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FENDL/A-1.1

Neutron Activation Cross-Section Data Library
for Fusion Applications
Version 1.1 of April 1993

Prepared by

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Abstract: This document describes the contents of a comprehensive neutron activation cross-section data library for more than 11 000 neutron activation reactions with 636 target nuclides in the incident energy range up to 20 MeV. FENDL/A-1.1 is a sublibrary of FENDL, the evaluated nuclear data library for fusion applications. It is supplemented by a decay data library FENDL/D in ENDF-6 format for about 2900 nuclides and isomers. The data are available from the IAEA Nuclear Data Section online via INTERNET by FTP command, or on magnetic tape upon request.

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94/11

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FENDL/A - 1.1

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IAEA Nuclear Data Section ("NDS")

Note: This is Revision 2 of document IAEA-NDS-148 describing version 1.1 of April 1993 of the data library FENDL/A.

(1) Introduction

This neutron activation cross section data base was produced within the IAEA FENDL project which has the goal of providing a comprehensive Fusion Evaluated Nuclear Data Library for predicting all nuclear processes in fusion devices such as the International Thermonuclear Experimental Reactor, ITER. The FENDL library is composed of several sublibraries describing the transport of both the plasma-source neutrons and secondary gamma rays through fusion reactor components, as well as the resulting radiation effects, such as nuclear heating, tritium breeding, activation and material damage. Complementing to the activation cross section library is the decay data library which, within the FENDL project, has the designator FENDL/D, it is described in the document IAEA-NDS-167.

(2) History of the FENDL/A files family

The FENDL activation programme was started since May 1989 at the FENDL meeting[1], when the Working Group on Neutron Activation Data initiated an intercomparison of activation cross sections important for fusion reactor technology. It was agreed that national nuclear data centers and research laboratories will send to the NDS their contributions, according to a list of reactions selected on the basis of inventory calculations.

2.1 FENDL/A-1 Activation Data Sublibrary of Important Reactions

FENDL/A-1 contains pointwise cross-section data for 256 reactions most important for activation. A list of 256 important reactions that are significant in producing activation both at short and long cooling times has been compiled by R. Forrest at the Harwell Laboratory, UKAEA (see Appendix 1). The list was distributed to all interested parties and in response many activation data files have been received at the NDS from institutes participating in this exercise. A detailed graphical intercomparisons have been prepared at the NDS, plotting, for each reaction, overlays of the various submitted evaluated data sets and experimental data from EXFOR. Selection of evaluations for FENDL/A activation sublibrary was made at the June 1990 FENDL meeting in Vienna[2]. The data were taken from the following libraries: REAC-2, REAC-ECN-5, ENDF/B-VI, SINCROSACT, BOSPOR-86, ADL-90. In addition, data for a few reactions were selected from JENDL-3 and BROND-2 libraries. The selected evaluations were converted to uniform ENDF-6 format with special rules described below. When it was necessary, the initial data were processed to pointwise evaluated data which includes linearization, reconstruction of resonance data from resonance parameters and summation with the background cross sections. FENDL/A-1 was finalized in May 1991.

2.2 FENDL/A-1 (Revised)

FENDL/A-1 pointwise activation sublibrary consisting of '256 reactions most important for activation' was reviewed in detail at the next FENDL meeting held in Vienna from 18 to 22 November 1991[3]. The review and selection process has been renewed, using, as additional source of data, the results of the IAEA Co-ordinated Research Programme on Activation Cross Sections for the Generation of Long-Lived Radionuclides and some new evaluations. The sources of data were agreed and this led to the creation of a second version of activation sublibrary, FENDL/A-1 (revised), which was released in March 1992. The following main revisions of activation cross sections data have been agreed and incorporated:

- evaluated (n,γ) data from REAC-ECN-5 which are the results of renormalization at 14.5 MeV to branching ratio BR = $\sigma^m/(\sigma^m+\sigma^g)$ = 0.5 have been replaced by EAF-2;

- all ADL-90 data have been replaced by ADL-91 data

2.3 FENDL/A-1.1

To enable realistic activation calculations to be performed by users the FENDL activation library should be as complete as possible (i.e., containing at least all target nuclides with T(1/2) > 10 days and all reactions energetically possible for En < 20 MeV). In order to achieve this in reasonable time, all reactions data from the European Activation File version 2 (EAF-2) in pointwise form were made available by J.Kopecky at the IAEA/NDS in the middle of 1992. After analysis and minor corrections these EAF-2 data were converted to ENDF-6 format and combined with the above FENDL/A-1 (revised) sublibrary. Resulting from this the revised and extended FENDL/A-1.1 pointwise activation library has been released in April 1993.

(3) Summary of Contents

The FENDL/A-1.1 file containts pointwise data for all stable and unstable target nuclides with half-lives longer than 1/2 day. If a reaction produces isomers the cross sections for the ground- and isomer-state are given separately. The FENDL/A-1.1 includes 636 target nuclides with about 11,000 reactions with non-zero cross sections below 20 MeV. List of target nuclides is given as Appendix 2.

The basic pointwise data library has a size of 75 Megabytes, i.e. 146265 blocks (1 block = 512 bytes).

It should be emphasized that this library containts evaluated neutron activation cross sections selected from existing activation data files. In assembling this library, no additional evaluation work was performed in order to improve evaluations; only existing evaluations were considered for inclusion. Therefore, in many cases the data given are theoretical estimates without experimental verification so that the data uncertainty may be significantly lower than for those evolved from careful evaluation.

(4) Format

The format of the FENDL/A-1.1 file is essentially that of MF-3 file of ENDF-6 format with the following deviations:

(a) The material number MAT consists of Z and two last digits of A. To describe metastable targets MAT has been increased by 50 or 70 (m1 or m2, respectively). For example, for stable and m1 metastable target nucleus 67-Ho-166 the material numbers are MAT=6766 and MAT=6816, respectively. For stable and m2 metastable target nucleus 65-Tb-156 the material numbers are MAT=6556 and 6626, respectively. Consequently, the order of the target nuclides (according to increasing MAT numbers) is not always in accordance with the increasing Z and A.

(b) The reaction nomenclature is that of ENDF format, except that reaction numbers leading to metastable states have been increased with 300 and 600 (for m1 and m2, respectively). The MT numbers which occur are listed below.

