International Atomic Energy Agency

INDC(NDS)-113/G+P

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

PROGRESS

IN

FISSION PRODUCT NUCLEAR DATA

Information about activities
in the field of measurements and compilation/evaluations
of fission product nuclear data (FPND)

collected
by
G. and M. Lammer

Nuclear Data Section
International Atomic Energy Agency
Vienna, Austria

No. 6 June 1980

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

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FOREWORD

This is the sixth issue of a report series on Fission Product Nuclear Data (FPND) which is published by the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA). The purpose of this series is to inform scientists working on FPND, or using such data, about all activities in this field which are planned, ongoing, or have recently been completed.

The main part of this report consists of unaltered original contributions which the authors have sent to IAEA/NDS. Therefore, the IAEA cannot be held responsible for the information contained nor for any consequences resulting from the use of this information. The present issue contains also a section with some recent references relative to fission product nuclear data, which were not covered by the contributions submitted.

The types of activities being included in this report are measurements, compilations and evaluations of:

Fission product yields (neutron induced and spontaneous fission);
Neutron reaction cross sections of fission products;
Data related to the radioactive decay of fission products;
Delayed neutron data of fission products; and
Lumped fission product data (decay heat, absorption etc.)

The fifth issue of this series has been published in June 1979 as INDC(NDS)-102/G+P. The present issue includes contributions which were received by NDS <u>between 1 August 1979 and 25 May 1980</u>.

The next issue of this report series is envisaged to be published in June 1981.

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*) Page numbers in brackets refer to collaborations, which are not listed under "Laboratory and address".

Table of Contents (cont'd) Page

Table of Contents (cont'd) Page

SUBMITTING CONTRIBUTIONS

The next issue is expected to be published in June 1981. All scientists who are presently working - or have recently completed work - in the field of FPND and who want to contribute to the 7th issue of this series, are kindly asked to send contributions to me between now and 20 May 1981, so that they reach NDS before the end of May 1981.

Those scientists or groups who have already contributed to the present issue and who want to leave their contribution(s) unchanged or who wish to suggest only slight changes, should write an appropriate note to me before the above deadline.

Format:

The size of one contribution should preferably not exceed one page. Of course, the number of contributions per working group or laboratory is not restricted. Similar experiments (or calculations, evaluations, etc.) performed by one person or group should preferably be combined to one contribution, if this is possible without loss of clarity.

The headings suggested for the 3 types of contributions are, for

Measurements:	Compilations:	Evaluations:
Laboratory and address: Names: Facilities:	Laboratory and address: Names:	Laboratory and address: Names:
Experiment:	Compilation:	Evaluation:
Method:	purpose:	purpose:
Accuracy:	major sources of information:	method:
Completion date:	deadline of literature coverage:	major sources of information:
Discrepancies to other reported data:	cooperation:	deadline of literature coverage:
Publications:	other relevant details:	status:
	computer file:	cooperation:
	completion date:	other relevant details:
	Publications:	computer file of compiled data:
		computer file of evaluated data:
		discrepancies encountered:
		completion date:
		Publications:

For the sake of consistency it is requested that the suggested headings be used as far as appropriate.

Compilation and evaluations: If applicable, the availability of numerical data from computer files could be indicated either under the headings "Computer files..." or under a separate heading "Availability..."

Editing: It would be a great help for producing an edited report if a margin of 2 cm is left on each side of the text and a 5 cm space is left at the top of each page (or 3 cm, if the name of the country is included).

Comments or suggestions concerning the format, content and layout of this report series are most welcome and should be directed to me in time before the next issue.

I would like to thank the contributors for their cooperation.

G. and M. Lammer

SUBJECT INDEX a)

1. MEASUREMENTS

1.1. Fission yields

a) with respect to the earlier issues, underlined page numbers refer to new work, page numbers in brackets refer to unchanged contributions, and others refer to revised contributions.

1.1. Fission yields (cont'd)

fission nuclide	inc. neutron energy	further specifications	page
U-238	spontaneous	Ru isotopes (+ others?), mass-spec	68
	fast	2 spectra, direct Ge(Li) + rad.chem.	51
		PFR, chain yields, mass-spec	(53)
		EBR-II, i.d. mass-spec	(64)
	fission spec.	cumul. ≈ chain, 13FP, Ge(Li)	(11)
	0.1 - 8 MeV	rad.chem., Ge(Li), normaliz. 200%	(57)
	3 MeV	element yields: Br,Kr,Rb,Te,I,Xe,Cs	12
	15 MeV	cumul. ≈ chain, 13 FP, Ge(Li)	(11)
		fract.indep.yields, ^{148,150}Pm, rad.chem.	70
Np-237	thermal	mass yields from FP γ-spectra	5
	fast	EBR-II, i.d. mass-spec	(64)
	15 MeV	Xe-isotopes, mass-spec	80
Pu-239	thermal	20 mass chains, mass-spec	(29)
		absolute yields, Ge(Li) + Mica	31
		cumul. + indep., rad.chem. + Ge(Li)	39
		"	50
		He-3 yield	(52)
		chain yields, i.d. mass-spec	66
		49 FP=36 chains, at 1550-10^{6}sec, Ge(Li)	71
		29 FP=23 chains, at 35-1115 sec, Ge(Li)	73
		fission fragments, physical, all A	(77)
	fast	2 spectra, direct Ge(Li) + rad.chem.	51
		He-3 yield	(52)
		PFR, chain yields, mass-spec	(53)
		EBR-II, i.d. mass-spec	64
		FFTF, i.d. mass-spec	65
	fission spec.	cumul. ≈ chain, 13 FP, Ge(Li)	(11)
	15 MeV	"	(11)
		Xe-isotopes, mass-spec	80
Pu-240	fast	He-3 yield	52
		PFR, chain yields, mass-spec	(53)
		EBR-II, i.d. mass-spec	(64)
Pu-241	thermal	20 mass chains, mass-spec	(29)
		He-3 yield	52
		17 FP=16 chains, Ge(Li)	71
	fast	He-3 yield	52
		PFR, chain yields, mass-spec	(53)
		EBR-II, i.d. mass-spec	64
		FFTF, i.d. mass-spec	65
Pu-242	fast	EBR-II, i.d. mass-spec	(64)
Am-241	fast	EBR-II, i.d. mass-spec	(64)
	fission spec.	rad.chem., recoil, normaliz. 200%	(69)
	15 MeV	"	69
Am-243	fast	EBR-II, i.d. mass-spec	(64)

1.1. Fission yields (cont'd)

fission nuclide	inc. neutron energy	further specifications	page
Cm-245	thermal	fract.cum. I-135, Ba-140, Ge(Li) R-value (Mo-99), all A, Ge(Li) 95 FP=51 chains, direct Ge(Li)	30 30 74
Cf-249	thermal	indep.yields, rad.chem. + Ge(Li)	78
many*)	thermal 0.1 - 8 MeV unspecified	indep.+cumul., rad.chem. + Ge(Li) rad.chem., Ge(Li), normaliz. 200% indep.yields, on-line mass-spec	50 (57) 48

*) several fissioning nuclides which are not yet specified (generally referring to future work)

1.2. Neutron reaction cross sections

FP	reaction	incident neutron energy	page
Br-79 Br-81	res. pars.	below 10 keV below 15 keV	37
Kr Kr-80	(n,γ), total	3 - 250 keV	17
Kr-82	res. pars. (transmission) (n,γ), total	1 eV - 1.5 keV 3 - 250 keV	15 17
Kr-83	res. pars. (transmission) (n,γ), total	1 eV - 1.5 keV 3 - 250 keV	15 17
Kr-84	res. pars. (transmission) (n,γ), total	1 eV - 1.5 keV 3 - 250 keV	15 17
Kr-86	res. pars. (transmission)	1 eV - 1.5 keV	15
Sr-86 Sr-87 Sr-88	(n,γ), res. pars.	3 - 200 keV	3
Y-89	(n,γ), res. pars. (n,γ) total	3 - 200 keV 14.7 MeV 50 keV - 4.5 MeV	3 49 52
Zr	total	50 keV - 4.5 MeV	52
Zr-90 Zr-91 Zr-92 Zr-94	(n,γ), res. pars.	3 - 200 keV	3
Zr-96	(n,γ), res. pars.	0.15 - 130 keV	32

1.2. Neutron reaction cross section (cont'd)

1.2. Neutron reaction cross section (cont'd)

1.2. Neutron reaction cross sections (cont'd)

FP	reaction	incident neutron energy	page
Eu-153	(n,γ)	3 - 100 keV	37
	integral σ(n,γ)	fast (EBR-II)	61
	total, (n,γ), res. pars.	0.02 - 600 eV	79
	res. pars. (transmission)	1.7 - 31 eV	82
Eu-154	(n,γ)	thermal	55
	integral σ(n,γ)	fast (EBR-II)	61
	total, (n,γ), res. pars.	0.02 - 20 eV	79
	res. pars., res. integ. (transm.)	0.2 - 27 eV	82
Eu-155	total, (n,γ), res. pars.	0.02 - 20 eV	79
	res. pars., res. integ. (transm.)	0.6 - 33 eV	83
Gd-152 Gd-158	(n,γ)	30 keV	17
FP *)	res. pars. (transmission)	1 eV - 1.5 keV	15
many +)	integral σ(n,γ)	fast (EBR-II)	61

*) gross FP-mixtures

+) several reactions not specified in detail

1.3. Decay data

FP	data type	page
Ga-79 Ga-80 Ga-81 Ga-82 Ge-79 Ge-80 Ge-81 Ge-82	γ-spectroscopy (no details)	48
Se-85 Se-86	Q_β	19
Br-85 Br-86	Q_β	(47)
Br-87	Q_β	(47)
	γ-,ce-spectroscopy	(48)
Br-88	Q_β	19, (47)
	Eγ, Iγ	48
Br-89	Q_β	(47)
	γ-spectroscopy	48
Br-90	Q_β	19,47
	γ-spectroscopy	48

FP	data type	page
Kr-85m	decay branching	60
Kr-90 Kr-92 Kr-93	Q_β	19
Rb-88	Q_β	20
Rb-89	Q_β	20
	β-strength funct.	26
Rb-90	Q_β	19,20
	β-strength funct.	26
Rb-91	Q_β	20
	β-strength funct.	26
Rb-92	Q_β	19,20
	β-strength funct.	26
Rb-93	Q_β	19,20
	β-strength funct.	26
Rb-94 Rb-95	Q_β	20
	β-strength funct.	26

1.3. Decay data (cont'd)

FP	data type	page
Rb-96	Q_β β-strength funct.	20 26
Rb-97	Q_β β-strength funct.	20 26
Rb-98	β-strength funct.	26
Sr-91	Q_β	20
Sr-93	Q_β	19
Sr-94	Q_β	20
Sr-95	Q_β	19
Sr-96	Q_β	19,20
Sr-97 Sr-98	Q_β	19
Y-94 Y-95	Q_β	20
Y-96	Q_β	19,20
Y-97 Y-97m	Q_β	19
Y-98	β-,γ-spectroscopy Q_β (also Y-98m)	16 19
Y-99 Y-100	β-,γ-spectroscopy	16
Zr-99	β-,γ-spectroscopy Q_β	16 19
Zr-100 Nb-98 Nb-100 Nb-101 Nb-102 Nb-103	Q_β	19
Nb-104	T1/2,β-,γ-spectr.	16
Mo-102	E_γ,I_γ,γ-γ	6
Tc-99m	T1/2 (chem.effect)	40
Tc-103	Q_β	19
A=104 A=105	Q_β	19
Tc-106 Tc-107 Tc-108	T1/2,E_γ,I_γ,γ-γ	46

FP	data type	page
Pd-113 Pd-114 Pd-115 Ag-113 Ag-114 Ag-115	T1/2,E_γ,I_γ	63
In-120 In-122 In-124 In-126	E_γ,I_γ,E_{ce},I_{ce},γ-γ	(48)
In-127	γ-spectroscopy	48
In-128	E_γ,I_γ,E_{ce},I_{ce},γ-γ	(48)
In-129 In-130	γ-spectroscopy	48
In-132	β-,γ-spectroscopy	16
A=133	decay properties	23
Sn-131	Q_β	19
Sn-132	β-,γ-spectroscopy	16
Sb-134	β-,γ-spectroscopy Q_β	16 19
Te-135 Te-136	Q_β	19
I-136	β-,γ-spectroscopy	16
I-137	γ-,ce-spectroscopy	48
I-138	E_γ,I_γ,γ-γ	48
I-139 I-140	Q_β γ-spectroscopy	47 48
Cs-138 Cs-139 Cs-140 Cs-141 Cs-142	Q_β	20
Cs-143	Q_β I_γ (rel)	20 24
Cs-144 Cs-145 Cs-146	Q_β	20
Ba-139	Q_β T1/2,I_γ (absol.)	20 62
Ba-140	I_γ (absol.)	55
Ba-141	Q_β	20

1.3. Decay data (cont'd)

FP	data type	page
Ba-143	Q_β I_γ, (rel)	19,20 24
Ba-144 Ba-145	Q_β	19
Ba-146	Q_β	19,20
La-138	T1/2,E_γ,I_γ	10
La-140	T1/2,I_γ (absol.)	55
La-141 La-142	I_γ (absol.)	62
La-143	I_γ (rel)	24
La-144	Q_β T1/2,Q_β,E_γ,I_γ	19 41
La-145	Q_β	19
La-146	Q_β	19,20
La-147	Q_β	19
Ce-141	β,γ,ce,X:en.+intens.	7
Ce-143	I_γ (rel)	24
Ce-145	T1/2,E_γ,I_γ Q_β	10 19

FP	data type	page
Ce-147 Ce-148 A=149 A=150 A=151	Q_β	19
Pr-144	E_γ,I_γ (rel.)	13
Pr-145 Pr-146	I_γ (absol.)	62
Pr-148	T1/2,E_γ,I_γ Q_β T1/2,Q_β,E_γ,I_γ	10 19 42
Sm-157 Sm-158	T1/2,E_γ,I_γ	63
Eu-154	T1/2	55
Eu-157 Eu-158	T1/2,E_γ,I_γ	63
many *)	T1/2,E_γ,I_γ,γ-γ	46

*) several unspecified FP with T1/2 > 0.5 s

1.4. Delayed neutron (del-n) data

FP	data type	page
Ga-79 Ga-80 Ga-81 Ga-82 Ga-83	P_n	(47)
As-75	E-spec., avg. E	27
Br-87	E-spec., avg. E P_n	27 (47)
Br-88	P_n	(47),48
Br-89	P_n	47
Br-90 Br-91	P_n	47
Rb-89 Rb-90 Rb-91	E-spec.	26 26 26

FP	data type	page
Rb-92	E-spec. E-spec., avg. E P_n spec.:avg.E + width	26 27 (47) 76
Rb-93 Rb-94 Rb-95	E-spec. E-spec., avg.E P_n spec.: avg.E + width	26 27 (47) 76
Rb-96	E-spec. E-spec. avg. E P_n spec.: avg.E + width	26 27 (47) 76
Rb-97	E-spec. E-spec. avg.E spec.: avg.E + width	26 27 76

1.4. Delayed neutron (del-n) data (cont'd)

*) Further measurements with other fissioning nuclides planned.

1.5. Decay heat

2. COMPILATIONS AND EVALUATIONS

I. MEASUREMENTS

Unchanged contributions are marked as such.

Updates: revisions with respect to the last issue are marked by a vertical bar on the left margin of the text.

New contributions show no marks.

AUSTRALIA

Laboratory and address:	Australian Atomic Energy Commission Lucas Heights, 2234, NSW, Australia
1. Names:	R.B. Taylor[1)], B.J. Allen, A.R. de L. Musgrove, R.L. Macklin[2)]
Experiment:	keV Neutron Capture in ^{141}Pr.
Method:	C_6F_6 detector at 40m flight path at ORELA; ^{6}Li monitor
Accuracy:	11%
Completion date:	18/12/79
Descrepancies:	Generally good agreement in resonance energies and s-wave neutron widths with total cross section results. Good agreement with capture cross section curve in BNL-325, Vol.11, 1976, in the range 4-100 keV.
Publications:	Austrl. J. Physics 32, 551 (1979)

2. Names:	A.R. de L. Musgrove, B.J. Allen, J.W. Boldeman, R.L. Macklin[2)]
Experiment:	Recent measurements of neutron capture cross sections in the fission product mass region. Measurements of: $^{86-88}Sr$, ^{89}Y, $^{90-92,94}Zr$, $^{95-98}Mo$, $^{104-106,108,110}Pd$, $^{110-114}Cd$, $^{134-138}Ba$, ^{139}La, ^{140}Ce, ^{141}Pr, $^{142-146,148}Nd$.
Method:	as above
Accuracy:	10-20%
Completion date:	25/9/78
Discrepancies:	see publication
Publication:	Proc. Int. Conf. on Neutron Physics and Nuclear Data for Reactors and other Applied Purposes, Harwell, 1978, OECD-NEA, proceedings page 449.

3. Names:	G. Hicks, B.J. Allen, A.R. de L. Musgrove, R.L. Macklin[2)]
Experiment:	keV Neutron Capture in ^{86}Sr and ^{87}Sr
Method:	as above
Accuracy:	15%
Completion date:	July 1980

1) Department of Physics, James Cook University of North Queensland, Townsville, Qld 4811

2) Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA

BELGIUM

Laboratory:	Centre d'Etude de l'energie Nucléaire CEN/SCK B-2400 MOL (Belgium)
Names:	P. del Marmol, P. Fettweis
Facilities:	BR1 Reactor
Experiment:	The independent isomeric yield ratio of $^{83m}Se/^{83g}Se$ is being determined in thermal neutron fission of ^{235}U.
Method:	Fast radiochemical separation of Se followed by γ-counting of the resulting activities.
Completion date:	work provisionally halted, will be resumed when possible.

BELGIUM

Laboratory and address :

Nuclear Physics Laboratory, Proeftuinstraat 86, B-9000 Gent, Belgium
Département de Recherche Fondamentale, CEN-Grenoble, France[1]
Institut Laue Langevin, B.P. no.156X, 38042 Grenoble Cedex, France[2]

Names : H. Thierens, E. Jacobs, P. D'hondt, D. De Frenne, A. De Clercq,
P. De Gelder and A.J. Deruytter
J. Blachot [1]
P. Perrin [2]

Facilities : High Flux Reactor, Institut Laue Langevin, Grenoble

Experiment : The thermal neutron sub-barrier fission of ^{237}Np

Method : measured : fission product γ-ray spectra; deduced : post neutron mass distribution, neutron emission curve

Completion date : February 1980

Discrepancies to other reported data : The peak-to-valley ratio was determined to be 510±50, instead of P/V = 151 as given by Asghar et al Nucl. Phys. A292 (1977) 225

Publications : H. Thierens et al, to be published in Nucl. Phys. A

BELGIUM

Laboratory and address :

Nuclear Physics Laboratory, Proeftuinstraat 86, B-9000 Gent, Belgium
Institut für Kernchemie, Universität Mainz, D-6500 Mainz, Germany [1)]
Département de Recherche Fondamentale, Centre d'études nucléaires, F-38042 Grenoble, France [2)]

Names : P. De Gelder, D. De Frenne, E. Jacobs, H. Thierens, A. De Clercq,
P. D'hondt, K. Heyde and A.J. Deruytter
G. Tittel, N. Kaffrell and N. Trautmann [1)]
F. Schussler [2)]

Facilities : Linear Electron Accelerator, Gent
Triga-reactor, Mainz
High Flux reactor and Mass Separator Lohengrin, Grenoble

Experiment : The β^--decay of ^{102}Mo

Method : $^{235}U(n_{th},f)$ and nat $U(\gamma,f)$; chemical and mass separation;
measured : E_γ, I_γ, $\gamma\gamma$-coin, Ge(Li) detectors

Completion date : July 1979

Publications : P. De Gelder et al, Nucl. Phys. A337 (1980) 285
P. De Gelder et al, Proc. Int. Workshop on Nuclear Spectroscopy of fission products, Inst. Phys. Conference Series Nr51 (1980) 297

E.E.C. BELGIUM

Laboratory and address	:	CEC-JRC, Central Bureau for Nuclear Measurements, Geel, Belgium
Names	:	H.H. Hansen, E. Celen, G. Grosse, D. Mouchel, A. Nylandsted Larsen, R. Vaninbroukx
Facilities	:	$4\pi\beta-\gamma$ coincidence device; double focusing magnetic β-spectrometer; solid state detectors
Experiments	:	Determination of decay properties of ^{141}Ce: β^- intensities, maximum energies and shape factors; γ-ray and K X-ray intensities; internal conversion coefficients and ratios
Methods	:	1) disintegration rate of the sources and the total internal conversion coefficient: efficiency extrapolation technique applied to $4\pi\beta-\gamma$ coincidence measurements; 2) γ-ray and K X-ray intensities: efficiency calibrated Si(Li) and intrinsic germanium detectors; 3) relative intensities, maximum energies and shape factors of the two β^- transitions and internal conversion ratios: magnetic β spectrometer spectrum scanning; 4) K-shell internal conversion probability: electron/K X-ray coincidence technique
Accuracies	:	0.6% and 1.2% for the γ-ray and K X-ray intensity, respectively; 2.1% for the internal conversion coefficients; between 0.9 and 3.1% for the relative electron intensities; about 15% for the β spectrum shape factors
Publication	:	H.H. Hansen, E. Celen, G. Grosse, D. Mouchel, A. Nylandsted Larsen, and R. Vaninbroukx, Z. Phys. A290, 113 (1979).

E.E.C., Belgium

Laboratory and address	: JRC,CBNM,Geel,Belgium +S.C.K./C.E.N.,Mol,Belgium
Names	: +P.Staveloz, +E.Cornelis, +L.Mewissen, +F.Poortmans, G.Rohr, R.Shelley, T.van der Veen
Facilities	: Neutron time-of-flight spectrometers at the 150 MeV Linac (pulse width : 4 nsec)
Experiments	: Resonance parameters for $^{104,105,106,108,110}Pd$ below 40 keV 1)Capture cross-section measurements : Experiments completed for all isotopes. $^{108,105}Pd$: analysis completed ^{110}Pd : analysis in progress 2) Total cross-section measurements : Experiments and analysis completed for all isotopes 3) Scattering cross-section measurements : $^{105,108}Pd$: experiments and analysis completed - Not planned on other isotopes 4)Parity assignment of resonances Experiments and analysis completed for all even isotopes Not planned on ^{105}Pd.
Method	: 1) Capture cross section measurements. Detector : C_6D_6-detectors using Maier Leibnitz method. Flight path length : 60 m. 2) Total cross section measurements. Detector : ^{3}He gaseous scintillàtors. Flight path length : 30 m and 60 m. Cooled samples at liquid nitrogen temperature. 3) Scattering cross section measurements. Detector : ^{3}He gaseous scintillators. Flight path length : 30 m. 4) Parity assignment of resonances is made on the basis of low-bias to high bias ratios deduced from capture gamma ray spectra measured with a NaI crystal. Flight path length : 30 m.
Accuracy	: Expected on final resonance parameters $g\Gamma_n, \Gamma_\gamma$ between 5 % and 20 % depending on the energy range and on the strength of the resonances.
Expected completion date	: $^{105,108}Pd$: completed ^{110}Pd June 1980 Other isotopes : end 1980.

E. E. C., Belgium

(cont'd)

Publications : 1)Neutron Resonances parameters of ^{105}Pd and ^{108}Pd, P.Staveloz,E.Cornelis,L.Mewissen, F.Poortmans,G.Rohr,R.Shelley,T. van der Veen, Proc.Int.Conf. on Neutron Physics and Neutron Data for Reactors, Harwell,September 1978, p. 701.

2) Neutron Resonance Parameters for Palladium Isotopes.
P.Staveloz,E.Cornelis,L.Mewissen, F.Poortmans, G. Rohr,R. Shelley, T. van der Veen, International Conference on Nuclear Cross-Sections for Technology. October 1979,Knoxville (to be published).

3) Neutron Resonance Parameters for Palladium Isotopes.
P.Staveloz,E.Cornelis, L.Mewissen,F.Poortmans, G.Rohr,R.Shelley,T. van der Veen.
Specialist Meeting on Fission Product Cross-sections. Dec. 1979, Bologna (to be published).

CANADA

Laboratory and address:	University of Toronto Erindale College 3359 Mississauga Road N. Mississauga, Ontario Canada L5L 1C6
Names:	H.W. Taylor
Facilities:	14 MeV neutron generator producing 2×10^{10} n/s through the (d,T) reaction.

1. Experiment: Study of the decay of ^{145}Ce and ^{148}Pr

Method: Gamma radiations studied with Ge spectrometers, γ-γ coincidence measurements; $T_{\frac{1}{2}}$ measured.

Accuracy: Energy levels in ^{145}Pr determined to ≤ 0.4 keV, in ^{148}Nd to ≤ 0.5 keV; half-life of ^{145}Ce determined to ± 0.08 m, of ^{148}Pr to ± 0.05 m.

Completion date: October 1978.

Discrepancies to other reported data:

i) in addition to improved energies for levels and transitions (Table of Isotopes, 1978), the decay scheme of ^{145}Ce has suggested levels at 783.1, 845.8, 1110.9 keV which have yet to be confirmed;

ii) a number of new levels have been suggested for ^{148}Nd which are not contained in the established scheme (Table of Isotopes 1978); a number of tentative levels remain to be confirmed.

Publications: H.W. Taylor and B. Singh "The Decay of 2.8 min ^{145}Ce and 2.3 min. ^{148}Pr", J. Phys. G: Nuclear Physics 5, 1445 (1979).

2. Experiment: Study of gamma rays emitted by ^{138}La.

Method: Gamma radiation studies with Ge spectrometer; $T_{\frac{1}{2}}$ measured.

Accuracy: Gamma ray energies to ± 0.07 keV; $T_{\frac{1}{2}}$ to $\pm 10\%$.

Completion date: February 1979.

Discrepancies to other reported data:

Publications: H.W. Taylor and R.J. Bauer "A Note on the Decay of ^{138}La", J. Phys. Soc. Japan 47, 1395 (1979).

FRANCE

Laboratory : *Service RADIOCHIMIE ET PHENOMENOLOGIE*
Centre d'Etudes de BRUYERES-LE-CHATEL
B.P. n° 561 - 92542 MONTROUGE CEDEX - FRANCE.

Names : *J. LAUREC - A. ADAM.*

Facilities : *PROSPERO Critical assembly and LANCELOT 14 Mev neutrons generator (S.E.C.R./C.E. VALDUC)*
Radiochimical Laboratory
Calibrated Ge-Li spectrometers.

Experiments : *Determination of cumulative yields of some fission products (^{95}Zr, ^{97}Zr, ^{99}Mo, ^{103}Ru, ^{105}Rh, ^{127}Sb, ^{131}I, ^{132}Te, ^{140}Ba, ^{141}Ce, ^{143}Ce, ^{144}Ce, ^{147}Nd) for ^{233}U, ^{235}U, ^{238}U and ^{239}Pu, with fission spectrum and 14,7 Mev neutrons.*

Method : *The fission number is measured by a fission chamber. The fission products activities of fissile target nuclides are determined by gamma direct spectrometry measurements with calibrated Ge-Li spectrometers. The targets and chamber deposits masses are determined by alpha and mass spectrometries.*

Accuracy : *3 to 5 % ; the branching ratio error is not included ; this last error is variable from one isotope to the other (1 % to 5 %).*

Completion : **work completed in 1979, except for ^{233}U at 14.7 MeV (end of 1980)**

Publication : *internal reports ; C.E.A. report to be published.*

FRANCE

Laboratory and address : Département de Recherche Fondamentale
Laboratoire de Chimie Physique Nucléaire
Centre d'Etudes Nucléaires de Grenoble
85 X - 38041 GRENOBLE CEDEX - France.

