INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

IAEA-NDS-7
Rev. 97/12

Index of Nuclear Data Libraries

available from the IAEA Nuclear Data Section

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Abstract: This document lists more than 100 nuclear data libraries together with references that give more detailed information about these libraries. The data libraries include neutron cross-sections, resonance parameters, fission-product yields, nuclear structure and decay data, gamma-rays from radionuclides, data of nuclear reactions induced by charged particles or heavy ions, photonuclear data, photoatomic interaction data, and many others, partly with related data processing computer codes. All data and documentation references are available upon request from the IAEA Nuclear Data Section, free of charge on magnetic tape, PC diskettes, CD-ROM or online through WWW, Telnet (menu driven within the Nuclear Data Information System NDIS), or through FTP file transfer.

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username: ANONYMOUS for FTP file transfer
username: FENDL for FTP file transfer of FENDL files
For users with web-browsers: http://www-nds.iaea.or.at

Note:

The IAEA-NDS-reports should not be considered as formal publications. When a nuclear data library is sent out by the IAEA Nuclear Data Section, it will be accompanied by an IAEA-NDS-report which should give the data user all necessary documentation on contents, format and origin of the data library.

IAEA-NDS-reports are updated whenever there is additional information of relevance to the users of the data library.

For citations care should be taken that credit is given to the author of the data library and/or to the data center which issued the data library. The editor of the IAEA-NDS-report is usually not the author of the data library.

Neither the originator of the data libraries nor the IAEA assume any liability for their correctness or for any damages resulting from their use.

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Citation guidelines:

When quoting a computer-based data library in a publication it is recommended

- to give first the print reference in which the author(s) desribe(s) the generation of the data,
- to give thereafter the database reference which contains the numerical data, including the version of the database,
- and then to mention the data center or the online service from which the data were received.

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Index of Nuclear Data Libraries

available from the IAEA Nuclear Data Section

Introduction

This document gives a brief summary of available computerized data libraries. Please contact the IAEA Nuclear Data Section for any additional information you need. Magnetic tape or CD-ROM copies of entire data libraries or selective retrievals on tape or on diskettes or in printed form are available free of charge upon informal request.

The word **online** in the right-hand margin indicates that data of this type are included in NDIS, the IAEA online Nuclear Data Information System as described in chapter 36.

The characters **FTP** in the right-hand margin indicates that files can be downloaded through FTP as described in chapter 36.

The data libraries listed in this document are sorted as follows:

1. Neutron nuclear data, experimental

EXFOR **online**

Contents: All experimental neutron nuclear data and derived quantities such as resonance-parameters, etc. It also includes experimental fission-product yield data (which were earlier compiled in separate libraries: Crouch, Meek/Rider). Updated in monthly intervals. More than 3 million records. Computer retrievals available online, or on tape upon request.

Summary documentation: IAEA-NDS-1 Rev. 6.

Dictionaries (for data definition and abbreviations): updated quarterly, tape copy available.
Printed copy: IAEA-NDS-2. - The version of Jan. 1995 available as INIS microfiche.

Detailed documentation of format and compilation rules:
NDS EXFOR Manual, IAEA-NDS-3, Rev. 91/11.
NNDC Exfor Manual, IAEA-NDS-103, Rev. 89-1.
Compare V. McLane, "EXFOR Basics" - a short guide to the Nuclear Reaction Data Exchange Format, Report BNL-NCS-63380 (July 1996).

Graphical plotting of EXFOR data in a VMS operating system. See C.L. Dunford, "BNL325 Nuclear Reaction Data Display Program", report IAEA-NDS-72 (Nov. 1994).

Bibliography and data index: CINDA, published once a year. **online**
Computer retrievals available on request.

CINDA formats: IAEA-NDS-9 Rev. 1.
CINDA compiler's manual: IAEA-NDS-109, Rev. 90/2

CSISRS: This is identical to EXFOR. In the U.S. online system CSISRS (= Cross-Section Information Storage and Retrieval System) is used instead of the internationally used term EXFOR. Much of the contents of EXFOR (in its status of the 1980's) was published in the book Neutron Cross-Sections by S.F. Mughabghab et al., U.S. National Nuclear Data Center, Academic Press, vol. 1: Neutron Resonance-Parameters and Thermal Cross-Sections, Part A Z=1-60 (1981), Part B Z=61-100 (1984), vol. 2: Neutron Cross-Section Curves (1988).

Resonance-Integrals and thermal activation cross-sections, a compilation by E.M. Gryntakis 1986, available on tape and in printed form as IAEA-NDS-64.
See also Handbook on Nuclear Activation Data, IAEA Technical Report No. 273 (1987) p. 199.

Neutron Scattering Lengths, a compilation of experimental data and recommended values by L. Koester, H. Rauch, E. Seymann, published in Atomic Data and Nuclear Data Tables 49, 65-120, 1991. This is an update of the work first published under an IAEA contract in the report Jül-1755, Dec. 1981, now covering the literature up to the end of 1990. - A similar work was published earlier by V.F. Sears, report AECL-8490, June 1984. - For the 1981 version by Koester et al., see document IAEA-NDS-44, and a wall chart which was obtainable for 420.- Austrian Schillings from H. Bittermann, Atominstitut, Schüttelstraße 115, A-1020 Wien. The 1981 version is available on tape (internal code: NEUTSCATL), with 2 parts: 1. experimental data; 2. recommended values.

Old compilations of experimental neutron cross-section data can be found in

BNL-325, a report published in several editions and supplements from 1955 to 1976 by the U.S. National Nuclear Data Center, at that time called Sigma Center resp. National Neutron Cross-Section Center.

Musgrove library of strength-function data,
see CINDU-11 p. 41.

2. ENDF format for evaluated nuclear data files

The internationally agreed format for data files of evaluated nuclear reaction data is ENDF-6. The earlier versions ENDF-5, ENDF-4 may still be in use.

ENDF was designed primarily for neutron reaction data with allowance for related decay data, fission-product yield data, photo-atomic interaction data and others. ENDF-6 also permits the inclusion of data for nuclear reactions induced by photons and charged particles.

ENDF-6 Format Manual: Available as document IAEA-NDS-76 Rev. 5. This is a reprint of the report ENDF-102 edited by P.F. Rose and C.L. Dunford, July 1990, including several revisions up to June 1997.

Many of the ENDF formatted data are available in different formats

a) with resonance parameters;
b) resonance parameters replaced by point data by means of the code RECENT (or a similar code);
c) edited format, for easier legibility but not suitable for further computer processing; used mainly for printed listings of not too voluminous retrievals, but also data requested on magnetic tape can be provided in edited format.

ENDF-5 Format Manual: Available as document IAEA-NDS-75 Rev. 1. This is a reprint of the report BNL-NCS-50496 (ENDF-102) 2nd Edition Oct. 1979 by R. Kinsey, and updated with the report BNL-NCS-50496 (ENDF-102) 2nd Edition Revised Nov. 1983 by B.A. Magurno.
(Note: The report of Oct. 1979 by R. Kinsey exists as microfiche IAEA-NDS-10/102. The update pages of Nov. 1983 by B.A. Magurno exist as report IAEA-NDS-73.)
A brief introduction and summary of the ENDF format exists as document IAEA-NDS-10 Rev. 2.

ENDF-4 Format Manual: Available as document IAEA-NDS-74. This is a reprint of the report BNL-NCS-50496 (ENDF-102) revised by D. Garber, C. Dunford, S. Pearlstein, Oct. 1975.

3. ENDF data processing codes

The new ENDF data processing codes operate on ENDF-4, ENDF-5 and ENDF-6 formatted data files. Available from the IAEA Nuclear Data Section are:

ENDF Utility Codes from NNDC, version 6.10 for ENDF-6 (and ENDF-5). Included are the data checking codes CHECKER, FIZCON, PSYCHE; the code INTER for retrieving thermal cross-sections and some other data; graphical plotting subroutines PLOTEF, GRALIB, INTLIB; and the file maintenance and retrieval codes LISTEF, SETMDC, GETMAT, STANEF. This program package is designed for CDC, IBM, DEC and PC computers. **FTP**
See document IAEA-NDS-29 Rev. 7 dated Nov. 1995.

The **1996 ENDF Pre-Processing Codes** by D.E. Cullen ("PRE-PRO 96"). Included are the codes CONVERT, MERGER, LINEAR, RECENT, SIGMA1, LEGEND, FIXUP, GROUPIE, DICTION, MIXER, VIRGIN, COMPLOT, EVALPLOT, RELABEL, SIXPAK. Some of the functions of these codes are: to calculate cross-sections from resonance-parameters; to calculate angular distributions, group averages, mixtures of cross-sections, etc.; to produce graphical plottings and data comparisons. As of 1996 all calculations in double precision. Working on all computers for all versions of ENDF formats. **FTP**
See document IAEA-NDS-39 Rev. 9.
This is supplemented by the following codes:

- PLOTTAB (a general plotting program) by D.E. Cullen, see documents IAEA-NDS-82 and -83 of June 1987.
- "Red's Natural Editor" (a program designed to edit FORTRAN programs) by D.E. Cullen, see document IAEA-NDS-149.

PLOTC4: plot experimental data with or without related ENDF formatted data. See document IAEA-NDS-79 Rev. 1.

CONV45/CONV56: converting ENDF-4 to ENDF-5 and ENDF-5 to ENDF-6 format. See document IAEA-NDS-78.

INDXENDF: a PC code by R. Paviotti Corcuera et al., which indexes ENDF-6 formatted data files that are on the hard disk. See document IAEA-NDS-131.

Not available from IAEA:

NJOY: A system for processing ENDF formatted data files. See the report by R.E. MacFarlane "The NJOY nuclear data processing system, version 91", LA-12740-M (1994). For a summary see document IAEA-NDS-119. This code package must be requested from the

Radiation Shielding Information Centre (RSIC)
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN, USA-37831

GRUKON: For the code GRUKON developed and used in Obninsk, Russia, see the report INDC(CCP)-344. This code must be requested from the

NEA Data Bank
Computer Program Library
Le Seine Saint-Germain
12 blvd des Iles
F-92130 Issy-les-Moulineaux
France

4. Evaluated neutron nuclear data: Comprehensive libraries

Five recent comprehensive data libraries for evaluated neutron reaction data are available. These are supplemented by two data libraries (FENDL/E and EFF) that had been developed for fusion applications but, of course, can be used for other applications as well. For a combined index of these seven see document IAEA-NDS-107 Rev. 10.

BROND-2.2: USSR evaluated neutron data library, issued in 1992 in ENDF-6 format and updated in 1993. The library is available as basic data with resonance-parameters, and/or as point data where resonance-parameters have been converted to cross-sections. **online**
Summary documentation see IAEA-NDS-90 Rev. 8.

CENDL-2.1, Chinese evaluated neutron data library issued in 1991, updated and supplemented in 1993 and 1995 with some minor revisions in 1997, in ENDF-6 format. **online**
Summary documentation see IAEA-NDS-61, Rev. 4.

ENDF/B-6, the US evaluated nuclear data file released in 1990 in ENDF-6 format, with revisions released in 1991, 1993, 1995 and 1997. The library is available as basic data with resonance-parameters, and/or as point data where resonance-parameters have been converted to cross-sections. **online**
Also available compressed on a set of PC diskettes.
Summary documentation including information on a variety of specialized sublibraries, see IAEA-NDS-100 Rev. 7.
For selected cross-section point data files (PEND-B6) derived from ENDF/B-6 resonance parameter data files, for different temperatures, see document IAEA-NDS-130.

JEF-2.2, the evaluated nuclear data library of the OECD Nuclear Energy Agency finalized in 1992 and released in 1993, in ENDF-6 format. Available in original form with resonance-parameters, and/or as "point data" where resonance-parameters have been converted to cross-sections. **online**
Also available compressed on a set of PC diskettes.
Summary documentation see IAEA-NDS-120 Rev. 3.

JENDL-3.2, the Japanese evaluated nuclear data library released in 1989 and significantly updated in 1994, in ENDF-6 format. **online**
Summary documentation see IAEA-NDS-110 Rev. 5.
For the status of JENDL special purpose files see the report JAERI-M-91-032 (March 1991).
Also available compressed on a set of PC diskettes.

FENDL/E. Evaluated nuclear data library for neutron reactions photon production, and photo-atomic interactions for coupled neutron-photon transport calculations in fusion (and other) applications. Version 1.0 of May 1994. **FTP**
55 materials from 1-H-1 to 83-Bi-209, selected from ENDF/B-6.2 (1993), JENDL-3.1 (1990), and BROND-2.
Available in 3 representations:

a) original ENDF-6 format with resonance parameters; documentation by S. Ganesan and P.K. McLaughlin, IAEA-NDS-128 Rev. 2 of Feb. 1996
b) FENDL/MG: processed by R.E. MacFarlane into multigroup data in GENDF and MATXS format; documentation: IAEA-NDS-129 Rev. 3 of Feb. 1996. Size 257 Megabytes.
c) FENDL/MC: processed by R.E. MacFarlane into the ACE format needed for input to the Monte Carlo code MCNP4A; documentation: IAEA-NDS-169 Rev. 3 of Feb. 1996.

Available on tape or online.

EFF-2.4, the "European Fusion File". Evaluated neutron nuclear data for 80 materials, selected for the European Fusion Programme, with some new evaluations and many evaluations based on JEF-2, JENDL-3, or ENDF/B-4,5,6, including revisions up to May 1995. Maintained by H. Gruppelaar.
Summary documentation see IAEA-NDS-170.

Some older or less comprehensive data libraries for evaluated neutron reaction data are listed in the following. Evaluations contained in these libraries are mostly of historical interest only and for intercomparison purposes. However, these libraries may contain selected data evaluations that are still valid in view of the fact, that not all evaluations contained in the above mentioned four comprehensive data libraries are new and up-to-date.

ENDL-84, LLNL Evaluated Neutron Data Library of 1984 in ENDF-5 format. Summary documentation: IAEA-NDS-11, Rev. 5.

INDL/V-85, IAEA Nuclear Data Library for Various neutron data evaluations in ENDF-5 format, 1985 version. With supplements. This includes primarily evaluated data that are not part of one of the comprehensive data libraries.
Summary documentation: IAEA-NDS-31, Rev. 3.

EXFOR-V ("VIEN"-) file, IAEA Evaluated Nuclear Data File for Various neutron data evaluations, in EXFOR format. This includes primarily evaluated data that are not part of one of the comprehensive data libraries, and also such evaluated data for which the ENDF format is less convenient. Indexed in CINDA as "VIEN-V..."
Summary documentation of contents: IAEA-NDS-34, Rev. 2.

