```
*****************************************
******************************* BIB-SECTI
*
* 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,V.C.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 I
*              WERE USED BY VARYING THE
* FACILITY    (VDG  ) 400KEV VAN DE GRA
*              FUR STRAHLENFORSCHUNG.
* METHOD      (ACTIV) GAMMA PULSES EX
*              TA-180M WHERE BETAS WER
* PART-DET    (DC   ) DECAY GAMMAS.
* SAMPLE      .NATURAL MATERIALS. ME
*              SAMPLES WERE PLACED A
*              CORRESPONDING TO 30 T
*              ENERGY, AND SUBTENDE
*              DISTANCE OF 100MM
* CORRECTION  .ANGULAR DEPENDENT NE
*              ELASTICALLY SCATTERE
*              SCATTERING CONTRIBUTI
*              DECAY CORRECTIONS.
* ERR-ANALYS  .SYSTEMATIC ERRORS, TA
*              ATTENUATION CORRECTION
*              (0.05 PC), DECAY CORRE
*              SHIFTS (0.1 PC). MAXIMU
*              THAN 0.9 PERCENT. STATI
*              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.
*             (800115E)
*             (800424A) DATA HEADINGS
*             (800603E)
*
** END BIB-SECTION ******************
*****************************************
******************************* 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
*             (800603F)
*
** END BIB-SECTION ******************

** NO COMMON-SECTION ****************

*****************************************
```

	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

```
** END DATA-SECTION ****************
```

NNDEN/ 43

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUE DE DONNÉES DE L'AEN

November 1989

NNDEN/ 43

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NEA DATA BANK
BANQUE DE DONNÉES DE L'AEN

November 1989

LEGAL NOTICE

Neither the Organisation for Economic Co-operation and Development, any of its Member countries or their agencies, nor any person or organisation acting either on behalf of any of them or otherwise in the development, compilation, publication or distribution of the information in this report:

1. Makes any warranty or representaton, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information which it contains, or that the use of any information, apparatus, method, or process disclosed may not infringe privately owned rights; or

2. Assumes any liabilities with respect to the use of, or for damage resulting from the use of any information, apparatus, method or process disclosed.

AVERTISSEMENT

L'Organisation de Coopération et de Développement Economiques, ses pays Membres, or leurs agences, les personnes ou organisations agissant en leurs noms ou pour le développement, la compilation, la publication ou la distribution de l'information dans ce rapport:

1. Ne garantissent, expressément ou implicitement ni que les informations ci-jointes sont exactes et complètes, ni que l'utilisation de ces informations, ainsi que des appareils, méthodes ou procédés décrits ne portent pas atteinte à des droits acquis; ou

2. N'assument aucune responsabilité en ce qui concerne l'utilisation des dites informations, appareils, méthodes ou procédés ainsi que les conséquences pouvant en résulter.

- - - - -

The NEA Data Bank is part of the Organisation for Economic Co-operation and Development and is financed by the following seventeen Member countries:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

La Banque de Données de l'AEN fait partie de l'Organisation de Coopération et de Développement Economiques et est financée par les dix-sept pays Membres suivants :

Allemagne, Autriche, Belgique, Danemark, Espagne, Finlande, France, Grèce, Italie, Japon, Norvège, Pays-Bas, Portugal, Royaume-Uni, Suède, Suisse et Turquie.

NEUTRON NUCLEAR DATA EVALUATION NEWSLETTER

NNDEN/43

The Newsletter reports:

1. Evaluation work on particular nuclides.
2. Development of codes for nuclear model calculations, and other codes needed for nuclear data work.
3. Publications relevant to the neutron data field.

Contributions have been received from:

		Page
AUSTRALIA	Australian Nuclear Science and Technology Organisation	8
CHINA	Institute of Atomic Energy, Beijing	9
	Institute of Heavy Ion Physics	10
FEDERAL REPUBLIC OF GERMANY	KFK Karlsruhe	13
FRANCE	CEN, Bruyères-le-Châtel	15
	CEN, Cadarache	16
GERMAN DEMOCRATIC REPUBLIC	Technical University, Dresden	17
INDIA	Bhabha Atomic Research Centre, Trombay	19
	Indira Gandhi Centre, Kalpakkam	21
ITALY	ENEA, Bologna	23
JAPAN	Nuclear Data Center, JAERI	28
NETHERLANDS	ECN, Petten	30
POLAND	Soltan Institute for Nuclear Studies	32
UNITED KINGDOM	AERE, Harwell	33
	Nuclear Physics Laboratory, Oxford	34
	AEE, Winfrith	37
USA	BNL, Upton	38
	LANL, Los Alamos	39
	ORNL, Oak Ridge	43
USSR	Institute of Nuclear Power, Minsk	47
EFF (European Fusion File)	ECN, Petten	48
IAEA	Nuclear Data Section, Vienna	50
OECD/NEA	Data Bank, Saclay	53

The next issue of NNDEN has been scheduled for October 1990 and contributors are asked to send in their reports by 15th September 1990.

NEW EVALUATIONS A) COMPLETED
B) IN PROGRESS
C) PLANNED IN THE NEAR FUTURE

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
H-1	many		41		
Li-6	many			41	
Li-7	R-matrix		41		
Li-7	many			41	
Li-7	many		48		
Be	many			48	
Be-9	many		41		
B-10	many			41	
B-10	$(n,\alpha_1)/(n,\alpha_0)$	10 KeV-1 MeV		45	
B-10	$(n,\alpha\gamma)$	100 KeV-5 MeV		46	
B-11	many		28		
B-11	R-matrix		41		
B-11	many			41	
C-12	many		41		
N-14	R-matrix			41	
N-15	many	0.01-20 MeV	28		
O-16	many		41		
O-16	R-matrix			41	
Al	many			41	
Al-27	many			41	
Si-28	many		41		
Sc-75	γ decay		37		
Ti	$(n,x\gamma)$				46
V-51	(n,α)	10-20 MeV	11		
Cr	many		45		
Cr	$(n,n'),(n,\alpha)$				46
Cr	many			48	
Cr	(n,n'),level density		51		
Cr	many		53		
Cr-51	γ decay		37		
Cr-52	many				46
Fe	many		41		
Fe	many		45		
Fe	$(n,n'),(n,\gamma)$			45	
Fe	many			48	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
Fe	(n,n′),level density		51		
Fe	many			53	
Fe-54	many	up to 20 MeV	24		
Fe-56	(n,p)		9		
Fe-56	(n,p)	5-20 MeV	11		
Fe-56	many	up to 20 MeV	24		
Fe-56	many	up to 1 GeV	38		
Fe-56	many	resonance region	44		
Fe-57	many	up to 20 MeV	24		
Fe-57	many				46
Fe-58	(n,γ)		9		
Fe-58	many	up to 20 MeV	24		
Co-59	(n,xn),(n,pn)	14 MeV	35		
Ni	many		30		
Ni	many		45		
Ni	(n,n′),(n,γ)				46
Ni	many		48		
Ni	covariance data			48	
Ni	(n,n′),level density		51		
Ni	many			53	
Ni-58	many			19	
Ni-60	many			19	
Cu-63	many				46
Cu-65	many				46
Zn-65	γ decay		37		
Ge-70	(n,p)	13-16.6 MeV	32		
Ge-72	(n,p)	13-16.6 MeV	32		
Ge-73	(n,p)	13-16.6 MeV	32		
Ge-74	(n,p)	13-16.6 MeV	32		
Se-74	(n,p)	13-16.6 MeV	32		
Se-76	(n,p)	13-16.6 MeV	32		
Se-77	(n,p)	13-16.6 MeV	32		
Se-78	(n,p)	13-16.6 MeV	32		
Y-88	(n,2n)		11		
Zr-90	(n,2n)	12-20 MeV	11		
Nb-93	(n,xn),(n,pn)	14 MeV	35		
Pd-106	(n,p)	13-16.6 MeV	32		
Pb-108	(n,p)	13-16.6 MeV	32		
Eu-151	many			41	
Eu-153	many			41	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
Ho-165	many			41	
Tm	many		15		
Hf-178	isomer prod.		35		
W	many		41		
W-184	(n,n')	11.5-26 MeV	32		
W-184	neutron emission	11.5-26 MeV	35		
Au-197	(n,2n)	11-20 MeV	11		
Au-197	(n,3n)	16-20 MeV	11		
Au-197	many			41	
Pb	many	high		38	
Pb	(n,n'),(n,γ)				46
Pb	many			48	
Th-232	neutron spectrum	2 MeV	8		
Th-232	fission yield	fast, 14 MeV	37		
U	T 1/2 total + spont.		38		
U-233	neutron spectrum	thermal	8		
U-233	fission yield	thermal, fast, 14 MeV	37		
U-233	many	10^{-5} eV-20 MeV		47	
U-234	fission yield	fast	37		
U-235	neutron spectrum	thermal	8		
U-235	ν p	10^{-5} eV-120 eV		16	
U-235	delayed neutron yield	10^{-5} eV-20 MeV		16	
U-235	fission yield	thermal, fast, 14 MeV	37		
U-235	many		41		
U-235	many			41	
U-235	resonance parameters	83 eV-2.25 KeV		45	
U-235	(n,f)	resonance region		45	
U-235	many			53	
U-236	fission yield	fast	37		
U-236	many		51		
U-238	neutron spectrum	2 MeV	8		
U-238	many		10		
U-238	many	4-600 KeV	13		
U-238	many			33	
U-238	fission yield	fast, 14 MeV	37		
U-238	many		41		
U-238	(n,xn)	1-100 MeV	41		
U-238	neutron spectrum	up to 100 MeV	41		
U-238	many		41		
U-238	many			41	
U-238	(n,γ)(n,f)			44	
U-238	many				46
U-238	many			53	

NUCLIDE	DATA TYPE	ENERGY RANGE	PAGE		
			A	B	C
Np-237	fission yield	thermal, fast	37		
Np-237	many		41		
Np-237	(n,xn)	1-100 MeV	41		
Np-237	many			41	
Np-238	fission yield	thermal, fast	37		
Pu	T 1/2 total + spont.		38		
Pu-238	neutron spectrum	spontaneous	8		
Pu-238	fission yield	thermal, fast	37		
Pu-238	many		51		
Pu-239	neutron spectrum	thermal	8		
Pu-239	(n,f)	up to 2 KeV		16	
Pu-239	delayed neutron yield	10^{-5} eV-20 MeV		16	
Pu-239	covariance data				16
Pu-239	fission yield	thermal, fast	37		
Pu-239	many		41		
Pu-239	many			41	
Pu-239	resonance parameters	up to 2 KeV	45		
Pu-239	(n,f)	resonance region		45	
Pu-239	many		53		
Pu-240	neutron spectrum	spontaneous	8		
Pu-240	fission yield	fast	37		
Pu-241	fission yield	thermal, fast	37		
Pu-241	resonance parameters	up to 300 eV	45		
Pu-241	many		53		
Pu-242	neutron spectrum	spontaneous	8		
Pu-242	fission yield	fast	37		
Am	T 1/2 total + spont.		38		
Am-241	many		28		
Am-241	fission yield	thermal, fast	37		
Am-242m	many		28		
Am-242m	fission yield	thermal, fast	37		
Am-243	many		28		
Am-243	fission yield	thermal, fast	37		
Am-244g	many		28		
Am-244m	many		28		
Cm	many			28	
Cm	T 1/2 total + spont.		38		
Cm-242	fission yield	spontaneous	37		
Cm-243	fission yield	thermal, fast	37		
Cm-243	many		47		
Cm-244	fission yield	thermal, fast	37		
Cm-244	fission yield	spontaneous	37		
Cm-244	many		47		
Cm-245	fission yield	thermal, fast	37		
Cf-252	neutron spectrum	spontaneous	8		
Cf-252	fission yield	spontaneous	37		

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION
LUCAS HEIGHTS RESEARCH LABORATORIES
(formerly Australian Atomic Energy Commission)

Address: Private Mailbag 1
Menai NSW 2234
Australia

Names: R.L. Walsh and G. Chircu*
(*University of New South Wales)

Activity: *Calculation of fission neutron spectra using Madland-Nix Model*

Results:

- Fission spectra and spectrum integrals calculated for
  - 2 MeV fission of ^{232}Th, ^{238}U
  - thermal fission of ^{233}U, ^{235}U, ^{239}Pu
  - spontaneous fission of ^{252}Cf
  - nuclei of importance to nuclear safeguards, viz. spontaneous fission of ^{240}Pu, ^{238}Pu and ^{242}Pu
- Effect of fragment spin incorporated (neutron anisotropy parameter b = 0.1)
- Effect of neutrons from accelerating fragments incorporated
- Tabulated data available

Publications:

R.L. Walsh
"Spin-dependent calculation of fission neutron spectra and fission spectrum integrals for six fissioning systems", Nucl. Sci. Eng., 102 (1989) 119.