Names : J. BLACHOT, J. CRANÇON, Ch. HAMELIN, G. LHOSPICE

Facilities : Melusine reactor (thermal neutron and caramel system for fast neutrons) 3 MeV neutrons generator and high flux reactor of I.L.L.

Experiment : The element yields of Bromine, Krypton, Rubidium, Tellurium, Iodine, Xenon, Caesium, have been measured for : $^{235}U(n_{th},f)$, $^{235}U(n_f,f)$, $^{235}(n_{3MeV},f)$, $^{232}Th(3MeV,f)$ $^{238}U(n_{3MeV},f)$.

Values for the odd even effects in Z for all these systems has been deduced.

Method : Direct growth and decay activities are measured with a Ge/Li detector and recorder in a multispectrum mode by a 4K multichannel analyser.

Accuracy : The average relative uncertainty of our measurements is between 5 and 10%.

Completion date : December 1980.

Publication : International Symposium on Physics and Chemistry of Fission - 14/18 May 1979 - Jülich (**IAEA-SM/241 – F29**)

FRANCE

Laboratory and address:	Laboratoire de Chimie Physique et Radiochimie Faculté des Sciences 28, av. Valrose 06034 Nice Cédex, France
Names:	G. Ardisson, C. Ardisson
Experiment:	Energies and intensities of γ-rays following the decay of $^{144}Pr^{m+g}$ in equilibrium with ^{144}Ce.
Method:	A sample of ^{144}Ce-$^{144}Pr^{g+m}$ separated from other fission products of ^{235}U was obtained from the Radiochemical Centre Amersham. It was purified from residual contaminants by extraction in a solution of bis(2 ethylhexyl) phosphoric acid in heptane by a procedure described elsewhere[1]. The spectra of the equilibrium mixture were measured with the aid of a coaxial Ge(Li) detector of 100 cm^3 which has a resolution of 2.0 keV (FWHM) for ^{60}Co.
Measurements and accuracy:	Energies and intensities following the decay of $^{144}Pr^{g+m}$ were recorded with the aid of a TRACOR 8192-channel analyzer. A series of 4 measurements was performed and the uncertainties of the energies quoted in the Table correspond to the observed standard deviations. The precise energies of the intense 1489 and 2185 kev γ-rays were determined with the aid of the full energy, the single and the double escape peak. The precision of the intensity measurements was determined as 4% for the more intense γ-rays and as 10% for the others.
Discrepancies to other authors:	The results of the present measurements are in good agreement with the data of Behar et al.[2], Tuli[3], as well as with those of Heath[4]. The mean values of energies and intensities shown in the Table below were calculated by averaging our results with those of ref. 2 and 4, taking as weight $W_j = E_j^{-1}$ and I_j^{-1} respectively, as was used elsewhere[5]. From the Table the existence of 7 transitions is evident which were not reported in previous studies[2-4]. These transitions can be interpreted in a level scheme of ^{144}Nd requiring 4 new excited states[1].
Publications:	See ref. 1 and 5.

References:

(1) M.S. PRAVIKOFF, G. BARCI-FUNEL, G. ARDISSON, Radiochem. Radioanal. Letters, 40, No 2 (1979) 123.
(2) M. BEHAR, Z.W. GRABOWSKY, S. RAMAN, Nucl. Phys. A219 (1974) 516.
(3) J.K. TULI, Nuclear Data Sheets, 27, No. 1 (1979) 124.
(4) R.L. HEATH, Gamma ray spectrum Catalogue. USAEC Rep- ANCR 1000-2.
(5) G. ARDISSON, Nucl. Instr. and Meth., 151 (1978) 505.

Table

Energies (keV): our measurements	Heath[4]	Behar et.al.[2]	mean	Intensities: our measurements	Heath[4]	Behar et.al.[2]	mean
618.2 5				0.15 7			
624.89 20	624.84 20	624.66 20	624.80 11	0.92 9	0.7 4	0.85 15	0.87 8
6 75.02 10		675.02 20	675.02 9	1.95 20		2.07 15	2.02 12
696.50 2	696.492 19	696.49 2	696.494 11	1000	1000	1000	1000
814.03 10	814.15 15	814.15 15	814.09 7	2.31 25	1.8 3	2.45 13	2.27 11
864.44 10	864.28 18	864.53 15	864.43 8	1.97 20	2.1 3	1.93 12	1.98 10
1376.31 30				0.29 3			
1388.20 10	1387.92 18	1388.00 15	1388.07 8	5.06 20	5.7 7	4.45 16	4.83 14
1489.16 5	1489.124 32	1489.15 5	1489.141 24	218 9	214 12	203 7	211 5
1561.0 5		1562 2	1561.2 6				
1978.67 10				0.71 7			
2046.6 5				0.21 4			
2072.7 7				0.16 4			
2185.601 50	2185.608 46	2185.70 6	2185.632 30	557 22	570 30	522 20	547 13
2368.4 1				0.03 1			
2654.1 5		2654.6 7	2654.3 4	0.16 2		0.14 2	0.15 2
2842.9 1				0.08 2			

Energies and intensities of photons following the decay of $^{144}Pr^{g+m}$. The intensities are normalized to a value of 1000 for the 696.5 keV γ-ray. The uncertainties indicated after the energies and intensities correspond to the last digits of the respective numbers.

GERMANY FED. REP.

Laboratory and address:

Institut für Reine und Angewandte Kernphysik der Universität Kiel (IKK), D-2054 Geesthacht, Reaktorstation

Names:

P. Fischer, U. Harz, H.G. Priesmeyer

Facility:

Fast Chopper Neutron Time-of-Flight Spectrometer, 42 m flight path in front of beam hole of 5 MW FRG-1 reactor. 15 ns/m nominal resolution, with special equipment for transmission measurements on highly radioactive samples; 11 Li-6 glass-scintillation detectors; max. rotor speed 12 000 upm; min. burst width 0.64 μs; min. time channel width 100 ns.

Experiments:

Neutron resonance investigations by transmission measurements between 1 eV and 1.5 keV on separated stable or radioactive isotopes of special interest to reactor physics (especially fission products), gross fission products. Possibility of extending energy range to thermal region with crystal spectrometer, which can be made available.

Completed: Transmission of ^{99}Tc below 50 eV. Resonance parameters determined to be in agreement with those at higher energies.

Cs-fission product mixture (133 : 135 : 137) transmission measurement below 1.2 keV. Four resonances assigned to either radioactive isotope. Analysis in progress.

Ongoing: Comparative measurement on stable ^{133}Cs as Cs Cl.

Planned: Transmission experiments on ^{129}I, Krypton isotopes and gross fission product mixtures.

Method:

Sample-in-beam, sample-out-of-beam transmission measurement; black resonance background determination technique.

Accuracy:

For resonance parameters: about 5 % or better, depending on statistical accuracy desired.

Recent publications:

P. Fischer, Diplomarbeit, Kiel 1980.
H.G. Priesmeyer, Low-energy Neutron Cross Section Measurements of Radioactive FP Nuclides, IAEA Specialist Meeting, Bologna 1979.

GERMANY, F.R.

Laboratory and address:

Institut für Kernphysik, Kernforschungsanlage Jülich, D-5170 Jülich, F.R.Germany

Names:

G. Battistuzzi, K. Kawade+, B.D. Kern++, T.A. Khan+++, W.D. Lauppe*, H. Lawin, H.A. Selič**, K. Sistemich, A. Wolf***

Experiment:

Studies at the Fission Product Separator JOSEF

Method:

The separator JOSEF at the research reactor FRJ-2 "DIDO" of the Kernforschungsanlage Jülich is used for nuclear spectroscopic investigations on fission products. Presently the main aims are the study of the onset of nuclear deformations around A=100 and of the nuclear shell structure near ^{132}Sn. In ^{98}Zr |1|, ^{99}Zr |2|, ^{100}Zr |3,4,5|, ^{99}Nb |2|, ^{132}Sn |6,7|, ^{134}Te |8| and ^{136}Xe |8| the properties of special levels (like spin, parity and life-time) have been studied through γ,γ angular correlation- und through delayed β,γ coincidence measurements. For ^{104}Mo |9,10| a detailed level scheme has been established, which indicates a permanent deformation of this nucleus. The properties of new levels in ^{132}Te |11| support the interpretation, that ^{132}Sn is a good closed shell nucleus.

Publications:

| 1| K. Kawade et al, Ann. rep. 1979 of the Inst. f. Kernphysik, KFA Jülich, p. 62

| 2| H.A. Selič et al., Z. Physik A289 (1979) 197

| 3| T.A. Khan et al., Z. Physik A284 (1978) 313

| 4| H.A. Selič et al., Z. Physik A 286 (1978) 123

| 5| A. Wolf et al., Ann. rep. 1979 of the Inst. f. Kernphysik, KFA Jülich, p. 63

| 6| K. Sistemich et al., Intern. Winter Meeting on Nucl. Phys., Bormio/Italy, ed. I. Jori, p. 224

| 7| K. Kawade et al., Ann. rep. 1979 of the Inst. f. Kernphysik, KFA Jülich, p. 65

| 8| K. Kawade et al., Ann. rep. 1979 of the Inst. f. Kernphysik, KFA Jülich, p. 67

| 9| B.D. Kern et al., Ann. rep. 1978 of the Inst. f. Kernphysik, KFA Jülich, p. 42

|10| K. Sistemich et al., Z. Physik A 289 (1979) 225

|11| K. Sistemich et al., Z. Physik A 292 (1979) 145

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* Now at the Programmgruppe Kernenergie und Umwelt, KFA Jülich, Germany

** Presently at the Weizmann Institute of Science, Rehovot, Israel

*** Permanent address Negev Nuclear Research Centre, Beer Sheva, Israel

GERMANY, FED. REP.

LABORATORY: Kernforschungszentrum Karlsruhe
Institut für Angewandte Kernphysik

1. NAMES: H. Beer, F. Käppeler

FACILITIES:
1) pulsed 3 MV Van de Graaff, kinematically collimated neutron beam, 25 keV above the $^{7}Li(p,n)$ reaction threshold
2) Ge(Li) detector (rel. efficiency for ^{60}Co: 7 %; energy resolution at 1.33 MeV: 2 keV)

EXPERIMENT: 30 keV capture cross section of ^{138}Ba, $^{140,142}Ce$, $^{152,154}Sm$, $^{152,158}Gd$ and capture cross section of ^{151}Eu to the 9.3 h isomeric state in ^{152}Eu at 48.5 keV

METHOD: activation technique

ACCURACY: 5-6 %

COMPLETION DATE: Results on ^{138}Ba, $^{140,142}Ce$ are published.
Data analysis started for $^{152,154}Sm$, $^{152,158}Gd$ and ^{151}Eu.

DISCREPANCIES TO OTHER DATA: ^{138}Ba: 8-160 %, ^{140}Ce: 30-100 %, ^{142}Ce: 180 %

PUBLICATIONS: Neutron Capture Cross Sections on ^{138}Ba, $^{140,142}Ce$, $^{175,176}Lu$ and ^{181}Ta at 30 keV: a prerequisite to investigate the ^{176}Lu Cosmic Clock
H. Beer, F. Käppeler, Phys. Rev. C21, 534 (1980) +)

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2. NAMES: F. Käppeler, B. Leugers

FACILITIES: pulsed 3 MV Van de Graaff

EXPERIMENT: Capture and Total Cross Section Measurements on Natural Xenon, Natural Krypton and on Various Krypton Isotopes *) Between 3 and 250 keV Neutron Energy.

+) Erratum in Phys. Rev. C21, 2139 (1980)

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METHOD: continuous neutron energy spectrum from $^{7}Li(p,n)$ reaction;
high pressure gas samples (300 bar in stainless steel spheres of 20 mm diameter and 0.5 mm wall thickness);
capture events detected by 2 C_6D_6-detectors of 1 l volume with pulse height weighting;
neutron energy determination by time-of-flight with a resolution of 1.5 ns/m;
^{197}Au-sample used as a standard.

ACCURACY: Statistical uncertainty typically 5 % for energy intervals corresponding to the experimental resolution. Systematic uncertainties between 4 and 15 % dependent on the isotopic composition of the samples.

COMPLETION DATE: summer 1980

DISCREPANCIES TO OTHER REPORTED DATA: No such data available

PUBLICATIONS: Preliminary data given in contributions to the following conferences:

- B. Leugers, F. Käppeler, KfK Karlsruhe and F. Fabbri, G. Reffo, CNEN Bologna "KeV Neutron Capture Cross Sections for the s-Process Isotopes of Se, Br and Kr and the Abundance of Krypton in the Solar System". Int. Conf. on Nuclear Cross Sections for Technology, Knoxville, Tennessee, 22.-26.10.1979
- F. Käppeler, B. Leugers "Capture Cross Section Measurements on Natural Xenon, Natural Krypton and on Various Krypton Isotopes Between 3 and 250 keV Neutron Energy" *) Specialists Meeting on Neutron Coss Sections of Fission Product Nuclei, Bologna, Italy, 12.-14.12.1979

*) $^{80,82,83,84}Kr$

GERMANY, FED. REP.

Laboratory and address: Kernspektroskopie, Institut A für Physik,
Technische Universität, Mendelssohnstr. 1A
D-33 Braunschweig, Germany

Names: U.Keyser, F.Münnich

Facilities: On-line mass separators LOHENGRIN and OSTIS, installed at the high-flux reactor of the ILL, Grenoble, France

Experiments: Determination of beta-decay energies of neutron-rich short-lived fission products in the mass range $85 \leq A \leq 105$ and $131 \leq A \leq 151$

Method: $\beta\gamma$ -coincidence measurements with a plastic-scintillator telescope , ß-singles measurements with a high-purity Ge detector

Accuracy: ΔE between 70 keV and 150 keV, depending upon the complexity of the decay scheme

Completion date: Systematic investigation

Publications: Zeitschrift für Physik A 284(1978)95 [1])
A 285(1978)287 [2])
A 288(1978)59 [3])
A 289(1979)407 [4])
Proc. Int. Conf. Atomic Masses and Fundamental Constants VI p. 443 and p. 485 (1979)

[1]) ^{88}Br, $^{90,92}Kr$, $^{90,92,93}Rb$, $^{93,95-98}Sr$, $^{96-98}Y$, $^{99,100}Zr$, $^{98,100-102}Nb$

[2]) $^{144,145}Ba$, $^{144,145,147}La$, $^{145,147,148}Ce$, ^{148}Pr

[3]) $^{85,86}Se$, ^{90}Br, ^{93}Kr, ^{103}Nb, ^{103}Tc

[4]) ^{131}Sn, ^{134}Sb, $^{135,136}Te$, $^{143,146}Ba$, ^{146}La

GERMANY, FED. REP.

Laboratory and address: 1) II. Physikalisches Institut, University of Giessen
Arndtstrasse 2, D-6300 Giessen, Fed. Rep. of Germany

and

2) Institut Max von Laue-Paul Langevin, X 56
Centre de Tri, F-38042 Grenoble-Cédex, France

Names: 1) Decker, R., Wuensch, K.D., Wollnik, H.
2) Koglin, E., Siegert, G., Jung, G.

Facilities: on-line mass separator OSTIS, Mattauch-Herzog type magnetic separator, intrinsic Ge-detector, Ge(Li) detector.

Experiment: Q_β values of some neutron-rich fission products.

Method: Alkaline fission products were generated by thermal fission of U235 and separated from non-alcaline atoms by diffusion in 1700 K hot graphite slabs, and by selective ionization at the hot Rhenium surface of the ion source of the on-line fission product separator OSTIS, which is currently installed at the Institut Max von Laue-Paul Langevin in Grenoble, France. The alkaline ions were mass separated by means of a Mattauch Herzog type magnetic separator, yielding a neighboring-mass contamination of only 1 part in 10^5.
The ions were collected on a moving tape system, and their decay observed with an Intrinsic Germanium Detector (for gamma-rays). Beta-single spectra and beta-gamma coincidence spectra were taken simultaneously.
Data evaluation was done using an interactive graphics computer program , taking into account the previously measured response function of the beta detector. Beta endpoints were determined, and if possible combined with results from beta-gamma coincidence measurements to deduce the Q-value of the nuclei.

Accuracy: Unprecedented accuracy and reliability of the endpoint measurement was achieved due to

1. high detector resolution of 10-20 keV (as compared with several 100 keV with conventional Plastic scintillation detectors)
2. excellent stability of electronics (temperature stabilized) and built-in check against drift (gamma lines superimposed to the beta continuum)
3. simultaneous measurement of all electron energies (as compared with magnetic spectrometers)
4. stability of energy calibration maintained to approx. 2 keV up to a beta energy of 6 MeV by daily recalibration with gamma lines of Rb90

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5. pulse pile-up was avoided by an electronic pile-up rejection circuit and by repetitive measurements set up with differing beta count rates.

The experimental results are given in the Table below.

Completion date: Last experiment done in October, 1977
Data evaluation completed in April, 1979

Discrepancies to other reported data: Most of previous measurements agree reasonably well with our data, taking into account the (mostly larger) experimental errors. Larger discrepancies between our data and those measured by the Ames group have been resolved by recalibration and recalculation of their experimental data.

Publications:

1. Decker, R., Wuensch, K.D., Wollnik, H., Koglin, E., Siegert, G., Jung, G.: Z. Physik A 294, 35-49 (1979)
2. Decker, R., Wuensch, K.D., Wollnik, H., Koglin, E., Siegert, G., Jung, G.: in preparation, to be submitted to Z. Physik
3. Wuensch, K.D., Decker, R., Wollnik, H., Jung, G., Siegert, G., Koglin, E.: in preparation, to be submitted to Nucl. Instrum. Methods.

Table:

fission product	Q_β (keV)	fission product	Q_β (keV)	fission product	Q_β (keV)
Rb-88	5318 ± 4	Rb-95	>8947 ± 100	Cs-141	5252^{+15}_{-60}
Rb-89	4510 ± 8	Y-95	4445 ± 5	Ba-141	3208 ± 35
Rb-90	6578 ± 15	Rb-96	>11303 ± 250	Cs-142	7329 ± 20
Rb-91	5857 ± 8	Sr-96	5413 ± 20	Cs-143	6287^{+40}_{-250}
Sr-91	2704.5 ± 3	Y-96	7120 ± 50	Ba-143	4259 ± 40
Rb-92	8111 ± 15	Rb-97	>10020 ± 50	Cs-144	8451^{+200}_{-30}
Rb-93	7485 ± 15	Cs-138	5388 ± 25	Cs-145	7358 ± 70
Rb-94	10304 ± 30	Cs-139	4213 ± 5	Cs-146	9300 ± 900
Sr-94	3512 ± 5	Ba-139	2336 ± 25	Ba-146	4280 ± 100
Y-94	4920 ± 5	Cs-140	6220 ± 15	La-146	6175 ± 100

GERMANY, FED. REP.

Laboratory: Institut für Kernchemie
Universität Mainz
D-6500 Mainz, Germany and
Institut Laue-Langevin
38 Grenoble, France

Names: H.O. Denschlag, Z. Alfassi, (U. Beersheva, Israel), J. Blachot (CENG, Grenoble), H. Braun, W. Pörsch, H. Schrader, R. Sehr, B. Sohnius

Facilities: LOHENGRIN Mass-separator for unslowed fission products at ILL, Grenoble

Experiment: The charge distribution among heavy-mass-peak fission products (A=138-146) from $^{235}U(n_{th},f)$ is being measured at various well defined kinetic energies (excitation energies) of the fission fragments

Method: Fission fragments separated according to mass (resolution $\frac{M}{\Delta M}$ = 400) and kinetic energy (resolution ∿2 MeV) are intercepted on a moving transport tape, transported continuously or discontinuously in front of a Ge(Li) γ-ray detector, and counted via the γ-rays emitted in their β-decay

Accuracy: Varying

Completion: Mass chains 132-137 completed, 138-146 in 1980/81

Publication: H.O. Denschlag, H. Braun, W. Faubel, G. Fischbach, H. Meixler, G. Paffrath, W. Pörsch, M. Weis, H. Schrader, G. Siegert, J. Blachot, Z.B. Alfassi, H.N. Erten, T. Izak-Biran, T. Tamai, A.C. Wahl, K. Wolfsberg, in Physics and Chemistry of Fission (Proceedings Symp. Jülich, 1979), IAEA, Vienna (1980), in press, and progress reports in Jahresbericht, Institut für Kernchemie, Universität Mainz and Annex to the Annual Report, Institut Laue-Langevin, Grenoble (1979)

GERMANY, FED. REP.

Laboratory: Institut für Kernchemie
Universität Mainz
Postfach 3980
D-6500 Mainz, Germany

Facilities: TRIGA Mark II Reactor

1. Names: H. Braun, H.O. Denschlag

Experiment: Yields and decay properties of the fission product chain with mass number A = 133 are being redetermined

Method: Radiochemical and by mass-spectrometry

Completion date: completed

Publications: Jahresbericht 1977
Institut für Kernchemie
Universität Mainz,
H. Braun, Dissertation, in preparation

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2. Names: G. Fischbach, H.O. Denschlag

Experiment: The fractional cumulative (*independent) yields of the following isotopes were measured in $^{235}U(n_{th},f)$: Ba-141*, Ba-143 to Ba-146, La-146, Ce-146, Ce-148 and Ce-149

Method: Fast radiochemical separations and direct γ-ray spectroscopic measurement and/or indirect measurements via daughter nuclides

Accuracy: Varying

Completion date: completed

GERMANY, FED. REP.

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Publications: Jahresberichte 1975, 1976 and 1977
Institut für Kernchemie
Universität Mainz,
G. Fischbach, Dissertation, Mainz 1980

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3. Names: R. Sehr, H.O. Denschlag

Experiment: Fractional cumulative fission yield of ^{77}Ga shall be redetermined in the fission of ^{235}U by thermal neutrons

Method: Fast radiochemical separation

Accuracy: $\sigma<10\%$

Completion date: 1980 ?

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4. Names: B. Sohnius, H.O. Denschlag

Experiment: Gamma-ray line intensities of ^{143}Cs, ^{143}Ba, ^{143}La and ^{143}Ce shall be redetermined relative to each other

Method: Fast radiochemical separations

Accuracy: $\sigma<10\%$

Completion date: 1980 ?

Publications: -

GERMANY, FED. REP.

(cont'd)

Laboratory: Institut für Kernchemie
Universität Mainz
Postfach 3980
D-6500 Mainz, Germany

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5. Names: M. Weis, H.O. Denschlag

Facilities: TRIGA Mark II Reactor

Experiment: The fractional independent or fractional cumulative (FC) yields of the following nuclides were determined in the fission of ^{235}U by thermal neutrons:
Nb-96, Nb-97(m+g), Nb-98m, Y-99 (FC), Zr-99, Nb-99m, Nb-99g, Zr-101 (FC), Nb-101, Mo-101, Zr-102 (FC), Nb-102(m+g), Nb-104 (FC), Nb-105 (FC)

Method: Fast radiochemical separation of Nb or Zr after pulsed irradiation

Completion date: completed

Publications: Jahresberichte 1975, 1976 and 1977
Institut für Kernchemie
Universität Mainz,

M. Weis, Dissertation, Mainz 1979

GERMANY, FED. REP.

Laboratory: Institut für Kernchemie
Universität Mainz
Postfach 3980
D-6500 Mainz, Germany

1. Names: H. Ohm, A. Schröder, W. Ziegert, K.-L. Kratz (Kernchemie Mainz), B. Pfeiffer, G. Jung (Universität Giessen/ILL Grenoble), C. Ristori, J. Crancon (CEN Grenoble)

Facilities: Alkali isotope separator OSTIS installed at the Grenoble high-flux reactor

Experiment: Energy spectra of β^--delayed neutrons have been measured in coincidence with γ-rays depopulating excited states in the respective neutron final nucleus.
With these data and the information from neutron singles and γ-ray spectra β^--strength functions (S_β) which extend to near Q_β of ten Rb isotopes have been constructed (A = 89-98). As expected from shell model calculations, the experimental strength below about 9 MeV differs considerably from that predicted by the gross theory of β-decay. The particular importance of these investigations lies in the fact that the shape of S_β is decisive not only in predictions of β-decay half-lives and β-delayed neutron emission probabilities, but also for radioactive decay heat analyses.

Completion date: Work is progressing

Publications: K.-L. Kratz, INDC (NDS)-107/G + Special, p. 103 (1979), K.-L. Kratz et al., Proc. Int. Workshop, Grenoble, France, Inst. of Physics Conf. Ser. No.51, p.142 (1979), K.-L. Kratz et al., Phys. Lett. 86B, p.21 (1979) and 90B, p.57 (1980)

GERMANY, FED. REP.

(cont'd)

2. Names: H. Gabelmann, H. Ohm, K.-L. Kratz

Facilities: TRIGA Mark II Reactor

Experiment: Time-dependent neutron spectra from $^{235}U(n_{th},f)$ corresponding to Keepin's 6 half-life groups

Method: Spectroscopy using ^{3}He-ionization chambers and 100 μg ^{235}U samples

Accuracy: Spectrum range from about 10 keV to 3 MeV with 2 keV channel width; energy resolution about 13-35 keV. Corrections for thermal neutrons, detector response and γ-ray pile-up.

Cooperation: J.G. Owen, D.R. Weaver (Univ. of Birmingham, U.K.)

Completion date: Probably end of 1980 for $^{235}U(n_{th},f)$. Further measurements with other fissioning nuclides are planned.

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3. Names: H. Ohm, A. Schröder, W. Ziegert and K.-L. Kratz

Experiment: From high-resolution delayed neutron energy spectra of ^{85}As, ^{87}Br, $^{92-98}Rb$, ^{135}Sb, ^{136}Te, $^{137,138}I$, $^{141-147}Cs$ measured with ^{3}He-ionization chambers (SEFORAD-Applied Radiation Ltd.) deduced average neutron energies ($\bar{E}_n$)

Accuracy: $\Delta\bar{E}_n \approx 20$ keV for 'soft' spectra
$\Delta\bar{E}_n \leq 75$ keV for 'hard' spectra

Cooperation: G. Rudstam (Studsvik, Sweden), P.L. Reeder (Batelle, Pacific NW, Richland, USA): a) Comparison of neutron spectra from ^{87}Br, $^{93-95}Rb$ and ^{143}Cs taken at 3 different laboratories with ^{3}He-spectrometers of different manufacture

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b) Comparison of $\bar{E}_n$ for calibration of the SOLAR neutron counting rate ratio system

Publications: Proc. of the Consultants' Meeting on Delayed Neutron Properties, Vienna, March 1979, INDC (NDS)-107/G + Special

INDIA

Laboratory & Address	: Radiochemistry Division Bhabha Atomic Research Centre Trombay, Bombay 400 085.
1. Names (same as INDC(NDS)-102)	: S.A. Chitambar, S.N. Acharya H.C. Jain, C.K. Mathews and M.V. Ramaniah.
Facilities	: CH-5 Mass spectrometer with thermoionic source assembly.
Experiment	: Determination of fission yield in thermal neutron induced fission of ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu.
Method	: Fission yields in thermal neutron induced fission of ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu have been determined for about 20 mass nos. in each of the fissioning system by employing mass spectrometric techniques for the determination of relative yields.
Accuracy	: About 2-3 percent for asymmetric masses.
Completion date	: March 1980.
2. Names (same as INDC(NDS)-102)	: S.B. Manohar, P.P. Venkatesan, S.M. Deshmukh Satya Prakash and M.V. Ramaniah
Facilities	: High Resolution Ge(Li) gamma spectrometric system, beta proportional counters and low back ground counters.
Experiment	: Determination of fission yield in the neutron induced fission of ^{232}U.
Method	: Fission yields in neutron fission of ^{232}U were determined employing direct counting of catchers on Ge(Li) as well as using radiochemical techniques. Yields were determined by comparison method using 235U and 99Mo as internal standard.
Accuracy	: About 4-8% for asymmetric masses 12-15% for symmetric masses
Completion date	: Already completed
Publications	: Phys.Rev. C 19, 1827 (May 1979)

INDIA
(cont'd)

3. Names (new) : T. Datta, S.P. Dange, S.B. Manohar, A.G.C. Nair, Satya Prakash and M.V. Ramaniah

Facilities : 1. Ge(Li) detector with 4 K Multi channel analyser

2. Class A Radiochemical laboratory

Experiment : Charge distribution in the thermal neutron induced fission of ^{245}Cm : Fractional cumulative yields of ^{135}I and ^{140}Ba

Method : Fractional cumulative yields of ^{135}I and ^{140}Ba have been determined by counting catcher foil directly over Ge(Li).

