NUCLEAR DATA FOR CTR RELATED PROJECTS
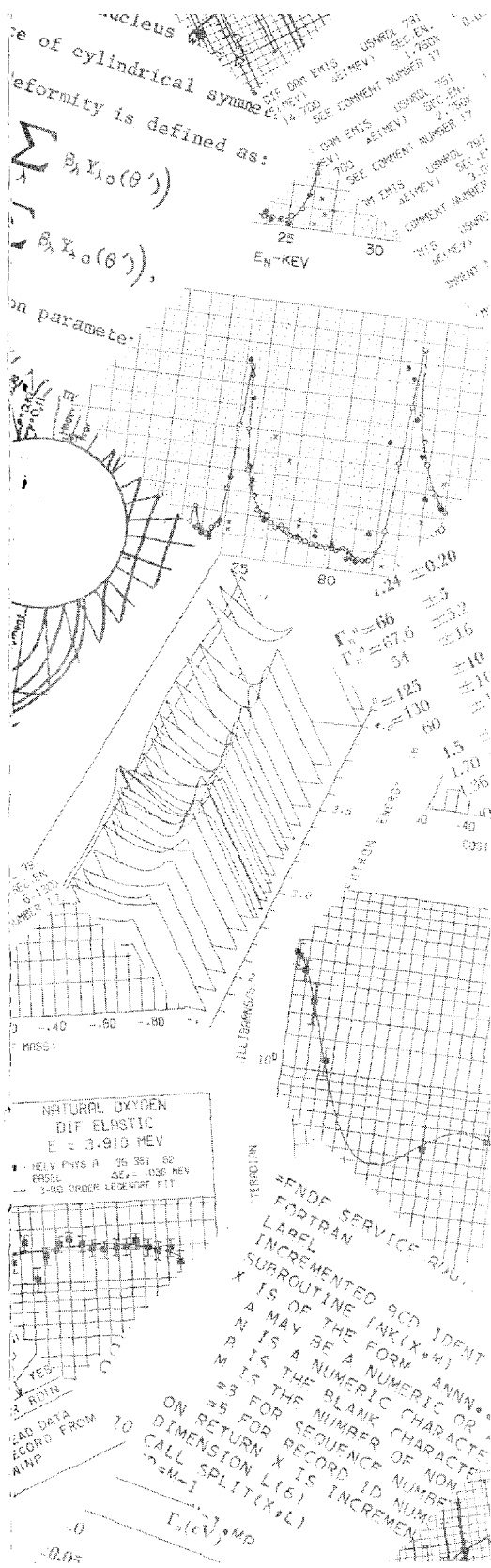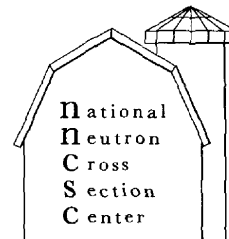
by

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October 1974

National
Neutron
Cross
Section
Center

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October 1974

NOTICE

<u>ABSTRACT</u>

This report describes the different types of nuclear
cross-section information that has been supplied to CTR related
projects and is available at the National Neutron Cross Section
Center. This has included data from the ENDF/B and ENDF/A
libraries as well as the results of calculations based on
nuclear systematics.

Table of Contents

Introduction

The National Neutron Cross Section Center (NNCSC) has provided cross-section data for a large number of nuclei of interest to the Controlled Thermonuclear Research (CTR) Program in the past year. The data were supplied to a small number of laboratories actively engaged in the CTR program and had a limited distribution. This report summarizes this voluminous body of material by giving (a) sources of partial or complete evaluations of the data (b) calculational methods used where no evaluations or experimental data exist (c) list of nuclei for which the cross-sections were given and (d) other archival material available at the National Neutron Cross Section Center. It is hoped that this information would be of interest to a larger class of users and indicate the type of data available from the NNCSC.

2. Nuclear Cross-Sections for the CTR Program

There is at present a large amount of research activity connected
with the CTR program as can be seen from the proceedings of a recent
conference.[1] Some of the areas of interest in this program are (1) tritium
breeding (2) energy deposition (3) material activation (4) helium and
hydrogen production (5) atomic displacement and materials damage
(6) dosimetry and transmutation analysis (7) fission-fusion systems and
(8) fission product burner systems. These studies need nuclear data of
different types, degree of detail and accuracy. In some cases a rather
reliable knowledge of nuclear cross-sections arrived at by a detailed
evaluation of all the experimental data are needed. This could be
supplied by the various evaluations in the ENDF/B Library, whose contents
and emphasis have been mainly determined by the needs of the thermal and
fast reactor research programs. In some other cases larger uncertainties
in the cross-sections could be tolerated because all that one needs are
order-of-magnitude estimates. In the latter case, one could use partial
evaluations of the various nuclei where the data files are made up of a
few reactions of immediate interest and the data files have not been
tested against integral measurements. In addition, there are a few nuclei
whose cross-sections have not been measured either because they are unstable
or because of other special experimental difficulties. In such cases,
the cross-sections have to be estimated from calculations based on nuclear
models and or nuclear systematics. In satisfying requests for nuclear
data for the CTR program, material obtained from these different sources
or procedures has been used and these methods are described below.

2.1 ENDF/B Library

The origin and the general philosphy of this neutron cross-section data library have been described.[2] It is meant to be a reference data library based on the best available microscopic experimental data and covers a neutron energy range from 1.0E-05eV to 20.0MeV. Though the earlier versions of this library contained only neutron cross-section data, Versions III and IV (the current version released Feb.-Sept.'74) also contain gamma production cross-sections for a few nuclei used as shielding materials. As mentioned earlier, since this data library was formed with the needs of thermal and fast reactor applications in mind, the energy region below a few MeV has perhaps received more emphasis than the higher energy at around 14 MeV which is of interest to CTR applications. This has been partly due to the fact that there are more reliable and larger number of measurements at lower energies than at higher energies except for the region in the immediate vicinity of 14 MeV. In addition, many of the evaluations are for an element rather than its individual isotopes; thus creating special problems in energy deposition and charged particle production calculations. However, attempts are being made to improve the data files in the high energy region guided by relevant integral measurements and to give isotopic information in the data files.* In addition, the ENDF/B data files are well documented[3] and have benefited from the results of benchmark experiments. Therefore, till evaluations specifically meant for CTR applications become available the data files in the ENDF/B system are the best available. As a result of this, in satisfying requests for the CTR programs the current ENDF/B Library list is scanned first and if the elements or isotopes whose cross-sections are requested are in

*In Jan. 1974, NNCSC received the ENDL evaluations which emphasize the high energy region of CTR interest and which in some cases have been compared against pulsed sphere experiments [24].

the library, the corresponding data files are sent. The list of evalu-
ations in the ENDF/B-IV Library are given in Appendix A.

2.2 ENDF/A Library

This data library consists of (i) earlier evaluations no longer in
current use (ii) partial evaluations which deal with only a few reactions
or (iii) complete or partial evaluations from other data libraries. As
far as possible attempts are made to convert these data files to conform
to the ENDF/B format, though in some cases they do not. In the latter
case, they will have to be modified for use with the usual ENDF/B processing
codes. In addition, the provenance of the evaluations in the ENDF/A library
may not be known. However, some of these evaluations could be of use
for preliminary calculations and feasibility studies. Therefore, if
the evaluation for a particular nucleus is not found in the ENDF/B
library, the contents of the ENDF/A library are searched. In addition
to the earlier evaluations, the ENDF/A library contains the following:

(1) UKNDL (Version 3) (United Kingdom) Received July 2, 1973

General cross-section data sets. There is no documentation on the
data files; there is only an index listing the various reactions in
the data files. It is titled "CCDN Index to the Aldermaston Nuclear
Data Library Version: March 1973". ENDF format

(2) UKNDL (Version 2) (United Kingdom) Received May 5, 1971

General cross-section data sets. Ref 4. ENDF format

(3) ENDL (U.S.A.) Received Jan. 25, 1974

The Lawrence Livermore Laboratory Evaluated Nuclear Data Library
(ENDL) translated into ENDF/B format. It includes photon production
cross-sections. Ref 5. ENDF format

(4) STANDARDS (U.S.A.) Received Jan. 25, 1973

ENDF/B-III cross-section measurement standards, Ref 6. ENDF format

(5) CEN (France) Received August 7, 1973

Compilation of properties of fission product nuclei. Ref 7. ENDF format

(6) SPENG (Sweden) Received Jan. 5, 1973

General cross-section data sets. This library which is in part

based on UKNDL, ENDF and KEDAK libraries contains data for a number

of materials not in ENDF/B-III. Ref 8

(7) KEDAK (W. Germany) Received October 26, 1970

General cross-section data sets. Ref 9

(8) SAND-II (U.S.A.) Received August 5, 1971

Dosimetry cross-sections. Ref 10

(9) AAEC (Australia) Received Sept. 15, 1971

Also referred to as "Cook Library" cross-sections for fission

product nuclides. Ref 11. ENDF format

(10) OBNINSK (Nikolaev) (U.S.S.R.) Received May 30, 1974

Elastic Scattering and Legendre Coefficient fits to some 42

nuclides. No reference. ENDF format.

