0.0141	+- 0.0002	)	RE8401	
91-PA-233	415.76	+- 0.04	EL7802	(0.0174	+- 0.0002	)	RE8401	
92-U -232	57.78	+- 0.05	SC8201	(20.0	+- 0.2	)E-4	CO8402	
92-U -232	129.08	+- 0.05	SC8201	(6.82	+- 0.04	)E-4	CO8402	
92-U -232	270.2	+- 0.2	SC8201	(0.316	+- 0.005	)E-4	CO8402	
92-U -232	327.9	+- 0.2	SC8201	(0.283	+- 0.006	)E-4	CO8402	
92-U -233	54.699	+- 0.001	RE8401	(18.2	+- 0.3	)E-5	RE8401	
92-U -233	118.968	+- 0.002	RE8401	(4.06	+- 0.04	)E-5	RE8401	
92-U -233	120.816	+- 0.001	RE8401	(3.32	+- 0.03	)E-5	RE8401	
92-U -233	135.3		RE8401	(2.32	+- 0.02	)E-5	RE8401	
92-U -233	146.345	+- 0.002	RE8401	(6.57	+- 0.06	)E-5	RE8401	
92-U -233	164.522	+- 0.002	RE8401	(6.23	+- 0.05	)E-5	RE8401	
92-U -233	208.171	+- 0.002	RE8401	(2.29	+- 0.03	)E-5	RE8401	
92-U -233	245.345	+- 0.002	RE8401	(3.62	+- 0.03	)E-5	RE8401	
92-U -233	291.354	+- 0.004	RE8401	(5.37	+- 0.05	)E-5	RE8401	
92-U -233	317.2		RE8401	(7.76	+- 0.07	)E-5	RE8401	
92-U -233	320.541	+- 0.005	RE8401	(2.90	+- 0.03	)E-5	RE8401	
92-U -234	53.20	+- 0.02	NI8401	(123.	+- 2.	)E-5	NI8401	
92-U -234	120.90	+- 0.02	NI8401	(34.2	+- 0.5	)E-5	NI8401	
92-U -234	454.95	+- 0.05	NI8401	(0.025	+- 0.005	)E-5	NI8401	
92-U -234	508.20	+- 0.10	NI8401	(0.015	+- 0.005	)E-5	NI8401	
92-U -234	581.7	+- 0.2	NI8401	(0.012	+- 0.005	)E-5	NI8401	
92-U -235	41.96	+- 0.15	SC8301	(0.0006	+- 0.0001	)	VA8401	
92-U -235	74.8	+- 0.2	SC8301	(0.0006	+- 0.0001	)	VA8401	
92-U -235	109.16	+- 0.02	SC8301	(0.0154	+- 0.0005	)	VA8401	
92-U -235	140.76	+- 0.04	SC8301	(0.0022	+- 0.0002	)	VA8401	
92-U -235	143.76	+- 0.02	SC8301	(0.1096	+- 0.0008	)	VA8401	
92-U -235	150.93	+- 0.02	SC8301	(0.0008	+- 0.0001	)	VA8401	
92-U -235	163.33	+- 0.02	SC8301	(0.0508	+- 0.0004	)	VA8401	
92-U -235	182.61	+- 0.05	SC8301	(0.0034	+- 0.0002	)	VA8401	
92-U -235	185.715	+- 0.005	SC8301	(0.572	+- 0.005	)	VA8401	
92-U -235	194.94	+- 0.01	SC8301	(0.0063	+- 0.0001	)	VA8401	
92-U -235	198.90	+- 0.02	SC8301	(0.00042	+- 0.00006	)	VA8401	
92-U -235	202.11	+- 0.02	SC8301	(0.0108	+- 0.0002	)	VA8401	
92-U -235	205.311	+- 0.010	SC8301	(0.0501	+- 0.0005	)	VA8401	
92-U -235	221.38	+- 0.02	SC8301	(0.0012	+- 0.0001	)	VA8401	
92-U -235	233.50	+- 0.03	SC8301	(0.00029	+- 0.00005	)	VA8401	
92-U -235	240.85	+- 0.08	SC8301	(0.00075	+- 0.00006	)	VA8401	
92-U -235	246.84	+- 0.04	SC8301	(0.00053	+- 0.00003	)	VA8401	
92-U -236	49.369	+- 0.009	SC8201	(0.00078	+- 0.00008	)	SC8201	
92-U -236	112.750	+- 0.015	SC8201	(0.00019	+- 0.00005	)	SC8201	

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILTIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (PHOTONS/DECAY) DATA	UNCERTAINTY	REFERENCE	COMMENT
92-U -237	26.348	+- 0.010	EL7803	(0.0224	+- 0.0033)	EL7803	
92-U -237	33.195	+- 0.011	EL7803	(0.00112	+- 0.00048)	EL7803	
92-U -237	51.01	+- 0.03	EL7803	(0.0020	+- 0.0009)	EL7803	
92-U -237	59.543	+- 0.015	EL7803	(0.345	+- 0.008)	LA8401	
92-U -237	64.83	+- 0.02	EL7803	(0.0131	+- 0.0003)	LA8401	
92-U -237	164.61	+- 0.02	EL7803	(0.0187	+- 0.0005)	LA8401	
92-U -237	208.005	+- 0.023	EL7803	(0.216	+- 0.005)	LA8401	
92-U -237	221.80	+- 0.04	EL7803	(0.000205	+- 0.000008)	LA8401	
92-U -237	234.40	+- 0.04	EL7803	(0.000205	+- 0.000008)	LA8401	
92-U -237	267.54	+- 0.04	EL7803	(0.00730	+- 0.00018)	LA8401	
92-U -237	332.36	+- 0.04	EL7803	(0.0121	+- 0.0003)	LA8401	
92-U -237	335.38	+- 0.04	EL7803	(0.00097	+- 0.00003)	LA8401	
92-U -237	368.59	+- 0.04	EL7803	(0.00042	+- 0.00002)	LA8401	
92-U -237	370.94	+- 0.04	EL7803	(0.00110	+- 0.00004)	LA8401	
