

PROGRESS REPORT OF THE IAEA NUCLEAR DATA SECTION

(Note: This report is an extract taken from the 1997/1998 report to the INDC,
see INDC(NDS)-400)

1. NUCLEAR DATA SECTION OVERVIEW

The budget and staffing level of the Nuclear Data Section has been relatively stable during the current reporting period, with the exception that the Section lost one G-4 secretarial position when Sofie Aung retired without replacement in late 1998. The authorized staff level for 1999-2000 is 18, consisting of 10 professionals (P-staff) and 8 support staff (G-staff). Of these 18 staff members, 3 (2 P-staff and 1 G-staff) are assigned to the Atomic and Molecular Data Unit.

As shown in Table 1, the budget approved for the 1999-2000 biennium is nearly constant in dollars, in comparison with 1997-1998. There has been some shift of emphasis in the programme of the Section, with more resources devoted to workshops and other user training initiatives than in the past, increased staff activity in the development of technical co-operation projects, and the 15-month appointment of a Web programmer, Scott Miller of the University of Texas. There have been declines in the hard copy printing budget, and in both staff and non-staff travel. Further pressure on printing and travel budgets can be expected in the future.

Table 1. Budget and staff summary 1997-2000

	1997	1998	1999	2000
Authorized Staff Level	19	18	18	18
Actual Staff Level	17.8	19	18.1	18
Staff Cost Budget	1,600,000	1,600,000	1,600,000	1,550,000
Programmatic Budget	645,000	602,000	570,000 ^{*)}	636,000
Total Budget US\$	2,245,000	2,202,000	2,170,000	2,186,000

*) Already includes recent cut by 47,000 US\$ in staff and non-staff travel

In spite of substantial staff turnover during the period, the Section has operated at full staff strength since November 1997, when Vladimir Pronyaev was appointed as successor to Hans Lemmel as Head of the Nuclear Data Centre Unit. Vladimir comes to us from the Nuclear Data Centre at IPPE Obninsk, Russia. In addition to numerous responsibilities connected with the design and delivery of nuclear data services to users, Vladimir also serves as the Scientific Secretary of the Nuclear Structure and Decay Data Evaluators Network.

The Section's long time Data Centre Systems Manager, Ramon Arcilla, completed 7 years of outstanding service in early 1998. Despite good arguments to the contrary, the post was deemed subject to staff rotation, and Mr. Arcilla left the Agency at the end of May. A vigorous recruiting effort (which included upgrading this post to the P-3 level by utilizing a previously frozen P-4 position) resulted in the hiring of William (Liam) Costello as our new Data Centre Systems Manager in May 1998. Liam comes to the Section with 13 years of

previous experience managing VMS systems in university science and engineering research centres in Ireland and Kuwait. In other staff movements, Harm (Harry) Wienke left the Section at the end of 1998 and was replaced by Victor Zerkin, who formerly managed the Ukraine Nuclear Data Centre. With Mr. Zerkin's appointment, this position has been redirected somewhat to focus more on the development of computer software for improved nuclear data services.

Mr. M. O'Connell's post in the NDS Computer Operations Unit was upgraded from G-4 to G-5. Mr. O'Connell continues to serve as Information Technology Co-ordinator (ITC) for the Division of Physical and Chemical Sciences along with his work as a programmer in the Nuclear Data Section.

The position of Head of the Atomic and Molecular Data Unit will be vacated this year with the retirement of Ratko Janev after 11-plus years of outstanding service. Mr. Janev's unique accomplishments were recognized formally by the Agency through the granting in 1998 of a Merit Promotion to the P-5 level. Merit promotions are awarded to fewer than one-half of one percent of Agency employees each year. It is anticipated that his successor will arrive in July 1999.

In September 1997 the IAEA General Conference approved the appointment of Dr. Mohamed ElBaradei as Director General of the IAEA, replacing Dr. Hans Blix. The new Director General has initiated an ambitious program of programme reviews, beginning with an in-house Senior Management Conference in early 1998. One of the outcomes of that conference is a new process which "will assist in implementing the staff rotation policy by identifying posts which require continuity, as opposed to those that need the periodic input of fresh talent". This increased attention to the need for continuity in core staff positions is a welcome development, and the Section is participating in the formulation of the new process. Another significant event was the convening of an Agency-wide review by the external Senior Expert Group (SEG), which completed its work in October 1998. Among the recommendations of the SEG was the initiation of Department-level Programmatic Performance Assessments (PPAS) of several Agency Departments, including our own, the Department of Nuclear Sciences and Applications.