(11) KONSHIN & NIKOLAEV (U.S.S.R.) Received Jan. 17, 1973

Fission cross-section for ^{235}U. Ref 23. ENDF format

(12) BOYAD (U.S.S.R.) Received Sept. 11, 1972

^{238}U evaluation. No reference.

(13) BENZI (Italy) Received Dec. 4, 1970

Fast neutron radiative capture cross-sections of nuclei. Ref 12.

(14) LIVOLSI 1500 (U.S.A.) Received Nov. 1, 1971

These are based on the Cook library, with some improvements and

modifications in the thermal and resonance regions. Ref 13. ENDF format

Further information on some of these data libraries may be found

in Ref 14.

A partial listing of the nuclides and their material numbers for

identification may be found in Appendix B.

2.3 Calculations Based on Nuclear Systematics

These calculations are performed by using the code THRESH[15] which has been described in detail. This code calculates some nineteen (n,particle) cross-sections induced by neutrons below 20.0 MeV in medium mass nuclei. The cross-sections for charged particle reactions as well as fission spectrum averages of the cross-sections can be calculated.

This code describes a particular cross-section and its variation with energy by a form given by the statistical model. Further, the various parameters such as peak height, its width, steepness with which it rises or falls are described by a set of parameters which are determined by existing experimental data and their variation for nuclei with different Z and N. Thus the only inputs needed for the code are the Z,N of the target nucleus and the Q-values for some nineteen nuclear reactions which could be calculated from the recent mass tables of Wapstra and Gove[16] or from an approximate mass formula built into the program. The reactions for which the cross-sections are calculated are (n,n'), (n,2n), (n,3n), (n,p), (n,d), (n,t), (n,^{3}He), (n,α), (n,np), (n,nd), (n,nt), (n,n^{3}He), (n,nα), (n,2p), (n,pα), (n,dn), (n,αn), and (n,αp). The code THRESH is being constantly updated to include the latest information on experimental data in the form of some 13 parameters in terms of which the cross-sections are calculated. Recently, it has also been extended to heavier nuclei to include the mass region up to A = 83. In addition, similar procedures have been adopted in a code CHAPIN to calculate charged particle cross-sections. The calculated cross-sections are given both in the form of a line-printer output as well as in the standard ENDF/B format from which they can be plotted or can be processed further.

It is interesting to compare the results of this code with available experimental data. This is shown in Fig. 1 where the experimental data on the ^{58}Ni(n,2n) cross-section are shown from the threshold of the reaction

at 12.415 MeV to 20.0 MeV. Some of the available data sets have been left out as they were thought to be highly discrepant or fear of cluttering up the figure with too many points. The continuous curve drawn through the experimental points is thought to be the best representation of the available experimental data. The dashed curve shows the result of THRESH calculations. The average ratio of the values on the continuous curve to the corresponding ones on the dashed curve is 0.74 with the minimum and the maximum ratios in the whole energy range differing by only 10%.

The problems associated with the (n,2n) cross-section of ^{93}Nb is another case where THRESH type calculations based on nuclear systematics have proved to be helpful. The activation measurements of the ^{93}Nb(n,2n) cross-section gave a value of about 450 mb at 14 MeV whereas nuclear systematics predicted[18] a cross-section of 1281 mb at 14.1 MeV. This problem was solved[19] with the realization that the ground state of ^{92}Nb populated in the (n,2n) reaction has a very long half-life and that the measured activity corresponds to transitions to the first excited state with a relatively short half-life. Subsequently, experiments designed to measure the outgoing neutrons and the (n,2n) cross-sections thus measured have given results in substantial agreement with the THRESH type calculations. Thus Mather et al[20] measured 1312±83 mb at 14.3 MeV and Häring et al[21] obtained 1350±250 mb at 14 MeV and Paulsen and Widera[22] got 1380±179 mb at 16.8 MeV. However, these examples should not be construed to mean that the results of THRESH calculations for all the (n,particle) reactions for all the medium mass nuclei agree so well with experimental data - the differences between them are usually much larger. Therefore, in those cases where there are no experimental data, this code can supply cross-section values which are sometimes moderately reliable or at least can be trusted to give order-of-magnitude estimates.

3. List of CTR Requests

There have been mainly three sets of requests for nuclear data for CTR related programs. They are by (1) C. W. Maynard of Wisconsin University for energy desposition, charged particle production and radioactivity calculations (2) J. R. Powell of Brookhaven in connection with his studies of the minimum activity blankets and (3) W. C. Wolkenhower for his calculations of the fission-product burner systems. The detailed lists of these requests and the different data sets sent in June - August 1973 are given in Appendix C. In each case, either the available evaluations and or the results of the THRESH calculations were sent to the requestor along with the plots of all the cross-sections. As such the data packages sent were voluminous and therefore are not given as part of this report. These data sets were also sent to some eight laboratories in the U.S. actively working in the CTR related programs. Similar requests for cross-sections can be satisfied in the future.

APPENDIX A

Contents of the ENDF/B-IV Library

ENDF/B VERSION-IV GENERAL PURPOSE FILE
1-NOV-74   PRESENT STATUS OF EVALUATIONS

SYMBOL	MAT	LAB	AUTHOR	REVIEWER	CAT	STATUS COMMENTS	DIST	TAPE
1- H- 1	1269	LASL	STEWART	HOWERTON	I		DIST, 23-MAY-74	404
1- H- 2	1120	BNW	LEONARD	N.A.	E-III		DIST, 15-APR-74	402
1- H- 3	1169	LASL	STEWART		I		DIST, 27-FEB-74	401
2-HE- 3	1146	LASL	STEWART	N.A.	E-III		DIST, 15-APR-74	402
2-HE- 4	1270	LASL	NISLEY		I		DIST, 27-FEB-74	401
3-LI- 6	1271	LASL	LABAUVE	LEONARD	I		DIST, 23-MAY-74	404
3-LI- 7	1272	LASL	LABAUVE	HOWERTON	I		DIST, 23-MAY-74	404
4-BE- 9	1289	LLL	HOWERTON	WEISBIN	I		DIST, 23-MAY-74	404
5- B- 10	1273	LASL	HALE	LEONARD	I		DIST, 23-MAY-74	404
5- B- 11	1160	GE,BNL	COWAN	D.T.S.	E-III	EXTENDED TO 20 MEV (BNL),	DIST, 6-MAY-74	403
6- C- 12	1274	ORNL	PEREY	LABAUVE	I	WITH ERROR FILES,	DIST, 15-JUL-74	406
7- N- 14	1275	LASL	YOUNG	LABAUVE	I	WITH ERROR FILES,	DIST, 15-JUL-74	406
8- O- 16	1276	LASL	YOUNG	LABAUVE	I	WITH ERROR FILES,	DIST, 15-JUL-74	406
9- F	1277	ORNL	PEREY	GRIMESY	I		DIST, 21-SEP-74	411
11-NA- 23	1156	HARD	PAIK	D.T.S.	E-III	EXTENDED TO 20 MEV (BNL)	DIST, 6-MAY-74	403
12-MG	1280	SAI	DRAKE	FU	I		DIST, 29-MAY-74	405
13-AL- 27	1193	LASL	YOUNG	ROUSSIN	I		DIST, 29-MAY-74	405
14-SI	1194	ORNL	PEREY	BHAT	I		DIST, 29-MAY-74	405
17-CL	1149	GGA	ALLEN	D.T.S.	E-III		DIST, 6-MAY-74	403
19- K	1150	GGA	DRAKE	D.T.S.	E-III		DIST, 6-MAY-74	403
20-CA	1195	ORNL	PEREY	MAERKER	I		DIST, 27-FEB-74	401
22-TI	1286	LLL	HOWERTON	ROUSSIN	I		DIST, 4-SEP-74	409
23- V	1196	ORNL	PENNY	YOUNG	I		DIST, 15-APR-74	402
24-CR	1191	BNL	PRINCE	MAERKER	I		DIST, 6-JUN-74	406
25-MN- 55	1197	BNL	TAKAHASHI	ROUSSIN	I		DIST, 4-SEP-74	409