92-U -238	49.55	+- 0.06	SH8301	(0.00064	+- 0.00008)	RO8401	
92-U -239	31.131	+- 0.002	NI8401	(0.00068	+- 0.00010)	NI8401	
92-U -239	43.533	+- 0.001	NI8401	(0.0416	+- 0.0011)	NI8401	
92-U -239	74.664	+- 0.001	NI8401	(0.481	+- 0.010)	NI8401	
92-U -239	86.72	+- 0.07	NI8401	(0.00052	+- 0.00006)	NI8401	
92-U -239	117.7	+- 0.1	NI8401	(0.0013	+- 0.0004)	NI8401	
93-NP-236	100.		SC8201	(0.005	+- 0.001)	SC8201	
93-NP-236	104.		SC8201	(0.075	+- 0.002)	SC8201	
93-NP-236	160.2	+- 0.6	SC8201	(0.276	+- 0.006)	SC8201	
93-NP-236M1	44.6	+- 0.1	SC8201	(0.000110	+- 0.000002)	SC8201	
93-NP-236M1	538.09	+- 0.15	SC8201	(0.00011	+- 0.00001)	SC8201	
93-NP-236M1	642.33	+- 0.09	SC8201	(0.0092	+- 0.0006)	SC8201	
93-NP-236M1	687.61	+- 0.10	SC8201	(0.0025	+- 0.0002)	SC8201	
93-NP-237	29.373	+- 0.010	EL7803	(0.153	+- 0.003)	RE8401	
93-NP-237	46.53	+- 0.04	EL7803	(0.00106	+- 0.00006)	RE8401	
93-NP-237	57.15	+- 0.04	EL7803	(0.00382	+- 0.00011)	RE8401	
93-NP-237	86.503	+- 0.020	EL7803	(0.123	+- 0.002)	RE8401	
93-NP-237	88.04	+- 0.16	EL7803	(0.00138	+- 0.00003)	RE8401	
93-NP-237	117.681	+- 0.030	EL7803	(0.00173	+- 0.00003)	RE8401	
93-NP-237	131.04		RE8401	(0.00086	+- 0.00002)	RE8401	
93-NP-237	134.23		RE8401	(0.00071	+- 0.00002)	RE8401	
93-NP-237	143.208	+- 0.025	EL7803	(0.00432	+- 0.00008)	RE8401	
93-NP-237	151.37	+- 0.04	EL7803	(0.00234	+- 0.00004)	RE8401	
93-NP-237	155.22		RE8401	(0.00092	+- 0.00002)	RE8401	
93-NP-237	169.17		RE8401	(0.00071	+- 0.00001)	RE8401	
93-NP-237	195.096	+- 0.020	EL7803	(0.00185	+- 0.00002)	RE8401	
93-NP-237	212.415	+- 0.025	EL7803	(0.00151	+- 0.00002)	RE8401	
93-NP-237	238.0		RE8401	(0.00059	+- 0.00001)	RE8401	
93-NP-238	101.9	+- 0.03	SH8301	(0.0027	+- 0.0001)	SH8301	
93-NP-238	119.9	+- 0.1	SH8301	(0.00108	+- 0.00006)	SH8301	
93-NP-238	174.0	+- 0.2	SH8301	(0.00026	+- 0.00001)	SH8301	
93-NP-238	357.62	+- 0.07	SH8301	(0.00053	+- 0.00003)	SH8301	
93-NP-238	515.5	+- 0.2	SH8301	(0.00043	+- 0.00002)	SH8301	
93-NP-238	561.11	+- 0.07	SH8301	(0.00114	+- 0.00002)	SH8301	
93-NP-238	605.13	+- 0.09	SH8301	(0.00081	+- 0.00004)	SH8301	
93-NP-238	617.36	+- 0.11	SH8301	(0.00065	+- 0.00004)	SH8301	
93-NP-238	882.63	+- 0.03	SH8301	(0.0087	+- 0.0003)	SH8301	
93-NP-238	918.69	+- 0.04	SH8301	(0.0059	+- 0.0002)	SH8301	
93-NP-238	923.98	+- 0.02	SH8301	(0.0286	+- 0.0009)	SH8301	
93-NP-238	936.61	+- 0.06	SH8301	(0.0040	+- 0.0001)	SH8301	
93-NP-238	938.95	+- 0.10	SH8301	(0.00026	+- 0.00003)	SH8301	
93-NP-238	941.38	+- 0.05	SH8301	(0.0054	+- 0.0002)	SH8301	
93-NP-238	962.77	+- 0.03	SH8301	(0.0070	+- 0.0002)	SH8301	
93-NP-238	984.45	+- 0.02	SH8301	(0.278	+- 0.008)	SH8301	
93-NP-238	1025.87	+- 0.02	SH8301	(0.096	+- 0.005)	SH8301	
93-NP-238	1028.54	+- 0.02	SH8301	(0.203	+- 0.008)	SH8301	
93-NP-239	61.460	+- 0.002	SC8301	(0.0129	+- 0.0002)	VA8401	
93-NP-239	106.123	+- 0.002	SC8301	(0.272	+- 0.004)	VA8401	
93-NP-239	181.71	+- 0.06	SC8301	(0.00081	+- 0.00004)	VA8401	
93-NP-239	209.753	+- 0.002	SC8301	(0.0342	+- 0.0005)	VA8401	
93-NP-239	226.42	+- 0.08	SC8301	(0.0028	+- 0.0002)	VA8401	
93-NP-239	228.183	+- 0.001	SC8301	(0.1127	+- 0.0018)	VA8401	
93-NP-239	254.41	+- 0.08	SC8301	(0.0011	+- 0.0001)	VA8401	
93-NP-239	272.84	+- 0.07	SC8301	(0.00077	+- 0.00004)	VA8401	
93-NP-239	277.599	+- 0.001	SC8301	(0.1438	+- 0.0021)	VA8401	
93-NP-239	285.460	+- 0.002	SC8301	(0.0079	+- 0.0002)	VA8401	
93-NP-239	315.880	+- 0.003	SC8301	(0.0160	+- 0.0003)	VA8401	
93-NP-239	334.310	+- 0.002	SC8301	(0.0207	+- 0.0003)	VA8401	