R.L. Walsh and G. Chircu
"Fission neutron spectra for ^{240}Pu, ^{238}Pu and ^{242}Pu", Proc. Int'l Conf. '50 Years with Nuclear Fission', Gaithersburg, USA, 25-28 April 1989.

R.L. Walsh and G. Chircu
"Calculation of fission neutron spectrum incorporating neutrons from accelerating fragments", ibid.

Institution: Chinese Nuclear Data Centre

Address: Institute of Atomic Energy
P.O. Box 275 (41)
Beijing
China, People's Republic

Contact: Zhou Delin

1. Zhao Zhixiang and Zhou Delin
   Systematics of Excitation Function for (n,γ) Reaction, to be published in Chinese Nuclear Physics.

2. Zhao Zhixiang and Zhou Delin
   Systematics of Excitation Function for (n,n+p) and (n,n+α) Reactions, to be published in Chinese Nuclear Physics.
   The codes related to the above systematics are available from CNDC.

3. Zhao Zhixiang and Liu Tong
   Evaluation of Fe-58(n,γ) Reaction Cross Section and Its Covariance. (Data set in ENDF/B-VI format is available from CNDC).

4. Zhou Delin
   A Compilation of Activation Cross Sections for Fusion Reactor Technology at 14.7 MeV.

5. Yuan Hanrong
   Evaluation of Fe-56(n,p) Cross Sections, (88 Mito and Rev.).

6. Wang Dao
   The Chinese evaluated data file of fission-product yields for 10 fissioning systems will be updated and improved. The EXFOR experimental database is updated; covariance techniques for data evaluation are invisaged; decay heat calculations are in progress.

Progress of Evaluation of Neutron Nuclear Data in The Institute of Heavy Ion Physics, Peking University

Bao Shanglian

Institute of Heavy Ion Physics
Peking University
Beijing 100871
P. R. China

1. Introduction

Since the 16th conference of International Nuclear Data Commission held in Beijing, October, 1987, the progress of the evaluation of the neutron nuclear data combined with the preparation of neutron nuclear data measurements reached some points.

2. Evaluation of Neutron Nuclear Data

1). Evaluation of Neutron Nuclear Data of Natural Calcium for CENDL-1[1] (Tang Guoyou, Bao Shanglian,Shi Zhaomin,Cao Wentian) will be published in a Collection of Progress of Chinese Neutron Nuclear Data and also presents here.

2). Evaluation of Neutron Nuclear Data of U-238 for CENDL-2 has got primary result, which was evaluated by Tang Guoyou et al. and cooperated with Ca. Denjiu et al., China Nuclear Data Center.

2. The Computer Code HFTT

The code HFTT (made by Huang Feizen et al.) developed in our laboratory has got a new version HFTTA, which can be used in a personal IBM-PC/AT type computer. The original version HFTT[2] was sent to the NEA Data Bank in October 1988. Comparing with HFTT, HFTTA is more convenient for user. The code was made

based on the evaporation model with preequilibrium emission described by the exciton model. In each calculation, the code can handle the decay sequence involving up to 3 compound nuclei. The first two decaying compound nuclei can emit 7 types of particles including neutron, proton, triton, ^{3}He, deuteron, alpha and gamma ray. The last compound nucleus can only emit neutron, proton and gamma ray. The incident particles permitted in the code calculation are n, p, t, ^{3}He, d and alpha. The incident energy below 40MeV are allowed in the calculations. The input data needed in the calculation are the types of incident and outgoing particles, the incident energy, the mass and atomic number of the target nucleus and the K factor in the exciton transition matrix elements. We have calculated many nuclear reaction cross sections using the code. The consistency between the calculations and the measurements[4-9] are satisfied. Some comparison results are shown in Fig. 1 to 6. We got the ^{88}Y(n,2n) reaction cross section by a indirect method[3]. The results are also compared with our calculations and other experiment results.

References

[1] Tang Guoyou, Bao Shanglian, Shi Zhao Minin, Proceeding of Progress of Neutron Nuclear Data Evaluation, to be published.

A summary report is available from the IAEA Nuclear Data Section as INDC(CPR)-15.

[2] Huang Feizeng, Shi Zhaomin, Bao Shangliang, Acta Scientiarum Naturalium Universitatis Pekinensis, V. 25, No.3 (1989)289 (in Chinese).

[3] Huang Feizeng, Shi Zhaomin et al., High Energy Physics and Nuclear Physics(in Chinese), 1989.

[4] H. Liskien et al.,J. Nucl. Energy parts A/B 19(1965)73.

[5] H. L. Lu et al., Scien. and Technology of Atomic Energy (Chinese), 2(1975)113.

[6] X. G. Long et al., Nucl. Phys. (Chinese), 9(1987)48.

[7] A. Pavlik et al., J. Phys. G Nucl. Phys. 8(1982)1283.

[8] R. Colle et al., Phys. Rev. C. 9(1974)1819.

[9] P. G. Fan et al., Scien. and Technology of Atomic Energy (Chinese), 2(1978)133.

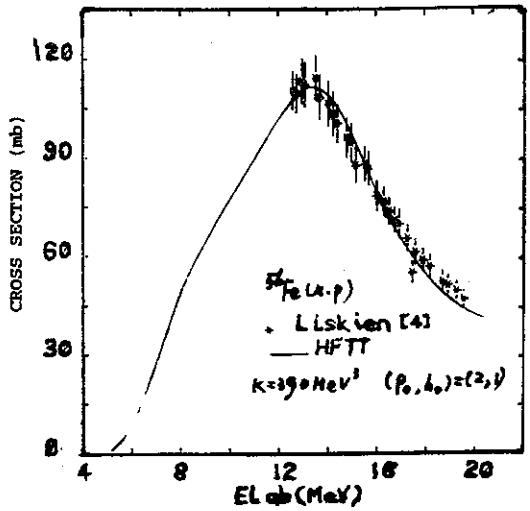

Fig. 1

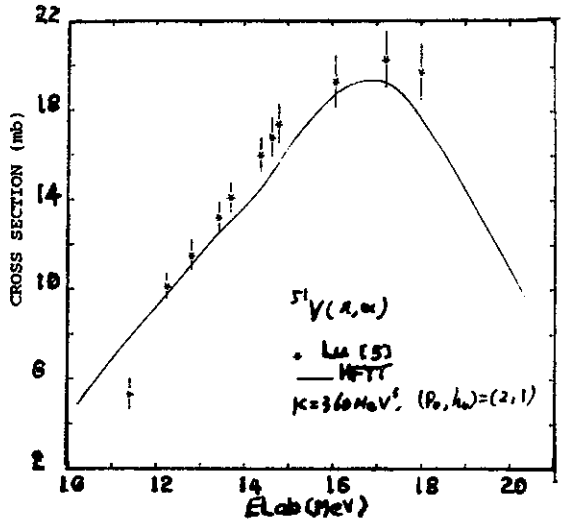

Fig. 2

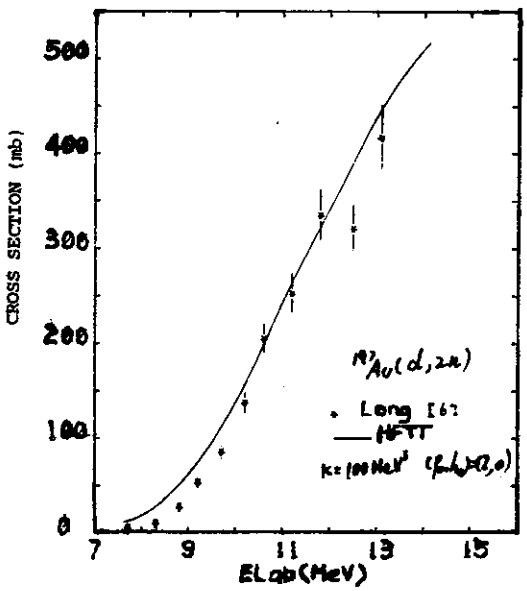

Fig. 3

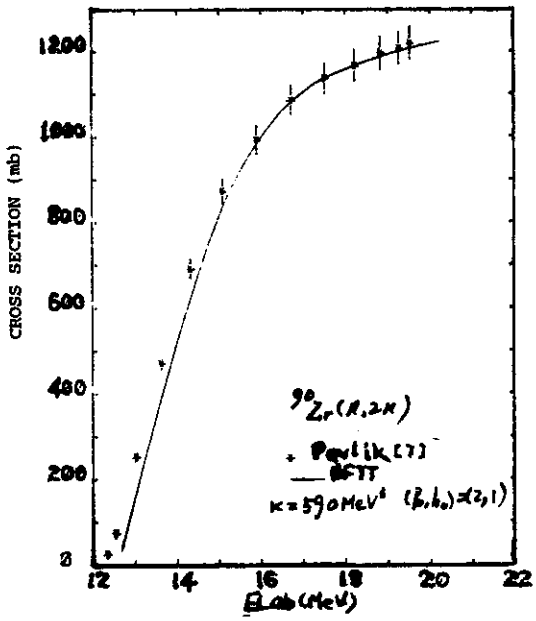

Fig. 4

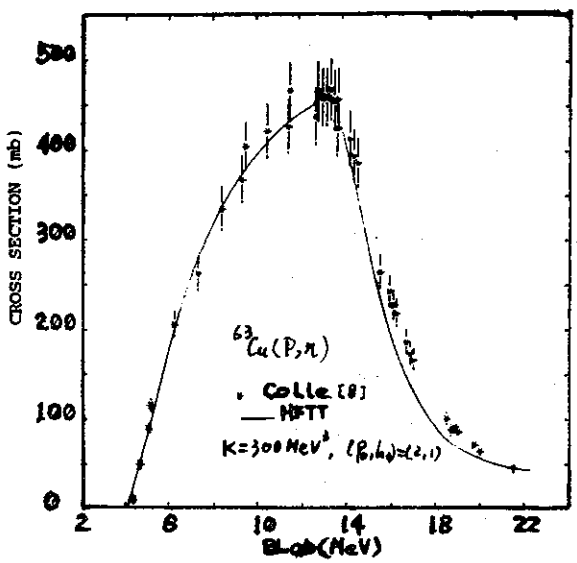

Fig. 5

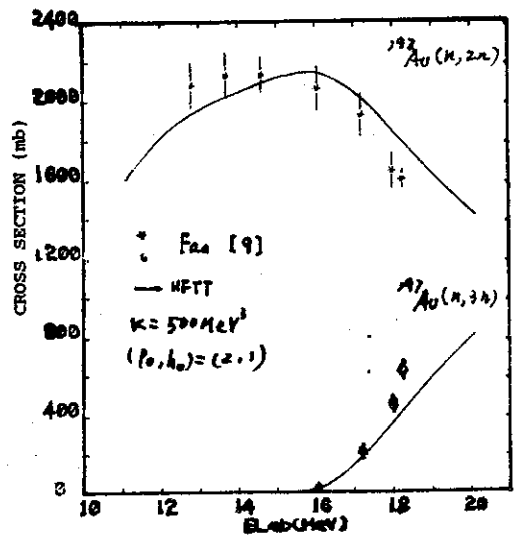

Fig. 6

KFK KARLSRUHE

GERMANY

Name: F.H. Fröhner

Address: Kernforschungszentrum Karlsruhe
Institut für Neutronenphysik und Reaktortechnik
Postfach 3640
75 Karlsruhe, West Germany

Work recently completed

1. U-238 Cross Sections in the Unresolved Resonance Region for JEF-2

A large body of transmission and capture data and recent precision data for inelastic neutron scattering has been fitted simultaneously between 4 and 600 keV with the code FITACS which employs modern Hauser-Feshbach theory (GOE averages over resonances /1/). Utilisation of the generalised (Bayesian) least-squares method permitted inclusion of a-priori information from resolved resonance parameters prepared at Harwell /2/ for JEF-2. An initial discrepancy between this prior information and the fits turned out to be caused by questionable parity assignments for weak levels. After reanalysis of the resonance parameters with the code STARA-81 full consistency was obtained between model fits, information from resolved resonances and optical-model results. The final average resonance parameters were used to compute recommended resonance-averaged point data for JEF-2 between 10 and 300 keV for all open reaction channels. The recommended total cross section data are in excellent agreement with the latest ANL evaluation /3/ above 45 keV (to better than 0.5 % over most of the range). The recommended capture data agree well with the latest (model-free) point evaluation for the ENDF/B-VI standards file /4/ except for the high- and low-energy ends of the range where the JEF-2 recommendation is higher but not really discrepant in view of the (preliminary) uncertainties (2-3 % in both evaluations).

