

IAEA Nuclear Data Section: Progress Report, 2004/05

Summary of Nuclear Data Studies by Staff of the IAEA Nuclear Data Section, 1 October 2004 – 30 September 2005, Editor: O. Schwerer

IAEA Technical Meeting, 12 - 14 October 2005
International Atomic Energy Agency, Headquarters,
Vienna, Austria

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1. Staff

The authorized staff level of the Nuclear Data Section remains at a total of 18 professionals and support staff. Three new staff members joined during the reporting period: Alberto Mengoni (effective from 1 July 2005), Mark Kellett (effective from 1 March 2005) and Janet Roberts (effective from 1 June 2005 (from temporary position)), succeeding former staff members Vladimir Pronyaev, Racquel Paviotti-Corcuera and Andrea Scherbaum, respectively.

2. Data Compilations

2.1 EXFOR and Dictionaries

Over the previous year, NDS staff have distributed 9 CPND TRANS files (D035 - D043), containing 174 new entries (160 compiled at NDS, 11 at ATOMKI, 3 at UkrNDC) and 2 revised entries, and one neutron TRANS file (3117) containing 9 new and 12 revised entries. The compilations consist of new literature as well as important old references for ion beam analysis, medical applications, and proton-induced data. A collection of EXFOR-relevant articles in pdf format has been initiated for internal use that includes about 1400 articles found from the Internet or scanned from hardcopies (NDS has recently acquired a new scanner with scanning speeds of up to 60 pages-per-minute simplex, and up to 120 pages-per minute duplex)

As of 29 September, 67 TRANS files were received, checked (with feedback to the originating centers) and processed, of which 58 were final versions that were added to the master file. These final transmissions contained 470 neutron entries (210 new, 260 revised), 857 CPND entries (712 new, 145 revised) and 80 photonuclear entries (60 new, 20 revised).

With effect from 1 July 2005, NDS offers a "common EXFOR master file" that has resulted from a detailed comparison in particular of the NDS and NNDC master files. Further checking and corrections of existing entries can be continued wherever necessary, and is facilitated by the fact that only one master file needs to be updated.

NDS staff have produced and distributed three regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9087-9089) in EXFOR, DANIEL (backup) and archive format. After updates of several related software programs, dictionary transmission 9089 is the first version in which all new dictionaries presented and approved in 2004 are available in all formats (including EXFOR format). At the same time, the CHEX checking program was upgraded to work with those new dictionaries (particularly the new quantity dictionary 236 and new nuclides dictionary 227). The feedback of Otsuka (JCPRG) on the dictionary transmissions is much appreciated.

Also, three lists of papers (mostly “old” literature) are still on control for completeness of compilation:

1. list for Ion Beam Analysis;
2. list for Reference Input Parameters Library (RIPL);
3. list for CRP on “Cross Sections for the Production of Therapeutic Radioisotopes”.

2.2 CINDA

CINDA meeting

"EXFOR-CINDA: revision of contents, compilation and plans" – meeting was held in Vienna, IAEA, 26-28 April 2005, to discuss in detail the algorithm for the import of information from EXFOR to new CINDA (extended by charged particles, photo-nuclear and missing neutron reaction data), and to define the steps that should be taken by nuclear data centres to produce the new common CINDA database. Other important tasks and problems were discussed: contents of CINDA and EXFOR databases, compilation process, plans regarding the CINDA database, on-going merger project of NNDC and IAEA versions of the EXFOR database. A major result was that all details for assembling the final “new CINDA” file were agreed and a plan of migration was fixed (Memo CP-D/433).

Status of CINDA at NDS

Agreed algorithms and procedures were implemented (see WP-2005-xxx) on the basis of the common EXFOR master file and dictionaries 9089. New CINDA contains old CINDA data and data imported automatically from the latest version of the common EXFOR database. The software also allows the import of the latest update(s) from EXFOR to CINDA; first version of a CINDA editor is ready; along with database maintenance tools.