ENDF/B-5, US Evaluated Neutron Data Library of 1979. Some revisions and supplements were issued in 1985/86 as ENDF/B-5.2.

Documentation of contents: Guide book for the ENDF/B-5 Nuclear Data Files, report EPRI-NP-2510 (= ENDF-328), July 1982. See also summary documentation compiled by R. Kinsey in report BNL-NCS-17541 (=ENDF-201), 3rd edition, July 1979, available as microfiche IAEA-NDS-10/201. For the summary documentation of ENDF/B-5.2 compiled by B.A. Magurno and P.G. Young see the report BNL-NCS-17541 (=ENDF-201) 3rd edition supplement 1, Jan. 1985. For the evaluations contributed by the Los Alamos Scientific Laboratory (LASL) see document LA-7663-MS of Jan. 1979.

Available files: Standard nuclides
Actinides
Fission-product yields
Fission products: cross-sections and decay data
Activation reactions
Dosimetry reactions
Gas production cross-sections

For details see on the following pages under the respective headings.

ENDF/B-5 modifications 1986: Document IAEA-NDS-65. This is a computer-produced listing showing all records where the new version differs from the old version.

ENDF/B-4, US Evaluated Neutron Data Library of 1974.
Summary documentation: IAEA-NDS-23, Rev. 3.
Available - in original form with resonance-parameters = 216.886 records
- as RECENT output, with resonance-parameters converted to cross-section = 1.053.950 records

ENDL-82, LLNL Evaluated Neutron Data Library of 1982, in ENDL Transmittal format. Summary documentation: IAEA-NDS-54.
ENDL Transmittal Format, see IAEA-NDS-53, Rev. 1.

JENDL-2, (Rev. 1) Japanese Evaluated Nuclear Data Library of 1984 (supersedes JENDL-1 and preliminary version of JENDL-2).
Available in original version and as RESENDD-output with resonance-parameters converted to cross-section data.
Summary documentation: IAEA-NDS-18, Rev. 3.
Detailed tables and curves see Y. Kikuchi,
Draft of Guidebook for users of JENDL-2, Report JAERI-memo-59-066 (Feb. 1984).

UKNDL-80, UK Nuclear Data Library
Brief summary of format: IAEA-NDS-20, Rev. 2.
Summary of contents: IAEA-NDS-30.
Most recent version available: UKNDL-81.

KEDAK-4, Karlsruhe Evaluated Neutron Data Library
Brief summary of format and contents: IAEA-NDS-21, Rev. 4.
Documentation: B. Goel, B. Krieg, Status of the Nuclear Data Library KEDAK-4, October 1984. Report KfK-3838, Feb. 1985.

SOKRATOR, USSR Evaluated Nuclear Data Library
SOKRATOR Manual: INDC(CCP)-97.
Note: The IAEA Nuclear Data Section converted most of the data into ENDF/B-5 format. These data are included in INDL/V, see above. Meanwhile these data are superseded. For the new USSR Evaluated Nuclear Data Library, see "BROND" above.

5. Evaluated neutron nuclear data: Multigroup libraries

In general, multigroup nuclear data libraries for reactor calculations should be requested from the NEA Data Bank, Le Seine Saint-Germain, 12 blvd des Iles, F-92130 Issy-les-Moulineaux, France.

The IAEA Nuclear Data Section has presently only the following:

FENDL/MG, Library of multigroup cross-sections in GENDF and MATXS format for neutron-photon transport calculations, generated by R.E. MacFarlane by processing FENDL/E-1. Check with IAEA Nuclear Data Section about availability of processed files derived from FENDL version 2.
Summary documentation by S. Ganesan and H. Wienke: IAEA-NDS-129 Rev 3, Feb. 1996.

FENDL/MC, the same, processed for input to the Monte Carlo code MCNP4A. Check with IAEA Nuclear Data Section about availability of processed files derived from FENDL version 2.
Summary documentation by S. Ganesan and H. Wienke: IAEA-NDS-169 Rev. 3, Feb. 1996.

WIMKAL-88. The 1988 version of the WIMS-KAERI library of 69-group neutron cross-sections for thermal reactor design analysis with the WIMS code system; by Jung-Do Kim, Korea Atomic Energy Research Institute. The library contains data evaluations for more than 130 materials selected from ENDF/B-5, ENDF/B-4, JENDL-2 and some other sources.
Summary of contents: IAEA-NDS-92.

WIMSD Nb Bi. WIMSD data for Nb and Bi derived from ENDF/B-6.1, JEF-2.2, JENDL-3.2, by JUNG-Do Kim, Choong-Sup Gil. Data on a PC diskette, 478 000 bytes. Tabular and graphical intercomparison and documentation: IAEA-NDS-152

FENDL/A: Multigroup data for neutron activation cross-sections, see chapter 13.

For an earlier collection of multigroup cross-section data libraries see the document IAEA-NDS-32 Rev. 2 (1981).

6. Nuclear data standards for nuclear measurements

ENDF/B-6 Standards of 1987
Evaluated data in ENDF-6 format for H-1(n,n) integral and differential, He-3(n,p), Li-6(n,t), B-10(n,a), C(n,n) integral and differential, Au-197(n,q), U-235(n,f). A second file contains cross-section uncertainties and recommended values for the 2200 m/s neutron cross-sections of U-233, 235, Pu-239, 241, and nu-bar of Cf-252. The International Nuclear Data Committee recommended the ENDF/B-6 standards data as international reference standards.
Summary documentation: IAEA-NDS-88, Rev. 3.

XG Standards. X-ray and gamma-ray standards for detector calibration. See below under "Nuclear Structure and Decay Data". Also included in the handbook NEANDC-311.

1991 NEANDC/INDC Nuclear Standards File:
See the handbook NEANDC-311 = INDC(SEC)-101, Nuclear Data Standards for Nuclear Measurements. H. Condé (ed.).
It includes the ENDF/B-6 Standards, the XG Standards, and some other data.

Standard monitor reactions for neutrons, Z. Bödy. - See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p./29-82.

Properties of Neutron Sources. Proceedings of an IAEA Meeting, Leningrad, 1986. IAEA-TECDOC-410 (1987). K. Okamoto (ed.).
Contents: 1. White neutron sources (pulsed); 2. Fast neutron fields; 3. Californium-252 prompt fission-neutron spectrum; 4. Monoenergetic sources and filtered beams; 5. 14 MeV neutron sources; 6. Medical applications; etc. - No computerized data files.

Cf-252 neutron spectrum. Evaluation of the californium-252 spontaneous fission neutron spectrum, by W. Mannhart, PTB Braunschweig, FRG, 1986/87.
Summary documentation: IAEA-NDS-98.
Compare also Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 163-186.
This data set was also included in the ENDF/B-6 decay data library under MAT 9861.

Neutron cross-section standards for the energy region above 20 MeV. No recommended data tables available yet. For a status report see report NEANDC-305, Paris 1991 (= proceedings of a meeting in Uppsala, 21-23 May 1991). Not available from IAEA, to be requested from the NEA Data Bank.

The following should be regarded as superseded:

ENDF/B-5 Standards, modification of 1986.
Documentation: a: IAEA-NDS-15, Rev. 2.
b: Standard reference and other important nuclear data by CSEWG, BNL-NCS-51123 (ENDF-300).
c: A.D. Carlson, M.R. Bhat (ed.): ENDF/B-V cross-section measurement standards, BNL-NCS-51619 (ENDF-301).

Note: the ENDF/B-5 standards are superseded by the ENDF/B-6 standards.

1982 INDC/NEANDC Nuclear Standards File:
See handbook IAEA Technical Report No. 227, Nuclear Data Standards for Nuclear Measurements, 97 pages.

7. Thermal neutron cross-sections, resonance-parameters, resonance integrals

ENDF-formatted libraries: Recent values of thermal neutron cross-sections and resonance integrals are in the data libraries BROND-2, CENDL-2, ENDF/B-6, JEF-2, JENDL-3 where, however, these values must be computed, for example with the code series LINEAR, RECENT, INTER. For JENDL-3 these values are tabulated in the report JAERI-M-90-099 pages 461-486. For the JENDL-3 Fission Product Library see the report JAERI-M-92-077 pages 453-488.- Note however, that the new version, JENDL-3.2, contains revised data for many nuclides.

JEF-2.2 INTER. From the JEF-2.2 point-data file tables of important cross-section values have been derived by the code INTER, including all cross-section values for 0.0253 eV, thermal Maxwellian, fission spectrum, 14 MeV, plus resonance-integrals and thermal g-factors. Available on tape or diskette.

JEF Report 14: For the ENDF-formatted data libraries JEF-2.2, ENDF/B-6 (after the 93 update), JENDL-3.2, BROND-2 and CENDL-2, this report lists the following quantities:
- 0.0253 eV cross-sections
- thermal Maxwellian average cross-sections
- resonance-integrals
- fission spectrum average cross-sections
- 14.0 MeV cross-sections.

The report is available from the NEA Data Bank.

Belanova: Handbook on neutron radiative capture cross-sections. T.S. Belanova, A.V. Ignatjuk, A.B. Pashchenko, V.I. Pljaskin. Energoatomizdat Moskva 1986. In Russian. Contents: (1) A table with nuclide, abundance/half-life, thermal cross-section, Westcott g-factor, resonance integral, 30 keV (n,γ) cross-section. (2) Average resonance parameters. (3) Group cross-sections 0-15 MeV for selected nuclides in tabular and graphical form. Available costfree as report INDC(CCP)-262.

Thermal neutron cross-sections and resonance-parameters: **online**
See reports BNL-325 and the books "Neutron Cross-Sections" (Academic Press), Vol.1,

Part A for Z = 1-60 (1981)
Part B for Z = 61-105 (1984)

containing thermal neutron cross-sections and resonance parameters. These books are not available from IAEA, and the corresponding data are not available on magnetic tape. Of these books the thermal neutron cross-section and resonance-integral data are available online in NDIS within the **NUDAT** database which is described in chapter 31 of this document.

Neutron Resonance-Parameters from BNL-325, third edition, 1973. Available on tape in either standard format or edited format. Description of content and format: IAEA-NDS-28.

UENDL/NAA, USSR Evaluated Nuclear Data Library for Neutron Activation Analysis. Contains activation cross-sections for thermal neutron capture and absorption reactions, resonance integrals and some other data.
See under "Neutron Activation" for further details.

Gryntakis File 1986: Contains thermal activation cross-sections, resonance-integrals, main gamma-rays, half-lives, for all nuclides: IAEA-NDS-64. See also Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, p. 199-260.

g-factors as function of temperature for non-1/v nuclides see E.M. Gryntakis, J.I. Kim, Radiochimica Acta 22 (1975) 128.

KORT 1981: Thermal neutron cross-sections, resonance-integrals and nu-bar of actinides. See report INDC(CCP)-185.

KORT 1988: Thermal neutron cross-sections and resonance-integrals of elements and isotopes up to 83-Bi-209. See report INDC(CCP)-327.

Neutron Scattering Lengths: L. Koester et al., journal Atomic Data and Nuclear Data Tables 49, 65-120, 1991. Compare in chapter 1 under "Neutron nuclear data, experimental".

8. Thermal neutron scattering law

ENDF/B-6 TSL2. The ENDF/B-6 thermal neutron scattering sublibrary, Release 2, by R.E. MacFarlane, 1995. 12 neutron moderator materials at 8 temperatures.
Summary documentation: IAEA-NDS-197, June 1995.

JEF-2 TSL. The JEF-2 thermal neutron scattering law data library, by J. Keinert and M. Mattes, 1984. 5 neutron moderator materials.
Summary documentation: IAEA-NDS-121 Rev. 1, Sept. 1994

ENDF/B-6 TSL1. The ENDF/B-6 thermal neutron scattering sublibrary, Release 1, by J.U. Koppel and D.H. Houston, 1978. 10 neutron moderator materials. This is the same data library as in ENDF/B-3, but the format was converted to ENDF-6. It may be considered as superseded by Release 2 (see above), but it contains the one or other material that was not included in Release 2.
Summary documentation: IAEA-NDS-97 Rev. 1, Sept. 1990.
Available in ENDF-3 format or ENDF-6 format.

9. Actinides

Evaluated neutron reaction data for actinide nuclides are now included in the major ENDF formatted data libraries **online**

- **BROND-2**
- **CENDL-2**
- **ENDF/B-6**
- **JEF-1**
- **JENDL-3**

See document IAEA-NDS-107 for a joint index to these libraries.

"MASLOV": Evaluated neutron reaction data for several Am, Cm and Pu isotopes, 1994/1996/1997, in ENDF-6 format, by V. Maslov et al., Minsk, Belarus. - Summary documentation: IAEA-NDS-164, Rev. 2 (1997).

WIND and WIND-2: Neutron nuclear data library for isotopes of U, Np, Pu up to 100 MeV, with one file of proton reaction data for U-238 and a file for Pu-239 up to 2 GeV. By A.Ju. Konobejev et al., Obninsk, Russia. Summary documentation: IAEA-NDS-143 Rev. 1.

Earlier specialized libraries for neutron reaction data of actinides:

ENDF/B-5 Actinides (Rev. 86), summary documentation: IAEA-NDS-13, Rev. 5. Data available

a) with resonance parameters
b) resonance parameters replaced by point data

INDL/A-83 IAEA Nuclear Data Library of Actinide neutron data evaluations. Summary documentation: IAEA-NDS-12, Rev. 7. Graphical plots: IAEA-NDS-12, Rev. 7 part 2.

INDL/A Suppl. 86/5: Documentation IAEA-NDS-12 Suppl. 86/5. (Contains five Minsk evaluations (U and Pu isotopes).

These are meanwhile superseded.

For a special file on the Cf-252 spontaneous fission neutron spectrum see under "Standards".

10. Fission product yields

For experimental fission-product yield data see EXFOR; this now includes most of the data compiled earlier in separate files by Crouch and Meek/Rider.

There are three major files for evaluated fission-product yield data for a large number of "fissioning systems", i.e. actinides fissioning by thermal neutrons, fast neutrons, 14 MeV neutrons, or spontaneous fission.

ENDF/B-6 fission-product yield data: this is a separate ENDF/B-6 sublibrary which was released in September 1991 and updated in June 1993 and May 1995. It has two parts: one part for neutron induced fission, another part for spontaneous fission. **online**
Summary see document IAEA-NDS-106 Rev. 3.

