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*************************** BIB-SECT
*
* REFERENCE   (C,68WASH,2,885,6803) PR
*              CONTRIBUTION.
*             (P,EANDC(E)-89,37,6802)
*             (J,NP/A,118,9,6805) FINA
*              MEASUREMENTS.
* AUTHOR      (H.K.VONACH,F.G.VONACH,H
* TITLE       -PRECISION MEASUREMENTS
*              OF (N,P),(N,A) AND (N,2
*              13.5 - 14.7 MEV NEUTRON
* INSTITUTE   (2GERMUN)
* N-SOURCE    (D-T  ) BOMBARDMENT OF A
*              DEUTERONS. A RANGE OF 1
*              WERE USED BY VARYING TH
* FACILITY    (VDG  ) 400KEV VAN DE GR
*              FUR STRAHLENFORSCHUNG.
* METHOD      (ACTIV)  GAMMA PULSES EX
*              TA-180M WHERE BETAS WER
* PART-DET    (DG   ) DECAY GAMMAS.
* SAMPLE      .NATURAL MATERIALS. ME
*              SAMPLES WERE PLACED A
*              CORRESPONDING TO 30 T
*              ENERGY, AND SUBTENDE
*              DISTANCE OF 100MM
* CORRECTION  .ANGULAR DEPENDENT NE
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*              SCATTERING CONTRIBUT
*              DECAY CORRECTIONS.
* ERR-ANALYS  .SYSTEMATIC ERRORS, TA
*              ATTENUATION CORRECTION
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*              SHIFTS (0.1 PC). MAXIMU
*              THAN 0.9 PERCENT. STATIS
*              IN THE TOTAL ERROR.
* DETECTOR    (NAICR) 5X5INCH WELL CRYS
*             (PROPC) CH4 FLOW COUNTER
*              TA-180M.
* STATUS      .FROM TABLES IN CONFERENC
* HISTORY     (781017C) PDJ. RECOMPILED
*             (790219E)
*             (800115A) REACTION STRING
*              022 AND 023 CHANGED.
*             (800115F)
*             (800424A) DATA HEADINGS C
*             (800603E)
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** END BIB-SECTION ******************
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*************************** BIB-SECTI
*
* REACTION    (23-V-51(N,A)21-SC-48,,SI
*              RATIO TO THE 14.7 MEV CR
* STATUS      .PUBLISHED TABLE.
* HISTORY     (781018C) PDJ.
*             (790219E)
*             (800424A) DATA HEADINGS C
*             (800603E)
*
** END BIB-SECTION ******************

** NO COMMON-SECTION ******************
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	EN MEV	EN-ERR MEV	DATA ARB-UNIT
1	13.6	0.075	0.820
2	13.7	0.075	0.836
3	13.8	0.075	0.852
4	13.9	0.075	0.867
5	14.0	0.075	0.885
6	14.1	0.075	0.902

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** END DATA-SECTION ******************
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NNDEN/30

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUES DE DONNÉES DE L'AEN

JULY 1981

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NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NNDEN/30

This Newsletter summarises evaluation activity in the OECD area. It should be noted that work in progress and future plans cited in this document may be changed without notice: consequently, the Newsletter should neither be quoted as a reference in publications nor be listed in an abstract journal.

The information contained in this newsletter concerns:

1. Evaluation work on particular nuclides;
2. Development of codes for the manipulation of data and for the calculation of cross sections;
3. Publications relevant to the neutron data field.

Contributions on evaluation activities have been received from:

		Page
FRANCE	CEN, Bruyères-le-Chatel	1
	CEN, Cadarache	3
GERMANY	KFK, Karlsruhe	4
ITALY	CNEN, Bologna	5
JAPAN	Japanese Nuclear Data Committee	7
NETHERLANDS	ECN, Petten	10
UNITED KINGDOM	AEE, Winfrith	11
UNITED STATES	National Nuclear Data Center	14

Other information included in this issue:

I.	Joint European-Japanese evaluated data file project	16
II.	Intercomparison of methods used to determine average resonance	16
III.	International nuclear model code comparison	17

July 1981

6231

1. NEW EVALUATIONS RECENTLY COMPLETED a), IN PROGRESS b), OR PLANNED IN THE NEAR FUTURE c)

Nuclide	Data Type	Energy Range	Page a	Page b	Page c
Li-6				15	
Li-7				15	
Na-22					10
Na-23	many			14	
Al	γprod.	1MeV-20MeV		8	
Si	γprod.	1MeV-20MeV		8	
Ar-38					10
Ar-40					10
Ca		<40MeV			
Ca	γprod.	1MeV-20MeV		8	
Cr		<50MeV		15	
Cr	(u,u')				9
Cr-52					6
Cr-53					6
Fe	(u,u')				9
Fe	γprod.	1MeV-20MeV		8	
Fe	n prod. γprod.		14		
Fe-54	many		14		
Fe-56	many		14		
Fe-56	res.params			12	
Fe-57			15		
Fe-58			15		
Fe-58	res.params			12	
Fe-isotopes	many	<400KeV	14		
Co-58			10		
Co-58m			10		
Ni	(n,n')				9
Ni	γprod.	1MeV-20MeV		8	
Ni-58	many	<6MeV		3	
Ni-60	many	<6MeV		3	
Ni-62	many	reson.		3	
Ni-nat	many				3
Ni		<50MeV		15	
Cu	γprod.	1MeV-20MeV		8	
Rb-85	many			15	
Rb-87	many			15	
Sr-90	many	10^{-5}eV-20MeV	7		
Zr-93	many	10^{-5}eV-20MeV	7		
Nb	γprod.	1MeV-20MeV		8	
Mo-95	many	10^{-5}eV-20MeV	7		
Mo-97	many	10^{-5}eV-20MeV	7		
Tc-99	many	10^{-5}eV-20MeV	7		
Ru-101	many	10^{-5}eV-20MeV	7		
Ru-102	many	10^{-5}eV-20MeV	7		
Ru-104	many	10^{-5}eV-20MeV	7		
Ru-106	many	10^{-5}eV-20MeV	7		