Coverage control

One of the functions of CINDA had been to control the process of EXFOR compilation. Because CINDA-2001 was in the preparation stage for a long time, this function was moved to a stand-alone local database called the CINDA coverage control system. Under this system, NDS staff scan over 58 journal titles (mainly through the Internet) for the purpose of compilation coverage control.

Over 600 journal issues from 1995 to 2005 were added to the database for CINDA coverage control in late 2004/2005. Journals references that should be compiled elsewhere were also dispatched to the relevant centres (Japan, Russia, Hungary and NEADB).

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

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 retrieval interface was extended by IRDF-2002 and JEFF-3.1 data
- ENDF-WINENDF update, July 2005-09-29
- ADS-Application Library for Accelerator Driven Systems, including ADS-ENDF, ADS-ACE, and ADS-MATXS

- XNWLUP Version August 2005
- EXFOR - CINDA Database and Retrieval System, Version 1.80, data updated June 2005 (CD-ROM)
- ENDVER/GUI and EXFOR-CINDA package; Integrated Tools for ENDF-Evaluators, Version 1.3, June 2005
- AMDC (Atomic Mass Data Center), by Audi *et al*, including 2003 Atomic Mass Evaluation and NUBASE 2003
- EMPIRE - Nuclear Reaction Model Code, Version 2.19 beta (Lodi), April 2005
- FENDL-2.1, Fusion Evaluated Nuclear Data Library Package, December 2004, including FENDL/E-2.1, FENDL/MC-2, FENDL/MG-2.1, FENDL/MG-2.1(MATXS), and FENDL/MG-2.1(GENDF)
- IRDF-2002 – International Reactor Dosimetry File, March 2005
- Minsk Actinide Library – Updates of April 2005
- POINT2004, temperature-dependent version of the ENDF/B-VI library, release 8; available on one DVD - data at eight temperatures between 0 and 2100K, reconstructed with 0.1% accuracy.
- PREPRO 2004. ENF/B Pre-Processing Codes, November 2004
- INDL/TSL Thermal Neutron Scattering Library
- IBANDL – Ion Beam Analysis Nuclear Data Library, updated CD (April 2005)

3. Services

Web Services

Since Web-services were migrated from VMS to a Linux-based system, further tuning and improvements have been implemented in the EXFOR/CINDA/ENDF retrieval systems: direct links to Web-journals, links to NSR (Web), new computational format (T4). ENDF extended by two libraries (IRDF-2002 and JEFF-3.1). Self-configuration was developed, so installation of the system became trivial. Clones of the system were installed in BARC (India) and IPEN (Brazil), and the system is also successfully functioning at NNDC. Statistics of usage of the Web retrieval system are presented in Fig. 1.

Telnet access to the nuclear data bases (“NDIS”) is no longer supported. Users are invited to switch to the web services.

CD-ROMs

- “EXFOR/CINDA for Windows” CD was issued twice. EXFOR contains common contents.
- “EXFOR/CINDA for Applications” for Linux and Windows was also issued twice; also distributed together as part of EndVer/GUI-CD and Empire-package.

Mail services

Between October 2004 and September 2005, NDS distributed 934 hardcopy documents (INDC reports, Charts of Nuclides, Nuclear Wallet Cards) and 1211 PC media (CD-ROMs and DVDs).

4. 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 the Transmutation of Minor Actinide Nuclear Waste*: completed, database and document preparation in progress
- *Improvement of the Standard Cross Sections*: on-going
- *Nuclear Data for the Production of Therapeutic Radioisotopes*: on-going
- *Data for the Th-U-fuel cycle*: on-going
- *Reference Input Parameter Library for Non-Energy Applications: (RIPL-III)*: on-going
- *Development of a Reference Database for Ion Beam Analysis*: started in 2005
- *Updated Decay Data Library for Actinides*: started in 2005
- *Reference Base for Neutron Activation Analysis*: started in 2005

Data development projects:

- FENDL-2.1 (updated)
- IRDF-2002 (revisions on-going)
- ADS-Lib (completed)
- INDL/TSL (on-going)
- Evaluation of Cd resonance range (started in 2005)
- Analysis of Pb slowing-down spectrometer benchmark (started in 2005)
- Update of the handbook and database “Nuclear data for Safeguards” (on-going)

5. Publications

a) Papers presented at the conference on Nuclear Data for Science and Technology, Santa Fe, New Mexico, USA (2004):

International Conference on Nuclear Data for Science and Technology, 27 September - 1 October 2004, Santa Fé, USA; also published in AIP Conf. Proc. - Int. Conf. on Nuclear Data for Science and Technology, Eds.: R.C. Haight, M.B. Chadwick, T. Kawano and P. Talou, Vol. 769, Part 1 and Part 2 (2005), AIP, Melville, New York, ISBN 0-7354-0254-X, ISSN 0094-243X.

Nuclear Reaction Data Centre Network: A success story

by O. Schwerer, V. McLane, H. Henriksson and S. Maev, Part 1, pp. 83-86

NEA Working Party on International Nuclear Data Cooperation – Recent achievements and plans

by P. Obložinský, J. Katakura, A.J. Koning, A.L. Nichols and C. Nordborg, Part 1, pp. 128-131

Nuclear decay data: On-going studies to address and improve radionuclide decay characteristics

by A.L. Nichols (invited paper), Part 1, pp. 242-251

Neutron cross-section evaluations for ^{70,72,73,74,76}Ge

by O. Iwamoto, M. Herman, S.F. Mughabghab, P. Obložinský and A. Trkov, Part 1, pp. 434-437

Review of neutron cross-section evaluations for fission products

by P. Obložinský, M. Herman, S. Mughabghab, I. Sirakov, J. Chang, T. Nakagawa,

K. Shibata, M. Kawai, A. V. Ignatyuk, V. G. Pronyaev, V. Zerkin, S. Qingbiao and Z. Youxiang, Part 1, pp. 438-441

SIGACE code for generating high-temperature ACE files; validation and benchmarking

by A.R Sharma, S. Ganesan and A. Trkov, Part 1, pp. 499-502

Data dissemination and international collaboration

by T. Fukahori, A.V. Ignatyuk, F.G. Kondev, K.-L. Kratz, V. McLane, A.L. Nichols, A. Nouri, O. Schwerer, A.A. Sonzogni and D.F. Winchell, Part 1, pp. 539-544

EXFOR-CINDA-ENDF: Migration of databases to give higher quality nuclear data services

by V.V. Zerkin, V. McLane, M.W. Herman and C.L. Dunford, Part 1, pp. 586-589

Status of the international neutron cross-section standards file

by V.G. Pronyaev, S.A. Badikov, C. Zhenpeng, A.D. Carlson, E.V. Gai, G.M. Hale, F.J. Hambsch, H.M. Hofmann, N.M. Larson, D.L. Smith, S.Y. Oh, S. Tagesen and H. Vonach, Part 1, pp. 808-815

Recent developments of the nuclear reaction model code EMPIRE

by M. Herman, P. Obložinský, R. Capote, M. Sin, A. Trkov, A. Ventura and V. Zerkin, Part 2, pp. 1184-1187.

Improvement of the fission channel in the EMPIRE code

by M. Sin, R. Capote, M. Herman, P. Obložinský, A. Ventura and A. Trkov Part 2, pp. 1249-1252

Review of experimental data on alpha-induced reactions on some nuclei (Mg-24, Si-28, S-32, Ar-36, Ca-40) in terms of astrophysical applications

by S.A. Dunaeva, V. McLane, M. Savin and S. Taova, Part 2, pp. 1386-1389

b) Other publications:

Table of radionuclides, Vol. 1 – A = 1 to 150

by M.-M. Bé, V. Chisté, C. Dulieu, E. Browne, V. Chechev, N. Kuzmanko, R. Helmer, A. Nichols, E. Schönfeld and R. Dersch, Monographie BIPM-5 (2004) Bureau International des Poids et Mesures.