JEF-2/FPY, the JEF-2 fission-product yield data library by the NEA Data Bank, in ENDF-6 format. The evaluated data have been taken over from UKFY2, the UK fission-product yield data library by M. James and R. Mills. **online**
Brief summary: IAEA-NDS-123 Rev. 1. Size: 46 000 records, available on tape. - The original UKFY2 file (see below) contains supplementary information such as chain yields, fractional independent
yields, and bibliographic references: available on tape.

JENDL-3.2/FPY, the JENDL fission-product yield data library, has been compiled by T. Nakagawa in ENDF-6 format. The evaluated data have been taken over from JNDC-FP2, a special format data library (see below) documented in the reports JAERI-M-89-204 (1989) and JAERI-1320 (1990). Available on tape. **online**

The ENDF/B-6 fission-product yield data are largely based on the following:

"BRADY". Fission-product yields and fission-neutron data for minor actinides, by M.C. Brady, R.Q. Wright, T.R. England, 1991. A set of two PC diskettes.

The JEF-2 fission-product yield data are largely based on the following:

UKFY2, the UK Fission-Product Yield Library, version 2, 1991.
Summary see document IAEA-NDS-124.

For some fissioning systems that are not included in above data libraries the following file should be used which has been obtained from a theoretical thermodynamical model:

ASIYAD, fission-product yield library by A.F. Grashin reported at the 1988 Mito Nuclear Data Conference, and converted to ENDF-6 format by the Russian Nuclear Data Center, Obninsk.
Summary see document IAEA-NDS-133.

Additional files which may still be in use and which may continue to be of interest for comparison purposes:

JNDC-FP2: The JNDC Nuclear Data Library of Fission-Products, version 2, including fission-yield data for 20 fissioning systems. For further information see the next chapter on Fission Products. Summary document IAEA-NDS-51 Rev. 3.

Chinese evaluated fission product yield library by Wang Dao et al.,1987. Summary see document IAEA-NDS-91.

ENDF/B-5 Fission-Product **Yield** data for 11 fissioning nuclides; latest version received in 1985.
Summary documentation: IAEA-NDS-62.

Additional specialized compilations:

Delayed fission-neutron yield data: see report NEACRP-L-323 (Dec. 1990) J. Blachot, M.C. Brady, A. Filip, R.W. Mills, D.R. Weaver, Status of delayed neutron data 1990. Data file not available on tape.

Review of fission product yields and delayed neutron data for selected actinides. Report NEANDC-300 by R.W. Mills. July 1990.

Importance of delayed neutrons in nuclear research, by S. Das. Report BARC/1993/E-003 (1993) and journal Progress in Nuclear Energy vol. 28 No. 3 (1994) p. 209-264.

11. Fission products - evaluated neutron reactions and decay data

ENDF/B-6 fission-product **cross-sections**: included in the ENDF/B-6 general purpose file, of which a retrieval for fission-product nuclei can be provided. Mostly identical with the ENDF/B-5 fission products library, but updated with several new evaluations. Summary see documents IAEA-NDS-100 Rev. 4 and IAEA-NDS-107 Rev. 6. **online**

ENDF/B-6 fission product **decay** data: this is included in the separate ENDF/B-6 special purpose file for decay data.

JEF-2 fission-product **cross-sections**: included in the JEF-2 general purpose file, of which a retrieval for fission-product nuclei can be provided. Mostly identical with the ENDF/B-5 fission products library, but updated with several new evaluations. Summary see documents IAEA-NDS-120 Rev. 2 and IAEA-NDS-107 Rev. 8. **online**

JEF-1 fission product **decay** data: Summary see document IAEA-NDS-122.

JENDL-3 fission-product cross-sections: for table of contents see document IAEA-NDS-107 Rev. 6. **online**

JNDC-FP2. The JNDC Nuclear Data Library of Fission Products, second version has been received from the Japanese Nuclear Data Committee in February 1991. The library contains nuclear decay data and fission yield data for 1078 unstable and 149 stable fission product nuclides, and neutron cross-section data for 166 nuclides. The decay data include half-life, branching ratio, and total beta- and gamma-ray energies released per decay of each unstable nuclide. The fission yield data are given for 20 fissioning systems. The data library is in a free format, i.e. not ENDF format. Summary documentation: IAEA-NDS-51 Rev. 3 (March 1991) by O. Schwerer.

Absolute gamma branching ratios for fission-products. A comprehensive compilation by G. Rudstam, Studsvik, Sweden. Report INDC(SWD)-24, Nov. 1993. Data not available on tape.

Beta and gamma spectra of short-lived fission products. By G. Rudstam, P.I. Johansson, O. Tengblad, P. Angaard, J. Eriksen, published in the journal Atomic Data and Nuclear Data Tables 45 (1990) 239-320. Data file not available on magnetic tape.

Delayed-neutron branching ratios of precursors in the fission-product region. By G. Rudstam, K. Aleklett, L. Sihver, published in the journal Atomic Data and Nuclear Data Tables 53 (1993) 1-22. Data file not available on magnetic tape.

The following libraries are old and should no longer be used.

ENDF/B-5 Fission Products Library (Rev. 2), **cross-sections** and **decay data** for 877 fission-product nuclides. Two files: EN5.2-FP1, EN5.2-FP2. Summary documentation: IAEA-NDS-25, Rev. 2, with a Supplement sheet (1986). For the 1986-modifications see IAEA-NDS-65. Data are available

a) with resonance parameters (on tape or on microfiche)
b) resonance parameters replaced by point data (on tape)

Blachot's Library of fission-product decay data (1978)
Summary documentation: IAEA-NDS-17. For a more recent version see also below under "Nuclear structure and decay data".

Australian fission products, neutron cross-sections 1971 version available as point data and 127 group data, see CINDU-11 p. 49 and CINDU-11 Suppl. 1 p. 18. Revised version of 1979, point data only.

Bologna fission products, neutron cross-sections.
1971 version in UKNDL format: CINDU-11, p. 51
1977 version in ENDF/B format: CINDU-11, Suppl. 1, p. 16

UKFPDD-2, UKNDL fission-product decay data.
Documentation: A. Tobias and B.S.J. Davies, report RD/B/N-4942, Nov. 1980.

UKNDL-81 fission-product cross-sections, retrieved at NDS from UKNDL-81.

RCN-3, fission product cross-sections in KEDAK format, by ECN Petten, 1983. This supersedes most but not all of the previous version RCN-2. Those parts of ECN-2 that are still valid, have been extracted into the library RCN-2*. - Documentation see report IAEA-NDS-67.

Rider library of fission product yields. Most recent version 3B available as microfiche NEDO-12154-3C (1981) (ENDF-322). This contains some additions as compared to the version 3A available on magnetic tape: "Meek-Rider 1980".

BIBFP and BIBGRFP, the Czechoslovakian fission-product library of 1978. Yields, thermal cross-sections and resonance integrals, decay data. Summary documentation: IAEA-NDS-14. Not available on magnetic tape.

12. Neutron induced gamma-rays

Lone's library of prompt gamma-rays from thermal-neutron capture. It lists for all elements the prompt gamma-ray energies in the range from 23. to 10829. keV, in terms of gamma-rays emitted per 100 neutron radiative captures. File 1 sorted by gamma-ray energies; file 2 sorted by element first and then by gamma-ray energies. The file available contains more information than the original version published in Atomic Data and Nuclear Data Tables vol. 26 p. 511-560 (1981).

Summary documentation: IAEA-NDS-115.

This data library has been included in a PC-diskette attached to the IAEA Technical Report 357: Handbook on Nuclear Data for Borehole Logging and Mineral Analysis (1993).

Tuli's library of thermal-neutron capture gamma-rays. It lists for isotopes heavier than A=44 the prompt gamma-ray energies in the range from 0.1 to 11447. keV, in percent of the strongest gamma-ray of the same isotope. Retrieved from ENSDF in 1988, superseding an earlier version which was published as BNL-NCS-51647 (1983).

Summary documentation: IAEA-NDS-116.

Orphan's library of thermal-neutron capture gammas: A compilation by Gulf General Atomic, San Diego, of "Line and Continum Gamma-Ray Yields from Thermal-Neutron Gapture in 75 Elements". Authors: V.J. Orphon, N.C. Rasmussen. Not available on magnetic tape. Available as microfiches AD 717 639 = GA-10248 (July 1970).

Demidov's handbook
A.M. Demidov, L.I. Govor, Yu.K. Cherepancev, M.R. Akhmed, S. Al-Nadzhar, M.A. Al-Amili, N. Al-Assafi, N. Rammo: Atlas of gamma-ray spectra from inelastic scattering of reactor fast neutrons. Moscow, Atomizdat 1978. Kurchatov Institute Moscow and Nuclear Research Institute Bagdad. Vol. 1: 3-Li to 42-Mo. Vol. 2: 44-Ru and up. In English, introduction also in Russian. (Had been distributed as INDC(CCP)-120.) Database not available on magnetic tape.

Atlas of energy-angular distributions of photons produced in neutron interactions. Report Yad. Konst. 1993(2) by A.I. Blokhin et al. Contents: Brief introduction in Russian. Index to available experimental data. Bibliography. 255 figures of double differential cross-sections for 52 elements. 100 figures of gamma production cross-sections. Limited number of copies available costfree upon request.

13. Neutron activation

This chapter includes evaluated data files for neutron activation cross-sections for general use.
See also the following chapter for application in dosimetry, and chapter 7 for thermal neutron activation cross-sections.

FENDL/A-2.0, Comprehensive neutron cross section library for 13006 neutron activation reactions with 739 target nuclides from H to Cm in the incident energy range up to 20 MeV. The data are in ENDF format with some modifications. Compared to the previous version FENDL/A-1.1, many nuclides and reactions were added or revised. The evaluations were selected from major activation libraries including EAF-4.1, ADL-3, JENDL/A-3.2 and others. Available on magnetic tape or by FTP file transfer.
Summary documentation: IAEA-NDS-173.

EAF-2 ("European Activation File"). Neutron cross-section data for many thousand reactions. At present not available from IAEA.
See J. Kopecky, D. Nierop, Contents of EAF-2.
Report ECN-1-91-053 (1991).

ADL-3, Russian Activation Data Library, evaluated neutron activation cross-sections of 20049 excitation functions. Documentation: O.T. Grudzevich, A.V. Zeleneckij, A.V. Ignatjuk, A.B. Pashchenko, Catalogue of ADL-3 library, in: Yadernye Konstanty, issue 1993 (3-4). Copies available costfree. (180 pages of index, self-explanatory, with an introduction in Russian, abstract in English.) Data library available on tape.
Summary documentation: IAEA-NDS-137.

Atlas of neutron capture cross sections. J. Kopecky et al. Report INDC(NDS)-362, 370 pages. Plots of neutron capture cross sections in the energy range 10^{-5} eV - 20 MeV as evaluated and compiled in recent activation libraries, compared with available experimental values at thermal energy, 30 keV and 14.5 MeV, for 739 targets from H and Cm. Report available cost-free. The evaluated cross section data are available in pointwise ENDF-5 format and can be downloaded from the NDS WWW page (http://www-nds.iaea.or.at).

LLCRP. Excitation functions of 16 long-lived activation reactions of importance in fusion reactor technology. Available in slightly modified ENDF-5 format on magnetic tape or by FTP file transfer.
Summary documentation: INDC(NDS)-344.

UENDL/NAA, USSR Evaluated Nuclear Data Library for Neutron Activation Analysis of 1988, by V.M. Bychkov et al. It contains recommended values for activation cross-sections of 14,5 MeV energy neutrons and neutrons from U-235 and Cf-252 fission; for resonance integrals of capture, aborption and fission reactions; for thermal neutron capture and absorption reaction cross-sections; for effective resonance energy values; for the main gamma-ray energies of neutron capture and for their absolute intensities; for half-lives and abundance for all known nuclides. Available on a set of two low density PC diskettes.
Documentation: IAEA-NDS-125 by A.B. Pashchenko.

ACTIV87. Fast Neutron Activation Cross-Section File by V.N. Manokhin, A.B. Pashchenko, V.I. Pljaskin, V.M. Bychkov, V.G. Pronjaev. This library contains evaluated cross-sections for 206 important fast- neutron induced activation reactions in the energy range from threshold up to 20 MeV. This file contains the numerical data of the graphical plots that had been published in the IAEA Handbook on Nuclear Activation Data (K. Okamoto, ed.), IAEA Technical Report 273 (1987), pp 305-411. A brief documentation of this data library is given in the report IAEA-NDS-96 (O. Schwerer, ed.).

ENDF/B-5 Activation file, (Rev. 2), neutron activation cross-sections and radioactive decay data for 127 nuclides from 1-H-3 to 96-Cm-242.
Summary documentation: IAEA-NDS-38, Rev. 1

ACTL-82 - LLNL evaluated neutron activation cross-section library of 1982, in **ENDL Transmittal** format.
Summary of contents: IAEA-NDS-55
Summary of format: IAEA-NDS-53

ACTL - LLNL evaluated neutron activation cross-section library 1978, in ENDF/B format. Evaluation techniques, reaction index and format description by M.A. Gardner and R.J. Howerton, see UCRL-50400, vol. 18 (1978).

RCN-2.CP: Evaluated neutron cross-section library for 13 corrosion products, cover-gas nuclides and other nuclides in the primary cooling circuit of a fast power reactor, by H. Gruppelaar et al., ECN Netherlands, 1982. In KEDAK format.
Summary documentation: IAEA-NDS-68.

In the following, some data compilations are listed which are not available on computer media. See the quoted references.

Kabina file - A file of reference data for multiple-element thermal neutron activation analysis. L.P. Kabina et al. (Leningrad), INDC(CCP)-216, Dec. 1983. Hard copy only, not on tape. (Based on decay data from ENSDF and thermal (n,gamma) cross-sections from BNL handbooks.).

14-MeV neutron activation cross-sections, see report ANL/NDM-89 (April 1985).

Data for 14-MeV neutron activation analysis, Z. Bödy, J. Csikai. - See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 261-304.

Index of neutron-induced gamma-production data in ENDF-formatted files, see report INDC(NDS)-189 by O. Schwerer, H.D. Lemmel (March 1987).

14-MeV neutron activation analysis, sensitivities and interferences, see R. Pepelnik, J. of Radioanal. and Nucl. Chem. 112 (1987) 435.