In support of the PPAS of the Department of Nuclear Sciences and Applications, the Nuclear Data Section has produced briefing materials on several topics of interest to the review panel, including (a) the special role of the Department of Nuclear Sciences and Applications in developing scientific databases which support the development of nuclear technology in Member States, (b) the close working relationship between the nuclear data programs of the IAEA and the OECD Nuclear Energy Agency, (c) an explanation of the important role of the International Nuclear Data Committee in providing programmatic guidance to Agency activities, and (d) the creation of a unified web site for our parent Division, the Division of Physical and Chemical Sciences (NAPC), on the Agency's central web server; see <http://www.iaea.org/programmes/napc/nd/>. (The NDS portion of this site provides a useful supplement to the Section's nuclear and atomic data dissemination sites, which continue to be developed separately). The PPAS panel has met twice already and is expected to complete its work in May 1999. The recommendations of the panel can be expected to have an impact on the future directions of the programme and budget of the Section, Division and Department, as well as the standing advisory groups that advise the Director General on these activities.

2. DATA CENTER ACTIVITIES

The main objectives of the NDS Nuclear Data Centre activity in 1997-1998 can be formulated as follows:

- to collect, assess, recommend and disseminate nuclear data required in the application of nuclear technology,
- to promote the exchange of nuclear data needed for applications,
- to co-ordinate world wide networks of national and regional nuclear reaction and nuclear structure and decay data centres,
- to maintain manuals and software for internationally agreed database formats and exchange procedures, and
- to improve the means by which the data centre provides information to its users.

2.1. *Nuclear Data Compilation*

Nuclear reaction data compilation includes the collection of bibliographic information and numerical data mainly from the NDS Nuclear Data Centre's area of responsibility, and their compilation in the computerized formats CINDA and EXFOR. This concerns first mainly experimental data.

General purpose evaluated nuclear reaction data libraries are created under national or regional programs and after distribution they are included in the common network's ENDF database by the NNDC, Brookhaven. Special purpose oriented nuclear data libraries and files are prepared in the framework of the IAEA Co-ordinated Research Projects or national and regional programs. They are documented by the IAEA NDS and, after checking and testing, disseminated via online access or off-line upon requests.

CINDA

The co-operation between the four major Nuclear Data Centres (NNDC Brookhaven, CJD Obninsk, NEA DB Paris and NDS Vienna) worked smoothly, and changes in the system and dictionaries were introduced in joint co-ordinated efforts. The top priority among these efforts is the preparation of 'CINDA 2000' (responsibility of NNDC, with input from other centres). This includes the necessary modifications for the coding and storage of data from year 2000 onwards, and an extension of the CINDA system to allow its use for non-neutron reaction data. At the same time, there is an action on NDS to prepare proposals for the coding of theoretical model parameters used in calculations and evaluations.

During 1997-1998, the NDS has prepared and transmitted 3677 CINDA entries either as direct input to the CINDA file (work in laboratories belonging to the responsibility of NDS) or for further processing by the responsible data centres.

CINDA 97 was published as a cumulative issue (1988-1997) and CINDA 98 was published as a supplement to CINDA 97. The introductory pages were revised and some parts

omitted that were difficult to keep up to date. The change in programming staff (R. Arcilla replaced by W. Costello) was smooth and caused no delay in the book production.

In 1998, the NEA Data Bank produced a trial version of CINDA on CD-ROM, for which NDS provided some input. The distribution of this CD-ROM will be cost free.

The online use of the CINDA file is increasing steadily. The Web interface is increasingly preferred by users over the Telnet interface.

EXFOR

In the years 1997-1998, 5 neutron-EXFOR transmissions were distributed by NDS to the other centres containing:

- 28 new entries with 315 new data tables (subentries),
- 69 revised or recompiled entries with 209 revised data tables.

The new entries contain data from Albania (1 entry), Bangladesh (2), Brazil (2), China (9), Hungary (4), India (1), Mexico (2), Poland (1), Romania (1), Slovakia (3), and Sudan (2).

In addition, NDS distributed two EXFOR transmissions containing new charged-particle nuclear data compiled at ATOMKI, Debrecen (Hungary) which were checked and finalized at NDS. These transmissions contained 17 new entries with 147 new data tables (subentries) and several revisions.

