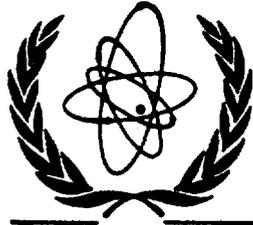




XA9848521



International Atomic Energy Agency

**INDC(NDS)-387**

**Distr. L**

---

**INDC**

**INTERNATIONAL NUCLEAR DATA COMMITTEE**

---

## **Nuclear Data Libraries and Online Services**

**An introduction to the data types and services  
available from the IAEA Nuclear Data Section**

P. Obložinský and O. Schwerer

September 1998

---

**IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA**

*L* 29-49

Printed by the IAEA in Austria  
September 1998

## **Nuclear Data Libraries and Online Services**

**An introduction to the data types and services  
available from the IAEA Nuclear Data Section**

P. Obložinský and O. Schwerer

**Abstract:** The IAEA Nuclear Data Section provides convenient, costfree access to the world's most comprehensive collection of numerical nuclear physics data. These nuclear data libraries result from a worldwide cooperation of nuclear data centres coordinated by the IAEA. An introduction is given to the various nuclear data types and libraries with particular emphasis to online services via the Internet. This paper summarizes a presentation for the IAEA Workshop on "Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety" held at ICTP Trieste, Italy, 23 February - 17 March 1998.

September 1998

# NUCLEAR DATA LIBRARIES AND ONLINE SERVICES

P. OBLOŽINSKÝ and O. SCHWERER

*Nuclear Data Section, International Atomic Energy Agency,  
P.O.Box 100, A-1400 Vienna, Austria*

The IAEA Nuclear Data Section provides convenient, cost-free access to the world's most comprehensive collection of numerical nuclear physics data. These nuclear data libraries result from a worldwide cooperation of nuclear data centers coordinated by the IAEA. Here we summarize the various nuclear data types and libraries available with particular emphasis to online services via the Internet. The URL address of the IAEA Nuclear Data Services is <http://www-nds.iaea.or.at>.

## 1 Introduction

The IAEA holds the most comprehensive collection of nuclear data libraries worldwide. The data are available free of charge to scientists in IAEA member states on computer media (diskettes, magnetic tapes, CD-ROM), hardcopy, or online through the Internet (Worldwide Web, Telnet, FTP).

Nuclear data describe the properties of atomic nuclei and the fundamental physical relationships governing their interactions. These data characterize fundamental physical processes which underlie all nuclear technologies. Important examples of nuclear data include cross sections, half-lives, decay modes and decay radiation properties, and  $\gamma$ -rays from radionuclides. The scope of the data collections includes all 85 natural elements with 290 stable isotopes and more than 2500 radionuclides.

The applications of nuclear data today include all areas of nuclear science and technology:

- Energy applications: Fission power reactors; fusion reactor technology
- Non-energy applications: Waste management and environment; radiation safety; safeguards; nuclear medicine; materials analysis and process control; basic research (e.g. nuclear astrophysics) and education.

## 2 The data centers and their services

Both the collection and the distribution of nuclear data are organised on a world-wide scale. Two international networks are coordinated by the IAEA Nuclear Data Section: the Network of Nuclear Reaction Data Centers (Fig.1) and the Nuclear Structure and Decay Data Network (Fig.2). The data centers participating in these networks are involved in the various stages of data preparation between measurement and application (i.e. compilation, review and/or evaluation, processing, distribution, see Fig.3).

The major nuclear data centers are:

- IAEA Nuclear Data Section, Vienna, Austria
- OECD NEA Data Bank, Paris, France

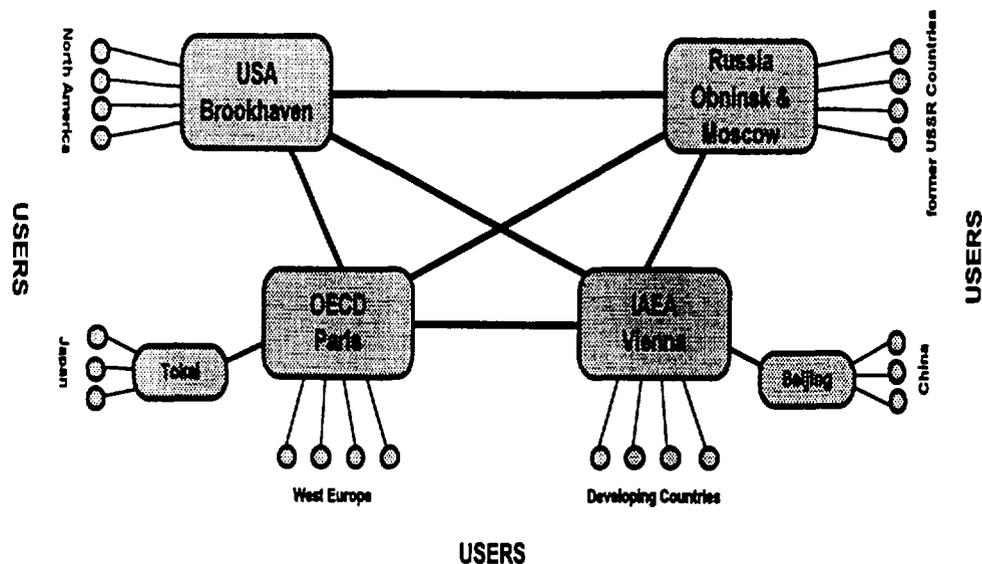


Figure 1: The Nuclear Reaction Data Centers Network

- U.S.National Nuclear Data Center, Brookhaven, USA
- Russian Nuclear Data Centers, Obninsk and Moscow, Russia
- Radiation Safety Information Computational Center, Oak Ridge, USA
- Chinese Nuclear Data Center, Beijing, China
- Japanese Nuclear Data Center, Tokai, Japan

Additional specialized data centers cooperate with the major centers in the various data center functions (in particular data compilation and evaluation). The sharing of work on a world-wide basis in the various areas of work (including data distribution) is defined partly geographically and partly by data types (scope) and is coordinated by the IAEA Nuclear Data Section, partly by organising regular data centers coordination meetings.

The type of nuclear data service varies with the type of information and the hardware configuration available. The main services offered by the IAEA Nuclear Data Section (to scientists in IAEA member states, in particular in developing countries) and the other major data centers are:

- Data upon request (**Vienna**)<sup>2</sup>: complete files on magnetic tapes, CD-ROM, diskette or by FTP; retrievals on diskettes, printout, by e-mail or FTP
- Documents upon request (**Vienna**): manuals and data library documentation; handbooks; meeting reports; research reports
- Interactive online retrieval by WWW and/or Telnet (**Vienna**, Brookhaven<sup>3</sup>, Paris restricted to members of NEA Data Bank): available 7 days a week, 24 hours a day

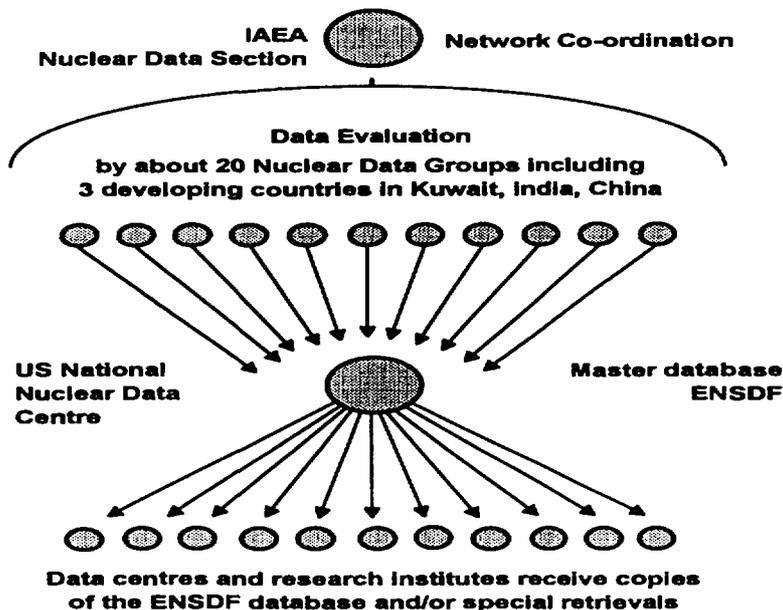


Figure 2: The Nuclear Structure Data Centers Network

- Computer codes: nuclear reaction models (Paris); processing (partly Oak Ridge<sup>4</sup>); fission reactors (Paris); utility programs, PC packages (**Vienna**)
- Processed data (Paris, partly Oak Ridge)