ENDF/B VERSION-IV GENERAL PURPOSE FILE
1-NOV-74   PRESENT STATUS OF EVALUATIONS

SYMBOL	MAT	LAB	AUTHOR	REVIEWER	CAT	STATUS COMMENTS	DIST	TAPE
26-FE	1192	ORNL	PEREY	STEWART	1		DIST, 6-JUN-74	406
27-CO- 59	1199	BNL	KRIEGER	COBB	I		DIST, 22-AUG-74	410
28-NI	1190	BNL	BHAT	MAERKER	I		DIST, 6-JUN-74	406
29-CU	1295	SAI	DRAKE	PEREY	I		DIST, 22-AUG-74	410
36-KR- 78	1181	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
36-KR- 80	1192	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
36-KR- 82	1183	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
36-KR- 83	1184	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
36-KR- 84	1185	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
36-KR- 86	1186	BNL	PRINCE	LIVOLSI	I		DIST, 15-APR-74	402
40-ZIRC-2	1284	BNW	LEONARD	COBB	I		DIST, 21-SEP-74	411
41-NB- 93	1189	ANL	SMITH	MUIR	I		DIST, 21-SEP-74	411
42-MO	1287	LLL	HOWERTON	ROUSSIN	I		DIST, 4-SEP-74	409
43-TC- 99	1137	B+M	LIVOLSI	D.T.S.	E-III EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
45-RH-103	1125	B+W	LIVOLSI	D.T.S.	E-III EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
47-AG-107	1138	BNL	BHAT	D.T.S.	E-III EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
47-AG-109	1139	BNL	BHAT	D.T.S.	E-III EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
48-CD	1281	UK,BNL	PEARLSTEIN	WHEELER	I		DIST, 21-SEP-74	411
48-CD-113	1282	UK,BNL	PEARLSTEIN	WHEELER	I		DIST, 21-SEP-74	411
54-XE-124	1170	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-126	1171	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-128	1172	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-129	1173	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-130	1174	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-131	1175	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402

ENDF/B VERSION-IV GENERAL PURPOSE FILE
1-NOV-74   PRESENT STATUS OF EVALUATIONS

SYMBOL	MAT	LAB	AUTHOR	REVIEWER	CAT	STATUS COMMENTS	DIST	TAPE
54-XE-132	1176	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-134	1177	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
54-XE-135	1294	BNW	LEONARD	D.T.S.	E-III		DIST, 23-MAY-74	404
54-XE-136	1178	BNL	BHAT	SCHENTER	I		DIST, 15-APR-74	402
55-CS-133	1141	BNL	BHAT	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
62-SM-149	1027	BNW	LEONARD	D.T.S.	E-III		DIST, 6-MAY-74	403
63-EU-151	1290	BNL	TAKAHASHI	SCHENTER	I		DIST, 22-AUG-74	410
63-EU-152	1292	BNL	TAKAHASHI	SCHENTER	I		DIST, 22-AUG-74	410
63-EU-153	1291	BNL	TAKAHASHI	SCHENTER	I		DIST, 22-AUG-74	410
63-EU-154	1293	BNL	TAKAHASHI	SCHENTER	I		DIST, 22-AUG-74	410
64-GD	1030	ANL	PENNINGTON	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
66-DY-164	1031	BNW	LEONARD		E-III		DIST, 15-APR-74	402
71-LU-175	1032	BNW	LEONARD		E-III		DIST, 15-APR-74	402
71-LU-176	1033	BNW	LEONARD		E-III		DIST, 15-APR-74	402
-TA-181	1285	LLL	HOWERTON	YOUNG	I		DIST, 21-SEP-74	411
73-TA-182	1127	AI	OTTER		E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
74-W-182	1128	AI,LASL	ALTER		I		DIST, 27-FEB-74	401
74-W-183	1129	AI,LASL	ALTER		I		DIST, 27-FEB-74	401
74-W-184	1130	AI,LASL	ALTER		I		DIST, 27-FEB-74	401
74-W-186	1131	AI,LASL	ALTER		I		DIST, 27-FEB-74	401
75-RE-185	1083	GE	HENDERSON	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
75-RE-187	1084	GE	HENDERSON	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 6-MAY-74	403
79-AU-197	1283	BNL	GOLDBERG	LEONARD	I		DIST, 21-SEP-74	411
82-PB	1288	ORNL	PEREY	LIVOLSI	I		DIST, 15-JUL-74	408
90-TH-232	1296	B+W	WITTKOPF	MATHEWS	E-III	EXTENDED TO 20 MEV, (BNL) NEW DELAYED N,YIELD AND F.P.YIELD DATA	DIST, 23-MAY-74	404

ENDF/B VERSION-IV GENERAL PURPOSE FILE
1-NOV-74 PRESENT STATUS OF EVALUATIONS

SYMBOL	MAT	LAB	AUTHOR	REVIEWER	CAT	STATUS COMMENTS	DIST	TAPE
01-PA-233	1297	BAPL	YOUNG	D.T.S.	E-III		DIST, 19-AUG-74	407
02- U-233	1296	BAPL		WESTON	E-III		DIST, 4-SEP-74	409
02- U-234	1043	GGA	DRAKE	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
02- U-235	1261	TASK F.	STEWART	HUTCHINS	I		DIST, 19-AUG-74	407
02- U-236	1163	SRL	MCCROSSON	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
02- U-238	1262	TASK F.	PAIK	STEWART	I		DIST, 4-SEP-74	409
03-NP-237	1263	ANC,LASL	SMITH	CARLSON	I		DIST, 4-SEP-74	409
04-PU-238	1050	AI	ALTER	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
04-PU-239	1264	TASK F.	HUTCHINS	PAIK	I		DIST, 19-AUG-74	407
04-PU-240	1265	TASK F.	HUMMEL	MCCROSBON	I		DIST, 19-AUG-74	407
04-PU-241	1266	TASK F.	HUMMEL	HUNTER	I		DIST, 19-AUG-74	407
04-PU-242	1161	AI,ANC	ALTER	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
05-AM-241	1056	ANC	SMITH	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
05-AM-243	1057	ANC	SMITH	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404
06-CM-244	1162	AI,ANC	ALTER	D.T.S.	E-III	EXTENDED TO 20 MEV, (BNL)	DIST, 23-MAY-74	404

APPENDIX B

Partial Contents of the ENDF/A Library

AAEC Fission Product Data Library Received 9/15/71
Cook Library

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Zn-72	1	7001	483
Ga-72	2	7002	"
Ge-72	3	7003	"
Ge-73	4	7004	"
Ge-74	5	7005	"
Ge-76	6	7006	"
Ge-77	7	7007	"
As-75	8	7008	"
As-76	9	7009	"
As-77	10	7010	"
Se-76	11	7011	"
Se-77	12	7012	"
Se-78	13	7013	"
Se-79	14	7014	"
Se-80	15	7015	"
Br-81	16	7016	"
Br-82	17	7017	"
Kr-82	18	7018	"
Kr-83	19	7019	"
Kr-84	20	7020	"
Kr-85	21	7021	"
Kr-86	22	7022	"
Rb-85	23	7023	"
Rb-86	24	7024	"
Rb-87	25	7025	"
Sr-86	26	7026	495
Sr-88	27	7027	483

(Cont'd)

ENDF/A-701 (cont'd)

Isotope[*]	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Sr-89	28	7028	483
Sr-90	29	7029	"
Sr-91	30	7030	"
Y-89	31	7031	"
Y-90	32	7032	"
Y-91	33	7033	"
Y-93	34	7034	"
Zr-90	35	7035	"
Zr-91	36	7036	489
Zr-92	37	7037	501
Zr-93	38	7038	483
Zr-94	39	7039	501
			18,891 TOTAL

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[*] σ_T, σ_{nn}, σ_{ne}, $n\gamma$, σ_{Tr} are the reaction type given for each isotope.

