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**Report of the IAEA Nuclear Data Section to the
International Nuclear Data Committee for the period
January 2006 – December 2007**

Edited by

Daniel H. Abriola
IAEA Nuclear Data Section
Vienna, Austria

April 2008

IAEA Nuclear Data Section, Wagramer Strasse 5, A-1400 Vienna, Austria

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Abstract

This report contains details of the main activities of the IAEA Nuclear Data Section (NDS) in 2006 and 2007, and is provided as information to the International Nuclear Data Committee (INDC). NDS staff and affiliated consultants have focused their work on continued data development and ensuring adequate, trouble-free services to all users in Member States. This information is complemented with descriptions of other related activities in the reporting period, including meetings and publications. The atomic and molecular data projects are presented to the INDC for their information only, since these specific activities are reviewed in depth by the A&M Data for Fusion Subcommittee of the International Fusion Research Council (IFRC).

April 2008

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Glossary of Abbreviations

A&M	Atomic and Molecular
ACE	A Compact ENDF library for MCNP Monte Carlo particle transport codes
ADLIST	Address List Database (IAEA Nuclear Data Section)
ADS	Accelerator Driven System
AMDC	Atomic Mass Data Centre
APID	Atomic and Plasma-material Interaction Data for fusion (IAEA journal)
ATOMKI	AtomMagKutató Intézet (Institute of Nuclear Research, Hungary)
BARC	Bhabha Atomic Research Centre, India
CCRA	Committees for Coordinated Research Activities (IAEA)
CINDA	Computer Index on Neutron Data (bibliographic database)
CD-ROM	Compact disk with read-only memory
CM	Consultants' Meeting (of the IAEA)
CPND	Charged-particle nuclear data
CRP	Coordinated Research Project (of the IAEA (see also RCM))
CV	Consultancy Visit
DANIEL	Format of EXFOR Output Dictionaries
DBMS	Data Base Management System
DCN	Data Centre Network (IAEA)
DDP	Data Development Project
DMZ	De-Militarized Zone
EGAF	Evaluated Gamma-ray Activation File
EMPIRE	Nuclear reaction modelling code for calculating cross sections
ENDF	Evaluated Nuclear Data File
ENDVER	ENDF Verification software package
ENEA	Ente per le Nuove Tecnologie, l'Energia e l'Ambiente, Italy
ENSDF	Evaluated Nuclear Structure Data File
EU	European Union
EXFOR	Computer-based system for the compilation and international exchange of experimental nuclear reaction data (EXchange FORmat)
FENDL	Fusion Evaluated Nuclear Data Library
ftp	file transfer protocol
GENIE	General Internet Search Engine for atomic data
GUI	Graphics user interface
HINDAS	High and Intermediate energy Nuclear Data for Accelerator-driven Systems
HP	Hewlett Packard
IAEA	International Atomic Energy Agency, Vienna, Austria
IBA	Ion Beam Analysis
IBANDL	Ion Beam Analysis Nuclear Data Library
IBM	Interacting Boson Model
ICC	Internal Conversion Coefficient
ICTP	International Centre for Theoretical Physics, Trieste, Italy
IFMIF	International Fusion Materials Irradiation Facility
IFRC	International Fusion Research Council
INDC	International Nuclear Data Committee
INDL	IAEA Nuclear Data Library
INIS	International Nuclear Information Service (IAEA)
IPEN	Instituto de Pesquisas Energeticas e Nucleares
IPPE	Institute of Physics and Power Engineering, Russia
IRDF	International Reactor Dosimetry File (IAEA)
IRMM	Institute for Reference Materials and Measurements, Belgium
IT	Information Technology
ITER	International Thermonuclear Experimental Reactor
JEFF	Joint Evaluated Fission and Fusion Project (OECD/NEA-DB)

LANL	Los Alamos National Laboratory
MATXS	Material Cross Section Library
MCNP	Monte Carlo N-Particle code
MCNPX	Monte Carlo N-Particle eXtended code
MIRD	Medical Internal Radiation Dose format
MTIT	Division of Information Technology (IAEA)
n_TOF	neutron Time-Of-Flight (CERN experimental facility)
NAPC	Division of Physical and Chemical Sciences (IAEA)
NCDP	Nuclear Physics Data Center, Sarov, Russia
NDS	IAEA Nuclear Data Section, Vienna, Austria
NDS	IAEA Nuclear Data Services
NEA	Nuclear Energy Agency of the OECD, Paris, France
NEA-DB	Nuclear Energy Agency – Data Bank
NENP	Division of Nuclear Power (of the IAEA)
NGAtlas	Atlas of Neutron Capture cross sections
NIST	National Institute of Science and Technology, USA
NJOY	NJOY nuclear data processing system
NNDC	National Nuclear Data Center, Brookhaven National Laboratory, Upton, USA
NRA	Nuclear Reaction database
NRDC	Network of Nuclear Reaction Data Centres
NSDD	Nuclear Structure and Decay Data
NSR	Nuclear Science References (bibliographic file related to ENSDF)
NUCLEUS	Nuclear Information and Knowledge Portal (IAEA)
NuDat	Nuclear Data (user-friendly presentation of nuclear structure data – NNDC, BNL))
OASIS	Agency Intranet
OECD	Organization for Economic Cooperation and Development
ORNL	Oak Ridge National Laboratory, Oak Ridge, USA
PC	Personal Computer
PDF	Portable Document Format
PGAA	Prompt Gamma Activation Analysis
POINT	Temperature Dependent ENDF/B-VI Release 8 Cross Section Library
PREPRO	ENDF/B Pre-processing code
RAM	Random Access Memory
RCM	Research Coordination Meeting
RIPL	Reference Input Parameter Library
RNAL	Reference Neutron Activation Library
SAMMY	Resonance analysis code (ORNL, USA)
SMELS	Synthetic Multi-Element Standards
SSA	Special Service Agreement (IAEA)
SSH	Secure Shell
TAGS	Total Absorption Gamma-ray Spectroscopy
TECDOC	Technical Document series published by the IAEA
TM	Technical Meeting (IAEA)
TRANS	Collection of some EXFOR entries
UkrNDC	Ukrainian Nuclear Data Centre
VMS	Operating system of the Compaq Alpha Server
WIMS	Winfrith Improved Multigroup Scheme of reactor lattice codes
WINENDF	Package for storage/retrieval of ENDF files
WPEC	Working Party on international nuclear data Evaluation Cooperation (OECD)
WS	Workshop
XML	Extensible Mark-up Language
XnWlup	Graphical user interface to plot WIMS-D library multigroup cross sections

Preface

The IAEA Nuclear Data Section is one of four Sections within the Division of Physical and Chemical Sciences, which in turn is one of five Divisions of the Department of Nuclear Sciences and Applications. A primary aim of the Section is the provision of good quality atomic and nuclear data to Member States of the International Atomic Energy Agency, covering both energy- and non-energy related applications. The Nuclear Data Section is internally organized into four Units as shown in the organizational chart. All material in this document has been prepared by the Unit Heads. Progress reports for all projects within the Atomic and Nuclear Data Sub-programme 1.D.1 are combined, along with other related support activities during 2006 and 2007. The focus of this report involves the nuclear data aspects of the Sub-programme, constituting about 80% of both staff efforts and the budget of the Section.

The International Nuclear Data Committee (INDC) along with the A&M Data for Fusion Subcommittee of the International Fusion Research Council (IFRC) are two standing committees that advise the Department of Nuclear Sciences and Applications at the individual Section and Unit levels. Both of these bodies provide extremely useful services to the Agency with respect to their advice and guidance.

The main text of the report is complemented by Appendices that provide additional information on the work of the Section. Appendix I is a list of meetings and visits organized and sponsored by the Section, while Appendix II summarizes all the scientific papers and publications involving NDS staff members during 2006 - 2007.

Alan L. Nichols
IAEA Vienna, Austria
April 2008

Nuclear Data Section

Organization Chart

(4 February 2008)

Section Head: A.L. Nichols

Nuclear Data Physicist
(21709/21710)

Deputy Section Head: D.H. Abriola

Nuclear Data Physicist
(21712/21711)

Section Secretary: J. Roberts

(21710)

Nuclear Data Services Unit	Nuclear Data Development Unit	Systems Development Unit	Atomic & Molecular Data Unit
A. Mengoni (Head) Nuclear Physicist (21717)	D.H. Abriola (Head) Nuclear Data Physicist (21712)	W.M. Costello (Head) Systems Analyst (21724)	R.E.H. Clark (Head) Atomic Physicist (21731)
V. Zerkin Software Engineer/Nuclear Physicist (21714)	R. Capote Noy Nuclear Physicist (21713)	M. Verpelli Systems Analyst (21723)	D. Humbert Atomic Physicist (21729)
S. Dunaeva Nuclear Physicist (21727)	M.A. Kellett Nuclear Physicist (21708)	K. Nathani Secretary/Clerk (temp) (21711)	K. Sheikh Database Clerk (21730)
N. Otsuka Nuclear Data Physicist (21715)	K. Nathani Secretary/Clerk (temp) (21711)		
G. Bush Production Programmer (21725)			
L. Vrapcenjak Secretary/Clerk (temp) (21716)		M. O'Connell (25%) Applications Programmer (21722)	

1. NUCLEAR DATA SECTION: OVERVIEW

Both the budget and staffing level of the Nuclear Data Section (NDS) have been stable, albeit continuous zero real growth that constitutes a small annual increase to accommodate inflation. The authorized staff level of the NDS for 2006 - 2007 was effectively a total of 17.25, consisting of 12 professional (P-staff) and 5.25 support staff (G-staff).

Alan Nichols has continued as Section Head during 2006 - 2007, and the Unit Heads during this same period have been:

Bob Clark, Atomic and Molecular Data Unit,
 Liam Costello, Systems Development Unit,
 Alberto Mengoni, Nuclear Data Services Unit,
 Andrej Trkov, Nuclear Data Development Unit (until April 2006), and
 Daniel Abriola, Nuclear Data Development Unit (since January 2007),

of which those in residence at the end of 2007 have contributed to this report.

Three new staff members joined the Section during the reporting period:

Daniel Abriola (effective from 8 January 2007), succeeding Andrej Trkov who returned to the Jožef Stefan Institute, Ljubljana, Slovenia.

Naohiko Otsuka (effective from 4 February 2008), succeeding Otto Schwerer who retired at the end of August 2007.

Kira Nathani (effective from 3 April 2006), and

Lidija Vrapcenjak (effective from 1 July 2007).

The budget and costs of NDS are outlined in Table 1, and also show a switch from US\$ to Euros at the beginning of 2006. Comparisons can be made by adopting a constant exchange rate (set at 0.82 Euros \cong \$1 US), but this approach becomes unrealistic by 2009. Staff costs have undergone analysis on the basis of individual NDS-staff time dedicated to the various technical projects as opposed to purely administrative duties and the Agency-support overhead. Staff resignations and the ensuing replacement exercises in 2006 and 2007 also caused minor fluctuations in the administrative and Sub-programme costs.

Table 1. Staff and budget - summary for 2005 - 2009 (derived from Fintrack).

	2005 (US\$)	2006 (€)	2007 (€)	2008 (€)	2009 (€)
Authorized Staff Level	18	18	17.25	17.25	17.25
Actual Staff Level	17	18	17.25	17.25	17.25
Admin + Agency O/H Support Costs	911260	773000	785900	794000	862000*
Technical Programme	1867340	1500000	1524400	1538000	1671000*
Total	2778600	2273000	2310300	2332000	2533000*

*uncertain figures based on another predictive source of data

2. NUCLEAR DATA COMPILATIONS

2.1. EXFOR and Dictionaries

NDS produces the EXFOR master file on a regular basis for use with retrieval software available through Web interfaces as well as for stand-alone programs distributed with CD-ROMs. Typically, updates of the EXFOR master file are carried out once a month and include all compilation data produced during the period under consideration (as TRANS files). The possibility to use a unique file for common applications facilitates the updates of the database, which needs to be done on a single file only.

During 2006 - 2007, NDS staff have distributed 14 CPND TRANS files (D044 - D058) that consist of 198 new entries (99 compiled at NDS, 30 at ATOMKI, 45 at UkrNDC, 24 at Indian compilation group) and 374 revised entries, 6 neutron TRANS files (3118-3124) containing 67 new (35 compiled at NDS, 21 UkrNDC, 11 at India) and 118 revised entries, 4 photonuclear TRANS files (G013-G016) containing 6 new (from UkrNDC) and 29 revised entries, and 4 TRANS files (Y001-Y004) containing 64 revised entries from various areas.

Some revisions of the formatting as well as the procedures were made according to NRDC recommendations. These modifications included simple tasks such as changing all remaining upper case entries to lower case, as well as permitting NDS to make trivial corrections directly to the common master file (while informing the originating centre).

NDS introduced the EXFOR coverage control system in 2006 through which all information about articles relevant to EXFOR compilations are registered. The current status of compilation activities is also available to EXFOR compilers on the NDS Web site. With the help of this Web site, 21 (of 76) articles from the ND2007 conference have already been compiled and are available in EXFOR. This compares, in the same period three years ago, with no entries having been compiled from the previous ND conference (ND2004).

The compilations consist of new literature as well as important old references for ion beam analysis, medical applications, and proton-induced data. Three separate lists of papers (mostly "old" literature) are maintained for the completeness of compilation: literature on Ion Beam Analysis, and references related to the Coordinated Research Project (CRP) on (a) "Reference Input Parameters Library" (RIPL) and (b) "Cross Sections for the Production of Therapeutic Radioisotopes". A collection of EXFOR-relevant papers in pdf format has been initiated for internal use that includes about 7500 articles found from the Internet or scanned from hardcopies.

129 TRANS files have been received, checked (with feedback to the originating centres) and processed in 2006 - 2007, of which 127 were final versions that were added to the master file. All TRANS files were checked twice before adding to the EXFOR database. These final transmissions contained 1302 neutron entries (306 new, 996 revised), 2248 CPND entries (861 new, 1387 revised) and 238 photonuclear entries (82 new, 156 revised).

NDS staff have produced and distributed six regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9090-9095) in EXFOR, DANIEL (backup) and archive format. A Dictionary database (in MS-Access) was created and regularly distributed as part of EXFOR-Editor software.

2.2. CINDA

The CINDA database was extended by information automatically imported from EXFOR (two updates), manual input from NEA (three updates) and automatically generated data from the US ENDF-B/VII.0 nuclear applications library. Algorithms and procedures for the CINDA extension were agreed at the NRDC meeting in 2006, implemented and developed by NDS staff in contact with NEA and JCPRG. All information and exchange files are available on the NDS Web site. Although all procedures of CINDA update are implemented, further development of CINDA is still needed: new concepts of CINDA, and proposals for modernization were presented and discussed at the NRDC meetings in 2006 and 2007.

