INDC International Nuclear Data Committee

**Report of the IAEA Nuclear Data Section to the
International Nuclear Data Committee for the period
January 2008 – December 2009**

Edited by

Daniel H. Abriola and Robin A. Forrest
IAEA Nuclear Data Section
Vienna, Austria

April 2010

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Abstract

This report contains details of the main activities of the IAEA Nuclear Data Section (NDS) during 2008 and 2009, and is provided as information to the International Nuclear Data Committee (INDC). NDS staff and affiliated consultants have focused their work on analysing and fulfilling data development needs and ensuring adequate, trouble-free services to all users in Member States. The present 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 Atomic and Molecular Data for Fusion Subcommittee of the International Fusion Research Council.

April 2010

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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 Intézete (Institute of Nuclear Research, Hungary)
BARC	Bhabha Atomic Research Centre, India
CCN	Code Centre Network
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
NRDF	Nuclear Reaction Data File
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	IAEA 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 Pointwise Cross-Section Library series, based on ENDF/B
PREPRO	ENDF 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	Ukranian 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 high quality atomic and nuclear data to Member States of the International Atomic Energy Agency, covering both energy and non-energy related applications. The Section is comprised of three 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 1.4.1 are combined, along with other related support activities during 2008–2009. 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 IAEA 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 workshops organized and sponsored by the Section, while Appendix II summarizes all of the various publications during 2008–2009.

Robin A. Forrest
IAEA Vienna, Austria
April 2010

Nuclear Data Section

Organization Chart
(March 2010)

Section Office (and INDC Secretariat)

Section Head: **R.A. Forrest**
Nuclear Data Physicist
(21709/21710)

Deputy Section Head: **D.H. Abriola**
Nuclear Data Physicist
(21712/21711)

Section Secretary: **L. Vrapcenjak**
(21710)

Nuclear Data Services Unit	Nuclear Data Development Unit	Atomic & Molecular Data Unit
_____ Unit Head (21717)	**D.H. Abriola** Unit Head (21712)	**B.J. Braams** Unit Head (21731)
V. Zerkin Software Engineer (21714)	**R. Capote Noy** Nuclear Physicist (21713)	**W.M. Costello** (IT Systems Analyst) (21724)
S. Dunaeva Nuclear Physicist (21727)	**M.A. Kellett** Nuclear Physicist/Programmer (21708)	**H.-K. Chung** Atomic Physicist (21729)
N. Otsuka Nuclear Data Physicist (21715)	**K. Nathani** Clerk (21711)	_____ Systems Analyst/Programmer (21723)
J. Roberts Nuclear Data Services Assistant (21725)		**K. Sheikh** Database Assistant (21730)
A. Oechs Clerk (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 with a continuous zero real growth budget that constitutes a small annual increase to accommodate inflation. The authorized staff level of the Nuclear Data Section (NDS) for 2008–2009 was effectively a total of 17.25, consisting of 12 professionals (P-staff) and 5.25 support staff (G-staff).However, 2009 has been a year with an unusually high turn over of personnel, causing the actual staff level to dip. The former four informal units of the Nuclear Data Section have been transformed into three official units shown on the Organisation Chart, with the former Systems Development Unit led by Liam (W.M.) Costello being absorbed into the Atomic and Molecular Data Unit (AMDU).

Alan Nichols retired as Section Head on 30 April 2009 and was succeeded by Robin Forrest on 6 July 2009. The Unit Heads have been:

- Robert Clark AMDU (retired 31 July 2009), succeeded by Bastiaan Braams (1 September 2009);

- Alberto Mengoni, Nuclear Data Services Unit (NDSU) (resigned 30 June 2009), position still vacant;

- Daniel Abriola, Nuclear Data Development Unit (NDDU),

of which those in post at the end of 2009 have contributed to this report.

There have been four other changes in the staff during the reporting period:

- Denis Humbert (final contract ended 29 September 2009), succeeded by Hyun Chung (1 October 2009).

- Marco Verpelli (resigned 31 December 2009), position still vacant.

- Georgina Bush (retired 31 December 2009), succeeded by Janet Roberts (4 January 2010).

- Lidija Vrapcenjak (4 January 2010) replacing Janet Roberts as Section Secretary.

In addition Vladimir Pronyaev was contracted for six months as a consultant to provide technical support during the recruitment of a new NDSU Head.

The budget and costs of NDS are outlined in Table 1 in Euro (2009 prices). Staff costs have been analysed 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 departures and the ensuing replacement exercises in 2009–2010 also caused minor fluctuations in the administrative and sub-programme costs.

Table 1. Staff and budget - summary for 2007–2011 (derived from PROBIS).

	2007	**2008**	**2009**	**2010**	**2011**
Authorized Staff Level	17.25	17.25	17.25	17.25	17.25
Actual Staff Level	17.25	17.25	16.50	16.05	17.25
Admin. + Agency O/H Support Costs(€)	934 037	872 344	875 507	814 387	814 387*
Technical Programme(€)	1 531 180	1 660 609	1 679 380	1 813 929	1 904 609*
Total (€)	2 465 217	2 532 953	2 554 887	2 628 316	2 718 996*

*uncertain figures

2. NUCLEAR DATA COMPILATIONS

2.1. EXFOR and Dictionaries

The EXFOR master file is produced by NDS on a regular basis for use with retrieval software 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 compilations (TRANS files) produced during the period under consideration. The ability to use a unique file for common applications facilitates the updating of the database, which needs to be done on a single file only.

During 2008–2009, NDS staff distributed 13 CPND TRANS files (D059–D071), containing 287 new entries (147 compiled at NDS, 41 at ATOMKI, 23 at UkrNDC, 74 by Indian compilation group, two at KAERI) and 146 revised entries, 18 neutron TRANS files (3125–3143) containing 112 new (79 compiled at NDS, 16 UkrNDC, 14 in India, three at KAERI) and 1012 revised entries, two photonuclear TRANS files (G017–G018) containing 16 new (15 compiled at UkrNDC, one in India) and one revised entry, three TRANS files (Y005–Y007) containing 97 revised entries from various areas.

The EXFOR coverage control system, which was introduced in 2006, has proved to be of immense help in reducing compilation time. During 2009, NRDC compiled 71% of the articles published in 2009 (same year), showing a gradual increase in the compilation ratio compared to the years 2000, 2006 and 2008 of 20%, 34% and 52% respectively.

The compilations consist of new literature as well as important old references for Coordinated Research Projects. A collection of EXFOR-relevant papers in PDF-format has been initiated for internal use and presently includes about 12,000 articles which were either found on the Internet or have been scanned from hardcopies.

178 TRANS files were received, checked (with feedback to the originating centres) and processed in 2008–2009, of which 158 were final versions that were added to the master file. All TRANS files were double-checked before being added to the EXFOR master file. These final transmissions contained 1975 neutron entries (323 new, 1652 revised), 1791 CPND entries (1114 new, 677 revised) and 198 photonuclear entries (74 new, 124 revised).

NDS staff produced and distributed four regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9096–9099) in EXFOR, DANIEL (backup) and archive format. A Dictionary database (in MS-Access) was created and regularly distributed as part of the EXFOR-Editor software.

Numerous significant, as well as less important, corrections were made in EXFOR. These corrections included simple tasks, such as change of upper case entries to lower case in EXFOR entries compiled by NDS, as well as minor corrections made directly to the EXFOR master file by NDS (with originating centres informed accordingly). Within this framework NDS finished retransmission of all old entries which required changing letters from upper case to lower case, as well as years from two digits to four digits. Revisions also included corrections to ensure conformity with the new EXFOR rules and the addition of information from various articles. Approximately 1800 entries have been retransmitted during the last three years; a task fulfilled by two centres – Sarov (Russia) and NDS.

The process of EXFOR compilation is made more efficient by the use of a stand-alone local database (EXFOR coverage control system). Under this system, NDS staff scan over 90 journal titles (mainly through the Internet) for the purpose of EXFOR compilation coverage and control. All articles missing in EXFOR were dispatched to the responsible centres for compilation, together with hardcopies of the papers if necessary. The list of new articles as

generated by the EXFOR coverage control system was used to monitor the compilation process. The new article list is regularly updated (weekly).

For a one-year trial period (2009), NNDC was fully responsible only for the compilation of articles published in four US journals (Physical Review C, Physical Review Letters, Nuclear Science and Engineering, Canadian Journal of Physics) and AIP Conference Proceedings. This was undertaken in accordance with a strong request from NNDC, albeit contrary to the views of the other centres. Approximately 60% of the published articles covered in this trial actually report results of experiments performed outside North America. Authors of these US journal articles often publish their preliminary data in laboratory reports, conference proceedings or domestic journals, and then publish their full articles in the US journals, as a result, it was observed that a considerable number of experiments were compiled twice, i.e., by the regional centre and by NNDC, since a measurement could have been compiled by the regional centres from laboratory reports, conference proceedings or domestic journals prior to its publications in a US journal.

Consequently, the outcome of the one-year trial has been perceived negatively by NDS because:

- NDS has to check carefully all compilations from NNDC for non-US data published in US journals;

- NDS has to reach agreement with centres regarding the entry when duplication occurs;

- Centres expend manpower for compilation of the same data twice or more;

- Centres lose strong connections to experimental sites in their areas.

In several duplications, regional centres had received numerical data from authors whereas the NNDC compiler digitized numerical data from figures. This indicates an advantage in the assignment of compilation responsibility by area of experimental sites, rather than journal publication area, which has functioned well for the past forty years of compilation. Furthermore, on the basis of the rule introduced in 2004, and in agreement with NDS, centres may compile articles from any area which, after three months, have still not been allocated for compilation.

Consequently, the recommendation of NDS will be made to the NRDC meeting in April 2010 to return to the previous assignment of responsibilities based on the location of the experimental site.

2.2. CINDA

The CINDA database was extended by information automatically imported from EXFOR (seven updates), by manual input from NEA (two updates) and by NDS (three updates). Algorithms and procedures for the CINDA extension were agreed and further developed in collaboration with NEA-DB. All information and exchange files are available on the NDS web site. A file of the whole database (SyBase and MySQL) was regularly produced and sent to NNDC.

3. NUCLEAR DATA SERVICES

3.1. Web-based services and software

The main links to provide services are continuously updated on the NDS web sever (http://www-nds.iaea.org/). An improved version of the NDS front page has been developed

and implemented. Additional tuning and improvements have been implemented in the EXFOR/CINDA/ENDF retrieval systems with advanced plotting and new output formats. The NDS web-based retrieval system is also successfully operating at the NNDC in Brookhaven. The ENDF retrieval system has been extended to include data from thirteen evaluated libraries. Two new types of web services were introduced: ENDF-Explorer and ENDF-Archive. New plotting features and services based on ZVView-2 were introduced.

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

- New NDS web front page was developed: this has a compact, modern view, with application oriented layout using advanced maintenance technology. Common web tools were developed allowing NDS staff to easily create pages in the new *standard* layout.

- ENDF web retrieval interface has been extended to include:
  - TENDL-2009: TALYS-based Evaluated Nuclear Data Library 2009
  - ROSFOND-2008: neutron library, 683 materials, Obninsk, Russia, 2008
  - TENDL-2008: TALYS-based Evaluated Nuclear Data Library 2008
  - FENDL-2.1: Fusion Evaluated Nuclear Data Library 2004
  - JENDL/HE-2007: High Energy File 2007
  - JENDL/AC-2008: JENDL Actinoid File 2008
  - JENDL/AN-2005: (Alpha,n) Reaction Data File 2005
  - JENDL/G-2005: Photoreaction Data File 2005
  - JENDL/HE-2004: High Energy File 2004
  - MENDL-2: Medium Energy Nuclear Data Library, 1995–1998
  - MINKS-ACT: Minsk Actinides Library (Maslov *et al*.,)
  - Wind: Library for U, Np, Pu, Obninsk, Russia
  - Yavshits: neutron, proton induced fission for Pb-Pu (20–200 MeV), St.Petersburg, Russia

- Processing ENDF-MF33 with visualization of covariance matrices were added to the ENDF web interface (includes 3D animation, cross-reaction and cross-material correlations, relative and absolute cross-section uncertainties).