Accuracy : $\pm$ 1-2%.

Completion date : March 1979

Discrepancies to other reported data : Significant discrepancy exists between FCY value of ^{135}I determined by us compared to value reported by R.M. Harbour, D.E. Troutner and K.W. MacMurdo, Phys. Rev. C-10, 769 (1979)

Publications : Phys. Rev. C. 21(1), 1411 (1980)

4. Names (new) A.Ramaswami, S.P. Dange, Satya Prakash and M.V. Ramaniah

Facilities 1. Ge(Li) detector with multichannel analyser

2. Beta proportional counters, low background beta proportional counter

3. Class A Radioactive laboratory

Experiment Mass Yield from Thermal Neutron Induced fission of ^{245}Cm

Method : Fission yields in thermal neutron induced fission of ^{245}Cm determined using comparison method using ^{99}Mo as internal standard. Countings were done either of catcher foils directly on Ge(Li) or using Ge(Li) and beta counters after radiochemical separation.

INDIA
(cont'd)

Completion date : October 1978

Accuracy : ± 5-10% for asymmetric fission product
± 10-15% for symmetric fission product

Discrepancies to other reported data : Our data is, in general, in good agreement with values published by Harbour and Mac Murdo (J. Inorg. Nucl. Chem. 24, 2109 (1972) but not in good agreement with values of Von Gunten et al (Phys. Rev. 161, 1192 (1967).

Publications : The work has been published in J. Inorg. Nucl. Chem. 41, 1649 (1979)

5. NAMES (update) : A. Ramaswami, V. Natarajan, B.K. Srivastava and R.H. Iyer

Facilities : 60 c.c. Ge(Li), 4 K Analyser

Experiment : Absolute yields of the fission products in the neutron induced fission of ^{232}Th and ^{233}U

Method : Track etch cum gamma ray spectrometry. The total no. of fissions are obtained from the track registered in a mica detector while the fission product activity was measured using a pre-calibrated 60 c.c Ge(Li) coupled to a 4096 channel analyser.

Accuracy : ± 5%

Completion date : Completed

Discrepancies to other reported data : In general yield values are higher than the quoted value by Meek and Rider

Publications : A part of this work has been presented in the "Nuclear Physics and Solid State Physics Symposium" held at Madras, December 1979.

Results from last years entry on fission yields from ^{235}U and ^{239}Pu (completed) were published in J. Inorg. Nucl. Chem. 41, 1531 (Nov. 1979)

Italy

(revised; previously under E.E.C. Belgium, see p.2 of INDC(NDS)-102)

Laboratory and address :	Laboratorio Dati Nucleari CNEN, via Mazzini 2 40138 Bologna, Italy
Names:	C. Coceva, P. Giacobbe, M. Magnani
Facility:	Neutron time-of-flight spectrometers at the CBNM Euratom electron Linac, Geel, Belgium
Experiment:	^{96}Zr resonance parameters by neutron total cross section measurement
Method:	ZrO_2 enriched samples. Enrichment from 61 to 85 percent Pulse width 22 ns. Flight path 100 m. Resolution $\Delta T/T \approx 5\times10^{-4}$ Energy range 150 eV-130 keV. Analysis below 40 keV Detector: 1.5 cm ^{10}B plug viewed by two 10x10 cm NaI(Tℓ) crystals Shape analysis by computing programme treating simultaneously several spectra with different thickness and enrichment. Exact shape of the resolution function introduced
Results and accuracy:	E_r, J, Π, $g\Gamma_n$ for 14 resonances. Γ_γ for the E_r=301 eV resonance Errors on $g\Gamma_n$ < 7% except for one resonance
Completion date:	August 1979
Discrepancies with other reported data:	$g\Gamma_n$ values, systematically higher than reported by other laboratories
Publication:	C. Coceva, P. Giacobbe, M. Magnani, "Resonance Parameters of ^{96}Zr below 40 keV", Proceedings of the International Conference on Nuclear Cross Sections and Technology, Knoxville, October 1979

ITALY

Laboratory and Address : Istituto di Ingegneria Nucleare
Politecnico di Milano
Via Ponzio 34/3
20133 MILANO,ITALY

+ ENEL-Centro di Ricerca Termica e Nucleare
Bastioni Porta Volta 10
20121 MILANO,ITALY

Names : A.Cesana,G.Sandrelli+,V.Sangiust,M.Terrani

Facilities: L54 reactor,neutron long counter,high resolution Ge-Li detector.

Experiment : Absolute total yields of delayed neutrons in the fission of ^{233}U, ^{237}Np, $^{238/240/241}Pu$, ^{241}Am.

(work performed under contract CRTN/33-ENEL)

Method : The samples were few milligrams of highly enriched isotopes(oxides) encapsulated in stainless steel or zircaloy vials. Their characteristics were as follows:

Target	mass (mg)	impurities
^{233}U	3.35	===
^{237}Np	30.2	===
^{238}Pu	2.82	^{234}U(5%),^{237}Np(1.2%),^{239}Pu(0.7%),^{240}Pu(1%)
^{240}Pu	4.6	^{239}Pu(1%),^{241}Pu(0.5%),^{242}Pu(0.7%), ^{241}Am(0.2%)
^{241}Pu	1.54	^{237}Np(0.2%),^{239}Pu(0.1%),^{240}Pu(0.2%), ^{241}Am(21%)
^{241}Am	5.36	^{237}Np(2%),^{239}Pu(0.8%)

Samples were irradiated in a B_4C filtered flux at the edge of L54 reactor core (1).
After irradiation they were transferred pneumatically to the neutron counter and delayed neutron decay was followed with a 100 channel multiscaler. The neutron efficiency was measured by counting the delayed neutron emission from a ^{235}U target for which the fission rate in the irradiation position had been accurately determined. The fission rates in all the samples were determined by measuring with a high resolution Ge-Li detector the absolute activities of some fission products: ^{103}Ru, ^{131}I and ^{140}La.
Fission yields were derived from ref. (2).
Both delayed neutron intensities and fission product activities were corrected for the presence of impurities.
The samples transfer time was about 0.6 sec, so that half-lives of less than 0.5 sec could not be seen. The delayed neutron decay curves were approximated by five groups (with half lives of about 55,22,6,2,0.5 sec) using a least square unfolding technique. Total delayed neutron yields were obtained as a sum of the yields of the groups listed above and the yield of a sixth group(with half life of about 0.2 sec) obtained by an empirical correlation(3) between the yields and the values of Z and A of each fissioning nuclide;for the determination of the fitting parameters the yields reported in ref.(3) were used. The results are listed below and compared,when possible with the values reported in the literature.

ITALY

(cont'd)

Accuracy: Errors are quoted in the second column of the table below. They are intended as standard errors (± 1 σ) and are obtained combining in the usual way the errors on the neutron intensities with those on the fission rates in the samples.

Completion date: Completed

Publications: to be published

Results:

Nuclide	total delayed neutron yield		
	present work	ref. (3)	ref. (4)
^{233}U	0.00779 ± 0.00026	0.00698 ± 0.00013	0.0074 ± 0.0004
^{237}Np	0.0122 ± 0.0002		
^{238}Pu	0.00406 ± 0.00015	0.00456 ± 0.00051	
^{240}Pu	0.0091 ± 0.0003	0.0096 ± 0.0011	0.0090 ± 0.0009
^{241}Pu	0.0160 ± 0.0007	0.0160 ± 0.0016	0.0157 ± 0.0015
^{241}Am	0.00394 ± 0.00015		

References:

1) P. Barbucci et al., En. Nucleare, 26, 11, (1979), 542.
2) B.F. Rider, NEDO-12154-3(A), (1979).
3) R.J. Tuttle, Nucl. Sci. Eng. 56, (1975), 37.
4) S.A. Cox, ANL/NDM-5, (1974).

JAPAN

Laboratory and address:	Japan Atomic Energy Research Institute Tokai-mura, Naka-gun, Ibaraki-ken, Japan
Names:	Kazuaki NISHIMURA, Sigeru OGAWA and Toshio TSUTIYA
Facilities:	JRR-3 (Japan Research Reactor No.3), and a 50 cc coaxial type Ge(li) detector.
Experiment:	Reactor neutron capture cross section of 60.3-day ^{124}Sb.
Method:	The radioactive nuclides $^{124}Sb(T_{1/2}=60.3$ d) and $^{125}Sb(T_{1/2}=2.77$ yr) were produced from natural antimony by JRR-3 reactor irradiation of 283.5 h through the single and double neutron capture processes. After cooling of 3.50 yr, the γ-ray spectrum of the antimony sample irradiated was meausred by a 50 cc coaxial type Ge(li) detector, and the photo-peak yield ratio of $^{125}Sb(E_\gamma=428$ keV) to $^{124}Sb(E_\gamma=1.691$ MeV) was obtained. By using a relation between this photo-peak yield ratio and the $^{124}Sb(n,\gamma)^{125}Sb$ cross section, the reactor neutron capture cross section of 60.3-day ^{124}Sb was obtained.
Accuracy:	$\sigma(n,\gamma)$ of $^{124}Sb = 17.4 \pm ^{2.8}_{2.5}$ barns
Completion date:	February, 1979
Discrepancies to other reported data:	2,000 barns: Murin et al.(1) 6.5 ± 1.5 barns: Courtemanche et al.(2) 2,990 ± 260 barns: Elgart(3)
Publication:	K. Nishimura, S. Ogawa and T. Tsutiya: Journal of Nuclear Science and Technology, 16, 546 (1979).
References:	(1) Murin et al.: J. Nucl. Energy, 7, 265 (1957) (2) Courtemanche et al.: Can. J. Phys., 44 2956 (1966) (3) Elgart: DA/B 32, 3245 (1971)

JAPAN

Laboratory and address: Nuclear Physics II Laboratory,
Japan Atomic Energy Research Institute,
Tokai-mura, Naka-gun, Ibaraki-ken, Japan.

Name: A. Asami, Y. Nakajima, M. Mizumoto, M. Ohkubo,
Y. Kawarasaki, Y. Furuta (JAERI)
M. Sugimoto (Tohoku Univ.)
Y. Kanda, N. Ohnishi (Kyushu Univ.)

Facilities: Neutron time-of-flight spectrometers at the 120 MeV linac (minimum pulse width 30 nsec)

1. Experiment — Neutron Capture Cross Section Measurements in the keV region.

Method Detector: 3500 l liquid scintillator tank for capture yield
^{6}Li-glass and ^{10}B-NaI detectors for neutron flux and transmission measurements.

Flight path: 52 m for capture measurements.
56 m for flux and transmission measurements.

Normalization: Saturated resonance method.

(1) Samples: ^{143,145,146,148}Nd, enriched to over 91 % for each isotope, Nd_2O_3 in chemical form, loaned from ORNL.

Energy region: 5 to 300 kev.

Accuracy: 8 to 30 %.

Expected completion date: Oct. 1980.

Publication: Y. Nakajima et al., Neutron capture cross section measurements of Nd-143, Nd-145, Nd-146 and Nd-148, Int. Conf. on Neutron Physic and Nuclear Data, Harwell, 1978, p438

(2) Samples: ^{147}Sm, ^{149}Sm (enriched to 98.34 and 97.72 %, respectively.)

Energy region: 3.3 to 300 keV.

Accuracy: 5 to 15 %.

Expected completion date: May. 1980.

Publication: M. Mizumoto et al., Neutron Radiative Capture and Transmission Measurements of ^{147}Sm and ^{149}Sm. Int. Conf. on Nuclear Cross Sections for Technology, Knoxville (1979)

JAPAN
(cont'd)

(3) Samples: Eu, ^{151}Eu and ^{153}Eu (enriched to 96.83 and 98.76 % respectively)

Energy region: 3 to 100 keV.

Accuracy: 5 to 13 %.

Completion date: Sep. 1979.

Publications: M. Mizumoto et al., Average Neutron Capture Cross Sections of ^{151}Eu and ^{153}Eu from 3 to 100 KeV J. Nucl. Sci. Technol. 16 (1979) 711.

N. Yamamuro and A. Asami, Measurements of capture cross sections in the FP region, NEANDC Specialist Meeting on Neutron Cross Sections of Fission Product Nuclei, CNEN, Blolgna Italy (1979)

2. Experiment: Neutron resonance parameters.

2-1 Method: A ^{6}Li-glass neutron detector and a Moxon-Rae detector at 47 m flight path.

Analysis: Atta-Harvey code and Monte Carlo code CAFIT.

(1) Samples: ^{79}Br, ^{81}Br.

Results: Isotopic Identification.
Resonance Parameters
^{79}Br 156 levels below 10 KeV.
^{81}Br 100 levels below 15 KeV.
Strength functions, Average level spacings.

Publication: M. Ohkubo. Y. Kawarasaki and M. Mizumoto. Neutron Resonance Parameters of ^{79}Br and ^{81}Br up to 15 KeV. Presented to the Int. Conf. Nuclear Cross Sections for Technology, Knoxville (1979), BB10.

2-2 Method: 3500 l liquid scintillator tank for capture yield. ^{6}Li-glass and ^{10}B-NaI detectors for neutron flux and transmission measurements. Data are analyzed with a multilevel Breit-Wigner code S10B, Atta-Harvey and GACA area aralysis codes.

Flight path: 52 m for capture experiments.
56 m for transmission experiments.

(2) Samples: ^{147}Sm and ^{149}Sm (enriched to 98.34 and 97.72 %, respectively.)

Energy region: 1.5-1200 eV for ^{147}Sm.
1.5-520 eV for ^{149}Sm.

Expected completion date: May. 1980.

JAPAN
(cont'd)

Publication:	M. Mizumoto et al., Neutron Radiative Capture and Transmission Measurements of ^{147}Sm and ^{149}Sm. Int. Conf. on Nuclear Cross Sections for Technology, Knoxville (1979)
(3) Sample:	La
Status:	Total radiation widths were obtained by the code TACASI for the s-wave resonances below 2.5 keV and the analysis for p- wave resonances is in progress.
Expected completion date:	Oct. 1980.

JAPAN

Laboratory and address:	Institute of Atomic Energy, Kyoto University, Uji, Kyoto 611, Japan
Names:	Tomota Nishi, Ichiro Fujiwara and Nobutsugu Imanishi
Facilities:	5 MW research reactor [Research Reactor Institute, Kyoto University]
Experiment:	Cumulative and independent fission-yields of some fission products in the thermal-neutron induced fission of ^{233}U, ^{235}U and ^{239}Pu.
Method:	Radiochemical for fission yields; Instrumental with GeLi detectors.
Accuracy:	Errors range from 7% to 20% with different combinations of the fission products and the fissile isotopes.
[Expected] completion date:	see Table I
Publication:	see Table I

Table I

Nuclides		Completion date	Publication
$^{128,130,132}Sn$, ^{133}Sb	[Cum.]		N.Imanishi, I.Fujiwara and
$^{128,130,132}Sb^{m,g}$,			T.Nishi, Nucl. Phys. A263,
^{131}Sb, $^{131,133}Te^{m,g}$	[Ind.]	Sep. 1975	141(1976)
^{135}I	[Cum.]		T.Nishi, I.Fujiwara and
$^{131,133}I$,			N.Imanishi, Inter. Conf. on Nucl.
$^{132,134,136}I^{m,g}$	[Ind.]	Dec. 1976	Structure,Tokyo, Sep. 1977 *)
$^{133,135}Xe^{m,g}$	[Ind.]	Dec. 1976	ibid. *)
$^{138}Cs^{m,g}$	[Ind.]	May. 1978	*)
$^{90}Rb^{m,g}$	[Ind.]	End of 1981	
$^{148}Pm^{m,g}$	[Ind.]	End of 1981	

*) **Final data to be published soon**

JAPAN

Laboratory and address: Laboratory of Nuclear Radiation
Institute of Chemical Research
Kyoto University
Yoshida, Sakyoku
Kyoto 606, Japan

1. Names: H. Mazaki, S. Kakiuchi, T. Mukoyama and M. Matsui

Experiment: Effect of chemical state on the decay constant of Tc-99m

Method: Differential method

Accuracy and result:

$$\frac{\lambda(TcO_4^-) - \lambda(Tc_2S_7)}{\lambda(Tc_2S_7)} = (31.8 \pm 0.7) \times 10^{-4}$$

$$\frac{\lambda(Tc_2S_7) - \lambda(\mathrm{metal})}{\lambda(\mathrm{metal})} = (5.6 \pm 0.3) \times 10^{-4}$$

Completion date: April 1979

Publication: Phys. Rev. C21 (1980) 344

2. Names: S. Kakiuchi, H. Mazaki, R. Katano, S. Shimizu and R. Sellam

Experiment: Effect of superconductivity on the decay constant of Tc-99m

Mehtod: Differential method

Accuracy and result:

$$\frac{\lambda(\mathrm{superconducting}) - \lambda(\mathrm{normal})}{\lambda(\mathrm{normal})} = (0.2 \pm 0.5) \times 10^{-4}$$

Completion date: August 1978

Publication: Nucl. Instr. Meth. 158 (1979) 435

JAPAN

Laboratory : 1. Department of Nuclear Engineering, Nagoya University

2. Institute for Atomic Energy, Rikkyo University

Address : 1. Furo-cho, Chikusa, Nagoya, Japan

2. Nagasaka, Yokosuka, Kanagawa, Japan

Names : Y. Ikeda[1)], H. Yamamoto[1)], K. Kawade[1)], T. Katoh[1)] and T. Nagahara[2)]

Facilities : TRIGA-II reactor of Rikkyo University, Pneumatic transport system, Apparatus for electrophoresis, Ge(Li) detector, plastic detector, 4096-channel pulse height analyzer

Experiment : Decay property of ^{144}La

Method : By using the rapid paper electrophoretic method, sources of ^{144}La was separated from fission products of ^{235}U irradiated at the TRIGA-II reactor. Energies and intensities of γ-ray, Q_β value of β-ray and a half-life of ^{144}La were measured and a decay scheme was proposed

Accuracy : Less than 0.6 keV for gamma-ray lower than 2052.5 keV, 40.6 ± 1.0 sec for half-life, 4.3 ± 0.1 MeV for Q value.

Completion date : May 1, 1979

Discrepancy to other reported data : Seventeen new gamma-rays were detected, 11 new levels of ^{144}Ce were proposed. The Q_β value was confirmed.

Publication : This work is reported in J. Phys. Soc. Japan Vol. 47, p. 1389 (1979)

JAPAN
(cont'd)

Laboratory : 1. Department of Nuclear Engineering, Nagoya University
2. Institute for Atomic Energy, Rikkyo University

Address : 1. Furo-cho, Chikusa, Nagoya, Japan
2. Nagasaka, Yokosuka, Kanagawa, Japan

Names : Y. Ikeda[1)], H. Yamamoto[1)], K. Kawade[1)], T. Katoh[1)] and T. Nagahara[2)]

Facilities : TRIGA-II reactor of Rikkyo University, Pneumatic transport system, Apparatus for electrophoresis, Ge(Li) detector, plastic detector, 4096-channel pulse height analyzer

Experiment : Decay property of ^{148}Pr isomers

Method : By using the rapid paper electrophoretic method, sources of ^{148}Pr was separated from fission products of ^{235}U irradiated at the TRIGA-II reactor. Energies and intensities of γ-rays, Q_β value of β-ray and half-lives of ^{148}Pr isomers were measured and decay schemes were proposed.

Accuracy : Less than 0.6 keV for gamma-ray energy, 2.27 ± 0.04 and 2.0 ± 0.1 min for half-lives, 4.8 ± 0.2 MeV for Q_β value.

Completion date : March 14, 1979

Discrepancies to other reported data : Existence of ^{148}Pr isomers became clear, 6 new levels of ^{148}Nd were proposed.

Publication : This work is reported in J. Phys. Soc. Japan Vol. 47, p. 1039 (1979)

JAPAN

Laboratory and address:	Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology 2-12-1, O-okayama, Meguro-ku, Tokyo
Names:	N. Yamamuro, M. Igashira, T. Sekiya (TIT) Y. Fujita, K. Kobayashi (Research Reactor Institute, Kyoto University)
Facilities:	46-MeV Electron Linear Accelerator (Research Reactor Institute, Kyoto University)
Experiment:	Capture Cross Section Measurements of ^{133}Cs from 3 to 270-keV using time-of-flight method
Method:	Gamma-rays from the neutron capture processes were detected by a pair of C_6D_6 liquid scintillation detectors. Neutron flux impinging on the sample was measured by ^{10}B (93%) disk placed at the sample position. The absolute value of cross section was determined by normalizing to the 24-keV cross section measured with Fe-filtered method. Corrections for self-shielding and multiple scattering were performed using resonance parameters.
Accuracy:	Error of absolute cross section at 24-keV is about 5% Statistical error of measured cross sections is 2 to 4%
(Expected) Completion Date:	Sept., 1980 for ^{133}Cs
Publications:	1. N. Yamamuro et al., J. Nucl. Sci. Technol. 15 637 (1978) 2. N. Yamamuro et al., Proc. Inter. Conf. Neutron Physics and Nuclear Data for Reactors and other Applied Purposes AERE Harwell Sept., 1978, **page 432 *)** 3. N. Yamamuro, A. Asami, NEANDC Specialists' meeting on neutron cross sections of fission product nuclei, CNEN Bologna Dec. 1979 *)

***) Including ^{93}Nb and ^{127}I from 3.2 to 80 keV (see INDC(NDS)-102, page 22). Final results of these 2 nuclides will be published in J.At.En.Soc. of Japan.**

JAPAN

Laboratory and adress: Nuclear Engineering Research Laboratory
Faculty of Engineering
University of Tokyo
2-22 Shirane Shirakata, Tokai-mura Naka-gun
Ibaraki, Japan

Names: M. Akiyama and S. An

Facilities: Fast Neutron Source Reactor "YAYOI"

Experiment: Fission Product Decay Heat for Fast-Neutron Fission of ^{235}U, ^{238}U, ^{239}Pu and ^{232}Th for cooling Times of 20 to 24000 seconds.

Method: Samples have been irradiated for short periods with fast neutrons, and returned pneumatically to a counting area. Gamma-ray energy spectra have been measured using NaI detector and beta-ray energy spectra have been obtained using plastic scintillation detector combined with $\Delta E/\Delta x$ type proportional counter to eliminate gamma-ray effects. Counting times have been chosen to provide good statistics within the time range of interest. Total energy release rates for beta and gamma-rays have been obtained to integrated beta and gamma-energy spectra respectively and summed to obtain the fission product decay heat.

Accuracy: 5% to 10% (1σ)

(Expected) Completion Dat : Measurements of gamma-ray energy release rates are finished, and we plan to start writing a report for publication soon. Measurements of beta-ray decay heat will be completed by end of 1980.

Discrepancies to other Reported Data : Data of gamma-ray energy release rates are in reasonable agreement with results of summation calculations.

ROMANIA

Laboratory and address:	Institute of Nuclear Power Reactors Section 1 7000 Bucharest, P.O.B. 5204, Romania
Names:	I. Garlea, C. Miron
Facility:	$\Sigma\Sigma$-IRNE system
Experiment:	Integral neutron cross section for $^{109}Ag(n,\gamma)^{110m}Ag$ in $\Sigma\Sigma$-spectrum. The absolute ^{109}Ag capture cross section measured in $\Sigma\Sigma$-spectrum is 24.3 ± 1.0 mb.
Method:	Target: Ag foils, purity: 99.98%, diameter: 20mm, thickness: 135 mg/cm^2. The samples have been exposed in the $\Sigma\Sigma$-facility centre, at fluences about 10^{15} n/cm^2. The flux monitoring was performed by fission chambers, type Saclay. Monitor: $^{235}U(n,f)$ cross section in $\Sigma\Sigma$-spectrum: 1512 ± 53 mb. Absolute measurements have been performed by high resolution Ge(Li) spectrometry (crystal: 100 cm^3). The absolute efficiency was determined by means of a ^{152}Eu gamma source supplied by PTB-Braunschweig, FRG. The measured value was not corrected for neutron self-shielding in the $\Sigma\Sigma$-spectrum. The absolute gamma activity was obtained by using the SAMPO code.
Accuracy:	- The absolute efficiency calibration error was 2.0% - Error in flux monitoring 1.0% - Statistical error 0.5%
Completion date:	Completed
Publication:	I. Garlea, C. Miron, F. Popa, Revue Roumaine de Physique, Tome 25, No. 2, 1980, p. 107-110.

SWEDEN

Laboratories:

Department of Nuclear Chemistry
Chalmers University of Technology
S-412 96 GÖTEBORG
Sweden

Department of Nuclear Chemistry
University of Oslo
Oslo 3
Norway

Institut für Kernchemie
Johannes Gutenberg Universität
Postfach 3980
D-6500 MAINZ
Germany

Names:

The SISAK Collaboration:

G. Skarnemark and K. Brodén (Göteborg)

D. Eriksen (Oslo)

N. Kaffrell and N. Trautmann (Mainz)

Facilities: SISAK system for studies of radionuclides with half-lives >0.5 s

Experiments: $T_{1/2}$-determinations, γ-singles, γ-γ coincidence and γ-γ angular correlation measurements

Method: Fast chemical on-line separations. The measuremants are carried out on flow cells or ion exchange columns. Ge(Li)-detectors are used.

Publications:

1) The Decay of ^{107}Tc to Levels in ^{107}Ru.
Radiochim. Acta 26, 127 (1979)

2) Levels in ^{106}Ru and ^{108}Ru
Nucl. Phys. A339, 74 (1980)

SWEDEN

Laboratory and address:	The Studsvik Science Research Laboratory S-611 82 Nyköping, Sweden.
Facility:	The OSIRIS on-line mass separator is used to extract selected nuclei from thermally fissioned ^{235}U. The extraction method has been extended in the sense that Al or CF_4 is added to the ion source to facilitate separation of halogenes or lanthanides, respectively.
1. Names:	K Aleklett, P Hoff, E Lund and G Rudstam
Experiment:	Delayed neutron emission probabilities, P_n-values, have in 1979 been deduced for the following precursors: $^{89-91}Br$, $^{139-141}I$.
Method:	Simultaneous measurement of neutron and beta activities in a multiscaling mode. Neutron counter consisting of 29 ^{3}He counters imbedded in paraffine, beta counter being a 2 mm plastic scintillator. Separation as $AlBr^+$ and AlI^+ molecular ions. The P_n-values have been determined with an accuracy of 5 - 10 %.
Completion date:	Indefinite for the P_n studies as such
Publications:	K Aleklett, P Hoff, E Lund and G Rudstam: Delayed neutron emission probabilities of the precursors $^{89,90,91}Br$ and $^{139,140,141}I$, Z Physik A (in print). E Lund, P Hoff, K Aleklett, O Glomset and G Rudstam: Z Physik A294 (1980) 233. *)
2. Names:	K Aleklett, P Hoff, E Lund and G Rudstam
Experiment:	Characterization of and P_n values for delayed neutron precursors of yttrium and lanthanides.
Method:	Detection as described for exp. 1. Separation of fluoride ions with CF_4 addition to the ion-source.
Completion date:	Indefinite
3. Names:	K Aleklett, E Lund and G Rudstam
Experiment:	Total beta decay energies and atomic masses have been deduced for the following nuclides during 1979: $^{139,140}I$, $^{89,90}Br$. The evaluation of the experiments is still in an early stage.
Method:	Beta particles were recorded in coincidence with gamma rays depopulating known levels in the daughter nucleus. The end-point energies of the beta-spectra were determined, and by adding the level energy the total beta-decay energies were obtained.