MT		Reaction	MT		Reaction	
4	=	(n,n)	304	=	(n,n)*	1st isomer production
16	=	(n,2n)	316	=	(n,2n)*	1t isomer production
			616	=	(n,2n)#	2nd isomer production
17	=	(n,3n)	317	=	(n,3n)*	1st isomer production
22	=	(n,nα)	322	=	(n,nα)*	1st isomer production
			622	=	(n,nα)#	2nd isomer production
28	=	(n,np)	328	=	(n,np)*	1st isomer production
			628	=	(n,np)#	2nd isomer production
32	=	(n,nd)				
33	=	(n,nt)				
34	=	(n,nHe3)				
102	=	(n,γ)	402	=	(n,γ)*	1st isomer production
			702	=	(n,γ)#	2nd isomer production
103	=	(n,p)	403	=	(n,p)*	1st isomer production
			703	=	(n,p)#	2nd isomer production

MT		Reaction	MT		Reaction	
104	=	(n,d)	404	=	(n,d)*	1st isomer production
			704	=	(n,d)#	2nd isomer production
105	=	(n,t)				
106	=	(n,He3)				
107	=	(n,α)	407	=	(n,α)*	1st isomer production
			707	=	(n,α)#	2nd isomer production
111	=	(n,2p)				

The cross sections for one material number are ordered according to increasing MT numbers;

(5) Availability

The files are available from the IAEA Nuclear Data Section online through INTERNET. The file transfer via INTERNET can be performed by FTP command to the address:

IAEAND.IAEA.OR.AT
or 161.5.2.2

The user should logon with the user name 'FENDL'. No password is required. After having logged on the user should go to the subdirectory

'[FENDLA.FENDLP]'

to see the index of reactions included in FENDLPA.INDEX file and obtain the available data files.

Because of the huge size of the library the file was divided into 9 subfiles of a convenient size adequate for FTP transfer :

FENDLP1.DAT	Isotopes of 1-H-1	to 26-Fe-56
FENDLP2.DAT	Isotopes of 26-Fe-57	to 31-Ga-66
FENDLP3.DAT	Isotopes of 31-Ga-67	to 42-Mo-97
FENDLP4.DAT	Isotopes of 42-Mo-98	to 50-Sn-113
FENDLP5.DAT	Isotopes of 50-Sn-114	to 54-Xe-133
FENDLP6.DAT	Isotopes of 54-Xe-134	to 63-Eu-152
FENDLP7.DAT	Isotopes of 63-Eu-153	to 70-Yb-171
FENDLP8.DAT	Isotopes of 70-Yb-172	to 76-Os-190
FENDLP9.DAT	Isotopes of 76-Os-191	to 84-Po-210

(6) Processing of FENDL/PA-1.1

6.1 FENDL/GA-1.1 groupwise data file

All materials that are represented in the FENDL/A-1.1 library have been processed at the NDS into 175 Vitamin-J multigroup form with a flat weighting spectrum using the GROUPIE pre-processing code and cast in ENDF/B-6 histogram format.

The user should go to the subdirectory

'[FENDL.FENDLG]'

to see index of reactions included in FENDLGA.INDEX file and obtain the groupwise activation cross section data file FENDL/GA-1.1.

Groupwise data file has a size of 20 Megabytes, i.e. 38666 blocks.

6.2 FENDL/A-MCNP and FENDL/A-175G processed data files

The processing of the FENDL/A-1.1 data files for input to computer calculations for ITER EDA applications has been carried out by F.M. Mann et al. of Westinghouse Hanford Company. The pointwise data library was processed into two formats:

- continuous energy format as used by the Monte Carlo neutron/photon transport code MCNP: '**FENDL/PA-1.1-MCNP**';

- ASCII 175-group multigroup format as used by transmutation code REAC*2/3: '**FENDL/PA-1.1-175G**'.

These data files are indexed, together with the description of the processing, in the report:

F.M.Mann, D.E.Lessor, L.L.Carter, 'Processing of FENDL-PA/1.1, Report WHC-EP-0727, Westinghouse Hanford Company, Richland, Washington, USA, Feb. 1994, (Revised in January 1995).

See also the IAEA-NDS-168 document, Rev. 2, February 1995, 'FENDL/A-MCNP and FENDL/A-175G. The processed neutron activation data files of the FENDL project'.

The user should go to the sublibrary

'[FENDLA.MANN.MCNP]'

to obtain the MCNP compartible processed activation data.

Because of the large size (96 Megabytes) of the MCNP processed files the resulting processed library was divided into 8 sections:

1. Isotopes of elements	1-H to 21-Sc
2. Isotopes of elements	22-Ti to 22-Zn
3. Isotopes of elements	31-Ga to 39-Y
4. Isotopes of elements	40-Zr to 46-Pd
5. Isotopes of elements	47-Ag to 52-Te
6. Isotopes of elements	53-I to 62-Sm
7. Isotopes of elements	63-Eu to 62-Lu
8. Isotopes of elements	72-Hf to 84-Po

The ASCII files 'actxs1.zz' contain pointers and continuous energy cross-section values for MCNP. The data suffix used is '.66y' for those targets in the ground state and '.67y' for those targets in isomeric state. The use of different suffixes follows the convention established by Los Alamos National Laboratory (LANL).

The ASCII files 'xsdir.zz' contain directory information for MCNP and indexes of reactions are given in 'out.zz' ASCII files. The section suffix '.zz' indicates the range of isotopes in the above data sets: HSC, TIZN, GAY, ZRPD, AGTE, ISM, EULU, HFPO.

The subdirectory

'[FENDLA.MANN.GROUP]'

provides the multigroup data in REAC format in 175 group structure. The resulting processed library in ASCII format, which has a size of 53109 blocks, was also divided in to 8 sections 'zz.175'. The '.zz' is a section suffix indicating the range of isotopes in the cross section set: CEEU, GAMO, GDLU, H1ZN, HFOS, IRPO, SBLA, TCSN. Index of reactions is in CROSS175.OUT file.

The FORTRAN and header files to convert the groupwise files to FISPACT and RACC are in the subdirectory

'[FENDLA.MANN.PROG]'

Additional information on the processed files may be obtained from

Dr. F.M. Mann
Westinghouse Hanford Company
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Richland, WA 99352, U.S.A.

Fax: 1-509-376-1293
Phone: 1-509-376-5728
E-mail: u1635@c.nersc.gov

(7) **FENDL/D decay data library**

Complementing to the activation cross section library is the ENDF/B-VI formatted decay data library (Ref.: IAEA-NDS-167 document, January 1995) supplied to NDS by F.Mann which is based on ENDF/B-VI and ENSDF decay data files. It contains decay properties (decay type, decay energy, half-life) of approximately 2900 nuclides and isomers.

FENDL/D decay data library are available as data file 'MANNDD.DAT' in the NDS open area 'FENDL' under the subdirectory

'[FENDL.FENDLD]'

It has a size of 27 Megabytes.

See also 'AAREADME.TXT' file in there for further information.

References

[1] Proceedings of the IAEA Specialists' Meeting on Fusion Evaluated Nuclear Data Library (FENDL), Vienna, 8-11 May 1989, Report INDC(NDS)-223, August 1989, V. Goulo.