### 3 Nuclear Data Types

Nuclear data are commonly categorized in two main groups: nuclear reaction data, describing the interactions of various projectiles such as neutrons, protons or photons with target nuclei, and nuclear structure and decay data, describing nuclear levels, half-lives and radioactive decay radiations. For both groups, the type of information given can be experimental data or evaluated data (both numeric) or bibliographic.

- **Bibliographic data:** Typical examples are: CINDA - Computerized Index of Neutron DATA (bibliographic references to neutron reaction data, covering the period from 1935 to present. It is published regularly as a book<sup>5</sup> and also available online); NSR - Nuclear Science References (bibliographic data base for low and intermediate energy nuclear physics, covering the period from 1910 to present. Published in *Nuclear Data Sheets* and also available online).
- **Experimental data:** The most important example is EXFOR<sup>6</sup> (EXchange FORmat - computerized system for the storage, retrieval and international exchange of experimental nuclear reaction data, including explanatory text. This library contains

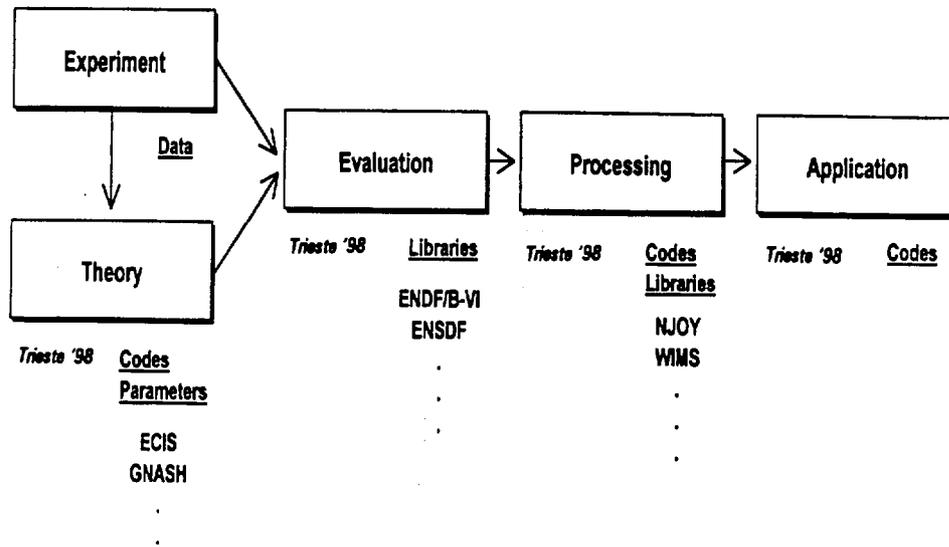


Figure 3: From experimental nuclear data to applications (Laboratory → Data Center → User). Major codes and libraries used in the nuclear data workshop (*Trieste '98*) are indicated.

reaction data for incident neutrons, charged particles and photons and is available online). CSISRS (Cross Section Information Storage and Retrieval System) is the US equivalent of EXFOR.

- **Evaluated data:** Evaluation is the process of analyzing experimentally measured nuclear physics data and combining them with the predictions of nuclear model calculations in order to arrive at a recommended value of the quantity. They are stored in specifically defined "formats" (collections of rules and procedures for computerized storage of data); often the name of the format is identical with the name of the library. Two important formats are ENDF-6 (Evaluated Nuclear Data File)<sup>7</sup> for reaction data and ENSDF (Evaluated Nuclear Structure Data File) for structure and decay data. For neutron reaction data, there are several major evaluated data libraries originating in USA, Russia, Europe, Japan, and China, whereas the ENSDF library is the major library for structure and decay data. In addition, there are many other evaluated data libraries for specific purposes.
- **Reaction data:**
  - Incident neutrons: This is the most complete collection, to be found in the specialized bibliography CINDA, the experimental data library EXFOR and the major evaluated libraries<sup>8</sup> ENDF/B-6<sup>9</sup> (USA), BROND-2 (Russia), JEF-2 (Europe), JENDL-3 (Japan), CENDL-2 (China), and FENDL-2 (IAEA, fusion applications). These libraries cover the neutron energy range from  $10^{-5}$  eV to 20 MeV with a high degree of completeness; data for higher energies are partly

Location: <http://www-nds.iaea.org/at/exf3.htm>

[What's New?](#) [What's Cool?](#) [Destinations](#) [Net Search](#) [People](#) [Software](#)

### IAEA Nuclear Data Services EXFOR database retrieval

EXFOR is the main database for experimental nuclear reaction data which are compiled, exchanged and distributed by a worldwide network of Nuclear Reaction Data Centers.

Target or product:	<input type="text" value="p-238"/>
Reaction or projectile:	<input type="text" value="p-p"/>
[Residual:]	<input type="text" value=""/>
Quantity:	<input type="text" value="c/s"/>
[Energy range:]	<input type="text" value=""/>
[Cutoff date:]	<input type="text" value=""/>
Accession number:	<input type="text" value=""/>

by Reaction or  by Product or  by Accession #

[back to Nuclear Data Services Intro](#)

Figure 4: Example of a database retrieval form at the *Nuclear Data Services* web page: EXFOR

included also.

- Incident charged particles and photons: less complete collection in EXFOR; only few evaluations available.
- **Structure and decay data:** Half-lives, decay schemes, nuclear level properties, energies and intensities of  $\gamma$ -rays and emitted particles, atomic masses. The major library is ENSDF (Evaluated Nuclear Structure Data File) which contains evaluated experimental data for most known nuclides (more than 2500) and is published in the journal *Nuclear Data Sheets*. A number of libraries, publications and computer programs are derived from or related to the ENSDF database, such as NUDAT<sup>10</sup>(NUclear DATA), the "Table of Isotopes"<sup>11</sup>, the "Nuclear Wallet Cards"<sup>12</sup>(properties of nuclear ground and isomeric states), or the "Isotope Explorer"<sup>13</sup>, a computer program for viewing ENSDF and for interactive access to nuclear structure and decay data. Other libraries include: NUBASE<sup>14</sup>, a library of nuclear and decay properties, containing mass, half-life, decay modes of ground and isomeric states for more than 3000 nuclides; "Atomic Masses 1995"<sup>15</sup>, a mass evaluation for more than 2900 nuclides.