*) **Pn-values for precursors:** $^{79-83}Ga$, $^{87-89}Br$, $^{92-96}Rb$, $^{127-132}In$ $^{134,135}Sb$, $^{137-139}I$ and $^{141-145}Cs$.

improved half-lives for : $^{127,129,132}In$

SWEDEN

(cont'd)

The beta-particles were recorded in a Si(Li) detector and the gamma-rays in a Ge(Li) detector or two NaI(Tl) crystals. In the future the experimental arrangement will be improved by using two Ge(Li) detectors for the gamma registration.

Completion date: Indefinite for the experiment as such.

Publication: K Aleklett, E Lund and G Rudstam: Total beta-decay energies and masses of $^{85-89}$Br, Z Phys A290 (1979) 173.

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4. Names: K Aleklett, P Hoff and E Lund

Experiment: Nuclear spectroscopic studies of the decays of ^{139,140}I, ^{89,90}Br. The studies aim at level scheme determinations to be combined with the Q_{β}-studies.

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5. Names: P Hoff, B Fogelberg

Experiment: Nuclear spectroscopic studies of $^{79-82}$Ga and $^{79-82}$Ge.

Completion date: 1980

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6. Name: B Fogelberg

Experiment: Nuclear spectroscopic studies in the Sn-region. The decays of $^{127-130}$In have been studied during 1979. Studies also of ^{87}Br, ^{137}I.

Publications: B Fogelberg and P Carlé: Levels and transition probabilities in $^{120-128}$Sn, Nucl Phys A 323 (1979) 205.

B Fogelberg and H Tovedal: Energy levels in ^{137}Xe populated in the decay of the delayed neutron precursor ^{137}I, submitted for publication.

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7. Names: P Aagaard, G Rudstam and H U Zwicky

Experiment: Determinations of independent fission yields.

Method: The OSIRIS mass separator is used as a source of separated fission products. It is in principle possible to determine the fission yields of all the separated nuclei, if a function describing the delay between production and collection of fission products can be determined for all the pertinent elements. The studies made up to now have been intended to develop the procedure for future measurements, and to study the delay function for selected cases.

Final publication from last year's entry:

"Levels of ^{137}Xe and ^{138}Xe Populated in the β-Decay of ^{138}I"
P. Hoff, J. inorg. nucl. Chem. 41 (1979) 1523

"The decay of ^{88}Br", P. Hoff, Phys. Scr. 21, 129 (1980)

SWEDEN

Laboratory and address:

Department of Nuclear Physics, University of Lund,
Sölvegatan 14, 223 62 Lund, Sweden.

Names: G. Magnusson, P. Andersson, R. Zorro and I. Bergqvist.

Experiment: Neutron capture cross-section measurements. Experimental and theoretical determination of corrections due to background low energy neutrons produced in reactions like (n,n') and (n,2n).

Concluded: Measurements at the neutron energy 14.7 ± 0.3 MeV for the nuclei ^{23}Na, ^{55}Mn, ^{89}Y, ^{127}I, ^{138}Ba, ^{186}W and ^{197}Au.

In progress: Measurements in the neutron range 1-10 MeV for ^{115}In and ^{197}Au.

Method: The activation technique

Accuracy: 10-30%

Discrepancies to other reported data: The present results agree well with the results of the spectrum method. Most of previous activation results do not.

Publications: G. Magnusson and I. Bergqvist, 14.7 MeV Neutron Capture Cross-Section Measurements with Improved Activation Technique, Nucl. Technol., 34, 114 (1977).

G. Magnusson, P. Andersson and I. Bergqvist, 14.7 MeV Neutron Capture Cross-Section Measurements with Activation Technique, Physica Scripta, 21, 21 (1980)

SWITZERLAND

Laboratory and address:	Eidg. Institut für Reaktorforschung, CH-5303 Würenlingen, Switzerland Institut für anorganische, analytische und physikalische Chemie, Universität Bern, CH-3012 Bern, Switzerland
Name:	H.R. von Gunten, H.N. Erten
Facility:	Swimming-pool type reactor (SAPHIR)
Experiments:	Determination of independent and cumulative yields in the fission of ^{232}Th, ^{233}U, ^{235}U, ^{239}Pu, and other nuclides Absolute yields in reactor neutron fission of ^{232}Th
Method:	Absolute fission counting Radiochemical and instrumental (GeLi)
Accuracy:	5 -10 %
Measurements completed:	^{148}Pm: completed ^{232}Th: completion date 1981
Publications:	H.U. Zwicky and H.R. von Gunten Independent yields of ^{148m}Pm and ^{148g}Pm in the thermal-neutron-induced fission of ^{233}U and ^{239}Pu Radiochimica Acta, in press

UNITED KINGDOM

Laboratory and Address	AERE Harwell	UKAEA, AERE. Harwell, Oxfordshire OX11 ORA U.K.
Names:	J.G. Cuninghame, H.H. Willis	
Facilities:	ZEBRA - BIZET	
Experiment:	To measure the effect of change of reactor neutron spectrum on fission yields.	
Method:	Four irradiations, each of two ^{235}U, two ^{238}U and two ^{239}Pu metal beads of approx. 100mg. weight have been made; two were in the inner breeder island and two in the outer core. One of the samples of each of the fissile materials was counted directly on a calibrated Ge(Li) detector, while the other was dissolved and used to prepare purified samples of certain fission products of very low yield, viz. As, Ag, Cd, Sn, Sb and Rare Earths. The irradiations are complete, and the data are being assessed.	
Accuracy:	Expected ± 10%	
Completion date:	Expected end 1980	

UNITED KINGDOM

Laboratory and Address:	AERE Harwell	UKAEA AERE, Harwell, Oxfordshire, OX11 ORA
Names:	I.C. McKean and E.A.C. Crouch	
Experiment:	^{3}H yield in thermal and fast fission spectra for U and Pu isotopes	
Facilities:	GLEEP and 'ZEBRA' Reactors	
Method:	The tritium produced in fission is converted to tritiated water, separated from other fission products and measured by liquid scintillation counting. A preliminary experiment has been completed in which solutions of ^{235}U were irradiated in a thermal flux. Samples have been irradiated in GLEEP (^{235}U + ^{239}Pu in solution) and in ZEBRA (^{235}U + ^{239}Pu metal) and await analysis. Samples of ^{240}Pu and ^{241}Pu have been obtained for further experiments.	
Accuracy:	$\pm$ 10%	

UNITED KINGDOM

(same as in INDC(NDS)-102, except for completion date)

Laboratory and Address:	DNPDE	Dounreay Nuclear Power Development Establishment, UKAEA, Northern Division, Thurso, Caithness, Scotland KW14 7TZ
Names:	W. Davies, V.M. Sinclair	
Facilities:	PFR	

Experiment: The measurement of the absolute yields of ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{143,145,146,148,150}Nd and perhaps other fission products, from the fission of ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu and ^{241}Pu

In progress

Method: Twelve sealed stainless steel capsules are to be irradiated. Of these,

3 capsules contain ^{235}U as highly enriched uranium dioxide,
3 capsules contain ^{239}Pu as low ^{240}Pu content plutonium dioxide,
2 capsules contain ^{238}U as depleted uranium dioxide with an isotopic analysis of 99.7% ^{238}U,
1 capsule contains ^{240}Pu as a dried aqueous solution of plutonium with an isotopic analysis of 99% ^{240}Pu,
1 capsule contains ^{241}Pu as a dried aqueous solution of plutonium with an isotopic analysis of 93% ^{241}Pu, and
2 capsules contain no added fissile material.

The ^{235}U and ^{239}Pu capsules contain stainless-steel powder mixed with the fissile material dioxide for heat transfer reasons.

It is expected that the ^{235}U and ^{239}Pu capsules will receive irradiation corresponding to about 16% burn-up of the fissile material, the ^{238}U capsule to about 0.7% burn-up, the ^{240}Pu capsule to about 4% burn-up and the ^{241}Pu capsule to about 23% burn-up.

A set of capsules identical to the irradiated set except for irradiation in the reactor will be dissolved and analysed alongside the irradiated set, the objective being to improve the reliability of the analyses.

The aim is to correlate loss of fissile material during irradiation with the amounts of fission products formed, for each capsule, (except ^{238}U) to enable absolute measurements of fission yields to be obtained.

Accuracy: $\pm$ 2% for ^{235}U and ^{239}Pu fission yields
$\pm$ 6% for ^{238}U, ^{240}Pu and ^{241}Pu fission yields

Expected completion date: 1982

UNITED KINGDOM

Laboratory and address:	Birmingham Radiation Centre	University of Birmingham P.O. Box 363 Birmingham B15 2TT United Kingdom
Names:	J.G. Owen, J. Walker, D.R. Weaver	
Facilities:	3MV Dynamitron accelerator (Birmingham) and the Tandem Van de Graaff and IBIS (Harwell)	
Experiments:	Delayed neutron spectrum measurements following monoenergetic fast neutron induced fission in ^{235}U and ^{239}Pu Spectrum measurement of an Am/Li source as recommended by the March 1979 Vienna Consultants' Meeting on Delayed Neutron Properties	
Method:	^{3}He spectrometers; for delayed neutron measurements cyclic irradiation and counting to give near-equilibrium contributions from all delayed neutron groups	
Accuracy:	A full covariance matrix is being calculated	
Publication:	A paper describing the Am/Li measurement and the method of obtaining the covariance matrix is in preparation	

UNITED KINGDOM

Laboratory and address :	University of London Reactor Centre, Silwood Park, Ascot, Berkshire, SL5 7PY, England.
Names :	J.B. Olomo, T.D. Mac Mahon
Facilities :	$4\pi\beta$-γ coincidence system, Ge(Li) detectors.
Experiment 1 :	Measurement of half-lives and absolute gamma ray emission probabilities in fission products.
Method :	Thin sources prepared from solutions of the radioisotope. Total disintegration rate measured in $4\pi\beta$-γ coincidence system. Gamma-ray emission rates determined using calibrated Ge(Li) detectors. Combination of results gives number of gamma rays emitted per disintegration (P_γ).
Accuracy :	Target accuracy is 1% (1σ) for P_γ, accuracies achieved within range 0.8 - 1.2%, limited mainly by efficiency calibration of Ge(Li) detectors.
Results :	^{140}La, $t_{\frac{1}{2}}$ = 40.295 ± 0.005 h. P_γ for 6 gamma rays of ^{140}Ba and 15 gamma rays of ^{140}La have been determined, and are listed in ref. 1, and will be published in open literature.
Discrepancies to other reported data :	There is good agreement with results of Debertin et al. (2) for most P_γ. ^{140}La half-life is most precise so far measured.

Experiment 2 :	A measurement of the half-life and thermal neutron cross-section of ^{154}Eu is commencing in collaboration with Dr. B.W. Hooton, A.E.R.E. Harwell.
Method :	Two ^{154}Eu sources have been produced, one by the ^{154}Sm(p,n)^{154}Eu reaction and one by the ^{153}Eu(n,γ)^{154}Eu reaction. Each source has had added to it some ^{60}Co. The decay of the ^{154}Eu 1274 keV gamma will be measured relative to the decay of the ^{60}Co gamma rays. The ^{154}Eu thermal neutron capture cross-section will be determined by measuring the rate of double neutron capture in ^{153}Eu leading to ^{155}Eu.
Accuracy :	It is estimated that the ^{154}Eu half-life could be determined to within 2% (1σ) after 1 year of decay.
Completion date :	mid-1981.

UNITED KINGDOM
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Publications : J.B. Olomo and T.D. Mac Mahon, "Half-lives of ^{46}Sc and ^{140}La", J. Phys. G : Nucl. Phys. 6 (1980) 367-368.

J.B. Olomo and T.D. Mac Mahon, "Gamma-Ray Emission Probabilities in the Decay of ^{144}Ce and ^{144}Pr", submitted to Journal of the British Nuclear Energy Society.

References :

1. J.B. Olomo, Thesis, University of London, 1979.

2. K. Debertin, U. Schotzig, K.F. Walz, Nucl. Sci. & Eng. 64 (1977) 784.

U. S. A.

Laboratory and address:	Argonne National Laboratory 9700 South Cass Avenue Argonne, Illinois 60439 USA
Names:	L. E. Glendenin, J. E. Gindler, J. W. Meadows
Facilities:	Fast-neutron generator facility (FNGF)
Experiment:	Determination of fission yields for monoenergetic neutron-induced fission as a function of incident neutron energy over the range 0.1 to 8 MeV.
Method:	Yields determined (1) radiochemically with either β- or γ-counting (RC) and (2) by γ-counting irradiated foils of fissionable material (γ). Neutrons produced by Li-p or D-d reaction. Flux monitored with fission chamber utilizing as the fission source the same material as that being irradiated. Absolute yields determined from flux measurements and/or 200% normalization of mass-yield distribution.
Accuracy:	Yields > 1% determined by γ-counting: 3-5% Yields < 1% determined by γ-counting: 5-20% Yields determined radiochemically with β-counting: 10-20%
Completion date:	Measurements of $^{238}U(n,f)$ for 1.5, 2.0, 3.9, 5.5, 6.9, and 7.7 MeV neutrons (published January 1978). $^{232}Th(n,f)$ completed; submitted to Phys. Rev. C., February 1980. $^{235}U(n,f)$ in progress. Continuing program for other fissile and fertile nuclides.
Publications:	"Mass distributions in monoenergetic-neutron-induced fission of ^{238}U" S. Nagy, K. F. Flynn, J. E. Gindler, J. W. Meadows, and L. E. Glendenin, Phys. Rev. C17, 163 (1978). "Fission yields for fast-neutron fission of uranium-238", J. E. Gindler, L. E. Glendenin, J. W. Meadows, and K. F. Flynn, Nucl. Sci. Eng. 70, 101 (1979).

U. S. A.

Laboratory and address:

Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois, 60439 USA

1. Measurement of fast-neutron capture cross sections of fission-product nuclei.

Authors:

W. P. Poenitz

Facilities:

Fast-neutron monoenergetic source capability based upon a tandem accelerator. Large liquid-scintillation detector.

Experiment:

Measurements of the fast-neutron capture cross sections of elemental rhodium, palladium, neodymium, and samarium were carried out in the energy range from 0.5-4.0 MeV. A large liquid scintillator and the time-of-flight technique were used in these measurements. The capture cross section of gold was used as a reference. The capture detection efficiency was in the range of 65-85% and is the major limiting factor for the uncertainty of the data which is ~10-15%.

Isotopes of the elements measured in the present work are among the 20 most important fission product nuclei. Data are rare or nonexistent in this energy range and evaluated data sets based upon nuclear model calculations differ substantially, with factors of 5 being common. The present results should provide a useful constraint for the evaluation of these cross sections. Extensive nuclear model calculations were carried out with the nuclear model code ABAREX. Parameter dependence was investigated and it was concluded that optical model parameters are insufficiently established in this mass region due to a lack of accurate total neutorn cross sections and scattering data.

A paper dealing with the above was contributed to the NEANDC Specialists' Meeting on Neutron Cross Sections of Fission Product Nuclei held in Bologna, December 12-14, 1979.

U. S. A.
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2. Measurement of neutron total cross sections in the fission-product region.

Authors:

W. P. Poenitz, J. Whalen, A. Smith and P. Guenther

Facilities:

Fast-neutron monoenergetic source capability based upon a tandem accelerator.

Experiment:

Accurate total-neutron-cross-section data are needed in the fission product mass region in order to establish reliable optical model parameter sets to be used in nuclear model calculations of capture cross sections. A perusal of existing data reveals a substantial lack of such data and/or the existence of discrepancies. Measurements were carried out in the energy range from 50 keV to 4.5 MeV for Y, Zr, Mo, Cd, Sn, Te, Ag, Nb, Rh, Pd, In, and Sb. These data await corrections for resonance self-shielding and will then be used together with scattering data for establishing optical model parameters.

U. S. A.

Laboratory and address: Argonne National Laboratory
Chemistry Division
9700 South Cass Avenue
Argonne, Illinois 60439, U.S.A.

Names: A. H. Jaffey, E. P. Steinberg, J. E. Gindler, J. Gray
E. P. Horwitz, J. P. Hughes and F. J. Schmitz

EXPERIMENT: BRANCHING FRACTION IN THE RADIOACTIVE DECAY OF ^{85m}Kr

Method:

Two samples of highly enriched ^{235}U were irradiated, one to 1.7% and the other to 42% burnup. For each sample, the ^{85}Kr gas was diluted with a known amount of carrier krypton, extracted, purified, and quantitatively diluted to a level suitable for counting. The ^{85}Kr was counted in GM counters whose efficiency was calibrated with a ^{85}Kr sample whose absolute counting rate had been measured to $\sim$ 1%. The ^{85}Rb content of the dissolver solution was measured by mass spectrometric isotope dilution. The ratio of total ^{85}Kr to total ^{85}Rb, when corrected for decay of ^{85}Kr, yields the branching fraction value 0.2160.

Accuracy:

1% (standard error).

Completion Date:

May, 1979

Discrepancies with Other Reports:

Other Values	References
0.211 ± .005	L. D. McIsaac, et al., Aerojet Report ANCR-1088, pp. 387-8 (October, 1972)
(γ-ray, conversion electron measurement)	F. K. Wohn, et al., Nucl. Phys. A152, 561 (1970) R. A. Meyer, et al., Livermore Report UCRL (80088), October, 1977
0.2176 ± 0.0024	F. L. Lisman, et al., J. Inorg. Nucl. Chem. 33, 643 (1971)
0.2194 ± .0008	W. J. Maeck, et al., Allied Chemical Report ICP-1142 (1978)

Publication:

Argonne National Laboratory Report ANL-79-107, February, 1980

U. S. A.

Laboratory and address: Idaho National Engineering Laboratory
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, Idaho 83415 USA

Name: R. A. Anderl and Y. D. Harker

Experiment: Integral cross-section measurements in fast-reactor-type environments.

Method: Enriched isotopes of fission-product-class materials are irradiated in the fast neutron fields of the Coupled Fast Reactivity Measurements Facility (CFRMF) and of the Experimental Breeder Reactor-II (EBR-II). The integral capture cross sections are derived from measurements which utilize gamma spectrometry and/or mass spectrometry. The neutron fields are characterized by means of transport calculations, active neutron dosimetry or passive neutron dosimetry. The integral data are suitable for integral testing of multigroup cross sections by least squares adjustment techniques.

Accuracy: 3% - 10% (1σ uncertainty)

Measurements Completed: Integral capture cross sections have been measured for $\sim$50 reactions for fission-product samples irradiated in the CFRMF. These earlier measurements have been re-evaluated and re-analyzed and the integral data are now based on ENDF/B-V decay data. Integral data measured for irradiation of Nd, Sm and Eu samples in EBR-II have been used in cross-section adjustments.

Publications:

Y. D. Harker and R. A. Anderl, "Integral Cross-Section Measurements on Fission Products in Fast Neutron Fields", invited paper presented at the NEANDC Specialist Meeting on Neutron Cross Sections of Fission-Product Nuclei, Dec. 12-14, 1979, Bologna, Italy.
R. A. Anderl et al. "Neodymium, Samarium and Europium Capture Cross-Section Adjustments Based on EBR-II Integral Data", contributed paper presented at the International Conference on Nuclear Cross Sections for Technology, Oct. 22-26, 1979, Knoxville, Tennessee, USA.

U. S. A.

Laboratory and address: Idaho National Engineering Laboratory
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, Idaho 83415 USA

1. Names: R. J. Gehrke, R. G. Helmer

Facilities:
1) 4π β-γ coincidence counting system
2) Calibrated Ge(Li) spectrometers

Experiment: Determination of absolute γ-ray emission probabilities for important fission-product isotopes.

Method: The decay rates are determined by the 4π β-γ coincidence counting system, which has two separate pulse-processing systems. One system is based on fixed pulse widths. The other is based on variable pulse widths and an overlap coincidence circuit. The dead time of the beta, gamma and coincidence channels is measured by counting the pulses from a 10 MHz clock.
The variable pulse width system is useful in measuring the γ-ray emission probabilities of short-lived (<30 m) fission products, where high count rates are needed.
The γ-ray emission rates are determined by Ge(Li) spectrometers whose efficiencies have been measured to an accuracy of $\pm$1-1/2% (1σ) between 0.3 and 2 MeV.

Accuracy: $\pm$1% to $\pm$5% (1σ uncertainty)

Measurement Completed: Emission probability of the prominent 748-keV γ ray from ^{145}Pr has been measured to a precision of 1.7% (1σ level) and the half-life has been remeasured with a precision of 0.17%. The relative intensities of the more intense γ rays were also measured. The emission probability of the 453-keV γ-ray from ^{146}Pr was also measured to a precision of $\sim$3% and its half-life was measured to a precision of $\sim$0.7%.

Completion Date: Measurement activity is an on-going effort.
^{141}La measurement in progress.
^{142}La measurement in progress.

Publications: R. J. Gehrke "Gamma-ray Emission Probabilities and Half-life of ^{139}Ba", Int. J. Appl. Radiat. and Isotopes, 31, 37 (1980).

U. S. A.

(cont'd)

	R. J. Gehrke and J. D. Baker "Absolute Intensities of the γ Rays Emitted in the Decay of ^{145}Pr", Int. J. Appl. Radiat. and Isotopes (in press). R. J. Gehrke and J. D. Baker "Emission Probability of the 453-keV γ Ray Emitted in the Decay of ^{146}Pr", Int. J. Appl. Radiat. and Isotopes (in press).

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2. Name:	R. C. Greenwood, R. J. Gehrke, J. D. Baker, D. H. Meikrantz, and V. J. Novick
Experiment:	Nuclear decay properties ($T_{1/2}$, γ-branching, β-branching) of short-lived fission products
Facility:	2-100 μg ^{252}Cf fission-product sources coupled via He-gas jet transport to a chemical separation laboratory
Method:	Fast on-line chemical separations using continuous centrifugal contactors and high pressure liquid chromatography followed by γ- and β-ray measurements
Measurements Completed:	The $T_{1/2}$ and γ-ray energies and intensities for the following fission products: ^{113}Pd-^{113}Ag, ^{114}Pd-^{114}Ag, ^{115}Pd-^{115}Ag, ^{157}Sm-^{157}Eu, ^{158}Sm-^{158}Eu.
Publications:	J. D. Baker, R. J. Gehrke, R. C. Greenwood, D. H. Meikrantz and V. J. Novick, "A New Isotope ^{158}Sm; Comments on the Decay of ^{157}Sm" J. Inorganic Nucl. Chem. (in press). J. D. Baker, R. J. Gehrke, R. C. Greenwood and D. H. Meikrantz, "Rapid Separation of Individual Rare-Earth Elements from Fission Products" Radiochim. Acta. (in press).

U. S. A.

Laboratory: Idaho National Engineering Laboratory

Address: Exxon Nuclear Idaho Co., Inc.
P. O. Box 2800
Idaho Falls, Idaho 83401
United States

1. Name: William J. Maeck

Experiment: Fast Reactor Fission Yields and Determination of Burnup for Fast Reactor Fuels (update)

A program is in progress at the Idaho Chemical Processing Plant (ICPP) laboratories to accurately measure absolute fast reactor fission yields for ^{233}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, and ^{243}Am. The irradiations were conducted in EBR-II, Row-8. Reports have been issued giving fast reactor yield data for ^{233}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu.

Method: The principal measurement technique was isotope dilution mass spectrometry for the isotopes of Kr, Rb, Sr, Zr, Mo, Ru, Xe, Ce, Ba, La, Ce, Nd, and Sm. The number of fissions was established by summing the total number of atoms in the heavy mass peak.

Accuracy: In general, the uncertainties assoicated with ^{233}U, ^{235}U, ^{237}Np, ^{239}Pu, ^{241}Pu, and ^{242}Pu yields range from 1.0-1.5% relative, and for ^{238}U and ^{240}Pu yields, the uncertainties range from 1.5-3.0% relative.

Future Work: To augment the fast yield data obtained from the irradiation in Row-8 of EBR-II, samples of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu which were irradiated in Row-4 of EBR-II have been analyzed. These data will provide more information relative to the effect of neutron energy on fission yields. A report giving fast reactor fission yields for samples of ^{233}U and ^{235}U irradiated in Row-4 of EBR-II has been issued. A similar report for ^{239}Pu and ^{241}Pu will be issued in the summer of 1980.

Special Comments: All yield data reported from this work are associated with a measured or calculated neutron spectrum. The study to correlate yields with neutron energy is continuing.

Publications: The results of this measurement program have been published in the reports listed below. These reports are available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, Virginia, 22161, USA.

U. S. A.

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1. W. J. Maeck, Editor, "Fast Reactor Fission Yields for ^{233}U, ^{235}U, ^{238}U, ^{239}Pu and Recommendations for the Determination of Burnup on FBR Mixed-Oxide Fuels: An Interim Project Report," Allied Chemical Corporation - Idaho Chemical Programs Rept., ICP-1050-I (January 1975).

2. W. J. Maeck, Editor, "Fast Reactor Fission Yields for ^{239}Pu and ^{241}Pu," Allied Chemical Corporation - Idaho Chemical Programs Rept., ICP-1050-II (August 1977).

3. W. J. Maeck, W. A. Emel, A. L. Erikson, J. E. Delmore, J. W. Meteer, "Fast Reactor Fission Yields for ^{237}Np," Allied Chemical Corporation - Idaho Chemical Programs Rept., ICP-1050-III (September 1977).

4. W. J. Maeck, R. L. Eggleston, A. L. Erikson, R. L. Tromp, "Fast Reactor Fission Yields for ^{240}Pu and ^{242}Pu," Allied Chemical Corporation - Idaho Chemical Programs Rept., ICP-1050-IV (February 1979).

5. W. J. Maeck, A. L. Erikson, R. L. Tromp, "Fast Reactor Fission Yields for ^{233}U and ^{235}U Irradiated in Row-4 of EBR-II, Exxon Nuclear Idaho Co., Inc., Rept., ENICO-1028 (February 1980).

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2. Name: William J. Maeck, R. L. Tromp

Experiment: Fast Reactor Fission Yield Measurements in FFTF. (new)

For many years, personnel at the Idaho Chemical Processing Plant (now operated by Exxon Nuclear Idaho Company, Inc.) at the Idaho National Engineering Laboratory, have been involved in the accurate measurement of absolute fission yields for use in the determination of burnup in fast reactor fuels. As a continuing effort of this program, an irradiation of heavy element nuclides (^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu) is planned for the eight-day full-power run associated with the FFTF Reactor Characterization Experiment at Hanford, Washington.

The primary purpose is to generate a group of heavy element reference standards for which the number of fissions and burnup are well known. By combining this experiment with others of a similar nature, these samples will serve as reference and comparison standards. A secondary purpose is to verify the fast reactor fission yields measured in EBR-II

U. S. A.

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and to assess the validity of using EBR-II values for irradiations conducted in FFTF.

For this experiment, ten samples each of highly-enriched ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu (as oxides), sealed in high-purity nickel capsules will be irradiated. Eight capsules (two each of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu) will be placed axially in one of the removable pins in Rows 1, 2, 4, 5, and 6. Each pin will be located immediately adjacent to an ILLR dosimetry package pin. The amount of material in each sample capsule has been adjusted such that each individual sample will give about 10^{19} fissions. The irradiation is scheduled for late 1980.

After completion of the irradiation, the samples will be returned to Idaho for analysis. The samples in Rows 1 and 6 will be dissolved and analyzed for the following fission product elements using isotope dilution mass spectrometry: Kr, Rb, Sr, Zr, Mo, Ru, Xe, Cs, Ba, La, Ce, Nd, and Sm. The absolute number of fissions will be established by summing the number of fission product atoms in the heavy mass peak. The samples in Rows 2, 4, and 5 will only be partially analyzed, principally for Nd, Cs, Kr, and Xe, to establish relative fission yield values for the intermediate reactor positions. Extensive correlation of the isotopic composition and fission yields of several of the fission product elements as a function of neutron energy will be made.