One of the functions of the CINDA activity has been to control the process of EXFOR compilation. This function was moved to a local stand-alone 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 and control. Journal references that should be compiled elsewhere were also dispatched to the relevant centres (in Japan, Russia, Hungary and NEA-DB). All relevant references that were found to be absent from EXFOR were sent to the responsible centres for compilation, along with hardcopies of the papers, if necessary. Web pages for the control of the compilation process and assignment of the work were created and regularly updated (once a week).

3. NUCLEAR SERVICES

3.1. Web-based services and software

The main service access tools are continuously updated on the NDS Web sever: <http://www-nds.iaea.org> Additional tuning and improvements have been implemented in the EXFOR/CINDA/ENDF retrieval systems with advanced plotting, new output formats and EXFOR statistics. The ENDF retrieval system has been extended to include six evaluated libraries. A clone of the NDS Web-based retrieval system is successfully operating at the NNDC, Brookhaven National Laboratory, USA.

Various new evaluated data libraries, files and programs for data checking, processing and graphical presentation have been added to the NDS Web site and distributed on CD-ROMs. A list of the most important extensions and/or updates performed includes:

- ENDF Web retrieval interface extended to include ENDF/B-VII.0, IAEA Nuclear Data Library/Thermal Scattering Law, IAEA charged-particle library for medical radioisotope production, IAEA-Standards (neutron cross sections), Differential charged-particle cross sections for ion beam analysis, and PADF-2007 Proton Activation Data File data;
- new EXFOR output formats: EXFOR+, extended EXFOR with explanations of coded information, links to Web journals, improved numerical data presentation; BibTeX, format used extensively for references in publication systems based on LaTeX; R33, format for presentation of angular distributions used in the Ion Beam Analysis community that allows fast export of EXFOR data to IBANDL;
- Web-based extended plotting system to provide plotting of differential cross-section data (experimental data alone and together with evaluations) with other advanced features;
- CD-ROM “ENDVER/GUI and EXFOR-CINDA for Applications” for Linux/Windows ported to MacOSX;

- PREPRO 2007. ENF/B Pre-Processing Codes, 2007;
- SigmaCalc Web-based software to provide evaluated and recommended differential cross sections for Ion Beam Analysis;
- ZVView package ported to MacOSX;
- CHEX (EXFOR checking code) ported to MacOSX;
- EXFOR-CINDA prepared and regularly updated;
- CHEX and EXFOR databases adapted to EXFOR Editor (NCDP);
- full EXFOR in C4 computational format delivered to WPEC Subgroup 30;
- Web pages for support management of EXFOR compilation activity developed and regularly updated;
- specialized Web pages and tools for “IRDF-2002 extension”.

3.2. NDS Electronic Document Project and CD-ROM based services

The NDS is compiling an electronic library of all documents produced by the IAEA pertaining to Nuclear Data Services. These documents are from the IAEA-NDS, INDC and the IAEA TECDOC and Technical Reports Series. All INDC reports produced in recent years are also available electronically. However, many of these reports from earlier times exist only in microfiche or original paper form – they need to be scanned in their original form and converted to a portable electronic format (usually pdf). All available documents will eventually be converted to pdf and placed on the main NDS Web server.

A total of 1,071 INDC reports (44% of the total available), 43 technical reports (all) and 72 IAEA-NDS reports (all) had been scanned and converted to pdf format by the end of 2007. All these documents are now available on the main NDS Web site.

As far as the CD-ROMs services are concerned, the following have been produced and distributed:

- “EXFOR/CINDA for Windows” was issued (two versions) - EXFOR contains common contents;
- “EXFOR/CINDA for Applications” for Linux and Windows has been issued twice; also distributed as part of EndVer/GUI-CD and EMPIRE-II package;
- ENDF - 14 evaluated libraries for nuclear applications in original and pointwise formats;
- POINT2007, temperature-dependent version of the ENDF/B-VII library, release 0; available on DVD - data at eight temperatures between 0 and 2100K, reconstructed with 0.1% accuracy;
- CD-ROM with 14 major evaluated libraries issued (includes ENDF-B/VII.0).

Over the course of 2006 and 2007, NDS staff distributed 2,099 hardcopy documents (INDC reports, Charts of Nuclides, Nuclear Wallet Cards) and 2,690 PC media (CD-ROMs and DVDs).

The Section has continued to scan relevant documents over the reporting period and converted them to a usable format for electronic distribution from the main Web server. This work is being undertaken in cooperation with INIS staff who have suitable equipment and expertise to handle microfiche and original texts. At the time of writing this report, the total numbers of documents defined in Table 2 had been scanned and placed on the Web server.

Table 2. Electronic documents.

(a) INDC reports

Country	Scanned	Pending	Country	Scanned	Pending	Country	Scanned	Pending
ARG	0	13	HUN	4	32	PRT	0	3
AUL	10	34	IAE	0	41	ROM	0	22
AUS	3	15	IBW	0	1	SAF	0	11
BLR	20	0	IND	1	45	SEC	2	103
BOL	1	0	IRN	0	4	SLK	0	2
BUL	2	14	IRQ	0	1	SLN	0	2
CCP	424	154	ISL	0	5	SPN	0	5
CPR	4	56	ITY	3	9	SUD	0	4
CSR	0	16	JAP	78	5	SWD	0	23
CUB	0	7	JPN	26	168	SWT	0	16
CZR	1	0	KOR	0	5	TAI	0	4
DEN	0	4	KWT	0	2	TUK	0	6
EAN	0	3	MOR	0	3	UK	1	89
EGY	0	7	NDS	486	0	UKR	1	7
ENE	0	20	NEA	0	10	UNI	0	7
EUR	0	31	NED	0	10	USA	2	105
FR	0	72	NOCODE	1	23	VN	1	10
GDR	0	50	NOR	0	3	YUG	0	11
GER	0	50	PAK	0	13			
GRC	0	3	POL	0	14			
						Total	1071	1373
							44% complete	

(b) Technical documents

Series	Scanned	Pending
IAEA	12	0
IAEA-TECDOC	24	0
Technical Reports Series	7	0
Total	43	0
		100% complete

(c) IAEA-NDS reports

Scanned	Pending
72	0
72	0
	100% complete

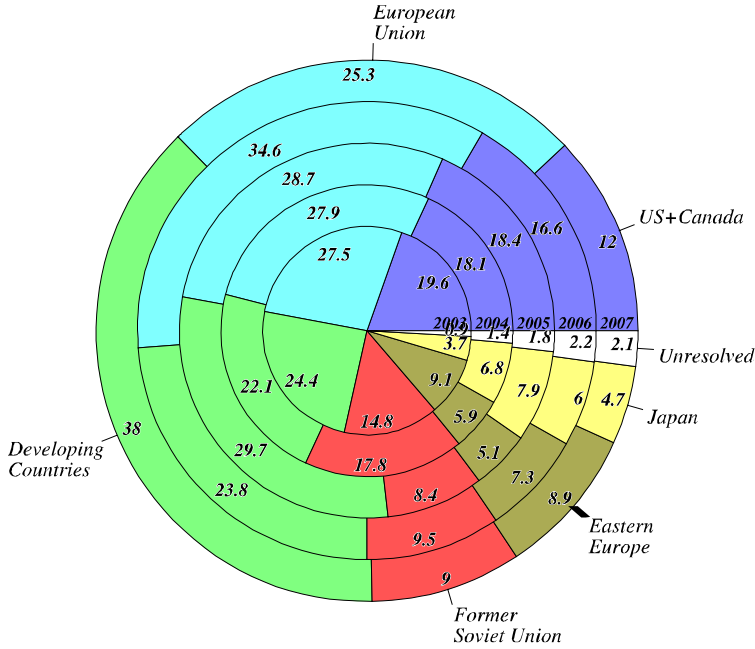
3.3. Statistics

Full statistics of usage of the Web retrieval system are presented in Fig. 1. Various representations of user access to the NDS Web server and the mirror servers in Brazil and India are presented, including definition of geographical area and technical topics. The total number of data retrievals has increased by 30% and 50% in 2006 and 2007, respectively, in comparison to the previous year. This increased demand arises mainly from customers for ENDF and EXFOR databases. A noteworthy feature is that the number of queries from developing countries shows substantial growth, and now represents 38% of the total number of retrievals.

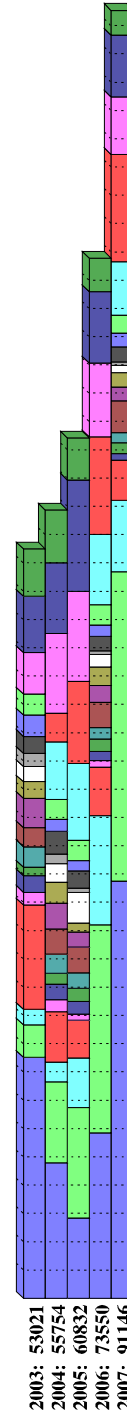
NDS+IPEN+BARC

Nuclear Data Services: Web Statistics

Geographical Distribution (%)



**Total per Year
(Number of accesses + retrievals)**



**Average per Month
(Number of accesses + retrievals)**

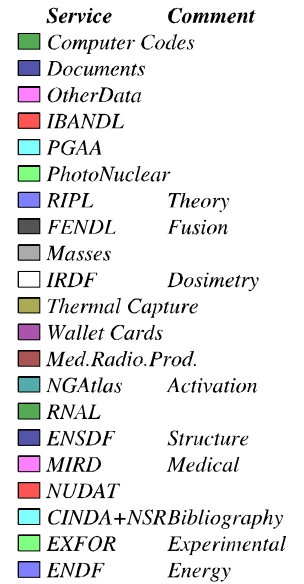
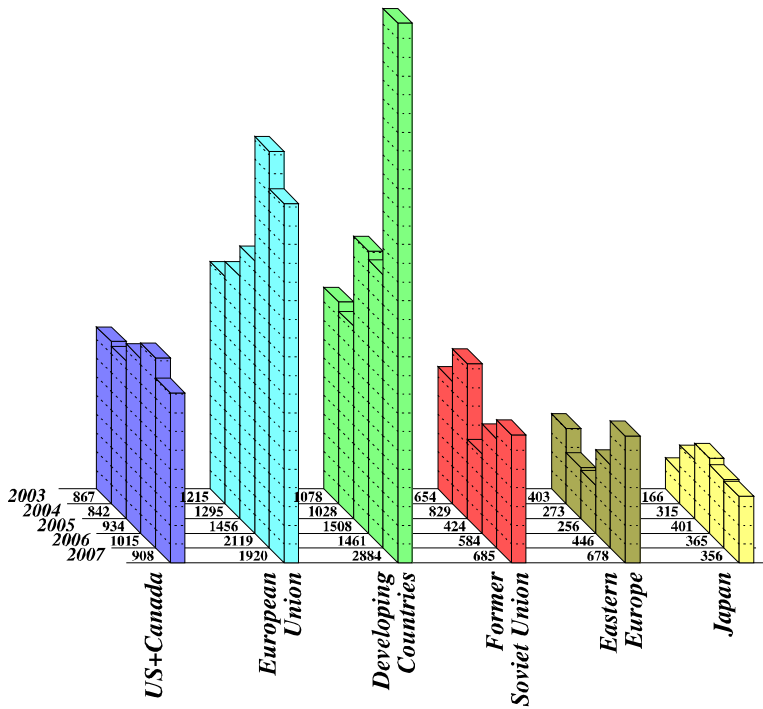


Fig.1. Nuclear data access and retrievals from IAEA-NDS, IPEN (Brazil) and BARC (India), 2003 to 2007.

4. NETWORK COORDINATION

4.1. Network of Nuclear Reaction Data Centres (NRDC)

NDS assists the International Network of Nuclear Reaction Data Centres by organising their annual coordination meeting. This network includes four core nuclear data centres, and nine national and specialised data centres. Biennial meetings of the data centre heads are designed to generate administrative recommendations on nuclear reaction data exchange and the development of shared databases and services. Technical matters associated with data exchange are also considered, and a dedicated technical meeting is held annually. Bilateral visits and consultancies are also used to identify and solve problems associated with data exchange and database development.

The annual technical and biennial Heads' of Data Centres Meeting on the Network of Nuclear Reaction Data Centres was held at IAEA Vienna, Austria, from 25 – 28 September 2006 (see INDC(NDS)-0503). This combined meeting was attended by 19 participants from 10 cooperating data centres of six Member States and two international organizations. Main topics were a review of the responsibilities, scope and coordination of EXFOR compilations, proposals for updating the EXFOR format, new compilation software, compilation quality control and corrections, technical questions on EXFOR quantities, codes, and dictionaries, and issues of the extended CINDA bibliography and an upcoming archival book production.

An IAEA Technical Meeting of the International Network of Nuclear Reaction Data Centres was held at IAEA Vienna, Austria, from 8 – 10 October 2007 (see INDC(NDS)-0519). The meeting was attended by 19 participants from 11 cooperating data centres of six Member States and two international organizations. This meeting focused on intensified quality control, systematic and streamlined checking and correction procedures using feedback and accounting for the needs of data evaluators, EXFOR-related software including the EXFOR editor, questions of upgrading output formats and/or the exchange format, timeliness and completeness of EXFOR compilations, questions of the CINDA bibliography, and technical details on the EXFOR/CINDA dictionaries and quantities. Twenty-three working papers were presented at the meeting. The results of the discussions were summarized as sixteen Conclusions and forty-five Actions.

Bilateral visits:

- G. Pikulina, Russian Federal Nuclear Centre, All Russian Scientific Research Institute of Experimental Physics (VNIIEF), Russia to NDS. Development of the EXFOR editor for data compilation.
22 - 26 May 2006;
20 - 29 September 2006;
17 - 23 May 2007.
- S. Taova, Russian Federal Nuclear Centre, All Russian Scientific Research Institute of Experimental Physics (VNIIEF), Russia to NDS. Development of the EXFOR editor for data compilation and advice on digitizing programs in connection with EXFOR editor.
22 - 26 May 2006;
20 - 29 September 2006;
17 - 23 May 2007;
9 - 10 October 2007.

- V. Varlamov, Russian Federation Institute of Nuclear Physics, Moscow State University to NDS. Advice on digitizing programs in connection with EXFOR editor. 9 - 10 October 2007.
- V. McLane (ex-NNDC) to NDS. Update EXFOR-related documentation and advice on the modified CINDA system. 8 - 9 November 2007.
- V. Zerkov (IAEA NDS) to NNDC/BNL. Software development for management and Web-retrieval of ENDF and EXFOR Relational Databases. 12 - 24 November 2007.

4.2. Network of Nuclear Structure and Decay Data Evaluators (NSDD)

Biennial meetings of the International Network of Nuclear Structure and Decay Data (NSDD) Evaluators are funded and organized under the auspices of the IAEA. A meeting of the NSDD network was held in St. Petersburg, Russian Federation, 11 - 15 June 2007 (see INDC(NDS)-0513). This meeting was attended by 27 scientists from 13 Member States concerned with the compilation, evaluation and dissemination of nuclear structure and decay data. The Network endorsed strongly the sponsorship of NSDD evaluators' workshops at ICTP, Trieste, Italy, with a further 2-week workshop scheduled for 28 April – 9 May 2008. Evaluation centres within NSDD were encouraged to invite and provide mentoring support to new ENSDF evaluators of mass chains.