#### 4 Nuclear Data Libraries at IAEA

The IAEA Nuclear Data Section holds a total of about 100 nuclear data libraries representing an enormous value. These include the bibliographic libraries CINDA and NSR;

Location: <http://www-nds.iaea.or.at/ngatlas/main.htm>

[What's New?](#) [What's Cool?](#) [Documentation](#) [NDS Search](#) [People](#) [Software](#)

## ATLAS OF NEUTRON CAPTURE CROSS SECTIONS

**Documentation**

**Elements Range**

H-1 to H-2, He-3 to He-4, Li-6 to Li-7, Be-9 to Be-10, B-10 to B-11, C-12 to C-13, N-14 to N-15, O-16 to O-17, F-19 to F-20, Ne-20 to Ne-21, Na-23 to Na-24, Mg-24 to Mg-26, Al-27 to Al-28, Si-28 to Si-30, S-32 to S-34, Cl-35 to Cl-37, Ar-36 to Ar-38, K-39 to K-41, Ca-40 to Ca-48, Sc-45 to Sc-46, Ti-48 to Ti-50, V-51 to V-52, Cr-52 to Cr-54, Mn-55 to Mn-56, Fe-56 to Fe-58, Co-59 to Co-60, Ni-58 to Ni-64, Cu-63 to Cu-65, Zn-64 to Zn-70, Ga-69 to Ga-71, Ge-72 to Ge-76, As-75 to As-76, Se-74 to Se-78, Br-79 to Br-81, Kr-78 to Kr-84, Rb-85 to Rb-87, Sr-84 to Sr-88, Y-89 to Y-90, Zr-90 to Zr-94, Nb-93 to Nb-95, Mo-92 to Mo-98, Tc-98 to Tc-99, Ru-96 to Ru-101, Rh-101 to Rh-103, Pd-102 to Pd-106, Ag-107 to Ag-109, Cd-112 to Cd-116, In-113 to In-115, Sn-112 to Sn-119, Sb-121 to Sb-123, Te-122 to Te-128, I-127 to I-129, Xe-124 to Xe-136, Ba-130 to Ba-138, La-138 to La-140, Ce-138 to Ce-142, Pr-140 to Pr-142, Nd-142 to Nd-148, Pm-145 to Pm-147, Sm-147 to Sm-152, Eu-151 to Eu-153, Gd-152 to Gd-157, Tb-157 to Tb-159, Dy-156 to Dy-163, Ho-163 to Ho-165, Er-162 to Er-168, Tm-162 to Tm-164, Yb-164 to Yb-174, Lu-174 to Lu-176, Hf-174 to Hf-178, Ta-177 to Ta-180, W-182 to W-186, Re-185 to Re-187, Os-187 to Os-192, Ir-187 to Ir-193, Pt-188 to Pt-196, Au-197 to Au-199, Hg-196 to Hg-202, Tl-203 to Tl-205, Pb-204 to Pb-208, Bi-209 to Bi-209, Po-209 to Po-214, At-210 to At-215, Rn-210 to Rn-222, Fr-223 to Fr-223, Ra-226 to Ra-226, Ac-227 to Ac-227, Th-232 to Th-232, Pa-231 to Pa-231, U-235 to U-238, Np-237 to Np-237, Pu-239 to Pu-244, Am-241 to Am-243, Cm-247 to Cm-250, Bk-247 to Bk-247, Cf-251 to Cf-251, Es-253 to Es-253, Fm-257 to Fm-257, Md-261 to Md-261, No-265 to No-265, Lr-262 to Lr-262, Rf-261 to Rf-261, Db-262 to Db-262, Sg-266 to Sg-266, Bh-264 to Bh-264, Hs-265 to Hs-265, Mt-268 to Mt-268, Ds-271 to Ds-271, Rg-272 to Rg-272, Co-285 to Co-285, Bh-284 to Bh-284, Hs-285 to Hs-285, Mt-289 to Mt-289, Ds-293 to Ds-293, Rg-294 to Rg-294, Co-309 to Co-309, Bh-310 to Bh-310, Hs-311 to Hs-311, Mt-315 to Mt-315, Ds-317 to Ds-317, Rg-318 to Rg-318, Co-333 to Co-333, Bh-334 to Bh-334, Hs-335 to Hs-335, Mt-339 to Mt-339, Ds-345 to Ds-345, Rg-346 to Rg-346, Co-359 to Co-359, Bh-360 to Bh-360, Hs-361 to Hs-361, Mt-365 to Mt-365, Ds-371 to Ds-371, Rg-372 to Rg-372, Co-383 to Co-383, Bh-384 to Bh-384, Hs-385 to Hs-385, Mt-389 to Mt-389, Ds-395 to Ds-395, Rg-396 to Rg-396, Co-409 to Co-409, Bh-410 to Bh-410, Hs-411 to Hs-411, Mt-415 to Mt-415, Ds-421 to Ds-421, Rg-422 to Rg-422, Co-433 to Co-433, Bh-434 to Bh-434, Hs-435 to Hs-435, Mt-439 to Mt-439, Ds-445 to Ds-445, Rg-446 to Rg-446, Co-459 to Co-459, Bh-460 to Bh-460, Hs-461 to Hs-461, Mt-465 to Mt-465, Ds-471 to Ds-471, Rg-472 to Rg-472, Co-483 to Co-483, Bh-484 to Bh-484, Hs-485 to Hs-485, Mt-489 to Mt-489, Ds-495 to Ds-495, Rg-496 to Rg-496, Co-509 to Co-509, Bh-510 to Bh-510, Hs-511 to Hs-511, Mt-515 to Mt-515, Ds-521 to Ds-521, Rg-522 to Rg-522, Co-533 to Co-533, Bh-534 to Bh-534, Hs-535 to Hs-535, Mt-539 to Mt-539, Ds-545 to Ds-545, Rg-546 to Rg-546, Co-559 to Co-559, Bh-560 to Bh-560, Hs-561 to Hs-561, Mt-565 to Mt-565, Ds-571 to Ds-571, Rg-572 to Rg-572, Co-583 to Co-583, Bh-584 to Bh-584, Hs-585 to Hs-585, Mt-589 to Mt-589, Ds-595 to Ds-595, Rg-596 to Rg-596, Co-609 to Co-609, Bh-610 to Bh-610, Hs-611 to Hs-611, Mt-615 to Mt-615, Ds-621 to Ds-621, Rg-622 to Rg-622, Co-633 to Co-633, Bh-634 to Bh-634, Hs-635 to Hs-635, Mt-639 to Mt-639, Ds-645 to Ds-645, Rg-646 to Rg-646, Co-659 to Co-659, Bh-660 to Bh-660, Hs-661 to Hs-661, Mt-665 to Mt-665, Ds-671 to Ds-671, Rg-672 to Rg-672, Co-683 to Co-683, Bh-684 to Bh-684, Hs-685 to Hs-685, Mt-689 to Mt-689, Ds-695 to Ds-695, Rg-696 to Rg-696, Co-709 to Co-709, Bh-710 to Bh-710, Hs-711 to Hs-711, Mt-715 to Mt-715, Ds-721 to Ds-721, Rg-722 to Rg-722, Co-733 to Co-733, Bh-734 to Bh-734, Hs-735 to Hs-735, Mt-739 to Mt-739, Ds-745 to Ds-745, Rg-746 to Rg-746, Co-759 to Co-759, Bh-760 to Bh-760, Hs-761 to Hs-761, Mt-765 to Mt-765, Ds-771 to Ds-771, Rg-772 to Rg-772, Co-783 to Co-783, Bh-784 to Bh-784, Hs-785 to Hs-785, Mt-789 to Mt-789, Ds-795 to Ds-795, Rg-796 to Rg-796, Co-809 to Co-809, Bh-810 to Bh-810, Hs-811 to Hs-811, Mt-815 to Mt-815, Ds-821 to Ds-821, Rg-822 to Rg-822, Co-833 to Co-833, Bh-834 to Bh-834, Hs-835 to Hs-835, Mt-839 to Mt-839, Ds-845 to Ds-845, Rg-846 to Rg-846, Co-859 to Co-859, Bh-860 to Bh-860, Hs-861 to Hs-861, Mt-865 to Mt-865, Ds-871 to Ds-871, Rg-872 to Rg-872, Co-883 to Co-883, Bh-884 to Bh-884, Hs-885 to Hs-885, Mt-889 to Mt-889, Ds-895 to Ds-895, Rg-896 to Rg-896, Co-909 to Co-909, Bh-910 to Bh-910, Hs-911 to Hs-911, Mt-915 to Mt-915, Ds-921 to Ds-921, Rg-922 to Rg-922, Co-933 to Co-933, Bh-934 to Bh-934, Hs-935 to Hs-935, Mt-939 to Mt-939, Ds-945 to Ds-945, Rg-946 to Rg-946, Co-959 to Co-959, Bh-960 to Bh-960, Hs-961 to Hs-961, Mt-965 to Mt-965, Ds-971 to Ds-971, Rg-972 to Rg-972, Co-983 to Co-983, Bh-984 to Bh-984, Hs-985 to Hs-985, Mt-989 to Mt-989, Ds-995 to Ds-995, Rg-996 to Rg-996, Co-1009 to Co-1009, Bh-1010 to Bh-1010, Hs-1011 to Hs-1011, Mt-1015 to Mt-1015, Ds-1021 to Ds-1021, Rg-1022 to Rg-1022, Co-1033 to Co-1033, Bh-1034 to Bh-1034, Hs-1035 to Hs-1035, Mt-1039 to Mt-1039, Ds-1045 to Ds-1045, Rg-1046 to