14. Neutron activation - for dosimetry

IRDF-90, the International Reactor Dosimetry File, version 2 of Oct. 1993. Summary documentation: IAEA-NDS-141, Rev. 3. This includes internationally recommended cross-sections with covariance data for a selected set of activation reactions used for reactor neutron dosimetry by foil activation. About half of the reactions has been taken over from ENDF/B-6; the other half are original evaluations prepared for IRDF-90. Available on tape or PC diskettes. **FTP**

For an introduction see the textbook "Nuclear Data Guide for Reactor Neutron Metrology", by J.H. Baard, W.L. Zijp, H.J. Nolthenius, Kluwer Academic Publishers (1989). - Not available from IAEA.

For a survey of a number of properties of IRDF-90 data (first version of 1990) see the report ECN-I-91-004 by E.M. Zsolnay and H.J. Nolthenius.

For the processing of covariance data see, e.g., Sz. Czifrus: "Processing of ENDF-6 format resonance region covariance data using a new algorithm" in journal Kerntechnik 60 (1995) 4 p.152-156.

NMF-90, Neutron Metrology File, an integrated database for performing neutron spectrum adjustment calculations. Documented in the reports IAEA-NDS-171 and INDC(NDS)-347 by N.P. Kocherov. It contains the IRDF database, together with 4 different adjustment codes, 6 data sets for reactor benchmark neutron fields, and utility codes for processing and plotting the input and output data. The package consists of 9 PC HD diskettes and code manuals. 10 Mb of diskspace is required.

ENDF/B-6 Dosimetry File: Partly superseded by IRDF-90. Not maintained as a separate data library; see the general ENDF/B-6 Library, documented in IAEA-NDS-100.

JENDL Dosimetry File: Data mostly from JENDL-3, but partly also from other sources, as of 1991. Detailed report: JAERI-1325 by M. Nakazawa et al.
Summary documentation: IAEA-NDS-140.

PRONDOS. Evaluations of selected neutron activation reactions for dosimetry by V.G. Pronjaev et al. 1988/89.
Summary in document IAEA-NDS-142.

Other dosimetry reaction files may be included in the "General purpose evaluated neutron nuclear data".

The following should be regarded as superseded by more recent files:

IRDF-85, the International Reactor Dosimetry File.
Summary documentation: IAEA-NDS-41, Rev. 1. This includes 640-group data derived from ENDF/B-5 Dosimetry File Rev. 2, ENDF/B-5 Gas Production File Rev. 2, some evaluations from INDL/V, two radiation damage files for iron, and 10 benchmark neutron spectra. Available also as cross-sections without resonance-parameters. The cross-section data are superseded by IRDF-90. The benchmark neutron spectra remain of interest.

ENDF/B-5 Dosimetry File: Rev. 2 (1984). Also available as 620 group data. Summary documentation: IAEA-NDS-24, Rev. 2
This file is superseded by the ENDF/B-6 Dosimetry File.

DOSCROS84, dosimetry cross-sections by ECN Netherlands, in 640 group structure. Documentation by W.L. Zijp et al. in ECN-160. This data file is referred to in the book by J.H. Baard, W.L. Zijp, H.P. Nolthenius: "Nuclear Data Guide for Reactor Neutron Metrology"; Kluwer Academic Publishers, 1989. Whereas the book continues to be useful, many of the numerical data included should be replaced by more recent data such as IRDF-90.

BOSPOR-78 and **BOSPOR-80** threshold neutron reactions by F.E.I. Obninsk. These data were compiled by the IAEA Nuclear Data Section into ENDF/B-5 format. They are included in INDL/V (see above under item 4).

UKNDL-81 Dosimetry File: This was extracted by NDS from UKNDL-81. UKNDL format plus one additional character to allow for four digit DFN numbers.

DETAN74. Based on files by W.N. McElroy from HEDL (USA), prepared by A. Fabry from CEN/SCK Mol (Belgium), documented by H.C. Rieffe and H.J. Nolthenius from ECN Petten (Netherlands) in Report RCN-75-139, Oct. 1975.

15. Miscellaneous specialized neutron data libraries

INGDB-90: The international neutron nuclear database for geophysics applications. It contains selected neutron cross-section data, spectrum data of selected neutron sources, and the cross-section data processing codes LINEAR and GROUPIE.
Assembled by N.P. Kocherov and P.K. McLaughlin.
Summary see document IAEA-NDS-127.
The full information see N.P. Kocherov, IAEA Technical Report 357: Handbook on Nuclear Data for Borehole Logging and Mineral Analysis (1993).

SGNucDat, Version 2. Safeguards Nuclear Data for Windows. Contains the data of report INDC(NDS)-248 (1991), updated 1997. A: Actinide nuclear data (decay data, selected neutron cross-section data, fission-neutron data); B: fission-product nuclear data (decay data and selected neutron cross-section data); C: fission-product yield data. PC code by G. Pospischil. Data compiled by M. Lammer, O. Schwerer and N.P. Kocherov, documented in report IAEA-NDS-248, Rev. 1 (1997).

Atlas of Neutron Capture Cross Sections. J. Kopecky et al. Report INDC(NDS)-362, 370 pages. Plots of neutron capture cross sections in the energy range 10^{-5} eV - 20 MeV as evaluated and compiled in recent activation libraries, compared with available experimental values at thermal energy, 30 keV and 14.5 MeV, for 739 targets from H to Cm. Report available cost-free. The evaluated cross section data are available in pointwise ENDF-5 format and can be downloaded from the NDS WWW page (http://www-nds.iaea.or.at, see NGATLAS).

JENDL-3 Sublibrary for Gas Production by T. Nakagawa and T. Narita. Contains neutron-induced hydrogen and helium production cross-sections for elements from 3-Li to 41-Nb.
Summary documentation: IAEA-NDS-139

ENDF/B-5 Gas Production File, (Rev. 2). Neutron cross-sections for gas production for 18 elements or isotopes from 5-B-11 to 29-Cu.
Summary documentation: IAEA-NDS-42, Rev. 1.
Data available on magnetic tape.

DAMSIG84 - Radiation damage cross sections by ECN Netherlands in 640 group structure.
Documentation by W.L. Zijp et al. in ECN-159

Californium-252 spectrum averaged neutron cross-sections, W. Mannhart - See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 413-440.

Reaction cross-sections induced by 14.5 MeV neutrons and by Cf-252 and U-235 fission spectrum neutrons. Data tables by A.B. Pashchenko. Data considered up to the end of 1989. Report INDC(CCP)-323, English translation of the Russian report FEI-236. Compared to the Russian original, in the English translation a few numbers were updated by the author.
Note a misprint: In the data tables, the column heading "14 MeV" should read "14.5 MeV".

Brenner/Prael: Nonelastic interactions of neutrons between 15 and 60 MeV with carbon and oxygen, calculated differential secondary-particle production cross-sections, by D.J. Brenner and R.E. Prael. - Not available on tape. See Atomic Data and Nuclear Data Tables, vol. 41 nr.1 p.71-130 (Jan. 1989).

Neutron capture reaction rates at 30 keV, tabulation of calculated values for about 4000 nuclides. See the journal Physics Reports vol. 208 (1991) p. 267-394, J.J. Cowan et al., the *r-process and* nucleochronology. Data tabulation on tape available from authors, but not available from IAEA-NDS. - Note that the data were derived from theory and that they were not computed from available nuclear data libraries.

Neutron scattering lengths: see chapter 1, experimental neutron data.

21. Photonuclear data

EXFOR, see documentation above under item 1. The EXFOR file contains in particular photo-neutron data (Berman Library) and selected other photonuclear data. At present, compilation continues primarily at the Photonuclear Data Center in Moscow. Selective retrievals available on tape or printed listing. Photoneutron and photofission data are indexed in CINDA. Retrievals available online, or on tape upon request. **online**

Berman library of photoneutron cross-sections with monoenergetic photons. Included in EXFOR with accession-numbers starting from L0001. For the 1976 version see the report UCRL-78482, B.L. Berman, Atlas of photoneutron cross-sections obtained with monoenergetic photons. Also available as microfiche. For the 1988 version see S.S. Dietrich, B.L. Berman: Atlas of photoneutron cross-sections obtained with monoenergetic photons. See journal Atomic Data and Nuclear Data Tables, vol. 38 p. 199-338 (1988).

GDR - Giant dipole resonance-parameters for gamma-rays. A PC diskette by the Chinese Nuclear Data Center ("CENDL.GDR"), Su Zongdi et al., based on data by S.S. Dietrich and B.L. Berman, ADNDT 38 199 (1988).
Summary documentation by A.B. Pashchenko, see IAEA-NDS-145 Rev. 1
Compare under "CENPL" on p. 27 of this document.

An **atlas** of selected experimental data from EXFOR and evaluated data of **photoneutron and photofission cross-sections** has been prepared by A.I. Blokhin and S.M. Nasyrova (Obninsk).
Available as report INDC(CCP)-337 (1991).

Photonuclear cross-sections, B. Forkman, R. Petersson. - See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 631-811.

NBSIR 83-2742: Photonuclear Data-Abstract Sheets, 15 volumes (1983-1986), by E.G. Fuller and H. Gerstenberg, US National Bureau of Standards. Includes reproductions of graphs and tables from various publications (1955-1982).
The data scope includes photonuclear data, electron scattering and some ground-state particle capture reactions, e.g. (α,γ_0). The energy range covered is 0 to 150 MeV, but various data up to 4 GeV were also included. Data not available on magnetic tape. The Nuclear Data Section has no spare copies of this report series but could provide upon request photocopies for selected reactions.

BOFOD, Russian evaluated photo-neutron data library, by A.I. Blokhin, N.N. Buleeva, S.M. Nasyrova, O.A. Pakhomova, S.V. Zabrodskaja, A.M. Cibulja. A detailed description of this data library, with tables and curves, is given in the journal Yadernye Konstanty 1992 (3-4) p. 3-54. Copies available, costfree. (5 pages of introductory text in Russian with an English abstract; the captions to tables and figures are self-explanatory.)

22. Photo-atomic interaction data

EADL, the evaluated Atomic Data Library of the Lawrence Livermore National Laboratory, USA. This data library is published in tabular and graphical form in the report UCRL-50400 vol. 30 (1991) by S.T. Perkins, D.E. Cullen, M.H. Chen, J.H. Hubbell, J. Rathkopf, J. Scofield, 288 pages. It contains evaluated atomic subshell and relaxation data for isolated neutral atoms, including fuorescence yields, subshell parameters (e.g. binding energies), both radiative and non-radiative transition probabilities, and energy deposition terms. This handbook is available as a set of microfiches from the IAEA INIS Microfiche Service, or from the US National Technical Information Service, 5285 Port Royal Rd., Springfield, VA, USA-22161.
The data library on magnetic tape is available from the IAEA Nuclear Data Section. For a summary see the document IAEA-NDS-156, format IAEA-NDS-159.

EEDL, the Evaluated Electron Data Library of the Lawrence Livermore National Laboratory, USA. This data library is published in tabular and graphical form in the report UCRL-50400 vol. 31 (1991) by S.T. Perkins, D.E. Cullen, S.M. Seltzer, 376 pages. It contains energy-dependent evaluated electron interaction cross-sections and related parameters for all elements from 1-H to 100-Fm, in tabular and graphic form. This handbook is available as a set of microfiches from the IAEA INIS Microfiche Service, or from the US National Technical Information Service, 5285 Port Royal Rd., Springfield, VA, USA-22161.
The data library on magnetic tape is available from the IAEA Nuclear Data Section. For a summary see the document IAEA-NDS-157, format IAEA-NDS-159.

EPDL, the Evaluated Photon Data Library of the Lawrence Livermore National Laboratory, USA. This data library is published in tabular and graphical form in the report UCRL-50400 Vol. 6 Rev. 4 (1989) by D.E. Cullen, M.H. Chen, J.H. Hubbell, S.T. Perkins, E.F. Plechaty, J.A. Rathkopf, J.H. Scofield. This report has 804 pages in 2 volumes (Z =1 to 50 resp. Z = 51 to 100). It contains cross sections, from 10 eV to 100 GeV, average energy deposits, and form factors in tabular and graphic form; in addition, photoelectric cross-sections for each shell and coherent anomalous scattering factors are presented in graphic form. This handbook is available as a set of microfiches from the IAEA INIS Microfiche Service, or from the US National Technical Information Service, 5285 Port Royal Rd., Springfield, VA, USA-22161.
The data library on magnetic tape is available from the IAEA Nuclear Data Section. For a summary see the document IAEA-NDS-158, format IAEA-NDS-159.

ENDF/B-6 Photo-atomic Interaction Data "EN6-PHOTO". **online**
This is essentially identical to EPDL mentioned above. The main differences are: This library is in ENDF-6 format (EPDL has its own format). The energy range is from 10 eV to 100 MeV (EPDL goes up to 100 GeV). A tape copy is available. For a summary description see the document IAEA-NDS-58 Rev. 3. In NDIS it is available online under the keyword XRAY. Selected materials from this library have been included in FENDL, the evaluated nuclear data library for fusion applications, see document IAEA-NDS-128.

JEF-2/Photo, the JEF-2 photo-atomic interaction data library containing pair production cross-sections, photoelectric cross-sections, coherent scattering cross-sections, atomic form factors, and other data for all elements from Z=1 to 100. It is based on the Livermore EPDL file and on the ENDF/B-6 Photo-Atomic data file. Compared to ENDF/B-6, the photo-electric cross-section data have been updated in 1990. - 260 000 records. Summary documentation: IAEA-NDS-58 Rev. 4. - Available online and on magnetic tape.

X-ray fluorescence cross-sections. Tabulated calculated XRF cross-sections for K-shell X-rays for elements Z=13 to 92 and L-shell X-rays for Z=35 to 92, in the energy range from 1 to 200 keV. S. Puri et al. (Punjab University, India), in Atomic Data and Nuclear Data Tables 61, 289-311 (1995).

XCOM: Photon-cross-sections for scattering, photoelectric absorption and pair production, as well as total attenuation coefficients, in any element, compound or mixture, at energies from 1 keV to 100 GeV, on a set of two diskettes, by M.J. Berger and J.H. Hubbell, NBS Washington. Summary documentation see IAEA-NDS-89. Full report see M.J. Berger, J.H. Hubbell, XCOM: Photon cross-sections on a personal computer, NIST report - NBSIR 87-3597 (1987).