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3. Name: William J. Maeck

Experiment: Thermal Fission Yields for ^{235}U and ^{239}Pu (update)

An existing experiment has been extended to remeasure the major fraction of the mass yield curve for the thermal fission of ^{235}U and ^{239}Pu. The need for this program resulted from serious discrepancies in some measured relative isotopic ratios for certain isotopes in the thermal fission of ^{239}Pu. New yield values, based on the analysis of six ^{235}U samples (three at 1 a/oF and three at $\sim$ 35 a/oF) and seven ^{239}Pu samples (three at 1 a/oF and four at 50 a/oF) have been published.

U. S. A.

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Method: The principal measurement technique was isotope dilution mass spectrometry for the isotopes of Kr, Rb, Sr, Zr, Mo, Ru, Xe, Cs, Ba, La, Ce, Nd, and Sm. For the ^{235}U samples, the number of fissions was established by two methods: 1) the summation of the total atoms in the heavy mass peak; and 2) the heavy element difference technique. For the ^{239}Pu samples, the number of fissions was established using the summation method.

Accuracy: The uncertainties associated with these new ^{235}U and ^{239}Pu yields range from 0.5 - 1.5% relative. A comparison of the number of fission determined by the summation technique and the heavy element difference technique show an agreement of $\pm$ 0.5% relative.

Data Discrepancies: See Publications.

Publications:

1. J. E. Delmore, L. L. Dickerson, F. A. Duce, W. A. Emel, J. H. Keller, W. J. Maeck, R. L. Tromp, "Discrepancies and Comments Regarding ^{235}U and ^{239}Pu Thermal Fission Yields and the Use of ^{148}Nd as a Burnup Monitor," Allied Chemical Corporation - Idaho Chemical Programs Report ICP-1092 (December 1976).

2. F. A. Duce, W. A. Emel, W. J. Maeck, J. W. Meteer, R. L. Tromp, "Absolute Thermal Fission Yields for ^{235}U," Allied Chemical Corporation - Idaho Chemical Programs Report ICP-1142 (September 1978).

3. F. A. Duce, R. L. Eggleston, W. A. Emel, W. J. Maeck, J. W. Meteer, R. L. Tromp, "Absolute Thermal Fission Yields for ^{239}Pu," Exxon Nuclear Idaho Company Report ENICO-1001 (September 1979).

U. S. A.

(cont'd)

4. Name: William J. Maeck

Experiment: Natural Fission Reactor Studies: ^{238}U Spontaneous Fission Yields (update)

In the process of analyzing approximately 25 rich uranium ore samples for fissiogenic ruthenium, a preliminary estimate of the ^{238}U spontaneous fission yields for ^{99}Ru, ^{101}Ru, ^{102}Ru, and ^{104}Ru has been obtained. The measurement technique was mass spectrometry.

After correction for the natural Ru component and the fissiogenic component resulting from ^{235}U induced fission, the best estimate for the isotopic composition of ^{238}U spontaneous fission Ru is:

99	0.236
101	0.285
102	0.314
104	0.165

Using a value of 6.0% for the ^{238}U spontaneous fission yield of ^{99}Mo, the preliminary ^{238}U spontaneous fission yields for the Ru isotopes are:

^{99}Ru	6.0% (relative to ^{99}Mo)
^{101}Ru	7.25
^{102}Ru	8.0
^{104}Ru	4.2

These values have been updated and supersede those reported in INDC (NDS)-86.

A new ore sample, believed to have a very high fraction of spontaneous fission is being hi-graded and will be analyzed to give improved ^{238}U spontaneous fission data for ruthenium. Mass spectrometric techniques are being investigated for the possibility of measuring the ^{238}U SF yields for ^{107}Pd, ^{135}Cs, and ^{129}I.

U.S.A.

LABORATORY	Lawrence Livermore Laboratory University of California P.O. Box 808 Livermore, CA 94550, U.S.A.	+ McClellan Central Laboratory 1155th Technical Operations Squadron McClellan AFB, CA 95652
1. NAMES	D. R. Nethaway A. L. Prindle D. H. Sisson	+ M. V. Kantelo + R. A. Sigg

FACILITY — FLATTOP Critical Assembly (Pu), Los Alamos Scientific Laboratory

EXPERIMENT — Measure fission yields for fission of Am-241 induced by fission-spectrum neutrons.

METHOD — Measurements were made by doing chemical separations on the irradiated Am-241 samples and by using the recoil catcher-foil technique. Absolute yields are based on a normalization of the mass-yield curve.

COMPLETION DATE — The measurements are finished, and a rough draft of a report for publication is being prepared.

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2. NAMES	D. R. Nethaway A. L. Prindle D. H. Sisson	+ M. V. Kantelo + R. A. Sigg

FACILITY — Livermore ICT Facility (14-MeV neutron source)

EXPERIMENT — Measure fission yields for fission of Am-241 induced by 14.8-MeV neutrons.

METHOD — Measurements were made by doing chemical separations on the irradiated Am-241 samples, and by using the recoil catcher-foil technique. The accuracy of the measurements is about $\pm$ 5%. Absolute yields are based on a normalization of the mass-yield curve.

COMPLETION DATE — The experiment is finished.

PUBLICATION — Phys. Rev. C <u>20</u>, 1824 (1979), (Report UCRL-82601)

U. S. A.
(cont'd)

3. NAMES	D. R. Nethaway A. E. Richardson*
FACILITY	Livermore ICT Facility (14-MeV neutron source)
EXPERIMENT	Measure independent fractional chain yields of ^{148m}Pm, ^{148g}Pm, and ^{150}Pm for fission of ^{235}U and ^{238}U induced by 14.8-MeV neutrons
METHOD	Measurements were made with Ge(Li) detectors on chemically-separated promethium and neodymium samples. The yields of ^{148}Pm and ^{150}Pm were measured relative to the mass 147, 149, and 151 chain yields with an accuracy of about $\pm$ 10%.
COMPLETION DATE	The experiment is finished.
PUBLICATION	The manuscript has been sent to J. Inorg. Nucl. Chem. A preprint is available as UCRL-84054 (Mar. 1980).

*Permanent address: Department of Chemistry, New Mexico State University, Las Cruces, NM 88003, U.S.A.

U.S.A.

Laboratory and Address: Oak Ridge National Laboratory
P. O. Box X, Building 6010
Oak Ridge, Tennessee 37830, USA

1. Names: J. K. Dickens and J. W. McConnell

Facilities: Fast Rabbit Transport Station at the Oak Ridge Research Reactor (ORR).

Experiment: (revised) Absolute yields of forty-nine fission products, representing thirty-six mass chains created by thermal-neutron fission of ^{239}Pu have been determined.

Method: A one microgram sample of ^{239}Pu was irradiated for 100 sec with thermal neutrons. Following irradiation the sample was moved to a low-background counting area. Gross fission product gamma-ray spectra were obtained using a large-volume Ge(Li) detector. Counting intervals were initiated between 1550 and 2.6×10^6 sec following the end of the irradiation.

Accuracy: Absolute 1σ uncertainties range between 2.5 and 25%, made up of 2.0% uncertainty assigned to detector efficiency, 1.3% uncertainty in determining the number of fissions created in the sample, and uncertainties in peak extraction and in branching ratios and lifetimes given in the literature.

Completion Date: January 1979

Discrepancies to Other Report Data: Cumulative fission yields agree well with previous measurements and recommended evaluations except for mass chains 101 and 105, for which the present results are larger than previously determined.

Publications: J. K. Dickens and J. W. McConnell, "Fission-product Yields for Thermal-neutron Fission of ^{239}Pu," Nucl. Sci. Eng. 73, 42 (1980).

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2. Names: J. K. Dickens

Facilities: Fast Rabbit Transport Station at Oak Ridge Research Reactor (ORR).

Experiment: (revised) Absolute yields of seventeen fission products, representing sixteen mass chains created by thermal-neutron fission of ^{241}Pu have been determined.

Method: A one microgram sample of ^{241}Pu was irradiated for 50 sec with thermal neutrons. Following irradiation the sample was moved to a low-background counting area. Gross fission-product gamma-ray spectra were obtained using a large volume Ge(Li) detector. Six counting measurements were made between 17 and 210 hours after the irradiation.

U.S.A.
(cont'd)

Accuracy: Between 4% and 15% (1σ), made up of 2.5% uncertainty assigned to detector efficiency, 2.8% uncertainty in determining the number of fissions created in the sample, and the remainder due to uncertainties in peak extraction and in branching ratios and lifetimes given in the literature. Uncertainties assigned to nine of the measured yields are smaller than existing evaluated uncertainties for these yields.

Completion Date: September 1978

Discrepancies to Other Report Data: Data agree with evaluation of Crouch (E.A.C. Crouch, Atomic Data and Nucl. Data Tables 19, 419 (1977)) for fifteen of the measured values.

Publications: J. K. Dickens, "Fission Yields for Thermal-Neutron Fission of ^{241}Pu," Nucl. Sci. Eng. 70, 177 (1979).

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3. Names: J. K. Dickens and R. W. Peelle

Facilities: Fast Rabbit Transport Station at Oak Ridge Research Reactor (ORR).

Experiment: (revised) Total Beta and Gamma Energy Release for Thermal-Neutron Fission of ^{235}U, ^{239}Pu, and ^{241}Pu for Cooling Times of 2 to 14000 sec.

Method: Microgram samples of ^{235}U, ^{239}Pu, and ^{241}Pu have been irradiated for short periods with thermal neutrons, and returned pneumatically to a counting area. Beta- and gamma-ray energy spectra of moderate resolution have been obtained using scintillation detectors (NE110 for beta rays and NaI for gamma rays) for selected time intervals within the time range of interest. The spectra have been reduced to differential production cross sections $d\sigma/dE$ and have been integrated to obtain total energy release rates for beta and gamma rays (separately). These data have been summed to obtain the total energy release.

Accuracy: 3% (1σ) for ^{235}U and ^{239}Pu, 4% for ^{241}Pu.

Completion Date: May 1977 for ^{235}U, December 1977 for ^{239}Pu, and August 1978 for ^{241}Pu.

Discrepancies to Other Report Data: Data are in reasonable agreement with other recent experiments and with results of summation calculations. However, present results are up to 15% smaller than recent data from Los Alamos; these discrepancies have not been resolved.

Publications: J. K. Dickens, J. F. Emery, T. A. Love, J. W. McConnell, K. J. Northcutt, R. W. Peelle, and H. Weaver, "Fission-Product Energy Release for Times Following Thermal-Neutron Fission of ^{235}U Between 2 and 14000 Seconds," ORNL/NUREG-14 (October 1977).

U.S.A.
(cont'd)

Publications: -continued-

J. K. Dickens, J. F. Emery, T. A. Love, J. W. McConnell, K. J. Northcutt, R. W. Peelle, and H. Weaver, "Fission-Product Energy Release for Times Following Thermal-Neutron Fission of ^{239}Pu Between 2 and 14000 Seconds," ORNL/NUREG-34 (April 1978).

J. K. Dickens, T. A. Love, J. W. McConnell, J. F. Emery, K. J. Northcutt, R. W. Peelle, and H. Weaver, "Delayed Beta- and Gamma-Ray Production Due to Thermal-Neutron Fission of ^{235}U, Spectral Distributions for Times After Fission Between 2 and 14000 Sec: Tabular and Graphical Data," NUREG/CR-0162, ORNL/NUREG-39 (August 1978).

J. K. Dickens, T. R. England, T. A. Love, J. W. McConnell, J. F. Emery, K. J. Northcutt, and R. W. Peelle, "Delayed Beta- and Gamma-Ray Production Due to Thermal-Neutron Fission of ^{239}Pu: Tabular and Graphical Spectral Distributions for Times After Fission Between 2 and 14000 Sec," NUREG/CR-1172, ORNL/NUREG-66 (January 1980).

J. K. Dickens, T. A. Love, J. W. McConnell, and R. W. Peelle, "Fission-Product Energy Release for Times Following Thermal-Neutron Fission of ^{235}U Between 2 and 14000 Seconds," Nucl. Sci. Eng. 74, 106 (1980).

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4. Names: J. K. Dickens, J. W. McConnell, and K. J. Northcutt

Facilities: Fast Rabbit Transport Station at the Oak Ridge Research Reactor (ORR).

Experiment: (new) Absolute yields of twenty-nine fission products having half-lives between 30 and 1100 sec, representing twenty-three mass chains created by thermal-neutron fission of ^{239}Pu have been determined.

Method: A one microgram sample of ^{239}Pu was irradiated for 5 sec with thermal neutrons. Unseparated fission product gamma-ray spectra were obtained using a large-volume Ge(Li) detector. Counting intervals were initiated between 35 and 1115 sec following the end of the irradiation.

Accuracy: Absolute 1σ uncertainties range between 6 and 25%, including 2.0% uncertainty assigned to detector efficiency, 1.2% uncertainty in determining the number of fissions created in the sample, and uncertainties in peak extraction and in branching ratios and lifetimes given in the literature.

Completion Date: March 1980

Discrepancies to Other Report Data: Cumulative fission yields are in fair agreement with previous measurements and recommended evaluations.

U. S. A.
(cont'd)

Publications: J. K. Dickens, J. W. McConnell, and K. J. Northcutt, "Yields of Short-Lived Fission Products Created During Thermal-Neutron Fission of ^{239}Pu," (preprint available May 1980).

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5. Names: J. K. Dickens and J. W. McConnell

Facilities: Fast Rabbit Transport Station at Oak Ridge Research Reactor (ORR)

Experiment: (new) Absolute yields of fifty-one mass chains created by thermal-neutron fission of ^{245}Cm have been determined from data obtained for 105 gamma rays following decay of 95 fission products.

Method: A one microgram sample of ^{245}Cm was irradiated for three irradiation periods: 4 sec, 40 sec, and 6 min with thermal neutrons. Following an irradiation the sample was moved to a gamma-ray counting area. Unseparated fission-product gamma-ray spectra were obtained using a large volume Ge(Li) detector. One hundred fifteen counting measurements were made between 30 sec and 0.3 yr after irradiation.

Accuracy: Between 8% and 50% (1σ), made up of 8% uncertainty in determining the number of fissions created in the sample, and the remainder due to uncertainties in peak extraction and in branching ratios and lifetimes given in the literature. Relative uncertainties range between 3% and 50%.

Completion Date: January 1980

Discrepancies to Other Report Data: Data agree with most prior measurements (von Gunten et al., Phys. Rev. 161, 1192 (1967); Harbour and MacMurdo, J. Inorg. Nucl. Chem. 34, 2109 (1972); Ramaswami et al., J. Inorg. Nucl. Chem. 41, 1649 (1979); Troutner and Harbour, Phys. Rev. C4, 505 (1971); and Harbour et al., Phys. Rev. C10, 769 (1974). Data disagree with measurements of Datta et al., Phys. Rev. C21, 1411 (1980).

Publications: J. K. Dickens and J. W. McConnell, "Yields of Fission Products Created by Thermal-Neutron Fission of ^{245}Cm," preprint available June 1980.

U. S. A.

Laboratory and Address:

Pacific Northwest Laboratory
P. O. Box 999
Richland, WA 99352
USA

Names: P. L. Reeder and R. A. Warner

Facilities: SOLAR - Spectrometer for On-Line Analysis of Radionuclides. This is an on-line mass spectrometer which incorporates a ^{235}U target in a surface ionization source located in the thermal column of a 1 MW TRIGA reactor at Washington State University, Pullman, WA.

Experiment: Isomer yield ratios for $^{235}U + n_{th}$.

Method: Ratios of independent yields of fission product isomers are being measured for thermal neutron fission of ^{235}U by use of an on-line mass spectrometric technique. A short burst of neutrons from the TRIGA reactor is used to produce various isomers of Br, Rb, In, I and Cs fission products within the surface ionization source. Selective ionization performs the rapid chemical separations and magnetic analysis performs the mass separation to give the desired nuclides as a beam of ions. Ions are collected on a moving tape collector system for a short time interval during and after the neutron pulse. The radioactive decay of the two isomers is followed by beta and gamma counting to determine the relative yield of each isomer.

Accuracy: The final accuracy will probably depend more on how well the decay schemes are known for particular cases than on statistical uncertainties.

Completion Date: Work is continuing.

U.S.A.
(cont'd)

Laboratory and Address: Pacific Northwest Laboratory
P. O. Box 999
Richland, WA 99352

Names: P. L. Reeder and R. A. Warner

Facilities: SOLAR - This is an on-line mass spectrometer which incorporates a ^{235}U target in a surface ionization source located in the thermal column of a 1 MW TRIGA reactor at Washington State University, Pullman, WA.

TRISTAN - This is an on-line isotope separator located at the High Flux Beam Reactor at Brookhaven National Laboratory, Upton, NY.

Experiment: Average neutron energy and width of the neuton spectrum are being measured for separated delayed-neutron precursors.

Method: Delayed neutrons from separated precursors are counted in a polyethylene moderated counter containing 3 rings of counter tubes. The ratio of counts in one ring compared to counts in another ring has been determined for several standard sources and the calibration of ring ratio versus average energy is known. The previously published technique[1] has been modified to give a more accurate calibration curve and the technique has been extended to measure the width of the neutron energy spectrum as well.

Accuracy: The average energies are being measured by this ring ratio technique as a check on delayed neutron spectra measured by various types of neutron spectrometers.[2]

Discrepancies: Comparisons of average energies measured by different techniques are given in Ref. 3. However, the ring ratio data reported there will be modified by the improved calibration technique presently in use.

Publications:

1. P.L. Reeder, J. F. Wright and L. J. Alquist, Phys. Rev. C 15, 2198 (1977), "Average Neutron Energies from Separated Delayed Neutron Precursors,"

2. P. L. Reeder, L. J. Alquist, R. L. Kiefer, F. H. Ruddy and R. A. Warner, "Energy Spectra of Delayed Neutrons from Separated Precursors - ^{93}Rb, ^{94}Rb, ^{95}Rb and ^{143}CS," Nucl. Sci. Eng. (to be published).

3. P. L. Reeder and R. A. Warner, "Measurement of Average Neutron Energies by a Counting Rate Ratio Technique," in Proceedings of the Consultants' Meeting on Delayed Neutron Properties, Vienna, 26-30, March 1979, International Atomic Energy Agency, INDC (NDS)-107/G + Special, page 239*).

*) Data for $^{92-98}Rb$ and $^{141-147}Cs$

U.S.A.

Laboratory and address: University of Illinois
Nuclear Radiation Laboratory
Nuclear Engineering Program
Urbana, Illinois 61801
U.S.A.

Names: Bernard W. Wehring

Facilities: Illinois Advanced TRIGA 1.5-MW Nuclear Reactor, HIAWATHA Fission-Fragment Mass Spectrometer.

Experiment: Direct Physical Measurement of the Primary Postneutron-Emission Nuclide Yields in Thermal-neutron Fission of U-235, Pu-239, and U-233

Method: The fission-fragment recoil mass spectrometer HIAWATHA, consisting of a cylindrical focusing electrostatic analyzer and time-of-flight system, is used to determine fragment masses while fragment energy loss is used to identify fragment atomic numbers in multiparameter experiment. All fragment velocities and charge states are measured.

Accuracy: 0.5-amu mass resolution, achieved,
about 1-Z atomic-number resolution, achieved,
1% standard error (relative error) in largest mass yield,achieved,
0.02-0.1% standard error (absolute error) in nuclide yields,achieved.

Completion date:

Publications:

Gino DiIorio, "Direct Physical Measurement of Mass Yields in Thermal Fission of Uranium 235," Ph.D. Thesis, University of Illinois at Urbana-Champaign, 1976.

Gino DiIorio and B.W. Wehring, "Direct Physical Measurement of Mass Yields for $^{235}U(n_{th},f)$," Trans. Am. Nucl. Soc. 24, 459 (1976).

Gino DiIorio and B.W. Wehring, "HIAWATHA, A Fission-Fragment Recoil Mass Spectrometer," Nucl. Instr. Methods 147, 487 (1977).

R.B. Strittmatter, "Nuclide Yields for Thermal Fission of Uranium 235," Ph.D. Thesis, University of Illinois at Urbana-Champaign, 1978.

R.B. Strittmatter and B.W. Wehring, "Direct Measurement of Nuclide Yields in Thermal-Neutron Fission Using HIAWATHA," Proceedings of the International Conference on Neutron Physics and Nuclear Data for Reactor and other Applied Purposes, Harwell, September 25-29, 1978.

R.B. Strittmatter and B.W. Wehring, "Fragment Atomic-Number Identification Using a Gas Ionization Chamber in Fission Yield Measurements," Nucl. Instr. Methods 166, 473 (1979).

U.S.A.

Laboratory and address:	University of Missouri Research Reactor Facility Columbia, Missouri 65211, USA
Name:	David E. Troutner
Facility:	10-megawatt research reactor. Fluxes up to 7 x 10^{14} n cm^{-2} S^{-1}. Pneumatic transfer tubes terminating in flux of 10^{14} n cm^{-2} S^{-1}.
Experiment:	Primary yields of products from neutron-induced fission.
Method:	Fission products are separated and purified by radiochemical methods and radioactivity determined by Ge(Li) detectors. Current facilities limit experiments to those which require separation times of about 1 minute or longer. Emphasis is on comparison of primary yields from fission of Cf-249 to those of fission of U-233. Yields from Cf-249 fission appear to be consistent with the charge distribution wider than that found for fission of U-233 and U-235.
Publications:	M.A. Monzyk and D.E. Troutner, "Fractional independent yields of Ba-139 and La-142 from the thermal-neutron-induced fission of Cf-249", Phys. Rev. C20, 212 (1979). D.K. Pal and D.E. Troutner, "Fractional independent yields of La-141 and La-142 from thermal-neutron-induced fission of U-233", submitted to J. Inorg. Nucl. Chem.

U.S.S.R.

Laboratory and address: Institute for Nuclear Research, Ukr. SSR Academy of Sciences, Prospekt Nauki 119, Kiev-28, USSR

Names: V.P. Vertebnyi, P.N. Vorona, A.I. Kalchenko, V.G. Krivenko, V.Y. Pshenichnyi

Facilities: Atomic Reactor WWR-M, Liev
Fast chopper

Experiments: Study of radioactive and stable Europium isotopes:

Resonance parameters, total cross sections $\sigma_t(E_n)$, neutron capture cross sections of the following Europium isotopes have been obtained:

isotope :	^{151}Eu	^{152}Eu	^{153}Eu	^{154}Eu	^{155}Eu
neutron energy range eV	0.02-110	0.02-20	0.02-600	0.02-20	0.02-20

Method: Time-of-flight spectrometry

Accuracy: 2 - 20%

Completion date: partially completed (see publications)

Discrepancies to other reported data: Total cross sections σ_t of stable isotopes of Europium 151, 153 for neutron energy E_n=0,0253 disagree with those of N.J. Pattenden (Second Geneva Conf., vol.16, p.43, paper p/II, 1958), G.J. Sims et al. (Nucl. Chem., 29, 2671, 1967) and for Europium 153 with L.H. Widder (Nucl. Sci. Eng., 60, N1, 53, 1976).

Publications:

1) "Research interaction of slow neutrons with radioactive ^{152}Eu", Proc. II All-Union Conf. on Neutron Physics, Kiev, v.2, p.85, Moscow (1973).
2) "Energy dependence determination of the total neutron cross section of the radioactive nucleus Eu-152g ($T_{1/2}$ = 12,4 y) for thermal neutrons". Report KINI-75-14, Kiev, 1975.
3) "Neutron resonances of radioactive Eu-152 with half-life 12,4 years". Report KINI-76-16, Kiev, 1976.
4) "Neutron resonances of radioactive isotope ^{152}Eu($T_{1/2}$ = 12,4 years)" International Conference on the Interactions of Neutrons with Nuclei, Lowell, USA, 6-8 July 1976 (contributed paper PG 1/B8).
5) "Study of neutron resonances of radioactive isotope ^{152g}Eu", Yad.Fiz.26, 1137(1977); English Sov.Nucl.Phys.26,601 (1977).

Note: Look also CINDA-76/77 and Supplement 5 CINDA-78 (by the IAEA, Vienna)

U.S.S.R.

Laboratory and address: Lensovjet Institut of Technology
Leningrad 198013, USSR

Names: V.F. Teplykh, E.V. Platygina, K.A. Petrzhak

Facilities: Mass-spectrometer

Experiments: Measurement of relative yields of Xenon isotopes for the fission of Th-232, U-235, Np-237, Pu-239 induced by 14.7 MeV neutrons and for the photofission of U-235, Np-237, Pu-239 by 15 and 20 MeV bremsstrahlung.

Method: After irradiation and cooling, Xenon isotopes were isolated from targets by thermal means.
Relative isotopic yields were measured on the mass-spectrometer.
Cumulative (chain) yields were calculated from the absolute I-131 yield. The absolute I-131 yield was measured by radiochemical methods.

Accuracy: The accuracy achieved for relative yields is within 0.6-2% (1σ), with a mean accuracy of 1%, with the exception of 15 MeV photofission of Np-237.
The accuracy of the radiochemical method is within 4-6%.

Completion date:

Np-237(γ,f)	: completed October 1975
Th-232(n,f) U-235(n,f),(γ,f) Pu-239(n,f),(γ,f)	: November 1976
Np-237(n,f)	: July 1978

Results:

Fissionable nucleus	Energy MeV	Yields, % Xe-131	Xe-132	Xe-134	Xe-136
Th-232+n	14.7	14.15±.3	18.8 ±.3	28.7 ±.75	38.25±.4
		2.05	2.70	4.73	5.50
U-235+n	14.7	20.75±.3	25.05±.4	28.35±.4	25.85±.4
		4.03	4.86	5.51	5.02
Pu-239+n	14.7	20.5 ±.3	24.9 ±.3	28.5 ±.3	25.75±.3
		3.77	4.58	5.24	4.74
U-235+γ	15	17.65±.35	23.1 ±.45	31.45±.6	27.8 ±.55
	20	20.0 ±.2	24.2 ±.3	28.5 ±.2	27.3 ±.2
Np-237+γ	15	19.7 ±1.2	21.4 ±1.5	31.8 ±1.1	27.1 ±.9
	20	21.5 ±.6	23.0 ±.7	29.1 ±.5	26.4 ±.4
Pu-239+γ	15	21.85±.15	25.65±.10	27.3 ±.15	25.2 ±.15
	20	20.75±.15	25.00±.25	29.2 ±.4	24.15±.2

Publications: Atomnaja Energija (USSR), 41, 44-45 (1976)
Atomnaja Energija (USSR), 42, 337-338 (1977)
Yadernaya Fizika (USSR), 29, 293-295 (1979)

U.S.S.R.

Laboratory: Nauchno-Issledovatel'skij Inst. Atomnykh Reactorov V.I. Lenina (V.I. Lenin Scientific Research Institute for Atomic Reactors)

Address: Dimitovgrad, Ulyanovskaya Oblast, USSR

Names: Valerij Aleksandrovich Anufriev

Facilities: Neutron time-of-flight spectrometer located in the horizontal channel of the SM-2 reactor with four synchronous rotors suspended in a magnetic field. The recording system consists of CNM-17 ^{3}He proportional counters and a 4096-channel time analyser. The better resolution was 70 nsec/m. The resonance level parameters were calculated by the "area" and "shape" methods on the basis of the Breit-Wigner single-level formula on a BEhSM-6 computer.

Method: The resonance parameters and total neutron cross-sections of the samples were studied by measuring transmission with the use of the time-of-flight technique [2,1].