Rg-1046, Co-1059 to Co-1059, Bh-1060 to Bh-1060, Hs-1061 to Hs-1061, Mt-1065 to Mt-1065, Ds-1071 to Ds-1071, Rg-1072 to Rg-1072, Co-1083 to Co-1083, Bh-1084 to Bh-1084, Hs-1085 to Hs-1085, Mt-1089 to Mt-1089, Ds-1095 to Ds-1095, Rg-1096 to Rg-1096, Co-1109 to Co-1109, Bh-1110 to Bh-1110, Hs-1111 to Hs-1111, Mt-1115 to Mt-1115, Ds-1121 to Ds-1121, Rg-1122 to Rg-1122, Co-1133 to Co-1133, Bh-1134 to Bh-1134, Hs-1135 to Hs-1135, Mt-1139 to Mt-1139, Ds-1145 to Ds-1145, Rg-1146 to Rg-1146, Co-1159 to Co-1159, Bh-1160 to Bh-1160, Hs-1161 to Hs-1161, Mt-1165 to Mt-1165, Ds-1171 to Ds-1171, Rg-1172 to Rg-1172, Co-1183 to Co-1183, Bh-1184 to Bh-1184, Hs-1185 to Hs-1185, Mt-1189 to Mt-1189, Ds-1195 to Ds-1195, Rg-1196 to Rg-1196, Co-1209 to Co-1209, Bh-1210 to Bh-1210, Hs-1211 to Hs-1211, Mt-1215 to Mt-1215, Ds-1221 to Ds-1221, Rg-1222 to Rg-1222, Co-1233 to Co-1233, Bh-1234 to Bh-1234, Hs-1235 to Hs-1235, Mt-1239 to Mt-1239, Ds-1245 to Ds-1245, Rg-1246 to Rg-1246, Co-1259 to Co-1259, Bh-1260 to Bh-1260, Hs-1261 to Hs-1261, Mt-1265 to Mt-1265, Ds-1271 to Ds-1271, Rg-1272 to Rg-1272, Co-1283 to Co-1283, Bh-1284 to Bh-1284, Hs-1285 to Hs-1285, Mt-1289 to Mt-1289, Ds-1295 to Ds-1295, Rg-1296 to Rg-1296, Co-1309 to Co-1309, Bh-1310 to Bh-1310, Hs-1311 to Hs-1311, Mt-1315 to Mt-1315, Ds-1321 to Ds-1321, Rg-1322 to Rg-1322, Co-1333 to Co-1333, Bh-1334 to Bh-1334, Hs-1335 to Hs-1335, Mt-1339 to Mt-1339, Ds-1345 to Ds-1345, Rg-1346 to Rg-1346, Co-1359 to Co-1359, Bh-1360 to Bh-1360, Hs-1361 to Hs-1361, Mt-1365 to Mt-1365, Ds-1371 to Ds-1371, Rg-1372 to Rg-1372, Co-1383 to Co-1383, Bh-1384 to Bh-1384, Hs-1385 to Hs-1385, Mt-1389 to Mt-1389, Ds-1395 to Ds-1395, Rg-1396 to Rg-1396, Co-1409 to Co-1409, Bh-1410 to Bh-1410, Hs-1411 to Hs-1411, Mt-1415 to Mt-1415, Ds-1421 to Ds-1421, Rg-1422 to Rg-1422, Co-1433 to Co-1433, Bh-1434 to Bh-1434, Hs-1435 to Hs-1435, Mt-1439 to Mt-1439, Ds-1445 to Ds-1445, Rg-1446 to Rg-1446, Co-1459 to Co-1459, Bh-1460 to Bh-1460, Hs-1461 to Hs-1461, Mt-1465 to Mt-1465, Ds-1471 to Ds-1471, Rg-1472 to Rg-1472, Co-1483 to Co-1483, Bh-1484 to Bh-1484, Hs-1485 to Hs-1485, Mt-1489 to Mt-1489, Ds-1495 to Ds-1495, Rg-1496 to Rg-1496, Co-1509 to Co-1509, Bh-1510 to Bh-1510, Hs-1511 to Hs-1511, Mt-1515 to Mt-1515, Ds-1521 to Ds-1521, Rg-1522 to Rg-1522, Co-1533 to Co-1533, Bh-1534 to Bh-1534, Hs-1535 to Hs-1535, Mt-1539 to Mt-1539, Ds-1545 to Ds-1545, Rg-1546 to Rg-1546, Co-1559 to Co-1559, Bh-1560 to Bh-1560, Hs-1561 to Hs-1561, Mt-1565 to Mt-1565, Ds-1571 to Ds-1571, Rg-1572 to Rg-1572, Co-1583 to Co-1583, Bh-1584 to Bh-1584, Hs-1585 to Hs-1585, Mt-1589 to Mt-1589, Ds-1595 to Ds-1595, Rg-1596 to Rg-1596, Co-1609 to Co-1609, Bh-1610 to Bh-1610, Hs-1611 to Hs-1611, Mt-1615 to Mt-1615, Ds-1621 to Ds-1621, Rg-1622 to Rg-1622, Co-1633 to Co-1633, Bh-1634 to Bh-1634, Hs-1635 to Hs-1635, Mt-1639 to Mt-1639, Ds-1645 to Ds-1645, Rg-1646 to Rg-1646, Co-1659 to Co-1659, Bh-1660 to Bh-1660, Hs-1661 to Hs-1661, Mt-1665 to Mt-1665, Ds-1671 to Ds-1671, Rg-1672 to Rg-1672, Co-1683 to Co-1683, Bh-1684 to Bh-1684, Hs-1685 to Hs-1685, Mt-1689 to Mt-1689, Ds-1695 to Ds-1695, Rg-1696 to Rg-1696, Co-1709 to Co-1709, Bh-1710 to Bh-1710, Hs-1711 to Hs-1711, Mt-1715 to Mt-1715, Ds-1721 to Ds-1721, Rg-1722 to Rg-1722, Co-1733 to Co-1733, Bh-1734 to Bh-1734, Hs-1735 to Hs-1735, Mt-1739 to Mt-1739, Ds-1745 to Ds-1745, Rg-1746 to Rg-1746, Co-1759 to Co-1759, Bh-1760 to Bh-1760, Hs-1761 to Hs-1761, Mt-1765 to Mt-1765, Ds-1771 to Ds-1771, Rg-1772 to Rg-1772, Co-1783 to Co-1783, Bh-1784 to Bh-1784, Hs-1785 to Hs-1785, Mt-1789 to Mt-1789, Ds-1795 to Ds-1795, Rg-1796 to Rg-1796, Co-1809 to Co-1809, Bh-1810 to Bh-1810, Hs-1811 to Hs-1811, Mt-1815 to Mt-1815, Ds-1821 to Ds-1821, Rg-1822 to Rg-1822, Co-1833 to Co-1833, Bh-1834 to Bh-1834, Hs-1835 to Hs-1835, Mt-1839 to Mt-1839, Ds-1845 to Ds-1845, Rg-1846 to Rg-1846, Co-1859 to Co-1859, Bh-1860 to Bh-1860, Hs-1861 to Hs-1861, Mt-1865 to Mt-1865, Ds-1871 to Ds-1871, Rg-1872 to Rg-1872, Co-1883 to Co-1883, Bh-1884 to Bh-1884, Hs-1885 to Hs-1885, Mt-1889 to Mt-1889, Ds-1895 to Ds-1895, Rg-1896 to Rg-1896, Co-1909 to Co-1909, Bh-1910 to Bh-1910, Hs-1911 to Hs-1911, Mt-1915 to Mt-1915, Ds-1921 to Ds-1921, Rg-1922 to Rg-1922, Co-1933 to Co-1933, Bh-1934 to Bh-1934, Hs-1935 to Hs-1935, Mt-1939 to Mt-1939, Ds-1945 to Ds-1945, Rg-1946 to Rg-1946, Co-1959 to Co-1959, Bh-1960 to Bh-1960, Hs-1961 to Hs-1961, Mt-1965 to Mt-1965, Ds-1971 to Ds-1971, Rg-1972 to Rg-1972, Co-1983 to Co-1983, Bh-1984 to Bh-1984, Hs-1985 to Hs-1985, Mt-1989 to Mt-1989, Ds-1995 to Ds-1995, Rg-1996 to Rg-1996, Co-2009 to Co-2009, Bh-2010 to Bh-2010, Hs-2011 to Hs-2011, Mt-2015 to Mt-2015, Ds-2021 to Ds-2021, Rg-2022 to Rg-2022, Co-2033 to Co-2033, Bh-2034 to Bh-2034, Hs-2035 to Hs-2035, Mt-2039 to Mt-2039, Ds-2045 to Ds-2045, Rg-2046 to Rg-2046, Co-2059 to Co-2059, Bh-2060 to Bh-2060, Hs-2061 to Hs-2061, Mt-2065 to Mt-2065, Ds-2071 to Ds-2071, Rg-2072 to Rg-2072, Co-2083 to Co-2083, Bh-2084 to Bh-2084, Hs-2085 to Hs-2085, Mt-2089 to Mt-2089, Ds-2095 to Ds-2095, Rg-2096 to Rg-2096, Co-2109 to Co-2109, Bh-2110 to Bh-2110, Hs-2111 to Hs-2111, Mt-2115 to Mt-2115, Ds-2121 to Ds-2121, Rg-2122 to Rg-2122, Co-2133 to Co-2133, Bh-2134 to Bh-2134, Hs-2135 to Hs-2135, Mt-2139 to Mt-2139, Ds-2145 to Ds-2145, Rg-2146 to Rg-2146, Co-2159 to Co-2159, Bh-2160 to Bh-2160, Hs-2161 to Hs-2161, Mt-2165 to Mt-2165, Ds-2171 to Ds-2171, Rg-2172 to Rg-2172, Co-2183 to Co-2183, Bh-2184 to Bh-2184, Hs-2185 to Hs-2185, Mt-2189 to Mt-2189, Ds-2195 to Ds-2195, Rg-2196 to Rg-2196, Co-2209 to Co-2209, Bh-2210 to Bh-2210, Hs-2211 to Hs-2211, Mt-2215 to Mt-2215, Ds-2221 to Ds-2221, Rg-2222 to Rg-2222, Co-2233 