94-PU-236	47.6		SC8201	(0.00069	+- 0.00021)	SC8201	
94-PU-236	109.0		SC8201	(0.00012	+- 0.00004)	SC8201	
94-PU-236	165.		SC8201	(0.0000066	+- 0.0000020)	SC8201	
94-PU-236	515.6		SC8201	(0.0000017	+- 0.0000005)	SC8201	
94-PU-236	563.2		SC8201	(0.0000010	+- 0.0000003)	SC8201	
94-PU-236	645.		SC8201	(0.0000024	+- 0.0000008)	SC8201	

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILITIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (PHOTONS/DECAY) DATA	UNCERTAINTY		REFERENCE	COMMENT
94-PU-237	59.5		EL7803	(0.0325	+- 0.0022	)	EL7803	
94-PU-237	198.61	+- 0.20	EL7904	(0.67	+- 0.12	)E-6	EL7904	
94-PU-237	205.05	+- 0.20	EL7904	(0.29	+- 0.05	)E-6	EL7904	
94-PU-237	228.56	+- 0.20	EL7904	(3.31	+- 0.57	)E-6	EL7904	
94-PU-237	258.46	+- 0.20	EL7904	(1.47	+- 0.25	)E-6	EL7904	
94-PU-237	261.66	+- 0.20	EL7904	(1.66	+- 0.29	)E-6	EL7904	
94-PU-237	280.40	+- 0.20	EL7904	(9.2	+- 1.6	)E-6	EL7904	
94-PU-237	296.89	+- 0.20	EL7904	(6.6	+- 1.1	)E-6	EL7904	
94-PU-237	305.4	+- 0.2	EL7904	(0.27	+- 0.05	)E-6	EL7904	
94-PU-237	313.34	+- 0.20	EL7904	(2.55	+- 0.44	)E-6	EL7904	
94-PU-237	320.75	+- 0.20	EL7904	(5.46	+- 0.95	)E-6	EL7904	
94-PU-237	411.1	+- 0.2	EL7904	(0.16	+- 0.03	)E-6	EL7904	
94-PU-237	463.1	+- 0.2	EL7904	(0.31	+- 0.05	)E-6	EL7904	
94-PU-237	503.9	+- 0.2	EL7904	(0.63	+- 0.11	)E-6	EL7904	
94-PU-238	43.498	+- 0.001	LA8401	(395.	+- 8.	)E-6	LA8401	
94-PU-238	99.853	+- 0.003	LA8401	(73.5	+- 0.8	)E-6	LA8401	
94-PU-238	152.720	+- 0.002	LA8401	(9.37	+- 0.10	)E-6	LA8401	
94-PU-239	38.660	+- 0.002	HE8201	(105.	+- 2.	)E-6	OK8401	
94-PU-239	40.41	+- 0.05	SC8301	(1.62	+- 0.17	)E-6	OK8401	
94-PU-239	42.06	+- 0.03	SC8301	(1.65	+- 0.06	)E-6	OK8401	
94-PU-239	46.218	+- 0.010	HE8201	(7.37	+- 0.75	)E-6	OK8401	
94-PU-239	46.69		SC8301	(0.58	+- 0.04	)E-6	OK8401	
94-PU-239	51.624	+- 0.001	HE8201	(271.	+- 5.	)E-6	OK8401	
94-PU-239	56.825	+- 0.003	HE8201	(11.30	+- 0.25	)E-6	OK8401	
94-PU-239	123.62	+- 0.05	SC8301	(0.197	+- 0.021	)E-6	OK8401	
94-PU-239	124.51	+- 0.03	SC8301	(0.613	+- 0.022	)E-6	OK8401	
94-PU-239	125.21	+- 0.10	SC8301	(0.711	+- 0.020	)E-6	OK8401	
94-PU-239	129.296	+- 0.001	HE8201	(63.1	+- 0.6	)E-6	OK8401	
94-PU-239	141.657	+- 0.020	SC8301	(0.320	+- 0.009	)E-6	OK8401	
94-PU-239	144.201	+- 0.003	HE8201	(3.035	+- 0.037	)E-6	OK8401	
94-PU-239	146.094	+- 0.006	SC8301	(1.190	+- 0.025	)E-6	OK8401	
94-PU-239	161.482	+- 0.021	HE8201	(1.23	+- 0.02	)E-6	OK8401	
94-PU-239	171.393	+- 0.006	HE8201	(1.10	+- 0.02	)E-6	OK8401	
94-PU-239	179.220	+- 0.012	HE8201	(0.66	+- 0.01	)E-6	OK8401	
94-PU-239	188.23	+- 0.10	SC8301	(0.109	+- 0.011	)E-6	OK8401	
94-PU-239	189.360	+- 0.010	HE8201	(0.83	+- 0.01	)E-6	OK8401	
94-PU-239	195.679	+- 0.008	HE8201	(1.07	+- 0.01	)E-6	OK8401	
94-PU-239	203.550	+- 0.005	HE8201	(5.69	+- 0.03	)E-6	OK8401	
94-PU-239	255.384	+- 0.015	HE8201	(0.80	+- 0.01	)E-6	OK8401	
94-PU-239	297.46	+- 0.03	HE8201	(0.498	+- 0.008	)E-6	OK8401	
94-PU-239	311.78	+- 0.04	HE8201	(0.258	+- 0.007	)E-6	OK8401	
94-PU-239	332.845	+- 0.005	HE8201	(4.94	+- 0.03	)E-6	OK8401	
94-PU-239	341.502	+- 0.019	HE8201	(0.662	+- 0.014	)E-6	OK8401	
94-PU-239	345.013	+- 0.004	HE8201	(5.56	+- 0.05	)E-6	OK8401	
94-PU-239	375.054	+- 0.003	HE8201	(15.54	+- 0.09	)E-6	OK8401	
94-PU-239	380.191	+- 0.006	HE8201	(3.05	+- 0.06	)E-6	OK8401	
94-PU-239	382.698	+- 0.016	HE8201	(2.59	+- 0.05	)E-6	OK8401	
94-PU-239	392.914	+- 0.014	HE8201	(5.53	+- 0.12	)E-6	OK8401	