Evaluated Data Libraries, Files and Programs

The following Evaluated Data Libraries, Files and Programs have been updated or added to the IAEA NDS collection (listed in chronological order of their inclusion):

- CENDL-2.1R. 7 revised materials (^{nat}Fe , $^{54,56,57,58}\text{Fe}$, ^{nat}Hg , ^{nat}Tl) were replaced in the previous version of the Chinese Evaluated Nuclear Data Library for neutron reaction data (CENDL-2.1). Available online and on CD-ROM.
- "Maslov" updates 97/2 and 98/01. Evaluated neutron reaction data for ^{238}Pu , ^{242}Pu and ^{238}Np were added to this file containing now evaluations for several Np, Pu, Am and Cm isotopes. Available on diskette.
- MENDL-2P. Proton reaction data library for nuclear activation which includes calculated proton cross sections in ENDF-6 format for 505 nuclei ($Z=13-84$) for energies up 200 MeV. The total number of reactions is 87196. Available on CD-ROM.
- SGNucDat Version 2. Safeguards Nuclear Data for Windows, update 1997, which includes: 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. Available on diskette.

- XMuDat. Photon attenuation data on PC. XMuDat is a package of computer code and data library to be used with Windows 95 or Windows NT for the calculation and presentation of mass attenuation-, mass energy transfer-, and mass energy absorption coefficients in a photon energy range of 1 keV to 50 MeV for materials, their mixture and compounds. Available online and on diskette.
- FENDL-2.0. A comprehensive and extensively tested nuclear data library developed for fusion (thermonuclear) applications and actually used for the ITER design. Evaluations contained in the library are judged to be the best available, as of February 1997. Their use can also be recommended for other (non-fusion) applications. FENDL-2.0 version 14 January 1999 is available online and on CD-ROM and consists of the following sublibraries:

ACTIVATION (FENDL/A-2.0) - neutron activation cross sections for 13006 reactions on 739 targets ranging from ^1H up to ^{248}Cm at incident energies up to 20 MeV. Pointwise and processed data in different formats are included.

DECAY (FENDL/D-2.0) - decay properties (decay type, decay energy, and half-life) for 1867 nuclides and isomers. FENDL/D-2.0 sublibrary is complementary to the activation sublibrary. Pointwise and processed data are included.

DOSIMETRY (FENDL/DS-2.0) - neutron cross sections to be used for reactor neutron dosimetry by foil activation, radiation damage cross sections, and benchmark neutron spectra. This sublibrary is identical to the International Reactor Dosimetry File (IRDF-90). Pointwise and processed data are included.

FUSION (FENDL/C-2.0) - charged-particle cross sections for the following fusion reactions: $^2\text{H}(d,n)^3\text{He}$, $^2\text{H}(d,p)^3\text{H}$, $^3\text{He}(d,p)^4\text{He}$, $^3\text{H}(t,2n)^4\text{He}$, and $^3\text{H}(d,n)^4\text{He}$. Pointwise and processed data are included.

TRANSPORT - validated basic nuclear data (neutron-nucleus interaction including photon production, and photon-atom interaction cross sections) for 57 nuclides relevant for fusion. In addition to the pointwise data (FENDL/E-2.0), the sublibrary also contains processed data FENDL/MG-2.0 and FENDL/MC-2.0 to be used in the discrete-ordinates and Monte Carlo transport calculations respectively.

BENCHMARKS - collection of benchmarks for FENDL-2.0 validation.

- NGATLAS. The files of this library contain neutron capture cross sections in the range 10^{-5} eV - 20 MeV as evaluated and compiled in recent activation libraries. Numerical values of (n, γ) cross sections are available for a total of 739 targets for the elements H (Z=1, A=1) to Cm (Z=96, A=248), totaling 972 reactions. Available online.
- RIPL. Reference Input Parameter Library for theoretical calculations of nuclear reactions. The library contains input parameters for theoretical calculations of nuclear reaction cross sections. Incident and outgoing particles can be n, p, d, t, ^3He , ^4He , and gamma with energies up to about 100 MeV. The information is given for Atomic Masses and Deformations, Discrete Level Schemes, Average Neutron Resonance Parameters, Optical

Model Parameters, Level Densities (Total, Fission, Partial), Gamma-ray Strength Functions and Continuum Angular Distributions. Available online and on CD-ROM.

- EPDL97. The Evaluated Photon Data Library, 1997 Version. It supersedes the earlier 1989 version of EPDL. The library includes photon interaction data for all elements with atomic numbers between 1 and 100 over energy range 1 eV to 100 GeV. The Evaluated Atomic Data Library (EADL), Evaluated Electronic Data Library (EEDL) and Evaluated Excitation Data Library (EXDL) are included to allow consistent coupled photon-electron calculations. Available on CD-ROM.
- EPICSHOW (Electron Photon Interactive Code - Show Data), 1998 Update. This is interactive graphics code that allows users to view and interact with neutron, photon, electron and light charged particle data. The code is implemented on UNIX, IBM-PC, Power MAC and Windows platform. Available on CD-ROM.
- ENDF/B-VI Library, Release 5. It includes revisions up to October 1998. Available online and on CD-ROM.
- ENDF/B-VI Charged-Particle Sublibraries, Version 1998. It contains interaction data between hydrogen and helium isotopes/nuclei. Available online and on CD-ROM.
- RRDF-98. Russian Reactor Dosimetry File. File contains cross sections (including plots with intercomparisons) and covariance matrices of uncertainties for 22 reactions used for neutron flux dosimetry by foil activation. Available online and on diskettes.