X-ray interactions. Photoabsorption, scattering, transmission, and reflection of x-rays in the energy-range 50 eV - 30 keV for all elements Z = 1-92. A data handbook with a textbook-similar introduction by B.L. Henke, E.M. Gullikson, J.C. Davis, Berkeley, published as vol. 54/2 of the journal Atomic Data and Nuclear Data Tables (1993).

Old data files that should be considered as superseded:

RSIC Photo-Atomic Interaction Library of 1983. This is the same as the ENDF/B-5 photon interaction library and the JEF-1 photon interaction library. Both are available from NDS in ENDF-5 format. Summary see document IAEA-NDS-58 Rev. 2. These should be superseded by the ENDF-6 version mentioned above, but may still be preferable to users not yet familiar with the ENDF-6 format.

X-ray cross-sections: For an old compilation see the report UCRL-50174 of 1969 (set of microfiches in the IAEA Library, copies available upon request). Authors are W.H. McMaster et al. from Livermore and J.H. Hubbell from the National Bureau of Standards.

ENDF/B-4 Photon-interaction library (1977). This was taken from Livermore and should be similar to the following:

ENDL photon-interaction cross-sections (1977)
Summary documentation: IAEA-NDS-58
Full tabulation and graphs: UCRL-50.400 Vol. 6 Rev. 2 (1978)
Superseded by EPDL, see above.

23. Charged-particle nuclear reaction data

EXFOR, compilation of experimental and evaluated nuclear reaction data induced by charged particles and heavy ions. Retrievals online (acronym "CSISRS"), or on tape upon request. **online**

Special emphasis:

a. Integral cross-sections and thick target yields
Magnetic tape: for documentation see above under item 1.
Handbook: Published within the series "Physik Daten/Physics Data" Karlsruhe 1979. (Partly superseded).
Bibliography and data index: Published as BNL-NCS-50640 and BNL-NCS-51771.

b. Neutron source reactions: available on magnetic tape.

c. Miscellaneous data, e.g. differential data, data for biomedical applications, charged-particle induced fission data.

NRDF, the Nuclear Reaction Data File of the Japan Charged-Particle Nuclear Reaction Data Group under H. Tanaka at the Hokkaido University. Much of this database has been converted and included in EXFOR. See M. Chiba et al, "A database translator of nuclear reaction data for international data exchange", in Journal of Information Science 12 (1986) p. 152-165.

Charged-particle induced neutron source reactions, see next chapter on "Nuclear data for thermonuclear fusion".

ENDF/B-6 charged-particle sublibraries, 1991 version. Includes complete (double differential) evaluations for the interaction of protons with 1-H-1 and 2-He-3, and evaluated cross-sections for five fusion reactions. Available on tape or floppy diskette. Documentation see IAEA-NDS-105. **online**

ENDF/B-6 High Energy Data File (1990): contains proton (and neutron) reaction data up to 1 GeV for 6-C-12, 26-Fe-56, 82-Ph-208, 93-Bi-209. See IAEA-NDS-113 Rev. 1. **online**

NRABASE 2.0. Differential charged-particle cross sections for Ion Beam Analysis. Experimental data compiled in tabular and graphical form by A. Gurbich, Obninsk, Russia, under a contract with the IAEA Physics Section. PC database with display software. Summary documentation: IAEA-NDS-201 (March 1997).

NNDC Evaluated Charged Particle Reaction Data Library, (1975). Selected p, d, and α induced reactions calculated for target nuclei with Z from 21 to 83, in an ENDF/B similar format.
Documentation of format and contents: IAEA-NDS-59, Rev. 1

Proton beam monitors, evaluated cross-sections. Report INDC(CCP)-330 by V.A. Vukolov and F.E. Chukreev.

Monitor reactions for radioisotope production, a status report on cross-sections. Report INDC(NDS)-218, Dec. 1989, by O. Schwerer and K. Okamoto.

Production of I-123, Xe-123 and Cs-123, a compilation of excitation functions for the production of radionuclides by charged-particle induced reactions. Report INDC(JPN)-144, Oct. 1990, by A. Hashizume, Y. Tendow, K. Kitao.

Stopping power data: ESTAR, PSTAR, ASTAR, a PC package for calculating stopping powers and ranges of electrons, protons and helium ions in various materials, by M.J. Berger, NIST, Washington. Available on 2 diskettes (compressed); documentation see IAEA-NDS-144.
For protons and alpha particles this work has been described in ICRU-report-49 which also contains tabulated data.

Stopping power data: POTAUS, a PC code for calculating the stopping power and range data of various beams in various materials, by F.E. Chukreev, CAJaD, Moscow. The code is based on P.G. Steward, report UCRL-18127 (1968).
Available on diskette; documentation see IAEA-NDS-146.

Neutron yields from alpha-particle induced reactions on Li, Be, B, C, O, F up to 10 MeV. Tables of recommended data see report INDC(CCP)-331 by V.A. Vukolov and F.E. Chukreev.

PNESD - Proton Nucleus Elastic Scattering Data by H. Leeb (1978).
Summary documentation: IAEA-NDS-22

Handbook: K.A. Keller, J. Lange and H. Münzel; Excitation Functions for Charged-Particle induced Nuclear Reactions.
Landolt-Börnstein Series Group I, Vol. 5b, Springer Verlag, Berlin (1973) pp. 1-493.
These data are <u>not</u> available in a computerized form.

Charged-particle activation cross-sections and thick target yields.
See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 441-630.

Thick Target Yields: Yield of radionuclides from proton, deuteron, alpha-particle and He-3 reactions. P.P. Dimitriev (Energoatomizdat, Moscow 1986).
English translation: report INDC(CCP)-263, costfree.
Data not available on magnetic tape.

CPX, experimental charged-particle reaction data compiled in 1962/67 by McGowan et al. This library (excepting the differential data) was checked by Kachapag against publications, doubtful and superseded data were deleted. The resulting file as published in Physik-Daten/Physics-Data 15-5 was included in EXFOR (accession-numbers starting with P...).

ECPL-86 - the LLNL evaluated charged-particle data library, for 14 target isotopes from 1-H-1 to 8-O-16, in ENDL Transmittal format.
Summary of contents: IAEA-NDS-56
Summary of format: IAEA-NDS-53

24. Intermediate energy nuclear data

a. Reactions induced by neutrons

MENDL-2, the Russian cross-section data library for transmutation and activation of materials irradiated by neutrons with energies up to 100 MeV. Yu.N. Shubin et al., report INDC(CCP)-385. - Available on tape from the IAEA Nuclear Data Section.
Summary documentation: IAEA-NDS-136.

WIND and WIND-2: Neutron nuclear data library for isotopes of U, Np, Pu up to 100 MeV, with one file of proton reaction data for U-238 and a file for Pu-239 up to 2 GeV. By A.Ju. Konobejev et al., Obninsk, Russia.
Summary documentation: IAEA-NDS-143 Rev. 1.

BISERM v.2: Nuclear Data Library for Evaluation of Radiation Effects in Materials Induced by Neutrons of Intermediate Energies. By Yu.A. Korovin et al., Obninsk, Russia. The library contains neutron displacement cross sections as well as hydrogen and helium production cross sections for 259 stable nuclei from Al-27 to Bi-209 at neutron energies up to 1 GeV. The data are in slightly modified ENDF-6 format. Available on PC diskette.
Summary documentation: IAEA-NDS-203 (March 1997).

b. Reactions induced by neutrons and charged particles

MENDL-2P. Proton reaction data library for nuclear activation by Yu.N. Shubin et al., Obninsk, Russia. This library includes calculated proton cross-sections in ENDF-6 format for 505 nuclei (Z=13-84) for energies up to 200 MeV. The total number of reactions is 87196. Available on a set of PC-diskettes (compressed), on CD-ROM or by FTP.
Summary documentation: IAEA-NDS-204.

ENDF/B-6 High Energy Data File (1990/1993): contains four sets of neutron and proton reaction data up to 1 GeV for 26-Fe-56 (1990) and 6-C-12, 82-Pb-208, 93-Bi-209 (1993). See IAEA-NDS-113 Rev. 1. **online**

EXFOR: Includes experimental data for reactions induced by intermediate-energy neutrons and charged particles, though the compilation does not claim completeness. Retrievals to be requested from the data centers. These data are included in the NDIS Online System. **online**

np and pp cross-sections up to 350 MeV, internationally recommended standard reference data. The data can be obtained from VL40, an energy-dependent partial-wave representation which can be accessed on-line through TELNET. See report NEANDC-311 (1992), the 1991 NEANDC/INDC Nuclear Standards File, p. 17.

c. Charged-particle induced reactions

WIND: The WIND library for neutron reaction data (see above), includes one file of proton reaction data for U-238.

Levkovski. Handbook by V.N. Levkovski: Cross-sections of medium mass nuclide activation (A=40-100) by medium energy protons and alfa particles (E=10-50 MeV). Moskva 1991. The book is in Russian. An English language abstract and table of contents is attached. The many tables and graphs are understandable without knowledge of Russian. - The book contains the experimental results of activation cross-sections for more than 500 nuclear reactions. The data have been measured on the cyclotron of the Nuclear Physics Institute of the Academy of Sciences of Kazakhstan. Most of them have not yet been published elsewhere. - The book can be obtained from Dmitri Levkovski, Russia, 140012, Moscow region, Lubertsy, 1-Pankovski proezd 1-2-17, Tel. (095)554-4789, e-mail Internet dima@misis,msk,su. The cross-section data from this book have been compiled in EXFOR by F.E. Chukreev, Nuclear Data Center of the Moscow Kurchatov Institute, and are included in the NDIS Online System as part of EXFOR. See the EXFOR entry number A0510 with 542 subentries. **online**

Carlson compilation. Proton-nucleus total reaction cross-sections and total cross-sections up to 1 GeV. Tables of all directly measured data. By R.F. Carlson, Univ. of Redlands, California. Published in Atomic Data and Nucl. Data Tables 63 (1996) p. 93-116. **Not** available as a computer file.

d. Literature:

Report INDC(NDS)-245 (1991). Intermediate energy nuclear data for applications. Proceedings of an IAEA meeting, 9-12 Oct. 1990. N.P. Kocherov (ed.)

Report JAERI-M-92-39. Proceedings of a JAERI meeting in high energy nuclear data, 3-4 Oct. 1991. T. Fukahori (ed.)

Report NEA/NSC/DOC(93)-6 (1993). Requirements for an Evaluated Nuclear Data File for Accelerator-Based Transmutation. A.J. Koning.

Report HEDL-TME-81-37 (1982). F.M. Mann, Transmutation of alloys in the MFE facilities as calculated by REAC (a computer system for activation and transmutation).

Production of Radionuclides at Intermediate Energies, H. Schopper (ed.), handbooks published in the Landolt-Börnstein series by Springer-Verlag, Heidelberg, Germany. (Not available from IAEA.)

- protons on targets He to Br: vol. I/13 a (1991)
- protons on targets Kr to Te: vol. I/13 b (1992)
- protons on targets I to Am: vol. I/13 c (1993)
- protons on misc. targets (Suppl.): vol. I/13 d (1994)
- pions and antiprotons on nuclei: vol. I/13 e (1994)
- deuterons, tritons, He-3 nuclei on nuclei: vol. I/13 f (1995)

25. Nuclear data for thermonuclear fusion

ENDF/B-6 charged-particle sublibraries, 1991 version, including fusion reactions between d,t, and He3 particles. Available on tape or floppy diskette. Documentation see IAEA-NDS-105.

FENDL/C-2.0, (March 1997). Integrated cross section evaluations and processed data for the fusion reactions H-2 (d,n)He-3, H-2(d,p)H-3, He-3(d,p)He-4, H-3(t,2n)He-4, and H-3(d,n)He-4, in ENDF-6 format. The data for the first four reactions are extracted from ENDF/B-6 (unchanged from previous version FENDL/C-1.0), while the data for the H-3(d,n)H-4 reaction were replaced with an improved evaluation by G.M. Hale and M. Drosg. Available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-177.

DROSG-96. Monoenergetic neutron source reactions, by M. Drosg, University of Vienna. The diskette database, previously known as DROSG-87, was extended significantly and contains now 30 reactions and various new features. The diskette contains the basic data and several FORTRAN programs for calculation of neutron yields, and white source properties. A detailed documentation is included in the diskette. The database with programs (in compressed form) is also available via anonymous FTP from the University of Vienna (FTP to PAP.UNIVIE.AC.AT, subdirectory NEUTRON).

GRAZ-87. A data library for evaluated nuclear reaction cross-sections and reaction rates for charged-particle reactions with light isotopes (Z=1/to 5), with related computer codes, by R. Feldbacher, INDC(AUS)-12, 1987.
Documentation of the tape see IAEA-NDS-86.

Nuclear physics constants for thermonuclear fusion, a reference handbook by S.N. Abramovich, B.Ya. Guzhovskij, V.A. Zherebtsov, A.G. Zvenigorodskij. The Russian original by Atominform can be obtained from the Collection Laboratory, P.O. Box 971, Moscow, USSR-127434. An English translation by A. Lorenz is available as report INDC(CCP)-326. This handbook contains tabular cross- section data for all relevant interactions of p, d, t, He3 and a particles on the light nuclei from 1-H-1 to 4-Be-9.

26. Nuclear data selected for fusion programs

FENDL-2. Several nuclear data files have been released and processed for the ITER fusion programme:

FENDL/A-2.0 (March 1997). Comprehensive neutron cross section library for 13006 neutron activation reactions with 739 target nuclides from H to Cm in the incident energy range up to 20 MeV. The data are in ENDF format with some modifications. Compared to the previous version FENDL/A-1.1, many nuclides and reactions were added or revised. The evaluations were selected from major activation libraries including EAF-4.1, ADL-3, JENDL/A-3.2 and others. Available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-173.

FENDL/A-2.0 Processed Files. (FENDL2/A-MCNP, FENDL2/A-VITJ_E, FENDL2/A-VITJ_FLAT). Pointwise cross sections (any resonance parameters contained in the original data files were converted to cross sections) for 13006 activation reactions for 739 target nuclides (including metastable states), processed for use with the Monte Carlo neutron/photon transport code MCNP, and as VITAMIN-J 175 multigroup data weighted with the VITAMIN-E neutron weighting spectrum and with a constant (flat) weighting spectrum. Available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-174 (March 1997).

