IAEA Nuclear Data Section: Progress Report, 2003/04

IAEA Technical Meeting, 4 - 7 October 2004
Co-ordination of the Network of Nuclear Reaction Data Centres,
Brookhaven, USA

Summary of nuclear data studies by staff of the IAEA Nuclear Data Section
1 July 2003 – 30 September 2004.

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1. Staff

The authorized staff level of the Nuclear Data Section remains at a total of 18 professional and support staff. Three new staff members joined during the reporting period: Roberto Capote Noy (effective from 2 February 2004), Marco Verpelli (effective from 7 September 2003) and Svetlana Dunaeva (effective from 12 October 2003), succeeding former staff members Mike Herman, Kevin McLaughlin and Meinhart Lammer, respectively.

2. Data compilations

2.1 CINDA

NDS staff scan over 40 journal titles (mainly through the Internet) for the purpose of CINDA-compilation coverage control. There were 3146 CINDA entries prepared in 2003/04, and transmitted either as direct input to the CINDA file (work in the area of NDS responsibility), or for further processing after submission by other responsible data centres.

A database for CINDA coverage control has been installed that includes papers of significance or may be significant in the future for EXFOR or CINDA compilations. Over 21 journal titles and 400 journal issues from 2000 to 2004 are included at present. Journals references that should be compiled elsewhere were dispatched to the relevant centres (Japan, Russia, Hungary, NEADB). Also, copies of the articles were sent for compilation if another centre requested.

Also, three lists of papers were revised for completeness of compilation:

1. Ion Beam Analysis;
2. Publications of S. Qaim (Institut für Nuklearchemie, Forschungszentrum Jülich GmbH);
3. List for CRP on “Cross Sections for the Production of Therapeutic Radioisotopes”.

All relevant references absent from EXFOR were sent to the responsible centres for compilation, along with hardcopies of the papers, if necessary.

2.2 EXFOR and Dictionaries

Over the previous year, NDS staff have distributed two neutron TRANS files (3115, 3116) containing 12 new and 30 revised entries. Furthermore, 8 CPND TRANS files (D027 - D034) were distributed, containing 127 new entries (100 compiled at NDS, 27 at ATOMKI) and 8 revised entries. The compilations consisted of both new literature and important old references for ion beam analysis (about 30) and medical applications (about 35). Numerous curves from twenty-nine papers were also digitized at NDS that are the responsibility of NNDC, and sent to NNDC for compilation.

Altogether 74 TRANS files (not counting those for which a preliminary version had been submitted before the last meeting) were received and processed (compared to 42 for the 2002/2003 period), containing 567 neutron entries (239 new, 328 revised), 1528 CPND entries (1149 new, 379 revised) and 19 photonuclear entries (14 new, 5 revised).

Since the 2003 NRDC meeting, NDS staff have produced and distributed four regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9083-9086) in EXFOR, DANIEL and archive format. In addition, a first version of the new dictionaries for CINDA 2001 was submitted and added to the NDS open area (transmission 9185, see memo CP-D/405), and was updated with transmission 9086.

2.3 Evaluated data libraries, files and programs

Various new evaluated data libraries, files and programs for data checking, processing and graphical presentation were added to the NDS IAEA Web-site and distributed on CD-ROM:

- ENDF/B-VI Library, release 8 (last for ENDF/B-VI library)
- POINT2003, a temperature-dependent version of the ENDF/B-VI library, release 8
- FOND-2.2 Evaluated Neutron Data Library; Russian library for generating ABBN group constants
- updates to EPDL97 library of photon and electron interactions with atoms, and atom relaxation libraries
- theoretical evaluation of neutron- and proton-induced fission cross sections for Pb-Pu targets over the energy range from 20 to 200 MeV
- WIMSD-IAEA-69 and 172-group libraries in WIMS-D format
- IBANDL Ion Beam Analysis Nuclear Data Library
- PGAA database for prompt gamma-ray neutron activation analysis
- Charged-particle cross section database for medical radioisotope production, Update January 2004 (with links to ENDF-formatted data)
- NUDAT-2.0, interactive searching and plotting of nuclear structure and decay data
- EXFOR - CINDA Database and Retrieval System, version 1.62, data updated June 2004 (CD-ROM)
- EXFOR - CINDA for Applications Databases and Retrieval Systems on Linux and Windows, version 1.62, June 2004 (CD-ROM)
- ENDVER/GUI and EXFOR-CINDA package. Integrated Tools for ENDF-Evaluators, Version 1.0, June 2004