AAEC Fission Product Data Library Received 9/15/71
Cook Library

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Zr-95	40	7040	483
96	41	7041	489
97	42	7042	483
Nb-95	43	7043	"
Mo-95	44	7044	"
96	45	7045	"
97	46	7046	"
98	47	7047	"
99	48	7048	"
100	49	7049	"
Tc-99	50	7050	"
Ru-100	51	7051	"
101	52	7052	"
102	53	7053	"
103	54	7054	"
104	55	7055	"
105	56	7056	"
106	57	7057	"
Rh-103	58	7058	"
105	59	7059	"
Pd-104	60	7060	"
105	61	7061	"
106	62	7062	"
107	63	7063	"
108	64	7064	"
109	65	7065	"
110	66	7066	"
112	67	7067	"
Ag-109	68	7068	"
111	69	7069	"

(cont'd)

ENDF/A-702 (cont'd)

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Cd-110	70	7070	483
111	71	7071	"
112	72	7072	"
113	73	7073	"
114	74	7074	"
115	75	7075	"
116	76	7076	"
In-115	77	7077	"
Sn-115	78	7078	"
			18,843 TOTAL

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* σ_T, σ_{nn}, σ_{ne}, nγ, σ_{Tr} are the reaction type given for each isotope.

AAEC Fission Product Data Library Received 9/15/71

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Sn-116	79	7079	483
117	80	7080	"
118	81	7081	"
119	82	7082	"
120	83	7083	"
121	84	7084	"
122	85	7085	"
123	86	7086	"
124	87	7087	"
125	88	7088	"
126	89	7089	"
Sb-121	90	7090	"
122	91	7091	"
123	92	7092	"
124	93	7093	"
125	94	7094	"
126	95	7095	"
127	96	7096	"
128	97	7097	"
Te-122	98	7098	"
123	99	7099	"
124	100	7100	"
125	101	7101	"
126	102	7102	"
127	103	7103	"
128	104	7104	"

(cont'd)

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Te-129	105	7105	483
130	106	7106	"
131	107	7107	"
132	108	7108	"
I-127	109	7109	"
129	110	7110	"
130	111	7111	"
131	112	7112	"
133	113	7113	"
135	114	7114	"
Xe-128	115	7115	"
130	116	7116	"
131	117	7117	"
			18,837

*
σ_T, σ_{nn}, σ_{ne}, $n\gamma$, σ_{Tr} are the reaction type given for each isotope.

ENDF/A-704

AAEC Fission Product Data Library Received 9/15/71
Cook Library

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Xe-132	118	7118	483
133	119	7119	"
134	120	7120	"
135	121	7121	"
136	122	7122	"
Cs-133	123	7123	"
134	124	7124	"
135	125	7125	"
136	126	7126	"
137	127	7127	"
Ba-134	128	7128	"
136	129	7129	"
137	130	7130	"
138	131	7131	"
140	132	7132	"
La-139	133	7133	"
140	134	7134	"
Ce-140	135	7135	"
141	136	7136	"
142	137	7137	"
143	138	7138	"
144	139	7139	"
Pr-141	140	7140	489
142	141	7141	483
143	142	7142	"
145	143	7143	"

(cont'd)

Isotope*	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Nd-142	144	7144	483
143	145	7145	"
144	146	7146	"
145	147	7147	"
146	148	7148	"
147	149	7149	"
148	150	7150	"
150	151	7151	"
Pm-147	152	7152	"
148	153	7153	"
149	154	7154	"
151	155	7155	"
Sm-147	156	7156	"
			18,843 Total

*σ_T, σ_{nn}, σ_{ne}, nγ, σ_{Tr} are the reaction type given for each isotope.

AAEC Fission Product Data Library Received 9/15/71
Cook Library

Isotope[*]	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Sm-148	157	7157	483
149	158	7158	"
150	159	7159	"
151	160	7160	"
152	161	7161	"
153	162	7162	"
154	163	7163	"
156	164	7164	"
Eu-153	165	7165	"
154	166	7166	"
155	167	7167	"
156	168	7168	"
157	169	7169	"
Gd-155	170	7170	"
156	171	7171	"
157	712	7172	"
158	173	7173	"
159	174	7174	"
160	175	7175	"
Tb-159	176	7176	"
160	177	7177	"
161	178	7178	"
Dy-160	179	7179	"
161	180	7180	"

(cont'd)

Isotope[*]	AAEC #	ENDF FORMAT MAT #	# OF RECORDS ENDF FORMAT
Dy-162	181	7181	483
163	182	7182	"
164	183	7183	"
Ho-165	184	7184	"
Tc-799	185	7185	"
Cd-815	186	7186	"
Te-823	187	7187	"
825	188	7188	"
827	189	7189	"
829	190	7190	"
831	191	7191	"
Pm-848	192	7192	"
			17,388 TOTAL

[*] σ_T, σ_{nn}, σ_{ne}, $n\gamma$, σ_{Tr} are the reaction type given for each isotope.

Reaction Type**

Isotope	K	G	K	G	K	G	K	G	K	G	KEDAK #
Al-27	1	458	1	459	2	152	2	153	2	154	130027
	3	001	3	002	3	003	3	004	3	005	
	3	016	3	027	3	102	3	103	3	107	
	3	201	3	251	4	002†					
C-12	1	458	1	459	2	152	3	001	3	002	60012
	3	003	3	004	3	005	3	016	3	027	
	3	102	3	103	3	107	3	201	3	251	
	4	002†									
Cd	1	458	2	152	3	001	3	002	3	003	480000
	3	004	3	005	3	016	3	027	3	102	
	3	103	3	107	3	201	3	251			
Cr	1	458	1	459	1	460	2	152	3	001	240000
	3	002	3	003	3	004	3	005	3	016	
	3	019	3	027	3	102	3	103	3	107	
	3	201	3	206	3	207	3	251	3	452	
	3	461	4	002†							
Cr-50	1	458	1	459	2	152	2	153	2	154	240050
Cr-52	1	458	1	459	2	152	2	153	2	154	240052
Cr-53	1	458	1	459	2	152	2	153	2	154	240053
Cr-54	1	458	1	459	2	152	2	153	2	154	240054
Fe	1	458	1	459	1	460	2	152	3	001	260000
	3	002	3	003	3	004	3	005	3	016	
	3	019	3	027	3	102	3	103	3	107	
	3	201	3	206	3	207	3	251	3	452	
	3	461	4	002†							
Fe-54	1	458	1	459	2	152	2	153	2	154	260054
Fe-56	1	458	1	459	2	152	2	153	2	154	260056
Fe-57	1	458	1	459	2	152	2	153	2	154	260057
Fe-58	1	458	1	459	2	154					260058

(continued)

ENDF/A-707[*] (continued)