94-PU-239	413.713	+- 0.005	HE8201	(14.66	+- 0.11	)E-6	OK8401	
94-PU-239	422.598	+- 0.019	HE8201	(1.22	+- 0.02	)E-6	OK8401	
94-PU-239	445.81	+- 0.10	HE8201	(0.088	+- 0.006	)E-6	OK8401	
94-PU-239	451.481	+- 0.010	HE8201	(1.894	+- 0.016	)E-6	OK8401	
94-PU-239	481.78	+- 0.12	HE8201	(0.046	+- 0.002	)E-6	OK8401	
94-PU-239	639.99	+- 0.10	HE8201	(0.087	+- 0.002	)E-6	OK8401	
94-PU-239	645.98	+- 0.03	HE8201	(0.152	+- 0.003	)E-6	OK8401	
94-PU-239	651.79	+- 0.10	HE8201	(0.066	+- 0.002	)E-6	OK8401	
94-PU-239	658.63	+- 0.15	HE8201	(0.097	+- 0.002	)E-6	OK8401	
94-PU-239	718.0	+- 0.5	HE8201	(0.028	+- 0.002	)E-6	OK8401	
94-PU-239	769.19	+- 0.04	DE8001	(0.119	+- 0.002	)E-6	OK8401	
94-PU-240	45.242	+- 0.003	SH8401	(447.	+- 7.	)E-6	CO8401	
94-PU-240	104.235	+- 0.005	SH8401	(71.4	+- 0.6	)E-6	CO8401	
94-PU-240	160.307	+- 0.003	SH8401	(4.02	+- 0.04	)E-6	CO8401	
94-PU-241	77.10	+- 0.10	EL8501	(0.207	+- 0.004	)E-6	LA8401	
94-PU-241	103.680	+- 0.005	EL8501	(1.02	+- 0.02	)E-6	LA8401	
94-PU-241	148.567	+- 0.010	EL8501	(1.859	+- 0.016	)E-6	LA8401	
94-PU-241	159.955	+- 0.020	EL8501	(0.0658	+- 0.0009	)E-6	LA8401	
94-PU-242	44.915	+- 0.013	SH8501	(3.73	+- 0.07	)E-4	VA8401	
94-PU-242	103.50	+- 0.04	SH8501	(2.55	+- 0.10	)E-5	VA8401	
94-PU-242	158.80	+- 0.08	SH8501	(3.0	+- 0.2	)E-6	VA8401	
94-PU-243	41.8	+- 0.2	EL8101	(0.0076	+- 0.0009	)	EL8101	
94-PU-243	42.2	+- 0.5	EL8101	(0.00076	+- 0.00007	)	EL8101	
94-PU-243	87.	+- 1.	EL8101	(0.0023	+- 0.0012	)	EL8101	
94-PU-243	84.0	+- 0.2	EL8101	(0.23	+- 0.02	)	EL8101	
94-PU-243	109.3	+- 0.2	EL8101	(0.00161	+- 0.00021	)	EL8101	
94-PU-243	322.2	+- 0.3	EL8101	(0.00028	+- 0.00003	)	EL8101	
94-PU-243	356.4	+- 0.3	EL8101	(0.00131	+- 0.00016	)	EL8101	
94-PU-243	381.7	+- 0.3	EL8101	(0.00552	+- 0.00066	)	EL8101	

RECOMMENDED GAMMA RAY ENERGIES AND EMISSION PROBABILTIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (PHOTONS/DECAY) DATA	UNCERTAINTY	REFERENCE	COMMENT
95-AM-241	26.345	+- 0.001	EL8501	(0.024	+- 0.001)	BA8401	
95-AM-241	33.205	+- 0.010	EL8501	(0.0012	+- 0.0001)	BA8401	
95-AM-241	43.423	+- 0.010	EL8501	(0.00071	+- 0.00010)	BA8401	
95-AM-241	59.537	+- 0.001	EL8501	(0.359	+- 0.004)	BA8401	
95-AM-241	98.97	+- 0.02	EL8501	(0.00020	+- 0.00001)	BA8401	
95-AM-241	102.98	+- 0.02	EL8501	(0.000196	+- 0.000010)	BA8401	
95-AM-241	123.01	+- 0.02	EL8501	(10.	+- 1.)E-6	BA8401	
95-AM-241	125.30	+- 0.02	EL8501	(41.	+- 1.)E-6	BA8401	
95-AM-241	146.55	+- 0.03	EL8501	(4.6	+- 0.2)E-6	BA8401	
95-AM-241	164.69	+- 0.04	EL8501	(0.72	+- 0.15)E-6	BA8401	
95-AM-241	169.56	+- 0.03	EL8501	(1.72	+- 0.15)E-6	BA8401	
95-AM-241	208.01	+- 0.03	EL8501	(7.9	+- 0.2)E-6	BA8401	
95-AM-241	322.52	+- 0.03	EL8501	(1.5	+- 0.1)E-6	BA8401	
95-AM-241	332.35	+- 0.03	EL8501	(1.5	+- 0.1)E-6	BA8401	
95-AM-241	335.37	+- 0.03	EL8501	(4.95	+- 0.10)E-6	BA8401	
95-AM-241	368.65	+- 0.03	EL8501	(2.2	+- 0.2)E-6	BA8401	
95-AM-241	662.40	+- 0.02	EL8501	(3.6	+- 0.2)E-6	BA8401	
95-AM-242	42.13	+- 0.01	SH8501	(0.456	+- 0.002)	SH8501	
95-AM-242	44.52	+- 0.02	SH8501	(0.106	+- 0.004)	SH8501	
95-AM-242M1	49.367	+- 0.004	SH8501	(0.0019	+- 0.0001)	SH8501	
95-AM-242M1	66.898	+- 0.020	SH8501	(0.00021	+- 0.00001)	SH8501	
95-AM-242M1	67.9		SH8501	(0.000073	+- 0.000002)	SH8501	
95-AM-242M1	86.68	+- 0.03	SH8501	(0.0004	+- 0.0001)	SH8501	
95-AM-242M1	92.5		SH8501	(0.00004	+- 0.00001)	SH8501	
95-AM-242M1	109.6		SH8501	(0.00024	+- 0.00001)	SH8501	
95-AM-242M1	111.1		SH8501	(0.00003	+- 0.00001)	SH8501	
95-AM-242M1	121.8		SH8501	(0.000060	+- 0.000002)	SH8501	