3. Services

At the end of June 2004, the NDS Web service was moved from our DEC Alpha/Open VMS to an Intel/Linux machine. All products were ported to the new environment. The most difficult element was the migration of all major databases and services, which was undertaken in close co-operation with NNDC (USA) - see Section 4 - and was carried out over a four-year period. As a result, all major databases and services were implemented on Linux, and opened for public access on both the NNDC and NDS Web sites.

Hardcopy and electronic versions of the biannual Nuclear Data Newsletters were published and distributed, advertising new NDS products and services. Twenty-two INDC-NDS and country reports were also prepared as hardcopy and electronically, including two issues of the Nuclear Constants journal translated from Russian to English. Twenty-seven country-based INDC reports were scanned, converted to pdf format, and added to the NDS web site.

4. Development of New Generation of Nuclear Databases and Services

Significant benefits were judged to accrue from moving the major nuclear databases and services from VMS/DBMS to other platforms. The "Migration" project was first considered in 1999 by NDS, and initiated in close co-operation with NNDC (USA). NDS was responsible for the primary nuclear reaction databases (EXFOR, CINDA and ENDF), while NNDC staff implemented the nuclear structure and decay databases (ENSDF, NSR and NuDat). New architecture based on relational-database and new Web technologies was successfully developed. The project also included significant revisions of the functionality of the existing data services to extend and implement at an advanced level, with the final goal of reaching a higher level of accessibility, functionality and service.

The "Migration" project at NDS aimed to create platform-independent nuclear reaction databases and services. This work has successfully been implemented on three nuclear reaction databases: bibliographic (CINDA in new format), experimental (EXFOR) and evaluated (ENDF) data. All three databases and software are being developed and tested on several platforms: Linux, Windows (even VMS), MySQL, SyBase and MS-Access. Web interfaces to all three databases were opened for public access on NDS and NNDC Web sites in 2004.

During the past year the following items were developed:

- ENDF loading/updating software
- ENDF Web retrieval system using Java-Servlet technology (with many improvements including Dictionaries and common plots with EXFOR)
- Web interfaces to EXFOR, CINDA and ENDF installed and tested with MySQL (NDS) and SyBase (NNDC)
- Tool for EXFOR compiler on CD-ROM for Windows distributed among workshop participants
- Charged-particle data imported from EXFOR to CINDA
- New CD-ROM "EXFOR-CINDA for Applications" for Linux and Windows with stand-alone database and retrieval system based on MySQL; contains a non-interactive retrieval utility for use from external software packages
- CINDA compilation and updating programs

Tasks for next year:

- develop ENDF CD-ROM Retrieval system
- finish CINDA compiler's tool to input data to database
- continue development of EXFOR-CINDA-ENDF Relational (utilities, documentation, etc), and prepare the system for deployment to other Nuclear Data Centres.

5. Nuclear data development

Although nuclear data developments are outside the immediate operations of the NRDC, we give a brief summary below.

Co-ordinated Research Projects (CRPs):

- *Update of X-Ray and Gamma-Ray Decay Data Standards for Detector Calibration and Other Applications:* completed, database and document preparation in progress
- *Fission Product Yield Data Required for Transmutation of Minor Actinide Nuclear Waste:* completed, database and document preparation in progress
- *Improvement of the Standard Cross Sections for Light Elements:* ongoing
- *Nuclear data for radiotherapy using radioisotopes or external radiation sources:* ongoing
- *Data for the Th-U-fuel cycle:* ongoing
- *Nuclear data for emerging technologies (RIPL-III):* ongoing

Data development projects:

- FENDL-2 (update)
- IRDF-2002 (update of IRDF-90 V.2) – completed; database and document preparation in progress
- Validation of photonuclear library
- Cross-section database for Ion Beam Analysis (IBANDL implemented, CRP proposed)

6. Publications

Some Recent Activities of the International Atomic Energy Agency in the Field of Nuclear Data by D.D. Sood and A. Trkov, *J. Radioanal. Nucl. Chem.* **255** (2003) 13-19.