to Co-2233, Bh-2234 to Bh-2234, Hs-2235 to Hs-2235, Mt-2239 to Mt-2239, Ds-2245 to Ds-2245, Rg-2246 to Rg-2246, Co-2259 to Co-2259, Bh-2260 to Bh-2260, Hs-2261 to Hs-2261, Mt-2265 to Mt-2265, Ds-2271 to Ds-2271, Rg-2272 to Rg-2272, Co-2283 to Co-2283, Bh-2284 to Bh-2284, Hs-2285 to Hs-2285, Mt-2289 to Mt-2289, Ds-2295 to Ds-2295, Rg-2296 to Rg-2296, Co-2309 to Co-2309, Bh-2310 to Bh-2310, Hs-2311 to Hs-2311, Mt-2315 to Mt-2315, Ds-2321 to Ds-2321, Rg-2322 to Rg-2322, Co-2333 to Co-2333, Bh-2334 to Bh-2334, Hs-2335 to Hs-2335, Mt-2339 to Mt-2339, Ds-2345 to Ds-2345, Rg-2346 to Rg-2346, Co-2359 to Co-2359, Bh-2360 to Bh-2360, Hs-2361 to Hs-2361, Mt-2365 to Mt-2365, Ds-2371 to Ds-2371, Rg-2372 to Rg-2372, Co-2383 to Co-2383, Bh-2384 to Bh-2384, Hs-2385 to Hs-2385, Mt-2389 to Mt-2389, Ds-2395 to Ds-2395, Rg-2396 to Rg-2396, Co-2409 to Co-2409, Bh-2410 to Bh-2410, Hs-2411 to Hs-2411, Mt-2415 to Mt-2415, Ds-2421 to Ds-2421, Rg-2422 to Rg-2422, Co-2433 to Co-2433, Bh-2434 to Bh-2434, Hs-2435 to Hs-2435, Mt-2439 to Mt-2439, Ds-2445 to Ds-2445, Rg-2446 to Rg-2446, Co-2459 to Co-2459, Bh-2460 to Bh-2460, Hs-2461 to Hs-2461, Mt-2465 to Mt-2465, Ds-2471 to Ds-2471, Rg-2472 to Rg-2472, Co-2483 to Co-2483, Bh-2484 to Bh-2484, Hs-2485 to Hs-2485, Mt-2489 to Mt-2489, Ds-2495 to Ds-2495, Rg-2496 to Rg-2496, Co-2509 to Co-2509, Bh-2510 to Bh-2510, Hs-2511 to Hs-2511, Mt-2515 to Mt-2515, Ds-2521 to Ds-2521, Rg-2522 to Rg-2522, Co-2533 to Co-2533, Bh-2534 to Bh-2534, Hs-2535 to Hs-2535, Mt-2539 to Mt-2539, Ds-2545 to Ds-2545, Rg-2546 to Rg-2546, Co-2559 to Co-2559, Bh-2560 to Bh-2560, Hs-2561 to Hs-2561, Mt-2565 to Mt-2565, Ds-2571 to Ds-2571, Rg-2572 to Rg-2572, Co-2583 to Co-2583, Bh-2584 to Bh-2584, Hs-2585 to Hs-2585, Mt-2589 to Mt-2589, Ds-2595 to Ds-2595, Rg-2596 to Rg-2596, Co-2609 to Co-2609, Bh-2610 to Bh-2610, Hs-2611 to Hs-2611, Mt-2615 to Mt-2615, Ds-2621 to Ds-2621, Rg-2622 to Rg-2622, Co-2633 to Co-2633, Bh-2634 to Bh-2634, Hs-2635 to Hs-2635, Mt-2639 to Mt-2639, Ds-2645 to Ds-2645, Rg-2646 to Rg-2646, Co-2659 to Co-2659, Bh-2660 to Bh-2660, Hs-2661 to Hs-2661, Mt-2665 to Mt-2665, Ds-2671 to Ds-2671, Rg-2672 to Rg-2672, Co-2683 to Co-2683, Bh-2684 to Bh-2684, Hs-2685 to Hs-2685, Mt-2689 to Mt-2689, Ds-2695 to Ds-2695, Rg-2696 to Rg-2696, Co-2709 to Co-2709, Bh-2710 to Bh-2710, Hs-2711 to Hs-2711, Mt-2715 to Mt-2715, Ds-2721 to Ds-2721, Rg-2722 to Rg-2722, Co-2733 to Co-2733, Bh-2734 to Bh-2734, Hs-2735 to Hs-2735, Mt-2739 to Mt-2739, Ds-2745 to Ds-2745, Rg-2746 to Rg-2746, Co-2759 to Co-2759, Bh-2760 to Bh-2760, Hs-2761 to Hs-2761, Mt-2765 to Mt-2765, Ds-2771 to Ds-2771, Rg-2772 to Rg-2772, Co-2783 to Co-2783, Bh-2784 to Bh-2784, Hs-2785 to Hs-2785, Mt-2789 to Mt-2789, Ds-2795 to Ds-2795, Rg-2796 to Rg-2796, Co-2809 to Co-2809, Bh-2810 to Bh-2810, Hs-2811 to Hs-2811, Mt-2815 to Mt-2815, Ds-2821 to Ds-2821, Rg-2822 to Rg-2822, Co-2833 to Co-2833, Bh-2834 to Bh-2834, Hs-2835 to Hs-2835, Mt-2839 to Mt-2839, Ds-2845 to Ds-2845, Rg-2846 to Rg-2846, Co-2859 to Co-2859, Bh-2860 to Bh-2860, Hs-2861 to Hs-2861, Mt-2865 to Mt-2865, Ds-2871 to Ds-2871, Rg-2872 to Rg-2872, Co-2883 to Co-2883, Bh-2884 to Bh-2884, Hs-2885 to Hs-2885, Mt-2889 to Mt-2889, Ds-2895 to Ds-2895, Rg-2896 to Rg-2896, Co-2909 to Co-2909, Bh-2910 to Bh-2910, Hs-2911 to Hs-2911, Mt-2915 to Mt-2915, Ds-2921 to Ds-2921, Rg-2922 to Rg-2922, Co-2933 to Co-2933, Bh-2934 to Bh-2934, Hs-2935 to Hs-2935, Mt-2939 to Mt-2939, Ds-2945 to Ds-2945, Rg-2946 to Rg-2946, Co-2959 to Co-2959, Bh-2960 to Bh-2960, Hs-2961 to Hs-2961, Mt-2965 to Mt-2965, Ds-2971 to Ds-2971, Rg-2972 to Rg-2972, Co-2983 to Co-2983, Bh-2984 to Bh-2984, Hs-2985 to Hs-2985, Mt-2989 to Mt-2989, Ds-2995 to Ds-2995, Rg-2996 to Rg-2996, Co-3009 to Co-3009, Bh-3010 to Bh-3010, Hs-3011 to Hs-3011, Mt-3015 to Mt-3015, Ds-3021 to Ds-3021, Rg-3022 to Rg-3022, Co-3033 to Co-3033, Bh-3034 to Bh-3034, Hs-3035 to Hs-3035, Mt-3039 to Mt-3039, Ds-3045 to Ds-3045, Rg-3046 to Rg-3046, Co-3059 to Co-3059, Bh-3060 to Bh-3060, Hs-3061 to Hs-3061, Mt-3065 to Mt-3065, Ds-3071 to Ds-3071, Rg-3072 to Rg-3072, Co-3083 to Co-3083, Bh-3084 to Bh-3084, Hs-3085 to Hs-3085, Mt-3089 to Mt-3089, Ds-3095 to Ds-3095, Rg-3096 to Rg-3096, Co-3109 to Co-3109, Bh-3110 to Bh-3110, Hs-3111 to Hs-3111, Mt-3115 to Mt-3115, Ds-3121 to Ds-3121, Rg-3122 to Rg-3122, Co-3133 to Co-3133, Bh-3134 to Bh-3134, Hs-3135 to Hs-3135, Mt-3139 to Mt-3139, Ds-3145 to Ds-3145, Rg-3146 to Rg-3146, Co-3159 to Co-3159, Bh-3160 to Bh-3160, Hs-3161 to Hs-3161, Mt-3165 to Mt-3165, Ds-3171 to Ds-3171, Rg-3172 to Rg-3172, Co-3183 to Co-3183, Bh-3184 to Bh-3184, Hs-3185 to Hs-3185, Mt-3189 to Mt-3189, Ds-3195 to Ds-3195, Rg-3196 to Rg-3196, Co-3209 to Co-3209, Bh-3210 to Bh-3210, Hs-3211 to Hs-3211, Mt-3215 to Mt-3215, Ds-3221 to Ds-3221, Rg-3222 to Rg-3222, Co-3233 to Co-3233, Bh-3234 to Bh-3234, Hs-3235 to Hs-3235, Mt-3239 to Mt-3239, Ds-3245 to Ds-3245, Rg-3246 to Rg-3246, Co-3259 to Co-3259, Bh-3260 to Bh-3260, Hs-3261 to Hs-3261, Mt-3265 to Mt-3265, Ds-3271 to Ds-3271, Rg-3272 to Rg-3272, Co-3283 to Co-3283, Bh-3284 to Bh-3284, Hs-3285 to Hs-3285, Mt-3289 to Mt-3289, Ds-3295 to Ds-3295, Rg-3296 to Rg-3296, Co-3309 to Co-3309, Bh-3310 to Bh-3310, Hs-3311 to Hs-3311, Mt-3315 to Mt-3315, Ds-3321 to Ds-3321, Rg-3322 to Rg-3322, Co-3333 to Co-3333, Bh-3334 to Bh-3334, Hs-3335 to Hs-3335, Mt-3339 to Mt-3339, Ds-3345 to Ds-3345, Rg-3346 to Rg-3346, Co-3359 to Co-3359, Bh-3360 to Bh-3360, Hs-3361 to Hs-3361, Mt-3365 to Mt-3365, Ds-3371 to Ds-3371, Rg-3372 to Rg-3372, Co-3383 to Co-3383, Bh-3384 to Bh-3384, Hs-3385 to Hs-3385, Mt-3389 to Mt-3389, Ds-3395 to Ds-3395, Rg-3396 to Rg-3396, Co-3409 to Co-