- New EXFOR output format X4± (interpreted interactive web tree) was developed; the database structure was extended and web-search by outgoing particles provided; remote EXFOR uploading system was released to NRDC compilers including checking on web and comparison with existing data. Export from web - EXFOR to R33 (format for presentation of angular distributions used by Ion Beam Analysis community) was significantly improved. Draft version of EXFOR-XML representation was developed. A correction system for experimental data in computational formats was introduced.

- Flexible ENDF-Explorer was released; this provides sequential data browsing using a tree representation of data from the database.

- ENDF-Archive: collection of evaluated data libraries for direct download (37 libraries).

- Web-based extended plotting system that provides graph of ratios and ratios converted to cross-sections, correction of experimental data and plotting of production cross-sections coded in MF5 and MF6 sub-sections.

- ZVView package was extended to work with two-dimensional arrays including map-presentation and 3-D animation; Linux/Windows/Mac versions have been released; it has also been adopted for use in the EMPIRE code package.

- Web-ZVView was developed and released allowing remote plotting via the web on server side without downloading the actual program.

- EXFOR-CINDA dictionaries database has been prepared and regularly updated.

- Full EXFOR in C4 computational format was regularly produced (quarterly) and delivered to WPEC Subgroup 30.

- Web pages for support management of EXFOR compilation activity were regularly updated and further developed.

3.2. NDS electronic document project and CD-ROM based services

Status of NDS electronic document project

While the compilation of an electronic library comprising all documents produced by the IAEA pertaining to Nuclear Data Services continues, i.e. by scanning reports which presently only exist on microfiche or in original paper form, although the project progresses rather slowly. The largest country series, INDC(CCP), INDC(JAP), INDC(JPN) and INDC(NDS), have been completed and all documents are available on the main NDS web server. Working alphabetically, documents from other country series, i.e., A to E, have been converted to PDFs and, over the last two years, another 389 electronic documents have been created, representing approximately 15% of the total, for a cumulative total of 59% complete. These are now in the process of being loaded to the main NDS web server. Work is being undertaken in cooperation with INIS staff who have suitable equipment and expertise to handle microfiche and original texts. A batch of documents covering F to G has now been forwarded to INIS for conversion. However, the more urgent demand on their services by other offices of the IAEA means the NDS scanning project has low priority. Consequently, in order to accelerate completion of the project, the possibility of continuing this work within the Nuclear Data Section itself is being looked into, i.e., would the quality of the electronic document produced on available NDS equipment be of an acceptable standard?

Table 2. Electronic documents.

Note: Italics indicates documents currently with INIS, Bold indicates documents still to do. A column "End 2009 to be put on Web" indicates documents which have been scanned by INIS but which still need to be loaded to the NDS server – this work also needs quite a lot of time as for each document the reference/title/authors have to be completed.

Country	End 2007 Scanned	End 2007 Pending	End 2009 Scanned	End 2009 to be put on Web	End 2009 Still to be Scanned	Remarks
ARG	0	13	13	0	0	completed
AUL	10	34	34	0	0	10 never published
AUS	3	15	15	0	0	completed
BAN			4	0	0	completed
BLG			1	1	0	completed
BLR	20	0	0	0	0	completed 2007
BOL	1	0	0	0	0	completed 2007
BUL	2	14	14	0	0	completed
BZL			33	0	0	completed; 2 never published
CAN			14	0	0	7 missing/not published
CCP	424	154	154	0	0	completed, 6 missing/never published

Code						Notes
CHL			3	0	0	completed
CND			8	0	0	completed; 1 missing/not published
CPR	4	56	26	0	0	1-26, 28,29,31,31 missing
CSR	0	16	16	0	0	completed
CUB	0	7	7	0	0	completed
CZR	1	0	1	0	0	only 1 document
DEN	0	4	1	0	0	completed; 3 documents missing
EANDC	0	3	5	5	0	1 missing
EGY	0	7	7	0	0	completed
ENEA	0	3	2	0	0	completed
EUR	0	31	29	0	0	completed; 4 missing
FR	0	*72*			72	*July 2009 given to INIS*
GDR	0	*50*			50	*for scanning, job not yet started*
GER	0	*50*			50	*due to other higher priorities*
GRC	0	**3**			3	
HUN	4	**32**			32	
IAE	0	**41**			41	
IBW	0	**1**			1	
IND	1	**45**			45	
IRN	0	**4**			4	
IRQ	0	**1**			1	
ISL	0	**5**			5	
ITY	3	**9**			9	
JAP	78	**5**			0	completed
JPN	26	**168**			0	completed
KOR	0	**5**			5	
KWT	0	**2**			2	
MOR	0	**3**			3	
NDS	486	**0**			0	completed
NEA	0	**10**			10	
NED	0	**10**			10	
NOCODE	1	**23**			23	
NOR	0	**3**			3	
PAK	0	**13**			13	
POL	0	**14**			14	
PRT	0	**3**			3	
ROM	0	**22**			22	
SAF	0	**11**			11	
SEC	2	**103**			103	
SLK	0	**2**			2	
SLN	0	**2**			2	
SPN	0	**5**			5	
SUD	0	**4**			4	
SWD	0	**23**			23	
SWT	0	**16**			16	
TAI	0	**4**			4	
TUK	0	**6**			6	
UK	1	**89**			58	Nos. 59-88 not used
UKR	1	**7**			7	
UNI	0	**7**			7	
USA	2	**105**			105	
VN	1	**10**			10	
YUG	0	**11**			11	
Total	1071	1373	389			
To complete	44%		59% *			

* Based on total numbers of reports counted in 2007.

CD-ROM Services:

- CD-ROM "EXFOR-CINDA Database and Retrieval System for Windows" issued three times;
- CD-ROM "ENDVER/GUI" for Linux/Windows/Mac: two issues;

- CD-ROM "EXFOR-CINDA for Applications" for Linux/Windows/Mac: two issues.

In total 2722 PC media (CD-ROMs and DVDs) were delivered as well as 589 hardcopy documents.

3.3. Statistics

Full statistics of usage of the web retrieval system is presented in Fig. 1.
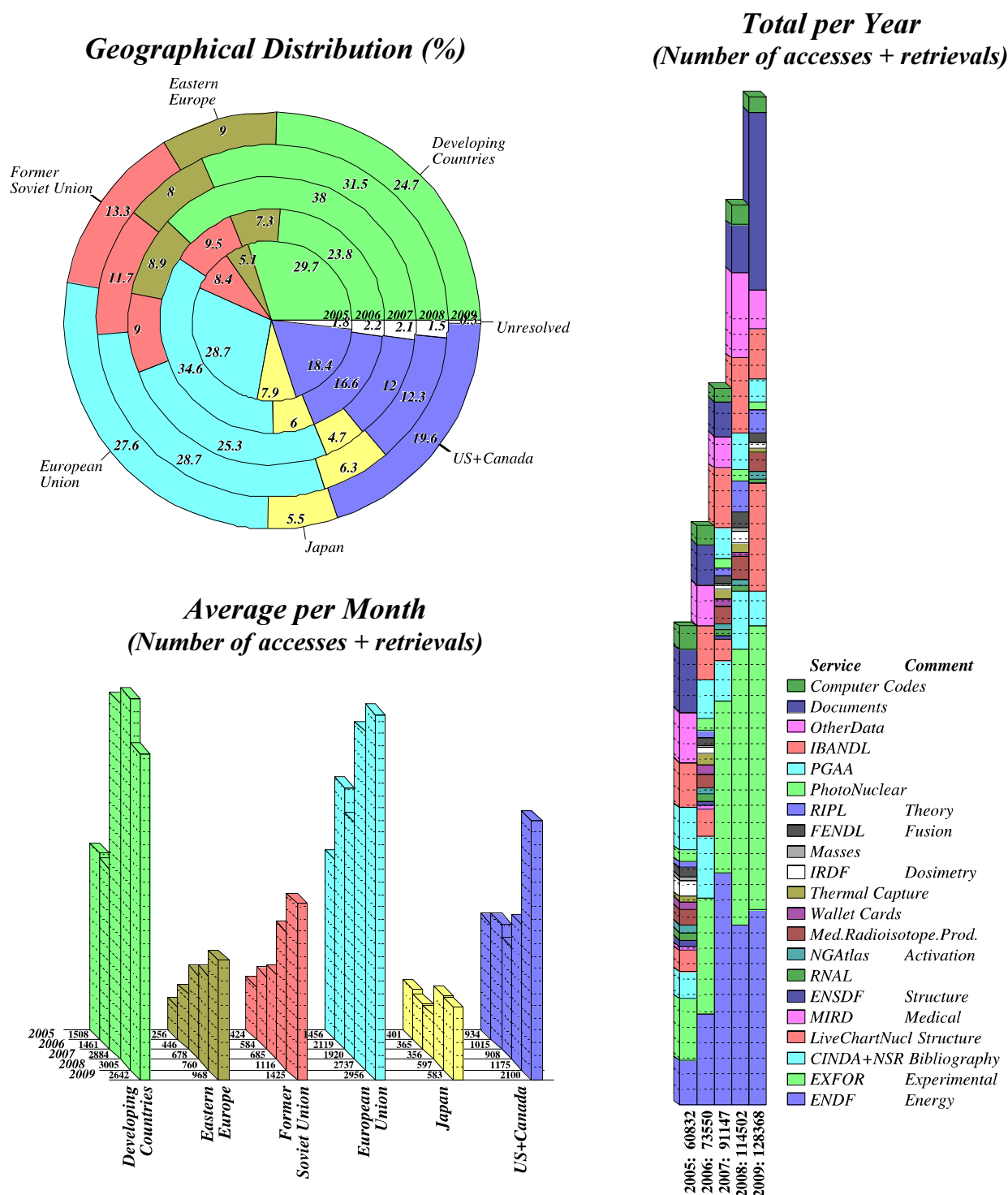
Fig. 1. Nuclear data access and retrievals from IAEA-NDS, IPEN (Brazil) and BARC (India) 2005–2009.

Various representations of user access to the IAEA 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 26% and 12% in 2008 and 2009 respectively, in comparison to the previous year. This increased demand arises mainly from customers for ENDF, EXFOR and the LiveChart databases. A noteworthy feature is that while the number of queries from the USA and Canada shows a dramatic increase of 60% during 2009, the corresponding number for developing countries shows a decrease of 22%.

4.   NETWORK COORDINATION

4.1.   International Network of Nuclear Reaction Data Centres (NRDC)

NDS assists the International Network of Nuclear Reaction Data Centres by organising their annual coordination meetings. This network includes four core nuclear data centres, and ten 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 of the International Network of Nuclear Reaction Data Centres was held at IPPE, Obninsk, Russia, from 22–25 September 2008 (INDC(NDS)-0536). This combined meeting was attended by 24 participants from 12 cooperating data centres from six Member States and two international organizations. Main topics were the introduction of new staff at several data centres, updates to the EXFOR/CINDA dictionaries, and intensified quality control in collaboration with the NEA WPEC Subgroup 30, as well as improved checking and correction procedures based on feedback and taking into account the needs of data evaluators. The EXFOR Editor software was presented and recommended for use in all EXFOR compilations. 38 working papers were presented at the meeting, and the results of the discussions were summarized as 26 Conclusions and 65 Actions.