/1/ F.H. Fröhner, Proc. 1988 Intern. Reactor Physics Conf., Jackson Hole, vol. III, p. 171; in print: Nucl. Sci. Eng., Oct. 1989
/2/ M.C. Moxon, M.G. Sowerby, Y. Nakajima and C. Nordborg ibid. vol. I, p. 281
/3/ A.B. Smith, priv. comm.
/4/ W.P. Poenitz, priv. comm.

2. New Approach to the Evaluation of Discrepant Experimental Data

Two-stage Bayesian estimation has been employed to work out a rigorous method for dealing with nonidentified systematic errors in discrepant data obtained in different measurements of the same physical quantity. It turns out that contrary to many ad-hoc recipes one cannot make definite predictions without at least a vague idea about the possible size of the unrecognised errors. Including such minimum information in the form of an appropriate maximum-entropy prior one gets definite best estimates (under quadratic loss) for the physical quantity and its uncertainty in a straightforward way. Furthermore, one gets estimates of the unrecognised errors which in saddle-point approximation resemble the controversial James-Stein estimators, but in contrast to those without pathological discontinuities, and with readily calculated uncertainties /1/.

/1/ F.H. Fröhner, in "Maximum Entropy and Bayesian Methods", J. Skilling (ed.), Dordrecht (1989), pp. 467-474

SERVICE DE PHYSIQUE ET TECHNIQUES NUCLEAIRES
CENTRE D'ETUDES DE BRUYERES-LE-CHATEL

ADDRESS : B.P. N° 12, 91680 BRUYERES-LE-CHATEL, France

I. RECENT PUBLICATIONS AND REPORTS

- Optical Model Description of the Neutron Interaction with ^{116}Sn and ^{120}Sn over a wide energy range.
  P.P. GUSS et al. [1] Phys. Rev. C39 (1989) 405

- Neutron ^{90}Zr mean field from a dispersive optical model analysis.
  J.P. DELAROCHE et al. [2] Phys. Rev. C39 (1989) 391

- Energy dependence of the deformed optical potential for neutron scattering from ^{54,56}Fe and ^{58,60}Ni up to 80 MeV.
  R.S. PEDRONI et al. [1] Phys. Rev. C38 (1988) 2052

II. WORK RECENTLY COMPLETED

- Ground state band deformations of ^{155,156,157,158,160}Gd from neutron scattering measurements and Hartree-Fock-Bogolyubov calculations.
  J.P. DELAROCHE et al., to be submitted to Phys. Rev. C.

- Evaluation of d(d,p)t, ^{3}He(d,p) α cross sections up to 10 MeV.
  O. BERSILLON

- Partial re-evaluation of Tm integral cross-sections
  O. BERSILLON, C.A. PHILIS

III. WORK IN PROGRESS

- Analyse des spectres de neutrons issus de la réaction d^{7}Li.
  O. BERSILLON

- Effet Doppler sur les sections efficaces différentielles.
  O. BERSILLON

- Evaluation of "B(p,3α) cross sections up to 10 MeV

- Preliminary Results for the Excitation Functions of ^{151,153}Eu(p,n) ^{151,153}Gd and ^{151,153}Eu(d,2n) ^{151,153}Gd : Measurements and Modeling [3]
  H.I. WEST, Jr.,R.G. LANIER, M.G. MUSTAFA, R.M. NUCKOLLS, J. FREHAUT, A. ADAM, and C.A. PHILIS.

REFERENCES

[1] In collaboration with Duke University, Durham, USA
[2] In collaboration with Ohio University, Athens, USA
[3] In collaboration with Lawrence Livermore Laboratory, CA, USA

CENTRE D'ETUDES NUCLEAIRES DE CADARACHE

ADDRESS : Department of Physics Research
building 230
C.E.N. Cadarache
131108 - Saint-Paul-lez-Durance Cedex
France

NAMES : H. DERRIEN, E. FORT, P. LONG

I - WORK IN PROGRESS

. Reevaluation of the fission cross section of ^{239}Pu by extension of the resolved range up to 2 KeV.
H.DERRIEN, G. de SAUSSURE.

. Evaluation of $\bar{\nu}_p$ for ^{235}U between 10^{-5}ev and 120 ev.
E.FORT, P.LONG.

. Evaluation of the total delayed neutron yield of ^{235}U between 10^{-5} 20 MeV.
E.FORT, P.LONG

. Evaluation of the total delayed neutron yield of ^{239}Pu between 10^{-5}ev and 20 MeV.
E.FORT, A.PHILIP, P.LONG.

. Impact of integral informations from SPX1 start up on the evaluation of ^{239}Pu.
E.FORT, J.C.CABRILLAT, P.SALVATORES.

II - WORK PLANNED FOR THE FUTURE

. Completion of the work on covariance matrices for ^{239}Pu evaluation.
E.FORT.

. Contribution to the JEF2 file validation : Data processing, benchmark calculations.
E.FORT.

Laboratory: Technische Universität Dresden, Sektion Physik

Names: H. Kalka, M. Torjman, M. Toepfer, D. Seeliger

Activity: Calculation of DDX and excitation functions between zero and 20 Mev for 30<A<250 within statistical multistep theory (code EXIFON)

Results: Consistent description including neutron and proton channels as well as multiple particle emission. Output in ENDF/B-format for BROND library.

Publications: H. Kalka et.al., Z. Phys. A329(1988)331,
H. Kalka and D. Seeliger, Proc. 5-th Int. Symp. on Nucleon Induced Reactions, Smolenice, 1988,
H. Kalka et.al., INDC(GDR)-054/LJ,
H. Kalka et.al., INDC(GDR)-055/LJ.

Work in progress: Global description of DDX and exicitation functions including neutron, proton, α, γ-ray and fission channels.

Address: Technische Universität Dresden
Sektion Physik
Mommsenstrasse 13
DDR-8027 Dresden, GDR

Contact: D. Seeliger

Laboratory: Technische Universität Dresden, Sektion Physik

Names: H. Märten, A. Ruben, D. Seeliger

Activity: Compilation of prompt fission neutron data

Results: Completion of model developement for description of
(i) energy partition as function of mass asymmetry in induced fission (scission point modell with semi-empirical, temperature-dependent shell effects, code TSM) and
(ii) multiplicities, energy and angular distributions of prompt fission neutrons (statistical model approach, code FINESSE);
Systematics of fission neutron data in the case of (n,f)-reactions at incidence energies below 6 Mev.

Publications: H. Märten, D. Seeliger, Nucl. Sci. Eng. 93(1986)370;
H. Märten, Proc. AGM on Nuclear Theory for Fast Nentron Nuclear Data Evaluation, Beijing, 1987, IAEA-TECDOC-483(1988)148.
H. Märten et.al., Proc. Int. Conf. on Fifty Years With Nuclaer Fission, Gaithersburg, 1989, in press
H. Märten et.al., Submitted to Nucl. Sci. Eng.

Work in progress: Model Application to $^{238,240,242}Pu(sf)$ neutron emission;
Extension of data systematics to incidence energies until 20 Mev in connection with statistical multi-step reaction theory (code EXIFON), e.g. $\bar{\nu}(E_n)$, $\bar{E}(E_n)$, DDX.

Address: Technische Universität Dresden
Sektion Physik
Mommsenstrasse 13
DDR-8027 Dresden, GDR

Contact: D. Seeliger

Government of India
BHABHA ATOMIC RESEARCH CENTRE
TROMBAY, BOMBAY 400 085, INDIA

NAMES : S.B. GARG

ADDRESS : Neutron Physics Division,
Bhabha Atomic Research Centre
Trombay, Bombay 400 085

recent publications

(i) S.B. Garg; Status of Nuclear Data Activity at BARC, Divisional Report (1988)

(ii) M. Srinivasan, K. Subba Rao, S.B. Garg and P.K. Iyengar; Systematics of Criticality Properties of Actinide Nuclides And Its Bearing On The Long Lived Fission Waste Problem, Paper Presented at the Fifth Intern. Conf. on Emerging Nuclear Energy Systems, Karlsruhe, FRG (1989)

(iii) S.B. Garg; A Comparative Study of Nuclear Models With Special Reference to Neutron Cross-Sections of Structural Elements, Proceedings Symp. on Nuclear Physics 31B, P46 (1988)

(iv) S.B. Garg; A Geometry Dependent Hybrid Model Based Study of Angle-Energy Correlated double Differential Cross-Sections, Proceedings Symp. on Nuclear Physics 31B, P45 (1988)

WORK RECENTLY COMPLETED

(i) Generation of 25 Group Photon Interaction Cross-sections With P_3-Anisotropic Scattering Matrices for H, B, C, O, Na, Ca, Mg, Si, Cu, S, Cl, Fe, Zn and Pb

(ii) Generation of 35 Group Neutron Interaction Cross-sections With Resonance Self-Shielding Factors and P_3-Anisotropic Scattering Matrices for U-236, U-239, Am-241, Am-243 and Cm-242 Using ENDL-4 Basic Cross-Section Library

(iii) Generation of Criticality Data For The Bare Fast Multiplying Assemblies Fuelled With U-236, U-238, U-239, Am-241 and Th-232

WORK IN PROGRESS

(i) Evaluation of Multiparticle Neutron Induced Reaction Cross-Sections, Energy Spectra of the Secondary Emitted Particles and the Angle-Energy Correlated Double Differential Cross-Sections for Ni-58 and Ni-60 Utilizing Multistep Hauser-Feshbach, Geometry Dependent Hybrid Model and Unified Exciton Model Schemes.

(ii) Evaluation of Direct Level Excitation Cross-Sections For Several Discrete Levels of Ni-58 and Ni-60 With the Distorted Wave Born Approximation of Direct Reaction Theory

COMPUTER CODES

(i) A new version of GNASH code has been modified, commissioned and tested. The code calculates multiparticle reaction cross-sections and energy spectra of the secondary emitted particles. The new version has a provision to calculate fission cross-sections and provides the flexibility of using different level density prescriptions

(ii) SCAT-2 code has been modified to generate total, reaction and shape-elastic cross-sections together with the transmission coefficients for use in the new version of GNASH Code.

INDIRA GANDHI CENTRE FOR ATOMIC RESEARCH, KALPAKKAM, INDIA

NAMES: S. Ganesan, M. M. Ramanadhan, V. Gopalakrishnan and K. Devan

ADDRESS: Nuclear Data Section
Indira Gandhi Centre for Atomic Research,
Kalpakkam, 603 102
Tamil Nadu, India

RECENT PUBLICATIONS AND REPORTS:

1.Budi Santoso*, A. Syuakat*, I. Subki* and S. Ganesan,
(*National Atomic Energy Agency, Indonesia.)

"Plans for Use of ENDF/B in Reactor Research in Indonesia",

Paper presented at II Asian Symposium on Research Reactors held in Jakarta, Indonesia during May 23-25, 1989. Also to be published as INDC(INDONESIA)-001 BY IAEA, Vienna.