95-AM-242M1	135.17	+- 0.06	SH8501	(0.00011	+- 0.00001)	SH8501	
95-AM-242M1	136.1		SH8501	(0.000096	+- 0.000003)	SH8501	
95-AM-242M1	152.75	+- 0.06	SH8501	(0.000014	+- 0.000003)	SH8501	
95-AM-242M1	153.84	+- 0.06	SH8501	(0.000046	+- 0.000001)	SH8501	
95-AM-242M1	163.24	+- 0.04	SH8501	(0.00024	+- 0.00001)	SH8501	
95-AM-243	43.53	+- 0.15	EL8101	(0.0593	+- 0.0013)	VA8401	
95-AM-243	74.67	+- 0.15	EL8101	(0.682	+- 0.014)	VA8401	
95-AM-243	86.79	+- 0.15	EL8101	(0.00338	+- 0.00007)	VA8401	
95-AM-243	142.18	+- 0.15	EL8101	(0.0012	+- 0.0001)	VA8401	
95-AM-244	42.9	+- 0.1	CH8101	0.00093		CH8101	
95-AM-244	99.4	+- 0.1	CH8101	0.0483		CH8101	
95-AM-244	154.	+- 1.	CH8101	0.180		CH8101	
95-AM-244	206.	+- 4.	CH8101	0.0026		CH8101	
95-AM-244	540.	+- 2.	CH8101	0.004		CH8101	
95-AM-244	746.	+- 1.	CH8101	0.665		CH8101	
95-AM-244	900.	+- 1.	CH8101	0.275		CH8101	
96-CM-242	44.08	+- 0.03	SH8501	(0.000325	+- 0.000012)	SH8501	
96-CM-242	101.93	+- 0.04	SH8501	(0.000025	+- 0.000004)	SH8501	
96-CM-242	157.42	+- 0.05	SH8501	(0.000014	+- 0.000002)	SH8501	
96-CM-242	561.02	+- 0.10	SH8501	(0.0000015	+- 0.0000004)	SH8501	
96-CM-242	605.04	+- 0.10	SH8501	(0.0000011	+- 0.0000003)	SH8501	
96-CM-243	44.663	+- 0.005	EL8101	(0.0012	+- 0.0002)	EL8101	
96-CM-243	209.753	+- 0.002	EL8101	(0.0329	+- 0.0010)	EL8101	
96-CM-243	228.184	+- 0.002	EL8101	(0.106	+- 0.003)	EL8101	
96-CM-243	254.41	+- 0.08	EL8101	(0.0011	+- 0.0001)	EL8101	
96-CM-243	272.87	+- 0.09	EL8101	(0.0008	+- 0.0001)	EL8101	
96-CM-243	277.599	+- 0.002	EL8101	(0.140	+- 0.004)	EL8101	
96-CM-243	285.460	+- 0.002	EL8101	(0.0073	+- 0.0002)	EL8101	
96-CM-243	311.7	+- 0.2	EL8101	(0.00017	+- 0.00002)	EL8101	
96-CM-243	315.880	+- 0.003	EL8101	(0.00018	+- 0.00002)	EL8101	
96-CM-243	322.3	+- 0.2	EL8101	(0.00007	+- 0.00001)	EL8101	
96-CM-243	334.310	+- 0.003	EL8101	(0.00024	+- 0.00002)	EL8101	
96-CM-244	42.824	+- 0.008	CH8101	(0.000248	+- 0.000006)	LA8401	
96-CM-244	98.860	+- 0.013	CH8101	(0.000011	+- 0.000001)	LA8401	
96-CM-244	152.630	+- 0.020	CH8101	0.0000099		LA8401	
96-CM-245	41.95	+- 0.03	EL8501	(0.0035	+- 0.0004)	EL8501	
96-CM-245	53.74	+- 0.06	EL8501	(0.00067	+- 0.00009)	EL8501	
96-CM-245	56.81	+- 0.06	EL8501	(0.00036	+- 0.00005)	EL8501	
96-CM-245	65.36	+- 0.06	EL8501	(0.00011	+- 0.00005)	EL8501	
96-CM-245	79.25	+- 0.06	EL8501	(0.00150	+- 0.00020)	EL8501	
96-CM-245	132.99	+- 0.03	EL8501	(0.0277	+- 0.0035)	EL8501	
96-CM-245	136.06	+- 0.06	EL8501	(0.00112	+- 0.00015)	EL8501	
96-CM-245	174.94	+- 0.04	EL8501	(0.095	+- 0.007)	EL8501	
96-CM-245	189.82	+- 0.06	EL8501	(0.0019	+- 0.0003)	EL8501	
96-CM-246	44.545	+- 0.009	SC8101	0.000276		SC8101	
98-CF-250	42.852	+- 0.005	SC8101	0.00014		SC8101	
98-CF-252	43.399	+- 0.025	SC8101	(0.000148	+- 0.000009)	SC8101	
98-CF-252	100.2		SC8101	0.00013		SC8101	
98-CF-252	160.	+- 15.	SC8101	0.000019		SC8101	

RECOMMENDED ALPHA RADIATION ENERGIES AND EMISSION PROBABILITIES

RECOMMENDED ALPHA RADIATION ENERGIES AND EMISSION PROBABILITIES

NUCLIDE	ENERGY (KEV) DATA	ENERGY (KEV) UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (ALPHAS/DECAY) DATA	EMISSION PROBABILITY (ALPHAS/DECAY) UNCERTAINTY	REFERENCE	COMMENT
90-TH-228	5340.54	+- 0.15	HO7601	0.267	+- 0.002	HO7601	
90-TH-228	5423.33	+- 0.22	HO7601	0.727	+- 0.010	HO7601	
90-TH-229	4797.8	+- 1.2	TO7801	0.0127		TO7801	
90-TH-229	4814.6	+- 1.2	TO7801	0.0930	+- 0.0008	TO7801	
90-TH-229	4837.		TO7801	0.048		TO7801	
90-TH-229	4845.3	+- 1.2	TO7801	0.562	+- 0.002	TO7801	