Nuclide	Data Type	Energy Range	Page a	Page b	Page c
Rh-103	many	10^{-5}eV-20MeV	7		
Pd-105					6
Pd-105	many	10^{-5}eV-20MeV	7		
Pd-107				10	
Pd-107	many	10^{-5}eV-20MeV	7		
Pd-107					6
Pd-stable				10	
Ag-107	many			15	
Ag-109	many	10^{-5}eV-20meV	7		
Ag-109	many			15	
Sn-112					10
I-129	many	10^{-5}eV-20MeV	7		
Xe-131	many	10^{-5}eV-20MeV	7		
Cs-133	many	10^{-5}eV-20MeV	7		
Cs-135	many	10^{-5}eV-20meV	7		
Cs-137	many	10^{-5}eV-20MeV	7		
Ce-144	many	10^{-5}eV-20MeV	7		
Nd-143	many	10^{-5}eV-20MeV	7		
Nd-144	many	10^{-5}eV-20MeV	7		
Nd-145	many	10^{-5}eV-20Mev	7		
Pm-147	many	10^{-5}eV-20MeV	7		
Sm-147	many	10^{-5}eV-20MeV	7		
Sm-149	many	10^{-5}eV-20MeV	7		
Sm-151	many	10^{-5}eV-20MeV	7		
Eu-153	many	10^{-5}eV-20MeV	7		
Eu-155	many	10^{-5}eV-20MeV	7		
Tm-169	many	10^{-5}eV-20MeV		2	
Tm-unstable	many				2
Ta	γprod.	1MeV-20MeV		8	
W-isotopes	many		15		
W-nat				15	
W-isotopes	many	500eV-20MeV		1	
Au	γprod.	1MeV-20MeV		8	
Pb	γprod.	1MeV-20MeV		8	
Bi-209	many	10^{-5}eV-20MeV		2	
U-233	many	thermal	7		
U-233				15	
U-233		thermal		15	
U-235		thermal		15	
U-235		reson.		15	
U-235	decay heat		7		
U-237	many	10^{-5}eV-20MeV		1	
U-238	res.params		8		
U-239	many	10^{-5}eV-20MeV +reson.		1	

Nuclide	Data Type	Energy Range	Page			Nuclide	Data Type	Energy Range	Page		
			a	b	c				a	b	c
Np-237	n,2n		3			Cm-243	many	10^{-5}eV-20MeV	8		
						Cm-244	many			4	
Pu-238	many	<3MeV		3		Cm-246		>10keV		5	
Pu-239		thermal		15		Cm-246		reson.	5		
Pu-239	t 1/2		12			Cm-247		>10keV		5	
Pu-241		thermal		15		Cm-247		reson.	5		
Pu-241	many	10^{-5}eV-20MeV		1		Cm-248		>10keV		5	
						Cm-248		reson.	5		
Am-241		<20MeV			9						
Am-241	many		4			F.P.	many		10		
Am-242m	many			4		F.P.	(n,γ)				10
Am-243	many			4		F.P.	many	10^{-2}eV-15MeV	8		
Am-243	many		12								
Am-243		<20MeV			9						

Service de Physique Neutronique et Nucléaire
Centre d'Etudes de Bruyères-le-Châtel
France

Names : O. BERSILLON, M. COLLIN, J.P. DELAROCHE, J. JARY, Ch. LAGRANGE, R. PERRIER, C. PHILIS, J. SALVY, N. VERGES .

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- Publication
  - "Progress Report of recent works on actinide nuclear data at Bruyères-le-Châtel", NEANDC (E) 211 "L", INDC (FR) 41/L (1981) .

- Work in progress
  - Coherent optical and statistical model calculations of neutron cross sections for Gd isotopes (J.P. DELAROCHE, Ch. LAGRANGE) .
  - Calculation of neutron cross sections for some Pt isotopes (J.P. DELAROCHE)
  - Evaluation of neutron cross sections for ^{241}Pu in the energy range 10^{-5} eV - 20 MeV (O. BERSILLON, Ch. LAGRANGE, D. MADLAND*) .
  - Calculation of neutron spectra from actinide (n,xn) reactions . Applications to ^{235}U and ^{239}Pu (J. JARY) .
  - Evaluation of ^{237,239}U neutron cross sections from 10^{-5} eV to 20 MeV (C. PHILIS, J. JARY, Ch. LAGRANGE) .
  - Evaluation of neutron cross sections and γ-ray production data for W isotopes in the energy range 500 keV - 20 MeV (E. ARTHUR* , C. PHILIS, A.B. SMITH**) .

.../..

- Complete evaluation of neutron cross sections and γ-ray production from 10^{-5} eV to 20 MeV for ^{209}Bi (O. BERSILLON, C. PHILIS, N. VERGES).
- Complete re-evaluation of ^{169}Tm from 10^{-5} eV to 20 MeV (E. ARTHUR*, M. COLLIN, D. GARDNER***, M. GARDNER***, P. NAGEL, C. PHILIS, P.G. YOUNG*).

- Plans for the near future
  - Complete evaluation of the neutron cross sections of unstable Tm isotopes .