2. V. Gopalakrishnan, R. V. Nandedkar,@ S. Ganesan and W. Kesternich,@@
(@:Centre for Advanced Technology, Indore, India
@@:Instt.fuer Festkorperforschung-KFA, Juelich, FRG)

"Estimation of Helium Production in Stainless Steel due to Neutron Irradiation",

Abstract accepted for poster presentation at the International Conference on Fusion Reactor Materials, ICFRM-4, Japan, (Dec 4-8, 1989).

3. S. Ganesan,

"Statistical Theory of Fluctuations in Neutron-Nucleus Cross sections and Use of "ABAREX", the Optical Staistical Model Code",

pp. 361-416 in APPLIED NUCLEAR THEORY AND NUCLEAR MODEL CALCULATIONS FOR NUCLEAR TECHNOLOGY APPLICATIONS, M. K. Mehta and J. J. Schmidt (Eds.) World Scientific and Co., Singapore (1989).

4. S. Ganesan,

"Highlights of the International Conference on Nuclear Data for Science and Technology held in Mito, Japan during May 30-June 3, 1988",

PHYSICS NEWS, Vol 20, No.1 pp. 22-25 (March 1989)

5. S. Ganesan,

"Development of Indian Coss Section Data Files for Th-232 and U-233 and Integral Validation Studies",

pp. 929-936 in NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, Saikon

Publishing Co., Ltd. Japan (1988).

Nuclear data services for meeting the needs of data for use in reactor application calculations at the Centre were made. These tasks cover variety of services as indicated in the reports mentioned below:

V. Gopalakrishnan and S. Ganesan,"One group cross sections of all nuclides from ENDL/84-V Library", Unpublished Internal Note (1989)

K. Devan, V. Gopalakrishnan and S. Ganesan, "Estimation of error in keff in ZPR-6-7 using covariance methodology", Unpublished Internal Note (1989)

K. Devan, V. Gopalakrishnan and S. Ganesan, "100 Group Cross Sections for Li-6, Li-7 and B-10 from JENDL-2 Library for Prediction of Tritium Production in PFBR", Unpublished Internal Note (1989)

S. Ganesan and V. Gopalakrishnan, " Remarks on Characteristics of Cross sections of Some materials" Unpublished Internal Note (1989)

V. Gopalakrishnan and S. Ganesan,"One group Cross Section for all Nuclides in the 1969 Adjusted Multigroup Library and for those in the ENDF/B-IV based IGCAR Multigroup Library", Unpublished Internal Note (1989)

K. Devan, V. Gopalakrishnan and S. Ganesan, "A Note on Optical-statistical Model Calculations for (n+ U-238) Cross Sections Using ABAREX code", Unpublished Internal Note (1989)

V. Gopalakrishnan, M. M. Ramanadhan and S. Ganesan, "Self-shielded Cross Section Averages of Sb-121 and Sb-123 for the Calculation of Neutron Source Regeneration in FBTR", Unpublished Internal Note (1988)

M. M. Ramanadhan, S. Ganesan and V. Gopalakrishnan, "A Program for Selective Retrieval of Cross Sections and other Relevant Data from EXFOR Library", Unpublished Internal Note (1988)

E.N.E.A. - Centro Ricerche Energia "E. Clementel"

Laboratorio Dati Nucleari e Codici

Divisione Calcolo

Dipartimento Tecnologie Intesettoriali di base

Via G.B. Ercolani, 8 -40138 Bologna, Italy

tel. 051/498111- telex 511578 ENEABO I

Names: F.Fabbri, G. Maino, E.Menapace, A. Mengoni,

G.C.Panini, M.Pescarini, G. Reffo, M. Rosetti

PUBBLICATIONS

/1/ G.C. Panini, G. Rinaldi, "An intercomparison between kerma factors form MACLIB-IV and from NJOY", OECD seminar-workshop on NJOY and THEMIS, NEA DATA BANK, Saclay, France 20-21 June 1989.

/2/ K.W. Burn, G.C. Panini "A note about PENDF's prepared by THEMIS-RECONS" , OECD seminar-workshop on NJOY and THEMIS, NEA DATA BANK, Saclay, France 20-21 June 1989.

/3/ E. Brega, E. Cupini, G.Ferro, G.C. Panini, R. Gandalini, "A nuclear data library for the KIM Montecarlo code", OECD seminar-workshop on NJOY and THEMIS, NEA DATA BANK, Saclay, France 20-21 June 1989.

1) Evaluation

Fe stable isotopes of natural element : 54-Fe(5.8%); 56Fe(91.72%); 57-Fe(2.2%); 58-Fe(0.28%).

Neutron cross sections and photon production data have been evaluated for each isotopes in the incident neutron energy range from 1 MeV, when the continuum region starts above the resonance domain, up to 20 MeV. Photon production cross sections and spectra following neutron induced reactions have been calculated by means of modified version of the PENELOPE code. Preequilibrium effects have been taken into account in the higher energy region within the framework of the simple exciton model. In the considered energy range the main sources of emitted gamma-rays are neutron radiative capture and inelastic scattering processes.The latter is predominant in the MeV region, just above the threshold energy. Gamma-ray cascades originating from (n,gamma) and (n,n'gamma) reactions are described in the framework of statistical model, allowing up to seven successive decays. The evaluated neutron cross sections and photon production data have been then set up in an evaluated nuclear data file, according to ENDF/B formats and rules.

2) Activities in nuclear data management processing and validation

a) The OMICRON code for translating ECPL-Evaluated Charged Particle Library- from the LNNL format to ENDF/B has been

produced and implemented. The code generates interpreted listings and plots from files and the comparison both with existing evaluations computer and device independent software. The code package has been sent to NEA-DB.

b) A new library of nuclear response functions is being produced in the VITAMIN-J structure. The set includes kerma, DPA and gas production data; basic data are those of EFF-1. NJOY has been used as basic processing code; however because of the well known inability of the code to compute some correct kerma, due to incompleteness of cross section of structural materials as from investigated available nuclear data files, the MACK-IV code has bee adopted for a certain number of materials. MACK-IV has been used to produce the MACKLIB-IV library of response functions and gamma-ray production matrices starting from ENDF/B-V data and to homogenize with NJOY the algorithms which compute the resonance cross sections and perform the Doppler broadering. The work is performed within the framework of Neutronics Data Base for Shielding task of the European fusion Tecnology Programme.

c) A new library for the KIM Montecarlo code has been produced. The library has been entirely computed by NJOY starting from JEF 1.1 nuclear data. A number of ancillary codes has been written to perform the format conversion from GENDF to KIM and to introduce in the library nuclear constants not found in the source file. The adoption of new data file lead to introduce some minor modification in the

structure of the KIM Library without loosing compatibility with previous versions. Work performed in cooperation among ENEA, CISE and ENEL. The library is validation process.

d) Further calculations and analysis for the PCA-Replica neutron shielding benchmark have been performed. The (H2O/Fe) PCA-Replica shielding benchmark is officially sponsored by OECD/NEACRP (the Nuclear Energy Agency Committee on Reactor Physics) for nuclear data validation and reproduce the ex-core configuration of a typical PWR. In particular the check of JEF-1 iron file has been completed by DOT 3.5-E (2-D/SN) transport calculations with an higher point flux convergence (0.0001). The results obtained show negligible differences from previous calculations.

A detailed spectral analysis has been performed as well. In particular the analysis has proved a trend to underestimate fluxes above about 1.0 MeV and more severely above about 3.0 MeV, in the T/4 C/E (calculated / expermental) iron test position (in the pressure vessel simulator). This suggests, as outlined by other validator's of the JEF-1 iron file, an overestimation of a few percentage points in the inelastic scattering cross section.

A future test of the JEF-2 iron file should be considered. First indications on this file, deduced in cooperation with the Bologna evaluation group (where the work on the fast energy range is in progress) give a sensitive reduction in the inelastic cross section in comparison with the JEF-1 file.

A detailed report on the PCA-Replica/JEF-1 benchmark is in progress.

CORRESPONDENT: E. Menapace, ENEA-Dept.TIB, Bologna (Italy)

Japanese Nuclear Data Committee
(Nuclear Data Center, JAERI)

Work Recently Completed and Publications

1) T. Nakagawa: "Evaluation of Nuclear Data for Americinm Isotopes", JAERI-M 89-008 (1989)

The nuclear data of ^{241}Am, ^{242m}Am and ^{243}Am were re-evaluated on the basis of the new experimental data. Mainly revised data are the fission and capture cross sections and resonance parameters. The data of ^{244g}Am and ^{244m}Am were newly evaluated.

2) T. Fukahori: "Evaluation of Nuclear Data of B-11", JAERI-M 89-046 (1989).

Nuclear data of ^{11}B have been evaluated in the energy range from 0.01 meV to 20 MeV. The evaluation was performed by using the R-matrix theory below 7 MeV and multistep statistical model above 7 MeV. Direct inelastic scattering processes were considered with DWBA calculation.

3) T. Fukahori: "Evaluation of Neutron Nuclear Data of N-15", JAERI-M 89-047 (1989).

Nuclear data of ^{15}N have been evaluated in the energy range from 0.01 meV to 20 MeV. The evaluation was performed by fitting the multilevel Breit-Wigner formula to the experimental data of the total cross section below 5.5 MeV, and by using the multistep statistical model above 5.5 MeV.

Work in Progress

1) Evaluation of Nuclear Data for Cm Isotopes

The data of curium isotopes (^{242}Cm - ^{249}Cm) were re-evaluated on the basis of recent experimental data. The data of ^{241}Cm were newly evaluated for JENDL-3.

[from T. Nakagawa, (JAERI)]

2) Compilation of JENDL-3

The compilation work of JENDL-3 general purpose file which containes the data for 171 nuclides has been almost completed. Compilation of comment data is in progress and will finish soon. The summary report will be published as JAERI-M.

The data of 172 FP nuclides are also being compiled. It will be completed in this autumn.

[from K. Shibata, JENDL Compilation group (JAERI)]

Work about Codes

1) Development of MCPNC Code for Evaluation of Photonuclear Reactions

A Computer program to calculate photonuclear reaction cross-sections and energy and angular double differential cross-sections (DDXs) of emitted particles is being developed now. The program estimates photo-absorption cross sections of a nucleus from the experimental systematics of the E1 giant resonance and those of quasi-deuteron absorption. The DDXs are calculated using the randam walk exciton model and the statistical evaporation model. The good agreement between experimental values and calculated ones is obtained.

[from N. Kishida, H. Kadotani (CRC), K. Shibata (JAERI)]

Tsuneo Nakagawa
Nuclear Data Center
Tokai Research Establishment
Japan Atomic Energy Research Institute
Tokai-mura, Naka-gun, Ibaraki-ken 319-11
Japan

ECN-PETTEN, THE NETHERLANDS

ADDRESS: Netherlands Energy Research Foundation ECN
P.O.Box 1
1755 ZG Petten
The Netherlands

NAMES: H. Gruppelaar, A. Hogenbirk, J. Kopecky (compiler), H.A.J. van der Kamp, J.M. Akkermans, A.J. Koning, D. Nierop

1. RECENT PUBLICATIONS AND REPORTS

[1] J. Kopecky and H. Gruppelaar, European Activation Library for Fusion Reactor Technology, Proc. NEANDC Specialists' Meeting on Neutron Activation Cross Sections, Argonne, 13-15 September 1989 and ECN-89-159.
[2] J. Kopecky, M.G. Delfini, H. Gruppelaar and M. Uhl, Testing new Approaches to Calculate Radiative Capture Cross-Sections, ibid and ECN-89-158.
[3] A.J. Koning and J.M. Akkermans, Forms of Nuclear Chaos in Multi-step Direct Reactions, ECN-89-155 and submitted to Phys.Rev.Lett.
[4] J.M. Akkermans and A.J. Koning, The Quantum Statistics of Pre-equilibrium Phenomenology, ECN-89-156 and submitted to Phys.Lett.B.
[5] J. Kopecky and M. Uhl, Test of Gamma-Ray Strength Functions in Nuclear Reaction Model Calculations, ECN report to be published and submitted to Phys.Rev.
[6] J. Kopecky and H.A.J. van der Kamp, Evaluation of Cross-Sections and Uncertainties for Important Reactions - A Supplement to the REAC-ECN-5 Data File, ECN report to be published.