90-TH-229	4901.0	+- 1.2	TO7801	0.1020	+- 0.0008	TO7801	
90-TH-229	4967.5	+- 1.2	TO7801	0.0597	+- 0.0006	TO7801	
90-TH-229	4978.5	+- 1.2	TO7801	0.0317	+- 0.0004	TO7801	
90-TH-229	5050.		TO7801	0.052		TO7801	
90-TH-229	5052.		TO7801	0.016		TO7801	
90-TH-230	4438.4	+- 1.6	EL8301	0.00030	+- 0.00015	EL8301	
90-TH-230	4479.8	+- 1.6	EL8301	0.0012		EL8301	
90-TH-230	4621.2	+- 1.5	EL8301	0.234	+- 0.001	EL8301	
90-TH-230	4687.7	+- 1.5	EL8301	0.763	+- 0.003	EL8301	
90-TH-232	3830.		SC8201	0.0020	+- 0.0008	SC8201	
90-TH-232	3954.	+- 8.	SC8201	0.23	+- 0.02	SC8201	
90-TH-232	4013.	+- 3.	SC8201	0.77	+- 0.02	SC8201	
91-PA-231	4506.	+- 1.	NI8401	0.000021	+- 0.000003	NI8401	
91-PA-231	4567.	+- 1.	NI8401	0.000054	+- 0.000005	NI8401	
91-PA-231	4598.	+- 1.	NI8401	0.00020	+- 0.00003	NI8401	
91-PA-231	4631.4	+- 0.8	NI8401	0.00052	+- 0.00003	NI8401	
91-PA-231	4640.7	+- 0.9	NI8401	0.00077	+- 0.00003	NI8401	
91-PA-231	4678.6	+- 0.9	NI8401	0.0161	+- 0.0007	NI8401	
91-PA-231	4710.7	+- 0.9	NI8401	0.0100	+- 0.0007	NI8401	
91-PA-231	4734.7	+- 0.8	NI8401	0.0847	+- 0.0040	NI8401	
91-PA-231	4792.4	+- 0.9	NI8401	0.0006	+- 0.0001	NI8401	
91-PA-231	4851.8	+- 0.9	NI8401	0.014	+- 0.001	NI8401	
91-PA-231	4934.4	+- 0.9	NI8401	0.030	+- 0.004	NI8401	
91-PA-231	4951.0	+- 0.9	NI8401	0.229	+- 0.005	NI8401	
91-PA-231	4976.0	+- 0.8	NI8401	0.004	+- 0.001	NI8401	
91-PA-231	4986.2	+- 0.8	NI8401	0.014	+- 0.002	NI8401	
91-PA-231	5013.5	+- 0.8	NI8401	0.254	+- 0.005	NI8401	
91-PA-231	5029.6	+- 0.8	NI8401	0.20	+- 0.02	NI8401	
91-PA-231	5032.2	+- 0.8	NI8401	0.032	+- 0.003	NI8401	
91-PA-231	5059.1	+- 0.8	NI8401	0.110	+- 0.005	NI8401	
92-U -232	5139.0	+- 2.0	SC8201	0.0030	+- 0.0002	SC8201	
92-U -232	5263.41	+- 0.09	SC8201	0.317	+- 0.004	SC8201	
92-U -232	5320.17	+- 0.14	SC8201	0.680	+- 0.004	SC8201	
92-U -233	4729.		EL7802	0.0185	+- 0.0005	RE8401	
92-U -233	4783.5	+- 1.2	EL7802	0.149	+- 0.002	RE8401	
92-U -233	4824.2	+- 1.2	EL7802	0.827	+- 0.003	RE8401	
92-U -234	4603.8	+- 0.9	NI8401	0.00199	+- 0.00002	NI8401	
92-U -234	4722.6	+- 0.9	NI8401	0.2842	+- 0.0002	NI8401	
92-U -234	4774.9	+- 0.8	NI8401	0.7137	+- 0.0002	NI8401	
92-U -235	4150.	+- 5.	SC8301	0.009	+- 0.002	SC8301	
92-U -235	4218.	+- 2.	SC8301	0.057	+- 0.006	SC8301	
92-U -235	4325.0	+- 0.9	SC8301	0.044	+- 0.005	SC8301	
92-U -235	4327.8	+- 0.9	SC8301	0.0021	+- 0.0004	SC8301	
92-U -235	4361.6	+- 0.9	SC8301	0.0024	+- 0.0007	SC8301	
92-U -235	4365.4	+- 0.9	SC8301	0.17	+- 0.02	SC8301	
92-U -235	4380.6	+- 0.9	SC8301	0.0031		SC8301	
92-U -235	4400.	+- 2.	SC8301	0.55	+- 0.03	SC8301	
92-U -235	4414.	+- 4.	SC8301	0.021	+- 0.002	SC8301	
92-U -235	4435.	+- 5.	SC8301	0.007		SC8301	
92-U -235	4502.	+- 2.	SC8301	0.017	+- 0.002	SC8301	
92-U -235	4556.	+- 2.	SC8301	0.042	+- 0.003	SC8301	
92-U -235	4599.	+- 2.	SC8301	0.050	+- 0.005	SC8301	
92-U -236	4332.	+- 8.	SC8201	0.0026	+- 0.0001	SC8201	
92-U -236	4445.	+- 5.	SC8201	0.259	+- 0.040	SC8201	
92-U -236	4494.	+- 3.	SC8201	0.738	+- 0.040	SC8201	
92-U -238	4039.	+- 5.	SH8301	0.0023	+- 0.0007	SH8301	
92-U -238	4147.	+- 5.	SH8301	0.23	+- 0.04	SH8301	
92-U -238	4196.	+- 5.	SH8301	0.77	+- 0.04	SH8301	
93-NP-237	4581.1	+- 2.0	EL7801	0.0040	+- 0.0004	EL7801	
93-NP-237	4598.7	+- 2.0	EL7801	0.0034	+- 0.0004	EL7801	
93-NP-237	4639.5	+- 2.0	EL7801	0.0618	+- 0.0012	EL7801	
93-NP-237	4664.1	+- 2.0	EL7801	0.0332	+- 0.0010	EL7801	
93-NP-237	4766.1	+- 1.5	EL7801	0.08	+- 0.03	EL7801	
93-NP-237	4771.1	+- 1.5	EL7801	0.25	+- 0.06	EL7801	