[2] Summary report of the IAEA Consultants' Meeting on the First Results of FENDL-1 Testing and Start of FENDL-2, Vienna, 25-28 June 1990, Report INDC(NDS)-241, October 1990, prepared by A.B. Pashchenko.

[3] Summary report of the Advisory Group Meeting on FENDL-2 and Associated Benchmark Calculations, Vienna, 18-22 November 1991, Report INDC(NDS)-260, March 1992, prepared by A.B. Pashchenko.

Appendix 1

LIST OF 256 ACTIVATION REACTIONS IMPORTANT FOR FUSION APPLICATIONS

Following the recommendation of the IAEA Specialists' meeting on Fusion Evaluated Nuclear Data Library (FENDL) held in Vienna from 8 to 11 May 1989, the Working Group on Neutron Activation Data initiated an intercomparison of activation cross sections important for fusion reactor technology. It was agreed that national nuclear data centers and research laboratories will send to the NDS their contributions, according to a list of reactions selected on the basis of inventory calculations.

A list of 256 important reactions that are significant in producing activation both at short and long cooling times has been compiled by R. Forrest at the Harwell Laboratory, UKAEA. The list was distributed to all interested parties and in response to this many activation data files have been recieved at the NDS from institutes participating in this exercise. Very detailed graphical intercomparisons have been prepared at the NDS, plotting, for each reaction, overlays of the various submitted evaluated data sets and experimental data from EXFOR. The list of 256 important reactions is given below.

KEY FOR THE FOLLOWING TABLE

The sources of the reactions are:

1	-	R.A. Forrest and D.A.J. Endacott AERE R-13402
2	-	E. Cheng Private Communication (REAC2)
3	-	C. Ponti Long-Lived Products (see ECN-207)
4	-	C. Ponti Short-Lived Products (Priv. Comm.)
5	-	A. Khursheed PhD Thesis

Under the column Target S = Stable target, otherwise the half-life of the target is given.

Under the column Reaction & indicates the sum of cross sections forming all isomeric states. If particular isomeric products are required these are shown by:

^{g} ground state, ^{m} 1st isomer, ^{n} 2nd isomer

For reference the half-lives of the isomers are shown below:

^{108m}Ag 127y	^{152g}Eu 13.3y
^{110m}Ag 250d	^{166m}Ho 1200y
^{113m}Cd 14.1y	^{178n}Hf 31y
^{117m}Sn 14.0d	^{177g}Lu 6.7d
^{119m}Sn 293d	^{180m}Ta 8.1h
^{121m}Sn 50y	^{186m}Re 0.2My
^{123m}Sn 40.1m	^{192n}Ir 240y
^{123m}Te 119.7d	^{195m}Hg 1.7d
^{150m}Eu 34.2y	^{204m}Pb 1.1h

Reactions Important for Activation

Number	Reaction	Target	Source
1	$^{11}B(n,d)$	s	5
2	$^{13}C(n,g)$	s	1,4,5
3	$^{13}C(n,a)$	s	1,5
4	$^{14}C(n,na)$	5730y	1
5	$^{14}N(n,p)$	s	2,3
6	$^{14}N(n,d)$	s	5
7	$^{14}N(n,np)$	s	5
8	$^{16}O(n,a)$	s	1
9	$^{17}O(n,a)$	s	1,5
10	$^{17}O(n,na)$	s	1
11	$^{20}Ne(n,a)$	s	1,5
12	$^{23}Na(n,a)$	s	1,5
13	$^{24}Mg(n,p)$&	s	4
14	$^{24}Mg(n,na)$	s	1,5
15	$^{26}Mg(n,g)$	s	1
16	$^{27}Al(n,2n)$&	s	1,3,5
17	$^{27}Al(n,a)$&	s	5
18	$^{27}Al(n,na)$	s	5
19	$^{28}Si(n,na)$	s	1
20	$^{28}Si(n,np)$	s	1,5
21	$^{28}Si(n,d)$	s	1,5
22	$^{30}Si(n,g)$	s	1,4,5
23	$^{31}Si(n,g)$	2.6h	1,5
24	$^{31}P(n,g)$	s	1,5
25	$^{32}P(n,p)$	14,3d	1,5
26	$^{34}S(n,g)$	s	4
27	$^{34}S(n,a)$	s	4
28	$^{35}Cl(n,a)$	s	4
29	$^{35}Cl(n,p)$	s	4
30	$^{37}Ar(n,np)$	35d	5
31	$^{37}Ar(n,d)$	35d	5
32	$^{40}Ar(n,g)$	s	4
33	$^{40}Ar(n,2n)$	s	1
34	$^{39}K(n,p)$	s	3,5
35	$^{39}K(n,a)$	s	5
36	$^{41}K(n,p)$	s	4

Number	Reaction	Target	Source
37	$^{40}Ca(n,a)$	S	5
38	$^{40}Ca(n,2p)$	S	5
39	$^{40}Ca(n,g)$	S	5
40	$^{40}Ca(n,np)$	S	3,5
41	$^{40}Ca(n,d)$	S	3,5
42	$^{42}Ca(n,2n)$	S	1
43	$^{42}Ca(n,a)$	S	1,3,5
44	$^{43}Ca(n,2n)$	S	1
45	$^{43}Ca(n,na)$	S	1
46	$^{43}Ca(n,2p)$	S	5
47	$^{44}Ca(n,2n)$	S	1
48	$^{44}Ca(n,a)$	S	4
49	$^{44}Ca(n,na)$	S	1
50	$^{44}Ca(n,g)$	S	4
51	$^{45}Ca(n,a)$	163d	1,3,5
52	$^{46}Ca(n,na)$	S	1,5
53	$^{46}Ca(n,g)$	S	4
54	$^{48}Ca(n,2n)$	S	4
55	$^{45}Sc(n,a)$	S	1
56	$^{45}Sc(n,p)$	S	1,4
57	$^{45}Sc(n,g)$&	S	4
58	$^{46}Sc(n,na)$	83d	1
59	$^{45}Ti(n,2n)$	3h	5
60	$^{46}Ti(n,a)$	S	1,5
61	$^{46}Ti(n,np)$&	S	1
62	$^{46}Ti(n,d)$&	S	1
63	$^{46}Ti(n,2n)$	S	5
64	$^{47}Ti(n,a)$	S	1
65	$^{47}Ti(n,2n)$	S	1,5
66	$^{48}Ti(n,a)$	S	1,3,5
67	$^{49}Ti(n,a)$	S	1,5
68	$^{49}V(n,a)$&	330d	1
69	$^{51}V(n,a)$	S	1,5
70	$^{51}V(n,na)$	S	1
71	$^{50}Cr(n,a)$	S	1,5
72	$^{50}Cr(n,na)$	S	1,5
73	$^{50}Cr(n,g)$	S	4