2. WORK RECENTLY COMPLETED

- See above-mentioned publications and reports.
- The Ni-evaluation has been completed (except for covariance data).
- Update of activation cross-section file; REAC-ECN-5 [1,6].
- Revision of thermal and resolved-resonance range of 65 fission product isotopes (cooperation with NEA Data Bank).

3. WORK IN PROGRESS

- Evaluation of Ni isotopes (covariance file).
- Extension of the activation file, compilation of the European Activation File (EAF-1) to be released in 1990 [1].

4. FUTURE PLANS

- Update of fission-product cross-sections.
- Work for EFF-2 (European Fusion File) and FENDL (IAEA, ITER).
- Theoretical study of pre-equlibrium processes [3,4].
- Study of photon production cross-section calculations [2,5].

Laboratory: Soltan Institute for Nuclear Studies

Contact: A. Marcinkowski

Address: Department P-I, Soltan Institute for Nuclear Studies,
Ul. Hoza 69, PL-00 681 Warsaw, Poland

Activity: 1. Analysis of (n,p) cross-sections

- Activation cross section for the $^{74,76,77,78}Se(n,p)^{74,76,77,78}As$, $^{70,72,73,74}Ge(n,p)^{70,72,73,74}Ga$ and $^{106,108}Pd(n,p)^{106,108}Rh$ reactions have been measured at 8 neutron energies in the range from 13.0 MeV to 16.6 MeV. The γ-ray activities of residual nuclei have been detected with the use of 80 cm^3 Ge(Li) detector equipped with standard ORTEC electronics and the ND-4420 data acquisition system.

  The results of measurements were analyzed in terms of the compound nucleus and the preequilibrium emission cross sections. All calculations were performed with the use of EMPIRE code [1]. The agreement between theory and experiment is satisfactory. The cross sections measured display a distinct isotopic effect

$$\sigma(n,p) = C\exp\left(K\,\frac{N-Z}{A}\right), \qquad (1)$$

  with the shape coefficient being projectile energy dependent K (13MeV) = −29 ± 3, K (14.5 MeV) = 42 ± 4 and K (16.6 MeV) = 53 ± 5.

Activity: 2. Theory of Feshbach, Kerman, Koonin

- The quantum-mechanical theory of Feshbach, Kerman and Koonin was applied to formulate and program an applicable version of multistep compound and multistep direct calculations providing double differential preequilibrium cross sections. The multistep compound calculations, including rigorously treated angular momentum coupling, have been programmed into the EMPIRE code.

  The multistep direct calculations, which involve microscopic DWBA angular distributions, have been improved by extending the averaging of the cross sections for population of continuum states over energy regions compatible with the spreading widths of the particle-hole excitations.

  The results of these calculations for inelastic scattering of neutrons with bombarding energies 11.5 MeV and 26 MeV on ^{184}W were validated by comparison with recent experimental data measured at the Ohio University [2].

---

[1] M. Herman, A. Marcinkowski and K. Stankiewicz, Comp. Phys. Comm. 33 (1984) 373

[2] A. Marcinkowski, R.W. Finlay, J. Rapaport, P.E. Hodgson and M.B. Chadwick, submitted for publication in Nucl. Phys.

Harwell Laboratory

United Kingdom Atomic Energy Authority
Oxfordshire OX11 ORA
U.K.

R. A. Forrest, M. C. Moxon and M. G. Sowerby

Recent Publications and Reports

"Activation data for some elements relevant to fusion reactors"
R. A. Forrest and D. A. J. Endacott
AERE R 13402 (1989)

Work Recently Completed

Preliminary JEF-2 U-238 file

Work in Progress

(1) Further work on U-238

(2) Work to improve the activation cross-section library UKACT1 and the decay data library UKDECAY1 used with the fusion activation inventory code FISPACT.

(3) Calculation of fusion activation with FISPACT and use of the code to identify data needing improvement.

Nuclear Physics Laboratory, Oxford, U.K.

P.E. HODGSON

I. Recent Publications

1. Multistep Processes in Nuclear Reactions. By P.E. Hodgson. Contemporary Physics **29** 457, 1988.

2. Angular Momentum in Multistep Compound Processes. By M.B. Chadwick, P.E. Hodgson and A. Marcinkowski. Proceedings of the Fifth International Conference on Nuclear Reaction Mechanisms, Ed. E.Gadioli, Varenna, June 1988. *Ricerca Scientifica ed Educazione Permanente.* Supplement **66** 102.

3. Pre-Equilibrium Processes in Nuclear Reactions: Intercomparison of Theories and Codes. By P.E. Hodgson. Proceedings of the International Conference on Nuclear Data for Science and Technology, Mito, Japan, May 30–June 3. Ed. S.Igarasi, Japan Atomic Energy Research Institute, Saikon Publishing Co. Ltd. 655, 1988.

4. Dispersion Relation Analysis of the Total Neutron Cross-Section Anomaly. By Su Zong Di and P.E. Hodgson, *J. Phys.* **G14** 1485, 1988.

5. Summary of the Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation. By P.E. Hodgson. Beijing 12–16 October 1987. *IAEA-TECDOC*-**483** 9, 1988.

6. The Neutron Optical Model Potential. By P.E. Hodgson. Proceedings of an Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation. Beijing 12–16 October 1987. *IAEA-TECDOC*-**483** 51, 1988.

7. Multistep Processes in Nuclear Reactions. By P.E. Hodgson. Proceedings of an Advisory Group Meeting on Nuclear Physics for Fast Neutron Nuclear Data Evaluation, Beijing 12–16 October 1987. *IAEA-TECDOC*-**483** 215, 1988.

8. Intercomparison of Nuclear Model Computer Codes. By P.E. Hodgson. Proceedings of an Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation, Beijing 12–16 October 1987. *IAEA-TECDOC*-**483** 309, 1988.

9. Preliminary Analysis of Neutron Optical Potential for A = 40–60 below 10 MeV. By Zongdi Su. INDC(CPR)-D13/LI. INT(88)-1. *IAEA*, 1988.

10. Multistep Compound Processes in Nuclear Reactions from 9 to 18 eV. By M.B. Chadwick, R. Bonetti and P.E. Hodgson. *J. Phys.* **G15** 237, 1989.

11. The Neutron Optical Model Potential. By P.E. Hodgson. Second Research Coordination Meeting to Review Methods for the Calculation of Fast Neutron Nuclear Data for Structural Materials of Fast and Fusion Reactors. Vienna 15–17 February 1988. INDC (NDS)-214/LJ, 49.

12. The Unification of the Nucleon Optical Model Potential. By P.E. Hodgson. Proceedings of the Discussion Meeting on Nuclear Optical Potentials and Nuclear Reactions. Tokyo Institute of Technology, 20 July 1988, 1.

13. Nucleon-Alpha Reactions in Nuclei. By E. Gadioli and P.E. Hodgson. *Reports on Progress in Physics* **52** 301, 1989.

14. Multistep Compound Processes in Nuclear Reactions. By P.E. Hodgson. Proceedings of the XVIIth International Symposium on Nuclear Physics, Ed. D.Seeliger and H.Kalka. Technical University of Dresden, November 9–13, 1987. INDC(GDR) 51/G10.

15. Calculations of the Production Cross-sections of High Spin Isomeric States in Hafnium. By M.B. Chadwick and P.G. Young. Oxford University Report OUNP-89-21.

II. Work Recently Completed and in Progress

1. Multistep Compound Reaction Calculations

M.B. Chadwick, N. Koumdjieva and P.E. Hodgson

The multistep compound reaction theory of Feshbach, Kerman and Koonin has been applied to analyse the reactions of 14 MeV neutrons with ^{59}Co and ^{93}Nb. The emission spectra for the (n, nx), (n, px) and (p, nx) reactions have been calculated, including the contributions from the $(n, 2n)$ and (n, pn) reactions. The cross-sections in all open channels are calculated and compared with experiment. A paper has been submitted for publication.

2. The Population of High-spin Isomers

M.B. Chadwick

The mechanism by which high-spin isomers are populated in neutron induced reactions has been studied. This problem is of particular interest to workers in the field of nuclear fusion-reactor technology, who need to know the production rates of isomeric states that might pose radioactive activation problems in the reactor casing. In particular there exists a 16^+ isomer in ^{178}Hf with a half life of 31 years which is likely to be produced when 14 MeV neutrons from the *dt* reaction are incident upon isotopes of hafnium. As the 16^+ state is at a high excitation energy (2.5 MeV), there exists little experimental information concerning the nuclear structure near the state. It was therefore necessary to describe statistically the excited nuclear states around the 16^+ state as well as constructing the likely rotational bands that would cascade into it. The exciton pre-equilibrium reaction theory was then used to calculate the cross section for the production of the isomeric state, which was found to agree within a factor of two with recent measurements taken at Harwell.

3. Neutron Emission Cross Sections on ^{184}W at 11.5 MeV and 26 MeV and the Neutron-Nucleus Scattering Mechanism

A. Marcinkowski, R.W. Finlay, J. Rapaport, P.E. Hodgson and M.B. Chadwick

Inelastic neutron emission at 11.5 MeV and 26 MeV incident energies has been studied for monoisotopic samples of ^{184}W. Time-of-flight spectra were taken at several angles between 12° and 160° using the beam swinger spectrometer. The data are averaged over 1 MeV energy bins and compared with the quantum-mechanical statistical multistep calculations.

4. **Gamma Ray Emission from Multistep Compound Reactions**
   P. Oblozinsky and M.B. Chadwick
   The multistep compound formalism of Feshbach, Kerman and Koonin has been extended to include gamma-ray emission. By allowing the first few simple pre-equilibrium states to decay via electromagnetic transitions rather than particle emission, the large number of high-energy gamma rays observed in the experimental data can be understood.

   It is assumed that single-particle and hole transitions lead to the emission of gamma rays, and the matrix elements for such transitions are calculated by exploiting the inverse process, photo-absorption. This is done by invoking the Brink-Axel hypothesis which states that the photo-absorption cross section on an excited nuclear state is equal to that on the ground state. It is found that between twenty and fifty per cent of the high-energy cross section for gamma ray emission can be accounted for by the multistep compound mechanism.

III. Work on Nuclear Model Codes

1. Weisskopf-Ewing and Hauser-Feshbach International Nuclear Model Code Intercomparison.
   E. Sartori and P.E. Hodgson
   The first results of this intercomparison have been received and are being analysed.

IV. Other Subjects of Related Interest

1. The Alpha-Particle Structure of ^{44}Ti. By P.E. Hodgson and A.C. Merchant. Proceedings of the Fifth International Conference on Nuclear Reaction Mechanisms. Ed. E.Gadioli, Varenna, June 1988. *Ricerca Scientifica ed Educazione Permanente*. Supplement **66** 375.
2. Theoretical Aspects of Clustering in Nuclei. By P.E. Hodgson. Proceedings of the Fifth International Conference on Clustering Aspects in Nuclear and Subnuclear Systems, Kyoto, Japan. *Physical Society of Japan*, 755, 1989.

P.E. Hodgson
August 1989

AEE WINFRITH

1. Fission Yields (M.F. James, AEE Winfrith; R.W. Mills and D.R. Weaver, University of Birmingham)

A new library has been produced of unadjusted independent fission yields for 39 fissioning systems (21 fissioning nuclides at different excitation energies). These are:

Th232 FH, U233 TFH, U234 F, U235 TFH, U236 F, U238 FH, Np237 TF, Np238 TF, Pu238 TF, Pu239 TF, Pu240 F, Pu241 TF, Pu242 F, Am241 TF, Am242m TF, Am243 TF, Cm243 TF, Cm244 TF, Cm245 TF, Cm242 Sp, Cm244 Sp, Cf252 Sp.