93-NP-237	4788.1	+- 1.5	EL7801	0.47	+- 0.09	EL7801	
93-NP-237	4803.4	+- 2.0	EL7801	0.0156		EL7801	
93-NP-237	4817.4	+- 2.0	EL7801	0.025	+- 0.004	EL7801	
93-NP-237	4873.1	+- 2.0	EL7801	0.026	+- 0.002	EL7801	
94-PU-236	5614.1		SC8201	0.0018		SC8201	
94-PU-236	5721.0	+- 1.0	SC8201	0.317	+- 0.009	SC8201	
94-PU-236	5767.7	+- 1.0	SC8201	0.681	+- 0.008	SC8201	
94-PU-238	5205.6	+- 0.3	SH8301	0.00003	+- 0.00001	LA8401	
94-PU-238	5357.7	+- 0.1	SH8301	0.00102	+- 0.00002	LA8401	
94-PU-238	5456.5	+- 0.4	SH8301	0.2884	+- 0.0006	LA8401	
94-PU-238	5499.21	+- 0.20	SH8301	0.7104	+- 0.0006	LA8401	

RECOMMENDED ALPHA RADIATION ENERGIES AND EMISSION PROBABILITIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (ALPHAS/DECAY) DATA	UNCERTAINTY	REFERENCE	COMMENT
94-PU-239	4829.45	+- 0.20	SC8301	0.0000371	+- 0.0000008	SC8301	
94-PU-239	4866.97	+- 0.20	SC8301	0.000010	+- 0.000001	SC8301	
94-PU-239	4870.46	+- 0.20	SC8301	0.000007	+- 0.000003	SC8301	
94-PU-239	4911.77	+- 0.20	SC8301	0.00003	+- 0.00001	SC8301	
94-PU-239	4935.08	+- 0.20	SC8301	0.000050	+- 0.000010	SC8301	
94-PU-239	4962.92	+- 0.20	SC8301	0.00006	+- 0.00003	SC8301	
94-PU-239	4988.21	+- 0.20	SC8301	0.00004	+- 0.00002	SC8301	
94-PU-239	5008.76	+- 0.20	SC8301	0.00019	+- 0.00002	SC8301	
94-PU-239	5029.59	+- 0.20	SC8301	0.00005	+- 0.00001	SC8301	
94-PU-239	5055.42	+- 0.20	SC8301	0.00030	+- 0.00004	SC8301	
94-PU-239	5078.35	+- 0.20	SC8301	0.00036	+- 0.00004	SC8301	
94-PU-239	5105.5	+- 0.8	SC8301	0.118	+- 0.002	SC8301	
94-PU-239	5143.8	+- 0.8	SC8301	0.150	+- 0.002	SC8301	
94-PU-239	5156.70	+- 0.14	SC8301	0.731	+- 0.007	SC8301	
94-PU-240	4883.6	+- 0.5	CO8401	0.0000113	+- 0.0000003	CO8401	
94-PU-240	5021.5	+- 0.5	CO8401	0.00089	+- 0.00002	CO8401	
94-PU-240	5123.68	+- 0.23	SH8401	0.270	+- 0.005	CO8401	
94-PU-240	5168.17	+- 0.15	SH8401	0.729	+- 0.005	CO8401	
94-PU-241	4784.	+- 5.	EL8501	0.05E-6	+- 0.02E-6	LA8401	
94-PU-241	4798.	+- 3.	EL8501	0.29E-6	+- 0.03E-6	LA8401	
94-PU-241	4853.4	+- 1.2	EL8501	2.92E-6	+- 0.05E-6	LA8401	
94-PU-241	4896.4	+- 1.2	EL8501	20.1E-6	+- 0.2E-6	LA8401	
94-PU-241	4972.	+- 2.	EL8501	0.31E-6	+- 0.06E-6	LA8401	
94-PU-241	4998.	+- 2.	EL8501	0.10E-6	+- 0.01E-6	LA8401	
94-PU-241	5042.	+- 2.	EL8501	0.25E-6		LA8401	
94-PU-241	5054.	+- 2.	EL8501	0.025E-6		LA8401	
94-PU-242	4598.5	+- 1.6	SH8501	0.0000086	+- 0.0000007	VA8401	
94-PU-242	4754.6	+- 1.3	SH8501	0.000307	+- 0.000014	VA8401	
94-PU-242	4858.2	+- 1.2	SH8501	0.2348	+- 0.0017	VA8401	
94-PU-242	4900.5	+- 1.2	SH8501	0.7649	+- 0.0017	VA8401	
95-AM-241	5322.	+- 1.	EL8501	0.00015	+- 0.00005	EL8501	
95-AM-241	5388.	+- 1.	EL8501	0.014	+- 0.002	EL8501	
95-AM-241	5442.90	+- 0.13	EL8501	0.128	+- 0.002	EL8501	
95-AM-241	5485.60	+- 0.12	EL8501	0.852	+- 0.008	EL8501	
95-AM-241	5512.	+- 2.	EL8501	0.0020	+- 0.0005	EL8501	
95-AM-241	5544.	+- 1.	EL8501	0.0034	+- 0.0005	EL8501	
95-AM-242M1	5064.2		SH8501	0.0000099	+- 0.0000007	SH8501	
95-AM-242M1	5082.		SH8501	0.0000014	+- 0.0000001	SH8501	
95-AM-242M1	5088.4		SH8501	0.0000086	+- 0.0000006	SH8501	
95-AM-242M1	5141.6	+- 0.5	SH8501	0.000262	+- 0.000017	SH8501	
95-AM-242M1	5206.8	+- 0.5	SH8501	0.00404	+- 0.00027	SH8501	
95-AM-242M1	5248.2		SH8501	0.0000050		SH8501	
95-AM-242M1	5250.0		SH8501	0.0000018	+- 0.0000001	SH8501	
95-AM-242M1	5273.		SH8501	0.000039	+- 0.000003	SH8501	
95-AM-242M1	5313.5		SH8501	0.000031	+- 0.000002	SH8501	
95-AM-242M1	5387.2		SH8501	0.0000527	+- 0.0000035	SH8501	