Effects of the Neutron Spectrum on the Neutron Activation Analysis Constants for ^{94}Zr and ^{96}Zr by B. Smodis, A. Trkov and R. Jacimovic, *J. Radioanal. Nucl. Chem.* **257** (2003) 481-487.

Development of Nuclear Technique for the Detection of Landmines by D.D. Sood, U. Rosengard and A. Trkov; pp. 13-24 in Proc. SPIE, vol. 5089, 21-25 April 2003, Orlando, Florida, USA.

IAEA Co-ordinated Research Project: Update of X-ray and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications by A.L. Nichols, presented at Int. Conf. on Radionuclide Metrology (ICRM2003), 2-6 June 2003, Dublin, Ireland; also published in *Appl. Radiat. Isot.* **60** (2004) 247-256.

IAEA Nuclear Data Section: Provision of Atomic and Nuclear Databases for User Applications by D.P. Humbert, A.L. Nichols and O. Schwerer, presented at Int. Conf. on Radionuclide Metrology (ICRM2003), 2-6 June 2003, Dublin, Ireland; also published in *Appl. Radiat. Isot.* **60** (2004) 311-316.

Nuclear Data Requirements for the Actinides and Fission Products Build-up and Burn-up by V.G. Pronyaev and A. Trkov, Proc. XII International Conference on Selected Problems of Modern Physics, 8-11 June 2003, Joint Institute of Nuclear Research, Dubna, Russian Federation.

Quantifying Uncertainties by V.G. Pronyaev, Proc. XII International Conference on Selected Problems of Modern Physics, 8-11 June 2003, Joint Institute of Nuclear Research, Dubna, Russian Federation.

Contribution to Plutonium Futures: Work of the IAEA (G. Andrew) by A.L. Nichols and A. Trkov, Proc. Conf. on Plutonium Futures, 6-10 July 2003, Albuquerque, New Mexico, USA.

Updates to the Atomic and Molecular Data Unit Databases by R.E.H. Clark, paper presented at the International Conference on Photonic, Electronic and Atomic Collisions, 23-29 July 2003, Stockholm, Sweden.

IAEA Nuclear Data Activities: Services and Emerging Databases by A.L. Nichols and O. Schwerer, presented at V Latinamerican Symposium on Nuclear Physics, 1-5 September 2003, Santos, Brazil.

Temporal Variation of the Neutron Flux in the Carousel Facility of a TRIGA Reactor by A. Trkov, Proc. Nuclear Energy for New Europe 2003, 8-11 September 2003, Portoroz, Slovenia.

IAEA Activities Related to Nuclear Data for P&T and ADS by A. Trkov, presented at ADOPT – Int. Workshop on P&T and ADS Development, 6-8 October 2003, Mol, Belgium; proceedings: http://www.sckcen.be/sckcen_en/activities/conf/conferences/20031006/cd/.

IAEA Nuclear Data Section: Data Development Activities and Services by A.L. Nichols, V.G. Pronyaev and O. Schwerer, pp. 20-30 in Proc. EU Enlargement Workshop on Neutron Measurements and Evaluations for Applications (NEMEA), 5-8 November 2003, Budapest, Hungary, Editor: A.J.M. Plompen, EUR 21100 EN, ISBN 92-894-6041-5, 2004.

7. Workshops 2003/2004 (since 2003 NRDC meeting)

- Atomic and Molecular Data for Fusion Energy Research, 8-12 Sept 2003, ICTP Trieste, Italy.
- Nuclear Structure and Decay Data: Theory and Data Evaluation, 17-28 Nov 2003, ICTP Trieste, Italy.
- Relational Databases for Nuclear Data Development, Dissemination and Processing: EXFOR Implementation, Maintenance and Compilation, 1-5 December 2003, IAEA Vienna, Austria.
- Workshop on Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety, ICTP Trieste, Italy, 16 February - 12 March 2004

8. Visits and inter-centres co-operation

The following visits have taken place and contributed towards data centre co-operation:

- V. Zerkin (IAEA/NDS) to BNL/NNDC, 20-31 October 2003: Develop Software for the Management and Compilation of CINDA and EXFOR,
- V. Zerkin (IAEA/NDS) to BNL/NNDC, 15 March – 02 April 2004: Development of Software for Management and Web-Retrieval of ENDF and EXFOR Relational Databases,
- A. Sonzogni (NNDC) to NDS, 13 - 16 April 2004: Advise on the new relational version of the NuDat nuclear database.