(T=thermal, F=fast, H=14MeV, Sp=spontaneous fission)

The database which included EXFOR is believed to be up-to-date to 1988. Chain yields and fractional independent yields were evaluated: Wahl's parametric Z model was used for the latter, but with parameters independently derived. All available measurements were included in the evaluation, discrepant data being down-weighted in a systematic manner. Tables were produced of mass chains with no or discrepant data, for either chain or fractional independent yields. Gaps were filled by deriving various semi-empirical correlations and using them for interpolation and extrapolation.

These yields will be adjusted by a least-squares method to fit to several constaints: to sum to 2; to give nucleon and charge balance; and to give equal yield for the most important complementary elements. They will be stored in ENDF/B6 format.

2. Decay data (Dr. A. Nicholls, AEE Winfrith)

A further evaluation exercise has been undertaken for Cr-51, Zn-65, Sc-75 and An-198, following new measurements for their decay under the auspices of an IAEA-CRP.

These evaluations have resulted in adjustments of the recommended $P\gamma$ data for Cr-51, Zn-65 and Sc-75. This work was undertaken as part of the IAEA-CRP on X and γ ray standards for detector calibration.

A report is being prepared on the evluation of decay data for the 4n chain of Np236-U232.

NATIONAL NUCLEAR DATA CENTER

ADDRESS Building 197D
Brookhaven National Laboratory
Upton, NY 11973 USA

NAMES S.Pearlstein, C.L.Dunford, T.Fukahori*, N.Holden

COMPILED BY V.McLane

I. Recent Publications and Reports

"Total and Spontaneous Fission Half-lives for Uranium, Plutonium, Americium and Curium Isotopes", N.E.Holden, *Pure & Applied Chemistry* **61**, 1483 (1989).

"Re-examination of 2200 meter/second Cross Section Experiments for Neutron Capture and Fission Standards", N.E.Holden and K.A.Holden, *Pure & Applied Chemistry* **61**, 1505 (1989).

"Prompt Neutron Emission Multiplicity distribution and Average Values (Nubar) at 2200 m/s for the Fissile Nuclides", N.E.Holden and M.S. Zucker, *Nuclear Science and Engineering* **98**, 174 (1988).

II. Work in Progress or Recently Completed

NNDC continues to coordinate the work of the Cross Section Evaluation Working Group. The majority of the ENDF/B-VI data evaluations have been processed at NNDC. Integral benchmark testing OF the data library should begin at the end of 1989. The general release of data file is planned in early 1990.

Evaluated data for neutron- and proton-induced reactions on ^{56}Fe in the energy range up to 1 GeV have been completed and are included in the ENDF/B-VI library. An article describing this work will be published in the Journal of Astrophysics.

Evaluation of high energy neutron- and proton-induced reactions on the lead isotopes is in progress (T.Fukahori, S.Pearlstein).

*of the Japanese Nuclear Data Center, currently working at NNDC.

LOS ALAMOS NATIONAL LABORATORY

ADDRESS Theoretical Division
Group T-2, MS B243
P.O. Box 1663
Los Alamos, NM 87545

NAMES E.D. Arthur, G.M. Hale, D.G. Madland, P.G. Young, M. Bozoian, T.R. England, R. E. MacFarlane, W. B. Wilson, and D. D. Strottman.

CONTACT P. G. Young
Phone: Com. (505) 667-7670

The Applied Nuclear Sciences Group at Los Alamos is involved in the evaluation and calculation of nuclear data for applications, as well as the development of nuclear theory and models for this purpose.

I. Recent Publications and Reports

"Medium-Energy Fission Model Calculations for the 14.5-MeV Neutron-Induced Fission of ^{238}U," E. D. Arthur, M. Bozoian, D. G. Madland, and P. G. Young, *Bull.Am. Phys. Soc.* **34**, 1836 [ED 12] (1989).

"Calculated Medium-Energy Fission Cross Sections," E. D. Arthur and P. G. Young, *Proc. Amer. Nucl. Conf. on Fifty Years with Nuclear Fission*, Gaithersburg, Maryland, April 25-28, 1989, in press.

"Fission Neutron Spectra for ^{240}Pu, ^{238}Pu, and ^{242}Pu," R. L. Walsh, G. Circu, and D. G. Madland, *Proc. Amer. Nucl. Conf. on Fifty Years with Nuclear Fission*, Gaithersburg, Maryland, April 25-28, 1989, in press.

"Recent Improvements in the Calculation of Prompt Fission Neutron Spectra: Preliminary Results," D. G. Madland, R. J. LaBauve, and J. R. Nix, Proc. IAEA Consultants' Meeting on the *Physics of Neutron Emission in Fission*, 24-27 May 1988, Mito, Japan [Ed. H. D. Lemmel, IAEA-INDC(NDS)-220 (1989) p. 259].

"Dirac Optical Potentials for Nucleon Scattering by ^{208}Pb at Intermediate Energies," R. E. Kozack and D. G. Madland, *Phys. Rev. C* **39**, 1461 (1989).

"Theory of Neutron Emission in Fission," D. G. Madland (invited), *Proc. Amer. Nucl. Conf. on Fifty Years with Nuclear Fission*, Gaithersburg, Maryland, April 25-28, 1989, in press.

"Use of GNASH Based Cross-Section Data in the Description of 75-MeV p+Cu Thick-Target Neutrons and Their Transmission Through Concrete," W. B. Wilson, R. C. Little, E. D. Arthur, R. J. LaBauve, P. G. Young, K. Shin, and Y. Ishii, Proc. *Amer. Nucl. Soc. Topical Mtg. on Advances in Nucl. Eng. Computation and Rad. Shielding*, Santa Fe, N.M., April 9-13, 1989, v. I, p. 2091.

"Prediction of Intermediate-Energy Neutron Scattering Observables from a Dirac Optical Potential," R. Kozack and D. G. Madland, submitted for publication.

"Calculation of the Fission Neutron Spectrum Matrix $N(E,E_n)$ for ^{235}U," D. G. Madland, to be presented at Int. Conf. *Fifty Years Research in Nuclear Fission*, Berlin, West Germany, April 3-7, 1989.

"Correction for Truncation in Coupled-Channels Optical Potentials," V. A. Madsen, L. F. Hansen, V. R. Brown, and D. G. Madland, accepted for publication in *Phys. Rev. C* (Sept., 1989).

"Back-Angle Scattering Improvements in HETC/LAHET After Exciton Multistage Preequilibrium Model Implementation," R. E. Prael and M. Bozoian, *Bull. Am. Phys. Soc.* **34**, 1815, CB 10, (1989).

"Generalized Exciton Model with Realistic Nucleon-Nucleon Scattering Kernel," M. Bozoian and R. D. Smith, *Bull. Am. Phys. Soc.* **34**, 1836, ED 11, (1989).

"Comparison of Experimental and Calculated Neutron Energy Spectra and Multiplicities from the Spontaneous Fission of ^{252}Cf," M. Bozoian, D. G. Madland, E. D. Arthur, and P. G. Young, *Bull. Am. Phys. Soc.* **34**, 1836, ED 11, (1989).

"New Cross Section Evaluations for Reactor Fuel Materials, L. W. Weston, P. G. Young, and W. P. Poenitz (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Structural and Shielding Material Evaluations for ENDF/B-VI," D. C. Larson and P. G. Young (invited), to be presented at the Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Double-Differential Cross-Section Calculations Based on a Monte Carlo Formulation of the Multistage Preequilibrium Model," M. Bozoian and R. E. Prael, to be presented at the Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"The Neutron Cross-Section Standards Evaluations for ENDF/B-VI," A. D. Carlson, W. P. Poenitz, G. M. Hale, and R. W. Peelle (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"ENDF/B-VI Six-Group Delayed Neutron Data," T. R. England and M. C. Brady (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"ENDF/B-VI Radioactive Decay and Yield Libraries," T. R. England, F. M. Mann, C. W. Reich, and R. E. Schenter (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Calculations of Medium-Energy Fission Cross Sections and Spectra," E. D. Arthur (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Transport Data Libraries for Incident Proton and Neutron Energies to 100 MeV," P. G. Young, E. D. Arthur, M. Bozoian, T. R. England, G. M. Hale, R. J. LaBauve, R. C. Little, R. E. MacFarlane, D. G. Madland, R. T. Perry, and W. B. Wilson, to

be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Calculated Proton-Induced Thick-Target Neutron and Gamma Yield Spectra for $E_p \leq 100$ MeV," W. B. Wilson, E. D. Arthur, M. Bozoian, R. T. Perry, and P. G. Young (invited), to be presented at Amer. Nucl. Soc. Winter Meeting, San Francisco, California, Nov. 26-30, 1989.

"Delayed Neutron Data and Group Parameters for 43 Fissioning Systems," M. C. Brady and T. R. England, *Nucl. Sci. Eng.* **103**, 129 (1989).

II. Work Recently Completed

Completed preliminary theoretical analyses for neutron-induced reactions on ^{235}U, ^{238}U, ^{237}Np, and ^{239}Pu for ENDF/B-VI. In collaboration with ORNL and HEDL, submitted new evaluations to ENDF/B-VI for these isotopes.

Completed theoretical analysis of neutron-induced cross sections and (n,xn) spectra on ^{237}Np and ^{238}U for $E_n = 1$-100 MeV and proton-induced reactions on ^{238}U for $E_p = 5$-100 MeV.

Completed theoretical calculation of fission neutron spectra from neutron- and proton-induced fission of ^{238}U to 100 MeV.

Completed R-matrix analyses for the ^{7}Li and ^{11}B compound systems, including new data and theoretical developments, that will be used to provide neutron cross sections for the ^{6}Li and ^{10}B ENDF-VI evaluations.

Completed theoretical analysis and evaluation of p-p and n-p reactions to 100 MeV.

Completed initial transport data library for neutron- and proton-induced reactions on ^{1}H, ^{9}Be, ^{12}C, ^{16}O, ^{27}Al, ^{28}Si, Fe, W, and ^{238}U.

III. Work in Progress

R-matrix analyses of neutron-induced reactions on ^{14}N and ^{16}O, to be combined with new experimental data evaluations for mod of ENDF/B-VI.

Extension of deformed rare-earth and actinide optical potentials to $E_n = 30$-40 MeV.

Development of medium-energy deuteron optical potential.

Finalization of $^{6,7}Li$, $^{10,11}B$, $^{151,153}Eu$, ^{165}Ho, ^{197}Au, $^{235,238}U$, ^{237}Np, ^{239}Pu evaluations for ENDF/B-VI.

Continue fission product yield evaluations.

Continue work on six-group fits plus spectra for delayed neutrons for 43 fuels completed for ENDF/B-VI.

IV. Work Planned for the Future

Theoretical analyses and evaluations will continue for materials not included in the first issue of ENDF/B-VI.

Model and nuclear theory development effort into the medium-energy range will continue.

V. Work on Codes

See entries under above items I, II, and III.

OAK RIDGE NATIONAL LABORATORY

Address: Oak Ridge National Laboratory
ORELA, Bldg 6010
Post Office Box 2008
Oak Ridge, TN 37831-6356 USA

Names: H. Derrien (Cadarache), G. de Saussure, J. K. Dickens, C. Y. Fu, D. M. Hetrick, D. C. Larson, N. M. Larson, R. L. Macklin, R. W. Peelle, F. G. Perey, C. M. Perey, R. B. Perez, L. W. Weston

Compiler: D. C. Larson

1. Recent publications and reports

J. K. Dickens and D. C. Larson, "^{10,11}B$(n, x\gamma)$ Reactions for Incident Neutron Energies Between 0.1 and 25 MeV," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 213-15.

D. C. Larson and J. K. Dickens, "^{53}Cr$(n, n'\gamma)$ Reactions and the Level Structure of ^{53}Cr," *Phys. Rev.* **C39**, 1736 (1989).

J. A. Harvey, N. W. Hill, F. G. Perey, G. L. Tweed, and L. Leal, "High-Resolution Neutron Transmission Measurements on ^{235}U, ^{239}Pu, and ^{238}U," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 115-118.

M. S. Moore, G. de Saussure, L. C. Leal, R. B. Perez, and N. M. Larson, "Resonance Structure in the Fission of (^{235}U + n)," International Conference Fifty Years Research in Nuclear Fission, Berlin, Germany, April 3-7, 1989.