* Los Alamos Scientific Laboratory (USA)

** Argonne National Laboratory (USA)

*** Lawrence Livermore Laboratory (USA)

SECTION DE PHYSIQUE DES NEUTRONS RAPIDES
CENTRE D'ETUDES NUCLEAIRES DE CADARACHE

NAMES : H. DERRIEN, E. FORT, D. LAFOND, P. LONG, J.P. DOAT

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Centre d'Etudes Nucléaires de CADARACHE
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WORK RECENTLY COMPLETED :

Reevaluation of the ^{237}Np(n,2n) cross-section with emphasis on ^{236}Pu formation cross-section. (E. FORT).

WORK IN PROGRESS :

. Evaluation of a complete set of neutron cross-sections for ^{238}Pu. Present extension up to 3 MeV (H. DERRIEN).

. Evaluation of a complete set of neutron cross-sections for ^{58}Ni, ^{60}Ni, ^{62}Ni. Present extension for ^{58}Ni and ^{60}Ni : 6 MeV (H. DERRIEN, D. LAFOND), for ^{62}Ni : resolved resonance region (H. DERRIEN).

WORK PLANNED FOR THE NEAR FUTURE :

Completion of the work on Nickel isotopes in order to obtain a complete set of data for natural Nickel.

Contribution to NNDEN-30

KFK-KARLSRUHE

GERMANY

Names : F.H. Fröhner , B. Goel, H. Jahn, B. Krieg

Address: Institut für Neutronenphysik und Reaktortechnik
Kernforschungszentrum Karlsruhe
Postfach 3640
D-7500 Karlsruhe, West Germany

Work recently completed

- The KEDAK evaluations of ^{241}Am+n cross sections is now completed and a first draft of the documentation was written. All resonance parameters were newly evaluated, and unknown fission widths were sampled from their estimated distribution. The lastest KfK fission data in the subthreshold region were used together with information from statistical analysis of the resolved resonances to calculate all cross sections up to 200 keV with a strength function model (code FITACS). Above 200 keV a global spherical optical potential for actinides was used, together with a global giant-dipole model for radiative transitions and a double-humped fission barrier fitted to recent fission data, in a Hauser-Feshbach calculation (code HAUSER-4) of all cross sections.
  (U.Fischer, F.H. Fröhner, B. Goel, H. Jahn, B. Krieg)

Work in progress

- Evaluation of ^{242m}Am, ^{243}Am and ^{244}Cm neutron cross sections: This work is in its final stage, with some calculations to be redone in the unresolved resonance range.
  (U. Fischer, F.H. Fröhner, B. Goel, H. Jahn, B. Krieg)

- Assessment of the outcome of the level spacing benchmark estimation initiated by P. Ribon (NEANDC(E) 213-AL): This very worthwhile exercise indicated clearly the need to account not only for levels below some observability threshold but also for unrecognised multiplets. The STARA code was modified correspondingly and the new version is being tested.
  (F.H. Fröhner)

- Study of combinatorial methods for level density calculations: The mathematical theory of partitions was used to derive quite rigorous level-density formulae. Their relationship to current approximations is under study.
  (A. Anzaldo, H. Jahn)

C.N.E.N. - DIVISIONE FISICA - LABORATORIO DATI NUCLEARI
Via Mazzini, 2 - 40138 BOLOGNA, ITALY - tel. 307562 - telex 610167 CNENBO I

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

Publications

1) T. Martinelli, E. Menapace, M. Motta, M. Vaccari
Evaluation of Cm-247 neutron cross sections in the resonance region, Proceedings of the Second Technical Meeting on the Nuclear Transmutation of Actinides, Ispra, 21-24 April 1980, EUR 6929.

2) T. Martinelli, E. Menapace, M. Motta, M. Vaccari, A. Ventura
Evaluation of Cm-246 neutron cross sections in the resonance region, CNEN Report, RT/FI(80)7, 1980.

3) T. Martinelli, E. Menapace, M. Motta, M. Vaccari, A. Ventura
Evaluation of Cm-248 neutron cross sections in the resonance region, CNEN Report, RT/FI(80)10, 1980.

Work in progress

1. Theoretical methods for nuclear data evaluation
The statistical method developed in ref. (1) for the calculation of thermodynamic functions, level densities in particular, of nuclei with an odd number of protons and/or neutrons is being extensively applied in order to deduce the trend of neutron (proton) ground state gap parameters, Δ_n (Δ_p), versus neutron (proton) number for both odd and even systems.
(V. Benzi, G. Maino, A. Ventura).

2. Actinide data
The evaluations of the Curium isotopes Cm-246, 247, 248 under IAEA research agreement No. 2114/CF are in progress with the extension of the capture and fission cross section calculations in the continuum region (beyond 10 keV).

---

(1) G. Maino, E. Menapace, A. Ventura, Nuovo Cimento 57A, 427 (1980).

The following parameters were selected for calculations:

- Dobs, $\bar{\Gamma}_\gamma$, $\bar{\Gamma}_f$, S_o , at neutron binding energy from analysis of resonances;
- Optical model parameters and those concerning fission barriers, giant resonances, etc. from local systematics and comparison with experimental data.

(G. Maino, T. Martinelli, E. Menapace, M. Motta, M. Vaccari, A. Ventura).

3. Structural material data

For the selection of a recommend file of Fe-56 a comparison is in progress among the results of capture integral data measured at fast critical facility RB-2 in Bologna and calculated ones, obtained using different files which were prepared with resonance data of different laboratories (Oak Ridge, Geel).

(E. Menapace, M. Motta, G.C. Panini, M. Vaccari).

Work planned for the next future

- A new evaluation of structural materials Cr-52 and Cr-53 is planned, followed by a comparison with integral capture data obtained in RB2 fast facility.
- A revision of the evaluations of Pd-105 and -107, starting from new resonance data, will be performed.