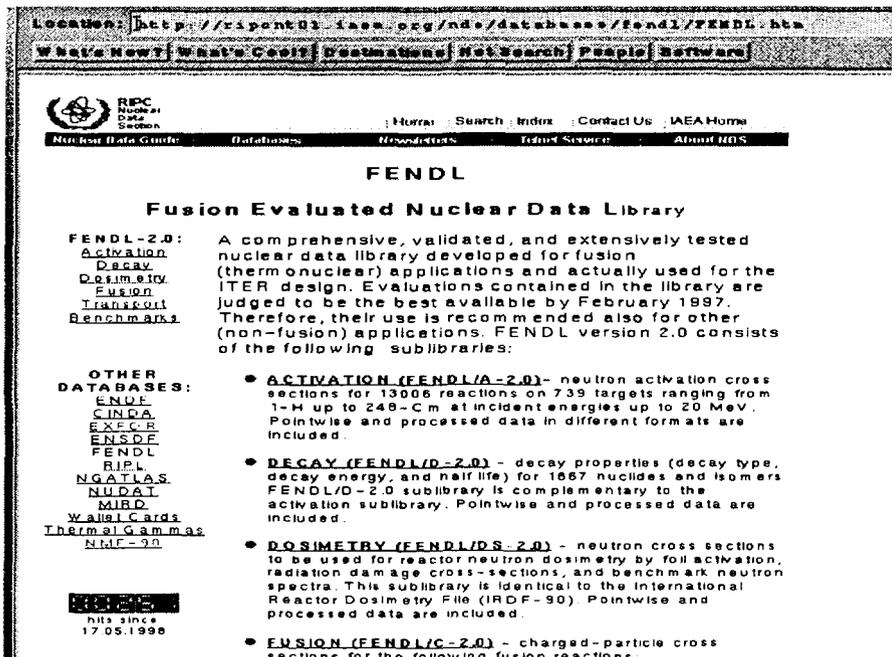


Figure 7: The FENDL web page

the experimental reaction data library EXFOR; all major evaluated neutron data libraries; various special purpose neutron data libraries (e.g. for thermal neutron scattering, fission products, actinides, neutron activation, and others); structure and decay data libraries; many special purpose files and libraries (partly for use on personal computers) for special applications. All libraries and the related documentation are available free of charge to scientists in IAEA member states. An overview is given in the document "Index of Nuclear Data Libraries available from the IAEA Nuclear Data Section"<sup>16</sup>.