Number	Reaction	Target	Source
74	$^{50}Cr(n,np)$	S	1
75	$^{50}Cr(n,d)$	S	1
76	$^{52}Cr(n,a)$	S	1,5
77	$^{54}Cr(n,g)$	S	1
78	$^{54}Mn(n,2n)$	312d	1,5
79	$^{55}Mn(n,2n)$	S	1,5
80	$^{55}Mn(n,g)$	S	1,5
81	$^{54}Fe(n,np)$	S	1,5
82	$^{54}Fe(n,d)$	S	1,5
83	$^{56}Fe(n,g)$	S	1,5
84	$^{56}Fe(n,2n)$	S	5
85	$^{57}Fe(n,g)$	S	1,5
86	$^{58}Fe(n,g)$	S	1,5
87	$^{59}Fe(n,g)$	45d	1,4
88	$^{58}Co(n,g)$	71d	1
89	$^{59}Co(n,g)$&	S	1,3,5
90	$^{60}Co(n,p)$	5.3y	1,2
91	$^{60}Co(n,g)$	5.3y	1,5
92	$^{58}Ni(n,p)$&	S	1
93	$^{58}Ni(n,g)$	S	1,2,3,5
94	$^{58}Ni(n,2n)$	S	4
95	$^{58}Ni(n,np)$	S	4
96	$^{58}Ni(n,d)$	S	4
97	$^{60}Ni(n,2n)$	S	1,2,3,5
98	$^{60}Ni(n,p)$&	S	1,3,5
99	$^{60}Ni(n,np)$	S	1
100	$^{60}Ni(n,d)$	S	1
101	$^{61}Ni(n,g)$	S	1,5
102	$^{62}Ni(n,g)$	S	1,2,5
103	$^{62}Ni(n,a)$	S	4
104	$^{63}Ni(n,a)$	100y	1
105	$^{64}Ni(n,2n)$	S	1,2,5
106	$^{63}Cu(n,p)$	S	1,2,3,5
107	$^{63}Cu(n,g)$	S	4
108	$^{63}Cu(n,a)$&	S	1,3,5
109	$^{64}Zn(n,2n)$	S	1
110	$^{64}Zn(n,p)$	S	1,4

Number	Reaction	Target	Source
111	$^{64}Zn(n,na)$	S	1
112	$^{64}Zn(n,2p)$	S	1
113	$^{64}Zn(n,np)$	S	1
114	$^{64}Zn(n,d)$	S	1
115	$^{64}Zn(n,g)$	S	4
116	$^{66}Zn(n,a)$	S	1
117	$^{66}Zn(n,2n)$	S	4
118	$^{92}Zr(n,g)$	S	1,5
119	$^{93}Zr(n,a)$	1.5My	1,5
120	$^{94}Zr(n,2n)$	S	1,2,5
121	$^{94}Zr(n,na)$	S	1,5
122	$^{94}Zr(n,g)$	S	1,4,5
123	$^{96}Zr(n,2n)$	S	1,5
124	$^{92}Nb(n,2n)$ &	36My	1
125	$^{93}Nb(n,2n)$ &	S	1,2
126	$^{93}Nb(n,p)$	S	1,2
127	$^{93}Nb(n,g)$ &	S	1,2,3,5
128	$^{95}Nb(n,2n)$ &	35d	1,2,5
129	$^{92}Mo(n,2n)$ &	S	1,2,5
130	$^{92}Mo(n,g)$ &	S	1,5
131	$^{92}Mo(n,np)$ &	S	1,5
132	$^{92}Mo(n,d)$ &	S	1,5
133	$^{94}Mo(n,p)$ &	S	1,2,3,5
134	$^{94}Mo(n,2n)$ &	S	3
135	$^{95}Mo(n,np)$ &	S	1
136	$^{95}Mo(n,d)$ &	S	1,3
137	$^{98}Mo(n,g)$	S	1,2,4,5
138	$^{100}Mo(n,2n)$	S	1,2,5
139	$^{103}Rh(n,g)$ &	S	1
140	$^{103}Rh(n,na)$ &	S	1
141	$^{104}Pd(n,g)$	S	1
142	$^{105}Pd(n,g)$	S	1
143	$^{106}Pd(n,g)$ &	S	1
144	$^{107}Pd(n,g)$	6.5My	1
145	$^{108}Pd(n,g)$ &	S	1
146	$^{107}Ag(n,g)^{m}$	S	1,3,5
147	$^{107}Ag(n,p)$ &	S	1

Number	Reaction	Target	Source
148	$^{107}Ag(n,2n)$&	S	1
149	$^{109}Ag(n,2n)^m$	S	1,2,3,5
150	$^{109}Ag(n,g)^m$	S	4,5
151	$^{110}Cd(n,g)$&	S	5
152	$^{111}Cd(n,g)$	S	5
153	$^{112}Cd(n,g)^m$	S	5
154	$^{112}Sn(n,a)$	S	5
155	$^{116}Sn(n,a)^m$	S	5
156	$^{117}Sn(n,n')^m$	S	4
157	$^{119}Sn(n,n')^m$	S	4
158	$^{120}Sn(n,g)^m$	S	1,4,5
159	$^{122}Sn(n,g)^m$	S	1,4,5
160	$^{124}Sn(n,g)$	S	5
161	$^{125}Sn(n,g)$	S	1,5
162	$^{121}Sb(n,p)^m$	S	1,4
163	$^{121}Sb(n,g)$	S	1
164	$^{121}Sb(n,2n)$	S	1
165	$^{123}Sb(n,g)$&	S	1
166	$^{123}Sb(n,2n)$&	S	1
167	$^{124}Sb(n,g)$	60d	1,5
168	$^{125}Sb(n,p)$&	2.7y	1
169	$^{126}Sb(n,p)$&	12.4d	1
170	$^{122}Te(n,g)^m$	S	1
171	$^{136}Cs(n,g)$	13d	5
172	$^{137}Ba(n,p)$	S	5
173	$^{139}La(n,a)$&	S	5
174	$^{139}La(n,h)$	S	5
175	$^{140}Ce(n,2n)$&	S	5
176	$^{140}Ce(n,a)$&	S	5
177	$^{148}Nd(n,g)$	S	5
178	$^{150}Nd(n,g)$	S	5
179	$^{150}Nd(n,2n)$	S	5
180	$^{150}Sm(n,g)$	S	5
181	$^{151}Sm(n,g)$	90y	5
182	$^{152}Sm(n,g)$	S	5
183	$^{152}Sm(n,2n)$	S	5
184	$^{151}Eu(n,g)$&	S	5