(G. Bonifazzi, E. Menapace, M. Motta, G.C. Panini, M. Vaccari).

Contribution to Neutron Nuclear Data Evaluation Newsletter-30

Japanese Nuclear Data Committee
(Nuclear Data Center, JAERI)

Work Recently Completed and Publications:

(i) Neutron Cross Sections of 28 Fission Product Nuclides Adopted in JENDL-1

Yasuyuki Kikuchi, Tsuneo Nakagawa, Hiroyuki Matsunobu, Masayoshi Kawai, Sin-iti Igarasi and Shungo Iijima

JAERI 1268 (1981)

This is the final report concerning the evaluated neutron cross sections of 28 fission product nuclides adopted in the first version of Japanese Evaluated Nuclear Data Library (JENDL-1). These 28 nuclides were selected as being most important for fast reactor calculations, and are ^{90}Sr, ^{93}Zr, ^{95}Mo, ^{97}Mo, ^{99}Tc, ^{101}Ru, ^{102}Ru, ^{103}Rh, ^{104}Ru, ^{105}Pd, ^{106}Ru, ^{107}Pd, ^{109}Ag, ^{129}I, ^{131}Xe, ^{133}Cs, ^{135}Cs, ^{137}Cs, ^{143}Nd, ^{144}Ce, ^{144}Nd, ^{145}Nd, ^{147}Pm, ^{147}Sm, ^{149}Sm, ^{151}Sm, ^{153}Eu and ^{155}Eu. The status of the experimental data was reviewed over the whole energy range. The present evaluation was performed on the basis of the measured data with the aid of theoretical calcualtions. The optical and statistical models were used for evaluation of the smooth cross sections. An improved method was developed in treating the multilevel Breit-Wigner formula for the resonance region.

(ii) Evaluation of Neutron Nuclear Data for ^{233}U in Thermal and Resonance Regions

Yasuyuki Kikuchi

JAERI-M 9318 (1981)

The thermal and resonance cross sections of ^{233}U were evaluated for JENDL-2. The cross sections below 1 eV were evaluated by the use of the measured fission and capture cross sections. The resolved resonance parameters were obtained so as to reproduce the measured total and fission cross sections. The cross sections from 100 eV to 30 keV are represented by the unresolved resonance parameters.

(iii) Decay Heat Calculations Based on Theoretical Estimation of Average Beta- and Gamma-Energies Released from Short-Lived Fission Products

Tadashi Yoshida and Ryuzo Nakasima

(To be published in J. Nucl. Sci. Tech. Vol. 18, No. 5)

Fission product decay heat of ^{235}U was calculated for short cooling-time on the basis of a preliminary version of a new decay data library recently completed by the Japanese Nuclear Data Committee. It was shown that a full adoption of recent publications of decay schemes to derive the average energies of beta- and gamma-rays, $\bar{E}_\beta$ and $\bar{E}_\gamma$, leads to a large underestimation of the gamma-ray component of the decay heat and to an overestimation of the beta-ray component. In order to remedy this, theoretical values of $\bar{E}_\beta$ and $\bar{E}_\gamma$ were introduced for high Q-value decays, which were obtained with a gross theory of beta-decay. It improved remarkably the agreement between calculation and experiment not only for the ^{235}U decay heat but for ^{239}Pu and ^{241}Pu as well.

(iv) Evaluation of Neutron Nuclear Data for ^{243}Cm

Tsuneo Nakagawa and Sin-iti Igarasi

(To be submitted to JAERI-M report)

The neutron nuclear data of ^{243}Cm were evaluated in the energy region of 10^{-5} eV to 20 MeV. The evaluated quantities are resonance parameters up to 27 eV, the total, fission, capture, elastic and inelastic scattering, (n,2n), (n,3n) and (n,4n) reaction cross sections, angular distributions of emitted neutrons and the number of neutrons per fission.

(v) Evaluation of ^{238}U resolved resonance parameters

Tsuneo Nakagawa

(To be submitted to JAERI report)

Evaluation of ^{238}U resonance parameters has been made for JENDL-2. All the available resonance parameters were compiled in a table. The systematic discrepancies among resonance energies were investigated. The neutron and capture widths were evaluated by the simultaneous evaluation similar to the area method.

Work in Progress:

(i) Reevaluaion of neutron cross sections for about 80 FP nuclides is in progress in the energy region from thermal to 15 MeV.
(from M. Kawai, NAIG)

(ii) The gamma-ray production cross sections associated with neutron induced reactions for natural molybdenum are evaluated in the energy region from thermal to 20 MeV. The gamma-ray spectrum in the low energy neutron capture is calculated on the basis of statistical model taking into account the discrete levels and E1, M1, E2 transitions. (from M. Mizumoto, JAERI)

(iii) As reported by M. Kawai in the NNDEN-29, gamma-ray production cross section for Al, Si,, Ca, Fe, Ni, Cu, Nb, Ta, Au and Pb have been analysed in the energy range from 1 to 20 MeV with the spin-dependent and multi-step evaporation model. The present model was useful for calculations of average energies and production cross sections of secondary gamma-rays from medium weight nuclei in the neutron energy region where the (n,n') reactions are dominant.
(from Y. Harima, TIT)

Work about codes and data files:

(i) A computer code GROGI-IV was developed in order to calculate gamma-ray production cross section and nucleon spectra with the multi-step evaporation model taking yrast level into consideration. This is a revised version of GROGI-3 developed by Takahashi, BNL.
(from M. Kawai, NAIG)

(ii) The decay data file for fission product nuclides (FP DECAY DATA FILE) has been prepared for summation calculation of the decay heat of fission products. The average energies released in β- and γ-transitions and necessary information have been arranged in tabular form together with the estimated results for 470 nuclides of which decay data are not available experimentally. This has been published in JAERI-M 9357. (from Z. Matumoto, JAERI)