FENDL/C-2.0, (March 1997). Integrated cross section evaluations and processed data for the fusion reactions H-2 (d,n)He-3, H-2(d,p)H-3, He-3(d,p)He-4, H-3(t,2n)He-4, and H-3(d,n)He-4, in ENDF-6 format. The data for the first four reactions are extracted from ENDF/B-6 (unchanged from previous version FENDL/C-1.0), while the data for the H-3(d,n)H-4 reaction were replaced with an improved evaluation by G.M. Hale and M. Drosg. Available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-177.

FENDL/D-2.0. Decay properties (decay type, decay energy, half-life) for 1867 nuclides and isomers, taken from the EAF-4.1 decay library. The data, in ENDF-6 format as well as processed into MNCNP and REAC-compatible formats, are available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-178 (March 1997).

FENDL/E: Selected evaluated neutron, photon interaction and photon production cross sections in ENDF format. Check with IAEA Nuclear Data Section about release of version 2.0. For version 1.1 see documents IAEA-NDS-128,-129,-169.

EFF. Several neutron nuclear data files have been selected for the European Fusion Programme: see chapter 4.

Superseded:

INDL/F-83 - evaluated neutron reaction data library for INTOR fusion calculations, containing evaluations selected from ENDF/B-4, ENDF/B-5, ENDL-78. Two formats, either with resonance parameters, or as RECENT output.
Summary documentation, IAEA-NDS-57

27. Nuclear model parameters

A reference input parameter library for nuclear model calculations of nuclear data (primarily neutron reaction data up to 30 MeV) is being developed by an IAEA Coordinated Research Program. See reports

INDC(NDS)-321 and
INDC(NDS)-335: Cervia meeting 19-23 Sept. 1994;
INDC(NDS)-350: Vienna meeting 30 Oct.-3 Nov. 1995.

EVLDF - "Evaluation data file", for storing basic data on nuclei, level scheme, deformation parameters, level density parameters and optical model parameters, by T. Fukahori and T. Nakagawa. Not available at IAEA. See report INDC(NDS)-335 p. 7. - Format description by T. Nakagawa see report INDC(NDS)-335 p. 21.

CENPL - "Chinese evaluated nuclear parameter library". Six sublibraries for

- masses and ground state constants
- discrete level schemes and gamma branching ratios
- level densities
- giant dipole resonance parameters for gamma strength functons (see "GDR" on p. 21 of this document)
- fission barrier parameters
- optical model parameters.

Not available at IAEA (except for "GDR"). Description by Su Zongdi et al. see report INDC(NDS)-335 p. 47-95, and Chin. J. of Nucl. Phys. 17(3) p.271-276.

Nuclear Charge Radii - Nuclear charge radii, root-mean-square values, measured by fast electron scattering and muonic atom X-rays, evaluated by I. Angeli, 1990. See Acta Physica Hungarica 69(3-4) pp. 233-247 (1991). (= IAEA-NDS-163).

Nuclear Charge Radii, see also: journal "Atomic Data and Nuclear Data Tables" vol. 60 Number 2, July 1995.

28. Nuclear model codes

In general requests for nuclear model computer codes should be addressed to the NEA Data Bank, Le Seine Saint-Germain, 12 blvd des Iles, F-92130 Issy-les-Moulineaux, France.

Mentioned here are only some codes which were converted for use on a personal computer at the IAEA Nuclear Data Section, or which were produced or updated in connection with an IAEA research contract or IAEA coordinated research project.

ALICE-87 (Livermore), precompound nuclear model code. Documentation for PC see IAEA-NDS-93.
Note that ALICE-91 now exists which should be requested from the NEA Data Bank.

EMPIRE (Poland), preequilibrium/compound nuclear model code. Documentation for PC see IAEA-NDS-94.

ICAR (Bologna), code for combinatorial calculations of level densities.
Documentation for PC see IAEA-NDS-94.

SCAT2 (Bruyères-le-Châtel), optical nuclear model code. Documentation for PC see IAEA-NDS-99.

STAPRE (Vienna), statistical pre-equilibrium code. Documentation for PC see IAEA-NDS-99.

PEGAS (Bratislava), PC version of a highly sophisticated pre-equilibrium code based on the unified model of nuclear reactions, by E. Betàk and P. Obložinský.
See report INDC(SLK)-1.

PEQAG (Bratislava), PC version of a fully pre-equilibrium computer code with gamma-emission, by E. Betàk.
See report INDC(CSR)-16.

31. Nuclear structure and decay data

FENDL/D-2.0. Decay properties (decay type, decay energy, half-life) for 1867 nuclides and isomers, taken from the EAF-4.1 decay library. The data, in ENDF-6 format as well as processed into MNCNP and REAC-compatible formats, are available on magnetic tape or by FTP file transfer. Summary documentation: IAEA-NDS-178 (March 1997).

ENSDF, evaluated nuclear structure and decay data file available online or on magnetic tape. Published in the journal "Nuclear Data Sheets". For a summary of its philosophy, content and uses see document IAEA-NDS-104. For the network of cooperating data centers in this field see report INDC(NDS)-296 (1993). A Manual for Preparation of Data Sets see J.K. Tuli, The evaluated nuclear structure data file (ENSDF), report BNL-NCS-51655 Rev. 87 (April 1987). Procedures Manual for ENSDF see BNL-NCS-40503 (Oct. 1987). **online**

For a brief description of ENSDF and instructions for the online service see IAEA-NDS-150 chapter 7.

Re ENSDF Physics Processing Codes, instructions for A-chain evaluations, and ENSDF Dictionaries see document IAEA-NDS-40; ENSDF analysis codes see IAEA-NDS-52. For a related bibliography, "NSR", see chapter 22 of this document.

Note: ENSDF can be accessed online. Tape copies can be made available as well, but their use and continuous update procedures require extensive training. - Many data files that are derived from ENSDF are available.

Isotope Explorer (previously VuENSDF), is a 32-bit Windowsprogram for retrieving, displaying, listing, manipulating and searching nuclear structure and decay data. Information from the Evaluated Nuclear Structure Data file (ENSDF) and the Table of Isotopes databases (nuclear structure data, radioactive decay data and superdeformed bands data) is available for viewing with Isotope Explorer.

Isotope Explorer is very flexible with regard to data sources: it can access the Table of Isotopes databases directly via the Internet from the Berkeley or Lund servers; it can use locally stored data (e.g. from the Table of Isotopes CD-ROM); and it can operate as a helper application for WWW browsers, allowing data in the ENSDF format available on the WWW to be accessed remotely.

The Isotope Explorer is available via the Internet from the Isotopes Project (http://ie.lbl.gov/isoexpl/isoexpl.htm) and the Lund Nuclear Data Service (http://www.fysik.lu.se/nucleardata/isoexpl/isoexpl.htm) web sites.

NUDAT. This is a database in which essential data have been extracted from ENSDF in a user friendly form. This database is accessible only in online manner. It includes for each nuclide **online**

- adopted levels and gamma-ray energies
- half-lives and other properties of ground and metastable states
- decay radiations.

For these data NUDAT is updated frequently, and simultaneously with ENSDF.

In addition, NUDAT includes thermal neutron cross-sections and resonance-integral data of the book "Neutron Cross-Sections" (1981/1984), see chapter 7 of this document.

For a description of NUDAT and instructions for the online service see IAEA-NDS-150 chapter 8. Note: NUDAT can be accessed only online; no tape copies are available.

PCNUDAT. A PC package which displays the data contained in the online system NUDAT, by Robert R. Kinsey. Summary documentation: IAEA-NDS-162.

RADLST, a program calculating decay radiations from ENSDF. The calculated decay radiations are included in NUDAT, see above. - T.W. Burrows, The program RADLST, report BNL-NCS-52142 (1988). See also IAEA-NDS-104.

NUCHART. A PC package which displays nuclear decay data from ENSDF/NUDAT, including a search routine for assigning gamma-ray energies to radionuclides. NUCHART for Windows, version 1.2 of Feb. 1995, by V. Osorio and H. Peraza, IAEA Physics Section. Documentation: IAEA-NDS-161. Available on a set of PC diskettes or by FTP. **FTP**

Table of Isotopes, 8th edition 1996, by R.B. Firestone, Lawrence Berkeley National Laboratory, USA. It contains nuclear structure and decay data for over 3100 nuclides with masses from 1 to 272. It contains in handbook form data from ENSDF (Evaluated Nuclear Structure Data File) maintained by the U.S. National Nuclear Data Center and updated by the nuclear data evaluators of the U.S. Nuclear Data Network and the Nuclear Structure and Decay Data Evaluators Network of the IAEA. The bulk of the book contains nuclear structure and decay data (levels, gamma-rays, etc.) In graphical and tabular form for all nuclides, sorted by mass number A and atomic number Z. It is supplemented by various additional data tables such as nuclear spectroscopy standards, atomic data, transition probabilities, range and stopping power data, and others. 3200 pages in two volumes, with a CD-ROM containing the same data. - **Not available from IAEA**. To be ordered through scientific book shops or from the publisher, John Wiley and Sons Inc., 605 3rd Avenue, New York, NY-10158. - Note: this book will serve as an international reference book for at least the next decade, similar to the previous edition which had been published by Mike Lederer in 1978. For those nuclides, however, where the evaluated data will be updated due to new and more precise experimental data, the Online Services should be consulted to obtain the most uptodate information.

NUBASE. New database for experimentally known nuclear properties, by G. Audi, O. Bersillon, J. Blachot, A.H. Wapstra. Available from the Atomic Mass Data Center (AMDC), see below. **Not available from IAEA**. - NUBASE contains mass, isomeric excitation energy, half-life, spin, parity, decay modes and intensities for more than 3000 nuclides. Published in the journal Nuclear Physics, Vol A624 (1997), pp. 1-124. Available by anonymous FTP from csnftp.in2p3.fr, directory /pub/symfond/audi/mass, or consult the AMDF web site at http://csnwww.in2p3.fr/amdc/.

JEF-Report 13, OECD Nuclear Energy Agency, August 1994. This report of 328 pages contains tabulations retrieved from the radioactive decay data library and the fission yield data library of JEF-2.2, the Joint Evaluated nuclear data File, version 2.2, of the NEA Data Bank. It also contains an intercomparison of the main decay parameters (half-life, Q-value and average gamma, beta and alfa energies) in the data libraries JEF-2.2, ENDF/B-6, and JNDC-2. While many of the decay data are in agreement, because they originate from a common source (i.e. ENSDF), there are significant discrepancies between the three data libraries for many nuclides. A limited number of copies of this report is available, costfree, from the IAEA Nuclear Data Section.

"XG Standards" - Decay data for radionuclides used as calibration standards, "X-Ray and Gamma-Ray Standards for Detector Calibration", produced by the participants of an IAEA Co-ordinated Research Project 1986-1990, IAEA-TECDOC-619 (1991). The recommended values are contained on a PC diskette "XG Standards" by Hartmut Lemmel 1991 documented in IAEA-NDS-112 Rev. 1 (1991). - H.D. Lemmel (ed.).
The recommended values are also quoted in the handbook NEANDC-311 "Nuclear Data Standards for Nuclear Measurements", 1991 NEANDC/INDC Nuclear Standards File, H. Condé (ed.).
This supersedes preliminary publications by A. Lorenz in several INDC(NDS)-reports and in the Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 187-198.

EME, data library of electron emissions. A handbook in two volumes, in French, issued in 1995 by the Laboratoire Primaire des Rayonnements Ionisants (LPRI) Saclay, B.P. Nr. 52, 91193 Gif-Sur-Yvette, France. - For 194 radionuclides energies and intensities of electron emissions are given, in nuclide sort and energy sort. The data are mostly from LPRI evaluations, in some cases from ENSDF. - At present not available from IAEA; contact the issuing institute.

Decay data of radionuclides are tabulated in the Chart of Nuclides 1992 of the Japanese Nuclear Data Committee, unnumbered report with fold-out map.

ENDF/B-6 decay data, see document IAEA-NDS-132. It includes radioactive decay data for 265 nuclides, and the fission neutron spectrum of 98-Cf-252 evaluated by W. Mannhart (compare under "Nuclear data standards" and document IAEA-NDS-98).

JEF-2/DD, the JEF-2 radioactive decay data library by the NEA Data Bank, in ENDF-6 format, containing decay data for 2345 radionuclides. The data, which were compiled by the JEF Decay Data Working Group, were mostly taken over from UK decay data files and from ENSDF. Brief documentation: IAEA-NDS-122 Rev. 1. Available online and on magnetic tape.

PANDORA, version 5.3 (Dec. 1991), a PC version of an ENSDF checking code to be used by ENSDF evaluators, is available on a PC diskette.

"Nuclear Wallet Cards", (July 1995), a booklet by J.K. Tuli, US National Nuclear Data Center, Brookhaven National Laboratory, Upton NY, USA-11973. It lists for all known nuclides and some of their isomers the natural abundance or the half-life and decay mode. Also included are spin and parity assignments and the mass excess. The data are included in NUDAT, see above. An appendix lists fundamental physics constants. This booklet can be obtained free of charge from the author at the address given above. - Limited number of copies available costfree from the IAEA Nuclear Data Section.

ENDF/B-6 decay data library, contains all pertinent decay data for all nuclides occurring in the ENDF/B-6 neutron reaction data library, specifically fission-product nuclei, radionuclides resulting from neutron activation, and actinides.
Summary documentation see IAEA-NDS-108.

Specific Activities of Radionuclides. See the report LA-12981 (Aug. 1995) by Jim Clow et al: "Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides". This report on hazard threshold for radiological protection contains a table of specific activities for radionuclides in Ci/g as a U.S. standard for safety analysis.

Decay Data of the Transactinium Nuclides. Values for half-lives and emission probabilities for alpha particles and selected gamma rays, recommended by an IAEA Coordinated Research Programme on the measurement and evaluation of transactinium isotope decay data. IAEA Technical Report 261 (1986). This handbook has a salesprice of 400,- Austrian Schillings. A limited number of copies is available free of charge to scientists in developing countries.

UKPADD-2: Activation product decay data, by A.L. Nichols, AEA Harwell, UK. It includes, in ENDF-6 format, comprehensive decay scheme data for 236 activation product nuclides: half-life; total decay energy (Q-value); branching fractions; alpha-particle energies, and emission probabilities; beta-particle energies, emission probabilities and transition types; gamma-ray energies, emission probabilities and internal-conversion coefficients; spontaneous fission data including prompt and gamma-ray spectra. - PC diskette. - Documentation: IAEA-NDS-134 (same as AEA-RS-5449, March 1993). (History: The first version had been published in the report AERE-R-8903 (1989), A.L. Nichols: Radioactive-nuclide decay data for reactor calculations; activation products and related isotopes.)