Number	Reaction	Target	Source
185	$^{151}Eu(n,2n)^m$	S	2,3,5
186	$^{152}Eu(n,g)$	13.3y	5
187	$^{153}Eu(n,g)$&	S	5
188	$^{153}Eu(n,2n)^g$	S	2,5
189	$^{154}Eu(n,g)$	8.6y	5
190	$^{158}Gd(n,g)$	S	3
191	$^{160}Gd(n,2n)$	S	3
192	$^{159}Tb(n,2n)$&	S	3,5
193	$^{158}Dy(n,p)$&	S	2
194	$^{165}Ho(n,2n)$&	S	1
195	$^{165}Ho(n,g)^m$	S	1,2,3,5
196	$^{166}Ho(n,n')^m$	1.1d	3
197	$^{164}Er(n,2n)$	S	1
198	$^{177}Hf(n,g)^n$	S	1,3,5
199	$^{178}Hf(n,n')^n$	S	1,3,5
200	$^{178}Hf(n,2n)$&	S	1
201	$^{178}Hf(n,g)^n$	S	4
202	$^{179}Hf(n,n')^n$	S	4
203	$^{179}Hf(n,2n)^n$	S	1,2,3,5
204	$^{180}Hf(n,2n)^n$	S	4
205	$^{180}Hf(n,g)$	S	1
206	$^{180}Hf(n,3n)^n$	S	1
207	$^{181}Hf(n,g)$&	42.4d	1,5
208	$^{179}Ta(n,2n)$&	1.8y	1
209	$^{181}Ta(n,na)^g$	S	1,5
210	$^{181}Ta(n,2n)^m$	S	1
211	$^{181}Ta(n,g)$&	S	1,4,5
212	$^{181}Ta(n,t)^n$	S	3
213	$^{181}Ta(n,nd)^n$	S	3
214	$^{182}Ta(n,p)$&	115d	1
215	$^{182}Ta(n,g)$	115d	1,5
216	$^{180}W(n,2n)$&	S	1,3
217	$^{182}W(n,a)^n$	S	3
218	$^{182}W(n,na)^n$	S	1,2,3,5
219	$^{182}W(n,g)$&	S	1,5
220	$^{183}W(n,g)$	S	1,5
221	$^{184}W(n,g)$&	S	1,3,5

Number	Reaction	Target	Source
222	^{186}W(n,g)	S	1,3,5
223	^{186}W(n,na)&	S	2
224	^{185}Re(n,g)^{m}	S	1,2,3,5
225	^{187}Re(n,2n)^{m}	S	1,2,3,5
226	^{187}Re(n,g)&	S	1,4
227	^{188}Os(n,g)&	S	1,4,5
228	^{188}Os(n,p)&	S	4
229	^{189}Os(n,g)&	S	1,4,5
230	^{190}Os(n,g)&	S	1,3,5
231	^{190}Os(n,a)	S	1
232	^{192}Os(n,g)	S	3
233	^{192}Os(n,2n)&	S	3
234	^{191}Ir(n,g)^{n}	S	1,2,3,5
235	^{191}Ir(n,na)	S	1
236	^{191}Ir(n,2n)&	S	1
237	^{192}Ir(n,n')^{n}	74d	1,5
238	^{193}Ir(n,2n)^{n}	S	1,2,3,5
239	^{192}Pt(n,g)&	S	1,4,5
240	^{194}Pt(n,2n)&	S	1,4,5
241	^{197}Au(n,a)&	S	1
242	^{197}Au(n,2n)&	S	1
243	^{195m}Hg(n,2n)	1.7d	1
244	^{196}Hg(n,2n)^{m}	S	1
245	^{203}Tl(n,2n)	S	4
246	^{204}Pb(n,p)	S	4
247	^{204}Pb(n,t)	S	4
248	^{204}Pb(n,2n)&	S	4
249	^{204}Pb(n,n')^{m}	S	4
250	^{206}Pb(n,2n)	S	1,3,5
251	^{206}Pb(n,a)	S	4
252	^{208}Pb(n,g)	S	1,3,5
253	^{208}Bi(n,2n)	0.37My	1,3,5
254	^{209}Bi(n,2n)	S	1,2,3,5
255	^{209}Bi(n,g)	S	1,3,5
256	^{210}Po(n,2n)	138d	1

Appendix 2

Library title: FENDL/A-1.1 pointwise activation library

List of isotopes in FENDL/A-1.1

Number	Isotope	Number of reactions
1	H-1	2
2	H-2	3
3	H-3	6
4	He-3	6
5	Li-6	9
6	Li-7	8
7	Be-9	14
8	Be-10	8
9	B-10	16
10	B-11	12
11	C-12	10
12	C-13	13
13	C-14	10
14	N-14	17
15	N-15	15
16	O-16	15
17	O-17	18
18	O-18	15
19	F-19	17
20	Ne-20	16
21	Ne-21	17
22	Ne-22	14
23	Na-22	18
24	Na-23	19
25	Mg-24	17
26	Mg-25	19
27	Mg-26	17
28	Al-26	20
29	Al-27	20
30	Si-28	17
31	Si-29	17
32	Si-30	16

Number	Isotope	Number of reactions
33	Si-31	16
34	Si-32	14
35	P-31	18
36	P-32	18
37	P-33	18
38	S-32	18
39	S-33	18
40	S-34	17
41	S-35	18
42	S-36	18
43	Cl-35	19
44	Cl-36	19
45	Cl-37	20
46	Ar-36	20
47	Ar-37	18
48	Ar-38	18
49	Ar-39	22
50	Ar-40	21
51	Ar-41	20
52	Ar-42	16
53	K-39	21
54	K-40	20
55	K-41	20
56	K-42	20
57	K-43	19
58	Ca-40	20
59	Ca-41	18
60	Ca-42	17
61	Ca-43	19
62	Ca-44	17
63	Ca-45	18
64	Ca-46	16
65	Ca-47	17
66	Ca-48	14
67	Sc-44m	21
68	Sc-45	21
69	Sc-46	20

Number	Isotope	Number of reactions
70	Sc-47	21
71	Sc-48	20
72	Ti-44	21
73	Ti-45	21
74	Ti-46	21
75	Ti-47	22
76	Ti-48	17
77	Ti-49	17
78	Ti-50	18
79	V-48	22
80	V-49	20
81	V-50	19
82	V-51	19
83	Cr-50	17
84	Cr-51	18
85	Cr-52	17
86	Cr-53	18
87	Cr-54	18
88	Mn-52	19
89	Mn-53	19
90	Mn-54	19
91	Mn-55	19
92	Fe-54	20
93	Fe-55	17
94	Fe-56	17
95	Fe-57	10
96	Fe-58	20
97	Fe-59	21
98	Fe-60	20
99	Co-55	23
100	Co-56	19
101	Co-57	20
102	Co-58	20
103	Co-59	22
104	Co-60	23
105	Ni-56	22
106	Ni-57	19