Work Planned for the Near Future:

(i) Reevaluations of neutron nuclear data for ^{241}Am and ^{243}Am are planned below 20 MeV. (from S. Igarasi, JAERI)

(ii) Reevaluation work will be made on the inelastic scattering cross sections of Cr, Fe and Ni by taking account of the direct process with the coupled channel optical model and DWBA. (from Y. Kikuchi, JAERI)

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May 10, 1981

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER-30

ECN-Petten - The Netherlands

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2. Recent publications and preprints (available upon request)

|1| Gruppelaar, H. and J.M. Akkermans, Comparison of experimental and calculated neutron emission spectra and angular distributions, Paper contributed to the Symposium on Neutron Cross Sections from 10 to 50 MeV, Brookhaven, May 12-14, 1980, BNL-NCS-5/245, Vol. 2 (1980) 711 (also ECN-80-071).

|2| Gruppelaar, H. and J.B. Dragt, Cross section adjustments using integral data, Review paper Conference on Nuclear Data Evaluation Methods and Procedures, Brookhaven, September 22-25, 1980 (ECN-80-159).

|3| Akkermans, J.M. and H. Gruppelaar, Random-walk model of precompound decay: dynamics and multiparticle emission, to be publ. in Z. für Physik A (ECN-81-027).

|4| Gruppelaar, H. and R.J. Heijboer, Dutch request list for fission product capture cross sections, Contr. to NEANDC-meeting, Aix-en-Provence, 6-10 April 1981 (STEK-Memo-90).

3. Work recently completed

- Part 1 of the revised and adjusted RCN-3 evaluation of neutron cross sections for fission products (KEDAK format) has been forwarded to the NEA Data Bank. The present library contains 29 materials.
- A short intercomparison of recent fission-product libraries (including ENDF/B-V) was made.
- The evaluations of neutron cross sections for the radioactive corrosion products ^{58g}Co and ^{58m}Co have been completed.

4. Work in progress

- Re-evaluation of neutron cross sections for the stable Pd-isotopes and ^{107}Pd.
- Work on precompound models |1,3|.

5. Work planned for the near future

- Continuation of efforts in evaluation and adjustment of capture cross sections for about 20 fission-product nuclides (RCN-3 evaluation).
- Evaluation of neutron cross sections for nuclides in the primary cooling circuit of a LMFBR, i.e. for ^{22}Na, ^{38,40}Ar, ^{112}Sn.
- Evaluation of neutron cross sections for fusion-design studies.

6. Computer codes

- Contributions have been prepared for the international comparisons of model codes for average resonance parameters and optical- and statistical-model calculations.
- A new code system has been developed to calculate multi-particle precompound emission with an arbitrary number of outgoing particles |3|.

NUCLEAR DATA EVALUATION NEWSLETTER

NO 30

The United Kingdom

1 PERSONNEL

The following graduate personnel are currently working on nuclear data evaluation:-

UK Atomic Energy Authority

i) Winfrith, Nuclear Data Group J S Story - M F James - R W Smith

Address: Building B21, Atomic Energy Establishment, Winfrith, Dorchester, Dorset. Telephone Dorchester 3111, Telex No 41231

Winfrith Technology Branch - A L Nichols

Address: Building A50, Atomic Energy Research Establishment, Winfrith, Dorchester, Dorset. Telephone Dorchester 3111, Telex No 41231

ii) Harwell, Electron Accelerator Group (Building 418)

J E Lynn - M C Moxon - M G Sowerby - C A Uttley

Address: Atomic Energy Research Establishment, Harwell, Oxfordshire, OX11 ORA. Telephone Abingdon 24141: Telex No 83135

Harwell Chemistry Division (Building 220)

J G Cuninghame - E A C Crouch - Katherine M Glover - M King

Address: Atomic Energy Establishment, Harwell, Oxfordshire, OX11 ORA. Telephone Abingdon 24141: Telex No 83135

iii) Central Electricity Generating Board

Berkeley Nuclear Laboratory - B S J Davies - A Tobias

Address: Berkeley Nuclear Laboratories, CEGB Berkeley, Gloucestershire, GL13 9PB. Telephone Berkeley 451.

iv) British Nuclear Fuels Limited

Windscale and Calder Works - V Barnes

Address: Windscale and Calder Works, Sellafield, Seascale, Cumbria. Telephone Seascale 333.

2 WORK COMPLETED

A report has been produced by Tobias & Davies (CEGB) on the new library of fission-product decay data (UKFPDD-2) mentioned in NNDEN-29. These data have been used, together with the CROUCH-3 fission yields, for summation calculations of decay heat, and show improved agreement with integral measurements, especially at short cooling times, as compared with calculations based on UKFPDD-1; see the paper of Tobias (1980).

An extensive evaluation of the half-life of 239-Pu has been undertaken, requiring detailed study of over 30 references; serious discrepancies between different measurements made during the past 40 years were critically examined. The recommended value of 24113 ± 45y has been incorporated into the heavy element decay data library, UKHEDD-1. A report on this work is in draft.

Evaluation of the neutron cross-section data for 243-Am was completed and a data file compiled in the UKNDL format in Dec 1980 by Bowey, Patrick & Sowerby (AERE). Documentation will be started shortly.

As part of a programme of work to produce a joint European-Japanese evaluated nuclear data library, a review of Fe evaluations has been carried out, by Moxon & Sowerby (AERE) and Story (AEEW), to define the composition of the file to be used in the initial version of the library.

3 WORK IN PROGRESS

Evaluation of spontaneous fission data, prompt gamma and neutron spectra, for the heavy element decay data library (UKHEDD-1), which is in the ENDF/B5 format, is nearly complete; James (AEEW).