Various technical issues were discussed, including the synchronization between ENSDF and Nuclear Wallet Cards (NWC), modernization of *Nuclear Data Sheets* (particularly new formats for tables and drawings), possible inclusion of cluster emissions in ENSDF, revision of guidelines for configuration/labels of band assignments, and the upper limits for reduced magnetic dipole transition probabilities.

NDS staff will continue to assist in the preparation of Nuclear Science References (NSR), and to collaborate in mass chain evaluations. There was a strong consensus on the continued initiative to improve non-North American contributions to ENSDF mass chain evaluations.

Bilateral visits:

- D. Winchell (NNDC/BNL) to NDS.
Nuclear Science References (NSR) collaboration.
10 - 16 June 2006.
- M.A. Kellett (IAEA NDS) to NNDC/BNL.
Nuclear Science References (NSR) collaboration.
9 - 13 October 2006.
- M. Bhattacharya (NNDC/BNL) to NDS.
Demonstration of techniques for efficient compilation of Nuclear Science References.
20 September - 5 October 2007.
- D. Abriola (IAEA NDS) to NNDC/BNL.
Mass chain evaluations.
6 - 22 November 2007.

5. ATOMIC AND MOLECULAR DATA

The primary role of the Atomic and Molecular (A&M) Data Unit is to provide data relevant to fusion energy and other research-based activities. A number of different activities are undertaken to achieve this goal, enhance the content and quality of the databases, and ensure that the databases are readily accessible to users in the fusion energy and nuclear physics communities. The databases maintained by staff of the A&M Data Unit include interactions of isolated atoms and molecules and their ions with other particles, particle-surface interactions, and materials property data. These last two sets of data type are combined under the term “plasma-material interaction”.

A&M Data Unit staff supervise CRPs under the guidance and control of a series of Research Coordination Meetings (RCMs), as well as coordinating the work of an A&M Data Centre Network (DCN). Data gathered from these sources and from Consultants’ Meetings (CMs) are evaluated and added to the databases maintained by the A&M Data Unit. All of the various activities are supervised and reviewed by the Atomic and Molecular Data for Fusion Subcommittee of the International Fusion Research Council (IFRC), which meets biennially.

5.1. Establishment of A&M databases

Over the period 2006 - 2007, one CRP was completed (Tritium inventory), two CRPs are continuing (Atomic data for heavy element impurities, and A&M data for plasma modelling) and one new CRP was initiated (Surface composition dynamics data relevant to erosion processes), so that three CRPs are currently operational within the Unit.

The final RCM on “Tritium inventory in fusion reactors” was held in September 2006. During the RCM the work of the CRP was summarized and evaluated. Specific recommendations for plasma wall facing materials were formulated. Participants will contribute summary articles on their work for publication in *Atomic and Plasma-Material Interaction Data for Fusion (APID)* and have also made a decision to write a comprehensive article summarizing the work of the CRP for publication in an external journal. This manuscript is in preparation.

The CRP on “Atomic and molecular data for plasma modelling” held a second RCM in June 2007. All participants provided progress reports. The work plan formulated at the first RCM was reviewed and revised according to the progress made. Significant progress has been made in most areas of the work plan, and data are now being used in several applications programs for divertor plasma models. However, further research is necessary on a number of topics. Accordingly, a final RCM will be held in 2008 to address the final portions of the work plan.

The second RCM for the CRP on “Atomic data for heavy element impurities in fusion reactors” was held in September 2007. The work plan from the first RCM was reviewed, with each participant reporting on the progress achieved. Significant advances have taken place, with data for several processes now available in electronic form. Several comparisons of calculations with observations have taken place with very encouraging results, particularly for radiative probabilities and electron impact ionizations. The work plan was updated to take into account work already accomplished, as well as the changing needs in the fusion community. A final RCM will be held in 2009.

A new CRP on “Data for surface composition dynamics relevant to erosion processes” was initiated with a first RCM in October 2007. The purpose of the CRP is to develop better understanding of erosion of plasma-facing materials through the comparison of modelling techniques with specific experimental measurements. Theoretical methods focus on large molecular dynamics calculations. With large parallel computers it is now feasible to carry out extensive calculations of particle interactions with surfaces. During the RCM several specific calculations were proposed along with experiments to make direct comparisons on these

cases. A second RCM is planned for 2009.

5.2. Coordination of A&M Data Centre Network (DCN)

The Data Centre Network (DCN) consists of 12 members from China, France, Germany, Italy, Japan, Republic of Korea, Russian Federation and the USA. The DCN meets every two years to discuss data needs and coordinate activities. The most recent meeting took place in October 2007 at IAEA Vienna, Austria, to report and assess recent and on-going activities. The list of data needs and priorities was reviewed and updated (available through the A&M home page: <http://www-amdis.iaea.org>). There was considerable discussion on the makeup of the DCN. While the current DCN consists of the most active data centres, others should be invited to the meetings as observers. Discussion on the ongoing development of XML schema for A&M data took place, with all participants expressing a willingness to incorporate such a schema when finalized. The implementation of XML will allow much easier data sharing among data centres.

5.3. Other A&M activities

Besides the normal data gathering activities of the Unit, other significant work has taken place during 2006 - 2007, including improved access to the databases, preparation of various publications, presentations at scientific conferences, and the continued developments of an extra-budgetary project.

The Web interface to the numerical databases has been upgraded for easier retrieval of data. Several consultants to the Unit contributed to the effort. In addition, work is underway to incorporate the developing XML schema in the output from the numerical database. Development has also continued on the general search engine (GENIE). Several new databases are now available and more search options have been added.

Support continues for internet access to computer codes for calculation of A&M data. A second meeting of the Code Centre Network (mentioned in the previous report) is scheduled for 2008. The existing Web interfaces continue to be maintained. In addition to excitation and charge exchange for heavy particle collisions, an option for ionization cross-sections has been added. A number of new features for the Los Alamos codes (also mentioned in the previous report) have also been added.

The A&M Unit continues to publish *Atomic and Plasma-Material Interaction Data for Fusion (APID)* series of technical reviews. Volumes 13 and 14 have experienced long delays, but are now in press. Manuscripts for volume 15 are in the process of being collected and edited. Staff also prepare and publish the International Bulletin that contains bibliographical information for fusion-related A&M data (volume 65 is the latest issue). Furthermore, two professional staff of the A&M Unit attended and presented papers at several international scientific conferences in 2006 - 2007. Staff also collaborate directly with several research institutes to generate data of interest to the fusion and nuclear physics research communities.

Finally, the A&M Data Unit continues to maintain an extrabudgetary activity on the preparation of "International Database on Irradiated Graphite Properties" – the Steering Committee for this project met in 2006 and 2007. The schedule agreed upon for data entry is being maintained, and the complete first version of the database should become accessible in mid-2009 to the financial supporters of this activity.

6. NUCLEAR DATA DEVELOPMENT

Nuclear data development activities are primarily aimed at improving the quality and quantity of nuclear data accessible by all Member States through the following functions:

- coordinated research projects,
- data development projects,
- individual research contracts, contractual and special service agreements with experts in specific fields,
- specialised technical meetings,
- work undertaken directly by NDS staff.

Immediate outputs of these data development projects include:

- creation of new databases designed and dedicated to various energy and non-energy based applications,
- new contributions or improvements to existing databases,
- documents related to the database description, verification and validation,
- software tools for data manipulation including visualisation and verification,
- users' manuals when appropriate.

6.1. Coordinated Research Projects (CRP)

An extended historic perspective of CRPs within the NDS can be seen in Table 3 that covers the previous 14 years of such activities (1994 - 2007), as well as giving some consideration of the future. As can be seen from these data, CRP commitments are solid up to 2011, and plans concerning future years are already being made on the basis of the envisaged completion dates of various on-going CRPs and previous recommendations of the INDC and IFRC.

During the course of 2006 - 2007 there were 14 CRPs at different stages of development. Four of them were A&M projects while the remaining ten were nuclear data CRPs. The latter are summarized in Table 4: three CRPs have been completed; two new CRPs were approved in 2006, for which contracts/agreements were awarded, and their first RCMs convened in 2007; one new CRP was approved in late 2007. Three A&M and seven nuclear data CRPs were active at the end of 2007.

Table 3. Past 14 years and the immediate future of NDS activities related to Coordinated Research Projects

CRPs - Technical reports	(5) 1994	(8) 1995	9 1996	9 1997	10 1998	12 1999	10 2000	9 2001	11 2002	12 2003	9 2004	12 2005	10 2006	12 2007	10 2008	(9) 2009	(4) 2010	(2) 2011
TECDOC-1168 (Lammer)																		
Fission yield nuclear data																		
TECDOC-1034 (Oblozinsky)																		
RIPL-1																		
APID, vol. 11 (Janev)																		
Radiative cooling rates/fusion impurities																		
INDC(NDS)-412 (Oblozinsky)																		
Photon production data																		
TECDOC-1285 (Herman)																		
Reference neutron activation library																		
Set aside (Janev) - see tritium CRP, below																		
Tritium retention in plasma-facing components																		
APID, vol. 12 (Clark)																		
Atomic and plasma-material interaction data for fusion																		
TECDOC-1211 (Oblozinsky)																		
Production cross-sections of diagnostic radioisotopes																		
TECDOC-1178 (Oblozinsky)																		
Photonuclear data for applications																		
STI/PUB, to be published in 2008 (Lammer)																		
Fission yield data for transmutation of minor actinides																		
APID, vol. 9 (Clark)																		
Atomic and plasma-material interaction data for fusion																		
APID, vol. 10 (Clark)																		
Charge exchange cross-section data for fusion plasma studies																		
TECDOC-1506 (Oblozinsky/Herman)																		
RIPL-2																		
STI/PUB/1287 (Herman/Nichols)																		
Update X and gamma-ray decay data standards																		
STI/PUB/1263 (Paviotti)																		
Prompt gamma rays for elemental analysis																		
STI/PUB/1264 (Trkov)																		
WIMS-3D																		
Technical Reports Series No 452 (Paviotti)																		
IRDF-2002 (DDP - not CRP)																		
APID, vol. 13 (Clark)																		
A+M data for plasma diagnostics																		
APID, vol. 14 (Clark)																		
Data for molecular processes in edge plasmas																		
STI/PUB/1291 (Pronyaev)																		
International evaluation of neutron cross-section standards																		
Technical report (Trkov)																		
Nuclear data for Th-U fuel cycle																		
APID, vol. 15 ? (Clark)																		
Tritium inventory in fusion reactors																		
Technical report (Capote Noy)																		
RIPL-3																		
Technical report (Capote Noy)																		
Nuclear data for production of therapeutic radionuclides																		
Technical report (Abriola)																		
Reference database for ion beam analysis																		
Technical report (Trkov/Kellett)																		
Reference database for neutron activation analysis																		
Technical report (Kellett)																		
Updated decay data library for actinides																		
APID, vol. (Humbert)																		
A+M data for plasma modelling																		
APID, vol. (Clark)																		
Atomic data for heavy element impurities in fusion reactors																		
Technical report (Capote Noy)																		
Heavy charged-particle interaction data for radiotherapy																		
APID, vol. (Clark)																		
Surface composition dynamics data - erosion processes																		
Technical report (Mengoni)																		
Minor actinide neutron reaction data																		
Technical report (Mengoni)																		
ND libraries for advanced systems: fusion devices (FENDL-3)																		

Table 4. Status of Coordinated Research Projects dedicated to nuclear data

No.	Short title	Duration	Participants (contracts)	Project Officer	Status	Section
1	Neutron cross-section standards	2002 - 2006	14 (4)	Pronyaev/Nichols	Completed	6.1.1.
2	Nuclear data for Th-U fuel cycle	2002 - 2007	11 (6)	Trkov/Nichols	Completed - Database/document in preparation	6.1.2
3	RIPL-3	2003 - 2008	12 (5)	Capote Noy	On-going / Close to completion	6.1.3
4	Nuclear data for the production of therapeutic radionuclides	2003 - 2007	8 (4)	Capote Noy	Completed/document in preparation	6.1.4
5	Reference database for ion beam analysis	2005 - 2009	10 (4)	Schwerer/Abriola	On-going	6.1.5
6	Reference database for neutron activation analysis	2005 - 2009	8 (4)	Trkov/Kellett	On-going	6.1.6
7	Updated decay data library for actinides	2005 - 2009	9 (4)	Kellett	On-going	6.1.7
8	Heavy charged-particle interaction data for radiotherapy	2007 - 2010	13 (2)	Capote Noy	Approved and on-going	6.1.8
9	Minor actinide neutron reaction data (MANREAD)	2007 - 2011	13 (5)	Mengoni	Approved and on-going	6.1.9
10	Nuclear data libraries for advanced systems: fusion devices (FENDL-3)	2007 - 2012	~10	Mengoni	Approved by CCRA: 2007-11-30	6.1.10

6.1.1. Improvement of the Neutron Cross-Section Standards for Light Elements (completed)

Objective:

- Improve the methodology for the evaluation of the covariance matrix of uncertainty in R-matrix model fits, and evaluate light element standards. Methodology was extended to high energies, and includes heavy element standards.

Outputs:

- Database made available on Web page <http://www-nds.iaea.org/standards/> January 2007.
- International Evaluation of Neutron Cross-Section Standards, STI/PUB/1291, IAEA, Vienna, Austria, 2007, ISBN 92-0-100807-4.

Remarks/Outcomes:

- The new cross-section standards are a significant improvement on previous recommendations, and provide the nuclear data measurements community with a much more reliable means of standardizing their activities.
- Resulting data have already been adopted in the US ENDF/B-VII nuclear applications library, as released in December 2006.

References:

- [1] A. Carlson, S. Badikov, Chen Zhenpeng, E. Gai, G. Hale, F.-J. Hamsch, H. Hofmann, T. Kawano, N. Larson, Soo-Youl Oh, V. Pronyaev, D. Smith, S. Tagesen and H. Vonach, An international neutron cross section standards evaluation, presented at Int. Conf. on Nuclear Data for Science and Technology, 22 - 27 April 2007, Nice, France (to be published).
- [2] S.A. Badikov, Chen Zhenpeng, A.D. Carlson, E.V. Gai, G.M. Hale, F.-J. Hamsch, H.M. Hofmann, T. Kawano, N.M. Larson, V.G. Pronyaev, D.L. Smith, Soo-Youl Oh, S. Tagesen, H. Vonach and A.L. Nichols, International evaluation of neutron cross-section standards, STI/PUB/1291, IAEA Vienna, Austria, 2007, ISBN 92-0-100807-4.

6.1.2. Evaluated Nuclear Data for the Thorium-Uranium Fuel Cycle (completed – database assembled/document in preparation)

Objectives:

- Update nuclear data relevant to systems utilizing the Th-U fuel cycle.
- Identify in more detail the variances in nuclear data that are responsible for the discrepancies observed in the calculated parameters of Th-U fuel cycle systems.