Number	Isotope	Number of reactions
107	Ni-58	20
108	Ni-59	20
109	Ni-60	21
110	Ni-61	23
111	Ni-62	22
112	Ni-63	23
113	Ni-64	21
114	Ni-65	19
115	Cu-63	22
116	Cu-64	22
117	Cu-65	20
118	Cu-67	20
119	Zn-64	19
120	Zn-65	19
121	Zn-66	20
122	Zn-67	20
123	Zn-68	21
124	Zn-70	23
125	Zn-72	22
126	Ga-67	19
127	Ga-69	22
128	Ga-71	25
129	Ge-68	19
130	Ge-69	19
131	Ge-70	20
132	Ge-71	21
133	Ge-72	24
134	Ge-73	23
135	Ge-74	23
136	Ge-76	23
137	As-71	19
138	As-72	19
139	As-73	21
140	As-74	22
141	As-75	24
142	As-76	24
143	As-77	23

Number	Isotope	Number of reactions
144	Se-72	20
145	Se-73	20
146	Se-74	21
147	Se-75	20
148	Se-76	24
149	Se-77	23
150	Se-78	23
151	Se-79	24
152	Se-80	23
153	Se-82	23
154	Br-77	22
155	Br-79	26
156	Br-81	25
157	Br-82	25
158	Kr-78	24
159	Kr-79	25
160	Kr-80	28
161	Kr-81	28
162	Kr-82	27
163	Kr-83	27
164	Kr-84	26
165	Kr-85	27
166	Kr-86	23
167	Rb-83	29
168	Rb-84	25
169	Rb-85	26
170	Rb-86	27
171	Rb-87	23
172	Sr-82	25
173	Sr-83	26
174	Sr-84	26
175	Sr-85	23
176	Sr-86	24
177	Sr-87	23
178	Sr-88	22
179	Sr-89	23
180	Sr-90	20

Number	Isotope	Number of reactions
181	Y-87	27
182	Y-88	26
183	Y-89	23
184	Y-90	25
185	Y-91	23
186	Zr-88	27
187	Zr-89	25
188	Zr-90	23
189	Zr-91	28
190	Zr-92	26
191	Zr-93	24
192	Zr-94	22
193	Zr-95	21
194	Zr-96	22
195	Nb-91	29
196	Nb-91m	29
197	Nb-92	29
198	Nb-92m	29
199	Nb-93	29
200	Nb-93m	29
201	Nb-94	28
202	Nb-95	25
203	Nb-95m	25
204	Mo-92	28
205	Mo 93	29
206	Mo-94	28
207	Mo-95	27
208	Mo-96	25
209	Mo-97	24
210	Mo-98	23
211	Mo-99	25
212	Mo-100	25
213	Tc-95	30
214	Tc-95m	30
215	Tc-96	11
216	Tc-97	27
217	Tc-97m	27

Number	Isotope	Number of reactions
218	Tc-98	27
219	Tc-99	24
220	Ru-96	27
221	Ru-97	27
222	Ru-98	25
223	Ru-99	24
224	Ru-100	22
225	Ru-101	22
226	Ru-102	21
227	Ru-103	21
228	Ru-104	21
229	Ru-105	20
230	Ru-106	19
231	Rh-99	27
232	Rh-99m	25
233	Rh-101	26
234	Rh-101m	25
235	Rh-102	25
236	Rh-102m	26
237	Rh-103	25
238	Rh-105	24
239	Pd-100	24
240	Pd-101	26
241	Pd-102	26
242	Pd-103	26
243	Pd-104	25
244	Pd-105	26
245	Pd-106	26
246	Pd-107	26
247	Pd-108	25
248	Pd-109	24
249	Pd-110	25
250	Ag-105	29
251	Ag-106m	29
252	Ag-107	28
253	Ag-108m	30
254	Ag-109	29

Number	Isotope	Number of reactions
255	Ag-110m	28
256	Ag-111	27
257	Cd-106	26
258	Cd-108	26
259	Cd-109	27
260	Cd-110	28
261	Cd-111	29
262	Cd-112	28
263	Cd-113	27
264	Cd-113m	27
265	Cd-114	27
266	Cd-115	28
267	Cd-115m	28
268	Cd-116	28
269	In-111	28
270	In-113	29
271	In-114m	29
272	In-115	30
273	Sn-112	28
274	Sn-113	28
275	Sn-114	28
276	Sn-115	28
277	Sn-116	29
278	Sn-117	30
279	Sn-117m	30
280	Sn-118	32
281	Sn-119	33
282	Sn-119m	33
283	Sn-120	32
284	Sn-121	33
285	Sn-121m	33
286	Sn-122	33
287	Sn-123	32
288	Sn-124	30
289	Sn-125	29
290	Sn-126	27
291	Sb-119	31

Number	Isotope	Number of reactions
292	Sb-120m	32
293	Sb-121	32
294	Sb-122	33
295	Sb-123	33
296	Sb-124	31
297	Sb-125	31
298	Sb-126	31
299	Sb-127	29
300	Te-118	28
301	Te-119	28
302	Te-119m	28
303	Te-120	27
304	Te-121	29
305	Te-121m	29
306	Te-122	29
307	Te-123	31
308	Te-123m	31
309	Te-124	29
310	Te-125	28
311	Te-125m	28
312	Te-126	29
313	Te-127	29
314	Te-127m	29
315	Te-128	28
316	Te-129	29
317	Te-129m	29
318	Te-130	29
319	Te-131m	31
320	Te-132	30
321	I-124	27
322	I-125	26
323	I-126	25
324	I-127	26
325	I-128	26
326	I-129	26
327	I-130	27
328	I-131	27

Number	Isotope	Number of reactions
329	Xe-124	22
330	Xe-125	23
331	Xe-126	23
332	Xe-127	24
333	Xe-128	23
334	Xe-129	23
335	Xe-129m	23
336	Xe-130	24
337	Xe-131	25
338	Xe-131m	25
339	Xe-132	26
340	Xe-133	28
341	Xe-133m	28
342	Xe-134	29
343	Xe-136	26
344	Cs-129	22
345	Cs-131	23
346	Cs-132	23
347	Cs-133	25
348	Cs-134	28
349	Cs-135	30
350	Cs-136	30
351	Cs-137	28
352	Ba-128	22
353	Ba-129	23
354	Ba-130	23
355	Ba-131	24
356	Ba-132	23
357	Ba-133	23
358	Ba-133m	23
359	Ba-134	24
360	Ba-135	28
361	Ba-135m	28
362	Ba-136	30
363	Ba-137	30
364	Ba-138	27
365	Ba-139	24