Further studies are in progress on the discrepancies, for 239-Pu fission, between integral measurements of fission-product decay heat, and calculated values using the summation method; James (AEEW).

Work has been started to extend and improve the UK file of decay data for activation products. A list of over 380 nuclides has been drawn up for inclusion in this file, as compared with the current file of 91 nuclides which was completed in 1977; however 158 of these nuclides are already listed in the fission-product decay data file UKFPDD-2, and 15 appear in the heavy element decay data file UKHEDD-1; consequently 211 nuclides remain to be evaluated for the activation product file.

Work has continued on evaluation of the resonance parameter data for 58-Fe and 56-Fe. With the help of the programmes LJPROB and DEEBAR it has been found possible to make rational assignments of spin and parity to almost all observed resonances, in keeping with the statistical predictions of the Fermi gas-model. The expected weak energy dependence of mean spacings has been taken into account; this implies a factor 2 reduction in the mean spacing of s-wave resonances over a range of about 1 MeV.

4 COMPUTER PROGRAMMES

The programme LJPROB has been developed for examining the possible (l,J) assignments of resonances. For each resonance it computes the neutron strength

$$Sn(l,J;E) = \Gamma_n^{(l)} / [\nu . D(J\pi, E)]$$

for each of a range of possible (l,J) assignments, where ν is the number of channel spin states. Using input values for the strength functions $\langle Sn(l) \rangle$, for each resonance the probability per cent is calculated of finding resonances of the same (l,J) with larger values of Sn(l,J;E).

5 PAPERS

Tobias A & Davies B S J (Nov 1980). CEGB Report RD/B/N4942; 'UKFPDD-2; a Revised Fission Product Decay Data File in ENDF/B4 Format'

Tobias A (Nov 1980). CEGB Report RD/B/4949; 'Decay Heat Summation Calculations Using UKFPDD-2'

J S STORY

Reactor Physics Division
AEE Winfrith

May 1981

USA CONTRIBUTION TO NNDEN-30

Via the National Nuclear Data Center

Recent Publications

BNL-NCS-28933 1980 September "Evaluation Methods for Neutron Cross Section Standards," M.R. Bhat.

LA-8626-MS 1980 December "Evaluated Neutron-Induced Cross Sections for 54, 56-Fe to 40 MeV," P.G. Young.

ORNL-5662 1980 September "An Evaluation of Cross Sections for Neutron-Induced Reactions in Sodium," D.C. Larson.

ORNL/TM-6405 1980 September "Evaluation of Resonance Parameters for Neutron Interaction with Iron Isotopes for Energies up to 400 keV. C.M. Perey, F.G. Perey.

ORNL/TM-7341 1980 October "GLUCS: A Generalized Least-Squares Program for Updating Cross Section Evaluations with Correlated Data Sets," D.M. Hetrick, C.Y. Fu.

ORNL/TM-7485 1980 November "User's Guide for SAMMY - A Computer Model for Multilevel R-matrix Fits to Neutron Data Using Bayes' Equations," N.M. Larson, F.G. Perey, J.A. Harvey.

ORNL/TM-7523 1980 November "Evaluation of Neutron and Gamma Ray Production Cross Sections for Natural Iron (ENDF/B-V Mat 1326)," C.Y. Fu, F.G. Perey.

Evaluations Recently Completed or In Progress

Material	Laboratory	Status
^{6}Li	LANL	In Progress
^{7}Li	LANL	In Progress
Ca	ORNL	Extension up to 40 MeV in is progress
Cr	BNL	Extension up to 50 MeV is in Progress
^{57}Fe, ^{58}Fe	ORNL	Contribution to Natural Iron is in progress
Ni	BNL	Extension up to 50 MeV is in progress.
$^{85,87}Rb$	BNL	Complete, Being Reviewed
$^{107,109}Ag$	BNL	Complete, Being Reviewed
W isotopes	LANL, ANL	Complete
Natural W	LANL	Summing of W isotopes is in progress
^{233}U	LANL	In Progress
^{235}U	BNL	Resolved resonance region revision to agree with ENDB-V standards is in progress.
^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu	BNL	Thermal Parameters Evaluations is in progress

Norman E. Holden
National Nuclear Data Center
Brookhaven National Laboratory
Upton, New York 11973
May 1981

d/f:10.3:2.4

I. Joint European-Japanese evaluated data file project

A second meeting of the NEACRP ad-hoc working group on coordination of evaluations was held during the April 1981 meeting of NEANDC at Aix-en-Provence. The meeting included representatives of NEACRP, the Chairman of the NEA Data Bank Committee, and a number of evaluators. Responsibility was assigned to different members of the group for selecting the evaluations needed to make up a first reference file. Subject to the approval o the Data Bank Committee, it was agreed that the Data Bank would take on th secretariat and technical work needed to coordinate members' contribution and to assemble the composite file. A detailed proposal was agreed on, t be considered by the Data Bank Committee for submission to the Steerir Committee for Nuclear Energy, which would give the project official terr of reference and an initial program of work. Following the Data Bar Committee's decision taken at its May 1981 meeting, a modified proposal h been prepared for consideration by the Steering Committee at its Octob 1981 meeting.

Meanwhile, work has started on selection of evaluations and transl tion of data for an initial file to contain data for:

Standard reference materials	:	He, Li, B, C, Au, U-235.
Structural materials	:	Fe, Cr, Ni, Ti.
Fuel materials	:	U-235, U-238, Pu-239, Pu-240, Pu-241.
High mass actinides	:	Cm isotopes
Fission products.		