The Technical Meeting of the International Network of Nuclear Reaction Data Centres was held at the IAEA in Vienna, Austria, from 25–29 May 2009 (see INDC(NDS)-0558). The meeting was attended by 23 participants from 13 cooperating data centres from eight Member States and two international organizations. Main topics were EXFOR quality control, with additional input from NEA-DB's JANIS system, EXFOR compilation completeness and transmission statistics together with first experiences of the modified distribution of compilation responsibilities, updates to the EXFOR/CINDA dictionaries, new formats for reporting experimental uncertainties, covariance and bibliographic information, compilation software including a new EXFOR Wizard and digitizing software. 31 working papers were presented at the meeting and the results of the discussions were summarized as 19 Conclusions and 57 Actions.

Bilateral visits:

- S. Hlavac, Institute of Physics, Slovak Academy of Sciences to NDS. Status of EXFOR compilations and adoption of EXFOR Editor software for digitizing figures, and procedures for information exchange.
  23 April 2008.

- V. McLane, (ex-NNDC) to NDS. Correction of old EXFOR entries according to new Exchange Format rules; preliminary processing and discussions on new REACTION code format.
  20–24 October 2008;
  28 September–9 October 2009.
- G. Pikulina, Russian Federal Nuclear Centre, All Russian Scientific Research Institute of Experimental Physics (VNIIEF), Russia to NDS. Install improved version of EXFOR-Editor.
  24–28 November 2008;
  25–29 May 2009.
- S. Taova, Russian Federal Nuclear Centre, All Russian Scientific Research Institute of Experimental Physics (VNIIEF), Russia to NDS. Install improved version of EXFOR-Editor, check functionality and compatibility with NDS Dictionary database; discuss further plans for the development of next version of EXFOR-Editor.
  24–28 November 2008;
  25–29 May 2009.
- P. Vorona, Institute for Nuclear Research, Kiev, Ukraine to NDS. Status of EXFOR compilations; appropriate software (EXFOR-Editor) to undertake agreed tasks for internationally-supported EXFOR database.
  15–19 December 2008.
- V. Varlamov, Russian Federation Institute of Nuclear Physics, Moscow State University to NDS. Extended functionality of EXFOR Editor 2.2 and DATA Editor 1.2; future development of digitizing programs.
  25–29 May 2009.
- H. Noto, School of Economics, Hokusei Gakuen University, Sapporo, Japan to NDS. Charged-particle nuclear data compiled in Nuclear Reaction Data File (NRDF) but not in EXFOR and translate NRDF data files missing in EXFOR into EXFOR format.
  1–30 August 2009.
- N. Otsuka (IAEA-NDS) to Japan Nuclear Reaction Data Center (JCPRG). Improvement of EXFOR utilization software.
  16–20 March 2009.
- N. Otsuka (IAEA-NDS) to Hokkaido University, Sapporo. Translation of experimental data from NRDF to EXFOR.
  20–24 March 2009.
- N. Otsuka (IAEA-NDS) to Korea Atomic Energy Institute (KAERI). Technical assistance for compilation and utilization of future EXFOR compilations.
  8–10 December 2009.
- V. Zerkin (IAEA-NDS) to JCPRG. Visit database handling facilities and discuss interests and problem solving towards improvement of EXFOR utilization software.
  16–20 March 2009.
- V. Zerkin (IAEA-NDS) to NNDC. Develop software for the management and web-retrieval of ENDF, CINDA and EXFOR relational databases.
  13 July–7 August 2009.

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

Biennial meetings of the International Network of Nuclear Structure and Decay Data Evaluators (NSDD) are funded and organized under the auspices of NDS. A meeting of the NSDD network was held at the IAEA Vienna, Austria, 23–27 March 2009 (INDC(NDS)-0559). This meeting was attended by 22 scientists from 14 Member States involved in the compilation, evaluation and dissemination of nuclear structure and decay data. The Network

strongly endorsed the training Workshop ENSDF-2009 in Bucharest and the sponsorship of NSDD Evaluators' workshops at the ICTP, Trieste, Italy, with a further one-week workshop scheduled for 11–15 October 2010. This last workshop, however, will be a hosted activity at ICTP meaning that the cost, administration and organization will be the responsibility of NDS. Evaluation centres within NSDD are providing mentoring support to new ENSDF evaluators of mass chains, and NDS is supporting this with "seed" contracts for new mass-chain evaluators and also for horizontal evaluations such as atomic masses and nuclear moments.

Participants discussed a wide range of technical matters, including recommendations to improve the quality of NSDD evaluations. A list of actions was also prepared for implementation during the course of the next two years. NSDD members prepared recommendations for implementation by NDS and the major evaluation centres, which are aimed at improving financial and technical support towards the Network. These recommendations include: the development of stronger links and understanding between key financial organizations and research facilities; planning of the IAEA and the ICTP workshops designed to train new NSDD evaluators; support by the major NSDD centres of the evaluation work undertaken by new groups through mentoring; and maintenance of the list of horizontal evaluations required by users or covered by on-going activities.

NDS staff will continue to assist in keyword preparation for the Nuclear Science References database (NSR), and 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:

- B. Pritychenko, NNDC to NDS. Install and load NSR database on NDS MySQL database server, discuss NSR compilations and revise technical procedures. 22–29 November 2009.
- D.H. Abriola (IAEA-NDS) to NNDC. Attendance at CSEWG and USNDP meetings, and carry out ENSDF work. 23 October–7 November 2008.
- D.H. Abriola (IAEA-NDS) to NNDC. Attendance at CSEWG and USNDP meetings, and carry out ENSDF work. 22 October–6 November 2009.
- M.A. Kellett (IAEA-NDS) to CEA. Visit LNHB concerning automatic extraction of data tables from the SAISINUC database. 6–8 April 2009.

5. ATOMIC AND MOLECULAR DATA

The primary role of the Atomic and Molecular (A+M) Data Unit (AMDU) is to provide atomic, molecular and plasma-material interaction (PMI) data relevant to fusion energy. The AMDU develops and maintains bibliographical (AMBDAS) and numerical (ALADDIN) databases. Coordinated Research Projects (CRPs) are organized to encourage worldwide collaboration in the production and validation of new data. Once every two to three years the AMDU organizes a summer school to train young researchers in the field of A+M/PMI data for fusion. The AMDU is also involved in the development of standards for exchange of A+M and PMI data. In its work the AMDU is advised by the Subcommittee on Atomic and Molecular Data of the International Fusion Research Council (IFRC). Priorities for data evaluation are also assessed by the Data Centre Network (DCN), an international

collaboration among the principal A+M data centres that is coordinated by the AMDU, and by the IAEA Technical and Consultants' Meetings on atomic and molecular data for fusion. The IFRC Subcommittee on Atomic and Molecular Data and the Data Centres Network each meet biennially, in alternate years.

5.1. Coordinated Research Projects

The AMDU is currently managing three CRPs of which one is to be completed in 2010; one new CRP will commence this year.

The CRP on Data for Surface Composition Dynamics Relevant to Erosion Processes (2006–2010) will have its third and final Research Coordination Meeting (RCM) in September 2010. This CRP was organized to increase understanding of erosion and redeposition processes in fusion devices and to study the associated changes over time in properties of the wall materials. A primary concern of this CRP is the dynamics of a wall of mixed materials, such as the C-Be-W wall that is planned for ITER and that is now being introduced into JET. Processes of interest include physical sputtering, reflection, and various chemical reactions.

The CRP on Characterization of Size, Composition and Origins of Dust in Fusion Devices (2008–2013) will hold its second RCM in June 2010. Formation of dust by erosion processes is of increasing importance for long-pulse fusion experiments. In ITER and in a fusion reactor the dust is likely to absorb tritium, and it may also be toxic and pose a fire risk if released in an accident. Dust particles can also become electrically charged and interact with the plasma and electric fields, degrading the performance of the fusion device. The overall objective of this CRP is the accumulation of new scientific knowledge on dust to address these important issues for fusion research.

The first RCM of the new CRP on Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions (2009–2013) took place from 18–20 November 2009. Light elements are the dominant impurity species in fusion research devices. The CRP will generate new data on processes including excitation, ionization, recombination and heavy particle collisions for ions of hydrogen, helium, lithium, beryllium, boron, carbon, nitrogen and oxygen and molecules of these atoms. The interest of the CRP is primarily in processes that take place in the cool near-wall region of fusion devices, where the ions are not fully stripped of electrons and where even molecular processes are of interest.

For each RCM a summary report is produced and these may be found on the AMDU web pages via the link http://www-amdis.iaea.org/CRP/.

The Committee on Coordinated Research Activities has approved a new CRP on Spectroscopic and Collisional Data for Tungsten from 1 eV to 20 keV, and this is scheduled to have its first RCM in the last quarter of 2010. Tungsten is the leading candidate for use as the wall material in the regions of high heat and particle flux in a fusion reactor and in ITER. However, as an impurity in the plasma, tungsten poses severe problems due to its high radiation efficiency. Its properties as a wall material and as an impurity are of great interest and are the subject of present fusion experiments and of numerical simulation. The proposed CRP will generate fundamental experimental and calculated data for radiative and collisional atomic processes involving tungsten ions interacting with the plasma. The output of the CRP will support the interpretation of spectroscopic measurements on current and future fusion experiments, the modelling of tungsten in fusion plasma, and the design and optimization of fusion reactor experiments, and will advance the fusion energy research effort.

5.2.   Coordination of A+M Data Centre Network and Code Centre Network

The Data Centre Network (DCN) consists of twelve members from the USA, Russian Federation, Japan, France, Germany, Italy, China and the Republic of Korea. The DCN meets every two years to discuss data needs and coordinate activities. The most recent meeting took place in September 2009 at the IAEA Vienna, Austria. The list of data needs and priorities was reviewed and updated (details are available on the AMDU home page http://www-amdis.iaea.org/).

The Code Centre Network (CCN) was formed recently and had its first meeting in December 2008 at the IAEA. This network is a joint effort coordinated by the AMDU to gather and provide access to codes that are relevant for modellers in fusion plasma science, supplementing the database activities of the AMDU. The network aims to provide codes that can be accessed via a web interface and (usually) run remotely in order to obtain A+M/PMI data that are not otherwise conveniently available.

5.3.   Other A+M activities

Besides the regular data gathering activities of the AMDU other significant work has taken place during 2008–2009, including improved access to the databases, preparation of various publications, presentations at scientific conferences, and the continued development of an extra-budgetary project.

A workshop on Atomic and Molecular Data for Fusion was organized in collaboration with the ICTP in Trieste, Italy, in June 2009. This workshop had the goal of introducing participants to the role of atomic and molecular data in nuclear fusion energy research and to give participants the opportunity to use actual data in some simple but realistic exercises. Lecturers gave presentations on major aspects of A+M data relevant to fusion research, covering the areas of molecular processes, heavy particle collisions, electron impact collisions, collisional radiative modelling, plasma-material interaction and codeposition of materials in fusion devices. Each lecture included a number of exercises applying data to realistic problems. Data were retrieved from a variety of online databases, demonstrating to participants the wide variety of data types available through the Internet. The workshop was attended by 22 students and three ICTP associates, representing ten Member States.

A joint international workshop on Challenges in Plasma Spectroscopy for Future Fusion Research Machines under the auspices of the Birla Institute of Technology (BIT), Plasma Science Society of India (PSSI) and the IAEA was organized at Birla, India, in February 2008. This workshop provided a platform for interaction among scientists, engineers and young researchers working in the area of fusion plasma spectroscopy. The three-day international workshop featured invited talks from expert scientists as well as poster sessions, and was attended by approximately 100 participants.

The web interface to the bibliographical and numerical databases is under continuous development. In addition, work is underway to incorporate the developing XML schema in the outputs from the numerical database. The project "XML Schema for Atoms, Molecules and Solids" (XSAMS), for which the AMDU is the principal host and organizer released its initial version (0.1) in September 2009.

The AMDU continues to publish documents from the Atomic and Plasma-Material Interaction Data for Fusion (APID) series of technical reviews. Volumes 13 and 14 appeared in 2008, and volumes 15 and 16 are currently in production. Staff also prepare and publish the

International Bulletin that contains bibliographical information for fusion-related A+M data (volumes 67 and 68 were published in 2008 and 2009). Furthermore, the two professional staff of the AMDU attended and presented papers at several international scientific conferences in 2008 and 2009. Staff also collaborate directly with several research institutes to generate data of interest to the fusion and nuclear physics research communities.

