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INTERNATIONAL NUCLEAR DATA COMMITTEE

MEASUREMENT AND EVALUATION

OF TRANSACTINIUM ISOTOPE NUCLEAR DATA

Summary Report of the Seventh Research Coordination Meeting
on the Measurement and Evaluation
of Transactinium Isotope Nuclear Data
organized by the International Atomic Energy Agency
held at IAEA Headquarters, Vienna, 5-9 November 1984

Prepared by A. Lorenz
Nuclear Data Section
International Atomic Energy Agency

February 1985

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

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Abstract

Proceedings of the seventh meeting of the participants in the IAEA Coordinated Research Programme to measure and evaluate the required nuclear decay data of heavy element radionuclides, convened by the IAEA Nuclear Data Section on 5-9 November 1984, at IAEA Headquarters in Vienna.

The meeting participants reviewed the status of the recommended list of half-lives, and of the final measurements and evaluations in preparation for the final report of this programme.

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I. SUMMARY OF THE MEETING

Introduction

The seventh and final meeting of the participants in the IAEA Coordinated Research Programme (CRP) on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data was convened by the IAEA Nuclear Data Section on 5-9 November 1984 at IAEA Headquarters in Vienna. The meeting was chaired by A. Lorenz, IAEA Nuclear Data Section.

The participants in this meeting are listed in Appendix 1.

Objectives

This coordinated research programme aims specifically at improving the quality and accuracy of nuclear decay data required to calculate the effects of transactinium isotopes on the fuel cycle of both thermal and fast reactors, to assess their impact on nuclear waste management, to improve the accuracy of safeguard techniques, and to improve the knowledge of their nuclear characteristics required in many applications in science and industry.

The principal objectives of this meeting were to review the status of measurements and evaluations performed by the participants in this programme, and to prepare the final draft of the report of this programme.

The Adopted Agenda is given in Appendix 2.

II. Meeting Programme

1. Progress Reports

- 1.1. A.J. Fudge (UK/AERE, Harwell)
- 1.2. R. Vaninbroukx (CBNM, Geel)
- 1.3. H. Okashita (JAERI, Tokai)
- 1.4. C.W. Reich (INEL, Idaho)
- 1.5. N. Coursol (LMRI, Saclay)
- 1.6. A.L. Nichols (AERE, Winfrith)

Progress reports are available upon request from the IAEA Nuclear Data Section.

2. Related and Future Activities

The recommendations of the International Nuclear Data Committee with regard to the future and associated activities of the TND Decay Data CRP are included as Appendix 3 to this report.

3. Review of the Recommended List of Half-Lives

The list of recommended transactinium nuclides half-lives was reviewed in preparation for the publication of the final report of this CRP:

- The list was reviewed for consistency of presentation;
- for all nuclides not evaluated or measured in the framework of the CRP, it was decided to adopt published Nuclear Data Sheets half-life values for those nuclides which were mass-chain evaluated after 1977; for those evaluated before 1978 it was decided to adopt the evaluated values given in the UKHEDD-1 file (published in "Radioactive Heavy Element Decay Data for Reactor Calculations", AEEW-R 1407, by A.L. Nichols and M.F. James, 1981);
- it was also decided to adopt the latest total and spontaneous fission half-lives of the uranium, plutonium, americium and curium nuclides, evaluated in 1984 by N.E. Holden (published in BNL-NCS-35521 and BNL-NCS-35514, and presented at the IAEA Advisory Group Meeting on Nuclear Standard Reference Data", November 1984, CBNM, Geel);
- the following half-life values which resulted from evaluations performed by the CRP were also adopted:

U239	(23.47 ± 0.05)m	(A.L. Nichols)
Pu240	(6563. ± 7.) y	(R. Vaninbroukx)
Am241	(432.7 ± 0.5) y	(R. Vaninbroukx)
Cf252	(2.645 ± 0.008) y	(J.R. Smith)
Cm242	(162.94 ± 0.06) d	(H. Okashita)
Cm242(SF)	(7.05 ± 0.14).10 ⁶ y	(H. Okashita)

- as well as the following values evaluated independently:

Pb205	(1.9 ± 0.3).10 ⁷ y	(N.E. Holden) ¹
Np236	(1.15 ± 0.12).10 ⁵ y	(P. Grundl) ²

4. Review of measurements and evaluations being performed by the CRP

In preparation of the final report, the CRP participants reviewed the status of measurements and evaluations of the decay data to be included.