Number	Isotope	Number of reactions
366	Ba-140	21
367	La-137	28
368	La-138	28
369	La-139	25
370	La-140	22
371	La-141	20
372	Ce-136	24
373	Ce-137m	27
374	Ce-138	27
375	Ce-139	25
376	Ce-140	22
377	Ce-141	21
378	Ce-142	19
379	Ce-143	19
380	Ce-144	19
381	Pr-141	22
382	Pr-142	22
383	Pr-143	21
384	Nd-140	26
385	Nd-141	24
386	Nd-142	22
387	Nd-143	24
388	Nd-144	22
389	Nd-145	22
390	Nd-146	21
391	Nd-147	20
392	Nd-148	20
393	Nd-149	21
394	Nd-150	21
395	Pm-143	22
396	Pm-144	22
397	Pm-145	21
398	Pm-146	21
399	Pm-147	21
400	Pm-148	21
401	Pm-148m	21
402	Pm-149	21

Number	Isotope	Number of reactions
403	Pm-150	21
404	Pm-151	22
405	Sm-144	21
406	Sm-145	22
407	Sm-146	19
408	Sm-147	20
409	Sm-148	20
410	Sm-149	21
411	Sm-150	21
412	Sm-151	20
413	Sm-152	21
414	Sm-153	23
415	Sm-154	24
416	Eu-145	21
417	Eu-146	21
418	Eu-147	19
419	Eu-148	20
420	Eu-149	21
421	Eu-150	22
422	Eu-150m	22
423	Eu-151	23
424	Eu-152	24
425	Eu-152m	23
426	Eu-153	24
427	Eu-154	24
428	Eu-155	23
429	Eu-156	23
430	Eu-157	22
431	Gd-146	20
432	Gd-147	22
433	Gd-148	20
434	Gd-149	20
435	Gd-150	20
436	Gd-151	22
437	Gd-152	23
438	Gd-153	24
439	Gd-154	24

Number	Isotope	Number of reactions
440	Gd-155	23
441	Gd-156	21
442	Gd-157	20
443	Gd-158	19
444	Gd-159	19
445	Gd-160	20
446	Tb-153	26
447	Tb-154	25
448	Tb-155	26
449	Tb-156	26
450	Tb-156m	26
451	Tb-157	23
452	Tb-158	23
453	Tb-159	20
454	Tb-160	20
455	Tb-161	19
456	Dy-154	24
457	Dy-155	25
458	Dy-156	25
459	Dy-157	25
460	Dy-158	24
461	Dy-159	23
462	Dy-160	21
463	Dy-161	20
464	Dy-162	19
465	Dy-163	19
466	Dy-164	20
467	Dy-165	20
468	Dy-166	20
469	Ho-163	23
470	Ho-165	23
471	Ho-166	23
472	Ho-166m	23
473	Er-162	27
474	Er-164	25
475	Er-165	24
476	Er-166	25

Number	Isotope	Number of reactions
477	Er-167	24
478	Er-168	22
479	Er-169	22
480	Er-170	21
481	Er-171	21
482	Er-172	21
483	Tm-165	24
484	Tm-166	23
485	Tm-167	23
486	Tm-168	23
487	Tm-169	22
488	Tm-170	21
489	Tm-171	20
490	Tm-172	20
491	Yb-166	21
492	Yb-168	21
493	Yb-169	21
494	Yb-170	21
495	Yb-171	21
496	Yb-172	19
497	Yb-173	19
498	Yb-174	19
499	Yb-175	20
500	Yb-176	21
501	Lu-169	23
502	Lu-170	25
503	Lu-171	25
504	Lu-172	23
505	Lu-173	22
506	Lu-174	21
507	Lu-174m	21
508	Lu-175	21
509	Lu-176	23
510	Lu-177	25
511	Lu-177m	25
512	Hf-174	23
513	Hf-175	22

Number	Isotope	Number of reactions
514	Hf-176	24
515	Hf-177	28
516	Hf-178	32
517	Hf-178m	32
518	Hf-179	33
519	Hf-179m	33
520	Hf-180	29
521	Hf-180m	29
522	Hf-181	25
523	Hf-182	20
524	Ta-177	24
525	Ta-179	34
526	Ta-180	35
527	Ta-180m	35
528	Ta-181	32
529	Ta-182	28
530	Ta-183	24
531	W-178	23
532	W-180	29
533	W-181	30
534	W-182	29
535	W-183	29
536	W-184	27
537	W-185	24
538	W-186	21
539	W-187	20
540	W-188	20
541	Re-181	24
542	Re-182	23
543	Re-183	25
544	Re-184	26
545	Re-184m	26
546	Re-185	26
547	Re-186	26
548	Re-186m	26
549	Re-187	23
550	Re-188	22

Number	Isotope	Number of reactions
551	Re-189	21
552	Os-184	24
553	Os-185	24
554	Os-186	24
555	Os-187	24
556	Os-188	24
557	Os-189	25
558	Os-190	25
559	Os-191	26
560	Os-191m	26
561	Os-192	25
562	Os-193	22
563	Os-194	20
564	Ir-188	22
565	Ir-189	24
566	Ir-190	28
567	Ir-191	32
568	Ir-192	34
569	Ir-192m	34
570	Ir-193	33
571	Ir-193m	30
572	Ir-194	28
573	Ir-194m	28
574	Ir-196m	23
575	Pt-188	22
576	Pt-189	21
577	Pt-190	22
578	Pt-191	27
579	Pt-192	33
580	Pt-193	35
581	Pt-193m	35
582	Pt-194	33
583	Pt-195	30
584	Pt-195m	30
585	Pt-196	28
586	Pt-197	27
587	Pt-198	26

Number	Isotope	Number of reactions
588	Au-194	33
589	Au-195	34
590	Au-196	33
591	Au-197	31
592	Au-198	30
593	Au-198m	30
594	Au-199	28
595	Au-200m	27
596	Hg-193	26
597	Hg-193m	26
598	Hg-194	29
599	Hg-195	30
600	Hg-195m	30
601	Hg-196	32
602	Hg-197	32
603	Hg-198	31
604	Hg-199	29
605	Hg-200	26
606	Hg-201	25
607	Hg-202	24
608	Hg-203	21
609	Hg-204	17
610	Tl-200	27
611	Tl-201	24
612	Tl-202	22
613	Tl-203	20
614	Tl-204	20
615	Tl-205	21
616	Pb-202	24
617	Pb-203	25
618	Pb-204	23
619	Pb-205	22
620	Pb-206	22
621	Pb-207	23
622	Pb-208	23
623	Pb-209	23
624	Pb-210	21

Number	**Isotope**	**Number of reactions**
625	Bi-205	27
626	Bi-206	24
627	Bi-207	23
628	Bi-208	25
629	Bi-209	25
630	Bi-210	23
631	Bi-210m	23
632	Po-206	25
633	Po-207	26
634	Po-208	26
635	Po-209	24
636	Po-210	23