R. L. Macklin and C. W. Alexander, "Neutron Absorption Cross Section of Uranium-236," ORNL/TM-10999 (November 1988).

Roger L. Macklin, R. B. Perez, G. de Saussure, and R. W. Ingle, "High Energy Resolution Measurement of the ^{238}U Neutron Capture Yield in the Energy Region Between 1 and 100 keV," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 71-74.

L. W. Weston and J. H. Todd, "High Resolution Fission Cross Section Measurements at ORELA," Conference on Fifty Years with Nuclear Fission, Gaithersburg, MD, April 26-28, 1989.

C. H. Johnson and C. Mahaux, "Neutron-^{40}Ca Mean Field Between −80 and +80 MeV from a Dispersive Optical-Model Analysis," *Phys. Rev.* **C38**(6), 2589 (December 1988).

L. C. Leal, G. de Saussure, R. R. Winters, and R. B. Perez, "Statistical Properties of the ^{235}U Resonance Parameters up to 300 eV," Presented at the American Nuclear Society Annual Summer Meeting, Atlanta, GA, June 4-8, 1989.

H. Derrien, G. de Saussure, N. M. Larson, L. C. Leal, and R. B. Perez, "R-Matrix Analyses of the ^{235}U and ^{239}Pu Neutron Cross Sections," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 83-86.

H. Derrien and G. de Saussure, "R-Matrix Analysis of the ^{241}Pu Neutron Cross Sections in the Energy Range Thermal to 300 eV," ORNL/TM-11123 (March 1989).

F. G. Perey, "RFUNC – A Code to Analyze Differential Elastic-Scattering Data," ORNL/TM-11112 (March 1989).

Nancy M. Larson and F. G. Perey, "Resonance Parameter Analysis with SAMMY," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 573-576.

Nancy M. Larson, "Updated Users' Guide for SAMMY: Multilevel R-Matrix Fits to Neutron Data Using Bayes' Equations," ORNL/TM-9179/R2 (June 1989).

Robert Peelle and Henri Conde, "Neutron Standard Data," *Nucl. Data for Sci. and Tech.*, Mito, Japan, 1988, pp. 1005-1012.

H. Derrien and G. de Saussure, "R-Matrix Analysis of ^{239}Pu Neutron Cross Sections in the Energy Range up to 1000 eV," ORNL/TM-10986 (January 1989).

C. Y. Fu, "Status of Theories Used for Calculations of Production Cross Sections of Long-Lived Radionuclides," to be published in the Proceedings of IAEA Consultants' Meeting on Cross Sections for the Production of Long-Lived Radionuclides, September 13-14, 1989, Argonne, IL.

C. Y. Fu, "A Review of Activation Cross Sections in the ENDF/B-VI General Purpose Files for Cr, Fe, Ni, Cu, and Pb," to be published in the Proceedings of the NEANDC Specialists' Meeting on Activation Cross Sections for Fission and Fusion Reactors, September 15-17, 1989, Argonne, IL.

C. Y. Fu, "Evaluated Cross Sections for Neutron Scattering from Natural Carbon Below 2 MeV Including R-Matrix Fits To ^{13}C Resonances," accepted for publication in Nucl. Sci. Eng. (October 1988).

2. Work recently completed

   a. A simultaneous analysis of total, capture and scattering data for the resonance region of ^{56}Fe has been completed, and results have been used in the ENDF/B-VI evaluation. Use of low-energy transmission data down to 40 eV has provided a set of resonance parameters which yield the correct scattering and capture thermal cross sections, and no background files are needed from 1.e-5 eV to 850 keV for the total, and to 400 keV for the capture.

   b. Analysis of the high-resolution ORELA capture measurement on ^{238}U is continuing, as a collaborative effort between Harwell, the University of Tennessee, and ORELA. Preliminary results were used in the new ^{238}U evaluation for ENDF/B-VI.

c. SAMMY resonance parameter analyses of transmission and fission data for ^{239,241}Pu have been completed to 2 keV for ^{239}Pu and 300 eV for ^{241}Pu. These results have been incorporated in the ENDF/B-VI evaluations for these materials.

d. The SAMMY manual revision to include new features incorporated in our Reich-Moore R-matrix code during the past three years has been completed.

e. Based on Phase I reviews and results of direct graphical comparisons with EFF2 and BROND evaluations, several improvements have been incorporated in evaluations for isotopes of Cr, Fe, and Ni for ENDF/B-VI.

Other work completed in the past year is covered in the Publications section.

3. Work in progress

a. A measurement of the ^{10}B$(n,\alpha_1)/^{10}$B(n,α_0) ratio from 10 keV to 1 MeV has been completed at ORELA. Solid state detectors were used to detect the lithium and alpha particles. Preliminary results are available, but further corrections are necessary before final results are released.

b. The capture system in use at the ORELA 40-m flight path for several years has been modified and upgraded. The C_6F_6 detectors were replaced by C_6D_6 detectors, and mass around the detectors and samples was minimized to reduce effects in the capture detectors of electron-produced gamma rays from the environs. This system will be used to re-measure capture cross sections for the structural materials, as well as materials of astrophysical interest.

c. Reich-Moore resonance parameter analysis with SAMMY is nearly completed for new transmission and fission data for ^{235}U. The goal is to extend the resolved resonance region from 83 eV to 2.25 keV. Preliminary results have been included in ENDF/B-VI so self-shielding effects in reactors may be better predicted.

d. A new high resolution measurement of the ^{235}U and ^{239}Pu fission cross sections in the resonance region has been completed. The resonance parameter analyses discussed above were limited by the energy resolution of the fission cross sections, and the new measurements at the 85-m flight path have the best resolution yet reported above 300 eV. Preliminary results were considered in the ENDF/B-VI evaluations.

e. A new multicrystal spectrometer, eventually to contain as many as 36 BaF_2 crystals, is nearing completion. Preliminary measurements and background determinations have begun with the 16 crystals now available. Initial measurements will be very high precision determinations of the ratio of capture to fission in ^{239}Pu and ^{235}U, and studies of fission gamma-ray multiplicities.

f. A system based on NE-213 scintillation detectors to measure neutron and gamma-ray emission cross sections for E_n = 1–20 MeV has been completed. Three detectors are used to measure energy and angle dependent spectra using pulse-shape discrimination to distinguish the neutrons and gamma rays. Measurements on a sample of natural iron are

nearly completed, and preliminary results are promising. A new data acquisition system for this experiment based on an IBM PS-2 Model 80 PC and an in-house interface has been completed and tested, and works well. In a three-parameter mode (ph,tof,psd), maximum count rates of 17000 c/s are presently obtained.

g. We are participating in the NEANDC/NEACRP Task Force on Evaluation Cooperation, as well as the IAEA Specialists' Meetings on FENDL.

h. We are participating with personnel from NIST (formerly NBS) in a remeasurement of the 478-keV gamma-ray production cross section from the $^{10}B(n, \alpha\gamma)$ reaction. This measurement will cover the neutron energy region from 100 keV to 5 MeV, with the purpose of extending the energy range of the boron standard.

4. Work planned for the future

a. The upgraded capture gamma-ray system at 40-m will be used to measure capture cross sections and spectra for structural materials.

b. High resolution transmission measurements will be done for ^{57}Fe, ^{52}Cr and $^{63,65}Cu$.

c. The possibility of doing more high resolution 200-m transmission measurements on ^{238}U will be investigated, this time using cooled samples.

d. Measurements of neutron and gamma-ray spectra as a function of angle and energy will continue, using the new system discussed earlier. Samples of chromium, nickel and lead will be measured.

e. The high resolution $(n, x\gamma)$ production cross-section measurements will continue, with the next sample being Ti.

f. Evaluations done for ENDF/B-VI will be followed through Phase II checking, and appropriate adjustments made. Covariance evaluations and remaining documentation for the evaluations will be completed. Evaluations of the tin isotopes will commence.

5. Work on nuclear model codes

a. The TNG code, a multi-step Hauser-Feshbach (H-F) code with a precompound component consistent with H-F methodology, is being improved such that the level density used in the H-F part and in the precompound part are consistent. The improvement involving calculating the particle-hole level density and its spin distribution using the BCS methodology for two kinds of Fermions has been completed and will be implemented in TNG.

b. A multiple-scattering correction option will be added to SAMMY for analysis of capture data. Presently, the resolution function is being upgraded to incorporate results of a detailed study of the ORELA neutron-producing target.

89-12489 (5576e/0541e)
Translated from Russian

INSTITUTE OF NUCLEAR POWER

Byelorussian Academy of Sciences
220109 Minsk, Sosny

A.B. Klepatskij, E.Sh. Sukhovitskij,
V.M. Maslov

1. At present we are working on the establishment of a complete file of evaluated neutron data for ^{233}U in the energy range 10^{-5} to 20 MeV. In the evaluation, all the available experimental data are being analysed and extensive use is being made of the latest theoretical models and representations (coupled channel method, neutron pre-equilibrium emission, density of transient states in the fission channel and so on).

The evaluation will be completed at the end of 1989 or the beginning of 1990 and the complete file, in the ENDF/B format, will be transferred to the Obninsk Nuclear Data Centre.

2. The neutron data evaluations for ^{243}Cm and ^{244}Cm have been completed. Owing to the lack of experimental data, the data are based to a considerable extent on the application of theoretical models and systems.

3. Publications:

1. BAKHANOVICH, L.A., KLEPATSKIJ, A.B., MASLOV, V.M. et al., Evaluation of ^{242}Cm neutron cross-sections for the establishment of a complete file - Voprosy atomnoj nauki i tekhniki, Ser. Yadernye Konstanty 1 (1989) 36 [in Russian].

2. KLEPATSKIJ, A.B., KOLESOV, A.M., MASLOV, V.M. et al., Evaluated neutron constants for curium-244 - Preprint IYaEh AN BSSR No. 1, Minsk (1989) [in Russian].

Note: English translations of these publications will be published by the IAEA Nuclear Data Section as INDC(CCP)-... reports.

EUROPEAN FUSION FILE (EFF)

ADDRESS: Netherlands Energy Research Foundation ECN
P.O.Box 1
1755 ZG Petten
The Netherlands

NAMES: H. Gruppelaar, A. Hogenbirk, J. Kopecky (compiler), D. Nierop

The EFF project is part of the European Fusion Technology Programme of the European Community. The following laboratories are contractors in the EFF project: CEA (Saclay), ECN (Petten), ENEA (Bologna) and KfK (Karlsruhe). Moreover, JRC Ispra and CBNM (Geel) are involved as EC institutes. The project is directed by the NET team at Garching and by EC in Brussels. Other European laboratories are also involved: SCK/CEN (Mol), the UK laboratories Harwell, Birmingham and Culham (JET), ENEA (Frascati), KFA (Julich), IKE (Stuttgart) and PSI (Wurenlingen). Furthermore, technical support is received from the NEA Data Bank.

1. RECENT PUBLICATIONS AND REPORTS

[1] J. Kopecky and H. Gruppelaar, European Activation Library for Fusion Reactor Technology, Proc. NEANDC Specialists' Meeting on Neutron Activation Cross Sections, Argonne, 13-15 September 1989 and ECN-89-159.

2. WORK RECENTLY COMPLETED

- Evaluation of Ni isotopes (ECN) and ^{7}Li (Birmingham).

3. WORK IN PROGRESS

- Evaluation of covariance file for Ni isotopes.
- Revision of cross-sections for Be, Al, Fe, Cr and Pb by various laboratories.
- Evaluation of EFF-1.1 file (structural materials only).
- Work on European Activation File (EAF-1) [1].

4. FUTURE PLANS

- Compilation of EFF-2 data library
- Compilation of EAF-1 (released during 1990).

5. Distribution

Since a large part of EFF-1 consists of evaluations taken from JEF-1, the same distribution policy as for JEF-1 (NEA Data Bank Member countries), was followed. The same holds also for the GEFF-1 data file, a multi-group constant library (VITAMIN-J format). For details see NNDEN/42.
The distribution of the EFF files shall be extended to all OECD countries.