A number of recent European and Japanese evaluations for other mate rials were noted to be considered for possible incorporation in an extende file. The Data Bank is preparing reports on ENDF/B V data processing an verification codes, and on codes for generating multigroup cross-sectio sets, which can be made available to Data Bank customers.

The program will be reviewed at a meeting of the working group to b held at Winfrith in conjunction with the NEACRP meeting, 14th to 18th September, 1981.

II. Intercomparison of methods used to determine average resonance parameters (coordinated by Dr. P. Ribon, CEN Saclay)

The 1979 meeting of NEA Nuclear Data Committee endorsed a proposal to carry out a benchmark intercomparison study of methods used to determine average parameters from resolved resonance parameters. The report NEANDC-(E)213"AL", sent out in September 1980 (First part: generation of test data) and March 1981 (Second part: results and their interpretation) showed important systematic discrepancies between the sets of solutions obtained by physicists using essentially the same approach to the calculation of average level spacings, strength functions and radiation widths in the two hypothetical nuclei for which artifically generated resonance parameters were supplied.

A workshop will be held at the NEA Data Bank in October 1981 for participants in this exercise. The aim of the workshop is to identify the origin of the discrepancies between different solutions; in order to provide a clearer basis for discussion, a second exercise has been distributed to the original participants, and to a small number of other physicists who

did not submit solutions but who regularly carry out calculations of this kind. Data has been sent for calculating two cases each, at three levels of complexity in calculation:

(a) two cases of pure reduced neutron width distributions (the only quantity to be determined is $\langle \Gamma_n^o \rangle$).

(b) two cases of resolved resonance parameters, without any experimental effect.

(c) two cases of pseudo-experimental resonance parameters sets, similar to case 1 of the previous exercise, but without the correlations introduced by a programming error into the data for the previous exercise.

It was clear from discussions during the analysis of the previous exercise that the methods used are not all fully prescribed, and that results may depend on the way in which physicists apply their judgement, for example in defining the neutron width threshold to exclude p-wave resonances. Detailed comments with solutions should make it possible to determine the importance of such differences.

III. International nuclear model code comparison (coordinated by Dr. E. Sartori, IAEA and NEA-DB)

This comparison is being carried out in three stages:

- coupled channel calculation for elastic and inelastic neutron scattering cross-sections on U-238;

- spherical optical model and statistical model calculations of a wide range of reactions for Co-59;

- pre-equilibrium effects at higher neutron energies in the context of the Co-59 problem above.

Results for the coupled channel calculation, using, in the main, different versions of the code JUPITOR have been received and analysed. The results of a first comparison of results were issued in the document NEANDC-A-136 presented at the April 1981 meeting of NEANDC. Subsequent investigations by Dr. Sartori showed that discrepancies between integral values of cross-sections at different energies were due to the methods used for integrating angular distibutions.

Only a few of the contributions expected for the second exercise on Co-59 have yet reached the Data Bank. A further report will be issued later.

A preliminary set of specifications for the third stage has been prepared and will be sent out when necessary checks have been made.

GENERAL RECOMMENDATIONS TO CONTRIBUTORS

Contents and Presentation

These newsletters are meant to be informal : nevertheless, we think it useful to give some recommendations concerning the contents, presentation, distribution, etc.

The Newsletters are concerned with evaluation activities - with evaluation work itself and with computer programs useful for evaluation.

Experimenters should be careful to distinguish between "evaluating" all the good data and the more customary process of simply analysing their own measurements.

When compiling your contribution, the following headings may serve as a guide :

1. Names, address, telephone number, telex code.
2. Work recently completed and publications.
3. Work in progress - please give names of physicists doing each evaluation.
4. Work planned for near future, i e., work expected to start within six months (before publication of the next newsletter).
5. Computer programs for : nuclear data file operations - nuclear data analysis - nuclear model calculations.

Any note or report mentioned should be available on request to another evaluator for his own use but not necessarily for widespread copying and re-distribution. The distribution list of each newsletter will be attached to it.

Contributions should be forwarded typewritten in single spacing, as the newsletters will be produced directly from this typescript.

IMPORTANT NOTE

Future Neutron Nuclear Data Evaluation Newsletters will be distributed on 1st June and 1st December each year.

Evaluators are requested to send their contributions by :

15th May and 15th November

to : NEA DATA BANK
91191 GIF SUR YVETTE CEDEX
France

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AUSTRALIA	W. Gemmell
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UNITED STATES	R. Benjamin, R.C. Block, C. Bowman, C.L. Cowan, H. Goldstein, J. Hardy, C.R. Head, P. Hemmig, W.B. Henderson, N. Holden, R. Howerton, B.R. Leonard, C.R. Lubitz, D. Mathews, C.W. Maynard, H. Motz, NNCSC Library, E.H. Ottewitte, O. Ozer, N.G. Paik, R.W. Peelle, E.R. Pennington, F.G. Perey, RSIC, G.L. Rogosa, R.E. Schenter, A.B. Smith, N. Steen, W.A. Wittkopf, P. Young