1. Experiment: NEUTRON RESONANCE PARAMETERS OF ^{147}Pm ($T_{1/2}$ = 2.6 a) IN THE 5.37 - 177.7 eV REGION

Deduced: $\bar{D}$, σ_{tot} at 2200 m/s, capture resonance integral I_γ.

Accuracy: Statistical accuracy of the transmission measurement <2%. Accuracy of the resonance parameter determination 3-15%.

Completion date: Completed. The final results have been published in Ref.[3].

Comparison with other data: On the whole the measurements of the resonance parameters agree with the data in Ref.[4]. The E_0 = 21.53 and 23.09 eV levels were found for the first time. In comparison with the data in Ref.[4] a difference was found in parameters $2g\Gamma_n$ and Γ for the E_0= 5.37 eV level.

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2. Experiment: NEUTRON RESONANCE PARAMETERS OF ^{150}Sm IN THE 20.64-380.6 eV REGION

Accuracy: Statistical accuracy of the transmission measurement <2%. Accuracy of the resonance parameter determination 10-15%.

Completion data: Completed. The final results have been published in Ref.[5].

Comparison with other data: The results agree within measurement errors with those recommended in Ref.[6].

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3. Experiment: NEUTRON RESONANCE PARAMETERS OF ^{151}Sm ($T_{1/2}$ = 87 a) IN THE 1.088-17.33 eV REGION

Sample: Irradiated ^{150}Sm sample.

Accuracy: Statistical accuracy of the transmission measurement <2%. Accuracy of the resonance parameter determination 8-20%.

U.S.S.R. (cont'd)

Completion date:	**Completed; The final results have been published in Ref.[5].**
Comparison with other data:	The results agree within measurement errors with the data published in Ref.[7] in the energy region studied.
4. Experiment:	NEUTRON RESONANCE PARAMETERS OF ^{133}Cs IN THE 5.88–397.7 eV REGION
	Deduced: $\bar{D}$, Capture resonance integral I_γ.
Accuracy:	Statistical error of the transmission measurement <2%. Error of the resonance parameter determination 10–15%.
Completion date:	Completed. The final results have been published in Ref.[8].
Comparison with other data:	The E_0 = 9.5, 59.7, 132.6 and 373 eV neutron levels are given for the first time; the resonance parameters for the remaining levels agree with the data in Ref.[6].
5. Experiment:	NEUTRON RESONANCE PARAMETERS OF ^{134}Cs ($T_{1/2}$ = 2.2a) IN THE 12.27–171 eV REGION
	Deduced: $\bar{D}$ and capture resonance Integral I_γ.
Sample:	Irradiated ^{133}Cs.
Accuracy:	Statistical accuracy of the transmission measurement <3%. Accuracy of the resonance parameter determination 15–30%.
Completion date:	Completed. The final results have been published in Ref.[8].
Comparison with other data:	Measurements of the resonance parameters of ^{134}Cs were obtained for six levels for the first time. The E_0 = 42.1 eV level possibly relates to the ^{135}Cs isotope.
6. Experiment:	NEUTRON RESONANCE PARAMETERS OF ^{153}Eu IN THE 1.728–31.2 eV REGION
Accuracy:	Statistical accuracy of the transmission measurement <2%. Error in resonance parameters 5–20%.
Completion date:	Completed. The final results have been published in Ref.[9].
Comparison with other data:	On the whole, the resonance parameters in the region investigated agree with those recommended in Ref.[6]. In the case of the E_0 = 4.77, 15.25 and 22.5 eV levels, noticeable differences are observed in $2g\Gamma_n^0$ parameters.
7. Experiment:	NEUTRON RESONANCE PARAMETERS OF ^{154}Eu ($T_{1/2}$ = 8.6a) IN THE 0.188–27.3 eV REGION
	Deduced: $\bar{D}$, capture resonance integral I_γ.
Sample:	Irradiated ^{153}Eu.

U.S.S.R. (cont'd)

Accuracy: Statistical accuracy of the transmission measurement <2%. Accuracy of the resonance parameter determination 10-20%.

Completion date: Completed. The final results have been published in Ref.[9].

Comparison with other data: The resonance parameters for the E_0 = 1.37 eV levels differ from those given in Ref.[10]; data are given for the first time in the region above 1.37 eV. The E_0 = 0.602 eV level given in Ref.[10] is attributed to the ^{155}Eu isotope.

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8. Experiment: NEUTRON RESONANCE PARAMETERS OF ^{155}Eu ($T_{1/2}$ = 4.7a) IN THE 0.602-33.1 eV REGION

Deduced: $\bar{D}$, capture resonance integral I_γ.

Sample: Irradiated ^{153}Eu.

Accuracy: Statistical accuracy of the transmission measurement <2%. Accuracy of the resonance parameter determination 15-30%.

Completion date: Completed. The final results have been published in Ref.[9].

Comparison with other data: The values of resonance parameters for sevel levels of ^{155}Eu are being communicated for the first time.

REFERENCES

1. Belanova, T.S., et al., The Neutron Time-of-Flight Spectrometer in the Sm-2 Reactor, NIIAR Report, P-6(272), Dimitrovgrad (in Russian).

2. Anufriev, V.A., et al., The Facility for Measurements of Neutron Cross-Sections of Radioactive Nuclei Using the Neutron Spectrometer of the SM-2 Reactor, NIIAR Report, P-II (345), Dimitrovgrad (1976) (in Russian).

3. Anufriev, V.A., et al., "Measurement of total neutron cross-sections and resonance parameters of ^{147}Pm ($T_{1/2}$ = 2.6a)", At. Ehnerg. 45 (1978) 453 (English: Soviet At. En. 45 (1979) 1189)

4. Kirouace, J., et al., Nucl. Sci. and Engn., 52 (1973) 310

5. Anufriev, V.A., et al., "Neutron resonances of the ^{150}Sm and ^{151}Sm isotopes ($T_{1/2}$ = 87 a)" in: Proceedings of the Fourth All-Union Conference on Neutron Physics, Kiev, 18-22 April (1977) (in Russian)

6. BNL-325, Third Edition (1973)

7. Kirouace, J., et al., Phys. Rev. C 6, 11 (1975) 895

8. Anufriev, V.A., et al., "Resonance parameters of the ^{133}Cs and ^{134}Cs isotopes ($T_{1/2}$ = 2.2a) in the energy region up to 400 eV", At. Ehnerg. 43 (1977) 201 (English: Soviet At. En. 43 (1978) 828)

U.S.S.R. (cont'd)

9. Anufriev, V.A., et al., "Measurement of total neutron cross-sections of ^{153}Eu, ^{154}Eu ($T_{1/2}$ = 8.6 a) and ^{155}Eu ($T_{1/2}$ = 4.7a)", At. Ehnerg. 46 (1978) 158 (English: Soviet At. En. 46 (1979) 182)

10. Vertebnyi, V.P., et al., "The level density, average widths and power function of the stable and radioactive isotopes of Europium" in:: Proceedings of the Conference on Neutron Physics, TsNIIatominform, Moscow, part 2 (1977) 267 (in Russian)

Note: The full contribution containing all experimental results is available in Russian and English from the editor upon request.

II. COMPILATIONS AND EVALUATIONS

Unchanged contributions are marked as such.

Updates: revisions with respect to the last issue are marked by a vertical bar on the left margin of the text.

New contributions show no marks.

BELGIUM

Laboratory and address : Nuclear Physics Laboratory
Proeftuinstraat 86
B-9000 Gent, Belgium

Names : P. De Gelder, D. De Frenne, E. Jacobs

Evaluation : Nuclear Data Sheets for A = 102

Purpose : to give a critical survey of all available information concerning A = 102 nuclei, and derivation of consistent best or preferred values with their uncertainties.

Method : cfr. Nuclear Data Project

Major sources of information : Recent References of NDP

Deadline of literature coverage : end 1980

Status : about 75 % of the data sets is reevaluated

Computer file of evaluated data : ENSDF

Completion date : end 1980

Publications : to be published as a Nuclear Data Sheets issue

FRANCE

Laboratory and address:	DRNR/SPNR C.E.N. Cadarache F-13115 St. Paul-Lez-Durance
Names:	E. Fort, D. Lafond
Evaluation:	Revision of resonance parameters
Purpose:	Update for new experimental data in the resolved and unresolved resonance region in order to control and eventually revise the evaluations already made. Determination of average parameters with the purpose to establish "local systematics".
Method:	- Criticism and renormalization of experimental data - Use of maximum likelihood method applied to neutron widths - distribution - (ESTIMA method).
Major source of information:	Neutron Physics Literature, BNL 325
Deadline of literature coverage:	None
Cooperation:	Partly with CNEN/Bologna, ECN/Petten
Expected completion date:	continuing effort

FRANCE

Laboratory and address : Département de Recherche Fondamentale
Laboratoire de Chimie Physique Nucléaire
Centre d'Etudes Nucléaires de Grenoble
85 X - 38041 GRENOBLE CEDEX - France.

Name : J. BLACHOT

Cooperation : C. FICHE** for developping the file and J.C. NIMAL*, B. DUCHEMIN* for the applications in summation calculation.

Compilation and Evaluation : Radionuclide decay data :
- to provide a comprehensive data bank of radioactive decay data with : half lives, Q-values, branching ratios, nuclear and spectra α, β, γ, energies and intensities with associated uncertainties.

Purpose :
- Decay data file for summation calculation of decay heat (Pepin code).
- Data bank for all people using decay data parameters.

Sources : ENSDF file mostly and new recent works on short lived F.P. not yet evaluated in ENSDF.

Computer file and programs :
- Magnetic tape available on line for those using the French CISI Network.
- Off line from the NEA Data bank (Saclay).

Publication : AT. Data and Nucl. Dat. Tab. Vol. 20 (1977) p.241.

* CEN/CADARACHE -
C.E.A - BP.1 - 13115 St-PAUL LES DURANCE

** CEN/SACLAY-
C.E.A - BP.2 - 91190 GIF SUR YVETTE -

FRANCE

Laboratory and address:	Laboratoire de Mêtrologie des Rayonnements Ionisants C.E.N. de Saclay B.P. No. 2, F-91190 Gif sur Yvette
Names:	J. Legrand, N. Coursol, F. Lagoutine
Evaluation:	Radionuclide decay data
Purpose:	Preparation of a document providing recommended values of the principle decay scheme parameters: half-life, energies and intensities of various radiations emitted (e.g. β, γ, c.e., X-rays)
Method:	- critical analysis of published results - determination of mean values and associated uncertainties
Source of information:	Nuclear Data Sheets, INIS-Atomindex, other recent publications
Publications:	Table de radionucléides, edition CEA-LMRI, containing among other radionuclides, the following fission products: - Vol.1: Kr-85, Sr-89, Mo-99, Tc-99, Ru-103 + Rh-103m, Sb-125 + Te-125m, Xe-133, Xe-133m, Ce-144 + Pr-144 - Vol.2: Rb-86, Sr-90 + Y-90, Y-91, Zr-95 + Nb-95, Ru-106 + Rh-106, Te-127m + Te-127, Te-131m + Te-131, I-131, Xe-131m, Cs-137 + Ba-137m, Ba-140 + La-140. - in preparation: Rb-88, I-129, Pr-143, Nd-147, Pm-147 (publication 1980)

GERMANY, DEM. REP.

Laboratory and address: Zentralinstitut für Kernforschung
Rossendorf
DDR 8051 Dresden
Postfach 19
Deutsche Demokratische Republik

Name: H.-C. Mehner

Evaluation: Effective resonance integral of ^{133}Cs in reactor fuel elements

Purpose: To clear differences between experimental and calculated fission product concentrations of ^{134}Cs observed in investigations of burnt fuel elements

Method: Calculation of effective resonance integral of ^{133}Cs taking into account shielding by ^{238}U resonances and self-shielding using Breit- Wigner formalism with Doppler broadening

Major sources of information: BNL - 325, 3rd. ed., 1973

Status: Completed

Publication: Radiochem. Radioanal. Letters 43(1980)77

GERMANY, FED. REP.

Laboratory and address:	Inst. for Nuclear Chemistry, Philipps-University Marburg, Lahnberge, D-3550 Marburg/Lahn
	* Gesellschaft für Schwerionenforschung mbH Postfach 110541, D-6100 Darmstadt
Names:	U. Reus, W. Westmeier and *I. Warnecke §
Compilation:	Gamma-Ray Catalog +

Type of data: Compilation of energies and intensities of gamma-rays originating from the radioactive decay of nuclides, as well as other important decay properties of these nuclides.

Arrangement: Part I is a listing of ca. 20,000 gamma-rays ordered by increasing energy with the corresponding nuclei and other information needed for identification purposes. Part II is ordered by nuclides (A,Z) and contains the complete data sets for ca. 2300 nuclides and isomers (i.e. ca. 35,000 gamma-energies), decay data, references, comments etc.

Purpose: Identification of gamma-rays, data for cross-section calculations, activation analysis etc.

Major sources of information: Nuclear Data Sheets and almost all important journals in nuclear physics and chemistry.

Deadline of literature coverage: 30.6.1978 (existing version), updating to cutoff date 1.1.1980 is in progress.

Other relevant details: The updated version will include the most important information on X-rays and an additional section ordered by energy also, but containing only the three strongest gamma-rays of each nuclide (for fast analyses).

Completion date: Feb. 1979 (existing version), appearance of the revised version is planned for the end of 1980.

Availability and publications: The existing version is no longer available; 250 copies have been distributed. Reprinting is not possible at the moment (1 copy = 800 pages!).

The revised version shall be published in an appropriate journal and will thereby be available commercially.

+ Work performed with the support of GSI (Gesellschaft für Schwerionenforschung mbH, Darmstadt).

§ Present address: Physikalisch-Technische Bundesanstalt, Abteilung SE, Bundesallee 100, D-3300 Braunschweig

HUNGARY

LABORATORY AND ADDRESS: Institute of Experimental Physics,
Kossuth University
Debrecen P.O.Box 105
H-4001

NAMES: G.Nagy, S.Daróczy, P.Raics, I.Matajsz, I.Boda

1. Compilation: Mass yields of products from the monoenergetic neutron induced fission of ^{238}U at neutron energies other than 14 MeV.

   Purpose:

   Major source of information: B.F. Rider, M.E. Meek, NEDO-12154-2D /1977/ General Electric Co; INIS Atomindex, Journals

   Deadline of Literature Coverage: 1979.

   Other relevant details: absolutisation of relative data, updating if the necessary reference nuclear data are given.

   Computer file: none

   Expected completion date: completed

   Publication: not planned, it is used in our evaluation

2. Evaluation: Investigation of the gross and fine structure ^{238}U fission product mass distributions at different neutron energies

   Purpose: Study the energy dependence of the gross and fine structures of mass distribution

   Method: Fitting of the summ of five gaussian function
   The gross structure is described by the fitting of the summ of fine gaussian functions to the mass distributions, the energy dependence of the fitted parameters is investigated. The significant differences of the measured yields from the fitted smooth curves are interpreted as fine structures.

   Computer files: none

   Completion date: 1980.

   Publication: to be published

INDIA
(same as INDC(NDS)-102)

Laboratory and address: Health Physics Division
Bhabha Atomic Research Centre
Bombay 400 085, India.

Names: P.P.Chakraborty, D.N.Sharma, M.R.Iyer and A.K.Ganguly.

THEORETICAL COMPILATION

(1) Type of data: Mass yield and Elemental yield prediction of fragments for spontaneous fission of various fissioning nuclides.

(2) Purpose: To predict mass and elemental yield of fragments from various fissioning nuclei using a model which is independent of any input fission data.

(3) Major source of information: The stable neutron numbers as a function of Z of nuclei obtained from the Nuclear Mass Tables is the only input required for the calculations. Using this input data the Order Disorder Model is applied to the fissioning nucleus to predict yield values.

(4) Results and discrepancies: The various characteritics of the mass yield distribution, viz., peak-to-valley ratios, bunching of higher mass peaks etc. agree well with those of experimental data. The absolute values have some discrepancies with experimental values, though an improvement in the right direction has been noticed by using the later data on nuclear stability. This leads to the conclusion that the accuracy of the predictions depend on the accuracy of the only input data used in the calculations viz., the stable

INDIA
(cont'd)

neutron number values. The yield distribution predicted for trans-californium nuclei show the onset of symmetric division for fission of higher mass number nuclei.

(5) Completion date: The first stage of the computation is completed by February 1977 and further improvement of the predictions is under progress using the improved stability data of nuclei.

(6) Publications: (i) Chakraborty P.P.

Asymmetry of Mass and Charge Distribution in Low Energy Fission and Fissile Material Identification Techniques

Ph D Thesis, Gujarat University, India 1977

(ii) Chakraborty P.P., Sharma D.N. , Iyer M.R. and Ganguly A.K.

Asymmetry of Mass and Charge Division

Pramana 13, 495 (Nov. 1979)

ITALY

Laboratory and address: CNEN, Centro Studi e Ricerche "E. Clementel"
Via Mazzini 2 - 40138 Bologna, Italy

Names: F. Fabbri, G. Maino, T. Martinelli, E. Menapace, M. Motta, G.C. Panini, G. Reffo, M. Vaccari, A. Ventura

Evaluation: Revised evaluation and group constant library for Pd-105, Nd-143, Sm-149, Sm-151 on the basis of recent experimental microscopic and integral data. Statistical analysis of resonance data in the mass region $40<A<180$ mainly for average s-wave level spacing estimate for comparison with theoretical calculation of level density. n,γ cross section evaluation of Kr-78,80,81,82,83,84,85; Se-76,78,79,80; Br-79,81 in keV-MeV region and Ir-191,193 evaluation 1 keV up to 20 MeV were performed.

Purpose: Estimate of long term reactivity changes and FP accumulation in fast reactor.

Method: Calculations by BW-single and -multilevel formalism (resonance region) and by statistical and optical models. Theoretical estimate of level density are based on microscopic model in the BCS approximation with pairing interactions. Collective effect for vibrational and rotational nuclei are included. "Missing level estimator method" (G.A. Keyworth, M.S. Moore and I.D. Moses in NEANDC(US)199/L) and a method based on "maximum likelihood" criterion (C. Coceva, M. Stefanon NPA135(1979)1 and M. Stefanon Nucl.Instr.Meth. to be published) have been applied in the resonance statistical analysis.

Major sources of information: NEUDADA, CINDA, Nuclear Data Sheets.

Deadline of literature coverage: December 1979

Status: The full evaluation, file compilation and group constant library are completed. First results concerning statistical analysis of resonances and theoretical estimate of level density were presented at the NEANDC Spec. Meeting on FP Data, Bologna (1979)

Cooperation: CEA - Cadarache and Saclay, and ECN - Petten

Other relevant details: 25-group constants were calculated at infinite dilution

Computer file of evaluated data: ENDF/B format

ITALY
(cont'd)

Publications:

G. Maino, E. Menapace and A. Ventura, Nuovo Cimento 50 A, 1 (1979).
G. Maino, E. Menapace and A. Ventura, CNEN Rep. RT/FI(78)24, 1978.
G. Maino, E. Menapace, M. Motta and A. Ventura, contr. to Int. Conf. on Neutron Cross Sect. and Techn., Knoxville (1979).

V. Benzi, G. Maino, E. Menapace and A. Ventura, contr. to NEANDC Spec. Meet. on Fission Product Data, Bologna (1979).
B. Leugers, F. Käppeler, F. Fabbri, G. Reffo, Second Conf. on Nuclear Reaction, Varenna (1979).
F. Fabbri, G. Reffo, M. Herman, A. Marcinkowski, Second Int. Symp. on Neutron Induced Reactions, Smolenice (1979).
G. Reffo, Int. Conf. on Theory and Applications of Moment Methods in Many Fermion Systems, Ames, Iowa (1979).
B. Leugers, F. Käppeler, F. Fabbri, G. Reffo, Int. Conf. on Nucl. Cross Sections for Technology, Knoxville (1979).
I.M. Akkermans, H. Gruppelaar, G. Reffo, submitted for publication in Phys. Rev. C.

JAPAN

Japanese Nuclear Data Committee, Secretariat address:

Japan Atomic Energy Research Institute
Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan

Decay Heat Nuclear Data Working Group:

R. Nakasima (Hosei University)
M. Yamada (Waseda University)
T. Tamai (Kyoto University)
M. Akiyama (University of Tokyo)
I. Otake (Power Reactor and Nuclear Fuel Development Corp.)
T. Nojuyama (Mitsubishi Atomic Power Industry)
A. Zukeran (Hitachi Ltd.)
S. Iijima, T. Murata, T. Yoshida (Nippon Atomic Industry Group Co.)
K. Umezawa, T. Tasaka, Z. Matumoto, T. Tamura, K. Ihara (JAERI)

1. Compilation: Decay data and delayed neutron data
   Purpose: Making FP decay data library for summation calculation of decay heat
   Major Sources of Information: Journals, Nuclear Data Sheets and ENSDF
   Deadline of Literature Coverage: None
   Status: It is difficult to scan all journals
   Cooperation: None
   Computer File: Nuclear structure data file NDFILE and retrieval program ABEG. ENSDF
   Expected Completion Date: Continuous compilation

2. Evaluation: (1) Preparation of input data for summation calculation
   (2) Estimation of released beta and gamma energies for short-lived FP
   (3) Evaluation of delayed neutron emission probability
   Purpose: Making FP decay data library for summation calculation of decay heat
   Sensitivity study for decay heat
   Method: Gross theory of beta decay and systematics are used in estimating the released energy
   Major Sources of Information: Own compiled data
   Status: Released beta and gamma energies have been calculated for about 630 nuclides based on experimental information, and estimated for more than 100 nuclides by means of gross theory of beta decay. Calculation of cumulative yield from independent yield given by Rider and Meak is now in progress
   Computer File of Evaluated Data: PROFP output file, which makes the table of half-life, decay constant, Q-beta, Q-EC, mean energies of beta, gamma and conversion electron, and branching ratio
   Expected Completion Date: FP decay data library (1-st version); in 1980
   Summation calculation; in 1980
   Sensitivity study; mid 1981
   Publication: in plan

JAPAN

Laboratory and address : Japanese Nuclear Data Committee/FPND W.G., Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki, Japan

Names : S. Iijima, M. Kawai, T. Yoshida(i), S. Igarasi, Y. Kikuchi, T. Nakagawa, Y. Nakajima(ii), H. Matsunobu(iii), T. Aoki(iv), A. Zukeran(v), T. Watanabe(vi), I. Otake, M. Sasaki(vii).

Evaluation : (1) Neutron cross sections of about 80 FP nuclides (Z=35 to 64).
(2) Integral test of JENDL FP library.

Purpose : Fast breeder reactor and thermal reactor calculation.

Method : (1) Calculation with spherical optical model and statistical theory. Single and muti-level BW formula in thermal and resonance regions. Optical model parameters are determined by SPRT method. Level density parameters are re-evaluated, deriving systematics of parameters.

(2) Calculation using JAERI-FAST type 70-group cross sections with resonance self-shielding factors, and the neutron spectrum data from STEK and CFRMF data.

Major sources of information : EXFOR library, CINDA, BNL-325 and recent literature, integral data from STEK and CFRMF.

Status : (1) Re-evaluation of smooth cross sections for Nd and Sm isotopes was completed in fall 1979. New evaluation for about 80 FP nuclides was started in May, 1980.

(2) Analyses of STEK reactivity and CFRMF activation data were completed in Sept., 1979. Intercomparison of integral and differential data was completed in Dec., 1979.

Other relvant details : The evaluation of 68 nuclides was completed in Aug., 1977, and the file is available from NEA Data Bank.

Computer file of compiled data : NESTOR-2 file and the domestic file of integral data.

Computer file of of evaluated data : JENDL (ENDF/B-IV Format).

(i) Nippon Atomic Industry Group Co., Ltd. (ii) JAERI (iii) Sumitomo Atomic Energy Industries, Ltd. (iv) Fuji Electric Co. (v) Hitachi Ltd. (vi) Kawasaki Heavy Industries (vii) PNC

JAPAN

(cont'd)

Discrepancy encountered : From intercomparison of integral and differential data, the following discrepancies may be noted.

Tc-99 : STEK results (C/E = 0.85 - 0.9) and CFRMF result (C/E = 1.21) are not mutually consistent. RPI capture data seem to support STEK data.

Pd-108: STEK data indicate smaller cross section than ENDF/B-4. CFRMF data indicate slightly opposite direction. Substantially high capture cross section at ORELA are probably not in agreement with either of integral data.

I-127 : STEK resuts (C/E = 0.85 - 1.0) and CFRMF result (C/E = 1.23) are not consistent.

Sm-149: Recent capture data at FEI and JAERI are significantly higher than that expected from STEK measurements.

Expected completion date : Dec., 1980.

Publications :

(1) H. Nishimura et al., Integral test of the JENDL-FP data file (in Japanese), JAERI-M 8163, p.136 (1979).

(2) S. Iijima et al., Fission product neutron cross section evaluations for JENDL and the integral test, NEA Specialists' Meet. on FP Nuclear Data, CNEN, Bologna, 12th - 14th Nov., 1979, Paper no. 22.

NETHERLANDS

Laboratory and adress	Netherlands Energy Research Foundation (ECN) Postbus 1, 1755 ZG Petten, The Netherlands. Telephone: (02246) - 6262, telex: 57211 reacp nl
Names	J.W.M. Dekker, H. Gruppelaar, R.J. Heijboer and A.J. Janssen
Evaluation	(1) RCN-2 evaluation of neutron cross sections (σ_t, σ_e, $\sigma_{n\gamma}$, $\sigma_{nn'}$-matrix, σ_{n2n}) for about 60 fission products in the energy range of 10^{-3} eV to 15 MeV, in KEDAK type format, for the following elements, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, Te, I, Xe, Cs, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb. (2) Generation of group cross sections for fast reactor calculations based on RCN-2 evaluation in the 26-group ABBN scheme with a fast reactor flux weighting spectrum and error files for capture group constants, including 26x26 covariance matrices. (3) Adjustment of capture group constants based on (2) and integral STEK+CFRMF measurements. (4) Generation of an adjusted point cross sections library based on STEK+CFRMF integral data. (5) Calculation of pseudo-fission-product cross sections.
Purpose	Fast breeder power-reactor data needs.
Method	Calculation with multilevel Breit-Wigner formula, optical model and revised statistical model, taking into account all available experimental information.
Major sources of information	BNL-325, NEUDADA, CINDA, Nuclear Data Sheets, recent literature, integral data mainly from STEK and CFRMF.
Status	(1-3) Completed and reported for 43 isotopes; planned for 1980: new evaluations for Eu-isotopes, revisions for important fission products; planned for 1981: 22 other isotopes. (4) In progress, completed 1981. (5) Updating in 1981.
Computer file	(1) KEDECN, KEDAK type format (co-operation with Dr. B. Goel, KfK, Karlsruhe), has been sent to NEA Data Bank at Saclay.
Completion date	1981.
Recent publications	(1) H. Gruppelaar, Tables of RCN-2 fission-product cross section evaluation, part 1, ECN-13 (1976), part 2, ECN-33 (1977), and part 3, ECN-65 (1979). (1) G. Delfini and H. Gruppelaar, Maximum likelihood analysis of resolved resonance parameters for 18 fission product nuclides, ECN-82 (1980).

NETHERLANDS

(cont'd)

(2,3) J.W.M. Dekker, Tables and figures of adjusted and unadjusted capture group cross sections based on the RCN-2 evaluation and integral measurements in STEK, part 1, ECN-14 (1977), part 2, ECN-30 (1977), and part 3, ECN-54 (1979).

(2,3) J.W.M. Dekker and H.Ch. Rieffe, Adjusted capture cross sections of fission-product nuclides from STEK reactivity worths and CFRMF activation data, ECN-28 (1977) and part 2, ECN-55 (1979).

(5) R.J. Heijboer, Pseudo fission-product cross sections for a 1300 Mwe fast breeder reactor (status July 1978), ECN-52 (1978).