Activities:

- 3rd and final RCM was held at IAEA Vienna, Austria, 30 January - 2 February 2006.
- RCM participants were assigned data preparation roles for the formulation of the database, along with the authorship responsibilities for the final technical report.

Outputs:

- Final versions of the evaluated data files are available on Web page <http://www-nds.iaea.org/Th-U/>
- Final report is in preparation.

Remarks / Outcomes:

- Comprehensive neutron cross-section data for the important Th, Pa and U isotopes have been extensively studied and evaluated – considerable improvements have been made in the production of these recommended data.
- Covariance data have been generated to quantify the uncertainties with much greater confidence than previously achieved.
- The present data files for ²³²Th and ^{231,233}Pa were adopted for ENDF/B-VII.

Reference:

P. Schillebeeckx and A. Trkov (Ed.), Summary Report Third Research Coordination Meeting on Evaluated Nuclear Data for Th-U Fuel Cycle, IAEA Vienna, Austria, 30 January - 2 February 2006, INDC(NDS)-0494, February 2006.

6.1.3. Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Nuclear Applications (RIPL-3) (on-going/close to completion)

Objectives:

- Extend RIPL-2 database to provide input parameters for nuclear model calculations required for energy and non-energy applications such as ADS, innovative reactors, medical radioisotope production, and astrophysics.
- Develop routines for calculation of certain input parameters in order to facilitate access of users to the RIPL library, and prevent misuse of the parameters.
- Establish well-defined and documented procedures for RIPL maintenance and future updates.

- RIPL validation using large-scale calculations of nuclear reactions across the nuclide table, and comparison with available experimental databases (including latest data from HINDAS, n_TOF, etc.).
- Uncertainty estimates and/or range of parameter variation for RIPL.

Activity:

- 3rd and final RCM was held at IAEA Vienna, Austria, 10 - 14 December 2007.

Outputs:

Expected output will be an updated and expanded RIPL-3 electronic database based on RIPL-2, which will supersede the previous version.

- Updated versions of work files are available on Web page <http://nds121.iaea.org/RIPL-3/>
- Optical Model database and interface were updated.
- Discrete levels database updated.
- Review, comparison and update of the RIPL-2 resonance spacings using latest Mughabghab recommendations.
- New phenomenological and microscopic level density parameterizations.

Remarks/Outcomes:

Several nuclear data needs have been addressed by this CRP: emerging nuclear technologies that require model parameters for the calculation of nuclear reactions; energy and non-energy applications such as advanced reactors, accelerator-driven waste incineration, production of radioisotopes for therapy and diagnostics, charged-particle beam therapy, and materials analysis. There is also a worldwide interest in nuclear astrophysics, which is constrained to rely on theoretical calculations of nuclear reaction cross-sections to model the distribution of isotopes in the universe.

The methodology of RIPL-2 (and RIPL-3) in the derivation of evaluated nuclear reaction data has been adopted by the ENDF/B-VII nuclear applications library. RIPL TECDOC reports describing the RIPL database (RIPL-1: IAEA-TECDOC-1034, and RIPL-2: IAEA-TECDOC-1506) are highly cited references by evaluators and theoretical nuclear physicists worldwide.

References:

- [1] R. Capote Noy and S. Goriely (Eds.), Summary Report Second Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-Energy Nuclear Applications (RIPL-3), IAEA Vienna, Austria, 28 November – 2 December 2005, INDC(NDS)-0492, January 2006.
- [2] R. Capote Noy and S. Goriely (Eds.), Summary Report Third Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-Energy Nuclear Applications (RIPL-3), IAEA Vienna, Austria, 10 – 14 December 2007, INDC(NDS)-0524, February 2008.

6.1.4. Nuclear Data for the Production of Therapeutic Radionuclides (completed – database assembled/document in preparation)

Objectives:

Reactor-produced radioisotopes

- Compile and evaluate cross sections as a function of energy in the range 0 to 20 MeV.
- Deduce spectrum-averaged data in the conventional way for thermal, epithermal and fast neutrons and compare with measurements.

Accelerator-produced radioisotopes

- Compile and evaluate cross sections as a function of energy up to 40 MeV (or 100 MeV,

- when necessary).
- Deduce from the microscopic cross sections the integral yield data as a function of incident energy, and compare with experimental thick target yields available in the literature.

All cases

- Carry out new measurements when required.
- Prepare missing entries of experimental data for inclusion in the EXFOR database.
- Assemble the newly evaluated data library in ENDF-6 format.

Activities:

- 3rd and final RCM was held at IAEA Vienna, Austria, 29 May - 2 June 2006.
- Participants were assigned authorship roles for the preparation of the final technical report.

Outputs:

- All of the important production cross sections identified during the course of the CRP have been successfully measured (if necessary) and comprehensively evaluated.
- Final report is in preparation.

Remarks/Outcomes:

Resulting recommended data are particularly important in ensuring that the optimum yields of the desired radioisotopes are achieved with the minimum of contamination from other radioactivity – adoption of these reaction data in the preparation of the specified radionuclides will maximise their desired dose rate and medical impact, while minimising and even eliminating the impact of undesirable radionuclidic impurities.

Reference:

J.-Ch. Sublet and R. Capote Noy (Eds.), Summary Report Third Research Coordination Meeting on Nuclear Data for the Production of Therapeutic Radionuclides, IAEA Vienna, Austria, 29 May - 2 June 2006, INDC(NDS)-0501, August 2006.

6.1.5. Development of a Reference Database for Ion Beam Analysis (on-going)

Objectives:

- Identify the most important nuclear reactions for Ion Beam Analysis (IBA).
- Compare data and perform measurements, apply model calculations, and incorporate all measured and evaluated data into the IBANDL database.

Activity:

- 2nd RCM was held at IAEA Vienna, Austria, 18 - 21 June 2007.

Outputs:

- Data assessments of nuclear reactions for several target-projectile combinations of interest to the IBA community have been loaded on to the Web page: <http://www-nds.iaea.org/iba/>
- IBANDL interface was modified to allow direct access to the EXFOR database.
- New evaluations are available in IBANDL through SigmaCalc.

Reference:

I. Vickridge and O. Schwerer (Eds.), Summary Report of the Second Research Coordination Meeting on Development of a Reference Database for Ion Beam Analysis, IAEA Vienna, Austria, 18 - 21 June 2007, INDC(NDS)-0511, July 2007.

6.1.6. Reference Database for Neutron Activation Analysis (on-going)

Objectives:

- Improve the database of integral nuclear constants for neutron activation analysis.
- Improve consistency between energy-dependent cross sections and integral constants.
- Contribute to the nuclear structure database.

Activities:

- 2nd RCM was held at IAEA Vienna, Austria, 7 - 9 May 2007.
- Tasks were assigned to participants, and the work is progressing well.

Outputs:

- Neutron spectrum characterisation of various experimental facilities.
- Detector efficiency calibrations.
- Testing/implementation/validation of spectrum analysis software.
- SMELS reference material analysis.
- Comparison and update of γ -ray emission probabilities in EGAF.

References:

- [1] R.B. Firestone and A. Trkov (Eds.), Summary Report of the First Research Coordination Meeting on Reference Database for Neutron Activation Analysis, IAEA Vienna, Austria, 3 - 5 October 2005, INDC(NDS)-0477, October 2005.
- [2] R.B. Firestone and M. A. Kellett (Eds.), Summary Report of the 2nd RCM on Reference Database for Neutron Activation Analysis, IAEA Vienna, Austria, 7 - 9 May 2007, INDC(NDS)-0514, March 2008.
- [3] <http://www-nds.iaea.org/naa>

6.1.7. Updated Decay Data Library for Actinides (on-going)

Objectives:

- Measure specific actinide decay data judged to be inadequate, assuming sources are available.
- Evaluate half-lives, and α -particle and γ -ray emission probabilities.
- Assemble a database that constitutes improved/recommended decay data files for actinides of direct application.

Activity:

- 2nd RCM was held at IAEA Vienna, Austria, 28 - 30 March 2007.

Outputs:

- New measurements undertaken and published by participants.
- Specific evaluations undertaken and published by participants.

References:

- [1] M.A. Kellett (Ed.), Summary Report First Research Coordination Meeting on Updated Decay Data Library for Actinides, IAEA Vienna, Austria, 17 - 19 October 2005, INDC(NDS)-0479, January 2006.
- [2] M.A. Kellett (Ed.), Summary Report of the Second Research Coordination Meeting on Updated Decay Data Library for Actinides, IAEA Vienna, Austria, 28 - 30 March 2007, INDC(NDS)-0508, December 2007.
- [3] http://www-nds.iaea.org/act_ddl

6.1.8. Heavy Charged-particle Interaction Data for Radiotherapy (approved and on-going)

Objective:

- Primary aim is to improve the quality of the heavy charged-particle interaction data for patient dose delivery calculations in radiotherapy.

Activities:

- CM was held at IAEA Vienna, Austria, 20 - 22 November 2006.
- 1st RCM was held at IAEA Vienna, Austria, 6 - 9 November 2007.

Reference:

R. Capote Noy and S. Vatnitskiy, Summary Report of Consultants Meeting Nuclear Data of Charged-Particle Interactions for Medical Therapy Applications, IAEA Vienna, Austria, 20 - 22 November 2006, INDC(NDS)-0504, January 2007.

6.1.9. MANREAD: Minor Actinide Neutron Reaction Data (approved and on-going)

Objective:

- Critical evaluation, uncertainty assessment and production of neutron cross-section data for an agreed set of minor actinides.

Activities:

- CM was held at IAEA Vienna, Austria, 23 - 24 November 2006.
- 1st RCM was held at IAEA Vienna, Austria, 19 - 23 November 2007.

References:

- [1] A. Plompen and A. Mengoni, Summary Report of Consultants Meeting on Minor Actinide Nuclear Reaction Data (MANREAD), IAEA Vienna, Austria, 23 - 24 November 2006, INDC(NDS)-0512, October 2007.
- [2] A. Mengoni *et al.*, Summary Report of First Research Coordination Meeting of MANREAD, IAEA Vienna, Austria, 19 - 23 November 2007, INDC(NDS) report , in preparation.
- [3] Web site: <http://www-nds.iaea.org/manread/>

6.1.10. Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3) (approved)

Objective:

- Primary objective is to provide an evaluated nuclear data library - substantial extension of the FENDL-2.1 library toward higher energies, with inclusion of incident charged particles and the evaluation of related uncertainties (library to be called FENDL-3.0).

Activities:

- TM was held at IAEA Vienna, Austria 31 October - 2 November 2007 to define objectives and prepare CRP proposal. Summary Report is in preparation.
- 1st RCM foreseen for November 2008.

Reference:

Website: <http://www-nds.iaea.org/fendl3>

6.2. Data Development Projects (DDP)

Several data development projects are on-going or have been completed in 2006 - 2007.

6.2.1. Improvements to the IRDF-2002 dosimetry library

A Consultants' Meeting was held in January 2007 to discuss the needs for new data for reactor dosimetry and possible extensions of IRDF-2002 to higher neutron energy applications (including adequate covariance data). Specific participants agreed to undertake a preliminary exercise to assess the feasibility of extending this library as requested – this work is still on-going.

L.R. Greenwood and A.L. Nichols, Summary Report of Consultants' Meeting - Review the Requirements to Improve and Extend the IRDF library (International Reactor Dosimetry File (IRDF-2002)), IAEA Vienna, Austria, 25 - 26 January 2007, INDC(NDS)-0507, January 2007.

6.2.2. Updates to the WIMS-D library package

Following the release of the JEFF-3.1 library, the collection of available WIMS-D libraries was extended to include new data. The JEFF-3.1 library includes new decay and fission product yield data, in addition to significantly improved neutron cross-section data. An updated version of the XnWlup package for display and intercomparison of the library data has also been provided by Indian researchers.

6.2.3. Evaluation of neutron-induced reactions on tungsten isotopes

Accurate nuclear data for tungsten radionuclides are required because tungsten is a candidate material for first-wall components in fusion devices, proposed target material for systems based on high-current accelerators, and is important in neutron dosimetry as a consequence of the $^{186}\text{W}(n, \gamma)$ reaction. New evaluations including covariance information for $^{180,182,183,184,186}\text{W}$ at neutron energies up to 150 MeV were produced. The evaluated files are being tested on selected fusion neutronics and fast neutron benchmarks, and exhibit marked improvements compared with other existing evaluations.

6.2.4. Phase-space database for external beam radiotherapy

A Consultants' Meeting was held in Vienna in December 2005 to discuss and recommend actions and activities to prepare a *Phase-space Database for External Beam Radiotherapy* (see IAEA report INDC(NDS)-0484). The recommendations of the meeting were implemented in 2006: new IAEA phase-space (*phsp*) format has been established and corresponding read/write subroutines have been developed. The *phsp* database is designed to disseminate phase-space data of those accelerators and ^{60}Co units used in radiotherapy through the compilation of existing data that have been properly validated. An International Advisory Committee consisting of recognized experts in the area of accelerator Monte-Carlo simulations was appointed by the IAEA to assess all *phsp* data submitted and rank their quality by means of well-specified criteria – this work is still on-going.

6.2.5. Beta decay and decay heat

Participants at a Consultants' Meeting at IAEA Vienna, Austria, in December 2005 debated the needs for additional decay data to be measured and entered in the various decay data libraries for decay heat calculations. Specific recommendations and actions arose from this meeting, and were addressed further at another Consultants' Meeting in May 2006 (also defined as a WPEC Subgroup 25 meeting). Decay-data requirements were reviewed, and a comprehensive list of radionuclides was prepared for recommended TAGS measurements

(total absorption gamma-ray spectroscopy). This meeting was organized in collaboration with the OECD/NEA Data Bank.

A.L. Nichols (Ed.), Summary Report of Consultants' Meeting on Beta Decay and Decay Heat, IAEA Vienna, Austria, 12 - 14 December 2005, INDC(NDS)-0483, January 2006.

A.L. Nichols (Ed.), Summary Report of the Second Consultants' Meeting on Beta-decay and Decay Heat, Paris, France, 3 May 2006, INDC(NDS)-0499, June 2006.

6.2.6. Input to JEFF project

Original NDS staff interest and technical expertise in the formulation of JEFF-3.1 has resulted in a series of additional studies for the JEFF project. Approximately 50 well-defined decay scheme evaluations were undertaken in 2006 to 2007, and this work continues as support to the European Fusion programme (approximately 20 radionuclides per year). NDS staff have also actively participated at the JEFF Subgroup on Decay Data and Fission Yields, and in the assembly and testing of the new JEFF-3.1.1 Radioactive Decay Data Library.

6.2.7. Neutron data file for Cd in the resolved resonance region

Work is on-going to produce an updated and evaluated nuclear data file of resonance parameters in ENDF-6 format for the cadmium isotopes. Outputs will include files in EXFOR format that contain the experimental data from IRMM, Geel, and resonance parameters of the Cd isotopes in ENDF-6 format, along with a report of the work – this work is still on-going.