Isotope	Reaction Type[**]					KEDAK #
	K G	K G	K G	K G	K G	
H-2(D)	1 458	1 459	3 001	3 002	3 003	10002
	3 004	3 016	3 027	3 102	3 103	
	3 107	3 201	3 251	4 002[†]		
H in H-2	3 001	3 002	3 003	3 004	3 016	11001
	3 027	3 102	3 103	3 107	3 201	
	3 251					
H in H$_2$O	3 001	3 002	3 003	3 004	3 016	12001
	3 027	3 102	3 103	3 107	3 201	
	3 251					
He-3	3 001	3 002	3 003	3 004	3 016	20003
	3 027	3 102	3 103	3 107	3 251	
He-4	1 458	1 459	3 001	3 002	3 003	20004
	3 004	3 016	3 027	3 102	3 103	
	3 107	3 201	3 251	4 002[†]		
Mo	1 458	1 459	1 460	2 152	3 001	420000
	3 002	3 003	3 004	3 005	3 016	
	3 027	3 102	3 103	3 107	3 201	
	3 251	4 002[†]				
Mo-92	1 458	1 459	2 152	2 153	2 154	420092
Mo-94	1 458	1 459	2 152	2 153	2 154	420094
Mo-95	1 458	1 459	2 152	2 153	2 154	420095
Mo-96	1 458	1 459	2 152	2 153	2 154	420096
Mo-97	1 458	1 459	2 152	2 153	2 154	420097
Mo-98	1 458	1 459	2 152	2 153	2 154	420098
Mo-100	1 458	1 459	2 152	2 153	2 154	420100
N	4 002[†]					70000

[*]ENDF/A Tape No. assigned but data not converted to ENDF format.
[**]See KFK-880 for reaction type values.
[†]Center-of-Mass System.

KEDAK Data Library Received 10/26/70

Reaction Type**

Isotope	K	G	K	G	K	G	K	G	K	G	KEDAK #
Ni	1	458	1	459	1	460	2	152	3	001	280000
	3	002	3	003	3	004	3	005	3	016	
	3	019	3	027	3	102	3	103	3	107	
	3	201	3	206	3	207	3	251	3	452	
	3	461	4	002*							
Ni-58	1	458	1	459	2	152	2	153	2	154	280058
Ni-60	1	458	1	459	2	152	2	153	2	154	280060
Ni-61	1	458	1	459	2	154					280061
Ni-62	1	458	1	459	2	152	2	154			280062
Ni-64	1	458	1	459	2	154					280064
O-16	1	458	1	459	2	152	3	001	3	002	80016
	3	003	3	005	3	016	3	027	3	103	
	3	107	3	201	3	251	4	002†			
	3	004	3	102							
U-235	1	456	1	457	1	458	1	459	2	152	920235
	2	153	2	154	2	155	3	001	3	002	
	3	003	3	004	3	005	3	016	3	019	
	3	027	3	102	3	103	3	107	3	201	
	3	206	3	207	3	251	3	452	3	461	
	4	002†									

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*ENDF/A Tape No. assigned but data not converted to ENDF format.
**See KFK-880 for reaction type values.
†Center-of-Mass System.

KEDAK Data Library Received 10/26/70

Reaction Type[**]

Isotope	K	G	K	G	K	G	K	G	K	G	KEDAK #
Na-23	1	458	1	459	2	152	2	153	2	154	110023
	3	001	3	002	3	003	3	004	3	005	
	3	016	3	027	3	102	3	103	3	107	
	3	201	3	251	4	002[+]					
Pu-239	1	456	1	457	1	458	1	459	2	152	940239
	2	153	2	154	2	155	3	001	3	002	
	3	003	3	004	3	005	3	016	3	019	
	3	027	3	102	3	103	3	107	3	201	
	3	206	3	207	3	251	3	452	3	461	
	4	002[+]									
Pu-240	1	456	1	457	1	458	1	459	2	152	940240
	2	153	2	154	2	155	3	001	3	002	
	3	003	3	004	3	005	3	016	3	019	
	3	027	3	102	3	201	3	206	3	207	
	3	251	3	452	4	002[+]					
Pu-241	1	456	1	457	1	458	1	459	2	152	940241
	2	153	2	154	2	155	3	001	3	002	
	3	003	3	004	3	005	3	016	3	019	
	3	027	3	102	3	201	3	206	3	027	
	3	251	3	452	4	002[+]					
Pu-242	1	456	1	457	1	458	1	459	2	152	940242
	2	153	2	154	3	001	3	002	3	003	
	3	004	3	005	3	016	3	019	3	027	
	3	102	3	201	3	206	3	207	3	251	
	3	452	4	002[+]							
U-238	1	456	1	457	1	458	1	459	2	152	920238
	2	153	2	154	3	001	3	002	3	003	
	3	004	3	005	3	016	3	019	3	027	
	3	102	3	103	3	107	3	201	3	251	
	3	452	3	461	4	002[+]					

[*]ENDF/A Tape No. assigend but data not converted to ENDF format.
[**]See KFK-880 for reaction type values
[+]Center-of-Mass System.

UKNDL Data Library Received 5/5/71
Version 2

Isotope	Reaction Type*										UKNDL #	ENDF MAT #	# of RECORDS
	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT			
H	2	151	3	1	3	2	3	102	4	2	901	8001	331
D in D$_2$O	2	151	3	1	3	2	3	3	3	16	256	8002	1115
	3	102	4	2	4	16	5	16					
Be-9	2	151	3	1	3	2	3	3	3	24	50	8003	857
	3	102	3	105	3	107	4	2	4	24			
	5	24											
C-12	2	151	3	1	3	2	3	3	3	23	68	8004	1908
	3	51	3	102	3	107	4	2	4	23			
	4	51	5	23									
O-16	2	151	3	1	3	2	3	3	3	4	33	8005	1371
	3	51	3	52	3	54	3	55	3	57			
	3	58	3	59	3	60	3	91	3	102			
	3	103	3	104			3	107	4	2			
	4	51	4	52	4	53	4	54	4	55			
	4	56	4	57	4	58	4	59	4	60			
	4	91	5	91	3	53	3	56					
U-235	2	151	3	1	3	2	3	3	3	16	66	8006	4083
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	91	3	102			
	4	2	4	16	4	17	4	18	4	51			
	4	52	4	53	4	54	4	55	4	56			
	4	91	5	16	5	17	5	18	5	91			
	1	452											
Pu-239	2	151	3	1	3	2	3	3	3	16	65	8007	3335
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	57	3	91			
	3	102	4	2	4	16	4	17	4	18			
	4	51	4	52	4	53	4	54	4	55			
	4	56	4	57	4	91	5	16	5	17			
	5	18	5	91									
	1	452											
U-233	2	151	3	1	3	2	3	16	3	17	87	8008	1876
	3	18	3	91	3	102	4	2	4	16			
	4	17	4	18	4	91	5	16	5	17			
	5	18	5	91									
	1	452											
U-238	2	151	3	1	3	2	3	3	3	16	401	8009	5819
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	57	3	58			
	3	59	3	60	3	91	3	102	4	2			
	4	16	4	17	4	18	4	51	4	52			
	4	53	4	54	4	55	4	56	4	57			
	4	58	4	59	4	60	4	91	5	16			
	5	17	5	18	5	91							
	1	452											

(continued)

ENDF/A-801 (continued)

Isotope	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT	UKNDL #	ENDF MAT #	# of RECORDS
						Reaction Type*							
Pu-241	2	151	3	1	3	2	3	3	3	16	60	8010	1982
	3	17	3	18	3	91	3	102	4	2			
	4	16	4	17	4	18	4	91	5	16			
	5	17	5	18	5	91							
Na-23	3	102									224	8011	78
Mg-24	3	103									225	8012	57
Al-27	3	102	3	107							226	8013	81
Al-27	3	107									95	8014	30
Al-27	3	107									96	8015	39
Si-28	3	103									227	8016	39
P-31	3	103									228	8017	118
S-32	3	103									229	8018	55
S-32	3	103									97	8019	41
S-34	3	107									230	8020	65
Cl-35	3	107									231	8021	29
Sc-45	3	16	3	26							207	8022	30
Mn-55	3	102									232	8023	102
Fe-54	3	103									63	8024	53
Fe-54	3	103									233	8025	37
Fe-56	3	103									62	8026	47
Fe-56	3	103									234	8027	34
Fe-56	3	103									98	8028	30
Co-59	3	102									235	8029	86
Ni-58	3	16	3	103							236	8030	57
Cu-63	3	16	3	102							237	8031	89
Cu-63	3	16									99	8032	25
Cu-65	3	16									100	8033	26
Y-89	3	16									208	8034	22
Zr-90	3	16									238	8035	27
Rh-103	3	16									204	8036	27

(continued)

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ENDF/A-801   (continued)

Isotope	Reaction Type*				UKNDL #	ENDF MAT #	# of RECORDS
	MF	MT	MF	MT			
Rh-103	3	51	4	51	·94	8037	59
In-115	3	51			239	8038	42
I-127	3	16			240	8039	28
Gd	3	1	3	102	223	8040	40
Tm-169	3	16			209	8041	23
Lu-175	3	16			210	8042	23
Th-232	3	18	3	102	242	8043	186
							24402 TOTAL

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*See ENDF-102 Vol 1 for reaction type values.