IAEA Nuclear Data Section
Wagramerstr. 5, P.O. Box 100
A-1400 Vienna, Austria

Tel. (0222)2360-1710, Telex No. 1-12645
Facsimile 43/1/234564, E-Mail RNDS@IAEA1

Recent meetings:

- Fusion Evaluated Nuclear Data Library (FENDL) and Benchmark Calculations, 8-11 May 1989. Proceedings will be published as INDC(NDS)-223.
  Contact: V. Goulo

- Gamma-ray standards for detector calibration, Braunschweig, Federal Republic of Germany, 31 May - 2 June 1989.
  The product will be a handbook on x-ray and gamma-ray standards for detector efficiency calibration.
  Contact: H.D. Lemmel

- Activation cross-sections for the generation of long-lived radionuclides, Argonne, USA, 11-12 Sept. 1989.
  Contact: Wang Dahai

- Nuclear data for radiation damage, Vienna, Austria, 19-22 Sept. 1989.
  Contact: N. Kocherov

- Compilation and evaluation of fission yield nuclear data, Vienna, Austria, 27-29 Sept. 1989.
  Contact: M. Lammer

- Status of actinide decay data, Vienna, Austria, 7-9 Nov. 1989.
  Contact: H.D. Lemmel

- Neutron emission spectra in (p,n) and (α,n) reactions, Bologna, Italy, 13-15 Nov. 1989
  Contact: N. Kocherov

Evaluated data files:

- Work on FENDL, the IAEA evaluated nuclear data file for fusion applications, is continuing.
  Contact: V. Goulo

- A supplement to the USSR evaluated nuclear data library BROND is being documented and will be released soon.
  Contact: H.D. Lemmel

- The new version of the International Reactor Dosimetry File IRDF is finalized and expected to be released in 1990.
  Contact: N. Kocherov

- A nuclear data file for applied geophysics is being prepared and expected to be released towards the end of 1990.
  Contact: N. Kocherov

Publications January - September 1989:

IAEA-TECDOC-483	Nuclear theory for fast neutron nuclear data evaluation. Proc. of an IAEA meeting, Beijing, China, 12-16 Oct. 1987.
IAEA-TECDOC-491	H.D. Lemmel (ed.): Nuclear data for the calculation of thermal reactor reactivity coefficients. Proc. of an IAEA meeting, Vienna, 7-10 Dec. 1987.
INDC(NDS)-220	H.D. Lemmel (ed.): Physics of neutron emission in fission. Proc. of an IAEA meeting, Mito City, Japan, 24-27 May 1988.
INDC(NDS)-214	V. Goulo (ed.): Status review of methods for the calculation of fast neutron nuclear data for structural materials of fast and fusion reactors. Invited papers at a meeting, Vienna, Austria, 15-17 Feb. 1988.
INDC(NDS)-215	Summary report of the same meeting
INDC(CCP)-290	O.A. Solnikov et al.: Spectra of inelastically scattered neutrons with an initial energy of 14.1 MeV and nuclear level density.
INDC(CCP)-295	A.B. Klepatskij et al.: Evaluated nuclear constants for U-236. (English translation of an original in Russian)
INDC(CCP)-296	A.B. Klepatskij et al.: Evaluated neutron data for Pu-238. (English translation of an original in Russian)
INDC(ROM)-20	M. Ivascu et al.: Pre-equilibrium emission and nuclear level densities in neutron-induced reactions on Fe, Cr and Ni isotopes.
INDC(GDR)-54	H. Kalka et al.: Statistical multistep reactions.
INDC(GDR)-55	H. Kalka et al.: Global description of (n,p) and (n,2n) activation cross-sections within statistical multistep theory.
INDC(CSR)-15	S. Gmuca et al.: Methods for the calculation of neutron-induced reactions.
INDC(CSR)-16	E. Beták: PEQAG, a PC version of fully pre-equilibrium computer code with gamma-emission.
INDC(CPR)-13	Su Zongdi: Preliminary analysis of neutron optical potential for A = 40-60 below 10 MeV.
INDC(CPR)-14	Zhang Jinshang, Shi Xiangjun: The formulation of "UNIFY" code for the calculation of fast neutron data for structural materials.

INDC(HUN)-26 S. Sudar: A solution for the neutron spectrum unfolding problem without using input spectrum.

INDC(BZL)-30 Dr. Brett V. Carlson: A multistep direct multistep compound description of fast particle induced reactions.

INDC(BZL)-31 Jaime Anaf and G.S. Chalhoub: Evaluation of the ETOG-3Q, ETOG-3, FLANGE-11, XLACS, NJOY and LINEAR/RECENT/GROUPIE codes in relation to resonance contributions and background collision cross-sections.

STATUS OF THE JEF-2 LIBRARY

NEA Data Bank

20th October 1989

At the last meeting of the JEF Scientific Coordination Group in May 1989, the status of the JEF-2 library was reviewed and recorded in the summary record of the meeting (JEF/DOC-281, NEACRP-A-966, NEANDC-A-255). The work has since then continued and at present it seems that the deadline of end of 1989 for the assembly of the complete JEF-2 library could be met. The covariance information will at that time not been included, but should be available in March 1990. The current status of the library is described below.

Actinides

U -235: A preliminary version of the U -235 evaluation, based on the JEF-1 evaluation and complemented with new resonance parameters by G. De Saussure and the ENDF/B-VI standard data has been compiled. Recent experimental data from Geel and Grenoble indicate a non-flat energy variation of η below the first resonance. It is proposed that the capture cross section have to be slightly modified, as ν is flat and the fission cross section has a 1/v shape according to recent experimental information from Geel.

U -238: A first version of the file is ready. Some minor modifications to the resonance parameters might be included before the end of 1989.

Pu-239: The JEF-2 evaluation has been completed.

Pu-241: The re-evaluated file has been completed, but some incompatibility between the evaluators format and the ENDF-6 format have to be investigated further.

Structural materials

Fe: Work on the resonance region of the iron isotopes are well advanced, and the files should be ready by the middle of November 1989.

Cr: The second version of the isotopic evaluations have been completed.

Ni: The isotopes -58 and -60 have been finalised, whereas some work still remains on including photon production data for the other stable isotopes. The work should be finished at the end of November 1989.

Fission products

The work to update the resolved resonance parameters of the major part of the fission product file has been completed. The data are undergoing final checking. The work to include missing (n,charge particle) data from the RCN activation library has been finished, whereas the re-evaluation of the inelastic cross sections would be performed at a later stage.

Thermal scattering law data

The data for JEF-2 have been translated to the ENDF-6 format and thoroughly checked. The data have also been processed with the NJOY/THEMIS code system and pointwise data have been obtained. One new element (Be) have been added to the file.

Radioactive Decay Data

The JEF-2 file will contain about 2250 isotopes. The new file will be based on parts of JEF-1, ENSDF, experimental and compiled data from Sweden and theoretical data from F.R. Germany. The compilation of the data is ongoing and the file would be ready at the beginning of December 1989.

Fission Yield Data

A new unadjusted library, containing 34 fissioning systems for 21 different nuclides has been completed. The adjusted version (the JEF-2 file), will be ready before the 1st December 1989.

JEF-2 Benchmark testing

Some preliminary testing of certain preliminary files have already been started, but the coordinated benchmark testing of the JEF-2 file will start in the beginning of 1990, with the generation of group cross section libraries. It was agreed that E. Fort, Cadarache, France, would coordinate the activity in cooperation with the NEA Data Bank. The aim would be to cover as wide an area as possible and to avoid unnecessary duplication of work. The NJOY/THEMIS code systems would be used in the preparatory group cross section calculations.

DISTRIBUTION LIST FOR OECD AND IAEA MEMBER COUNTRIES

ARGENTINA	H.M. Antunez
AUSTRALIA	J. Boldeman, R.L. Walsh
AUSTRIA	F. Putz, H. Vonach
BANGLADESH	M.A. Mannan
BELGIUM	H. Ceulemans, F. Motte
BRAZIL	L.T. Auler, R. Paviotti Corcuera, S. de Queiroz Bogado Leite
BULGARIA	N. Janeva
CANADA	W.B. Lewis
CHINA (PEOPLE'S REP.)	Bao Shanglien, Cai Dunjiu, Huo Yu-kun, Le Junchu, Li Yesha, Wang Dao, Wang Gongqing, Yu Zi-Qiang, Zhou Yongyi
CZECHOSLOVAKIA	R. Filip, I. Ribansky
DENMARK	E. Nonbøl
EURATOM	K.H. Boeckhoff, H. Liskien, H. Rief, G. Rohr, E. Wattecamps, H. Weigmann
FEDERAL REPUBLIC OF GERMANY	S. Cierjacks, F.H. Fröhner, B. Goel, E. Kiefhaber, H. Küsters, M. Mattes, M. Rittberger
FINLAND	F. Wasastjerna
FRANCE	M. Darrouzet, C.Devillers, H. Derrien, E. Fort, R. Joly, J. Legrand, A. Michaudon, V.C. Philis, J. Ravier, P. Ribon, M. Salvatores, J. Salvy, H. Tellier, R. Vidal
GERMAN DEMOCRATIC REPUBLIC	H. Märten, D. Seeliger
GREECE	M. Dritsa, J. Kollas, S. Synetos
HUNGARY	Z.T. Body, J. Csikai, P. Vertes
IAEA	V. Goulo, V.A. Konshin, M. Lammer, H.D. Lemmel, J.J. Schmidt
ICELAND	M. Magnusson
INDIA	S. Ganesan, S.B. Garg, S.S. Kapoor, V.S. Ramamurthy
IRELAND	T.A. Nevin
ISRAEL	S. Yiftah

ITALY	V. Benzi, U. Farinelli, E. Menapace, G.C. Panini
JAPAN	S. Igarasi, S. Iijima, Y. Kanda, I. Kimura, H. Kitazawa, H. Matsunobu, R. Nakasima, A. Sugawara, K. Sugiyama, A. Zukeran
KOREA, REP. OF	Jung-Do Kim
NEA	J.A.G. Rosén, N. Tubbs
NETHERLANDS	H. Gruppelaar, J. Kopecky, H. van Dam
NORWAY	E. Andersen, J.O. Berg
PAKISTAN	K. Gul
POLAND	M. Herman, A. Marcinkowski
PORTUGAL	F. Gama Carvalho
ROMANIA	G. Vasiliu
SINGAPORE	Tang Seung-Mun
SOUTH AFRICA	E. Barnard
SPAIN	R. Caro Manso, M. Gomez Alonso, C. Sanchez del Rio, G. Velarde
SWEDEN	H. Condé, C. Grägg
SWITZERLAND	K. Gmür, P.-A. Haldy, S. Huwyler, K. Junker, H.W. Reist, J. Stepanek, P. Stiller, P. Vontobel
THAILAND	T. Vilaithong
TURKEY	C. Ertek
UNION OF SOVIET SOCIALIST REPS.	M.V. Blinov, A.V. Ignatyuk, V.P. Korennoj, A.B. Klepatskij, V.N. Manokhin, M.N. Nikolaev, V.G. Pronjaev, V. Shpakov, G.B. Yankov
UNITED KINGDOM	A.J. Briggs, P.Christmas, C.J.Dean, A.C. Douglas, R.A. Forrest, P. Hodgson, M.F. James, M.C. Moxon, A.L. Nichols, B.H. Patrick, E.D. Pendlebury, J.L. Rowlands, R.W. Smith, M.C. Sowerby
UNITED STATES OF AMERICA	E. Arthur, R.C. Block, A. Carlson, E. Cheng, C. Dunford, D. Gardner, H. Goldstein, R.C. Haight, J. Hardy, P. Hemmig, D.C. Larson, P. Lisowski, C.R. Lubitz, F. Mann, R. McKnight, D.W. Muir, Donald J. Hughes Library, O. Ozer, S. Pearlstein, R.W.Peelle, S. Perkins, W. Poenitz, C. Reich, P. Rose, R. Roussin, R.E. Schenter, D.L. Smith, L. Weston, S.L. Whetstone, P. Young
YUGOSLAVIA	A. Trkov

793049