(5) H. Gruppelaar and B.P.J. van den Bos, The contributions of (n,p) and (n,α) reactions to fission-product capture cross sections, ECN-78 (1979).

NETHERLANDS

Laboratory	: Netherlands Energy Research Foundation ECN, Postbus 1, 1755 ZG Petten, The Netherlands.
Names	: Willem L. Zijp and J.H. Baard.
Compilation	: **Selected fission yields and fission product decay data for reactor neutron metrology application.**
purpose	: Creation of a common data set for all laboratories working in the field of reactor neutron metrology. The guide was prepared on behalf of the Euratom Working Group on Reactor Dosimetry.
Major sources of information	: . Cuninghame, J.G., Technical Report IAEA-213 (IAEA, Vienna, 1978); . Gilliam, D.M., et al., Report NUREG/CP-004 (NRC, Washington D.C., 1978); . Data supplied by the computer program MEDLIST from the Evaluated Nuclear Structure Data File (ENSDF); . Data supplied by the Physikalisch Technische Bundesanstalt, Braunschweig.
Deadline of literature coverage	: Spring 1979.
Cooperation	: Members of Euratom Working Group on Reactor Dosimetry.
Other relevant details	: Fission yields and decay data and decay schemes are given for the following fission products: ^{95}Zr, ^{97}Zr, ^{103}Ru, ^{131}I, ^{132}Te, ^{137}Cs and ^{140}Ba. The fissionable isotopes considered are: ^{235}U, ^{238}U, ^{239}Pu, ^{237}Np.
Computer file	: Not present.
Completion date	: August 1979.
Publications	: Report ECN-71.

UNITED KINGDOM

(same as INDC(NDS)-102)

Laboratory and Address:	AERE Harwell	UKAEA AERE, Harwell, Oxfordshire, Ox11 ORA

Name: E.A.C. Crouch

Compilation: Chain, Cumulative and Independent fission product yields for all neutron induced fission reactions with neutrons of energy up to 14 MeV, including spontaneous fission. Ongoing compilation.

Purpose: Basic data for fission yield evaluation.

Sources: Journals, Proceedings of Learned Societies, or other open literature, Project reports if the work is complete but unlikely to be published.

Deadline: No results prior to 1950 are collected.

Cooperation: We are prepared to exchange files with other groups.

Computer File: Information held in standard forms on Computer Files.

Completion Date: Continuous compilation.

Publications: AERE R6642 'A library of neutron induced fission product yields maintained and interrogated by computer methods'.
'Part I: The establishment of the library'.
E.A.C. Crouch, December 1970.

AERE R7207 'A library of neutron induced fission product yields maintained and interrogated by computer methods'.
'Part II: The interrogation of the library'.
E.A.C. Crouch, August 1972.

Fission Product Yields from Neutron-Induced Fission - E.A.C. Crouch.
Atomic Data and Nuclear Data Tables, Vol. 19, 5, May, 1977.
Contains experimental values and adjusted values after fitting to conservation laws .

UNITED KINGDOM

(same as INDC(NDS)-102)

Laboratory and Address:	AERE Harwell	UKAEA AERE Harwell Oxfordshire OX11 ORA

Name: E.A.C. Crouch

1. Evaluation

(1) Neutron induced fission product yields for all fissile nuclides at neutron energies up to 15 MeV; chain yields and independent yields.

(2) Adjustments of the chain yields and the calculated independent yields to force agreement with the conservation laws i.e. to form a 'consistent set'.

Purpose: UKND File to be used in Reactor design and operation.

Method:

(1) The individual yields for a given reaction (both chain and independent), are examined, weighted and the means calculated together with the errors.

(2) The evaluated yields are augmented by interpolation to fill missing values or in the case of independent yields by calculation based on parameters estimated from known values. The results are fitted by least squares to the conservation conditions to give adjustments for chain yields and independent yields.

Complete - the fitting of conservation laws and the equality of yields of complementary elements. The set will be tested for its ability to produce an estimate of after heat from ^{239}Pu Fission nearer to experimental values than previous sets.

Sources: Compilation mentioned above.

Deadline: No results prior to 1950 are collected. Compilations believed to be complete up to end 1975, some 1976 results included.

Status: Evaluation and Consistent set complete at January 1977. Further development continuing.

Cooperation: We are prepared to exchange files with other groups.

UNITED KINGDOM
(cont'd)

Computer Files of Compiled Data:	Compilation as above.
Computer File of Evaluated data:	Magnetic tape or punched cards of the consistent set in ENDF/BIV format.
Discrepancies found:	Files are compared with those of B.F. Rider and discrepancies found are resolved.
Publication:	Fission Product Yields from Neutron-Induced Fission. E.A.C. Crouch. Atomic Data and Nuclear Data Tables, vol. 19, 5, May 1977.

2. Evaluation:	Compilation and evaluation of the half lives of delayed neutron emitter precursors and emission probabilities of the delayed neutron emitters. Hence, using the fission product consistent sets, calculation of the delayed neutron yields ... Proceeding.
Purpose:	UK Nuclear Data File for use in Reactor design and operation calculations.
Sources:	The open literature
Deadline:	Continuous compilation.
Status:	Compilation of delayed neutron data proceeding.
Cooperation:	We are prepared to exchange information with other groups.
Computer files:	Not yet implemented.

UNITED KINGDOM

Laboratory and Address	CEGB Berkeley	Berkeley Nuclear Laboratories Berkeley Gloucestershire GL13 9PB U.K.

Working Group:	B. Aldred	BNFL, Windscale
	B.S.J. Davies	CEGB, BNL.
	A. Tobias	CEGB, BNL.
	M.F. James	AEE, Winfrith.
	A.L. Nichols	AEE, Winfrith.
	D.G . Vallis	AWRE, Aldermaston.
	Mrs. K.M. Glover	AERE, Harwell.

1. Compilation and Evaluation:

Radionuclide decay data

purpose: to provide a comprehensive, updated data file of radioactive decay data, including half lives, Q-values branching ratios, mean α, β and γ energies and intensities with associated uncertainties.

progress: updating of the data set has continued. Theoretical half-life values for 75 short-lived nuclides have been replaced with measured values. Decay schemes for about 200 nuclides have been revised, and for a further 70 nuclides theoretical decay energies have been replaced with measured values. These data require final testing before the existing recommended set for UK use (UKFPDD-1) is replaced by the updated set.

2. Decay scheme calculations - the CASCADE Programme

purpose: to compare experimental data with decay data calculated from a more basic data set (e.g. US ENSDF file) and to produce mutually consistent catalogues of emission data for different radiation types.

progress: the CASCADE code development is nearing completion. CASCADE and its suite of programmes are being tested in all of the possible options to eliminate any bugs.

The major γ - γ and γ - x and other coincidence data sets can now be evaluated automatically.

The results can be reproduced in standard ENDF/B IV and/ or V format. Decay data information not previously included in ENDF/B IV or V but evaluated by CASCADE can be included in an ENDF/B IV or V type format (e.g. inclusion of γ - γ coincidence data tables). This is now being tested.

completion date: expected complete by end of 1980.

Publications:

Tobias, A. "Decay Heat" Report RD/B/N4611 and Prog. in Nuc. En., 1980. Vol·5 No. 1 PP 1-93.
Tobias, A. "U235 Fission Product Gamma Spectra: A comparison between experiment and calculation" Report RD/B/N4667.

UNITED KINGDOM

Laboratory and address:	Birmingham Radiation Centre, University of Birmingham, P.O. Box 363, Birmingham B15 2TT, United Kingdom
Name:	D.R. Weaver
Evaluation:	Equilibrium and near-equilibrium delayed neutron spectra
Purpose:	For reactor physics calculations and analysis of delayed neutron yield measurements. The evaluation was recommended by the March 1979 Vienna Consultants' Meeting on Delayed Neutron Properties
Method:	Calculation of a full covariance matrix for the spectra
Deadline of literature coverage:	None. Raw experimental data from laboratories who used either ^{3}He or proton recoil counters has been obtained. Further data would be welcomed
Status:	A method of obtaining a full covariance matrix has been derived based upon the sensitivity of the spectra obtained from unfolding to changes in the calibration parameters of the detector. A paper describing the technique and measurement of the Am/Li spectrum using a ^{3}He counter is in preparation

U. S. A.

Laboratory and address:

National Nuclear Data Center, Bldg. 197D
Brookhaven National Laboratory
Upton, L.I., N.Y. 11973, U.S.A.

Names:

S.F. Mughabghab, M. Divadeenam, N.E. Holden

Evaluation:

BNL-325 Neutron Cross Sections Vol. I. Resonance Parameters

Purpose:

Update resonance parameter evaluations

Major Sources of Information:

CSISRS Data File, CINDA, Private Communications and Personal Files

Status:

Part I for Z=1-60 evaluation nearly complete and proof pages for Z=20-60 are ready to be sent for review. Part II for Z=61-98 evaluation will begin as soon as Part I goes to press.

Other Relevant Details:

Any other details may be obtained from S.F. Mughabghab

Completion Date:

Projected Publication Dates:

Part I (Z=1-60) goes to press July 1980
Part II (Z=61-98) goes to press June 1981

U. S. A.

Laboratory and address:	Idaho National Engineering Laboratory EG&G Idaho, Inc. P.O. Box 1625 Idaho Falls, Idaho 83415 USA
Names:	C. W. Reich, R. L. Bunting, M. A. Lee
Compilation:	Decay data for fission products. Quantities treated include: $T_{1/2}$; $Q\beta$; branching fractions for the various decay modes; energies and intensities of all emitted radiations (e.g., β, γ, c.e., x-ray); K-, L- and total ICC; delayed-neutron energy spectra for individual precursors; uncertainties in all measured values.
Purpose:	Decay data file for ENDF/B.
Major sources of information:	Nuclear Data Sheets, Table of Isotopes (7th. Ed.), preprints of recent work.
Deadline of literature coverage:	Ongoing. For Version V of ENDF/B, cut-off date is approximately September, 1978.
Computer File:	Decay data are included in ENDF/B Fission Product File. Tapes available through normal ENDF/B procedures. Evaluated decay data sets for 318 fission-product nuclides (and isomeric states) have been prepared for inclusion in the ENDF/B-V Fission-Product File. Release of the Version-V Fission-Product File is scheduled for May, 1980.
Publications:	C. W. Reich, "Applications of Fission-Product Decay Data", in Proceedings of the Isotope Separator On-Line Workshop, U. S. DOE Report BNL 50847 (July, 1978) pp. 109-148.

U.S.A.

Laboratory and address	General Electric Company Vallecitos Nuclear Center P. O. Box 460 Pleasanton, California 94566 U.S.A.
Name	B. F. Rider
Compilation	Fission Product Yields for 40 neutron induced fissioning systems:

U235T	U233F	U234F	Th227T
U235F	U233HE	U237F	Th229T
U235HE	U236F	Pu240H	Pa231F
U238F	Pu239H	U234HE	Am241T
U238HE	Pu240F	U236HE	Am241H
Pu239T	Pu241F	Pu238F	Am242MT
Pu239F	Pu242F	Am241F	Cm245T
Pu241T	Th232H	Am243F	Cf249T
U233T	Np237F	Np238F	Cf251T
Th232F	Cf252S	Cm242F	Es254T

where T = Thermal, F = Fast, H = High Energy (14 MeV), and S = Spontaneous.

Purpose	For burnup, and fission rate and decay heat calculations. The basis for ENDF/B-V fission product yields.
Sources	Open literature, CINDA, INIS ATOMINDEX, correspondence.
Coverage	Literature through June 1980
Cooperation	U.S. National Nuclear Data Center, CSEWG, Fission Product Decay Heat Task Force, Fission Yield Subcommittee.
Details	About 25,000 entries from 1200 references. Complete set of recommended independent and cumulative yields for all F.P. nuclides.
Computer File	Tape available as ENDF/B-V from U.S. National Nuclear Data Center, Brookhaven National Laboratory, Upton, N.Y. 11973 U.S.A.
Completion Date	September 1980
Publications	"Compilation of Fission Product Yields," NEDO-12154-3B (1980). Available on Fiche from General Electric Co., P. O. Box 460, Pleasanton, California 94566, U.S.A., Attn: B. F. Rider

U.S.A.

Laboratory and address:

Hanford Engineering Development Laboratory
P.O. Box 1970
Richland, WA 99352

Names:

RE Schenter, FM Mann, DL Johnson, and F Schmittroth

Evaluation:

ENDF/B-V, Mods to ENDF/B-V, and ENDF/B-VI Fission Product Data File and Fission Yield Files

A. Coordinate generation and testing of complete ENDF/B-FP files which will contain cross sections, decay data and fission yields for approximately 900 fission product nuclei and 20 fissionable nuclei. Coordination is part of the responsibility as Chairman of CSEWG (Cross Section Evaluation Working Group) Fission Product and Actinide Data Subcommittee. Two subcommittees related and contributing to this subcommittee are chaired by TR England (LASL) and CW Reich (INEL) and cover the areas of fission yields and experimental decay data, respectively. Evaluations to these files will be contributed by essentially all CSEWG member laboratories.

B. Evaluate important FP cross sections for fast and thermal reactor application. These will mainly involve updating about 180 cross section evaluations from ENDF/B-V with emphasis on capture. Use will be made of combining recent integral and differential data results from CFRMF, STEK, RPI and ORNL.

C. Evaluate decay data parameters $\overline{E}_\beta$, $\overline{E}_\gamma$ for "Theoretical" ("no line data") FP nuclides using extrapolated "fits" to known data and integral testing of recent decay heat measurements.

D. Evaluate delayed neutron spectra using summation method from individual precursors in cooperation with TR England (LASL) and CW Reich (INEL)

Purpose:

Update ENDF/B Fission Product Data Files

Completion dates:

ENDF/B-V FP file will be issued May 1980. ENDF/B-V Fission Yield Files issued April/May 1979. Mods to ENDF/B-V expected to be released May 1981 and May 1982.

References:

References related to this work may be obtained from R.E.Schenter.

U. S. A.

(same as INDC(NDS)-102)

Laboratory and Address:

University of California
Los Alamos Scientific Laboratory
P. O. Box 1663
Los Alamos, New Mexico 87545 (U.S.A.)

Names:

T. R. England (LASL)
R. E. Schenter (HEDL)
B. F. Rider (G.E.)
J. Liaw (U. of Oklahoma)

Compilation:

Library of evaluated fission product yields for Version V of the Evaluated Nuclear Data Files (ENDF/B-V).

Deadline of Literature Coverage:

Mid-1978, including recent unpublished data.

Cooperation:

Subcommittee consisting of members from major U.S.A. commercial and government laboratories.

Other Relevant Details:

Twenty yield sets for 11 fissionable nuclides ($^{233,235,236,238}U$, $^{239,240,241,242}Pu$, ^{237}Np, ^{232}Th, and ^{252}Cf). Each set contains $\sim$1100 yields and uncertainties; independent yields before delayed neutron emission and cumulative yields (by A and Z) after delayed neutron emission are given. Yield distributions account for isobaric states, Z and N pairing effects, ternary fission and delayed neutron branching.

Completion Date:

August 1978 for compilation.
Phase I testing completed.
Phase II testing in progress.

Publications:

Report on Phase I testing, and other relevant details in progress.

Computer File:

Distributed by the National Nuclear Data Center at the Brookhaven National Laboratory.

U.S.A.

(same as INDC(NDS)-102)

LABORATORY AND ADDRESS:

University of California
Los Alamos Scientific Laboratory
P O Box 1663
Los Alamos, New Mexico 87545 (USA)

NAMES:

T. R. England
R. J. LaBauve
W. B. Wilson

COMPILATION:

Library of processed 154-group ENDF/B-IV fission_product reaction cross sections.

PURPOSE:

Data file of multigroup values (10^{-5} eV-20 MeV) for use in collapsing to few-group values.

MAIN SOURCE OF INFORMATION:

ENDF/B-IV Fission-Product Data File

OTHER RELEVANT DETAILS:

Cross sections were processed into the Power Reactor Studies (PRS) 154-group structure described in Ref. 1 and 2, using the PRS Neutron Flux Weighting Function described in Ref. 1. Cross sections were processed at 900 or 1000 K at infinite dilution. A total of 181 nuclides are described with total, elastic, total inelastic, and radiative capture multigroup values. Additional neutron absorption reaction cross-section tabulations are given for 36 of the nuclides. A total of 960 multigroup cross-section tabulations are included in the data file, which is issued with a companion collapsing code TOAFEW.

COMPUTER FILE:

The data file and collapsing code are available from the Radiation Shielding Information Center, Oak Ridge National LAboratory, P O Box X, Oak Ridge, Tennessee 37830 (USA).

REFERENCES:

1. W. B. Wilson, T. R. England, and R. J. Labauve, "Multigroup and Few-Group Cross Sections for ENDF/B-IV Fission Products; the TOAFEW Collapsing Code and Data File of 154-Group Fission-Product Cross Sections," Los Alamos Scientific LAboratory report LA-7174-MS (March 1978).

2. R. J. LaBauve and W. B. Wilson, "Proposal to Extend CSEWG Neutron and Photon Multigroup Structures for Wider Applications," Los Alamos Scientific Laboratory report LA-6240-P (February 1976).

U.S.A.

(same as INDC(NDS)-102 except for additional publications)

Laboratory and Address:

University of California
Los Alamos Scientific Laboratory
P. O. Box 1663
Los Alamos, New Mexico 87545

Names:

T. R. England
R. J. LaBauve
D. G. Madland
W. B. Wilson

Cooperation:

R. E. Schenter, chairman of the ENDF/B actinide and fission product subcommittee, and F. Schmittroth of the Hanford Engineering Development Laboratory, P. O. Box 1970, Richland, Washington 93352.

Compilations:

A) Nuclide Parameter Evaluated Compilations

1) β and γ decay energies, branching fractions [decay and (n,γ)], half-lives, Q-values and cross sections for 824 fission products are tabulated in Ref. 1. This is a basic data set that includes the major types of parameters, with corrections, from ENDF/B-IV, except for yields and the energy dependence of cross sections.

2) Multigroup β and γ spectra are tabulated in Ref. 2 for 180 fission product nuclides. The β spectra are given in 75 groups and the γ spectra in 150 groups. These data are based on ENDF/B-IV.

3) Multigroup cross sections are compiled in Ref. 11, processed from ENDF/B-IV.

4) Few group fitted spectral functions available in Ref. 9.

5) Comparisons with experiment and a new decay heat standard are presented in Ref. 14. Reference 15 is a code incorporating the pulse function data of the new ANS Decay Heat Standard.

B) Evaluations

1) Yield distribution (pairing effects) and branching to isomeric states are evaluated and modeled in Refs. 3 and 4. Estimated values from the modeling are also included in these references.

2) Ternary fission is evaluated and compiled in Ref. 5.

3) β and γ spectra, decay heating and absorption buildup are evaluated by comparison with experiment in Refs. 6-13.

U.S.A.

(cont'd)

Purpose:

Research by the Los Alamos nuclear data group (T-2) is directed at improvement in the national data file ENDF/B and at the use of these data in, e.g., determining a new decay heat standard, absorption buildup, etc.

References

1. T. R. England and R. E. Schenter, "ENDF/B-IV Fission Product Files: Summary of Major Nuclide Parameters," Los Alamos Scientific Laboratory report LA-6116-MS [ENDF-223] (October 1975).

2. T. R. England and M. G. Stamatelatos, "Multigroup Beta and Gamma Spectra of Individual ENDF/B-IV Fission-Product Nuclides," Los Alamos Scientific Laboratory report LA-NUREG-6622-MS (Decamber 1976).

3. D. G. Madland and T. R. England, "The Influence of Pairing on the Distribution of Independent Yield Strengths in Neutron-Induced Fission," Los Alamos Scientific Laboratory report LA-6430-MS [ENDF-240] (July 1976).

4. D. G. Madland and T. R. England, "Distribution of Independent Fission-Product Yields to Isomeric States," Los Alamos Scientific Laboratory report LA-6596-MS [ENDF-241] (November 1976).

5. D. G. Madland and Leona Stewart, "Light Ternary Fission Products: Probabilities and Charge Distributions," Los Alamos Scientific Laboratory report LA-6783-MS [ENDF-247] (April 1977).

6. D. G. Foster, Jr. and T. R. England, "Time-Dependent Spectra of Photons and Spontaneous-Fission Neutrons for Applied Problems," Invited Paper, Trans. Am. Nucl. Soc. 23, 551 (1976).

7. T. R. England and M. G. Stamatelatos, "Beta and Gamma Spectra and Total Decay Energies from Fission Products," Trans. Am. Nucl. Soc. 23, 493 (1976).

8. M. G. Stamatelatos and T. R. England, "Fission-Product Gamma-Ray and Photoneutron Spectra and Energy-Integrated Sources," NUREG-0155 [LA-NUREG-6345-MS] (Issued December 1976) (See also Addendum 1, March 1977).

9. R. J. LaBauve, et al., "The Application of a Library of Processed ENDF/B-IV Fission-Product Aggregate Decay Data in the Calculation of Decay-Spectra," LA-7483-MS (September 1978).

10. M. G. Stamatelatos and T. R. England, "Short Irradiation Fission-Product Beta Spectra and Total Energy: Calculations Versus Experiment," (ANS Summary accepted for ANS Annual Meeting June 12-17, 1977).

11. T. R. England, W. B. Wilson, and M. G. Stamatelatos, "Fission-Product Data for Thermal Reactors
Part 1
A Data Set for EPRI-CINDER Using ENDF/B-IV
Part 2
Users Manual for EPRI-CINDER Code and Data," Los Alamos Scientific Laboratory reports LA-6745-MS and LA-6746-MS (December 1975) [To be issued by EPRI ~ March 1977].

U.S.A.
(cont'd)

12. W. B. Wilson and T. R. England, "Status of Fission-Product Data for Absorption Calculations," LA-UR-78-1452, (May 1978).

13. E. T. Jurney, P. J. Bendt, and T. R. England, "Fission Product Gamma Spectra," LA-7620-MS (January 1979).

14. T. R. England, R. E. Schenter, and F. Schmittroth," Integral Decay-Heat Measurements and Comparisons to ENDF/B-IV and V," NUREG/CR-0305 [LA-7422-MS] (August 1978).

15. W. B. Wilson, T. R. England, and R. J. LaBauve," DKPOWR: A Code for Calculating Fission-Product Decay Power (report in preparation).

16. T. R. England, W. B. Wilson, "TMI-2 decay power: LASL fission-product and Actinide decay power calculations for the president's commission on the accident at Three Miles Island " LA-8041-MS, Revised (March 1980).

17. "Generation of Pulse Functions for Beta and Gamma Decay Spectra " LA-8277-MS.

18. "Comparisons of Calculated and Measured Pu-239 Beta and Gamma Spectra " NUREG/CR-1172 (ORNL/NURGE-66).

19. "Status of ENDF/B-5 Yields " Third ASTM Euratom Symposium, Ispra, Italy, Oct. 1979.

U.S.A.

(same as in INDC(NDS)-102)

Laboratories	Washington University, Dept. of Chemistry, St. Louis, MO., USA Los Alamos Scientific Laboratory, Group CNC-11, Los Alamos, NM USA
Names	A. C. Wahl and K. Wolfsberg
Compilation and Evaluation	Independent yields and other data related to nuclear charge distribution in fission are being compiled and evaluated for low-energy fission processes (excitation energies up to ~ 20 MeV).
Purpose	Development of systematics that will allow reliable estimates to be made for unmeasured independent yields and that will increase understanding of the fission mechanism.
Sources	Journals, reports, preprints, and personal communications
Method	Data from various types of measurements are compared for evaluation of the reliability of the newer methods.
Cooperation	We are prepared to exchange files with other groups.
Computer File	Information is held in standard forms on computer files.
Completions	Continuous compilation
Publications	A. C. Wahl, A. E. Norris, R. A. Rouse, and J. C. Williams, in Proceedings of the Second International Atomic Energy Symposium on Physics and Chemistry of Fission, Vienna, Austria, 1969 (I.A.E.A.), p. 813. K. Wolfsberg, Los Alamos Scientific Laboratory Report No. LA-5553-MS (1974). A. C. Wahl, "Nuclear-Charge Distribution in Fission - Investigation of Systematics and Methods of Estimation of Independent Yields," Contribution to IAEA Petten Panel on Fission Product Nuclear Data - Sept., 1977. Published in: INDC(NDS)-87 (1978), 215. A. C. Wahl, "Systematics of Nuclear Charge Distribution in Fission - The Z_p Model," J. Radioanal. Chem. 55, 111 (1980).

U. S. S. R.

Laboratory:	Moscow Physical Engineering Institute, Moscow, USSR
Names:	Byalko A.A., Zhivun V.M., Kovalenko V.V., Koldobski A.B.
Evaluation:	Evaluation of pairing effects on charge distribution of fission product yields.
Method:	Charge distribution parameters were determined by fitting to experimental data.
Major sources of information:	Journals and reports
Deadline of literature coverage:	1975
Publication:	"Accounting for Pairing Effects in the Analitical Representation of Isobaric Charge Distribution of Uranium-235 Products of Fission by Thermal Neutrons" "Atomnaya Energija" v. 43(1), (1977), 51-52.

III. RECENT PUBLICATIONS RELATED TO FPND

The publications listed below refer to activities related to FPND which are not covered by the contributions contained in this issue. They are sorted according to

1. Fission yields and charge distribution
2. Neutron reaction cross sections
3. Decay data
4. Delayed neutron data
5. FP decay heat
6. Reviews and summaries

Completeness of this Section has not yet been attempted. For papers presented at meetings see section IV.