Table of radionuclides, Vol. 2 – A = 151 to 242

by M.-M. Bé, V. Chisté, C. Dulieu, E. Browne, V. Chechev, N. Kuzmanko, R. Helmer, A. Nichols, E. Schönfeld and R. Dersch, Monographie BIPM-5 (2004) Bureau International des Poids et Mesures.

Recent data generation activities at the Atomic and Molecular Data Unit of the IAEA

by R.E.H. Clark and D. Humbert presented at APIP Conference, April 2004, Santa-Fe, USA; also published in AIP Conf. Proc. on Atomic and Molecular Data and their Applications, Eds.: T. Kato, H. Funaba and D. Kato, Vol. 771 (2005) 263-269.

Microionization chamber for reference dosimetry in IMRT verification: clinical implications on OAR dosimetric errors

by F. Sánchez-Doblado, R. Capote, A. Leal, J.V. Roselló, J.I. Lagares, R. Arráns and G.H. Hartmann, presented at Advanced Workshop on Current Topics in Monte Carlo Treatment Planning, 3-5 May 2004, McGill University, Medical Physics Unit, Montréal, Québec, Canada; also published in *Phys. Med. Biol.* **50** (2005) 959-970.

On the thermal scattering law data for reactor lattice calculations

by A. Trkov, M. Mattes, Eds.: I. Jencic, M. Tkavc, Proc. Int. Conf. Nuclear Energy for New Europe 2004, pp. 201.1-201.8, Nuclear Society of Slovenia (2004).

IAEA nuclear data for applications: cross section standards and the reference input parameter library (RIPL)

by R. Capote, A.L. Nichols and V.G. Pronyaev presented at Enlargement Workshop “Neutron Measurements, Evaluations and Applications, NEMEA-2”, Bucharest, Romania, 20-23 October 2004. Proceedings to be published by IRMM.

Fission of thorium isotopes

by M. Sin, R. Capote, M. Herman, P. Obložinský, A. Trkov and A. Ventura, presented at Enlargement Workshop “Neutron Measurements, Evaluations and Applications, NEMEA-2”, Bucharest, Romania, 20-23 October 2004. Proceedings to be published by IRMM.

Neutron activation cross section measurements from threshold to 20 MeV for the validation of nuclear models and their parameters

A.J. Plompen, R. Capote Noy, et al. A report by the Working Party on International Evaluation Co-operation of the NEA Nuclear Science Committee (WPEC-19). Proceedings to be published by NEA.

Nuclear Data Services of the International Atomic Energy Agency: An overview

by A.L. Nichols, L. Costello and V.V. Zerkin (invited paper), presented at DAE-BRNS National Workshop on Nuclear Data for Reactor Technology and Fuel Cycle, 7-10 March 2005, Bhabha Atomic Research Centre (BARC), Anushaktinagar, Mumbai, India.

Nuclear databases for energy applications: an IAEA perspective

by R. Capote, A.L. Nichols and A. Trkov presented at International Workshop on Nuclear Data Needs for Generation IV Nuclear Energy Systems, 5-7 April 2005, Antwerp, Belgium. Proceedings to be published by IRMM.

IAEA Co-ordinated Research Project on fission product yield data for minor actinides up to 150 MeV

by M. Lammer and A.L. Nichols, presented at 3rd International Workshop on Nuclear Fission and Fission-product Spectroscopy, Fission 2005, 11-14 May 2005, Cadarache, France. To be published in proceedings.

Nuclear decay data: observations and reflections

by A.L. Nichols (invited paper), presented at 15th Int. Conf. on Radionuclide Metrology and its Applications (ICRM 2005), 5-9 September 2005, Oxford, UK; to be published in *Appl. Radiat. Isot.*

Revisiting the ²³⁸U thermal capture cross section and gamma-ray emission probabilities from ²³⁹Np decay

by A. Trkov, G.L. Molnár, Zs. Révay, S.F. Mughabghab, R.B. Firestone, V.G. Pronyaev, A.L. Nichols and M.C. Moxon, *Nucl. Sci. Eng.* **150** (2005) 336-348.