Strengths of gamma-ray transitions in nuclei A = 5-44, by P.M. Endt, in the journal Atomic Data and Nuclear Data Tables 55, 171-197 (1993). Not available on magnetic tape.

ENSGAM. A PC database for about 15000 gamma rays from 2777 radioactive nuclides derived from ENSDF by P. Ekström and L. Spanier, Lund University, Sweden.
Documentation: IAEA-NDS-118.
A set of 6 PC diskettes available costfree from IAEA Nuclear Data Section.

"Strong-gammas". A PC database of strong gamma-rays emitted from radionuclides, extracted from ENSDF as of Sept. 1993, by T. Narita, T. Ichimiya, and K. Kitao (JAERI), compare the tabulation that was published in the report JAERI-M-94-059 (1994). Summary of contents: IAEA-NDS-111, Rev. 1.

An extract from an earlier version of this database (report JAERI-M-92-051, 1992), for all gammas with intensities higher than 5% has been included in a PC diskette attached to the IAEA Technical Report 357: Handbook on Nuclear Data for Borehole logging and Mineral Analysis (1993).

Catalog of gamma-rays unplaced in radioactive decay schemes. Compilation extracted from ENSDF. Report JAERI-M-91-037 by T. Narita and K. Kitao. At the IAEA Nuclear Data Section only the report is available, not the computer file.

Kondrashov Gammas. A PC database for gamma-rays form radionuclides, by V. Kondrashov. 16682 gamma lines from 749 nuclides. Either ASCII text file or in MS Word. Designed for use with the code DIMEN. Origin of the database: Publication 38 of the "International Commission on Radiological Protection", Moscow, Energoatomizdat, 1987. - Summary documentation: IAEA-NDS-172.

UKHEDD-1 - Radioactive heavy element decay data for reactor calculations in ENDF/B format, by UK Chemical Nuclear Data Committee, A.L. Nichols, M.F. James. 125 nuclides 80-Hg-206 to 99-Es-253, 35949 records. Full report: AEEW-R-1407 (Dec. 1981). Summary Documentation: IAEA-NDS-60
Note: This is superseded by UKHEDD-2 issued in Spring 1992.

Internal conversion coefficients: Compilation of experimental values of internal conversion coefficients and ratios for nuclei with Z>60, by H.H. Hansen, CBNM Geel. Report Physik Daten/Physics Data Nr. 17-2, 1985. Data not available on tape.

Decay alphas: Recommended energy and intensity values of alpha particles from radioactive decay. A consistent set of recommended energy and branching values, evaluated by A. Rytz, Bureau International des Poids et Mesures, France. Not available on tape. See Atomic Data and Nuclear Data Tables 47, 205-239 (1991).

Decay alphas: Catalog of alpha particles from radioactive decay. Compilation by W. Westmeier and A. Merklin. See Physikdaten/Physics Data No. 29-1 (1985). Not available on tape.

SGNucDat, Version 2. Safeguards Nuclear Data for Windows. Contains the data of report INDC(NDS)-248 (1991), updated 1997. A: Actinide nuclear data (decay data, selected neutron cross-section data, fission-neutron data); B: fission-product nuclear data (decay data and selected neutron cross-section data); C: fission-product yield data. PC code by G. Pospischil. Data compiled by M. Lammer, O. Schwerer and N.P. Kocherov, documented in report IAEA-NDS-248, Rev. 1 (1997).

Beta and antineutrino decay of radionuclides. A handbook by V.G. Aleksankin, S.V. Rodichev, P.M. Rubcov, P.A. Ruzhanskij, F.E. Chukreev, Moscow, Energoatomizdat 1989. 100 pages text in Russian, 700 pages of energies and intensities of beta and antineutrino radiations plus other decay parameters for all radionuclides.
Neither the book nor the data file are available from IAEA.

CDRL-82 and **ENSL-82**. Evaluated nuclear structure library. On tape or microfiche. See UCRL-50400, vol. 23, plus addendum.
Also IAEA-NDS-37

Blachot library: Decay data for heavy nuclides, fission products and activation products, with program package. J. Blachot, Sept. 1982. Three data files plus 3 computer codes (EDIBIB, TRIGAL, ISOTAB).

Jülich Decay Gamma Data File (1979): Compilation of gamma and X-rays for 2055 radionuclides. Main purpose: Evaluation of gamma-ray spectra. Summary documentation: IAEA-NDS-19 Rev. 2.
See also the report Jül-Spez-34 (April 1979) by G. Erdtmann and W. Soyka: The radionuclide gamma ray data file "GAMDAT-78".

GAMCAT, gamma and alpha rays from radioactive decay. A PC-diskette database offered by the Fachinformationszentrum Kalrsruhe, D-7514 Eggenstein-Leopoldshafen 2, for a sales price of 980.- DM, plus tax. Not available from IAEA. Compare document IAEA-NDS-117. This database is based on the following publications:

1. U. Reus, W. Westmeier: Catalog of Gamma Rays from Radioactive Decay; Atomic Data and Nuclear Data Tables Vol. 29 p. 1-406 (1983); this superseded the earlier publication by U. Reus, W. Westmeier, I. Warnecke: Gamma-Ray Catalog, report GSI-79-2 (1979), which is available from IAEA-NDS on tape under the library name GSIGAM79.

2. W. Westmeier, A. Merklin: Catalog of Alpha Particles from Radioactive Decay; Physik-Daten/Physics Data no. 29-1 (1985).

ENDF/B-5 Actinide Decay Data: Available as microfiche INEL-RLB-FXUB-TRA or included in the ENDF/B-5 Actinides library (see above under "Actinides").

Spontaneous fission data: Yields and spectra of fission neutrons and fission products, see EXFOR.

Nuclear quantities such as nuclear temperatures, level density parameters, spin cut-off factors, see EXFOR.

Japanese gamma-ray spectrum data library of fission product nuclides, see report JAERI-1311, March 1988, by J. Katakura and T. Yoshida.

Fission product decay data
See above under "Fission products - evaluated neutron reactions, yields and decay data".

Radioactive Decay Data Tables, a handbook of decay data for application to radiation dosimetry and radiological assessments, by David C. Kocher, Oak Ridge, (1981). Not available from IAEA-NDS.

Superseded:

Table of Radioactive Isotopes, by E. Browne, R.B. Firestone (Lawrence Berkeley Laboratory), John Wiley & Sons, New York, 1986.

32. Gamma ray analysis

IDGAM, A PC code and database to identify isotopes in a radioactive sample by their gamma rays. Diskette by R. Paviotti Corcuera, M. de Moraes Cunha, K.A. Jayanti, Sao José dos Campos, Brazil.
It uses the database "Strong gammas" (see preceding chapter) by T. Narita et al. with about 6000 gamma lines. Documentation: IAEA-NDS-135.

GAMQUEST, a computer program to identify gamma rays, by E. Browne, Lawrence Berkeley Laboratory, USA. Not available from the IAEA. - This program is especially suited to the analysis of samples produced by neutron activation, and of environmental samples containing radioactive pollutants. It searches a large database of over 60 000 gamma rays to identify the spectral lines from samples. It runs on the VAX/6610 computer cluster of the Lawrence Berkeley Laboratory and can be accessed from individual accounts of through Hepnet, Internet, or World Wide Web networks. - Documentation see report LBL-35715.

NUCHART. A PC package which displays nuclear decay data from ENSDF/NUDAT, including a search routine for assigning gamma-ray energies to radionuclides. NUCHART for Windows, version 1.2 of Feb. 1995, by V. Osorio and H. Peraza, IAEA Physics Section. Documentation: IAEA-NDS-161. **FTP**
Available on a set of PC diskettes, or via FTP.

Handbook: C. Vylov et al., Spectra of radioactive nuclides radiation, measured with semiconductor detectors. Atlas of measured spectra. Reports ZfK-399 and ZfK-505, 1983.

GANAAS. A PC software for gamma spectrum analysis, activitiy calculations and neutron activation analysis, by the IAEA Physics Section. A set of four HD diskettes and a software handbook IAEA/CMS-3. The package uses the thermal neutron cross-section data by E. Gryntakis et al. (Handbook of Nuclear Activation Data, IAEA Technical Report 273, 1987, p. 199) and fast neutron cross-sections by R. Pepelnik (unpublished). Available also via FTP.

33. Nuclear constants, Charts of Nuclides

Chart of The Nuclides, issued by **General Electric** and **Knolls Atomic Power Laboratory** (15th edition, revised to 1996, by J.R. Parrington, H.D. Knox, S.L. Breneman, E.M. Baum, F. Feiner). It consists of a wall chart and a booklet "Nuclides and Isotopes" and can be ordered from GE Nuclear Energy, 175 Curtner Ave. M/C 948, San Jose, CA 95125-1088, USA, e-mail: nuclides@sjcpo2.ne.ge.com. A limited number of copies is available from IAEA cost-free for scientists in developing countries.

Karlsruher Nuklidkarte (Karlsruhe chart of Nuclides), 6th ed. 1995, by G. Pfennig, H. Klewe-Nebenius, W. Seelmann-Eggebert. A: wall chart, B: desk copy with a fold-out chart and introductory text in German, English, Spanish and French. The chart contains many "new" nuclides; all nuclear half-lives and other included parameters have been updated.

It can be ordered from "Marktdienste Haberbeck", Industriestrasse 17, D-32791 Lage/Lippe, Germany. Fax: +49-5232-68445. The sales price is about DM 40,- per set plus shipment costs, with price reductions for multiple orders. A limited number of copies is available from IAEA costfree for scientists in developing countries.

Chart of Nuclides 1996 issued by JNDC and JAERI-NDC, compiled by T. Horiguchi et al. Desk chart showing decay modes and half-lives. Supplemented by five tables (periodic table of elements; fundamental constants; γ-ray energy and intensity standards; α-particle energies and intensities; isotopic abundances and thermal neutron cross sections). A limited number of copies is available cost-free from IAEA. For a WWW version (containing additional data) see http://cracker.tokai.jaeri.go.jp/CN96/index.html.

Strasbourg Chart of the Nuclides 1992 by M.S. Antony, Centre de Recherches Nucléaires et Université Louis Pasteur, F-67037 Strasbourg Cédex 2, France. The chart contains a new independent evaluation of nuclear half-lives and selected decay properties. It can be ordered from above address for a small fee in favour of a welfare association. A limited number of free copies has kindly been made available to the IAEA Nuclear Data Section for scientists in developing countries, upon request.

NUDAT - Nuclear levels, decay radiations, half-lives and other properties extracted from ENSDF (see chapter 31), plus thermal neutron cross-sections and resonance integrals from the book "Neutron Cross-Sections" (1981/1984) (see chapter 7). Accessible only online; instructions see IAEA-NDS-150 chapter 8.

NUCHART. A PC package which displays nuclear decay data from ENSDF/NUDAT, including a search routine for assigning gamma-ray energies to radionuclides. NUCHART for Windows, version 1.2 of Feb. 1995, by V. Osorio and H. Peraza, IAEA Physics Section. Documentation: IAEA-NDS-161. Available on a set of PC diskettes or via FTP from the IAEA Physics Section. **FTP**

NUBASE. New database for experimentally known nuclear properties, by G. Audi, O. Bersillon, J. Blachot, A.H. Wapstra. Available from the Atomic Mass Data Center (AMDC), see below. Not available from IAEA. - NUBASE contains mass, isomeric excitation energy, half-life, spin, parity, decay modes and intensities for more than 3000 nuclides. Published in the journal Nuclear Physics, Vol A624 (1997), pp. 1-124. Available by anonymous FTP from csnftp.in2p3.fr, directory /pub/symfond/audi/mass, or consult the AMDF web site at http://csnwww.in2p3.fr/amdc/.

Atomic Masses 1995. The 1995 atomic mass evaluation by G. Audi and A.H. Wapstra. Available online or on tape. Summary documentation IAEA-NDS-47, Rev.3. Published in Nucl. Phys. A595 (1995) p. 409-480. **FTP**
This supersedes earlier versions:
A.H. Wapstra et al. Nucl. Phys. A432 (1985) pages 1ff, 55ff, 140ff, 185ff.
The 1988 update has been published by A.H. Wapstra, G. Audi, R. Hoekstra, "Atomic masses from (mainly) experimental data", in Atomic Data and Nuclear Data Tables 39, 281-287 (1988), Compare also the following item:

Nuclear Masses (Möller). A data file by P. Möller et al. including nuclear masses as computed by P. Möller [see At. Data Nucl. Data Tables 39, 225-233 (1988)] and the nuclear masses compiled by A.H. Wapstra et al. [see At. Data Nucl. Data Tables 39, 281-287 (1988)]. Summary documentation: IAEA-NDS-147, Rev. 1, Feb. 1992.
Note: Möller data should be used for nuclides, which are not in the Wapstra file.

Nuclide Guide, a handbook in Russian and English by T.V. Golashvili, V.P. Chechev, A.A. Lbov, Atominform Moscow 1995. It contains, for all known nuclides, properties of ground and isomeric states, mass, half-life, decay modes, intensities, particle energies, and the energies of the dominating decay gammas. - Not available from IAEA. The book can be obtained from V.P. Chechev, Khlopin Radievyj Institut, 194021 Sankt-Petersburg, Russia, fax (812)247-80-95.

Isotopic abundances of the elements, 1989. See the journal Pure and Applied Chemistry 63(7) p. 991-1002 (1991). - Literature survey of isotopic abundance data for 1987-1989 by N.E. Holden, report BNL-NCS-43162 (1989).

Computer Chart, microfiche produced by NNDC in March 1982, based on ENSDF, ENDF/B-5, NNDC book "Neutron Cross-Sections", Atomic Masses by Wapstra 1977, and Isotopic Abondements by Holden 1981.

Nuclear Properties, J.K. Tuli. See Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273, Vienna 1987, p. 3-28.

Fundamental Physical Constants: 1986 recommended values by E.R. Cohen, B.N. Taylor, Codata Bulletin Nr.63 (Nov.1986). The tables of recommended values were reproduced in IAEA-NDS-50. An extract is included also in the booklet "Nuclear Wallet Cards", see preceding chapter.