Finally, the AMDU continued to maintain an extra-budgetary activity on International Database on Irradiated Graphite Properties, by organizing Steering Committee meetings in 2008 and 2009. This project has been hosted by the AMDU, but as of January 2010 it has moved to the Nuclear Energy directorate. In its new home the project will also take on a new name, the IAEA International Knowledge Base on Irradiated Nuclear Graphite Properties.

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, and
- 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, and
- User manuals where appropriate.

6.1.   Coordinated Research Projects (CRPs)

An extended historical perspective of CRPs within the NDS can be seen in Fig. 2 which covers the previous 12 years of such activities (1998–2009), 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 2008–2009 there were 13 CRPs at different stages of development. Five of them were A+M projects while the remaining eight were nuclear data CRPs. The latter are summarized in Table 3, along with other relevant nuclear CRPs, from where it can also be seen that one CRP was completed over the 2008–2009 time period. Four new CRPs were approved in 2007, for which contracts/agreements were awarded, and their first RCMs convened in 2008. By the end of 2009 four A+M data and seven nuclear data CRPs were active.

CRPs - Technical reports	10 1998	12 1999	10 2000	9 2001	11 2002	12 2003	9 2004	12 2005	10 2006	12 2007	12 2008	12 2009	11 2010	(8) 2011	(6) 2012	(4) 2013	(2) 2014
INDC(NDS)-412 (Oblozinsky) **Photon production data**	█	█															
TECDOC-1285 (Herman) **Reference neutron activation library**	█	█	█	█	█												
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. (Braams) **A+M data for plasma modelling**								█	█	█	█	█					
APID, vol. (Braams) **Atomic data for heavy element impurities in fusion reactors**								█	█	█	█	█	█				
Technical report (Capote Noy) **Heavy charged-particle interaction data for radiotherapy**										█	█	█	█				
APID, vol. (Braams) **Surface composition dynamics data - erosion processes**										█	█	█	█				
Technical report (Otsuka) **Minor actinide neutron reaction data**										█	█	█	█	█			
Technical report (Forrest) **ND libraries for advanced systems: fusion devices (FENDL-3)**										█	█	█	█	█			
APID, vol. (Braams) **Size, composition and origins of dust in fusion devices**											█	█	█	█	█	█	█
APID, vol. (Braams) **Light element atom, molecule, radical behav. in divertor region**												█	█	█	█	█	█
Technical report (Capote Noy) **Prompt fission neutron spectra of actinides**												█	█	█	█	█	
Technical report (Capote Noy) - planned **Charged-particle nuclear data for medical isotope production**														█	█	█	█
Technical report (Abriola) - planned **Nuclear data for Particle Induced Gamma Ray Emission analysis**														█	█	█	█

Fig. 2. Coordinated Research Projects - previous 12 years and the immediate future.

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Table 3. Status of Coordinated Research Projects Dedicated to Nuclear Data

No.	Short title	Duration	Participants (contracts)	Project Officer	Status	Section
1	Nuclear data for Th-U fuel cycle	2002–2007	11 (6)	Capote Noy	Completed/document in press	6.1.1
2	RIPL-3	2003–2008	11 (5)	Capote Noy	Completed/ full paper published/document in preparation	6.1.2
3	Nuclear data for the production of therapeutic radionuclides	2003–2007	8 (4)	Capote Noy	Completed/document in press	6.1.3
4	Reference database for ion beam analysis	2005–2010	10 (4)	Abriola	Completed/ document in preparation	6.1.4
5	Reference database for neutron activation analysis	2005–2010	7 (4)	Kellett	Completed/ document in preparation	6.1.5
6	Updated decay data library for actinides	2005–2010	7 (4)	Kellett	Completed/ document in preparation	6.1.6
7	Heavy charged-particle interaction data for radiotherapy	2007–2010	12 (2)	Capote Noy	On-going	6.1.7
8	Minor actinide neutron reaction data (MANREAD)	2007–2011	12 (4)	Otsuka	On-going	6.1.8
9	Nuclear data libraries for advanced systems: fusion devices (FENDL-3)	2007–2011	15 (3)	Forrest	On-going	6.1.9
10	Prompt fission neutron spectra for actinides	2009–2012	12 (6)	Capote Noy	On-going	6.1.10
11	Charged-particle nuclear data for medical isotope production and technological applications	2011–2014	-	Capote Noy	Planned	6.1.11
12	Nuclear data for Particle Induced Gamma Ray Emission (PIGE) analysis	2011–2014	-	Abriola	Planned	6.1.12

6.1.1. Evaluated Nuclear Data for the Thorium-Uranium Fuel Cycle

Status: completed – database assembled/document in press

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.

Outputs:
- Final versions of evaluated data files are available on web page http://www-nds.iaea.org/Th-U/, together with documentation.

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- Final report submitted for publication at the IAEA in May 2009.

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 Th-232 and Pa-231,233 were adopted for ENDF/B-VII.0
- A Consultants' Meeting is planned in 2010 to review benchmark performance of the CRP's thorium evaluated nuclear data file. Covariance data are being reviewed within the ENDF/B-VII.1 project, the existing file will be updated.

6.1.2. Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Nuclear Applications (RIPL-3)

Status: completed – database assembled/comprehensive technical paper published; TECDOC in preparation

Objectives:
- Extend RIPL-2 database to provide input parameters for nuclear model calculations required for energy and non-energy emerging 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 nuclides table and comparison with available experimental databases (including newest data from HINDAS, n_TOF, etc.).
- Uncertainty estimates and/or range of parameter variation for RIPL.

Activity:
- Third and final RCM was held at the IAEA Vienna, Austria, 10–14 December 2007.

Outputs:
- RIPL-3 electronic database released in January 2009 and updated in January 2010. The web page was redesigned and is available at http://www-nds.iaea.org/RIPL-3/.
- A comprehensive technical paper describing the contents of the IAEA Reference Input Parameter Library was published in *Nucl. Data Sheets* **110** (2009) 3107–3214 in December 2009 [1].

Remarks/Outcomes:
The RIPL data and methodology in the derivation of evaluated nuclear reaction data has been adopted by major national evaluation projects worldwide, and included in ENDF/B-VII, JENDL-Actinoid, CENDL 3.1 and JEFF-3.1.1 nuclear applications libraries. RIPL TECDOCs documenting the RIPL database (RIPL-1: IAEA-TECDOC-1034, RIPL-2: IAEA-TECDOC-1506) have become highly cited references by evaluators and theoretical nuclear physicists worldwide. It is expected that the recently published paper in Nuclear

Data Sheets [1] documenting the whole RIPL project will also become a highly cited reference.

References:
[1] R. Capote, M. Herman, P. Oblozinsky, P.G. Young, S. Goriely, T. Belgya, A.V. Ignatyuk, A.J. Koning, S. Hilaire, V.A. Plujko, M. Avrigeanu, O. Bersillon, M.B. Chadwick, T. Fukahori, Zhigang Ge, Yinlu Han, S. Kailas, J. Kopecky, V.M. Maslov, G. Reffo, M. Sin, E.Sh. Soukhovitskii, and P. Talou, RIPL – Reference Input Parameter Library for Calculation of Nuclear Reactions and Nuclear Data Evaluations, *Nucl. Data Sheets* **110** (2009) 3107–3214.

6.1.3. Nuclear Data for the Production of Therapeutic Radionuclides

Status: completed – database assembled/document in press

Objectives:

For reactor-produced radioisotopes:

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

For 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.

For all radionuclides:

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

Activities:

- Third and final RCM was held at the IAEA Vienna, Austria, 29 May–2 June 2006.
- Two consultants (S. Takacs and D. Aldama) produced ENDF-6 formatted data and updated the dissemination web page during 2008–2009.

Outputs:

- Final versions of evaluated data files are available on web page http://www-nds.iaea.org/radionuclides/, together with documentation; these data and associated documents are also accessible through a Medical Portal http://www-nds.iaea.org/medportal/.
- Produced nuclear data are also available in ENDF-6 format for neutrons, protons, deuterons and alpha particles.
- Final report submitted for publication at the IAEA in April 2010.

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 radionuclide impurities.

6.1.4. Development of a Reference Database for Ion Beam Analysis

Status: completed – document in preparation

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:
- Third RCM was held at the IAEA Vienna, Austria, 27–30 April 2009 [2].

Outputs:
- Data assessments of nuclear reactions for several target-projectile combinations of interest to the IBA community have been uploaded to the web page: http://www-nds.iaea.org/iba/
- The IBANDL interface was modernized, a CD-ROM version was prepared.
- New evaluations are available in IBANDL through the SigmaCalc software.
- The final technical report is in preparation for publication.

References:
[1] I. Vickridge and O. Schwerer (Eds.), Summary Report of the 2nd RCM on Development of a Reference Database for Ion Beam Analysis, IAEA Vienna, Austria, 18–21 June 2007, INDC(NDS)-0511, July 2007.
[2] D. Abriola and I. Vickridge (Eds.), Summary Report of the 3rd RCM on Development of a Reference Database for Ion Beam Analysis, IAEA Vienna, Austria, 27–30 April 2009, INDC(NDS)-0555, December 2009.

6.1.5. Reference Database for Neutron Activation Analysis

Status: completed – document in preparation

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:
- Third RCM was held at the IAEA Vienna, Austria, 17–19 November 2008 [3].
- Tasks and final report chapters were assigned to participants, and the work is progressing almost as planned; however, there are with only some minor delays in obtaining final experimental results owing to a longer than anticipated reactor refuelling outage.

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

References:
[1] R.B. Firestone and A. Trkov (Eds.), Summary Report of the 1st RCM 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] M. A. Kellett (Ed.), Summary Report of the 3rd RCM on Reference Database for Neutron Activation Analysis, IAEA Vienna, Austria, 17–19 November 2008, INDC(NDS)-0542, December 2009.
[4] http://www-nds.iaea.org/naa/

6.1.6. Updated Decay Data Library for Actinides

Status: completed – document in preparation

Objectives:
- Measure specific actinide decay data judged to be inadequate, assuming suitable 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 in nuclear facilities, and for waste management.

Activities:
- Third RCM was held at the IAEA Vienna, Austria, 8–10 October 2008 [3].
- Review of progress of evaluations/measurements and finalised timescale for the delivery of remaining evaluations.

Outputs:
- New measurements undertaken and published by participants through this CRP.
- 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] M.A. Kellett (Ed.), Summary Report of the Third Research Coordination Meeting on Updated Decay Data Library for Actinides, IAEA Vienna, Austria, 8–10 October 2008, INDC(NDS)-0539, July 2009.
[4] http://www-nds.iaea.org/act_ddl/

6.1.7. Heavy Charged-particle Interaction Data for Radiotherapy

Status: 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:

- Second RCM was held at the LNS, Catania, Italy, 8–12 June 2009 [1]; third and final RCM planned for 2010 in Vienna.
- Benchmark of spallation reaction models and subsequent analysis on-going, see http://www-nds.iaea.org/spallations/

Remarks / Outcomes:
- Emphasis on nuclear data needs for proton and carbon therapies.
- The benchmark exercise is complementary to the CRP activities.

Reference:
[1] H. Palmans and R. Capote Noy, Summary Report of Second Research Coordination Meeting on Heavy Charged-Particle Interaction Data For Radiotherapy, Catania, Italy, 8–12 June 2009, INDC(NDS)-0567, December 2009.

6.1.8. Minor Actinide Neutron Reaction Data (MANREAD)

Status: On-going

Objective:
- To assess experimental capabilities to undertake measurements of neutron reaction cross-sections for the important isotopes of the minor actinide elements.
- To report measurements of neutron-induced reaction cross-sections on minor actinides just completed or planned in the period of activity of the CRP at research laboratories world wide.
- To assess uncertainty of available experimental information on minor actinide neutron cross-section data.
- To assess quality and uncertainties of minor actinide data present in the evaluated nuclear data libraries.