Status and perspective of nuclear data production, evaluation and validation

by A. Trkov (invited paper), *Nucl. Eng. Technol.* **37** (2005) 11-24.

Level densities of transitional Sm nuclei

by R. Capote, A. Ventura, F. Cannata and J. M. Quesada, *Phys. Rev.* **C71** (2005) 064320.

Dispersive coupled channel analysis of nucleon scattering from ^{232}Th up to 200 MeV

by E.Sh. Soukhovitskii, R. Capote, J.M. Quesada and S. Chiba, *Phys. Rev.* **C72** (2005) 024604

Micro ionization chamber dosimetry in IMRT verification: clinical implications of dosimetric errors in the PTV

by F. Sánchez-Doblado, R. Capote, J.V. Roselló, A. Leal, J.I. Lagares, R. Arráns and G.H. Hartmann, *Radiother. Oncol.*, **75** (2005) 342-348.

Nuclear reaction and structure web services of the National Nuclear Data Center

B. Pritychenko, A.A. Sonzogni, D.F. Winchell, V.V. Zerkin, R. Arcilla, T.W Burrows, C.L. Dunford, M.W. Herman, V. McLane, P. Obložinský, Y. Sunborn and J.K. Tuli;
to be published in *Nucl. Instrum. Meth. Phys. Res. A*.

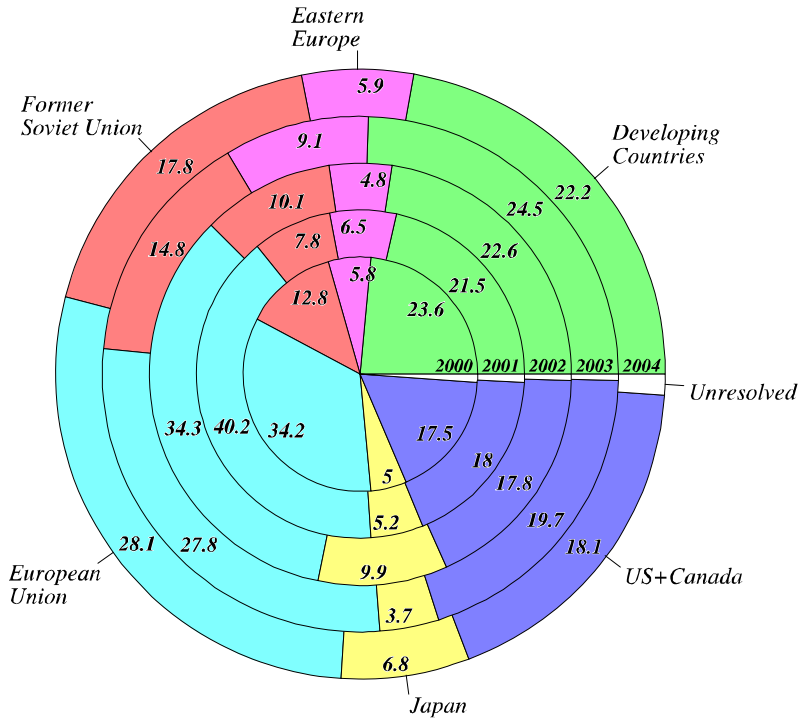
6. Workshops 2004/2005 (since 2004 NRDC Meeting)

- Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, 4-15 April 2005, ICTP Trieste, Italy.
- Workshop on Data Libraries for Monte-Carlo Calculations (MCNPX), IAEA Headquarters, Vienna, Austria, 12-16 September 2005