Japanese Chart of the Nuclides, 1984, Japanese Nuclear Data Committee and Nuclear Data Center, JAERI, compiled by Y. Yoshizawa et al. Fold-out map, contains abundances and half-lives of ground and metastable states. In tabular form it contains various physical constants and Gamma-Ray Intensity Standards for selected nuclides. Has been distributed as report NEANDC(J)-113 and INDC(JPN)-99.

Chart of Stable Atomic Nuclei, with attached periodic table of elements, in Chinese. Booklet with fold-out chart.

34. Atomic Data

EADL, the evaluated Atomic Data Library of the Lawrence Livermore National Laboratory, USA. This data library is published in tabular and graphical form in the report UCRL-50400 vol. 30 (1991) by S.T. Perkins, D.E. Cullen, M.H. Chen, J.H. Hubbell, J. Rathkopf, J. Scofield, 288 pages. It contains evaluated atomic subshell and relaxation data for isolated neutral atoms, including fuorescence yields, subshell parameters (e.g. binding energies), both radioactive and non-radioactive transition probabilities, and energy deposition terms. This handbook is available as a set of microfiches from the IAEA INIS Microfiche Service, or from the US National Technical Information Service, 5285 Port Royal Rd., Springfield, VA, USA-22161. For a summary see the document IAEA-NDS-156, format IAEA-NDS-159.

Atomic and molecular data for radiotherapy and radiation research. IAEA-TECDOC-799 (750 pages), N. Kocherov (ed.). Final report of Coordinated Research Project. Contents: Particle therapy in cancer management; heavy ion therapy. Ionization by fast charged particles. Electron collision cross-sections. Low energy electron interaction with condensed matter. Photoabsorption, photoionization, photodissociation cross-sections. Collision processes between ions and molecules. Stopping powers, ranges, and straggling. Yields of ionization and excitation in irradiate matter. Track structure quantities. ESTAR, PSTAR, ASTAR; computer programs for calculating stopping powers and ranges for electrons, protons, and helium ions - Limited number of copies available costfree upon request.

Note: For "Atomic and Molecular Data" and interaction of fusion plasma with wall materials ("PMI data"), which are not topic of the present index, contact the A+M Unit of the IAEA Nuclear Data Section, and the on-line system AMDIS, http://www.iaea.org/programmes/amdis.

Particle reflection from surfaces - a recommended database. Report INDC(NSD)-249 (1991) by E.W. Thomas, R.J. Janev, J.J. Smith.

35. Bibliographic files, WRENDA, etc.

CINDA, bibliography and database index for experimental and evaluated neutron reaction data. It also includes references to (γ,n),(γ,f) and spontaneous fission. It Includes an index to EXFOR data and to the more important evaluated neutron reaction data libraries. Handbook published annually. Specific computer retrievals available upon request. **online**

CINDA formats:
Summary see IAEA-NDS-9.
CINDA Coding Manual, Rev. by S. Webster, IAEA-NDS-109 Rev. 90/2
The complete CINDA handbook consists of
- CINDA-A (1935-1987) published in 5 volumes in 1990,
- plus CINDA-97 (1988-1997)

NSR, ("nuclear structure references") an international bibliography of nuclear data maintained in support of the network of nuclear structure data evaluators who produce the ENSDF database; see chapter 20 of this document. This bibliography is published regularly under the title "Recent References" in the journal "Nuclear Data Sheets". The NSR database which is updated quarterly, is searchable online in the IAEA NDIS system. **online**

Reference: W. Bruce Ewbank, The Nuclear Structure References (NSR) file, report ORNL-5397 (1978).
Format: S. Ramavataram and C.L. Dunford, Nuclear Structure References Coding Manual, report BNL-NSC-51800 (1984), U.S. National Nuclear Data Center.
For a brief description of NSR with instructions for the online service see IAEA-NDS-150, chapter 6.

"Papyrus NSR", a CD-ROM version of NSR as of December 1993, for use on IBM/PC. "Papyrus NSR" is the result of a collaboration between Lund University, Sweden, and the Isotopes Project, Lawrence Berkeley Laboratory. This new product contains the entire NSR file as of December 1993 with over 130 000 fully-searchable references. For an efficient performance of the database the use of an IBM/PC or compatible with a 386 (or higher) processor running DOS 6.2 and Windows 3.1 (or later), and a double-speed CD-ROM drive is recommended. The Isotopes Project has a limited number of CD-ROMs for distribution free of charge. To order a complimentary copy of PAPYRUS NSR write to: Edgardo Browne, Isotopes Project, Bldg. 50A, Room 6120, Berkeley, California 94720, U.S.A. **CD-ROM**

Bibliography of integral charged-particle nuclear data
Including index to EXFOR data.
Handbook published as BNL-NCS-50640, 4th ed. March 1980 with two supplements March 1981 and March 1982, then discontinued. Available on tape:

File 1 March 1980, 39 000 records.
(= BNL-NCS-50640,4th ed.)
File 2 March 1980 - March 1981, 6 000 records.
(= Suppl. 1)
File 3 May 1981 - Nov. 1981, 1 400 records.
(= Suppl. 2)
File 4 Nov. 1981 - Sept. 1982. (unpublished)

Then continued in a revised format as BNL-NCS-51771 (1st edition) April 1984, covering literature scanned from 1 March 1982 to 31 March 1984, continued annually. It does no longer include an index to EXFOR data. In 1990 this series was discontinued. The last issue is BNL-NCS-51771, first edition, supplement 5, Dec. 1989.

Photonuclear Data/Fotojadernye Dannye, a bibliography published periodically by the USSR Photonuclear Data Center in Moscow, in English and Russian. Available as documents, not on tape.

Special issues: (γ,Xγ) reactions, 1985
Photodisintegration of Lithium, 1984 and 1986
Photofission of heavy nuclei, 1983
Index 1976-1980 (1982)
Index 1976-1985 (1986)
Index 1986-1990, published as report INDC(CCP)-348 (1993)
Index 1976-1995 (1996)

Photonuclear reaction data, bibliographic index 1955-1992, report JAERI-M-93-195. This index which has a format close to CINDA (see above), contains bibliographic references not only for photonuclear reaction data in the narrower sense but also for the inverse reactions, i.e. gamma producing reactions induced by neutrons, protons, deuterons, tritons, He3 and alpha particles, and also electron scattering and electron induced nuclear reactions. Available as printed report, not tape.

A+M/BDB: Atomic and Molecular Bibliographic Data Base. Documentation: IAEA-NDS-AM12, Vienna, Oct. 1982. This data base includes references to atomic collision data, structure and spectra data, surface interaction data, and general references pertinent to atomic and molecular data for fusion. This data-base is used for the production of the International Bulletin on Atomic and Molecular Data for Fusion, and the periodic publication of the Index to the Literature on Atomic and Molecular Collision Data Relevant to Fusion Research, CIAMDA. Selected retrievals from this file are available on request.

WRENDA - World request list for measurements of nuclear data that are known with insufficient accuracy only.
WRENDA 93/94 published as INDC(SEC)-104.

WRENDA Supplement: Requests for fission yield measurements.
M. Lammer, ed. Report INDC(SEC)-105.

INDC/NEANDC "joint discrepancy file 1990". Compilation of nuclear data discrepancies. B.H. Patrick, N.P. Kocherov, eds.
Report INDC(NDS)-235.

IAEA-NDS-Documentation Series
See document IAEA-NDS-0 for an index to the IAEA-NDS-documents summarizing format and contents of nuclear data libraries.

CINDU - Catalogue of numerical nuclear data available from the IAEA Nuclear Data Section. This series was discontinued and replaced by the IAEA-NDS-Documentation Series. The last issues, CINDU-11 (1976) and its Supplement 1 (1977), contain some documentations of old nuclear data libraries, some of which may still be of historic interest.

36. Online nuclear data service

online

World Wide Web: The IAEA Nuclear Data Section's home page (http://www-nds.iaea.or.at) contains now direct web access to several databases (ENSDF, MIRD, Nuclear Wallet Cards, Thermal neutron capture gammas; implementation of nuclear reaction databases has started). For access to the other online databases there is a link to the Telnet-based online service NDIS. Other new features are the "IAEA Nuclear Data Guide", a web version of IAEA-NDS-7 (Index of Nuclear Data Libraries available from the IAEA Nuclear Data Section) and the possibility of downloading various manuals, files and nuclear data utility programs.

NDIS, the **interactive** IAEA Nuclear Data Information System includes the most important nuclear databases in online access through international computer networks. For details see the document IAEA-NDS-150 by C.L. Dunford and T.W. Burrows. Included are the following databases:

EXFOR

Experimental nuclear reaction data induced by neutrons, γ-rays, charged-particles, heavy ions. See chapter 1 of this document. This database shows up under the keyword "CSISRS".

ENDF

Evaluated neutron reaction data of the files BROND, CENDL, ENDF, JEF, JENDL. See chapter 4.

CINDA

Bibliography and database index to experimental and evaluated neutron reaction data. See chapter 35.

ENSDF

Evaluated nuclear structure and decay data. See chapter 31.

NSR

Bibliographic references to nuclear data publications relevant to the evaluation of nuclear structure and decay data. See chapter 35.

Photo-atomic interaction

Evaluated photo-atomic interaction data, showing up under the keyword "XRAY".

NUDAT

Nuclear levels, decay radiations, half-lives and other properties extracted from ENSDF (see chapter 26), plus thermal neutron cross-sections and resonance-integrals of the book "Neutron Cross-Sections" (1981/84), (see chapter 7).

Citation Guidelines. When citing data libraries in publications, care should be taken (1) that credit is given to the author(s) of the data library, (2) that credit is given to the data center which makes the data library available, and (3) that the version of the data library and the date of retrieval are quoted. For citation guidelines see the inner cover of the IAEA-NDS-reports. See also V. McLane, "Citation guidelines for nuclear data retrieved from databases resident at the Nuclear Data Centers Network", report BNL-NCS-63381 (July 1996).

Access to NDIS
(online Nuclear Data Information System)
via INTERNET (TCP/IP):

Sample login:

TELNET iaeand.iaea.or.at

IAEA VAX-VMS V5.4-3

Username: **IAEANDS**

Welcome to VAX/VMS version V5.4-3 on node M4300
.....
.....

Enter NDS assigned authorization code (or GUEST): **GUEST**
(or your authorization code if you have one)

Enter your last name (or DEFAULT or?) _ _ _ _ _

Authorization

As a "GUEST", you will have 30 seconds of CPU time allocated. At the end of a GUEST session, you may sign up directly for an authorization code for full access service. (This code still needs to be activated by the NDIS manager before you can use it for future access.) Or, you may contact the IAEA Nuclear Data Section for assignment of an authorization code.

Retrieval system:

A user-friendly system provides ample help to the user who specifies the retrieval criteria in response to step-by-step prompts by the system. It also provides interactive assistance through HELP files. More detailed documentation on the system may be obtained by contacting the IAEA Nuclear Data Section.

FTP

In addition to the menu-driven NDIS online system, various libraries, documents and FORTRAN source codes can be downloaded through FTP, the file transfer option of the INTERNET computer network. **FTP**

Procedure: FTP IAEAND.IAEA.or.at
user ANONYMOUS (no password required)

At present, the open area includes, among other items:

- the Audi-Wapstra mass table from 1995;
- IRDF Version 2 (1993)
- ENDF Pre-Processing and Utility Codes, ENSDF codes.

This list is growing continuously.

Some of the items may also be downloaded directly from within an NDIS session (go to menu FILES).

For access to the **FENDL** database (see page 26.2), use the username **FENDL** for FENDL-1 files, or **FENDL2** for FENDL-2 files.

41. Elementary-particle physics data

(Note that this data category is outside the scope of the IAEA Nuclear Data Section)

"Review of Particle Physics", special issue of Physical Review D (Particles and Fields), vol. 54 (1996), No. 1, Part I.

Paricle Physics Booklet (1996), available from LBNL and CERN.

A Guide to Data in Elementary Particle Physics
See document LBL-90 Revised, Sept. 1986.

Compilation of elementary-particle cross-sections
See document series CERN-HERA...; see also the references given on the back cover of this series.

Review of particle properties
Particle Data Group, Lawrence Berkeley Laboratory, et al. See Physics Letters B, vol. 204, 1988.

See also **CERN-HERA** reports.

51. Proceedings of the Trieste Courses and Workshops on Nuclear Data and Reactor Physics

Starting in 1978, nuclear data related courses were held at the International Centre for Theoretical Physics, Trieste, Italy. The proceedings of the earlier courses (1978-1982) were published as IAEA reports. Unless a full-size copy is still available, these can be requested as INIS-Microfiches.

The proceedings of the subsequent courses are not available from IAEA. They have been published by the World Scientific Publishing Co., P.O. Box 128, Farrer Road, Singapore 9128. U.S. Office: Suite 1B, 1060 Main Street, River Edge, NJ 07661. U.K. office: 57 Shelton Street, Covent Garden, London WC2H 9HE.

1996: Nuclear Reaction Data and Nuclear Reactors - Physics, Design and Safety.
15 April - 17 May 1996.
To be published.

1994: Nuclear Reactors, Physics, Design and Safety.
11 April - 13 May 1994.
Editors: A. Gandini, S. Ganesan, J.J. Schmidt.
World Scientific, Singapore.

1992: Computation and Analysis of Nuclear Data Relevant to Nuclear Energy and Safety. 10 Feb - 13 March 1992.
Editors: M.K. Mehta, J.J. Schmidt.
World Scientific, Singapore.

1990: Reactor Physics Calculations for applications in nuclear technology. 12 Feb - 16 March 1990.
Editors: D.E. Cullen, R. Muranaka, J.J. Schmidt.
World Scientific, Singapore.

1988: Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications. 15 Feb - 19 March 1988.
Editors: M.K. Mehta, J.J. Schmidt.
World Scientific, Singapore.

1986: Applications in Nuclear Data and Reactor Physics. 17 Feb - 21 March 1986. Editors: D.E. Cullen, R. Muranaka, J.J. Schmidt.
World Scientific, Singapore.

1982: Nuclear theory for applications. 25 Jan - 19 Feb 1982.
Report IAEA-SMR-93. Copies still available, costfree.

1980: Nuclear theory for applications. Jan/Feb 1980.
Report IAEA-SMR-68.

1978: Nuclear theory for applications. 17 Jan - 11 Feb 1978.
Report IAEA-SMR-43.

1975: Nuclear theory in neutron data evaluation. Consultants' Meeting, Trieste 1975. Report IAEA-190, 2 vols.

52. Selected Nuclear Data Handbooks Available from the IAEA Nuclear Data Section

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