95-AM-242M1	5409.3		SH8501	0.0000468	+- 0.0000031	SH8501	
95-AM-243	4695.	+- 3.	EL8101	0.000017	+- 0.000005	EL8101	
95-AM-243	4930.	+- 3.	EL8101	0.0000018		EL8101	
95-AM-243	4946.	+- 3.	EL8101	0.0000034		EL8101	
95-AM-243	5088.	+- 3.	EL8101	0.00004		EL8101	
95-AM-243	5113.	+- 1.	EL8101	0.000054		EL8101	
95-AM-243	5181.	+- 1.	EL8101	0.011		EL8101	
95-AM-243	5233.4	+- 1.0	EL8101	0.105		EL8101	
95-AM-243	5275.3	+- 1.0	EL8101	0.879		EL8101	
95-AM-243	5321.	+- 1.	EL8101	0.0012		EL8101	
95-AM-243	5350.	+- 1.	EL8101	0.0016		EL8101	
98-CM-242	5814.	+- 2.	SH8501	0.000031	+- 0.000005	SH8501	
98-CM-242	5971.	+- 3.	SH8501	0.00035	+- 0.00002	SH8501	
98-CM-242	6089.42	+- 0.12	SH8501	0.250	+- 0.005	SH8501	
98-CM-242	6112.72	+- 0.08	SH8501	0.740	+- 0.005	SH8501	
96-CM-243	5287.	+- 3.	EL8101	0.000015		EL8101	
96-CM-243	5316.	+- 3.	EL8101	0.00001		EL8101	
96-CM-243	5323.	+- 3.	EL8101	0.00003		EL8101	
96-CM-243	5332.	+- 3.	EL8101	0.00003		EL8101	
96-CM-243	5523.	+- 3.	EL8101	0.00002		EL8101	
96-CM-243	5532.	+- 3.	EL8101	0.00006		EL8101	
96-CM-243	5537.	+- 3.	EL8101	0.00002		EL8101	
96-CM-243	5568.	+- 3.	EL8101	0.00007		EL8101	
96-CM-243	5575.	+- 3.	EL8101	0.00007		EL8101	
96-CM-243	5582.	+- 3.	EL8101	0.00009		EL8101	
96-CM-243	5587.	+- 3.	EL8101	0.0002		EL8101	
96-CM-243	5593.	+- 3.	EL8101	0.0001		EL8101	
96-CM-243	5612.	+- 3.	EL8101	0.0003		EL8101	
96-CM-243	5622.		EL8101	0.0006		EL8101	
96-CM-243	5639.	+- 3.	EL8101	0.0014		EL8101	
96-CM-243	5846.	+- 3.	EL8101	0.0003		EL8101	
96-CM-243	5682.	+- 3.	EL8101	0.002		EL8101	
96-CM-243	5886.	+- 3.	EL8101	0.016		EL8101	
96-CM-243	5742.2	+- 1.0	EL8101	0.106	+- 0.002	EL8101	
96-CM-243	5785.1	+- 1.0	EL8101	0.735	+- 0.010	EL8101	
96-CM-243	5876.	+- 3.	EL8101	0.006		EL8101	
96-CM-243	5907.	+- 3.	EL8101	0.001		EL8101	
96-CM-243	5992.2	+- 1.0	EL8101	0.065	+- 0.002	EL8101	
96-CM-243	6010.	+- 3.	EL8101	0.010		EL8101	
96-CM-243	6058.	+- 3.	EL8101	0.047		EL8101	
96-CM-243	8067.	+- 3.	EL8101	0.015		EL8101	

RECOMMENDED ALPHA RADIATION ENERGIES AND EMISSION PROBABILITIES

NUCLIDE	ENERGY (KEV) DATA	UNCERTAINTY	REFERENCE	EMISSION PROBABILITY (ALPHAS/DECAY) DATA	UNCERTAINTY	REFERENCE	COMMENT
96-CM-244	5515.5		LA8401	0.000035		LA8401	
96-CM-244	5665.7		LA8401	0.000163	+- 0.000007	LA8401	
96-CM-244	5762.84	+- 0.03	CH8101	0.2300	+- 0.0005	LA8401	
96-CM-244	5804.96	+- 0.05	CH8101	0.7698	+- 0.0005	LA8401	
96-CM-245	5234.6	+- 1.2	EL8501	0.0032		EL8501	
96-CM-245	5273.0	+- 1.2	EL8501	0.0007		EL8501	
96-CM-245	5303.8	+- 1.0	EL8501	0.050	+- 0.001	EL8501	
96-CM-245	5362.0	+- 0.7	EL8501	0.932	+- 0.005	EL8501	
96-CM-245	5436.3	+- 0.5	EL8501	0.0004	-	EL8501	
96-CM-245	5488.7	+- 0.5	EL8501	0.0083		EL8501	
96-CM-245	5529.2	+- 0.5	EL8501	0.0058		EL8501	
96-CM-246	5343.	+- 3.	SC8101	0.21	+- 0.01	SC8101	
96-CM-246	5386.	+- 3.	SC8101	0.79	+- 0.01	SC8101	
96-CM-248	4931.1	+- 0.5	SC8101	0.00070	+- 0.00011	SC8101	
96-CM-248	5034.93	+- 0.25	SC8101	0.1654	+- 0.0017	SC8101	
96-CM-248	5078.45	+- 0.25	SC8101	0.7514	+- 0.0037	SC8101	
98-CF-250	5890.0		SC8101	0.003		SC8101	
98-CF-250	5989.1	+- 0.6	SC8101	0.151	+- 0.012	SC8101	
98-CF-250	6030.8	+- 0.6	SC8101	0.845	+- 0.012	SC8101	
98-CF-252	5976.6		SC8101	0.0023	+- 0.0004	SC8101	
98-CF-252	6075.7	+- 0.5	SC8101	0.152	+- 0.003	SC8101	
98-CF-252	6118.3	+- 0.5	SC8101	0.816	+- 0.003	SC8101	

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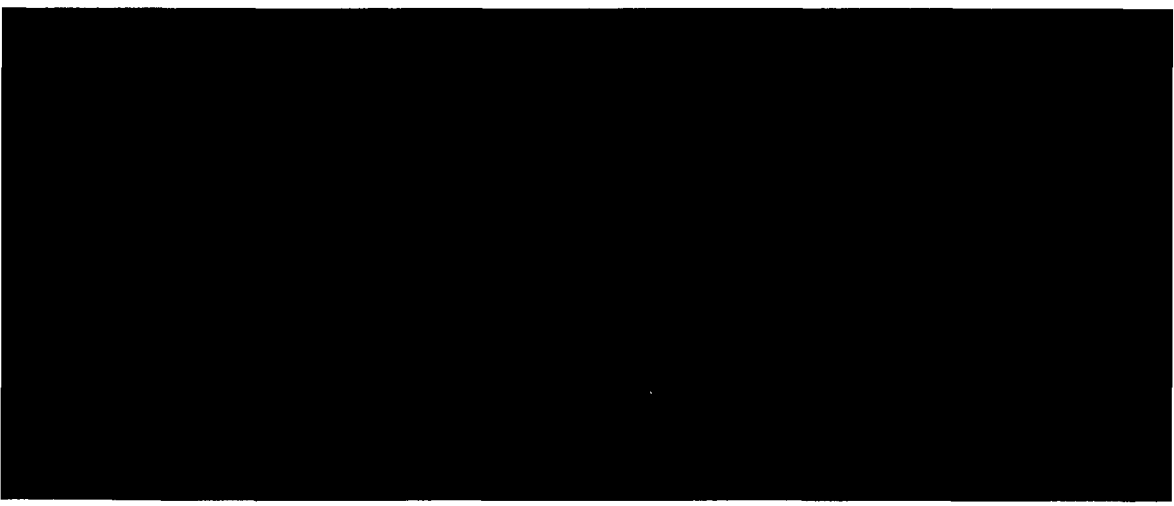

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