*Selected examples of special purpose libraries:*

- FENDL-2 (Fusion Evaluated Nuclear Data Library)<sup>17</sup>: This is a recent example of a worldwide effort coordinated by the IAEA. The complete library includes basic evaluated neutron reaction data for 63 materials as well as derived working libraries (processed data). Aimed primarily at fusion applications, the data are useful also for a variety of other applications. The major "customer" for FENDL is ITER (International Thermonuclear Experimental Reactor), the common fusion project of USA, Russia, Europe and Japan (design activity 1992-1998). FENDL-2 consists of 810 files (1 Gbyte of data) and is available online from the IAEA Nuclear Data Section.
- X-ray and  $\gamma$ -ray standards for detector calibration (XG Standards)<sup>18</sup>: This is a PC diskette which contains for selected nuclides their half-lives and the energies and emission probabilities of  $\gamma$ -rays and X-rays suitable for detector and efficiency calibration.

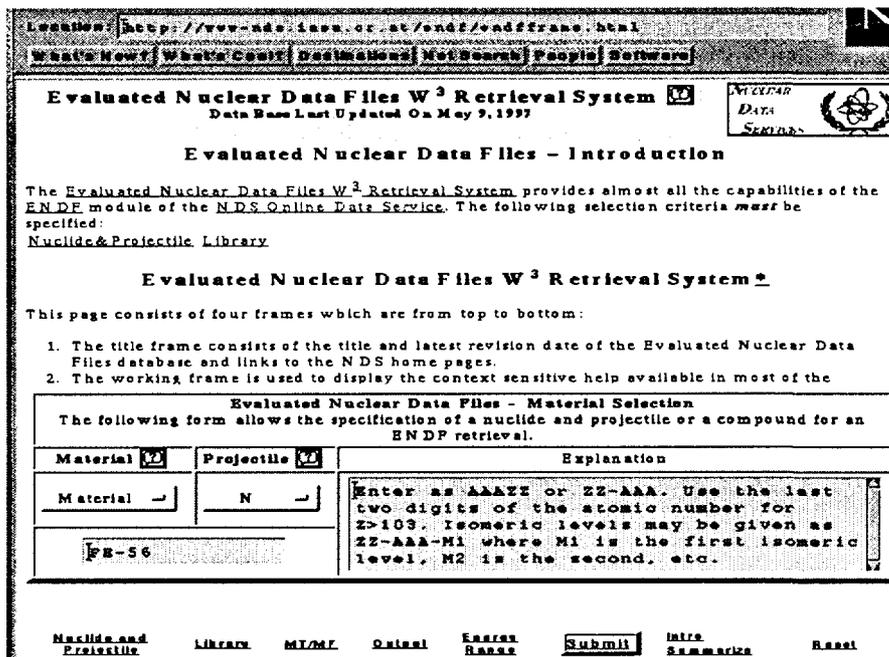


Figure 8: The ENDF web page

- Nuclear Data for Safeguards (SGNucDat): a PC database (also available as a handbook<sup>19</sup>) containing nuclear data needed for the development and application of nuclear materials accounting techniques.

## 5 Online Services

Distribution via electronic networks has become a main way of distributing numerical nuclear data in the past years. The IAEA Nuclear Data Section, like most of the other nuclear data centers, is offering a variety of electronic services while at the same time the more conventional data services (e.g. mailing data on tapes or diskettes) will be continued for the foreseeable future. The basis of the electronic services is the Internet, a "network of networks" which links many thousands of local networks and millions of computers. Within the Internet protocol, several methods of data transfer are in use:

- **Worldwide Web** (Other names: WWW, W3, Web). Originally developed by CERN, Switzerland, for the high energy physics community, now in use as a medium for scientific, commercial and any other type of information. It is based on hypertext (text containing links to other documents allowing the user to conveniently navigate between documents and websites). The *IAEA Nuclear Data Services* web page can be found at the web address (URL) <http://www-nds.iaea.or.at> and contains interactive access to most of the main databases including EXFOR, CINDA, ENSDF, NUDAT,

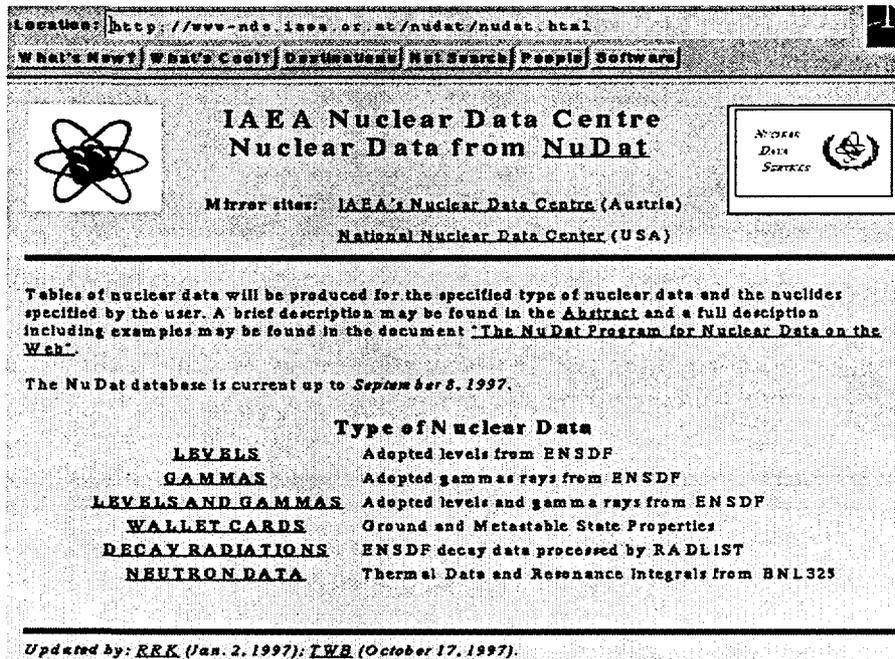


Figure 9: The NUDAT web page

ENDF (collection of main evaluated cross section libraries), NGATLAS (atlas of neutron capture cross sections<sup>20</sup>) and others (Figs.4-9); an overview of all nuclear data libraries and databases available from the IAEA (the *IAEA Nuclear Data Guide*); access to download complete files (such as FENDL-2, IRDF-90, Atomic Mass Evaluation) as well as to various documents, manuals (in PostScript) and nuclear data utility programs; the latest issues of the IAEA's Nuclear Data Newsletter, and a link to the Telnet nuclear data service NDIS.