The data which will be included in the final report of the CRP have been subdivided into three categories:

Category 1: data measured and evaluated by the CRP

Category 2: data critically assessed and/or evaluated by the CRP

Category 3: data adopted by the CRP with a minimum or no modification.

1. N.E. Holden. Half-lives of thirty-six longlived radionuclides of interest. Published in un-numbered BNL-NCS report, dated 19 July, 1983.
2. P.C. Grundl, private communication (1984)

A list of the Category 1 and Category 2 data, and their respective measurement laboratories and evaluators, is given in Table I.

The nuclides for which data requirements have been identified at the last IAEA meeting on Transactinium Isotope Nuclear Data (Uppsala, May 1984), and their evaluation assignments with the CRP are listed in Table II.

In formulating the content of the final report, the CRP participants decided on the following guidelines to be followed in their evaluations:

1. Uncertainties of mean values:

In ascribing uncertainties to the recommended values, the group re-emphasized that:

- the total uncertainty be defined as

"1 sigma random error plus 1/3 the linear of the systematic errors based on a statistical confidence level of 68.3 percent", and that

- an uncertainty assigned on a mean value, should not be smaller than the smallest uncertainty on the values used to calculate the mean

- the total uncertainty should in no case be lower than 0.1 percent.

2. Uncertainties of gamma-ray intensities:

<u>E_γ (keV)</u>	<u>Percent uncertainty</u>
0 - 100	2
(Am241)	0.5
>120	0.3 (minimum)

3. X-ray data:

It was decided not to include X-ray data in the final report.

5. Publication of the Final Report

The final report of the CRP, summarizing all measurements and evaluations performed under its auspices, and listing transactinium isotope decay data recommended by this CRP, will be published in the form of an IAEA Technical Report during the first half of 1985. All contributions to this report should reach the Agency not later than 28 February 1985.

Table I

Category 1 Data: Measured and Evaluated by CRP

<u>Nuclide</u>	<u>Measurement</u>	<u>Evaluation</u>
Th228	INEL+CBNM (Pγ)	Vaninbroukx/Coursol (Pγ)
Th229	INEL (Pγ)	Reich (Pγ)
Pa231	Harwell (Pγ)	Nichols (Pγ)
Pa233	CBNM (Pγ)	Reich (Pγ)
U232	Harwell (T _{1/2})	Vaninbroukx/Coursol (Pγ)
U233	Harwell (Pγ)	Reich (Pγ, Pa)
U234	JAERI+CBNM (Pa), CBNM (Pγ)	Nichols (T _{1/2} , Pγ, Pa)
U235	INEL (Pγ)	Vaninbroukx (Pγ)
U237	Harwell, INEL (Pγ)	Lagoutine (Pγ)
U239	Imperial College (Pγ)	Nichols (Pγ)
Np237	CBNM+ANL (Pa), CBNM+Harwell (Pγ)	Reich (Pγ)
Np239	CBNM (Pγ)	Vaninbroukx (Pγ)
Pu237	LMRI (T _{1/2})	Lagoutine (T _{1/2})
Pu238	INEL+DBNM (Pγ), CBNM (Pa)	Lagoutine (Pγ, Pa)
Pu239	LMRI (Pa), Harwell+Imperial College + Hiroshima U. (Pγ)	Okashita (Pγ, Pa)
Pu240	LMRI+INEL (Pγ)	Coursol (Pγ, Pa)
Pu241	CBNM+Harwell (ST _{1/2}) Harwell+INEL (Pγ)	Vaninbroukx (T _{1/2}) Lagoutine (Pγ, Pa)
Pu242	CBNM (Pγ)	Vaninbroukx, (Pγ, Pa)
Am241	CBNM (Pγ)	Vaninbroukx (Pγ)
Am243	CBNM+Imperial College (Pγ)	Vaninbroukx (Pγ)
Cm242	JAERI+Harwell (T _{1/2})	Okashita (T _{1/2})
Cf252	CBNM (T _{1/2})	Reich/J.R. Smith (T _{1/2})

Category 2 Data: Evaluated by CRP

Th228	T _{1/2}	Vaninbroukx
U236	Pγ	Coursol
U239	T _{1/2}	Nichols
Pu240	T _{1/2}	Vaninbroukx
Pu241	αT _{1/2}	Vaninbroukx
Am241	T _{1/2}	Vaninbroukx/Bambynek
Am242m	T _{1/2}	Nichols
Am243	T _{1/2}	Vaninbroukx
Cm244	T _{1/2} , Pγ, Pa	LMRI