III.1. Fission yields and charge distribution

(For fission yields of delayed neutron precursors see also "delayed neutrons")

Light-charged-particle emission in keV neutron-induced fission of ^{239}Pu

B. Krishnarajulu, S. Sen, G.K. Mehta, J.Phys.G 5, 319 (Feb.1979)

[yields and energy spectra; E_n = 100 keV - 1 MeV]

A detailed investigation of the thermal neutron induced ternary fission of ^{235}U

C. Guet, C. Signarbieux, P. Perrin, H. Nifenecker, M. Asghar, F. Caitucolli, B. Leroux, Nucl.Phys. A314, 1 (1979)

[energy and angular distribution of long-range α)

Independent yields of Rb and Cs isotopes from thermal-neutron induced fission of ^{235}U

S.J. Balestrini, R. Decker, H. Wollnik, K,D. Wünsch, G. Jung, E. Koglin, G. Siegert, Phys.Rev.C 20, 2244 (December 1979)

[deduced: charge dispersion, odd-even Z effect]

Fission fragment energy correlation measurements for the sub-barrier (n_{th},f) of ^{241}Am and ^{243}Am

M. Asghar, F. Caitucolli, P. Perrin, G. Barreau, B. Leroux, Nucl.Phys. A334, 327 (1980)

[Fragment mass and kinetic energy distribution]

Nuclear charge distribution in fission products

J.H. Baik, H.-I. Bak, J. of the Korean Nuclear Society 11, 295 (December 1979)

[calc. charge distribution in ^{235}U thermal fission compared to experiments]

Charge distribution in the spontaneous fission of ^{252}Cf

H.N. Erten and N.K. Aras, J.Inorg.Nucl.Chem. 41, 149 (1979)

[experimental Z_p-values compared to UCD, ECD; odd-even and magic number effects investigated]

III.2. Neutron reaction cross sections

Note on the energy dependence of the absoption cross-section of the fission-product aggregate

A. Radkowsky, A. Galperin, Annals of Nucl.En. 6, 249 (1979)

[Reference case (BWR) calculation of FP -absorption: non-1/v behaviour must be taken into account]

The thermal-neutron capture cross section for the production of ^{108m}Ag

T.B. Ryves, Nucl.Sci.Engg. 72, 357 (1979)

[also Cd-ratios and RI/σ_o for production of $^{108m,110m}Ag$)

Level structure of odd-mass nuclei and the unified model II: etc

see decay data, Phys.Rev. C 20, 2370 (December 1979)

[also measured: thermal neutron cross sections for production of $^{117g,117m}Cd$]

Neutron resonances in ^{100}Mo and valence neutron capture

Weigmann, S. Raman, J.A. Harvey, R.L. Macklin, G.G. Slaughter Phys.Rev. C 20, 115 (July 1979)

[total and capture cross section, E_n = 0.1-26 keV; gamma spectrum 0.1-8 keV; deduced: resonance parameters, levels]

$^{104,105,106,108,110}Pd(n,\gamma)$ cross sections above 26 keV

R.L. Macklin, J. Halperin, R.R. Winters, Nucl.Sci.Engg. 71, 182 (1979)

$^{100,101,102,104}Ru(n,\gamma)$ and $^{103}Rh(n,\gamma)$ cross sections above 26 keV

R.L. Macklin, H. Halperin, Nucl.Sci.Engg. 73, 174 (Feb. 1980)

III.3. Decay data

(for delayed neutron precursor decay data see also "delayed neutrons")

γ-ray energies for ^{88}Rb decay

R.G. Helmer, Nucl.Instr.Meth. 158, 489 (January 1979)

Total β-decay energies and the mass-energy surface of very neutron-rich nuclei near mass 100

P. Peuser, H. Otto, N. Kaffrell, A. Nymen, E. Röckl, Nucl.Phys. A332, 95 (1979)

[$^{96,98}Rb$, $^{96,98}Sr$, ^{98g}Y: Q_β; $^{96,98}Rb$: E_γ, I_γ]

Determination of Q_β values from endpoint energies of beta spectra

H. Otto, P. Peuser, G. Nyman, E. Röckl, Nucl.Instr.Meth. 166, 507 (1979)

[^{144}Pr]

Beta decay of ^{99}Tc^m

D.E. Alburger, P. Richards, Phys.Rev.C 21, 705 (Feb. 1980)

Beta-decay of ^{99m}Tc and dose calculations

C.W.E. van Eijk, J. Wijnhorst, B.J. Glenn, V. van Nooijen, A.V. Ramayya, J.H. Hamilton, Int.J.Appl.Radiat.Isot. 31, 313 (May 1980)

[β^--branch to 89,36 keV level of ^{99}Ru and I_γ to ground state relative to respective radiations to and from 140.5 keV level]

Selective on-line gas phase separation methods for Tc and Ru

V. Matschoß, K. Bächmann, J.Inorg.Nucl.Chem. 41, 141 (1979)

[methods, γ-ray spectra, half-lives]

Half-life of ^{132}Te

J.K. Dickens, Radiochem.Radioanal. Letters 39, 107 (1979)

Decays of mass-separated ^{139}Xe and ^{139}Cs

M.A. Lee, W.L. Talbert, Jr., Phys.Rev. C 21, 328 (Jan. 1980)

[^{139}Xe, ^{139}Cs: E_γ, I_γ, Q_β]

Level structure of odd-mass In nuclei and the unified model.II. ^{117}In levels populated in the decay of ^{117}Cd isomers

M.D. Glascock, E.W. Schneider, W.B. Walters, S.V. Jackson, R.A. Meyer, Phys.Rev. C 20, 2370 (December 1979)

[^{117g,m}Cd: E_γ, I_γ]

Radioactive decay of 1.7-h ^{149}Nd to levels of transitional ^{149}Pm

E.W. Schneider, M.D. Glascock, W.B. Walters, R.A. Meyer, Z.Phys. A 291, 77 (1979)

Energy levels and γ-ray transitions in ^{147}Pm

T. Seo, T. Hayashi, Y. Miyatake, Nucl.Phys. A321, 341 (1979)

[^{147}Nd decay: E_γ, I_γ]

The γ-rays following the β^--decay of ^{149}Pm

Y. Miyatake, S. Yamada, Annual Reports of the Research Reactor Inst., Kyoto Univ., 12, 114 (1979)

Level scheme of ^{149}Pm

T. Seo, S. Yamada, Y. Miyatake, T. Hayashi, Annual Report of the Research Reactor Inst., Kyoto Univ., 12, 152 (1979)

[^{149}Nd decay: γ-γ coinc., ^{149}Pm levels deduced]

On the decay of ^{155}Eu to ^{155}Gd

Z. Awwad, M.A. Farouk, M. Morsy, T. Bayomy, A.M. Mousa, Atomki Közlem. (Hungary), 21, 335 (1979)

[^{155}Eu decay: E_γ, I_γ of 17 γ-lines, conversion coeff.]

Half-lives of 35 radionuclides

H. Houtermans, O. Milosevic, F. Reichel, Int.J.Appl.Rad. Isot. 31, 153 (March 1980)

[among others the following FP: ^{95}Zr, ^{95}Nb, ^{99}Mo, ^{99m}Tc, ^{103}Ru, ^{106}Ru, ^{110m}Ag, ^{125}Sb, ^{131}I, ^{134,137}Cs, ^{140}La, ^{144}Ce]

High precision γ-ray energy measurements of fission products

A.G. Börner, W.F. Davidson, J. Almeida, J. Blachot, J.A. Pinston, P.H.M. van Assche, Nucl.Instr.Meth. 164, 579 (Sept. 1979)

[^{79}Ge, $^{85,87-95}$Kr, $^{91-93,95,98}$Rb, ^{92,93,96,98}Sr, $^{92,94,96-100}$Y, $^{97,99-101}$Zr, $^{99-104}$Nb, $^{99,101,103-105,108}$Mo, $^{99,101-106}$Tc, ^{105,109}Ru, ^{105,109}Rh, ^{109}Pd, ^{121}Cd, $^{125,128,130-132}$Sn, $^{127,128,130,132-134}$Sb, $^{131-136}$Te, $^{131-136,138,140}$I, $^{138-143}$Xe, $^{138,140-146}$Cs, $^{139-146}$Ba, $^{140-142,144-148}$La, $^{143,144,146-148}$Ce, $^{146-148}$Pr]

III.4. Delayed neutrons

Half-lives and delayed neutron emission probabilities of short-lived Rb and Cs precursors

C. Ristori, J. Crançon, K.D. Wünsch, G. Jung, R. Decker, K.-L. Kratz, Z.Physik A 290, 311 (1979)

[$^{94-98}$Rb, $^{143-147}$Cs]

Half-lives, neutron emission probabilities and Fission Yields of neutron-rich Rubidium isotopes in the mass region A=96 to A=100

P. Peuser, H. Otto, M. Weis, G. Nyman, E. Röckl, J. Bonn, L. von Reisky, C. Spath, Z.Phys.A 289, 219 (1979)

[identification of ^{100}Rb, half-lives of $^{96-100}$Rb, P_n-value of ^{99}Rb, fission yields of $^{97-99}$Rb]

III.5. Decay heat

(experiments and calculations)

Theoretical beta spectrum from Uranium-235 fission fragments in secular equilibrium

F.T. Avignone III, L.P. Hopkins, Z.D. Greenwood, Nucl.Sci. Engg. 72, 216 (1979)

[semi-empirical β-decay data used for unknown FP; calculated total β-spectra compared to experiments]

Decay spectra of fission products from Uranium-235 thermal fission: comparison of calculations with experiments

M.G. Stamatelatos, T.R. England, Nucl.Technol. 45, 219 (October 1979)

A revised ANS standard for decay heat from fission products

V.E. Schrock, Nucl.Technol. 46, 323 (December 1979)

[description of the 1978 ANS standard]

III.6. Reviews and summaries

Nuclei far away from the line of beta stability: studies by on-line mass separation

P.G. Hansen, Ann.Rev.Nucl.Part.Sci. 29, 69 (1979)

[experimental techniques and examples: nuclear masses, spectroscopy, half-lives, delayed neutrons, etc]

Standard cross sections used in measurements of (n,γ) cross section for fission product nuclides

H. Matsunobu, J.At.En.Soc. Japan, 21, 637 (1979)

[experimental values for standards and discrepancies among them are examined; renormalization attempted; in Japanese]

Compilations and evaluations of nuclear structure and decay data, Issue No. 5

Compiled by A. Lorenz, report INDC(NDS)-112 (1980)

[list of references]

Evaluation of decay heating in shutdown reactors

V.E. Schrock, Progr. in Nucl.En. 3, 125 (1979)

[review of decay heat research: background, recent developments, revision of ANS standard]

IV. MEETINGS

IV.1. Special meetings on FPND

Consultants' Meeting on Delayed Neutron Properties

Vienna, 26-30 March 1979

Following a recommendation by the International Nuclear Data Committee (INDC) a Consultants' Meeting on Delayed Neutron Properties was convened by the IAEA Nuclear Data Section in Vienna from 26-30 March 1979. It was attended by 13 scientists from 7 member states.

The main objectives of the meeting were to review the current requirements for delayed neutron data with special emphasis on energy applications, to review the status of delayed neutron data and try to resolve the existing discrepancies in experimental data, and to formulate specific recommendations for necessary future work and its coordination.

In order to achieve these objectives, four review papers and several contributed papers were presented in the first part of the meeting, followed by extensive plenary discussions on the delayed neutron data requirements and status in the second part of the meeting.

Specific conclusions and recommendations were formulated referring to the following subjects:

- Requirements for delayed neutron data (for reactor design, power reactor operation, critical experiment operation and interpretation, reactor dynamics and safety;

- Delayed neutron yields;

- Delayed neutron branching ratios;

- Delayed neutron energy spectra (including equilibrium and near-equilibrium spectra, decay-group spectra, separated precursor spectra and theoretical spectra).

A number of new measurements, compilations and evaluations were recommended in areas where no or only few data exist or where existing data are discrepant and were assigned different priorities.

The proceedings are published as INDC(NDS)-107/G+Special (August 1979)

Specialists' Meeting on Neutron Cross Sections of Fission Product Nuclei

CNEN, Bologna, Italy
12th - 14th December 1979

The Nuclear Energy Agency Nuclear Data Committee (NEANDC) held a Specialists' Meeting on Neutron Cross Sections of Fission Product Nuclei at CNEN, Bologna, Italy, from 12-14 December 1979.

The following topics were dealt with at the meeting:

- Measurements of neutron cross sections
- Problems in the analysis of measured data and in evaluations (average spacings, strength-functions, etc.)
- Measurements of integral data and their use
- Application of theory to meet the requirements and to fit experimental data
- Intercomparison of measured and evaluated data

On the first two days of the meeting, invited and contributed papers were presented in three sessions:

SESSION I: Measurements of differential and integral data and experimental techniques

Integral cross section measurements on fission-product nuclides in fast neutron fields

Y.D. Harker, R.A. Anderl

Measurements of capture cross sections in the FP mass region

N. Yamamuro, A. Asami

Techniques for the determination of capture cross sections of radioactive fission product nuclides

M.S. Moore, G.F. Auchampaugh

Neutron resonance parameters for Pd isotopes

E. Cornelis, L. Mewissen, F. Poortmans, G. Rohr, R. Shelley, P. Staveloz, T. Van der Veen

Neutron capture cross sections of Rubidium, Yttrium, Niobium, Cesium, Cerium and Gadolinium between 0.5 and 3.0 MeV

J. Voignier, S. Joly, G. Grenier

Capture cross section measurements on natural Xenon, natural Krypton and on various Krypton isotopes between 3 and 250 keV neutron energy

B. Leugers, F. Käppeler

Low energy neutron cross section measurements of radioactive FP nuclides

H.G. Priesmeyer

Fast neutron capture cross section measurements, evaluation and model calculation of fission product nuclei

W.P. Poenitz

SESSION 2: Resonance parameters: average values and systematics

Review of the different methods to derive average spacing from resolved resonance parameter sets

E. Fort, H. Derrien, D. Lafond

Efficient estimation of strength functions and average level spacings from resonance parameters

F.H. Fröhner

Statistical analysis of neutron resonance parameters

M. Stefanon

Maximum likelihood analysis of resolved resonance parameters for some fission product nuclides

G. Delfini, H. Gruppelaar

Status of radiative widths, neutron strength functions and improved evaluations using Lane-Lynn theory

S. Mughabghab

Phenomenological and theoretical basis for the parameterization of nuclear models used in reactor data evaluation

G. Reffo

Evaluation of average level spacings and S-wave strength functions performed for more than 240 nuclei

G. Rohr, L. Maisano

The level density systematics applied to fission product nuclei

G. Rohr, L. Maisano, R. Shelley

BCS level density calculations and consistent estimate of radiative widths by meas of a thermodynamic model

V. Benzi, G. Maino, E. Menapace, A. Ventura

SESSION 3: Neutron cross sections: theory and evaluations

On optical model calculations in the mass region A=80 to A=170

Ch. L. Lagrange

ENDF/B-5 fission product cross section evaluations

R.E. Schenter, T.R. England

Few group cross sections and sensitivities for LWR's

T.R. England, W.B. Wilson

The contribution of (n,p) and (n,α) reactions to fission-product capture cross sections

H. Gruppelaar, B.P.J. Van den Bos

Intercomparison of adjusted data sets for capture cross sections of fission products

H. Gruppelaar, P. Hammer, L. Martin-Deidier

Fission product neutron cross section evaluations for JENDL and the integral tests

S. Iijima, T. Watanabe, T. Yoshida, Y. Kikuchi

Fission product nuclear data at the NEA data bank

P.D. Johnston, W.W. Osterhage

Neodymium, Samarium and Europium capture cross section adjustments based on EBR-II integral measurements

R.A. Anderl, Y.D. Harker, F. Schmittroth

Status of pseudo fission-product cross sections for fast reactors; sensitivity studies for sodium void effects

R.J. Heijboer, A.J. Janssen, F. Lekkerkerk

Plenary discussion on the proposed international intercomparison of procedures in evaluating average spacings of neutron resonances.

On the third and last day of the meeting, two working groups were formed to deal with the following topics:

Working group 1: Status of the capture cross sections for the most important fission product nuclei.

Working group 2: Status of evaluation of and theory on $\langle D\rangle, \Gamma_\gamma$ and the neutron and gamma strength functions.

For the assessment of the present status of fission product capture cross sections by Working Group 1, the conclusions and recommendations issued by the 2nd IAEA Advisory Group Meeting on Fission Product Nuclear Data, Petten, Netherlands, 1977, were used as starting point. It was noted that the accuracy requirements for fast reactor calculations (which is the main area of application for fission product cross sections) have essentially remained unchanged. Only for a few nuclides, the target accuracy of spectrum averaged (="integral") cross sections should be tightened from 7% to about 5% in order to account for future requirements arising with the further development of fast breeder reactors.

As regards experiments, a great number of new differential capture cross sections have been measured, many of which are not yet included in the most recent evaluated data files. However, the measurement of total cross sections and inelastic scattering data had been rather neglected in the past years. As such data are needed for model calculations and evaluations, the meeting recommended to devote more experiments to the determination of total and inelastic scattering cross sections.

Measurements of "integral" cross sections (i.e. cross sections averaged over a fast reactor neutron spectrum) are presently being carried out in France and in the USA. Such data are required for the comparison of evaluated data files with experimental results, but also for direct use in fast breeder reactor calculations. The discrepancies between different experiments were mainly attributed to inaccurate account for selfshielding. A recommendation in this respect was issued.

The four current evaluated data files for fission products, CNEN/CEA, ENDF/B, JENDL-1 and RCN-2 were compared among each other and against experimental integral data. Of these, ENDF/B-4 showed the most prominent discrepancies compared to the other files as well as to experimental data. It is expected, however, that the agreement of the new updated version, ENDF/B-5 with experiments and other evaluations will be greatly improved.

Working Group 2 considered the requirements for and the status of average resonance parameters, as determined from experiments and deduced from theory or systematics.

As regards the requirements, it was agreed that the neutron strength functions of important nuclides should be known to 10-15%, which is equivalent to an accuracy of about 7% for the gamma widths and the average level density.

The meeting was not able to issue a comprehensive list of accuracies presently achieved, but the prevalent impression of the participants was that most of the requirements were still not satisfied. Especially the long-lived unstable nuclides require many more experimental data, which are lacking at present due to the technical difficulties in handling of radioactive materials. Therefore, the improvement of present techniques and the development of new ones are strongly recommended.

The use of nuclear model calculations and systematics for the determination of average resonance parameters was also discussed. It was agreed that the theoretical interpolation between nuclides with well-known data was in general accurate enough. However, when global systematics are used, the uncertainties rise to about a factor of 2. The meeting recommended therefore to study and delimit the range of application and validity of the different models and formulae in use. It was also agreed that an improvement of the strength function systematics was required.

This working group devoted a great part of its time to the discussion of the international comparison of methods for the derivation of average parameters, particularly level densities, from measured resolved resonance data. P. Ribon from CEN Saclay, France, had presented a paper in which he suggested the detailed procedure for such intercomparison: he would supply artificially generated "experimental" data to all participating laboratories by about February 1980. Each laboratory would use its own method to derive average parameters from these data and would send the results to P. Ribon before July 1980. All the results together with a detailed analysis by P. Ribon would then be distributed to all participating laboratories.

After long discussions, this suggestion found large interest among the participants. The possible participation of about twelve laboratories (including three from non-OECD countries) was either confirmed or envisaged already at the meeting. It was agreed that the participation of non-OECD countries in this comparison should be invited by the IAEA Nuclear Data Section.

IV.2. Some other meetings which include papers on FPND

International Symposium on Physics and Chemistry of Fission

Jülich, FRG, 14-18 May 1979

F2 Detailed Study of the Nuclide Yields in $^{235}U(n_{th},f)$ and their Relation to the Properties of the Scission Configuration and the Dynamics of the Fission Process

H.-G. Clerc, W. Lang, H. Wohlfarth, H. Schrader, K.-H. Schmidt

F3 Fission Fragment Energy Correlation Measurements for $^{241}Am(n_{th},f)$, and Shell Effects in Thermal Neutron Induced Fission

M. Asghar, F. Caitucoli, P. Perrin, C. Barreau, C. Guet B. Leroux and C. Signarbieux

F5 Possible Viscosity Effects in Neutron-Induced Fission of ^{232}Th and ^{238}U

J.E. Gindler, L.E. Glendenin, B.D. Wilkins

(Mass-yield distributions for the fission of ^{238}U and ^{232}Th with essentially monoenergetic neutrons from approximately 2 to 8 MeV. See also contribution on page 57)

F6 Viscosity Effects at Low Excitation in the Neutron Fission of ^{239}Pu

R.L. Walsh, J.W. Boldeman and M.M. Elcombe

(Fragment kinetic energies and mass yields for $^{239}Pu(n,f)$ for $E_n = 0.296$, 0.081 and 0.033 eV)

F7 Fission Fragment Mass- and Energy-Distribution for the Neutron Induced Fission of ^{239}Pu in Function of the Resonance Spins

C. Wagemans, G. Wegener-Penning, H. Weigmann and R. Barthelemy

F9 Distribution of Nuclear Charge and Angular Momentum in Chains 132-137, 99, and 102 of $^{235}U(n_{th},f)$ at Various Kinetic Energies and Charge States of the Fragments

H.O. Denschlag, H. Braun, W. Faubel, G. Fischbach, H. Meixler, G. Paffrath, W. Pörsch, M. Weis, H. Schrader G. Siegert, J. Blachot, Z.B. Alfassi, H.N. Erten, T. Izak-Biran, T. Tamai, A.C. Wahl, K. Wolfsberg

(See also contribution on page 22)

F10 Influence de l'Energie Cinétique des Fragments sur l'Alimentation d'Etats Isomeriques dans la Fission de U^{236}

J.P. Bocquet, F. Schussler, E. Monnand, K. Sistemich

(^{88}Br, ^{95}Y, ^{97}Y, ^{98}Y, ^{131}Sn, ^{132}Sn, ^{132}Te)

F16 Evidence for the Occurrence of New Shoulders in Low Energy Fission Mass Distribution

R.H. Iyer, V.K. Bhargava, V.K. Rao, S.G. Marathe, S.M. Sahakundu

(Cumulative fission yields of 12 mass chains - A = 66, 67, 72, 73, 77 on the lighter region and A = 161, 167, 171, 172, 173, 175 and 177 on the heavier mass region - were measured relative to ^{99}Mo)

F18 Fission Fragment Mass Distribution of Th-229

R. Zaghloul

F21 Yields of Products in the Spontaneous Fission of ^{252}Cf by Direct Gamma-Ray Spectroscopy

L. Toppare, H.N. Erten, N.K. Aras

(Mass chains studied: 101, 104, 106, 109, 116, 131, 133, 135, 137, 138, 141, 144, 146, 149 and 151)

F23 Fission Yield Measurements Far From the Center of the Isotopic Distributions in $^{235}U(n_{th},f)$

M. Simid, Y. Nir-El, G. Engler, S. Amiel

(yields of $^{92-99}$Rb, $^{94-100}$Sr, $^{142-148}$Cs and $^{143-149}$Ba were measured)

F26 Persistence of Even-Odd Effects for Fission Induced by 14 MeV Neutrons

Feu Alvim C.A., J.P. Bocquet, R. Brissot, J. Crançon, A. Moussa

(Evaluation of even-odd effect for 14.7 MeV neutron induced fission of ^{238}U and ^{232}Th, using experimental fractional yield data)

F29 Effet Pai-Impair de la Charge des Fragments de la Fission Induite par des Neutrons de 3 MeV, de Fission, Thermiques pour Differents Systèmes Fissiles

J. Blachot, J. Crançon, Cg. Hamelin, A. Moussa

(Thermal neutron induced fission of ^{233,235}U, fission of ^{233,234,235,238}U, ^{232}Th, ^{237}Np by fission spectrum neutrons and spontaneous fission of ^{252}Cf; see also contribution on page 12)

F36 Nuclide Yields for Thermal Fission of Uranium-235

R.B. Strittmatter, B.W. Wehring

(See also contribution on page 77)

Meeting of the Nuclear Physics Division of the American Physical Society

Knoxville, Tennessee, 18-20 October 1979

GC8 Study of Resonances and Level Schemes in Se(n,γ) Experiments

G. Engler, R.E. Chrien and H.I. Liou

GA1 Studies of Neutron-Rich Nuclei with ISOL Facilities

F.K. Wohn

BC14 Decay of 9.5-h ^{91}Sr and 50-m ^{91}Y^{m}

H.C. Griffin, E.C. Kao, W.D. Ruhter

International Conference on Nuclear Cross Sections for Technology

Knoxville, Tennessee, 22-26 October 1979

BB10 Neutron Resonance Parameters of ^{79}Br and ^{81}Br up to 15 keV

M. Ohkubo, Y Kawarasaki, M. Mizumoto

(See contribution on page 37)

CC1 Cross Sections for Fast Neutron Capture on Se, Cd, and Os Isotopes

M. Herman and A. Marcinkowski

(Activation cross sections for fast neutron capture at 0.53 MeV, 0.86 MeV, 1.20 MeV, and 1.31 MeV on ^{78,80,82}Se, ^{114,116}Cd)

CC2 Optical model calculations of nucleon interactions with ^{93}Nb, from 10 keV up to 50 MeV

Ch. Lagrange

CC3 Neutron Resonance Parameters for Pd Isotopes

P. Staveloz, E. Cornelis, L. Mewissen, F. Poortmans, G. Rohr, R. Shelley, T. Van der Veen

(See contribution on page 8)

CC4 Resonance Parameters of ^{96}Zr below 37 keV

C. Coceva, P. Glacobbe, M. Magnani

(See contribution on page 32)

CC5 Neutron capture cross sections of Y, Nb, Gd, W and Au between 0.5 MeV and 3.0. MeV

G. Grenier, J.P. Delaroche, S. Joly, Ch. Lagrange, J. Voignier

(Absolute neutron capture cross section measurements for Y, Nb, Gd, ^{155}Gd, ^{156}Gd, ^{157}Gd, ^{158}Gd, ^{160}Gd, in the 0.5 MeV - 3.0 MeV energy range)

CC6 Neutron Radiative Capture and Transmission Measurements of ^{147}Sm and ^{149}Sm

M. Mizumoto, M. Sugitomo, Y. Nakajima, Y. Kawarasaki, Y. Furuta and A. Asami

(See contribution on page 37)

CC11 The Measurement of Maxwellian Averaged Capture Cross Sections for ^{138}Ba, ^{140}Ce, ^{175}Lu and ^{176}Lu with a Special Activation Technique

H. Beer, F. Käppeler

(See contribution on page 17)

DB6 Gamma-Ray Production Cross Sections for Fast Neutron Interactions with Al, Ni, Cu and Nb

Y. Hino, T. Yamamoto, S. Itagaki and K. Sugiyama

(At neutron energies of 5.3, 5.9, 6.4 and 7.0 MeV)

ED4 Neodymium, Samarium and Europium Capture Cross-Section Adjustments Based on EBR-II Integral Measurements

R.A. Anderl and Y.D. Harker

(See contribution on page 61; Preliminary results indicate a need for a significant upward adjustment of the capture cross sections for ^{143}Nd, ^{145}Nd, ^{147}Sm and ^{149}Sm as much as a factor of 2 for ^{149}Sm in the energy range from 1 keV to 100 keV.)

FB5 Evaluations of Fission Product Capture Cross Sections for ENDF/B-V

R.E. Schenter, D.L. Johnson, F.M. Mann, F. Schmittroth, H. Gruppelaar

(See contribution on page 112)

FB6 Beta and Gamma Decay Heat Evaluation for the Thermal Fission of ^{235}U

G.K. Schenter and F. Schmittroth

(See contribution on page 112)

GD1 keV Neutron Capture Cross Sections for the s-Process Isotopes of Se, Br and Kr and the Abundance of Krypton in the Solar System

B. Ludgers, F. Käppeler, F. Fabbri, G. Reffo

(See contribution on page 17)

GD5 The Measurement of the Total ^{145}Nd Neutron Cross Section

V.A. Anufriev, A.G. Kolesov, S.I. Babich , V.A. Safonov

(Cf. contribution on page 81)

GD6 Fast Neutron Radiative Capture Cross Sections and Average Resonance Parameters for Rare Earth Nuclei

V.N. Kononov, E.D. Poletaev, D.D. Yurlov

(From the experimental cross section curves for ^{115}In, ^{142,144,146,148,150}Nd, ^{144,147,148,149,150,152,154}Sm, ^{151,153}Eu, ^{156,158,160}Gd, ^{166,168,170}Er, ^{181}Ta, ^{197}Au the s-, p-, d-wave neutron and radiative strength functions were determined).

GD7 Neutron Resonances of Odd-Odd Radioactive Isotopes

V.P. Vertebnyi, P.N. Vorona, A.I. Kaltchenko and V.G. Krivenko

(See contribution on page 79)

Non-microscopic FP nuclear data, but of interest to applied fields (full abstract given):

BC12 Effect of Resonance interference Between U-238 and Cs-133 on Isotopic Correlation of Fission Product

H. Takano, Y. Ishiguro, S. Matsuura

Interference effect between resonances of U-238 and Cs-133 was calculated for the spent fuel rod of Japan Power Demonstration Reactor 1 (JPDR-1). The resonance interference effect reduces resonance integral of Cs-133 by 6-14 percent. The main reduction is caused by the resonance interference between 5.9 eV of Cs-133 and 6.67 eV of U-238. The interference effect depends considerably on both the concentration of Cs-133 and the void fraction of coolant water, but its dependence on temperature variation of fuel rod is small. The effective resonance integral of Cs-133 becomes small by about 5 percent when the void fraction of coolant water is changed from zero to 45 percent. It is concluded that the value of five percent is very important correction factor which proves a linear correlation between activity ratio Cs-134/Cs-137, neutron capture product to direct fission product, and burnup. The effect of uncertainty in nuclear data of Cs-133 on effective resonance integrals of Cs-133 is studied and more accurate information for 5.9 eV resonance of Cs-133 is required from calculational standpoint for non-destructive burnup measurement.