6.2.8. Handbook of Nuclear Data for Safeguards, INDC(NDS)-0502, January 2007

A set of recommended nuclear data has been assembled that are judged to be suitable for application with respect to nuclear materials accounting techniques. These revised data supersede the tabulations to be found within IAEA report INDC(NDS)-376, December 1997. The update is based on assessments of available evaluated nuclear databases and recently published files, books and technical reports. Every effort has been made to ensure that the recommended data are credible and correct with respect to their original sources.

7. TECHNOLOGY TRANSFER

Technology transfer activities throughout 2006 - 2007 have focused on help in the maintenance of the mirror site facilities at BARC, Mumbai, India, and at IPEN, São Paulo, Brazil. Direct training of young nuclear physicists has also involved a step change in emphasis, particularly with respect to identifying and mentoring “new blood” for mass chain evaluations (nuclear structure and decay data). This work will continue in conjunction with the demands of the International Network of Nuclear Structure and Decay Data Evaluators.

7.1. Technical cooperation: regional centres for nuclear data services

NDS staff commissioned a mirror server at the Bhabha Atomic Research Centre (BARC), Mumbai, India, in September 2004. This work was undertaken in conjunction with counterparts at the BARC IT department, who supplied the server and installed the necessary software; NDS staff built the data services and the mirroring procedures. The new service was officially launched during a visit of the Director General of the IAEA to BARC on 15 November 2004.

During the course of May 2005, the VMS Alpha AS800 mirror server at IPEN, Brazil, was replaced by a new Linux server. This new service was officially launched on 1 June 2005. As with the BARC mirror server, the local facility supplied the hardware, software and a counterpart to build the basic system; NDS supplied the data services and mirror procedures.

NDS has full administrator access to both mirror servers. Access logs are collected periodically and added to the NDS access statistics, and the mirror servers are updated automatically every 24 hours. Both mirror computers provide the same services as the NDS main server with the exception of ENSDF, NuDat and NSR. Since the relational versions of ENSDF, NSR and NuDat as provided by the NNDC are written around SYBASE DBMS (proprietary product), NDS is unable to provide these databases to remote mirror servers; electronic requests for these databases are directed to the NDS server at IAEA Vienna, Austria.

Contact has also been made with the China Nuclear Data Center to initiate the provision of a mirror server, but no progress has been made with respect to this proposal in the course of 2006 - 2007.

7.2. Workshops

IAEA-NDS sponsored and organised three workshops in 2006 - 2007, of which one was related to atomic and molecular data. These workshops are described below.

7.2.1. Nuclear Structure and Decay Data: Theory and Evaluation (ICTP Trieste, Italy, 20 February - 3 March 2006)

Workshop Directors: A.L. Nichols (IAEA-NDS), J.K. Tuli (NNDC) and A. Ventura (ENEA).

A third two-week workshop was organized by the IAEA in collaboration with NNDC, USA and ENEA, Italy. The programme was based on the previous three successful workshops (November 2002, one-week trial, IAEA Vienna, Austria; November 2003 and April 2005, two weeks each, ICTP, Trieste, Italy).

Objectives:

- Familiarize students with new experimental data that characterize the nucleus, and with modern nuclear models.
- Train participants in methodology of NSDD evaluations and in production of evaluated nuclear structure and decay data (as ENSDF mass-chain evaluations).

Topics:

- ENSDF evaluation philosophy (J.K. Tuli);
- NSDD network, relevant IAEA activities, and access to appropriate Web pages (A.L. Nichols and T. Burrows);
- nuclear structure models - IBM (P. Van Isacker and S. Brant);
- experimental measurements (P. von Brentano and F. Kondev);
- statistical analysis techniques (T.D. MacMahon);
- ENSDF evaluations and computer codes (C. Baglin, E. Browne, T. Burrows and J.K. Tuli);
- databases (C. Baglin, E. Browne, T. Burrows, K. McLaughlin and J.K. Tuli);
- presentations of participants' own work.

Actions:

- Workshop material was presented as lectures (mainly mornings) and exercises (afternoons), with hands-on introduction of participants to mass chain evaluations through group and individual PC/computing activities.

- Students were given the opportunity to review the workshop through a written questionnaire and direct discussions.

Remarks/Outcomes:

- 23 participants from 14 countries received training from 10 lecturers and demonstrators,
- one participant expressed strong interest in undertaking NSDD evaluation work (this person is now working with evaluators from NSDD network),
- training documents prepared from lecturers' material (also on CD-ROM)
 - INDC(NDS)-452, Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, Manual – Parts 1 and 2, November 2004,
 - INDC(NDS)-0473, Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, Manual – Addendum, July 2005,
 - INDC(NDS)-0496, Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, Manual – Addendum, June 2006.

These NSDD workshops have been particularly successful in achieving significant technology transfer and the identification of “new blood” for ENSDF mass chain evaluations (subsequently pursued through a mentoring process in association with the International Network of Nuclear Structure and Decay Data Evaluators).

7.2.2. Workshop on Atomic and Molecular Data for Fusion Energy Research (ICTP, Trieste, Italy, 28 August - 8 September 2006).

Workshop Director: R.E.H. Clark (IAEA-NDS).

Atomic and Molecular (A+M) Data for Fusion Subcommittee of the International Fusion Research Council (IFRC) had recommended holding such a workshop at their review meeting of the IAEA work programme on 24 - 25 June 2004.

Objective:

- Provide practical examples of applications of data issues to actual problems related to fusion energy research.

Topics:

- R.E.H. Clark of the IAEA gave six lectures that focused on structure and electron impact processes in atoms and ions, as well as using such data in the modelling of plasmas in fusion machines;
- D. Humbert of the IAEA presented three lectures that focused on electronic database issues;
- J. Davis of the Institute for Aerospace Studies, University of Toronto, Canada, presented three lectures on co-deposition and plasma interaction with co-deposited materials;
- T. Schwarz-Selinger of the Max-Planck Institut fur Plasmaphysik, Germany, gave presentations on plasma interactions with materials;
- R. McCarroll of the Université Pierre et Marie Curie, France, gave six lectures on photon and heavy particle collision processes for molecules;
- J. Abdallah of the Los Alamos National Laboratory, USA, reviewed the basics of modelling plasmas;
- D. Reiter from the Institut für Plasmaphysik, Germany, presented an overview of the modelling molecular processes in fusion plasmas;
- T. Märk of the Universität Innsbruck, gave a review of processes involving molecules in fusion plasmas.

Actions:

- General approach was to begin each day with one hour of discussion of the material from the previous day, including solutions to the assigned exercises.
- This review was followed by three lectures, with a break for lunch.
- Latter part of the afternoon was devoted to work on the exercises, with the lecturers being available for individual help.
- A substantial computing room was made available for the students at the ICTP with good Internet connection.

Remarks/Outcomes:

- Workshop was attended by 14 students and three ICTP associates representing 11 Member States.
- Total of eight lecturers, including six external to the Agency, made presentations to the workshop.
- Second ICTP workshop organized by the A&M Unit on atomic and molecular data for fusion energy research – judged to be successful from both the students' and lecturers' points of view.

7.2.3. Nuclear Data for Science and Technology: Medical Applications (Trieste, Italy, 12 - 23 November 2007)

Workshop Directors: R. Capote Noy (IAEA-NDS) and S.M. Qaim (Germany).

Continuation of a series of “Nuclear Data for Science and Technology” Workshops initiated in 1999 - two-week workshop organized by IAEA in collaboration with the International Centre for Theoretical Physics in Trieste, Italy.

Objective:

Facilitate the application of modern nuclear technology in therapy and diagnostics by training scientists, medical physicists and engineers, particularly from developing countries, in the use and understanding of nuclear data of relevance to medical applications.

Topics:

- Nuclear techniques used in medicine (cancer therapy using radioisotopes, gamma rays, neutrons, protons and heavy ions; diagnostics with SPECT and PET);
- radiation sources employed in radiotherapy applications;
- biological effects of therapy beams and treatment planning;
- nuclear data for medical applications (e.g., cross sections for interaction of neutrons and charged particles with tissue elements, cross sections for radioisotope production, spectroscopic data and calibration standards);
- nuclear data for monitoring beam parameters;
- benchmarking of nuclear data for medical applications;
- theoretical methods for nuclear data production (nuclear reaction models and codes);
- nuclear data processing;
- on-line retrieval of nuclear data.

Actions:

- Each morning and afternoon session consisted of two 1.5-hour lectures (or exercises) followed by discussions. One afternoon was devoted to the on-line retrieval of nuclear data through group and individual PC/computing activities.

- Students were given the opportunity to review the workshop through a written questionnaire and direct discussions.

Remarks / Outcomes:

- 40 participants (35 from developing countries) received training from 11 lecturers - participants expressed their high satisfaction with the workshop;
- participants would have welcomed more hands-on exercises, especially with Monte Carlo codes which were only covered by lectures; there was also a strong interest in the various computer codes;
- one-week workshop on Nuclear data for non-energy applications (including medical and other applications) would be appropriate - potential participants would be mainly nuclear data physicists involved in the measurement and modelling of nuclear data for non-energy applications, including astrophysical, medical, analytical and environmental applications of nuclear data. Could also schedule more lectures on nuclear data theory, and practical exercises with nuclear reaction systems such as EMPIRE II.

8. COMPUTER SUPPORT

Major highlights in computer services and systems development during 2006 - 2007 are as follows:

- physical relocation of nuclear data servers to the main Agency computer room on F06;
- further relocation to new Lights-Out Data Centre on C01;
- removal of the NDS Ethernet infrastructure from A23;
- acquisition of three 64-bit computers running Redhat Enterprise Linux;
- progress made on the provision of new facilities for data services.

8.1. Computer networks

As required in order to conform to the Agency-wide computer network security policy, the NDS Ethernet sub-network with addresses in the range 161.5.7.0 to 161.5.7.254 remains inside the Agency Firewall within a special network zone known as the De-Militarized Zone (DMZ). This zone is designed for servers and other computers that are accessed from the Internet, and is secured by the IAEA network firewall. This firewall filters all traffic into and out of the DMZ, and also between the DMZ and the Agency Intranet. NDS staff work closely with MTIT to meet Agency security requirements, and to ensure the continued efficient provision of the data services.

All NDS Ethernet-based computers have been grouped into logical sets within the firewall management software of the Agency. Network access rules through the firewall decide access from the world and to/from the Agency Intranet, and have been assigned on the basis of group properties for service classes such as data servers, development servers and workstations. Intercommunication between nodes on the NDS Ethernet is unrestricted. An overview of the Section's positioning within the Agency firewall is shown in Fig. 2.

Following the recommendations of the external Agency-wide IT audit (2005 – 2006) and in conjunction with the move of the Section to the Q building for the asbestos removal exercise, all Nuclear and Atomic & Molecular servers were relocated from floor A23 to the central Data Services computer room on floor F06 in the first week of November 2006. The relocated machines were as follows:

- Compaq ML530 G2 – www-nds.iaea.org and www-amdis.iaea.org - primary Nuclear Data and Atomic & Molecular data server;
- Compaq ML530 G2 – nds121.iaea.org - NDS development server;

- Dell Precision – castor.iaea.org - GANDR project;
- 64-bit computer – nds120.iaea.org;
- Compaq Alpha Server 2100 – ndsalph.iaea.org.

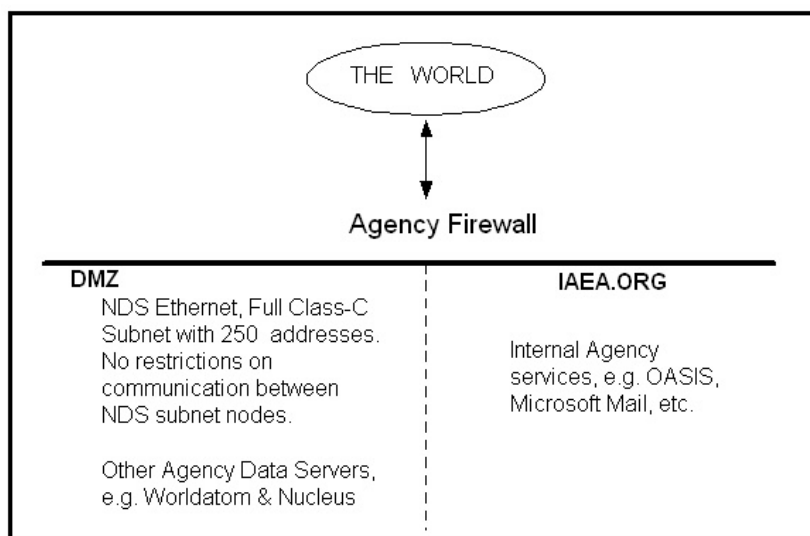


Fig. 2. Overview of NDS Ethernet and Agency firewall.

The Agency decided in late 2007 to move the entire IAEA Data Centre from floor F06 to a new facility located elsewhere. This new facility will have extremely limited physical access and will contain all Agency data services. NDS participated, and our servers were successfully relocated on 27 December 2007. The Compaq Alpha Server 2100 was moved back to the Section on floor A23 (only used occasionally for EXFOR work by Section staff).

Physical console control of the two Compaq servers is via Compaq Remote Insight boards. Thus, the physical console can be emulated by NDS from dedicated PCs on A23. X Terminal access by NDS staff to production and development servers is carried out through Hummingbird Exceed X-emulation on Agency-standard PCs. This approach works from node to node on the NDS Ethernet and from nodes on the Agency Intranet to the NDS network over secure firewall tunnels. SSH and Secure Copy are used for terminal emulation and file transfer, in compliance with Agency IT security policy.

8.2. Data servers

8.2.1. VMS systems

NDS continues to maintain one Alpha server running Open VMS: a Compaq AS2100 at IAEA Vienna, Austria. This machine is no longer located in the Agency DMZ, and is used primarily for EXFOR pre-processing, and verification.

8.2.2. Linux systems

Nuclear and Atomic & Molecular data services are served to the Internet from a Compaq ML530 G2 server running Linux. The Web addresses are: <http://www-nds.iaea.org/> and <http://www-amdis.iaea.org> respectively. A second Compaq ML530 G2 (nds121.iaea.org) server acts as a development system and as back-up for the primary server. As mentioned earlier, these machines are logically located in the Agency DMZ and located physically in the main computer room on floor C01. External access to nds121.iaea.org is granted to specific members of the NSDD evaluators, NRDC network and associates for file transmission and

project collaboration, e.g. for EXFOR Trans files.

Figs. 3. and 4. show the flow of data into and out of the Nuclear and Atomic & Molecular services. Nuclear Data Services are mirrored to servers at BARC, Mumbai, India and IPEN, Sao Paulo, Brazil, which are managed from Vienna in conjunction with counterparts at the respective institutes. All nuclear data services (except for NSR, ENSDF and ENSDF derivatives (such as NuDat and MIRD)), ongoing CRPs and Data development projects are mirrored daily.