UKNDL Data Library Received 5/5/71
Version 2

Isotope	Reaction Type*										UKNDL #	ENDF MAT #	# of RECORDS
	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT			
Pu-240	2	151	3	1	3	2	3	3	3	16	77	8044	1180
	3	17	3	18	3	51	3	52	3	53			
	3	91	3	102	4	2	4	16	4	17			
	4	18	4	51	4	52	4	53	4	91			
	5	16	5	17	5	18	5	91					
	1	452											
Th-232	2	151	3	1	3	2	3	3	3	16	22	8045	1045
	3	17	3	18	3	91	3	102	4	2			
	4	16	4	17	4	18	4	91	5	16			
	5	17	5	18	5	91							
	1	452											
U-234	2	151	3	1	3	2	3	3	3	16	74	8046	1170
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	91	3	102			
	4	2	4	16	4	17	4	18	4	51			
	4	52	4	53	4	54	4	55	4	56			
	4	91	5	16	5	17	5	18	5	91			
	1	452											
U-236	2	151	3	1	3	2	3	3	3	16	75	8047	1025
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	91	3	102			
	4	2	4	16	4	17	4	18	4	51			
	4	52	4	53	4	54	4	55	4	56			
	4	91	5	16	5	17	5	18	5	91			
	1	452											
U-238	2	151	3	1	3	2	3	3	3	16	76	8048	1069
	3	17	3	18	3	51	3	52	3	53			
	3	54	3	55	3	56	3	57	3	58			
	3	59	3	60	3	91	3	102	4	2			
	4	16	4	17	4	18	4	51	4	52			
	4	53	4	54	4	55	4	56	4	57			
	4	58	4	59	4	60	4	91	5	16			
	5	17	5	18	5	91							
	1	452											
Pu-238	2	151	3	1	3	2	3	3	3	16	216	8049	620
	3	17	3	18	3	91	3	102	4	2			
	4	16	4	17	4	18	4	91	5	16			
	5	17	5	18	5	91							
	1	452											
Pa-233	2	151	3	1	3	2	3	3	3	16	86	8050	981
	3	18	3	91	3	102	4	2	4	16			
	4	18	4	91	5	16	5	18	5	91			
	1	452											
Np-237	3	18									61	8051	86

(continued)

Isotope	Reaction Type*					UKNDL #	ENDF MAT #	# of RECORDS
	MF MT	MF MT	MF MT	MF MT	MF MT			
Na	2 151	3 1	3 2	3 3	3 16	182	8052	1762
	3 51	3 52	3 53	3 54	3 55			
	3 56	3 57	3 91	3 102	3 103			
	3 107	4 2	4 16	4 51	4 52			
	4 53	4 54	4 55	4 56	4 57			
	4 91	5 16	5 91					
K	2 151	3 1	3 2	3 3	3 4	84	8053	2804
	3 16	3 22	3 51	3 52	3 53			
	3 54	3 55	3 56	3 91	3 102			
	3 103	3 107	4 2	4 16	4 22			
	4 51	4 52	4 53	4 54	4 55			
	4 56	4 91	5 16	5 22	5 91			
Al	2 151	3 1	3 2	3 16	3 51	35	8054	1306
	3 52	3 53	3 54	3 55	3 56			
	3 57	3 58	3 59	3 91	3 102			
	3 103	3 107	4 2	4 16	4 51			
	4 52	4 53	4 54	4 55	4 56			
	4 57	4 58	4 59	4 91	5 16			
	5 91							
Zr	2 151	3 1	3 2	3 3	3 16	82	8055	1958
	3 51	3 52	3 53	3 54	3 55			
	3 56	3 57	3 58	3 91	3 102			
	3 103	4 2	4 16	4 51	4 52			
	4 53	4 54	4 55	4 56	4 57			
	4 58	4 91	5 16	5 91				
Fe	2 151	3 1	3 2	3 51	3 52	91	8056	2938
	3 53	3 54	3 55	3 56	3 57			
	3 58	3 59	3 60	3 91	3 102			
	3 103	3 107	4 2	4 51	4 52			
	4 53	4 54	4 55	4 56	4 57			
	4 58	4 59	4 60	4 91	5 91			
Cu	2 151	3 1	3 2	3 4	3 16	73	8057	3274
	3 51	3 52	3 53	3 54	3 55			
	3 56	3 57	3 58	3 59	3 91			
	3 102	3 103	3 107	4 2	4 16			
	4 51	4 52	4 53	4 54	4 55			
	4 56	4 57	4 58	4 59	4 91			
	5 16	5 91						
Mo	2 151	3 1	3 2	3 3	3 4	81	8058	1457
	3 16	3 17	3 22	3 51	3 52			
	3 53	3 54	3 91	3 102	3 103			
	4 2	4 16	4 17	4 22	4 51			
	4 52	4 53	4 54	4 91	5 16			
	5 17	5 22	5 91					

(continued)

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ENDF/A-802   (continued)

Isotope				Reaction Type*									UKNDL #	ENDF MAT #	# of RECORDS
	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT			
W	2	151	3	1	3	2	3	3	3	16	213	8059	378
	3	91	3	102	4	2	4	16	4	91			
	5	16	5	91									
Cr	2	151	3	1	3	2	3	3	3	16	45	8060	1085
	3	51	3	52	3	53	3	54	3	55			
	3	56	3	57	3	58	3	91	3	102			
	3	103	4	2	4	16	4	51	4	52			
	4	53	4	54	4	55	4	56	4	57			
	4	58	4	91	5	16	5	91					
Ni	2	15	3	1	3	2	3	3	3	16	46	8061	1460
	3	51	3	52	3	53	3	54	3	55			
	3	56	3	57	3	58	3	91	3	102			
	3	103	3	107	4	2	4	16	4	51			
	4	52	4	53	4	54	4	55	4	56			
	4	57	4	58	4	91	5	16	5	91			

25535   Total

*See ENDF-102 vol 1 for reaction type values.

UKNDL Data Library Received 5/5/71
Version 2

Isotope	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT	UKNDL #	ENDF MAT #	# of RECORDS
Nb	2	151	3	1	3	2	3	3	3	4	79	8062	5669
	3	16	3	51	3	52	3	53	3	54			
	3	55	3	56	3	57	3	58	3	59			
	3	60	3	91	3	102	3	103	3	107			
	4	2	4	16	4	51	4	52	4	53			
	4	54	4	55	4	56	4	57	4	58			
	4	59	4	60	4	91	5	16	5	91			
Si	2	151	3	1	3	2	3	3	3	91	25	8063	399
	3	102	3	103	3	107	4	2	4	91			
	5	91											
Pb	2	151	3	1	3	2	3	3	3	16	26	8064	533
	3	91	3	102	4	2	4	16	4	91			
	5	16	5	91									
B-10	2	151	3	1	3	2	3	3	3	4	90	8065	608
	3	51	3	52	3	53	3	54	3	55			
	3	56	3	91	3	101	3	103	3	104			
	3	105	3	107	4	2	4	51	4	52			
	4	53	4	54	4	55	4	56	4	91			
	5	91											
B-11	2	151	3	1	3	2	3	51	3	52	49	8066	821
	3	53	3	91	3	102	3	103	3	105			
	3	107	4	2	4	51	4	52	4	53			
	4	91	5	91									
Cd	2	151	3	1	3	2	3	3	3	16	70	8067	2323
	3	51	3	52	3	53	3	54	3	91			
	3	101	3	102	3	103	3	107	4	2			
	4	16	4	51	4	52	4	53	4	54			
	4	91	5	16	5	91							
Cd-113	2	151	3	1	3	2	3	3	3	16	71	8068	1199
	3	51	3	52	3	53	3	91	3	101			
	3	102	3	103	3	107	4	2	4	16			
	4	51	4	52	4	53	4	91	5	16			
	5	91											
Xe-135	2	151	3	1	3	2	3	102	4	2	4	8069	103