All these files, libraries and codes are documented either in the IAEA-NDS Report series (available online) or in INDC Report (NGATLAS) and IAEA-TECDOC Report (RIPL).

2.2. Nuclear Data Services: Improvement and Statistics

Due to the variety of requirements from users, different media are used for user services. These services include answering requests using ordinary mail with enclosure of hard copies of documents, PC diskettes and CD-ROMs for local use, and online transfer of data retrieved by users through Telnet/NDIS or via Web access to the databases, files and documents. The main innovations and improvements in the user's services in the last two years can be summarized in the following way:

- Platform independent and user-friendly Web access was opened to all major nuclear databases: CINDA, EXFOR and ENDF in 1997-1998.
- CD-ROM versions of important databases, libraries and files (CINDA, EXFOR, ENDF) with retrieval programs were prepared in co-operation with other data centres or by NDS (FENDL-2.0, RIPL). This service is primarily focused on users with limited access to the Internet (new for CD-ROMs with databases and retrieval programs).

- Twenty-two recent reports with descriptions of data and computer codes available from Nuclear Data Section (reports of the IAEA-NDS series) were ported to the NDS Web site. Six of the latest INDC reports which had electronic version were placed at the NDS Web site. Six of the latest Nuclear Data Newsletters announcing new NDS services and products were made available online (new for IAEA-NDS and INDC Reports).

Table 2. NDS nuclear data retrieval statistics by year

Type of Medium	Year			
	1995	1996	1997	1998
Ordinary mail ^{a)}	1556	786	1846	1775
Including:				
Documents (hard copies)	1155	554	1547	1430
Data (diskettes and CD-ROMs)	373	219	286	320
Online retrievals (Telnet and Web)	4462	5688	7350	9300
Web sessions ^{b)}	-	840	13517	28601
Including access to:				
ENDF	-	-	67	1833
EXFOR	-	-	219	1063
CINDA	-	-	33	680
ENSDF	-	67	592	827
FENDL	-	-	512	1044
RIPL	-	-	102	1574
Newsletters and Reports	-	15	182	1224
Volume of information downloaded from the Web server (Mbytes)	-	35	2551	8556

^{a)} Retrievals prepared upon requests.

^{b)} A Web session is defined as being any, non-IAEA domain, client connection to the NDS Web server. Such sessions can be of any duration provided that they are not interrupted for a period of more than 30 minutes.

The general statistics of user services in 1997-1998 is shown in Table 2. Also shown for comparison are the years 1995-1996. Figures are given in terms of retrievals for 3 different media. Ordinary mail includes retrievals prepared by the NDS staff upon user requests and sent to them via ordinary mail. Online retrievals are made directly by users through their Telnet or Web access to the databases, libraries, files and reports. One retrieval usually contains one homogenous piece of information. This can represent one report, or a set of different data retrieved from one library or database, or computer code or codes when they are distributed as a package. Online retrieval corresponds to one user creating output either on hard disk or in screen mode. Further given in Table 2 is the number of Web sessions at the NDS server and the number of Web sessions with access to the major databases, libraries and reports. Finally, the total volume of downloaded information with details on several databases, libraries and files is shown.

Fig. 1 shows the country statistics of the NDS data services in 1997 subdivided into three categories: ordinary mail, user initiated online Telnet retrievals, and Web sessions. The countries are grouped according to four areas of the responsibility, that is those of the four major data centres.

Fig. 2 demonstrates the activity of users from different countries at the NDS server over the last two years. The NDS server provides access to many data libraries, files, computer codes and reports which are specific to IAEA activity. This is one of the reasons why the NDS server is accessed by users of other centres service areas.

The following tendencies in the user's services can be seen during the last two years:

- The number of requests fulfilled through ordinary mail remains fairly stable.
- The number of data sets and computer code packages distributed on diskettes and CD-ROMs is also relatively stable with a high share of CD-ROMs in the last two years.
- Since access to the databases through the Web is generally more comfortable than through the Telnet, about 70% of all users used the Web and only 30% used Telnet for data retrieval in 1998.
- The number of Web sessions doubled in 1998 compared to 1997, with an 8 to 10% share of users from developing countries. Users from a total of 82 different countries have visited the NDS Web server in 1998. At present, 85% of all addresses have been resolved in the analysis of the Web log records.

•