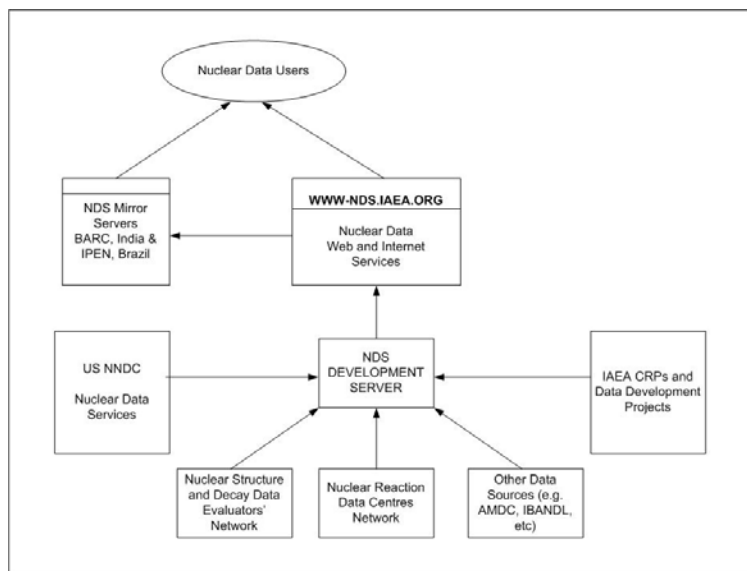


Fig. 3. Data flow through the Nuclear Data Services.

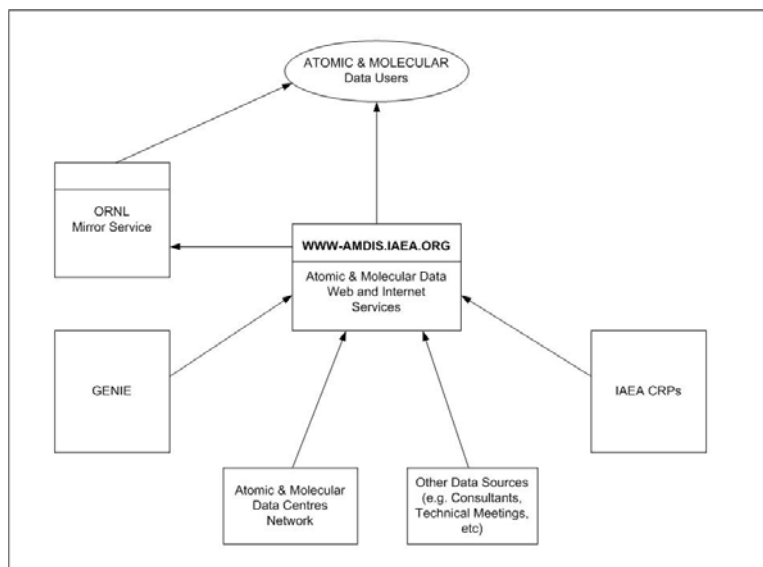


Fig. 4. Data flow through the A&M Data Services.

Over the course of 2006 - 2007, the Section acquired three new 64-bit computers that run under Redhat Enterprise Linux 64-bit. Intel 64-bit C++ and FORTRAN compilers were also installed. These machines are used for data processing and pre-processing of both Nuclear and

Atomic & Molecular data. Processing times for large codes have been reduced (e.g. EMPIRE and NJOY) and the load removed from the main servers.

8.2.3. Microsoft systems

All members of staff have an Agency-standard PC running Agency-standard Microsoft Windows XP. Access rights to the operating system on these desktops are strictly controlled by MTIT user and group security profiles. NDS has been able to acquire enhanced access for certain members of staff to allow the installation of non-Agency standard applications (e.g. FORTRAN compilers, X-windows, etc.). NDS staff also use the Agency-supplied Microsoft XP laptop image for Section laptops.

NDS maintains a dedicated Microsoft Windows file server located inside the Agency Intranet. This server is equipped with CD and DVD writers, and is used to store master copies of all data libraries and services distributable on CD-ROM, diskette and other media.

8.3. Software and applications development

NDS staff have continued to collaborate with IT specialists in the Agency (MTIT) on the development of the Agency Nuclear Information and Knowledge Portal (NUCLEUS). NUCLEUS will allow Member-State counterparts, members of the public and specialists access to scientific, technical and regulatory Agency data, information and knowledge (stored in documents, databases and on Web sites). The NUCLEUS portal is now open to all and can be seen at address: <http://nucleus.iaea.org/>

NDS staff will continue to provide input to the project by providing links, indices and descriptions of data services to the NUCLEUS team to ensure that all nuclear data are up-to-date and accessible.

The Systems Development Unit has continued to expand the support given to the Section in the development of new facilities and tools to enhance data services accessibility. Thus, the following work has been completed or is nearing completion:

- ADLIST - NDS contacts management system, with 7500 people and 70 distribution lists for NDS reports and communications. Now fully ported to Sybase DBMS and available at: <http://www-nds.iaea.org/adlist>
- Database of nuclear data for safeguards. Suitable for application with respect to nuclear materials accounting techniques.
Available at: <http://www-nds.iaea.org/sgnucdat>
- Database of X-ray and gamma-ray decay data standards for detector calibration and other applications, available at: http://www-nds.iaea.org/xgamma_standards/
- Table of Nuclides under development - Web-accessible database of nuclide properties, including decay radiations and thermal neutron cross sections.

8.4. Hardware acquisition

Table 5 lists the main computer hardware acquisitions during the reporting period of 2006 - 2007.

Table 5. NDS computer hardware purchases for 2006 – 2007.

Item	Quantity
XEON 3.6GHz, Dual-core, 64-bit, Workstation	3
Agency standard XTRA PCs	2
Fujitsu-Siemens Lifebook Laptops	3
Mac Book pro	1
HP LaserJet P2005n printer	1
HP LaserJet 2420d printer	1
19" monitor	2
21" monitor	3
Canon DR-6080 Sheet feed document scanner	1
USB iDiskII 4GB flash disk	6

8.5. Software acquisition

NDS has continued to acquire PC and other software as deemed necessary to facilitate the continued provision and enhancement of NDS data services. Principal software products acquired during 2006 - 2007 are shown in Table 6.

Table 6. NDS computer software purchases for 2006 – 2007.

Item	Quantity
Red Hat Enterprise Linux Workstation	10
SYBASE Adaptive Server Enterprise, Small Business Edition, V15 Linux	2
ABSOFIT Standard FORTRAN 64-bit, v10, for Linux	1
Origin Pro v7.5E	2
INTEL 64-bit FORTRAN compiler v9.0 for Linux	1
INTEL 64-bit C++ compiler v9.0 for Linux	1
Altova XML Spy 2006 professional Edition	5
Roxio WINONCD v8	1
Borland Delphi 2006 Enterprise Edition	1

9. CONCLUDING REMARKS

A number of notable outcomes have been fairly rapidly achieved in terms of specific IAEA-NDS outputs being adopted by international (JEFF-3.1 (OECD/NEA)) and national nuclear applications libraries (US ENDF/B-VII):

- 1) adoption of 1999 - 2000 IAEA photonuclear database;
- 2) adoption of thermal scattering law data from the 2003 - 2005 IAEA-sponsored database;
- 3) adoption of the neutron cross-section standards from the 2006 IAEA database;
- 4) adoption of ^{232}Th , ^{231}Pa and ^{233}Pa neutron cross-section data and covariances from the 2006 IAEA database;
- 5) incorporation of RIPL-2 (and on-going RIPL-3) methodology into the derivation of evaluated nuclear reaction data;
- 6) past and future incorporation of IAEA decay data files into the JEFF-3.1 nuclear applications library;
- 7) extensive use of ENSDF decay data (as continuously maintained for over 30 years by the International Network of Nuclear Structure and Decay Data Evaluators under the auspices of the IAEA);
- 8) extensive use of the information-based files of EXFOR for the evaluation of much neutron cross-section data.

NDS programme outcomes of this nature are normally achieved over much greater periods of time (at least 10 to 15 years) - such speeds of adoption for these important data sets are particularly gratifying. Also note that these particular outcomes represent only the clearly defined "public" use of IAEA-based data - our atomic and nuclear data files have been less obviously interrogated and adopted by users around the world during the course of 2006 - 2007.

A significant number of important technical reports were published to a high presentational style and editorial standard: Atomic and molecular data for fusion plasma diagnostics, APID, Vol. 13, 2007; Database of prompt gamma rays from slow neutron capture, STI/PUB/1263, January 2007; WIMS-D library update, STI/PUB/1264, May 2007; Update of X-ray and gamma-ray decay data standards, STI/PUB/1287, May 2007; International evaluation of neutron cross-section standards, STI/PUB/1291, November 2007. Specific advances were also made in the visual appearance of the new Web pages containing IAEA atomic and nuclear databases finalised in 2007: ALADDIN; ENDF; X-ray and gamma-ray decay data standards; Nuclear data for safeguards; Compilation of recommended nuclear structure and decay data; and others. The impact of these particular outputs are important in maintaining the interest and confidence of users within the public domain - our atomic and nuclear data files need to be interrogated in a user-friendly manner for them to be easily adopted by specialists around the world.

Much important technical information and related material had been generated over the previous two years by IAEA staff, and they have been able to demonstrate the high quality of these efforts through an impressive array of seminal papers and conference presentations. Improved communications have been realized through the foresight of ensuring a healthy presence of atomic and nuclear data specialists from the IAEA at key events and meetings during 2006 - 2007. These technical activities and our inputs will continue through on-going staff efforts and CRPs.

Some degree of change in emphasis occurred in Sub-programme 1.D.1 during 2006 - 2007, based on the developing data needs within the advanced fuel cycles of fission reactors and multinational initiatives in fusion systems (i.e. refinements to 1.D.1.04 involving atomic and

molecular data for fusion experiments, and extension of 1.D.1.07 towards advanced fission and fusion devices).

The IAEA can take justifiable pride and satisfaction in the impressive technical outputs and positive impacts of the work of the Nuclear Data Section (NDS) involving advances in their atomic and nuclear databases. For example, our work was well represented within the programme of the ND2007 international nuclear data conference in Nice, France (April 2007). This promotion of our work was aided considerably by the supportive presence of six members of staff at various times throughout the week to ensure and maintain the desired impact. Following the launches of RIPL-1 (1998), RIPL-2 (2005 - 2006) and a preliminary version of RIPL-3 (2007), citation of this work within other technical literature is judged to be high. A similar measure of usage is also expected in the future for the new neutron cross-section standards and Th-U nuclear data formulated within IAEA-NDS CRPs.

MEETINGS AND SCIENTIFIC VISITS IN 2006

Month / Duration	Responsible Officer	Type	Meeting Title / Type of Visit	Home Institute	Location
<u>January</u>					
09.01-13.01	Mengoni	CV	F.K. Käppeler: review experimental dissemination platform (related to n_TOF experiments through Nuclear Data Services Unit)	Forschungszentrum Karlsruhe Institut für Kernphysik, Germany	Vienna
16.01-31.03	Nichols	SSA	D. Lopez Aldama: nuclear data for safeguards, and preparation of program for updating safeguards to database	Centro de Tecnologica Nuclear Cuba	Vienna
30.01-02.02	Trkov	RCM	Final Research Coordination Meeting on evaluated nuclear data for the Thorium-Uranium fuel cycle		Vienna
<u>February</u>					
27.02-10.03	Dunaeva	CV	A. Gurbich: work on databases EXFOR and IBANDL; adapt SigmaCalc for implementation on NDS web server; implement software tool for generating SigmaCalc output in tabular form	Institute of Physics and Power Engineering (IPPE), Russia	Vienna
<u>March</u>					
15.03-16.03	Humbert	CM	Consultants' Meeting: 8 th Technical Steering Committee for the International Database on Irradiated Nuclear Graphite Properties		Vienna
21.03-23.03	Humbert	CV	D.R. Schultz: development of an upgraded version of Atomic and Molecular Data Markup Language (AMDML)	Oak Ridge National Laboratory, USA	Vienna
21.03-24.03	Humbert	CV	Y. Ralchenko: development of an upgraded version of Atomic and Molecular Data Markup Language (AMDML)	National Institute of Standards and Technology (NIST), USA	Vienna
23.03-24.03	Humbert	CV	M.L. Dubernet: development of an upgraded version of Atomic and Molecular Data Markup Language (AMDML)	Observatoire de Paris, LERMA, France	Vienna

23.03-24.03	Humbert	CV	M. Guainazzi: development of an upgraded version of Atomic and Molecular Data Markup Language (AMDML)	European Space Agency, Spain	Vienna
23.03-24.03	Humbert	CV	P. Osuna: development of an upgraded version of Atomic and Molecular Data Markup Language (AMDML)	European Space Agency, Spain	Vienna
27.03-19.05	Nichols	SSA	P.K. McLaughlin: produce an addendum reference document from the proceeds of a 2-week workshop on Nuclear Structure and Decay Data, February 2006, and retrieve archival IAEA-NDS documents in electronic format and produce documentation in Microsoft WORD and Adobe PDF formats for availability on NDS web pages		Vienna
<u>April</u>					
03.04-07.04	Clark	CV	B. Lavrov: review the current scope of data for energy levels of ro-vibrational states, and review current status of radiative transition probabilities for hydrogen molecules	St. Petersburg State University, Russia	Vienna
20.04-21.04	Clark	TM	Technical Meeting: 15 th Meeting of the IFRC Sub- Committee on Atomic and Molecular Data for Fusion		Vienna
<u>May</u>					
03.05	Nichols	CM	Consultants' Meeting: Beta-decay and Decay Heat		Paris, France
04.05-05.05	Nichols	CV	A. Ignatyuk: NEA Working Party on International Nuclear Data Evaluation Cooperation (WPEC)	Institute of Physics and Power Engineering (IPPE), Russia	Paris, France
04.05-05.05	Nichols	CV	Yu Hongwei: NEA Working Party on International Nuclear Data Evaluation Cooperation (WPEC)	China Institute of Atomic Energy (CIAE), China	Paris, France
09.05-12.05	Nichols	TM	Technical Meeting: 26 th International Nuclear Data Committee		Vienna
11.05-23.05	Nichols	CV	V. Pronyaev: preparation of an IAEA technical report on "Improved standards cross sections", and data files to the Web and onto CD-ROM	Institute of Physics and Power Engineering (IPPE), Russia	Vienna