Table II

List of Nuclides for which there are decay data requirements and their evaluation assignments within the CRP

<u>Nuclide</u>	<u>T_{1/2}</u>	<u>Category</u>		<u>Evaluator</u>
		<u>P_Y</u>	<u>P_Q</u>	
Pb 214	3	-	-	(none)
Po 208	3	-	-	(none)
Th 228	2	1	-	Vaninbroukx/Coursol
Th 229	3	1	-	Reich
Th 230	3	-	-	(none)
Th 231	3	3	-	(none)
Th 232	3	3	-	(none)
Th 233	3	3	-	(none)
Pa 231	3	1	3	Nichols
Pa 233	3	1	-	Reich
U 232	3	1	3	Vaninbroukx/Coursol
U 233	3	1	1	Reich
U 234	1	1	1	Nichols
U 235	3	1	3	Vaninbroukx
U 236	3	2	3	Coursol
U 237	3	1	-	Lagoutine
U 238	3	3	3	(none)
U 239	2	1	-	Nichols
Np 236	3	3	-	(none)
Np 236m	3	3	-	(none)
Np 237	3	1	3	Reich
Np 238	3	3	-	(none)
Np 239	3	1	-	Vaninbroukx
Pu 236	3	3	3	(none)
Pu 237	1	-	-	Lagoutine
Pu 238	3	1	1	Lagoutine

<u>Nuclide</u>	<u>T_{1/2}</u>	<u>Category</u>		<u>Evaluator</u>
		<u>Pγ</u>	<u>Pα</u>	
Pu 239	3	1	1	Okashita
Pu 240	2	1	1	Vaninbroukx/Coursol
Pu 241	1	1	1	Vaninbroukx (T _{1/2}) and Lagoutine (Pγ, Pα)
Pu 242	3	1	1	Vaninbroukx
Am 241	2	1	3	Vaninbroukx/Bambynek
Am 242	3	3	-	(none)
Am 242m	2	3	-	Nichols
Am 243	2	1	3	Vaninbroukx
Cm 242	1 (+ SF)	3	-	Okashita
Cm 243	3	3	3	(none)
Cm 244	2	2	2	Lagoutine
Cm 245	3	3	3	(none)
Cm 246	3	3	3	(none)
Cm 248	3	3	3	(none)
Cf 250	3	-	-	(none)
Cf 252	1 (+ SF)	-	-	Reich/J.R. Smith

List of Participants

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Seventh Meeting of the CRP on the
Measurement and Evaluation of Transactinium
Isotope Nuclear Decay Data

IAEA, Vienna, 5-9 November 1984
Vienna International Centre Meeting Room A-27

Adopted Agenda

1. Introductory Items
2. Review of Actions from June 1983 meeting
3. Related and future activities
 - Gamma calibration standards
 - ICRM meetings
 - Periodic review of TND decay data status
 - Review of May 1984 TND meeting decay data recommendations
4. Review of half-life compilation
5. Drafting of Final Report
 - Discussion of individual evaluations

Recommendations of the International Nuclear
Data Committee (INDC) with regard to the future and
associated activities of the TND Decay Data CRP
(October 1984 INDC Meeting)

1. Gamma-ray standards for detector calibration

The Standards Subcommittee discussed the recommendation made by the TND Advisory Group Meeting at Uppsala, May 1984 (INDC/P(84)-24) to select and evaluate gamma-ray standards for detector calibration.

It was recommended that Okamoto in consultation with Deruytter arrange a discussion at the Geel Meeting with participants representing the International Committee on Radionuclide Metrology (ICRM), the IAEA CRP on Transactinium Isotope Nuclear Decay Data and the INDC Standard Subcommittee.

The possibility to charge ICRM with the task to set up a gamma-ray standard file for detector calibration should be investigated at this occasion. The Subcommittee also recommended that an option should go into the discussion at Geel to have a small meeting of experts arranged by NDS to assess the current status of the data and agree about the content of the file.

2. TND Decay Data Request List

Subcommittee A recommended that a TND-decay data request list be maintained. WRENDA is a proper vehicle, particularly if these requests are highlighted in a special section.

3. TND Decay Data Status Review

Subcommittee A recommended that the momentum of the excellent TND-decay work be maintained. It was suggested that a Specialists' Meeting toward this end be held every 2-3 years, possibly in conjunction with the regional conference now held on a 3 year cycle.