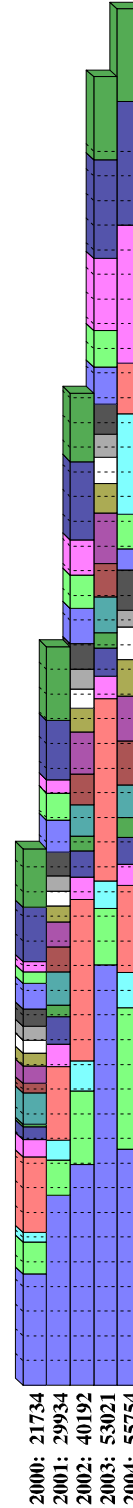
7. Visits and Inter-centre Cooperation

- V. Zerkin (IAEA/NDS) to BNL/NNDC, 10-21 March 2003: Develop Software for the Management and Dissemination of Shared Databases (EXFOR, CINDA and ENDF).
- V. Zerkin (IAEA/NDS) to BNL/NNDC, 20-31 October 2003: Develop Software for the Management and Compilation of CINDA and EXFOR.

Geographical Distribution (%)



Total per Year (Number of accesses + retrievals)



Average per Month (Number of accesses + retrievals)

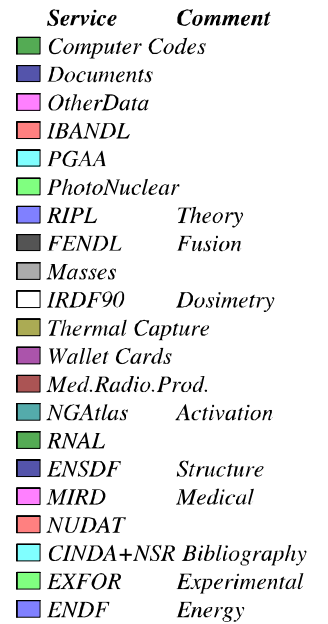
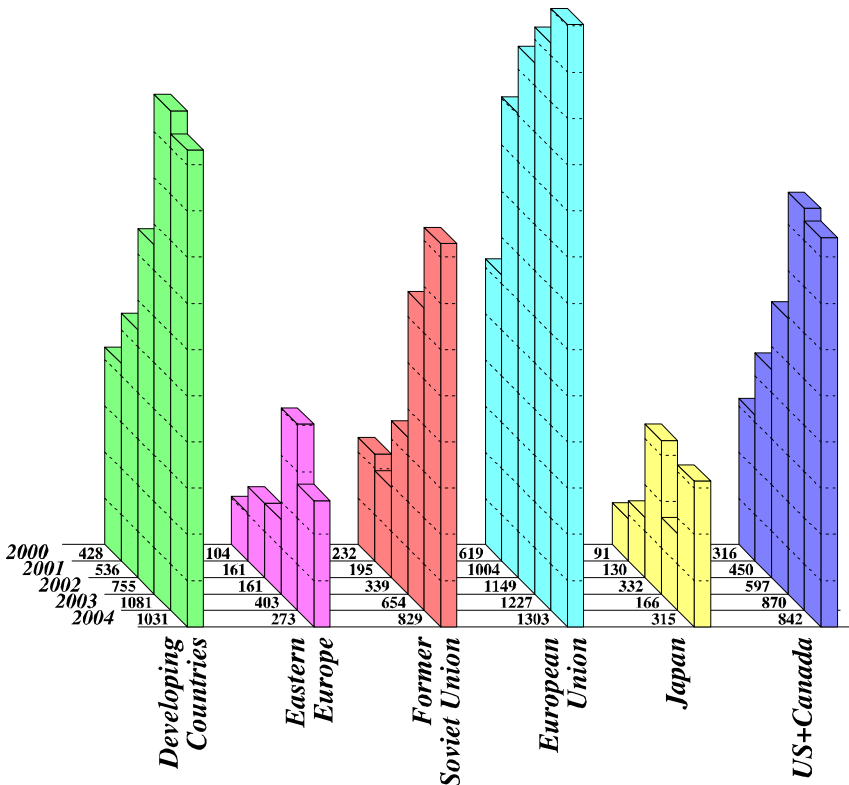


Fig.1. Statistics of accesses and retrievals from IAEA-NDS, IPEN (Brazil) and BARC (India)