22.05-26.05	Zerkin/ Dunaeva	CV	G. Pikulina, S. Taova: development of the EXFOR editor for data compilation	Russian Federation Nuclear Centre, Russia	Vienna
29.05-02.06	Capote Noy	RCM	Final Research Coordination Meeting on Nuclear Data for Production of Therapeutic Radionuclides		Vienna
29.05-02.06	Capote Noy	CV	B. Scholten: advise at RCM (as above)	Institut für Nuklearchemie, Forschungszentrum Jülich, Germany	Vienna
29.05-02.06	Capote Noy	CV	A. Koning: advise at RCM (as above)	NRG Nuclear Research and Consultancy Group, The Netherlands	Vienna
29.05-02.06	Capote Noy	CV	S. Takacs: advise at RCM (as above)	Institute of Nuclear Research, Hungarian Academy of Sciences, Hungary	Vienna
29.05-02.06	Capote Noy	CV	E. Menapace: advise at RCM (as above)	ENEA, Applied Physics Division Bologna, Italy	Vienna
29.05-02.06	Clark	CV	P.D. Fainstein: consult on excitation of atomic ions through heavy particle collisions and possible inclusion of calculation of excitation cross sections in existing heavy particle collision code	Centro Atomico Bariloche, Comision Nacional de Energia Atomica, Argentina	Vienna
29.05-02.06	Clark	CV	A. Dubois: excitation of atomic ions through heavy particle collisions and possible inclusion of calculation of excitation cross sections in existing heavy particle collision code	Laboratoire de Chimie Physique Matiere et Rayonnement, Universite Pierre et Marie Curie, France	Vienna
29.05-02.06	Schwerer	CV	B. Kiraly: EXFOR compilations of charged-particle induced reactions	Institute of Nuclear Research, Hungarian Academy of Sciences, Hungary	Vienna

June

12.06-16.06	Kellett	CV	D. Winchell: Nuclear Science References (NSR) collaboration	National Nuclear Data Center, Brookhaven National Laboratory, USA	Vienna
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August

28.08-08.09	Capote Noy	CV	M. Sin: validation of EMPIRE PFNS calculations for ^{238}U and ^{232}Th	Physics Dept., Bucharest University, Romania	Vienna
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September

11.09-15.09	Capote Noy	CV	J. Raynal: implementation of new features into the ECIS code for nuclear reaction calculations using coupled channel optical model		Vienna
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20.09-29.09	Zerkin / Dunaeva	CV	G. Pikulina, S. Taova: development of the EXFOR editor for data compilation	Russian Federation Nuclear Centre, Russia	Vienna
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25.09-27.09	Clark	RCM	Final Research Coordination Meeting on Tritium Inventory in Fusion Reactors		Vienna
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25.09-28.09	Schwerer	TM	Technical Meeting: Network of Nuclear Reaction Data Centres		Vienna
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October

02.10-15.12	Nichols	SSA	D. Lopez Aldama: review nuclear data on existing Website for Safeguards to improve all actinide, fission product and fission yield data	Centro de Tecnologica Nuclear, Cuba	Vienna
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16.10-20.10	Capote Noy	CV	I. Kawrakow: implementation of IAEA phase-space format in BEAMnrc/EGSnrc system	National Research Council of Canada, Ontario	Vienna
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09.10-13.10	Mengoni	CV	M. Beard: advise on combining nuclear structure computer code "OXBASH" with a programme for calculation of direct radiative capture processes	Dept. of Physics, University of Notre Dame, USA	Vienna
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11.10-13.10	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data		Paris, France
<u>November</u>					
20.11-22.11	Capote Noy	CM	Consultants' Meeting: Charged-particle Interactions for Medical Therapy		Vienna
20.11-24.11	Humbert	CV	K. Olsen: advise on XML Schema for Atomic and Molecular Data (AMDML)	National Institute of Standards and Technology (NIST), USA	Vienna
20.11-01.12	Schwerer	CV	A. Gurbich: development of a procedure to convert evaluated differential cross section data for IBA to ENDF format	Institute of Physics and Power Engineering (IPPE), Russia	Vienna
23.11-24.11	Mengoni	CM	Consultants' Meeting: Minor Actinides Neutron Reaction Data		Vienna
27.11-01.12	Nichols	CV	A. Trkov: advise on WIMS library, nuclear data for safeguards, and the IBA project	Jožef Stefan Institute, Slovenia	Vienna
<u>December</u>					
04.12-05.12	Clark	TM	Technical Meeting: Assessment of Atomic and Molecular Data Priorities		Vienna
05.12-08.12	Capote Noy	CM	Consultants' Meeting: Systematics of Fission Parameters for Nuclear Reaction Calculations		Vienna
11.12-12.12	Clark	CM	Consultants' Meeting: Core Concentrations of Hydrogen Isotopes and Light Elements in Burning Plasmas		Vienna
11.12-15.12	Capote Noy	CV	E. Soukhovitski: development of a consistent set of optical model parameters for the description of neutron- and proton-induced reactions on ^{103}Rh , ^{90}Zr and ^{92}Zr	Joint Institute of Energy and Nuclear Research-Sosny, Belarus	Vienna

MEETINGS AND SCIENTIFIC VISITS IN 2007

Month / Duration	Responsible Officer	Type	Meeting Title / Type of Visit	Home Institute	Location
<u>January</u>					
25.01-26.01	Nichols	CM	Consultants Meeting: Review of Requirements to Improve and Extend the IRDF Library		Vienna
29.01-02.02	Costello	CV	P.K. McLaughlin: link and test PREPRO-2007 codes on VMS operating system, create distribution kit and test release on Linux		Vienna
<u>March</u>					
26.03-27.03	Clark	CM	Consultants' Meeting: 9 th Technical Steering Committee for the International Database for Irradiated Nuclear Graphite Properties		Vienna
28.03-30.03	Kellett	RCM	Second Research Coordination Meeting on Updated Decay Data library for Actinides		Vienna
28.03-30.03	Kellett	CV	G. Mukherjee: advise at RCM (as above)	Variable Energy Cyclotron Centre, India	Vienna
<u>April</u>					
02.04-03.04	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data		Vienna
19.04-20.04	Nichols	CV	A. Ignatyuk: NEA Working Party on International Nuclear Data Evaluation Cooperation (WPEC)	Institute of Physics and Power Engineering (IPPE), Russia	Paris, France
19.04-20.04	Nichols	CV	Yu Hongwei: NEA Working Party on International Nuclear Data Evaluation Cooperation (WPEC)	China Institute of Atomic Energy (CIAE)	Paris, France
22.04-24.04	Mengoni	CM	Consultants' Meeting: Uncertainties in Nuclear Data Evaluations: the GANDR Approach		Nice, France

May

07.05-09.05	Kellett	CV	M.A. Menezes: present and discuss progress on Monte Carlo modelling of irradiation facility	CDTN/CNEN, Brazil	Vienna
07.05-09.05	Kellett	CV	M. Blaauw: discuss recent developments involving k_0 -IAEA software	Reactor Institute, Delft, Netherlands	Vienna
07.05-09.05	Kellett	CV	A. Trkov: advise on neutron activation analysis	Jožef Stefan Institute, Slovenia	Vienna
07.05-09.05	Kellett	RCM	Second Research Coordination Meeting on Reference Database for Neutron Activation Analysis		Vienna
17.05-23.05	Dunaeva	CV	G. Pikulina, S. Taova: advise on installation of new version of EXFOR-Editor for data compilation	Russian Federal Nuclear Centre, Russia	Vienna

June

11.06-15.06	Nichols	TM	Technical Meeting: 17 th Meeting of the Nuclear Structure and Decay Data (NSDD) Evaluators		St. Petersburg, Russia
18.06-20.06	Humbert	RCM	Second Research Coordination Meeting on Atomic and Molecular Data for Plasma Modelling		Vienna
18.06-21.06	Schwerer	RCM	Second Research Coordination Meeting on Development of a Reference Database for Ion Beam Analysis		Vienna

July

30.07-02.08	Capote Noy	CV	E. Soukhovitski: advise on development of dispersive coupled-channel optical models	Joint Institute for Power and Nuclear Research, Belarus	Vienna
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August

02.08-03.08	Clark	CV	K. Aggarwal: advise on existing atomic data at Queen's University, Belfast	Astrophysics Research Centre Queen's University, Northern Ireland	Vienna
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06.08-10.08	Capote Noy	CV	M. Sin: advise on latest version of EMPIRE system	Physics Dept. Bucharest University, Romania	Vienna
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September

24.09-05.10	Abriola	CV	M. Bhattacharya: Demonstration of techniques for efficient compilation of Nuclear Science References	National Nuclear Data Center, Brookhaven National Laboratory, USA	Vienna
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26.09-28.09	Clark	RCM	Second Research Coordination Meeting on Atomic Data for Heavy Element Impurities in Fusion Reactors		Vienna
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October

01.10-31.10	Mengoni	SSA	O. Schwerer: participate in NRDC network meeting, and contribute to editing summary report of meeting		Vienna
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01.10-02.10	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data		Vienna
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01.10-25.10	Nichols	SSA	V. Pronyaev: basic codes for cross section standards, update GMA database and address criticism of smoothing capture cross sections for ^{197}Au and ^{238}U	Institute for Physics and Power Engineering (IPPE), Russia	Vienna
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03.10-05.10	Humbert	TM	Technical Meeting: Coordination of Network of A&M Data Centres and ALADDIN		Vienna
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08.10-11.10	Dunaeva	TM	Technical Meeting: Network of Nuclear Reaction Data Centres		Vienna
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09.10-10.10	Dunaeva	CV	S. Taova: advise on digitizing programs in connection with EXFOR editor	Russian Federal Nuclear Centre, Russia	Vienna
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09.10-10.10	Dunaeva	CV	V. Varlamov: advise on digitizing programs in connection with EXFOR editor	Institute of Nuclear Physics, Moscow State University, Russia	Vienna
11.10	Mengoni	CM	SG-30: to discuss quality and interfacing improvements for an experimental Nuclear Data Library (EXFOR)		
17.10-19.10	Clark	RCM	First Research Coordination Meeting on Data for Surface Composition Dynamics relevant to Erosion Processes		Vienna
17.10-19.10	Clark	CV	J. Chen: advise on matters involving erosion processes in fusion machines	Institute of Plasma Physics, Chinese Academy of Science, China	Vienna
17.10-19.10	Clark	CV	K. Krieger: advise on matters involving erosion processes in fusion machines	Max-Planck-Institut für Plasmaphysik, Germany	Vienna
22.10-25.10	Capote Noy	CV	L. Leal: to review and improve evaluations of tungsten isotopes in the low energy region	Oak Ridge National Laboratory, USA	Vienna
29.10-30.10	Capote Noy	CV	D. Smith: discuss implementation of the unified Monte Carlo method for covariance matrix calculations	Argonne National Laboratory, USA	Vienna
31.10-02.11	Mengoni	TM	Technical Meeting: Nuclear Data Library for Advanced Systems – Fusion Devices		Vienna
<u>November</u>					
06.11-09.11	Capote Noy	RCM	First Research Coordination Meeting on Heavy Charged-particle Interaction Data for Radiotherapy		Vienna
06.11-09.11	Capote Noy	CV	I. Pshenichov: advise at RCM (as above)	Johann Wolfgang Goethe University, Germany	Vienna
06.11-09.11	Capote Noy	CV	H. Palmans: advise at RCM (as above)	National Physical Laboratory (NPL), United Kingdom	Vienna

06.11-09.11	Capote Noy	CV	A. Ferrari: advise at RCM (as above)	European Organization for Nuclear Research (CERN)	Vienna
08.11-09.11	Dunaeva	CV	V. McLane: update EXFOR-related documentation and advise on the modified new CINDA system		Vienna
19.11-23.11	Mengoni	RCM	First Research Coordination Meeting on Minor Actinide Neutron Reaction Data		Vienna
19.11-23.11	Mengoni	CV	R. Reifarh: advise at RCM (as above)	Gesellschaft für Schwerionenforschung (GSI), Germany	Vienna
19.11-23.11	Mengoni	CV	Y. Nagai: advise at RCM (as above)	Osaka University, Japan	Vienna
26.11-30.11	Clark	CV	B. Lavrov: collaborate with IAEA A&M Data Unit on data for atomic and molecular hydrogen	St. Petersburg State University, Russia	Vienna
27.11-07.12	Capote Noy	CV	J.H. Quesada: update the OPTMAN code	Universidad de Sevilla, Spain	Vienna
28.11-07.12	Capote Noy	CV	E. Soukhovitski: update the OPTMAN code	Joint Institute for Power and Nuclear Research, Belarus	Vienna
<u>December</u>					
03.12-14.12	Abriola	CV	A. Gurbich: include data in the ENDF library, convert EXFOR-R33 files, perform IBANDL database maintenance	Institute of Physics and Power Engineering (IPPE), Russia	Vienna
10.12.-14.12	Capote Noy	RCM	Final Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of relevance to Non-energy Nuclear Applications (RIPL-3)		Vienna
10.12.-14.12	Capote Noy	CV	A. Ignatyuk: advise at RCM (as above)	Institute of Physics and Power Engineering (IPPE), Russia	Vienna
10.12.-14.12	Capote Noy	CV	M. Avrigneau: advise at RCM (as above)	Institutul de Fizica si Inginerie Nucleara "Horia Hulubei", Romania	Vienna

10.12.-14.12	Capote Noy	CV	M. Kumar: advise at RCM (as above)	Nuclear Power Corporation of India Ltd., Mumbai, India	Vienna
10.12.-14.12	Capote Noy	CV	T. Belgya: advise at RCM (as above)	Hungarian Academy of Sciences, Hungary	Vienna
17.12-18.12	Dunaeva	CV	S. Hlavac: status of EXFOR calculations	Institute of Physics, Slovak Academy of Sciences, Slovakia	Vienna
17.12-21.12	Capote Noy	CV	M. Herman: advise on development of EMPIRE system and its application to nuclear data evaluations	National Nuclear Data Centre, Brookhaven National Laboratory, USA	Vienna
17.12-21.12	Capote Noy	CV	M. Sin: discuss the application of the EMPIRE code for the calculation of fission cross sections of exotic fissile nuclei	Physics Dept., Bucharest University, Romania	Vienna

Scientific Papers and Publications 2006 and 2007**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; also published in Proc. Int. Workshop on Nuclear Data Needs for Generation IV Nuclear Energy Systems, World Scientific, Singapore, Ed: P. Rullhusen (2006) pp. 244-252, ISBN 981-256-830-1.

Measurement of $^{139}\text{La}(n, \gamma)$ cross section

by R. Terlizzi, R. Capote, A. Mengoni, *et al.*, presented at 12th Int. Symposium on Capture Gamma-Ray Spectroscopy and Related Topics, 4 - 9 September 2005, University of Notre Dame, USA; also published in AIP conference proceedings Vol. 819, Eds: A. Woehr and A. Aprahamian (2006) pp. 283-287.

Measurement of the resonance capture cross section of $^{204,206}\text{Pb}$ and termination of the s-process

by C. Domingo-Pardo, R. Capote, A. Mengoni, *et al.*, presented at 12th Int. Symposium on Capture Gamma-Ray Spectroscopy and Related Topics, 4 - 9 September 2005, University of Notre Dame, USA; also published in AIP conference proceedings Vol. 819, Eds: A. Woehr and A. Aprahamian (2006) pp. 288-292.