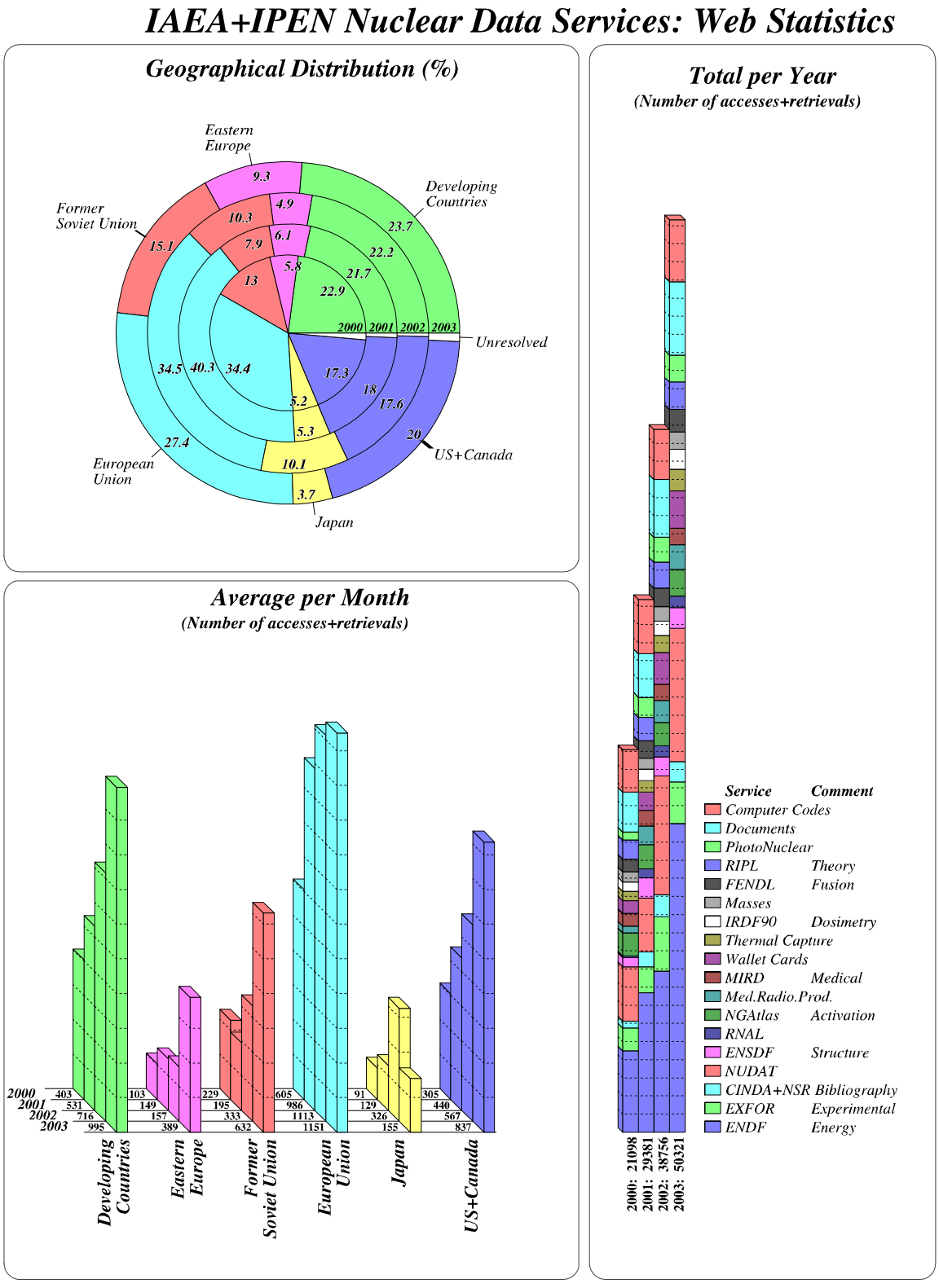

Fig. 1. Statistics of accesses and retrievals from NDS and IPEN (NDS-mirror in Latin America) Web sites.