- **FTP** (File Transfer Protocol). The IAEA Nuclear Data Section keeps several accounts for file transfer requiring no password (all accessible by the FTP address *iaeand.iaea.or.at*): ANONYMOUS (read-only), contains several complete libraries, utility codes and documents for public use; FENDL2 (read-only), contains the data library for fusion applications FENDL-2; NDSOPEN (read and write), used for bilateral file exchange; NDSOVL (read-only), contains files saved by users of the Telnet-based online system NDIS (Nuclear Data Information System) to "local area"; RIPL (read-only), contains the new Reference Input Parameter Library<sup>21</sup>.
- **TELNET**: the standard Internet protocol for remote login. This is the method used to connect to the IAEA's first online nuclear data service NDIS which was introduced in 1992. The starting command for NDIS is *telnet iaeand.iaea.or.at*, then the username *iaeands* has to be entered. A detailed manual is available online in PostScript or as a hardcopy<sup>22</sup>. This type of online service has lost some of its importance to the rapidly

expanding WWW technology but is still considered very useful by many users and will be kept in parallel for the foreseeable future. NDIS provides access to the main interactive nuclear databases (as listed above under WWW) as well as to PostScript documents and utility programs.

## 6 Future developments

Within the Internet-based services, the shift towards Web-based interfaces, as a convenient alternative to FTP- and Telnet-based services, is in good progress and will continue. However, in consideration of the varying needs, in particular of users in developing countries having very diverse hardware and networking infrastructure, all currently used distribution methods, including conventional mail services, will be continued at least for the next several years.

The data available online will be supplemented gradually with "minor" (specialized) databases (so far typically distributed on diskettes) and with more electronic versions of hardcopy documents and reports. At present, the limiting factor for electronic distribution of large documents or full libraries is often the capacity of the network connection (bandwidth). Possible solutions are the distribution of databases on CD-ROM (possibly with a web-type user interface) and the possibility of (automatic) updates through Internet; and the creation of regional copies of the "Nuclear Data Services" website (the "mirror site" concept). It may be necessary to implement both solutions in parallel to satisfy all users' needs for the coming years.

## References

1. "Nuclear Structure and Decay Data Network", in "Nuclear Data Newsletter", issue No. 20, November 1994 (IAEA, Vienna, Austria)
2. "Nuclear Data Newsletter", (IAEA, Vienna, Austria). Issued 2 times per year. Also available through <http://www-nds.iaea.or.at/>.
3. "National Nuclear Data Center Newsletter", issued three times per year (National Nuclear Data Center, Brookhaven, USA)
4. "RSICC Newsletter", issued monthly (Radiation Safety Information Computational Center, Oak Ridge, USA). Also available through <http://epicws.epm.ornl.gov/NEWSLETTER.html>.
5. "CINDA 98, The Index to Literature and Computer Files on Microscopic Neutron Data" (IAEA, Vienna, Austria, August 1998)
6. "Short Guide to EXFOR", Report IAEA-NDS-1 (Revision 7), November 1996, by H.D. Lemmel (IAEA, Vienna, Austria)
7. Ed. V. McLane, C.L. Dunford and P.F. Rose, "ENDF-6 Format Manual", Report IAEA-NDS-76 (Revision 5), June 1997 (IAEA, Vienna, Austria)
8. "Index to BROND-2, CENDL-2, ENDF/B-6, JEF-2, JENDL-3, IRDF, EFF-2.4 and FENDL/E", Report IAEA-NDS-107 (Revision 11), March 1996, by H.D. Lemmel (IAEA, Vienna, Austria)

9. "ENDF/B-6, U.S. Evaluated Nuclear Data Library for Neutron Reaction Data", for Summary of Contents see Report IAEA-NDS-100 (Revision 7), February 1997, by H.D. Lemmel and P.K. McLaughlin (IAEA, Vienna, Austria). Note: The original US name of this library is *ENDF/B-VI*.
10. C.L. Dunford and T.W. Burrows, "NuDat System for Access to Nuclear Data", Report IAEA-NDS-205 (Revision 98/7), July 1998 (IAEA, Vienna, Austria)
11. "Table of Isotopes", 8th edition (1996), ed. by R.B. Firestone, V.S. Shirley, S.Y.F. Chu, C.M. Baglin, and J. Zipkin (John Wiley and Sons, New York)
12. "Nuclear Wallet Cards", Fifth edition, July 1995, ed. J.K. Tuli (National Nuclear Data Center, Brookhaven, USA)
13. S.Y.F. Chu, H. Nordberg, R.B. Firestone, L.P. Ekström, "Isotope Explorer", see <http://ie.lbl.gov/isoexpl/isoexpl.htm>
14. G. Audi, O. Bersillon, J. Blachot, A.H. Wapstra, "The NUBASE evaluation of nuclear and decay properties", *Nucl. Phys. A* **624**, 1-124 (1997). The database is available in electronic form from the Atomic Mass Data Center, see <http://csnwww.in2p3.fr/amdc/>.
15. G. Audi and A.H. Wapstra, "The 1995 Update to the Atomic Mass Evaluation", *Nucl. Phys. A* **595**, 409-480 (1995). See also Report IAEA-NDS-47 (Revision 3), November 1995 (IAEA, Vienna, Austria)
16. "Index of Nuclear Data Libraries Available from the IAEA Nuclear Data Section", Report IAEA-NDS-7 (Revision 98/8), August 1998, by H.D. Lemmel and O. Schwerer (IAEA, Vienna, Austria). Also available through <http://www-nds.iaea.or.at/> as *IAEA Nuclear Data Guide*.
17. A.B. Pashchenko, H. Wienke, D.W. Muir, "FENDL-2: An improved nuclear data library for fusion applications", in *Proceedings of International Conference on Nuclear Data for Science and Technology, Trieste, Italy, 19-24 May 1997*, ed. G. Reffo, A. Ventura, and C. Grandi (Italian Physical Society, Conference Proceedings Vol. 59, Bologna, 1998) pp. 1150 - 1154
18. "X-ray and gamma-ray standards for detector calibration", IAEA-TECDOC-619, September 1991 (IAEA, Vienna, Austria). Data available on the WWW through <http://www.nts-ltd.demon.co.uk/IAEA/menu619.htm>
19. N. Kocherov, M. Lammer, O. Schwerer, "Handbook of Nuclear Data for Safeguards", Report INDC(NDS)-376, December 1997 (IAEA, Vienna, Austria)
20. "Atlas of Neutron Capture Cross Sections", ed. by J. Kopecky, graphs published in Report INDC(NDS)-362, April 1997 (IAEA, Vienna, Austria). Numerical data available through <http://www-nds.iaea.or.at/ngatlas/main.htm>
21. "Handbook for Calculations of Nuclear Reaction Data (Reference Input Parameter Library)", IAEA-TECDOC-1034, August 1998 (IAEA, Vienna, Austria). See also <http://www-nds.iaea.or.at/ripl> and CD-ROM (IAEA-NDS-CD-02, Vienna, May 1998)
22. C.L. Dunford and T.W. Burrows, "Online Nuclear Data Service", Report IAEA-NDS-150 (Revision 98/9), September 1998 (IAEA, Vienna, Austria)

---

Nuclear Data Section  
International Atomic Energy Agency  
P.O. Box 100  
A-1400 Vienna  
Austria

e-mail: [services@iaeand.iaea.or.at](mailto:services@iaeand.iaea.or.at)  
fax: (43-1) 26007  
cable: INATOM VIENNA  
telex: 1-12645  
telephone: (43-1) 2600-21710

---

Online: TELNET or FTP: [iaeand.iaea.or.at](http://iaeand.iaea.or.at)  
username: IAEANDS for interactive Nuclear Data Information System  
usernames: ANONYMOUS for FTP file transfer,  
FENDL2 for FTP file transfer of FENDL-2.0;  
RIPL for FTP file transfer of RIP;  
NDSONL for FTP access to files sent to NDIS "open" area.

Web: <http://www-nds.iaea.or.at>

---