Activities:
- CM was held at IAEA Vienna, Austria, 23–24 November 2006 [1].
- First RCM was held at the IAEA Vienna, Austria, 19–23 November 2007 [2].
- Second RCM was held at the IAEA Vienna, Austria, 31 March–3 April 2009 [3].

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] F. Käppeler and A. Mengoni (ed.), Summary Report of First RCM on MANREAD, IAEA Vienna, Austria, INDC(NDS)-0528, September 2008.
[3] Y. Nagai and A. Mengoni (ed.), Summary Report of Second RCM on MANREAD, IAEA Vienna, Austria, INDC(NDS)-0557, July 2009.
[4] Web site: http://www-nds.iaea.org/manread/index.html

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

Status: on-going

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

Activities:
- First RCM was held at the IAEA Vienna, Austria, 2–5 December 2008 [2].
- Second RCM was held at the IAEA Vienna, Austria, 23–26 March 2010.

Outputs:
- Summary report of first RCM available (see reference 2)
- Starter file available on web site: http://www-nds.iaea.org/fendl3/
- Documents from the second RCM available on web site.

Reference:
[1] R. Forrest and A. Mengoni, Technical Meeting on Nuclear Data Libraries for Advanced Systems: Fusion Devices, INDC(NDS)-0525, April 2008.
[2] A. Trkov, R. Forrest and A. Mengoni, Summary Report of the First RCM on Nuclear Data Libraries for Advance Systems - Fusion Devices (FENDL-3), IAEA Vienna, Austria, 2–5 December 2008, INDC(NDS)-0547, March 2009.

6.1.10. Prompt Fission Neutron Spectra for Actinides

Status: approved and on-going

Objectives:
- To make available existing experimental information on prompt fission neutron spectra (PFNS) relevant to fission reactor applications, that can be processed and used by users worldwide.
- To incorporate available experimental information on PFNS for major actinides into evaluated nuclear data files.
- To recommend evaluations of PFNS with covariances from thermal to 20 MeV incident neutron energy.

Outputs:
- CM was held at the IAEA Vienna, Austria, 24–27 November 2008 [1].
- First RCM was held at the IAEA Vienna, Austria, 6–9 April 2010.

Reference:
[1] R. Capote Noy, V. Maslov, E. Bauge, T. Ohsawa, A. Vorobyev, M.B. Chadwick and S. Oberstedt, Summary Report of Consultants' Meeting on Prompt Fission Neutron Spectra of Major Actinides, IAEA Vienna, Austria, 24–27 November 2008, INDC(NDS)-0541, January 2009.

6.1.11. Charged-particle nuclear data for medical isotope production and technological applications

Status: planned. A related CM was held from 3–5 September 2008: INDC(NDS)-0535

Suggested Objectives:
- Update available monitor-reaction cross-sections for charged-particle measurements with accelerators.
- Undertake evaluations of decay data of relevance for isotope production.
- Compile and evaluate isotope production cross-sections as a function of energy (up to 200 MeV, when necessary) for PET and SPECT radionuclides, including Mn-52, Co-55, Fe-52, Cu-64, Ga-66, As-71, Se-73, Br-76, I-124, Mo-99 and Tc-99 among isotopes of interest.
- 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

literate.

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

6.1.12. Nuclear data for Particle Induced Gamma Ray Emission (PIGE) analysis

Status: planned. A related CM was held from 1–2 March 2010: INDC(NDS)-0568.

Suggested Objectives:
- Assess available data and determine a priority list for new measurements to complement, extend or improve the quality of the existing ones.
- To stimulate the measurement of cross-sections mainly related to the analysis of the most important elements for interdisciplinary applications such as sodium, aluminium, boron, fluorine, magnesium, sulphur, beryllium, silicon, nitrogen, oxygen and chromium, using light ion beams.
- To evaluate the compiled and measured data, and validate the cross-section data through benchmark experiments.

6.2. Data Development Projects (DDP)

Several DDPs were completed through consultancy visits, service agreements, and work undertaken directly by NDS staff.

6.2.1. Maintain the international neutron cross-section standards file and evaluation techniques

A CM was organized to review the status of the international cross-section standards released in 2006, and to consider the possibility of extending the energy ranges and including new reactions that could be considered for adoption as reference cross-sections. The summary report was published in November 2008 [1].

A comprehensive technical paper [2] was published in the Nuclear Data Sheets journal in December 2009.

On-going work is coordinated through contracts issued to V. Pronyaev, and work undertaken directly by NDS staff. A CM is being organized for November 2010.

References:
[1] V.G. Pronyaev, A. Mengoni and A.D. Carlson, Summary Report Consultant's Meeting on International Neutron Cross-Section Standards: Measurements and Evaluation Techniques, IAEA Vienna, Austria, 13–15 October 2008, INDC(NDS)-0540, November 2008.
[2] A.D. Carlson, V.G. Pronyaev, D.L. Smith, N.M. Larson, Chen Zhenpeng, G.M. Hale, F.-J. Hambsch, E.V. Gai, Soo-Youl Oh, S.A. Badikov, T. Kawano, H.M. Hofmann, H. Vonach and S. Tagesen, International evaluation of neutron cross-section standards, *Nucl. Data Sheets* **110** (2009) 3215–3324.

6.2.2. Extension of the IRDF-2002 dosimetry library

Extension of the IRDF-2002 dosimetry library has been pursued following recommendations of the 2008 CM [1]. A total of 15 new evaluated reactions have been produced by K.I. Zolotarev (IPPE/Russia) supported by the IAEA; documentation of new

evaluations was published as reports INDC(NDS)-0526 (August 2008) and INDC(NDS)-0546 (April 2009). Additional work has been undertaken to include the IAEA standards in coordination with ORNL (US) and IPPE (Russia). Evaluated data files have been assembled, checked and uploaded onto the NDS web server http://nds121.iaea.org/irdf2002ext/meeting200701/new_eval/.

A CM was held in July 2009 to discuss new evaluations and processing needs. It was agreed to name the new dosimetry library as IRDFF/1; new evaluations have been processed through NJOY to produce 640-group and Monte Carlo libraries, results are being assessed and documentation is in preparation to be published as an INDC(NDS) report. A new CM is scheduled for May 2010 in Vienna to assess data needs, discuss the IRDFF/1 release and the future of the project.

[1] 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.

6.2.3. Ion Beam Analysis Nuclear Data Library (IBANDL)

A. Gurbich (IPPE) visited NDS from 17–28 October 2008 to update the interface to be used in the CD-ROM distribution of IBANDL, and also to carry out IBANDL maintenance. During a second visit from the 16–27 November 2009, the assembly and writing of several chapters of the final report on IBANDL took place, in collaboration with NDS staff, and the database was further maintained.

6.2.4. Phase-space database for external beam radiotherapy

The project has helped the developers of three major Monte Carlo code systems used in medical applications (EGSnrc, Geant-4 and PENELOPE) to implement the IAEA phase space (phsps) format and interface; the IAEA format is well recognized and established for exchange of relevant data among major Monte Carlo codes.

A CM was held in Vienna in May 2009 to review the status of the IAEA phase space submission initiative and to collect validated phase-space data for submission into the database. More than 10 new phsps families were reviewed and incorporated into the database, including Co-60 and electron accelerator data. The project web page has been redesigned and all new data are available at the NDS web site http://www-nds.iaea.org/phsp/. Compilation of data continues; the IAEA server is being updated to deal with huge data volumes generated by this project (currently ~1Tb data); these data and associated documents are also accessible through the Medical Portal http://www-nds.iaea.org/medportal/.

Consultants stressed that the phsps project has great merit in different areas of application including Monte Carlo treatment planning, beam model development, accurate dosimetry, correction factors, small field dosimetry, etc.

6.2.5. Application Library for Accelerator Driven Systems and New Reactor Designs: the ADS 2.0 library package

Following the release of the ENDF/B-VII.0 and JENDL-Actinoid libraries, the selection of data for accelerator driven system ADS-Lib v1.0 (INDC(NDS)-0474) was updated to include new data. The generation of the ADS nuclear data library for testing was undertaken by NDS staff. The number of materials was extended from 30 to 156 in 2008 on the basis of the same processing procedures (INDC(NDS)-0545). The new ADS 2.0 library package and corresponding documentation are available on the NDS web site

6.2.6. Development of evaluation methodology and nuclear reaction modelling systems

Further development of the EMPIRE and GANDR codes is being supported through NDS staff, consultancy visits and service agreements. Several technical papers have been published at major nuclear data conferences and in peer-reviewed journals; these activities support the extension of nuclear data evaluation capabilities including covariance generation relevant for other projects.

6.2.7. Neutron data file for Mn-55 nucleus up to 150 MeV

Work is on-going to produce an updated and evaluated nuclear data file in ENDF-6 format for the Mn-55 target up to 150 MeV incident neutron energy. Output will include resonance parameters and associated covariances derived at Oak Ridge National Laboratory, USA, evaluation of the fast neutron region including covariances based on the EMPIRE/GANDR system (NDS and Josef Stefan Institute, Slovenia) and validation using benchmarks (Josef Stefan Institute, Slovenia), along with a report of the work.

6.2.8. Missing Level corrections using experimental neutron spacings

A data development project is on-going to develop and properly document Random Matrix Theory methods to correct raw resonance data for missing resonances. A FORTRAN code developed is available at http://www-nds.iaea.org/missing-levels/. Documentation has been published as INDC(NDS)-0561 covering even-even isotopes.

6.2.9. Nuclear data of specific positron emitters used in PET

A CM on High-precision beta-intensity measurements and evaluations for specific PET radioisotopes was organized at the IAEA in Vienna on 3–5 September 2008. Participants assessed and reviewed decay data for almost 50 positron-emitting radionuclides. Technical discussions are described in the report INDC(NDS)-0535, along with detailed recommendations and a priority list for future work. Direct positron and X-ray measurements are required to resolve a significant number of outstanding issues associated with the radionuclides reviewed.

6.2.10. Beta decay and decay heat

A CM at the IAEA, Vienna, Austria, in January 2009 [1], was organised with the purpose to report and discuss progress and plans to measure total gamma-ray spectra in order to derive mean beta and gamma decay data for decay heat calculations and other applications. The meeting proved beneficial in ensuring that all relevant parties were brought up to date with current and proposed TAGS measurement programmes, and further meetings of a similar type should be held on a two or three-year cycle, as much work remains to be done. Decay data needs embrace decay heat calculations, anti-neutrino spectral signatures, and basic nuclear physics. Good progress is being made, and TAGS measurements and high-resolution gamma-ray spectroscopy studies need to continue in order to assemble new and improved data files for specific applications, and also to contribute to important research on nuclear structure. During the meeting, it became clear that India has shown a specific interest in becoming more involved in such studies, specifically due to needs for quantifying Th/U fuelled reactor decay heat. A subsequent assessment, by Manipal University, to identify specific needs was encouraged and supported by NDS staff and it was noted that Indian scientists wish to collaborate on

existing measurements, with the ultimate goal of creating their own experimental facility.

[1] A.L. Nichols and C. Nordborg, Summary Report of Consultants' Meeting on Total Absorption Gamma-ray Spectroscopy (TAGS), Current Status of Measurement Programmes for Decay Heat Calculations and Other Applications, IAEA, Vienna, Austria, 27–28 January 2009, INDC(NDS)-0551, February 2009.

6.2.11. Input to JEFF project

Continuing collaboration between NDS and the OECD/NEA continues through contributions to the JEFF Project. Existing technical expertise of NDS staff has resulted in almost 50 new decay scheme evaluations during 2008–2009, supporting the European Fusion programme. NDS staff have also contributed technically to the JEFF Decay Data and Fission Yields' sub-group, by providing verification and documentation [1] for the JEFF-3.1.1 Radioactive Decay Data Library.