Attachment

DISTRIBUTION OF THE FENDL LIBRARY

(As recommended at the IAEA Advisory Group Meeting on FENDL,
held in Del Mar, California, 5-9 Dec.1995)

The master copy of the FENDL-1 library resides with the Nuclear Data Section of the International Atomic Energy Agency. To facilitate user access to the library the official copy of FENDL-1 was distributed in February 1996 to the major nuclear data centres in Europe (NEA Data Bank, Paris), Japan (JNDC, Tokai-mura), Russia (CJD,Obninsk) and USA (NNDC, Brookhaven and RSIC, Oak Ridge). As agreed between data centers, sharing common FENDL information, the recipients are receiving now the same products from all above centers. The data are available and may be further distributed to the user community according to the customer service options given below. Each FENDL sub-library will be in a single data set, i.e. Activation, Decay, etc. in the 8 mm tape, 6 mm tape, 4 mm tape or standard 9 track magnetic tape (6250 bpi or 1600 bpi) and CD-ROM options. The interested scientists may request FENDL-1 (or parts of it) directly from the IAEA/NDS or from one of these centers.

Table 1. FENDL CUSTOMER SERVICE OPTIONS

MEDIA	FORMAT	By WHOM
Electronic	FTP	IAEA, NEADB, NNDC
4 mm tape	UNIX TAR	CJD, IAEA, NEADB, NNDC, RSIC
	VAX BACKUP	CJD, IAEA, NEADB, NNDC
	ASCII	NEADB
6 mm tape	UNIX TAR	NEADB
	VAX BACKUP	NEADB
	ASCII	NEADB
8 mm tape	UNIX TAR	NEADB, NNDC, RSIC
	VAX BACKUP	NEADB, NNDC
	ASCII	NEADB
9 track	ASCII	CJD, IAEA
	EBCDIC	CJD, IAEA
CD-ROM	UNIX TAR	RSIC
	ASCII	NEADB

Table notes
1) NNDC will distribute FENDL unprocessed data
2) RSIC will distribute FENDL processed data
3) RSIC offers cost free service to ITER customers

FENDL SUMMARY

FENDL is the evaluated nuclear database for fusion applications. Its present version consists of the following sublibraries for which the documentation and the FTP subdirectory for online service are given below. At the ITER neutronics coordination meeting in San Diego, Feb. 1995, the ITER participants agreed to use FENDL in all design calculations.

1. **FENDL/A-1.1** (April 93): neutron activation cross-sections, selected from different available sources, for 636 nuclides, given in four representations:
   - FENDL/A: "point data", i.e. cross-sections as function of energy in ENDF-6 format (see IAEA-NDS-148, Rev. 2, Feb. 1995). FTP subdirectory: ACTIVATION.FENDLA
   - "MCNP": processed into the format for input to the MCNP Monte-Carlo transport code (see IAEA-NDS-168, Rev. 3, Feb. 1996). FTP subdirectory: ACTIVATION.PROCESSED.MCNP
   - "VITJ_E": VITAMIN-J 175 group data, processed for input to the code REAC*2/3 using the VITAMIN-E weighting spectrum (see IAEA-NDS-168, Rev. 3, Feb. 1996). FTP subdirectory: ACTIVATION.PROCESSED.VITJ_E
   - "VITJ-FLAT": VITAMIN-J 175 group data, processed using a flat weighting spectrum (see IAEA-NDS-148, Rev. 2, Feb. 1995). FTP subdirectory: ACTIVATION.PROCESSED.VITJ_FLAT
2. **FENDL/D-1.0** (Jan. 92): nuclear decay data for 2900 nuclides in ENDF-6 format, extracted from ENDF/B-6 and ENSDF (see IAEA-NDS-167, Jan. 1995). FTP subdirectory: DECAY.FENDLD
3. **FENDL/DS-1.0** (Oct. 93): neutron activation data for dosimetry by foil activation. This is identical with file 1 (neutron activation cross-sections) of the International Reactor Dosimetry File IRDF-90 version 2 of Oct. 1993 (see IAEA-NDS-141, Rev. 2, Oct. 1993), given as multigroup data in 640 group extended SAND-2 format, without covariance data. FTP subdirectory: DOSIMETRY.FENDLDS
4. **FENDL/C-1.0** (Nov. 91): data for the fusion reactions D(d,n), D(d,p), T(d,n), T(t,2n), He-3(d,p) extracted from ENDF/B-6 and processed (see IAEA-NDS-166, Jan. 1995). FTP subdirectories: FUSION.FENDLC and FUSION.PROCESSED
5. **FENDL/E-1.1** (Nov. 94): data for coupled neutron-photon transport calculations, including
   - a data library for neutron interaction and photon production for 63 elements or isotopes, selected from ENDF/B-6, JENDL-3, or BROND-2 (see IAEA-NDS-128, Rev. 2, Feb. 1996)
   - a photon-atom interaction data library for 34 elements taken from ENDF/B-6 (see IAEA-NDS-58, Rev. 4, Sept. 1994)

   These are available in three representations:
   - original ENDF-6 format, as above, with resonance-parameters where applicable. FTP subdirectory: TRANSPORT.FENDLE
   - "FENDL/MG" (March 95): VITAMIN-J 175 group data in GENDF and MATXSR format processed by NJOY using the VITAMIN-E weighting spectrum (see IAEA-NDS-129, Rev. 3, Feb. 1996). FTP subdirectory: TRANSPORT.PROCESSED.FENDLMG
   - "FENDL/MC" (March 95): processed into the ACE format needed for input to the Monte Carlo code MCNP4A (see IAEA-NDS-169, Rev. 3, Feb. 1996). FTP subdirectory: TRANSPORT.PROCESSED.FENDLMC

FENDL BENCHMARKS

The FENDL/BENCHMARKS subdirectory contains compiled fusion benchmark descriptions and data, provided by the international community of benchmark specialists, for validation of the above mentioned FENDL libraries.

INTERNET/FTP online access to FENDL files

The FENDL data files can be electronically transferred to users from the IAEA Nuclear Data Section online system through INTERNET. In the NDS open area 'FENDL', a subdirectory was created for each sublibrary. The subdirectory names are given above. The file transfer via INTERNET (unix system) can be performed by 'ftp' command to the address 'iaeand.iaea.or.at' or '161.5.2.2'. The user should logon to the foreign user name 'FENDL'. No password is required. After having logged on, the user can set the definition to any required subdirectory and transfer files as desired. A grand total of 47 (sub)directories with 810 files with total size of nearly 2 million blocks or about 1 Gigabyte (1 block = 512 bytes) of numerical data is currently available on-line.