Neutron capture cross section measurements at n_TOF of ^{237}Np , ^{240}Pu and ^{243}Am for the transmutation of nuclear waste

by A. Mengoni, *et al.* (n_TOF Collaboration), presented at 12th Int. Symposium on Capture Gamma-Ray Spectroscopy and Related Topics, 4 - 9 September 2005, University of Notre Dame, USA; also published in AIP conference proceedings Vol. 819, Eds: A. Woehr and A. Aprahamian (2006) pp. 318-322.

International Atomic Energy Agency: Dedicated nuclear databases

by A.L. Nichols (invited paper), presented at a plenary session on "Advances in Nuclear Data Libraries", PHYSOR-2006, ANS Topical Meeting on Advances in Nuclear Analysis and Simulation, 10 - 14 September 2006, Vancouver, British Columbia, Canada; also published in proceedings PHYSOR-2006, ANS, Inc., Topical Meeting on Reactor Physics, ISBN: 0-89448-697-7, B113:1-10.

Measurement of the neutron capture cross section of ^{236}U

by F. Gunsing, R. Capote, A. Mengoni, *et al.*, presented at PHYSOR-2006, ANS Topical Meeting on Advances in Nuclear Analysis and Simulation, 10 - 14 September 2006, Vancouver, British Columbia, Canada; also published in proceedings PHYSOR-2006, ANS, Inc., Topical Meeting on Reactor Physics, ISBN: 0-89448-697-7, B072:1-9.

Measurement at n_TOF of the $^{237}\text{Np}(n, \gamma)$ and $^{240}\text{Pu}(n, \gamma)$ cross sections for the transmutation of nuclear waste

by A. Guerrero, R. Capote, A. Mengoni, *et al.*, presented at PHYSOR-2006, ANS Topical Meeting on Advances in Nuclear Analysis and Simulation, 10 - 14 September 2006, Vancouver, British Columbia, Canada; also published in proceedings PHYSOR-2006, ANS, Inc., Topical Meeting on Reactor Physics, ISBN: 0-89448-697-7, C032:1-10.

Measurement of the neutron capture cross section of ^{234}U in n_TOF at CERN

by W. Dridi, R. Capote, A. Mengoni, *et al.*, presented at PHYSOR-2006, ANS Topical Meeting on Advances in Nuclear Analysis and Simulation, 10 - 14 September 2006, Vancouver, British Columbia, Canada; also published in proceedings PHYSOR-2006, ANS, Inc., Topical Meeting on Reactor Physics, ISBN: 0-89448-697-7, C031:1-8.

n_TOF fission data of interest to GEN-IV and ADS

by C. Paradela, R. Capote, A. Mengoni, *et al.*, presented at PHYSOR-2006, ANS Topical Meeting on Advances in Nuclear Analysis and Simulation, 10 - 14 September 2006, Vancouver, British Columbia, Canada; also published in proceedings PHYSOR-2006, ANS, Inc., Topical Meeting on Reactor Physics, ISBN: 0-89448-697-7, B076:1-9.

Validation of ^{232}Th evaluated nuclear data through benchmark experiments

by A. Trkov and R. Capote, presented at Nuclear Energy for New Europe, 18 - 21 September 2006, Portoroz, Slovenia; also published in Proc. Int. Conf. on Nuclear Energy for New Europe, NSS, Slovenia, 2006, pp. 110.1-110.7.

Highlights from the coordinated research project on the thorium-uranium fuel cycle

by A. Trkov and R. Capote, presented at NEMEA-3, 3rd Workshop on Neutron Measurements, Evaluations and Applications, 25 - 28 October 2006, Borovets, Bulgaria; also published in European Commission Report EUR 22794 EN, Ed: A.J.M. Plompen (2006) pp. 43-48, ISBN 978-92-79-06158-5.

Modelling of nuclear data in the fast neutron region

by R. Capote, M. Sin and A. Trkov, presented at NEMEA-3, 3rd Workshop on Neutron Measurements, Evaluations and Applications, 25 - 28 October 2006, Borovets, Bulgaria; also published in European Commission Report EUR 22794 EN, Ed: A.J.M. Plompen (2006) pp. 13-18, ISBN 978-92-79-06158-5.

Neutron capture cross section of ^{232}Th measured at the n_TOF facility at CERN in the unresolved resonance region up to 1 MeV

by G. Aerts..., R. Capote, A. Mengoni, *et al.*, *Phys. Rev. C* **73** (2006) pp. 054610:1-10.

Measurement of the $^{151}\text{Sm}(n,\gamma)$ cross section from 0.6 eV to 1 MeV via the neutron time-of-flight technique at the n_TOF facility

by S. Marrone..., R. Capote, A. Mengoni, *et al.*, *Phys. Rev. C* **73**, (2006) pp. 034604:1-18.

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by S. Marrone, A. Mengoni, *et al.* (n_TOF Collaboration), pp. 502-504 in AIP Conference Proceedings, Vol. 831, Eds: S. V. Harissopoulos, P. Demetriou and R. Julin, College Park, American Institute of Physics (2006), ISBN 0-7354-0323-6.

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Resonance capture cross section of ^{207}Pb

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Optical spectroscopy of lowly ionized plasmas

by Ch. Berenguer, K. Katsonis, R.E.H. Clark, M. Cornille and M. Ganciu, Europhysics Conference Abstracts **30** (2006) p. 241.

Monte Carlo correction factors for a Farmer 0.6 cm³ ion chamber dose measurement in the build-up region of the 6 MV clinical beam.

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Neutron cross section measurements at n_TOF for ADS related studies

by P.F. Mastinu, R. Capote, A. Mengoni, *et al.*, *J. Phys.* **41** (2006) pp. 352-360.

Pulse shape analysis of signals from BaF₂ and CeF₃ scintillators for neutron capture experiments

by S. Marrone, E. Berthomieux, F. Becvar, D. Cano-Ott, N. Colonna, C. Domingo-Pardo, F. Gunsing, R.C. Haight, M. Heil, F. Kappeler, M. Krlicka, P. Mastinu, A. Mengoni, P.M. Milazzo, J. O'Donnell, R. Plag, P. Schillebeeckx, G. Tagliente, J.L. Tain, R. Terlizzi and J.L. Ullmann, *Nucl. Instrum. Methods Phys. Res.* **A568** (2006) pp. 904-911.

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Evaluation of neutron cross section data in the unresolved resonance region with a link to the optical model

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Activation product decay data: UKPADD6.7

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Heavy element and actinide decay data: UKHEDD2.5

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IAEA atomic and molecular data support for fusion energy research

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Atomic and nuclear data services of the International Atomic Energy Agency

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Uncertainty estimation in intensity-modulated radiotherapy absolute dosimetry verification

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Measurements of the half-life of ²⁴⁶Cm and the α-decay emission probabilities of ²⁴⁶Cm and ²⁵⁰Cf

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Approximated Lane consistency of the dispersive coupled channel potential for actinides

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EMPIRE: Nuclear reaction model code system for data evaluation

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International efforts to improve atomic and nuclear databases for energy and non-energy applications

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IAEA fusion activities and nuclear data support for innovative concepts

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The $^{139}\text{La}(n,\gamma)$ cross section: Key for the onset of the s-process

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Angular distributions of protons scattered by ^{40}Ar nuclei with excitation of the 2^+ (1.46 MeV) and 3^- (3.68 MeV) collective levels for incident energies of 25.1, 32.5, and 40.7 MeV

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Measurement of the neutron capture cross section of the s-only isotope ^{204}Pb from 1 eV to 440 keV

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Measurement of the neutron induced fission cross section on transuranic (TRU) elements at the n_TOF facility at CERN

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Assessment of fission product decay data for decay heat calculations

by M.A. Kellett, A.L. Nichols, O. Bersillon, H. Henriksson, R. Jacqmin, B. Roque, J. Katakura, K. Oyamatsu, T. Tachibana, T. Yoshida, A. Algora, B. Rubio, J.L. Tain, C.J. Dean, W. Gelletly, R.W. Mills, I.C. Gauld, P. Möller and A. Sonzogni, A Report by the Working Party on International Evaluation Co-operation of the NEA Nuclear Science Committee, Vol. 25, NEA/WPEC-25, OECD/NEA, Paris, 2007.

Mass chain evaluations for the Evaluated Nuclear Structure Data File (ENSDF) – An urgent appeal for European participation

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Exploring the reactor heat problem: Study of the beta decay of $^{104,105}\text{Tc}$ using the TAS technique

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The aims and activities of the International Network of Nuclear Structure and Decay Data Evaluators (invited)

by A.L. Nichols and J.K. Tuli, presented at International Conference on Nuclear Data for Science and Technology, 22 - 27 April 2007, Nice, France; to be published in the conference proceedings (2008).

Status and future work of the NEA Working Party on international nuclear data evaluation cooperation (invited)

by A.J. Koning, J. Katakura, P. Obložinský, A.L. Nichols, C. Nordborg, presented at International Conference on Nuclear Data for Science and Technology, 22 - 27 April 2007, Nice, France; to be published in the conference proceedings (2008).

The JEFF evaluated nuclear data project (invited)

by A.J. Koning, R.A. Forrest, M.A. Kellett, A.L. Nichols, *et al.*, presented at International Conference on Nuclear Data for Science and Technology, 22 - 27 April 2007, Nice, France; to be published in the conference proceedings (2008).

Nuclear data for the production of therapeutic radionuclides

by R. Capote, E. Betak, B.V. Carlson, *et al.*, presented at International Conference on Nuclear Data for Science and Technology, 22 - 27 April 2007, Nice, France; to be published in the conference proceedings (2008).

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Presentations

Transition probabilities of important multiplets

by K. Katsonis, M. Cornille, R.E.H. Clark, J. Abdallah Jr., Ch. Berenguer and A.Ndiayé;

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A collisional – radiative model for Ar I to Ar VI spectra diagnostics

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by A. Mengoni, presented at NEMEA-3, 3rd Workshop on Neutron Measurements, Evaluations and Applications, 25 - 28 October 2006, Borovets, Bulgaria.

Atomic and nuclear data for all

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Material demand for fusion power plants: IAEA projects, initiatives and databases

by R.E.H. Clark, G. Mank, N. Dytlewski, D. Humbert, A. Malaquias, A. Mengoni, F. Mulhauser, A.L. Nichols and A. Stanculescu, presented at Workshop on Structural Materials for Innovative Nuclear Systems (SMINS), 4 - 6 June 2007, Karlsruhe, Germany.

Nuclear physics and astrophysics at CERN n_TOF

by A. Mengoni, *et al.* (n_TOF Collaboration), International Nuclear Physics Conference (INPC) – 2007, Tokyo, Japan, 3 - 8 June 2007.

NDS Publications in 2006 and 2007

Series and No.	Titles
Periodicals	Bulletin on Atomic and Molecular Data for Fusion N ^{os} 64, 65 and 66
Newsletter	Nuclear data newsletter N ^{os} 41, 42, 43 and 44
INDC(NDS)-0478	Summary Report of the Technical Meeting on Nuclear Data for the International Fusion Materials Irradiation Facility (IFMIF)
INDC(NDS)-0479	Summary Report of the 1 st Research Coordination Meeting on Updated Decay Data Library for Actinides
INDC(NDS)-0480	Report of the Technical Meeting of the Network of Nuclear Reaction Data Centres
INDC(NDS)-0492	Summary Report of the 2 nd Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-Energy Nuclear Applications
INDC(NDS)-0493	Resolution Broadening of Measured Leakage Spectra from IPPE Spheres
INDC(NDS)-0494	Summary Report of the 3 rd Research Coordination Meeting on Evaluated Nuclear Data for Th-U Fuel Cycle
INDC(NDS)-0495	Summary Report of the 2 nd Research Coordination Meeting on Tritium Inventory in Fusion Reactors
INDC(NDS)-0496	Addendum 2006 -Workshop on Nuclear Structure and Decay Data: Theory and Evaluation (on Web only)
INDC(NDS)-0497	Report of the IAEA Nuclear Data Section to the INDC for the period January 2004 - December 2005
INDC(NDS)-0498	Summary Report of the Consultants' Meeting, IAEA International Database on Irradiated Nuclear Graphite Properties, 8 th Meeting of the Technical Steering Committee
INDC(NDS)-0499	Summary Report of the 2 nd Consultants' Meeting on Beta Decay and Decay Heat
INDC(NDS)-0500	Quality Assurance for the IAEA International Database on Irradiated Nuclear Graphite Properties (on Web only)
INDC(NDS)-0501	Summary Report of the 3 rd Research Coordination Meeting on Nuclear Data for the Production of Therapeutic Radionuclides
INDC(NDS)-0502	Handbook of Nuclear Data for Safeguards
INDC(NDS)-0503	Report of the Technical Meeting of the Network of Nuclear Reaction Data Centres
INDC(NDS)-0504	Summary Report of the Consultants' Meeting on Nuclear Data of Charged-Particle Interactions for Medical Therapy Applications

INDC(NDS)-0505	Summary Report of IAEA Workshop: Atomic and Molecular Data for Fusion Energy Research
INDC(NDS)-0506	Summary Report of the Technical Meeting: 15 th Meeting of the IFRC Subcommittee on Atomic and Molecular Data for Fusion
INDC(NDS)-0507	Summary Report of the Consultants' Meeting, Review the Requirements to Improve and Extend the IRDF library (International Reactor Dosimetry File (IRDF-2002))
INDC(NDS)-0508	Summary Report of the 2 nd Research Coordination Meeting on Updated Decay Data Library for Actinides
INDC(NDS)-0509	Summary Report of the Consultants' Meeting, IAEA International Database on Irradiated Nuclear Graphite Properties
INDC(NDS)-0510	Summary Report of the Consultants' Meeting on XML Schema for Atomic and Molecular Data
INDC(NDS)-0512	Summary of the Consultants' Meeting on Minor Actinide Nuclear Reaction Data (MANREAD)
INDC(NDS)-0513	Summary Report of the Technical Meeting: Coordination of the International Network of Nuclear Structure and Decay Data Evaluators
INDC(NDS)-0515	Summary Report of the 2 nd Research Coordination Meeting on Atomic and Molecular Data for Plasma Modelling
INDC(NDS)-0516	Summary Report of the Final Research Coordination Meeting on Tritium Inventory in Fusion Reactors
INDC(NDS)-0517	Summary Report of the Technical Meeting: Assessment of Atomic and Molecular Data Priorities
INDC(NDS)-0518	Summary of the Consultants' Meeting on Core Concentrations of Hydrogen Isotopes and Light Elements in Burning Plasmas
INDC(NDS)-0519	Report of the Technical Meeting of the Network of Nuclear Reaction Data Centres
INDC(NDS)-0524	Summary Report of the Final Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Nuclear Applications (RIPL-3)

<u>Report</u>	<u>Country of Origin</u>	<u>Numbers of Reports</u>	<u>Total Reports</u>
INDC(ITY)	Italy	0013, 0014	2
INDC(CCP)	Russian Federation	0443, 0444, 0445	3
INDC(UK)	United Kingdom	0090, 0091	2

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