CROSS SECTION COMPUTATIONAL FORMAT

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INDEX — DATA COLUMNS

ATOMIC No. N	MASS No. A	REACTION CODE	STANDARD	METHOD	FLAGS	LABORATORY	DATE	EXFOR No.	NEUTRON ENERGY	ERROR	LEVEL ENERGY	ANGLE	ERROR	CROSS SECTION	ERROR	STANDARD	ERROR
023051	NA3	LAC				HAM	612090	4003	1.6000E+07	4.0000E+05				3.1700E-02	6.9740E-03		
023051	NA3	LAC				HAM	612090	4003	1.7100E+07	4.0000E+05				3.7000E-02	7.7700E-03		
023051	NA3	LAC				HAM	612090	4003	1.8000E+07	4.0000E+05				3.0900E-02	6.4890E-03		
023051	NA3	LAC				HAM	612090	4003	1.9400E+07	3.0000E+05				2.4200E-02	4.8400E-03		
023051	NA3	LAC				HAM	612090	4003	1.9600E+07	3.0000E+05				2.6000E-02	5.9800E-03		
023051	NA3	LAC				AEP	793052	3006	1.7970E+07	2.7000E+05				1.9700E-02	1.3000E-03	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.7180E+07	3.8000E+05				2.0300E-02	1.3000E-03	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.6050E+07	4.3000E+05				1.9300E-02	1.2000E-03	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.4770E+07	2.5000E+05				1.7400E-02	9.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.4610E+07	2.1000E+05				1.6800E-02	9.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.4360E+07	1.5000E+05				1.6000E-02	8.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.3680E+07	3.5000E+05				1.4100E-02	7.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.3410E+07	1.6000E+05				1.3200E-02	7.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.2790E+07	2.9000E+05				1.1500E-02	7.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.2230E+07	1.4000E+05				1.0100E-02	6.0000E-04	1.1750E-01	3.0000E-0
023051	NA3	LAC				AEP	793052	3006	1.1400E+07	8.0000E+05				5.3000E-03	7.0000E-04	1.1750E-01	3.0000E-0

NEUTRON DATA SERVICES FROM NEA DATA BANK

This cover illustrates the three formats now in use for answering user requests for experiment neutron data. These data are compiled and exchanged with the three other neutron data centres in "EXFOR" format, and stored at the Data Bank together with the CINDA bibliography in an inte grated data base.

NEA Data Bank makes selective searches in this data base for users in its member countries, an supplies either listings structured as in EXFOR of data and associated comments (experiment description and bibliography) or data on tape in one of the computational formats shown on thi cover, accompanied by a listing of comment information. NNDC (Brookhaven) supplies data in similar formats to its customers in USA and Canada.

Users are asked to specify their requests in as precise and selective a form as possible : thi avoids the delay and expense of sending out quantities of data much larger than the requester really wants. Data sent out to users are accompanied by documentation or other explanation of the formats used, and a list will be sent on request of all the other files of neutron and non neutron nuclear data, experimental or evaluated, available from the Data Bank.

RESONANCE PARAMETERS COMPUTATIONAL FORMAT

1 — 22

INDEX — DATA COLUMNS

ATOMIC No. Z	MASS No. A	LABORATORY	DATE	EXFOR No.	RESONANCE ENERGY	ERROR	PARITY	SPIN	MOMENTUM	TOTAL WIDTH Γ	ERROR $\Delta\Gamma$	FLAG	NEUTRON WIDTH Γ_n	ERROR $\Delta\Gamma_n$	FLAG	FISSION WIDTH Γ_f	ERROR $\Delta\Gamma_f$	FLAG	GAMMA WIDTH Γ_γ	ERROR $\Delta\Gamma_\gamma$	FLAG
026	056	KFK	700	620370008	1.6900E+05	1.0000E+03		0					8.70E+02	7.00E+01							*
026	056	KFK	700	620370008	1.8800E+05	1.0000E+03		0					3.43E+03	2.70E+02							*
026	056	KFK	700	620370008	2.2000E+05	1.0000E+03		0					1.47E+03	8.50E+01							*
026	056	KFK	700	620370009	2.2790E+04	7.0000E+01		1							G						*
026	056	KFK	700	620370009	3.4250E+04	1.0000E+02		1							G						*
026	056	KFK	700	620370009	3.6690E+04	1.1000E+02		1							G						*
026	056	KFK	700	620370009	3.8380E+04	1.2000E+02		1							G						*
026	056	KFK	700	620370009	4.6040E+04	1.4000E+02		1							G						*
026	056	KFK	700	620370009	5.2200E+04	1.6000E+02		1							G						*
026	056	KFK	700	620370009	5.3600E+04	1.6000E+02		1							G						*
026	056	KFK	700	620370009	5.5300E+04	2.0000E+02		1							G						*
026	056	KFK	700	620370009	5.9250E+04	1.8000E+02		1							G						*
026	056	KFK	700	620370009	6.3450E+04	1.9000E+02		1							G						*
026	056	KFK	700	620370009	7.2500E+04	5.0000E+02		1							G						*
026	056	KFK	700	620370009	7.6900E+04	5.0000E+02		1					8.60E+00	6.00E-01	G						*
026	056	KFK	700	620370009	8.0300E+04	3.0000E+02		1					1.80E+01	4.00E+00	G						*
026	056	KFK	700	620370009	9.2600E+04	3.0000E+02		1					6.00E+00	2.00E+00	G						*
026	056	KFK	700	620370009	9.6100E+04	3.0000E+02		1					5.00E+01	8.00E+00	G						*
026	056	KFK	700	620370009	1.0240E+05	3.0000E+02		1					7.00E+01	1.20E+01	G						*
026	056	KFK	700	620370009	1.0580E+05	3.0000E+02		1							G						*
026	056	KFK	700	620370009	1.1260E+05	3.0000E+02		1							G						*
026	056	KFK	700	620370009	1.5100E+05	1.0000E+03		1							G						*
026	056	KFK	700	620370009	1.5300E+05	1.0000E+03		1							G						*
026	056	KFK	700	620370009	1.6300E+05	1.0000E+03		1							G						*
026	056	KFK	700	620370009	1.7940E+05	1.2000E+03		1							G						*
026	056	KFK	700	620370009	1.8070E+05	1.2000E+03		1							G						*
026	056	KFK	700	620370009	1.9510E+05	1.0000E+03		1					1.00E+02	2.40E+01	G						*