(Continued)

Isotope	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT	UKNDL #	ENDF MAT #	# of RECORDS
H-3(T)	2	151	3	1	3	2	3	3	3	16	252	8070	676
	4	2	4	16	5	16							
He-3	2	151	3	1	3	2	3	3	3	103	220	8071	243
	3	104	4	2									
He-4	2	151	3	1	3	2	4	2			221	8072	290
Li-6	2	151	3	1	3	2	3	3	3	22	214	8073	962
	3	24	3	51	3	102	3	103	3	107			
	4	2	4	22	4	24	4	51	5	22			
	5	24											
Li-7	2	151	3	1	3	2	3	3	3	16	215	8074	902
	3	22	3	24	3	51	3	102	3	104			
	4	2	4	16	4	22	4	24	4	51			
	5	16	5	22	5	24							
B	2	151	3	1	3	2	3	3	3	91	57	8075	367
	3	101	4	2	4	91	5	91					
N	2	151	3	1	3	2	3	3	3	16	259	8076	3664
	3	51	3	52	3	91	3	102	3	103			
	3	104	3	105	3	107	3	108	4	2			
	4	16	4	51	4	52	4	91	5	16			
	5	91											
F	2	151	3	1	3	2	3	3	3	16	23	8077	398
	3	91	3	101	4	2	4	16	4	91			
	5	16	5	91									
Cl	2	151	3	1	3	2	3	3	3	16	141	8078	563
	3	91	3	102	3	103	3	107	4	2			
	4	16	4	91	5	16	5	19					
Ca	2	151	3	1	3	2	3	3	3	91	138	8079	362
	3	102	3	103	3	107	4	2	4	91			
	5	91											
Ti	2	151	3	1	3	2	3	3	3	16	190	8080	1150
	3	51	3	52	3	53	3	54	3	91			
	3	102	3	103	3	107	4	2	4	16			
	4	51	4	52	4	53	4	54	4	91			
	5	16	5	91									

(continued)

ENDF/A-803 (continued)

Isotope	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT	UKNDL #	ENDF MAT #	# of RECORDS
Cu-63	2	151	3	16	3	102	3	103	3	107	250	8081	84
Cu-65	2	151	3	16	3	102	3	103	3	107	251	8082	88
Ga	2	151	3	1	3	2	3	3	3	16	105	8083	366
	3	91	3	101	4	2	4	16	4	91			
	5	16	5	91									
Ta-181	2	151	3	1	3	2	3	4	3	16	328	8084	2204
	3	51	3	52	3	53	3	54	3	55			
	3	56	3	57	3	58	3	91	3	101			
	4	2	4	16	4	51	4	52	4	53			
	4	54	4	55	4	56	4	57	4	58			
	4	91	5	16	5	91							

The header above MF/MT columns reads "Reaction Type*".

*See ENDF-102 vol 1 for reaction type values.

UKNDL Data Library Received 5/5/71

Isotope	Reaction Type[*]										UKNDL #	ENDF MAT #	# of RECORDS
	MF	MT	MF	MT	MF	MT	MF	MT	MF	MT			
Au-197	2	151	3	1	3	2	3	3	3	16	222	8085	968
	3	26	3	51	3	52	3	53	3	54			
	3	55	3	56	3	57	3	58	3	59			
	3	91	3	102	3	103	4	2	4	16			
	4	26	4	51	4	52	4	53	4	54			
	4	55	4	56	4	57	4	58	4	59			
	4	91	5	16	5	26	5	91					
Au-197	3	102									241	8086	111
Fp	3	1	3	2	3	3	3	16	3	91	106	8087	350
	3	101	4	2	4	16	4	91	5	16			
	5	91											
VAC	3	1	3	2	4	2					172	8088	39
1/V	3	1	3	2	3	102	4	2			55	8089	45
SCAT	3	1	3	2	4	2					56	8090	39
ABS	3	1	3	2	3	102	4	2			151	8091	45
												1597	Total

*See ENDF-102 vol 1 for reaction type values.

Version 3

Nucleus	UK Library No.	No. of Cards	Tape No.
H	923(A)	299	805
DIND20 (Deuterium in D_2O)	905(A)	789	"
T	252(A)	436	"
He-3	220(E)	195	"
He-4	221(D)	230	"
Li-6	914(A)	1080	"
Li-7	215(E)	496	"
Be-9	967(A)	351	"
B-10	90(B)	475	"
B-11	49(B)	725	"
C	902(B)	1317	"
N	259(A)	3534	"
O	933(A)	1037	"
F-19	23(E)	288	"
Na-23	182(E)	1582	"
Al-27	35(F)	905	"
Si	25(E)	296	"
Cl	141(E)	408	"
K	84(B)	2569	"
Ca	138(E)	253	"
Ti	190(B)	881	"
V	952(A)	804	"
Cr	45(E)	839	"
Fe	906(B)	7003	806
Fe	908(A)	7447	"
Ni	907(B)	3328	"
Cu	73(A)	3076	"
Cu-63	250(B)	54	"
Cu-65	251(B)	58	"
Ga	105(B)	292	"
Zr	82(B)	1742	"

U.K. Library (continued)

Nucleus	UK Library No.	No. of Cards	Tape No.
Nb-93	79(C)	5579	807
Mo	81(B)	1309	"
Ag-107	973(A)	1107	"
Ag-109	974(A)	1205	"
Cd	70(A)	2203	"
Cd-113	71(B)	1088	"
Xe-135	4(F)	66	"
Eu-151	921(A)	3458	"
Eu-153	922(A)	4055	"
Ta	328(B)	2069	"
W	213(B)	238	"
Au-197	222(E)	690	808
Pb	26(C)	545	"
Th-232	930	774	"
Pa-233	86(A)	900	"
U-233	87(B)	1835	"
U-234	953(A)	823	"
U-235	159(B)	4354	"
U-236	954(A)	749	"
U-238	160(A)	5886	"
U-239	276(A)	1119	"
U-240	277(A)	1060	"
Pu-238	274(A)	438	"
Pu-239	161(A)	3334	809
Pu-239	404(B)	4382	"
Pu-240	402(B)	2669	"
Pu-240	77(B)	1052	"
Pu-241	403(B)	1661	"
Pu-241	60(A)	2155	"
Pu-242	975(A)	1069	"
Am-241	956(A)	1213	"
Am-243	957(A)	574	"
Cm-244	976(A)	1649	"

The contents of the Speng Library are as follows:

Pu-239	Na-23	Pu-240
B-10	D-2	Al
B-11	F	Mn
Si	Zr	Ni
He	Mo	Cr
Li-6	(Fiss. P. 239)	U-235
Li-7	W-186	Cu
Ta	Au-197	H-1
Er	Fe	Pu-241
U-238	B	

LLL ENDL Data in ENDF/B Format

Received Jan. 25, 1974

Material	MAT Number	N,xγ Included
Neutron	7000	---
Hydrogen	7001	Yes
Deuteron	7002*	Yes
Triton	7003	---
He^3	7004	Yes
He^4	7005	---
Li^6	7006	Yes
Li^7	7007	Yes
Be^9	7008	Yes
B^{10}	7009	Yes
B^{11}	7010	Yes
C^{12}	7011	Yes
N^{14}	7012	Yes
O^{16}	7013	Yes
F^{19}	7014	Yes
Na^{23}	7015	Yes
Mg^{Nat}	7016	Yes
Al^{27}	7017	Yes
Si^{Nat}	7018	Yes
P^{31}	7019	Yes
S^{32}	7020	Yes
Cl^{Nat}	7021	Yes
Ar^{Nat}	7022	Yes

*The energy-angle distribution of secondary neutrons from the n,2n
reaction for D is represented by an energy-angle Legendre expansion
in the ENDL system. No equivalent representation exists in the
ENDF/B system. Consequently, the representation in the translated
form is deficient.