[1] M.A. Kellett, O. Bersillon and R.W. Mills, The JEFF-3.1/-3.1.1 Radioactive Decay Data and Fission Yields Sub-libraries, JEFF Report 20, OECD Nuclear Energy Agency, 2009.

7.   TECHNOLOGY TRANSFER

Technology transfer activities throughout 2008–2009 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). A successful workshop was conducted in Bucharest, Romania (see section 7.2.6), as a result of which several new evaluators joined the Network. NDS staff were also involved in the mentoring of new evaluators. 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 continue to support mirror servers at the Bhabha Atomic Research Centre (BARC), Mumbai, India and at IPEN, São Paulo, Brazil. This work is undertaken in conjunction with counterparts at the BARC and IPEN IT departments.

NDS has full administrator access to both mirror servers. Access logs are collected periodically and added to the NDS access statistics. Both mirror computers provide the same services as the NDS main server with the exception of ENSDF, NuDat and NSR. NDS does not provide databases originating from NNDC (ENSDF, NSR and NuDat) to remote mirror servers; electronic requests for these databases are directed to the NDS server at the IAEA, Vienna, Austria.

Contact was made with the China Nuclear Data Center to initiate the provision of a mirror server there, but no progress has been made with respect to this proposal in the course of 2008–2009.

7.2.   Workshops

NDS sponsored and organised six workshops in 2008–2009, of which two were 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, 28 April–9 May 2008)

Workshop Directors: A.L. Nichols, D.H. Abriola (NDS), J.K. Tuli (NNDC) and A. Ventura (ENEA).

A fifth two-week workshop was organized by the NDS in collaboration with NNDC, USA and ENEA, Italy. The programme was based on the previous four successful workshops (November 2002, one-week trial, IAEA Vienna, Austria; November 2003, April 2005 and February-March 2006 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).
- Nuclear structure models - IBM (P. Van Isacker and S. Brant).
- Experimental measurements (T. Kibedi and F. Kondev)
- Statistical analysis techniques (T.D. MacMahon).
- ENSDF evaluations and computer codes (C. Baglin, E. Browne, A. Sonzogni and J.K. Tuli).
- Databases (C. Baglin, E. Browne, A. Sonzogni, 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:
- 32 participants received training from 10 lecturers and demonstrators.
- four participants were already involved in mass-chain evaluations and further improved their skills.
- Some participants expressed a strong interest in undertaking NSDD evaluation work (two of them as a result are working now with mentors from NSDD network and with support from the IAEA).
- Addendum, training document prepared from lecturers' material (also 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

– INDC(NDS)-0533, Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, June 2008.

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. Challenges in Plasma Spectroscopy for Future Fusion Research Machines

(Birla Institute of Technology (BIT), Jaipur, Rajasthan, India, 20–22 February 2008)

Workshop organizers: R. Prakash (Department of Applied Physics, BIT) and R.E.H. Clark (NDS).

Objectives:

Organized under the auspices of BIT, the IAEA, and the Plasma Science Society of India (PSSI), the workshop was intended for young researchers from India familiar with plasma and/or atomic and molecular physics who might be motivated to join the Indian Fusion Programme or contribute to the ITER project. The goal of this workshop was to identify R&D areas that will contribute to the future development of fusion plasma diagnostic techniques based on spectroscopy and A+M physics, and to introduce young scientists to fusion technology.

Topics:

- Fusion plasma diagnostics using radiations covering infrared to X-ray region.
- Development of high performance instrumentation for spectroscopy and detection.
- Active diagnostics using atomic beam and laser imaging techniques.
- Simulation and modelling for interpretation of spectra.
- Collisional-radiative and impurity transport modelling.
- Generation of new atomic and molecular data relevant to fusion research.

Actions:

There were three sessions on the first day followed by a discussion session at the end of the day to provide future directions. The first session was focused on a discussion of fusion plasma diagnostics using radiation ranging from the infrared to X-ray regions. The second session was the poster session, which provided an excellent platform for young researchers to discuss the important aspects of plasma spectroscopy with the distinguished experts. The third session included talks on simulation and modelling to interpret spectra. On the second day there were three sessions in addition to a special session for sponsor presentations, a feedback session at the end of the day and a cultural programme. The first session was focused on the collisional-radiative and impurity transport modelling. The next session was devoted to the generation of new atomic and molecular data relevant to fusion research. The last session of the day presented the development of high performance instrumentation for spectroscopy. The third day began with a session on active diagnostics using atomic beams and lasers. The next session was dedicated to the discussion of imaging techniques. The final session was the concluding session followed by a valedictory function.

Remarks/Outcome:

Approximately 125 researchers from across the globe participated in this activity in addition to the 25 local organizing participants. The training covered during this three day

workshop was well appreciated by participants as well as speakers as noted during the concluding and feedback sessions.

7.2.3. Workshop on Nuclear Reaction Data for Advanced Reactor Technologies

(ICTP, Trieste, Italy, 19–30 May 2008).
Workshop Directors: A. Mengoni (NDS) and A. Stanculescu (IAEA-NPTD).

Objective:
The purpose of the workshop was to provide training and information exchange for nuclear physicists, nuclear engineers, and other users of Nuclear Data for advanced technological applications. Starting from the facilities and techniques used for the experimental determination of basic Nuclear Data quantities, through the evaluation procedures and creation of reliable nuclear reaction data libraries, lectures focused on providing the most recent developments and results in the field.

Main Topics:
- Facilities and instrumentation for nuclear reaction data measurements.
- Experimental techniques for measurements of nuclear reaction data.
- Modern theoretical nuclear structure and reaction models.
- Evaluation of nuclear data and creation of evaluated nuclear reaction data libraries.
- Simulation tools for design studies of advanced nuclear systems.
- Overview of strategies for advanced nuclear technologies.

Actions:
Both lectures and computer exercises were planned. Substantial computing facilities were made available for the students at the ICTP.

Remarks/Outcomes:
Workshop was attended by 44 students representing 25 Member States. Total of 11 lecturers external to the IAEA and one tutor made presentations to the workshop.
The workshop was judged to be successful from both the students' and lecturers' points of view.

7.2.4. Workshop on Modelling and Evaluating Nuclear Reaction Data for Transport Calculations

(IAEA, Vienna, Austria, 15–19 December 2008).
Workshop Director: R. Capote Noy (NDS).

Objective:
To gain extensive and up-to-date training on the use and understanding of the EMPIRE code system for nuclear data evaluation and modelling of nuclear reactions, and to generate nuclear data libraries of relevance to the application of modern nuclear technology.

Topics:
A total of 20 hours of lectures and 22 hours of computer exercises were provided.
- M. Herman: Overview of the EMPIRE system for theoretical modelling of nuclear reactions and nuclear data evaluations. Statistical model in EMPIRE: Hauser Feshbach theory, width fluctuation corrections (HRTW method), gamma cascade,

nuclear level densities, isomers. Pre-equilibrium models in EMPIRE: MSD+MSC (quantum-statistical models), exciton and Hybrid Monte Carlo (HMS) models.

- R. Capote Noy: Direct reaction theory in EMPIRE: Optical model, coupled channels, distorted wave Born approximation. Cross-section covariances of nuclear models: Monte Carlo method.
- M. Sin: Charged-particle induced reactions with EMPIRE. Nuclear fission modelling with EMPIRE.
- A. Trkov: Introduction to nuclear data evaluation. Nuclear data processing for applications. Exercises: EMPIRE setup, RIPL uses, retrieval, selection and formatting of experimental data, EMPIRE input preparation, EMPIRE calculations.

Actions:

General approach was to begin each session with a 90 minute lecture. Latter part of each session was devoted to work on exercises, with lecturers being available for individual help. Substantial computing facilities were made available for the students at the IAEA using local NDS computers.

Remarks/Outcomes:

An intensive five-day workshop, which consisted of lectures and software demonstrations, was attended by nineteen students representing twelve Member States (Belarus, China, Egypt, Hungary, India, Italy, Republic of Korea, Pakistan, Russian Federation, Spain, Ukraine, USA). A total of four lecturers, including three external to the IAEA (from Romania, Slovenia and the USA), made presentations to the workshop. The workshop was judged to be successful from both the students' and lecturers' points of view.

7.2.5. Workshop on Atomic and Molecular Data for Fusion Energy Research

(ICTP, Trieste, Italy, 20–30 April 2009)
Workshop Director: R.E.H. Clark (NDS)

Objective:

To train potential new researchers in fusion energy on the basics of atomic, molecular and plasma-material interaction data. The workshop participants were guided through the use of such data in fusion-relevant plasma situations and were introduced to a variety of sources of data. Exercises made use of specific modelling codes using data from sources available through Internet links.

Topics:

Specific categories of data covered by the workshop included plasma-material interaction data for pure materials; codeposition of materials and the interaction of the mixed materials with the plasma; electron collision processes in atoms and molecules and their ions; molecular formation and dissociation; and charge transfer processes. The lecturers and their topics were:

- A. Dubois, UMR/CNRS, Paris, France, delivered three lectures on heavy particle collision processes.
- J. Abdallah Jr., Los Alamos, USA, delivered four lectures on use of atomic data in plasma modelling.

- R.E.H. Clark, NDS, delivered five lectures on calculation of atomic data for plasma modelling.
- D. Humbert, NDS, delivered four lectures on atomic, molecular and particle-surface interaction web databases and data exchange.
- T. Maerk, Universitat Innsbruck, Austria, delivered two lectures on molecular processes in plasma.
- T. Schwarz-Selinger, MPI, Munchen, Germany, delivered three lectures on plasma-wall interactions in magnetic fusion.
- D. Reiter, Forschungzentrum Juelich, Germany, delivered three lectures on the science of fusion boundary plasmas: atomic, molecular and surface processes.
- J.W. Davis, University of Toronto, Canada, delivered three lectures on codeposition and plasma interaction with co-deposited/mixed materials.

Actions:
The 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 discussion was followed by three lectures, with a break for lunch. The remainder of the afternoon was then devoted to work on the exercises, with the lecturers being available for individual help.

Remarks/Outcomes:
- The workshop was attended by 25 participants.
- Eight lecturers contributed presentations.
- This third IAEA/ICTP workshop on atomic and molecular data for fusion energy research was judged to be successful by both participants and lecturers.

7.2.6. NSDD Evaluators' Workshop

(IFIN-HH, Bucharest, Romania, 30 March–3 April 2009).
Program committee: N. V. Zamfir (IFIN-HH, Romania), J.K. Tuli (NNDC, USA), F. Kondev (ANL, USA), T. Kibedi (ANU, Australia), B. Singh (McMaster University, Canada), A. Sonzogni (NNDC, USA), D. Balabanski (INRE, Bulgaria) and D.H. Abriola (NDS).

Objective:
The purpose of the workshop was to provide training to nuclear scientists in the methods and procedures adopted to generate Evaluated Nuclear Structure Data Files (ENSDF), and to encourage their continued interest to work as mass-chain evaluators.

Main Topics:
- History of evaluation, international cooperation.
- How to use NSR for evaluations.
- ENSDF format.
- Analysis codes.
- Evaluated observables.
- How to create data sets.
- XUNDL - how to use it.
- Evaluator guidelines and policies.
- Demonstration: How to use the ENSDF editor.
- Demonstration: How to use BrIcc, Logft, Ruler and GTOL.
- Demonstration: How to use NuDat.

Actions:
Both lectures and computer exercises were planned. Substantial computing facilities were made available for the students at the IFIN-HH.

- *Group exercise*: Evaluation of A=84 mass chain (Group Coordinator: B. Singh).

- *Round table*: 'ENSDF evaluation - present status and future developments'; the participants expressed interest in continuing with mass chain evaluations.