LLL ENDL Data in ENDF/B Format

Material	MAT Number	N,xY Included
K^{Nat}	7023	Yes
Ca^{Nat}	7024	Yes
Ti^{Nat}	7025	Yes
V^{51}	7026	No (Planned)
Cr^{Nat}	7027	No (Planned)
Mn^{55}	7028	Yes
Fe^{Nat}	7029	Yes
Ni^{58}	7030	Yes
Cu^{Nat}	7031	Yes
Ga^{Nat}	7032	Yes
Zr^{Nat}	7033	No (Planned)
Nb^{93}	7034	Yes
Mo^{Nat}	7035	Yes
Ag^{107}	7036	No (Planned)
Ag^{109}	7037	No (Planned)
Cd^{Nat}	7038	Yes
Sn^{Nat}	7039	Yes
Ba^{Nat}	7040	Yes
Eu^{Nat}	7041	Yes
Gd^{Nat}	7042	Yes
Ho^{165}	7043	Yes
Ta^{181}	7044	Yes
W^{Nat}	7045	Yes
Pt^{Nat}	7046	Yes
Au^{197}	7047	Yes
Pb^{Nat}	7048	Yes
Th^{232}	7049	Yes
U^{233}	7050	Yes

LLL ENDL Data in ENDF/B Format

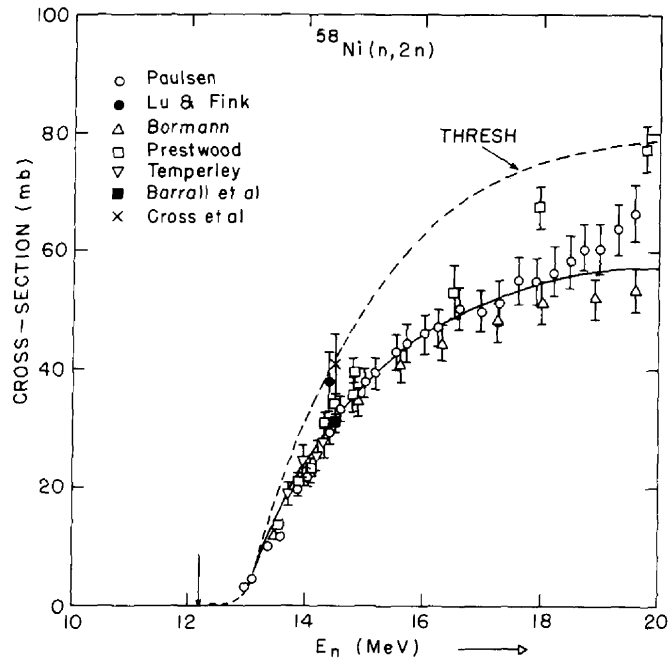| Material	MAT Number	N,xγ Included
U^{234}	7051	Yes
U^{235}	7052	Yes
U^{236}	7053	Yes
U^{237}	7054	Yes
U^{238}	7055	Yes
U^{239}	7056	Yes
U^{240}	7057	Yes
Np^{237}	7058	Yes
Pu^{238}	7059	Yes
Pu^{239}	7060	Yes
Pu^{240}	7061	Yes
Pu^{241}	7062	Yes
Am^{242}	7063	Yes
Sc^{45} (Partial)	7064	No
Fe^{54} (Partial)	7065	No
Fe^{56} (Partial)	7066	No
Fe^{58} (Partial)	7067	No
Re^{185} (Partial)	7068	No
Re^{187} (Partial)	7069	No
Ir^{191} (Partial)	7070	No
Ir^{193} (Partial)	7071	No
Crude Fission Product	7072	No

Fig. 1. ^{58}Ni (n,2n) Cross-Section

APPENDIX C

Requests for CTR Related Projects

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
H					1148		
He					1088		
^{3}He			8071		1146		
^{6,7}Li					1115 1116		
^{9}Be					1154		
^{10}B			8065		1155		
^{11}B					1160		
^{12}C					1165		
N					1133		
O					1134		
F			8077				
^{23}Na					1156		
Mg					1014		
Al					1135		
^{28}Si			8016				
^{29}Si							
^{30}Si							
P			8017				
^{39}K					1150		
^{41}K							
^{45}Sc							X
^{46}Ti							X
^{47}Ti							X
^{48}Ti							X
^{49}Ti							X
^{50}Ti							X

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
^{49}V							X
^{60}V							X
^{61}V							X
^{50}Cr							X
^{51}Cr							X
^{52}Cr							X
^{53}Cr							X
^{54}Cr							X
^{53}Mn							X
^{54}Mn							X
^{55}Mn					1019		
^{54}Fe			8024 8025				X
^{55}Fe							X
^{56}Fe			8026 8027 8028				X
^{57}Fe							X
^{58}Fe							X
^{57}Co							X
^{59}Co					1118		
^{60m}Co							X
^{58}Ni			8030				X
^{59}Ni							X
^{60}Ni							X
^{61}Ni							X
^{62}Ni							X

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
^{63}Ni							X
^{64}Ni							X
^{63}Cu					1085		
^{65}Cu					1086		
^{64}Zn							
^{66}Zn							
^{84}Kr	7020	1521					X
^{85}Kr	7021	1522					X
^{88}Sr	7027						X
^{89}Sr	7028	1530					X
^{90}Sr	7029	1531					X
^{88}Y							X
^{89}Y	7031		8034				X
^{90m}Y	7032						X
^{91m}Y	7033						X
^{90}Zr	7035		8035				X
^{91}Zr	7036						X
^{92}Zr	7037						X
^{93}Zr	7038						X
^{94}Zr	7039						X
^{95}Zr	7040				1202		X
^{96}Zr	7041						X
^{92}Nb							X
^{93m}Nb							X

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
^{94}Nb							X
^{92}Mo						573 Benzi	X
^{93m}Mo							X
^{94}Mo						574 Benzi	X
^{95}Mo	7044				1204		X
^{96}Mo	7045						X
^{97}Mo	7046				1205		X
^{98}Mo	7047				1206		X
^{99}Mo	7048				1207		X
^{100}Mo	7049				1208		X
^{97}Tc							X
^{98}Tc							X
^{99m}Tc	7050				1137		X
^{112}Sn						630 Benzi	X
^{114}Sn						631 Benzi	X
^{115}Sn	7078						X
^{116}Sn	7079						X
^{117}Sn	7080						X
^{118}Sn	7081						X
^{119}Sn	7082						X
^{120}Sn	7083						X
^{122}Sn	7085						X
^{124}Sn	7087						X
^{121}Sb	7090						X
^{123}Sb	7092						X

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
^{129}I	7100	1614					X
^{134}Cs	7124	1628					X
^{135}Cs	7125	1629					X
^{136}Cs	7126	1630					X
^{137}Cs	7127	1631					X
^{134}Ba	7128	1633					X
^{135}Ba		1634					X
^{136}Ba	7129	1635					X
^{137}Ba	7130	1636					X
^{139}Ba	7131	1637					X
^{181}Ta					1126		X
^{182}W					1060		X
^{183}W					1061		X
^{184}W					1062		X
^{186}W					1063		X
^{204}Pb							X
^{206}Pb							X
^{207}Pb							X
^{208}Pb							X
^{241}Am					1056		
^{242}Am							
^{243}Am					1057		
^{244}Am							

Nucleus	Cook Library	Livolsi "1500" Series	UKNDL	Speng	ENDF/B III MAT NO	Any Other	THRESH Calculation
^{242}Cm						.	
^{243}Cm							
^{244}Cm					1162		
^{245}Cm							
^{246}Cm							
^{237}Np					1145		
^{238}Pu					1050		
^{239}Pu					1159		
^{240}Pu					1105		
^{241}Pu					1106		
^{242}Pu					1161		

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