Remarks/Outcomes:
Eleven new evaluators were trained in ENSDF methodology. As a result of the training exercise and further mentoring of the participants the evaluation was published in a journal: Nuclear Data Sheets for A = 84, D.H. Abriola, *et al., Nucl. Data Sheets* **110** (2009) 2815-2944.

8.   COMPUTER SUPPORT

Major highlights in computer services and systems development during 2008–2009 are as follows:

- Acquisition and commissioning of new web server and new development server in the Agency Data Centre on C-01.
- Progress made on the provision of new facilities to enhance provision of data services.
- Incorporation of the members of the Systems Development Unit into the Atomic and Molecular Data Unit.
- Departure of Nuclear Data Analyst/Programmer.

8.1.   Computer networks

In order to conform to the IAEA-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 IAEA 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 IAEA Intranet. NDS staff have worked closely with MTIT to meet the IAEA security requirements, and to ensure the continued efficient provision of the data services.
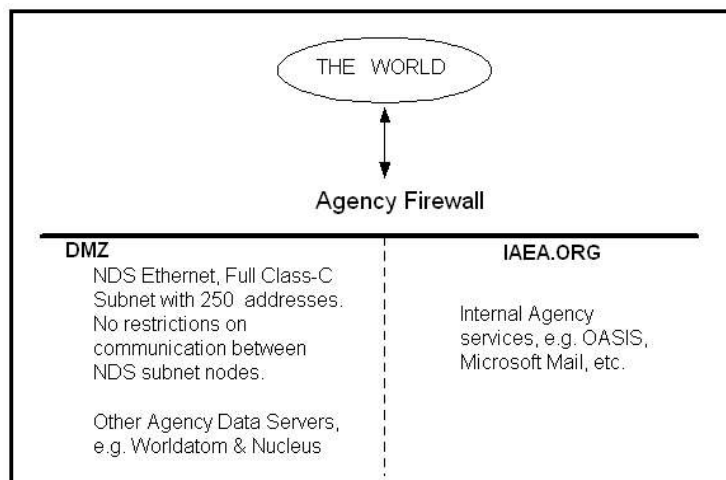
All NDS Ethernet–based computers have been grouped into logical sets within the firewall management software of the IAEA. Network access rules through the firewall decide access from the world and to/from the IAEA Intranet, and have been assigned on the basis of group properties for service classes such as data servers, development servers and workstations. Intercommunication between nodes on the NDS Ethernet is unrestricted. An overview of the NDS's positioning within the IAEA firewall is shown in Fig. 3.

The following NDS machines are located in the DMZ in the IAEA Data Centre on floor C-01:

- **www-nds.iaea.org** and **www-amdis.iaea.org**, the primary Nuclear Data and Atomic and Molecular data servers.
- **nds121.iaea.org**, the NDS development server.
- **castor.iaea.org**, a Dell Precision, Linux-based computer hosting the GANDR project.

- **nds120.iaea.org**; a 64-bit Linux computer used for Monte Carlo and other calculations.

THE WORLD

Agency Firewall

DMZ	IAEA.ORG
NDS Ethernet, Full Class-C Subnet with 250 addresses. No restrictions on communication between NDS subnet nodes.	Internal Agency services, e.g. OASIS, Microsoft Mail, etc.
Other Agency Data Servers, e.g. Worldatom & Nucleus	

Fig. 3. Overview of NDS Ethernet and IAEA firewall.

X Terminal access by NDS staff to production and development servers is carried out through X-Win32 over SSH on their standard PCs. This approach works from node to node on the NDS Ethernet and from nodes on the IAEA Intranet to the NDS network over secure firewall tunnels. SSH and Secure Copy are used for terminal emulation and file transfer, in compliance with IAEA 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. This machine is no longer located in the IAEA DMZ and hence no longer accessible from outside. It is maintained primarily for legacy reasons.

8.2.2. Linux systems

The principal nuclear and atomic and molecular data services are connected to the Internet from two web addresses: http://www-nds.iaea.org/ and http://www-amdis.iaea.org/ respectively. The server which hosts these services was replaced in 2008 with a new HP DL380 G5 2 X Quad Core (i.e. with eight CPUs) rack mounted machine. A second similar machine (**nds121.iaea.org**) acts as a development server where modifications, new applications etc. are tested before being moved to the main server. As mentioned earlier these machines are logically located in the IAEA DMZ and located physically in the main computer room on C-01. External access to **nds121.iaea.org** is granted to specific members of the NSDD, NRDC and associates for file transmission projects, e.g. for EXFOR Trans files.

Figs. 4 and 5 show the flow of data into and out of the Nuclear and Atomic and Molecular services. Nuclear data services are mirrored to servers at BARC, Mumbai, India and IPEN, São 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.
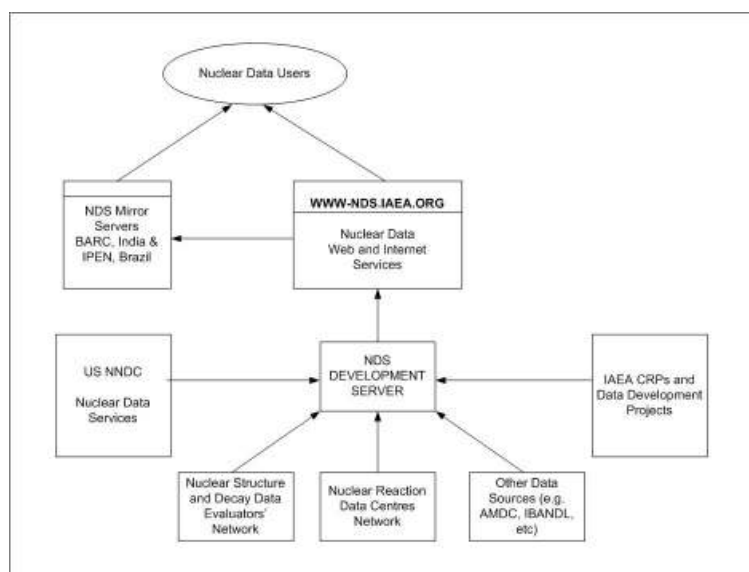
Fig. 4. Data flow through the Nuclear Data Service.
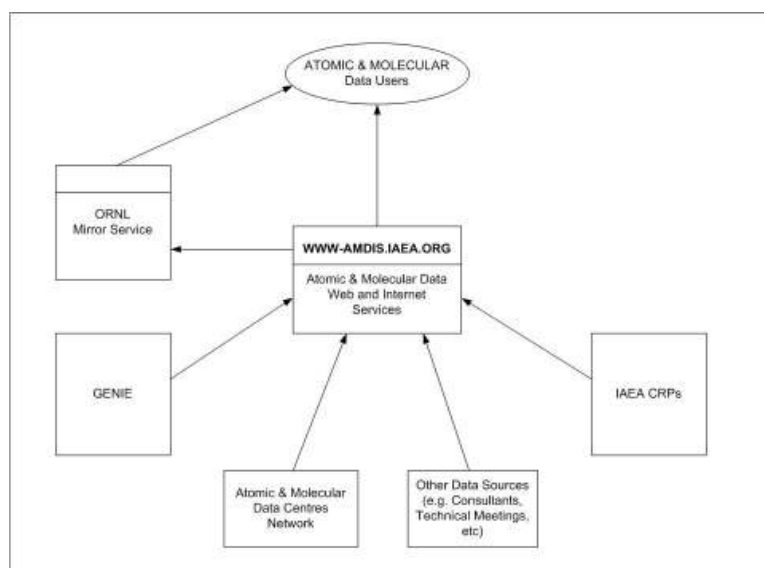
Fig. 5. Data flow through the A+M Data Service.

Over the course of 2008–2009, the NDS acquired a new 64-bit computer (Dell Precision Quad Core) that runs under Redhat Enterprise Linux 64-bit. Intel 64-bit C++ and 64-bit FORTRAN compilers were installed. This machine is used for processing and pre-processing of nuclear data. Processing times for large codes (e.g. EMPIRE and NJOY) have been significantly reduced.

The Phase Space CRP has resulted in the acquisition of large amounts of new data, by the end of 2009 this amounted to almost 0.5 TB, and approximately a further 1TB is expected over the course of the project. This, plus the addition of almost 70GB of new data (i.e. TENDL) to the ENDF libraries, has highlighted the need for considerable additional disk storage on the main server. This will be addressed during 2010.

8.2.3. Microsoft systems

All members of staff have an IAEA-standard PC running IAEA-standard Microsoft Windows XP. Access rights to the operating system on these desktops are strictly controlled by the IAEA IT services (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-IAEA standard applications (e.g. FORTRAN compilers, X-windows, etc.). NDS staff also use the IAEA-supplied Microsoft XP laptop image for laptops.

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

The old web server (the Compaq ML350) which was replaced in 2008 is now located within the NDS. The Microsoft Windows Server operating system was installed and this machine is now being used by the NDSU for storing and sharing work related to EXFOR (compilations, scanned documents, etc.).

8.3. Software and applications development

Following discussions with the IAEA Human Resources, the four informal units were replaced by three Units. This meant that members of the former Systems Development Unit were incorporated into the Atomic and Molecular Data Unit. This reorganization has not hindered computer, software and application support and development in any way, and the IT Systems Analyst still plays a leading role in software support within the NDS.

NDS staff have continued to collaborate with IT specialists in MTIT on the development of the IAEA Nuclear Information and Knowledge Portal (NUCLEUS). NUCLEUS allows Member State counterparts, members of the public and specialists access to scientific, technical and regulatory data, information and knowledge (stored in documents, databases and on web sites). The NUCLEUS portal is now open to all and can be accessed at the address: http://nucleus.iaea.org/, and from which the NDS web page can be reached.

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.

Nuclear Science References (NSR), which is developed and maintained by the NNDC was converted to MySQL and this new form was transferred to and installed on the NDS server in October 2009. Updates to NSR are received from the NNDC monthly. Since NDS no longer hosts either ENSDF or NuDat it has been possible to discontinue the use of the Sybase DBMS with a cost saving. All relational nuclear databases now served by NDS are MySQL-based (i.e., NSR, EXFOR, ENDF, CINDA and the address list database ADLIST).

We have continued to expand the support given to the NDS 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, the NDS contacts management system contains details for 7500 people and 70 distribution lists for NDS reports and communications. Recently ported from the Sybase DBMS to MySQL. This service is currently restricted to NDS use only.

- Pocket ENSDF, a Microsoft Access DBMS version of ENSDF which can be distributed on CD-ROM and run locally. Users can open this MS-Access database and execute their own SQL queries on their own computer. This product is still under development and is not yet available for distribution.

- LiveChart of Nuclides was completed. This is a web-accessible database of nuclide properties, including decay radiations and thermal neutron cross-sections. Two interfaces are available: the graphical, interactive Chart of Nuclides and an advanced form-based query system, where users fill fields in the form to retrieve the required data. This new service is accessible to all and can be accessed at: http://www-nds.iaea.org/livechart/.

- Two web-accessible, relational database indices of documents (based on MySQL and java): IAEA(NDS)-0, Index to the IAEA-NDS Documentation Series and IAEA(NDS)-7, Index of Nuclear Data Libraries Available from the IAEA Nuclear Data Section, have been developed but not yet completed. This application will allow quicker and easier access to the lists and also means that the documents on which this application are based no longer need to be maintained or printed.

Completion of Pocket ENSDF, the relational indices and the development of LiveChart of Nuclides have been temporarily interrupted due to the departure of the Nuclear Data Analyst/Programmer responsible for them. This work is expected to resume in mid-2010 when a replacement is expected.

8.4. Hardware acquisition

Table 4 lists the main computer hardware acquisitions during the reporting period of 2008–2009.

Table 4. NDS computer hardware purchases for 2008–2009.

Item	Quantity
Servers (HP DL380 G5 Rack Mount Servers)	2
Workstation (Dell Precision 64-bit Workstation)	1
IAEA Standard Desktop PCs	13
Laptops (HP Notebooks)	3
HP LaserJet M3027 MFP Scanner/Printer	1
External Hard Drives (IOMEGA 1.5 TB)	6
External Hard Drives (IOMEGA 500 GB)	8
External Hard Drives (LaCie 320 GB)	6

9. CONCLUDING REMARKS

The outcome of ensuring support of Member States by the provision of high quality atomic and nuclear data has been achieved by many outputs during 2008–2009. These include:

- A major update of the web site dedicated to nuclear data for safeguards has been completed and documented.
- Extension of a comprehensive database for ion beam analysis (IBANDL) has been completed.
- The Medical Portal on the web site giving centralised access to many medically relevant databases including the large and comprehensive phase space database has been updated.
- Maintenance of the neutron cross-section standards is continuing.
- Extraction of data from various regional files and processing to provide a cross-section library of relevance to ADS applications has been completed.
- Extension of the range of ENDF formatted data libraries and enhancement of the plotting capabilities through ZVView-2, including the ability to present covariance data as 3-D plots has been achieved.
- Completion of the RIPL-3 database of parameters to aid in model calculations and data evaluations has been achieved.
- Overall production of the JEFF-3.1.1 nuclear applications library, inclusion of IAEA produced decay data files and provision of the documentation of the library carried out.
- Maintenance of ENSDF decay data by the International Network of Nuclear Structure and Decay Data Evaluators under the coordination of the NDS. Data have been extended and made more accessible by the LiveChart web-based application.
- Comprehensive collection of experimental data in the EXFOR database used for the evaluation of much neutron cross-section data maintained.
- Continued development of the bibliographical (AMBDAS) and numerical (ALADDIN) databases for Atomic and Molecular data for fusion.
- Provision of workshops enabling a wide range of people to be trained in the use of atomic and nuclear data for applications as diverse as energy production, medical and analytical techniques.

A significant number of important technical reports were published to a high presentational style and editorial standard: Data for Molecular Processes in Edge Plasma, APID, Vol. 14, 2008; Fission Product Yield Data for the Transmutation of Minor Actinide Nuclear Waste, STI/PUB/1286, April 2008; Nuclear Data Sheets for A=96, D. Abriola and A.A. Sonzogni, *Nucl. Data Sheets*, **109** (2008) 2501–2655; Nuclear Data Sheets for A = 84, D. Abriola, *et al., Nucl. Data Sheets*, **110** (2009) 2815–2944; RIPL – Reference input parameter library for calculation of nuclear reactions and nuclear data evaluations, R. Capote Noy, *et al., Nucl. Data Sheets*, **110** (2009) 3107–3214; International evaluation of neutron cross-section standards, A.D. Carlson, V.G. Pronyaev, *et al, Nucl. Data Sheets,* **110** (2009) 3215–3324. Specific advances were also made in the visual appearance of the new web pages containing IAEA atomic and nuclear databases finalised in 2008–2009: EXFOR; ENDF; NSR; Medical applications; Ion Beam Analysis data and nuclear data for safeguards. A particular example is the LiveChart of the nuclides

tool which enables easy interaction with ENSDF data. The impact of these particular outputs is important in maintaining the interest and confidence of users within the public domain, by enabling the data to be interrogated in a user-friendly manner.

Much important technical information and related material has been generated over the previous two years by NDS 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 NDS at key events and meetings during 2008–2009. These technical activities and our inputs will continue through on-going staff efforts and Coordinated Research Projects (CRPs).

Some change in emphasis occurred in the Sub-programme 1.4.1 during 2008–2009. Proposed NDS support to the EC CANDIDE project did not materialise because of administrative difficulties associated with establishing links with EU projects. In response to recommendations made at the previous INDC meeting to address significant difficulties in recent cross-section evaluations, a new CRP on fission neutron spectra of thorium and the major actinides was quickly initiated.

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 PHYSOR 2008 international nuclear data conference in Interlaken, Switzerland (September 2008). Following the launch of RIPL-3 in 2007 and particularly following the publication of a comprehensive paper on this subject in 2009, citation of this library within other technical literature is very high. Looking forward to 2010 we will have the opportunity to present the results detailed above at the ND-2010 international conference to be held in Korea. Four members of staff will be attending this extremely important event to showcase the NDS's work.

MEETINGS AND SCIENTIFIC VISITS IN 2008

Month/ Duration	Responsible Officer	Type	Meeting Title/Type of Visit	Home Institute	Location
January					
14.01– 15.02	Mengoni	SSA	O. Schwerer: revise EXFOR Formats manual and LEXFOR manual; issue first revision of the Dictionary manual; assist/advise on conversion of EXFOR database into C4 format		Vienna
28.01– 01.02	Capote Noy	CV	S. Takacs: convert cross–sections for production of therapeutic radionuclides into ENDF.6 format	Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary	Vienna
28.01– 06.02	Capote Noy	CV	A. Trkov: covariance calculation of ^{89}Y(n,2n) reaction	Jožef Stefan Institute, Slovenia	Vienna
March					
03–07	Capote Noy	CV	M. Sin: develop new method to calculate neutron–induced fission cross–section; finalise paper on "Transmission through multi–humped fission barriers with absorption: a recursive approach"	Physics Dept., Bucharest University, Romania	Vienna
10–14	Capote Noy	CV	E. Soukhovitski: define dispersive optical model potentials to be included into RIPL–3 database; finalise paper on "Lane consistent optical model potential based on dispersive relations: application to deformed nuclei in the mass range A~50–250"	Joint Institute of Energy and Nuclear Research–Sosny, Minsk, Belarus	Vienna
26–27	Humbert	CM	Consultants' Meeting: 10th Technical Steering Committee for the International Database on Irradiated Nuclear Graphite Properties		Vienna

14–18	Nichols	CV	K. McLaughlin: ensure all electronic copies of material and administrators' aids are in place for IAEA–ICTP workshop		Trieste, Italy
17–18	Clark	TM	Technical Meeting: 16th Meeting of the IFRC Subcommittee on Atomic and Molecular Data for Fusion		Vienna
21–25	Humbert	CV	W. Eckstein: update particle surface interactions (PSI) database; advice/feedback on new database structure and ALADDIN interface developed for PSI data	Max–Planck–Institut für Plasmaphysik, Garching, Germany	Vienna
21.04–30.05	Mengoni	SSA	O. Schwerer: check and verify entries of EXFOR database with respect to restoring numerical tables and other significant changes; produce up–to–date manual version of EXFOR basics		Vienna
22–25	Nichols	TM	Technical Meeting: 27th Meeting of the International Nuclear Data Committee (INDC)		Vienna
23	Dunaeva	CV	S. Hlavac: discuss status of EXFOR compilations, adoption of EXFOR Editor software for digitizing figures, and procedures for information exchange	Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia	Vienna

May

05.05–20.06	Nichols	SSA	D. Lopez Aldama: nuclear data for safeguards – new fission yields and recommendations for activation product decay data, verification/validation set of evaluated nuclear data files, and ACE–format data sets	Centro de Tecnologica Nuclear, Cuba	Vienna
13–14	Nichols	CV	S. Ganesan: advise on plans involving the Indian Nuclear Data Committee and on–going initiatives; discuss technical details beneficial to Indian nuclear data projects and their applications	Reactor Physics Design Division, Bhabha Atomic Research Centre, Mumbai, India	Vienna

15–16	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data		Vienna
June					
05–06	Nichols	CV	Yu Hongwei: NEA Working Party on International Nuclear Data Evaluation (WPEC)	China Institute of Atomic Energy (CIAE)	Tokai, Japan
09–13	Clark	CV	M. Imai: review charge transfer cross–section measurements for fusion–related materials; presentation of charge transfer database; formulation of plan for construction of interface for database allowing access through the GENIE search engine	Department of Nuclear Engineering, Kyoto University, Japan	Vienna
09–13	Humbert	CV	A. Whiteford: review recommendations made by experts on OPEN–ADAS beta version; modify interface in light of recommendations, prepare first release of OPEN–ADAS	Department of Physics, University of Strathclyde, Glasgow, Scotland	Vienna
09.06–18.07	Nichols	SSA	P.K. McLaughlin: construct reference document from all lectures presented during the IAEA–ICTP Workshop on Nuclear Structure and Decay Data (NSDD); update the proceeding of the IAEA–ICTP Workshop on Nuclear Data for Advanced Reactor Systems; assemble the updated files for the 2002 International Reactor Dosimetry File (IRDF2002)		Vienna
27	Clark	CV	R. Srivastava: atomic data/collaboration visit to A+M Data Unit	Indian Institute of Technology, Physics Department, Roorkee, India	Vienna
August					
06–07	Clark	CV	G.P. Gupta: establish numerical databases on atomic, molecular and plasma–surface interactions for use in fusion energy research	S.D. (P.G.) College, Muzaffaranagar, India	Vienna

11–15	Capote Noy	CV	M. Sin: agree final version of paper "Production of ^{230}U/^{226}Th for Targeted Alpha Therapy via Proton Irradiation of ^{231}Pa	Physics Department., Bucharest University, Romania	Vienna
26–27	Mengoni	CM	Consultants' Meeting: Minor Actinide Neutron Reaction Data (MANREAD)		Cologne, Germany
26–27	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data		Vienna
26–29	Clark	CV	Y. Ralchenko: new standard for atomic and molecular data exchange (XSAMS) based on XML, to replace the ALADDIN system; incorporate recently adopted modifications of XSAMS working group; collaborate on implementation of new standard	National Institute of Standards and Technology, Gaithersburg, USA	Vienna

September

03–05	Capote Noy	CM	Consultants' Meeting: High–precision Beta–intensity Measurements/Evaluations for Specific PET Radioisotopes		Vienna
08–11	Capote Noy	CV	L. Leal: evaluation of cross–sections and covariance data in the resonance region for neutron–induced reactions on ^{55}Mn	Oak Ridge National Laboratory (ORNL), USA	Vienna
09–11	Capote Noy	CV	M. Dunn: cross–section evaluation and nuclear data activities at ORNL	Oak Ridge National Laboratory (ORNL), USA	Vienna
22–25	Dunaeva	TM	Technical Meeting: International Network of Nuclear Reaction Data Centres		Obninsk, Russia

October

06	Capote Noy	CV	S. Takacs: set up web page of therapeutic radioisotopes at IAEA–NDS	Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary	Vienna

06.10–19.12	Mengoni	SSA	O. Schwerer: review, check, verify and correct old entries from EXFOR database concerning formal and scientific correctness		Vienna
08–10	Kellett	RCM	Final Research Coordination Meeting: Updated Decay Data Library for Actinides		Vienna
08.10–05.11	Nichols	SSA	V. Pronyaev: maintain and improve IAEA database of neutron cross–section standards	Centr. Jadernykh Dannykh, Fiziko–Energeticheskij Institut, Obninsk, Russia	Vienna
13–15	Nichols	CM	Consultants' Meeting: International Neutron Cross–section Standards: Measurements and Evaluation Techniques		Vienna
16–17	Nichols	CV	P. Talou: measurement and evaluation techniques of reaction cross–sections, and comparison of methods for prompt fission neutron spectra calculations	Los Alamos National Laboratory (LANL), USA	Vienna
20–24	Dunaeva	CV	V. McLane: correction of old EXFOR entries according to new Exchange Format rules		Vienna
20–24	Capote Noy	CM	Consultants' Meeting: Fission Cross–section Calculations Using Microscopic Input Data		
27	Humbert	CM	Consultants' Meeting: XML Schema for Atomic and Molecular Data and Particle Surface Interactions		Beijing, China

November

08–10	Mengoni	CV	J.–C. David: technical aspects of the organization of spallation benchmark, and the online access to results	DAPNIA/SPhN, CEA – Centre d'Etudes de Saclay, France	Vienna
10–11	Nichols	TM	Technical Meeting: Reference Data Libraries for Advanced Nuclear Applications (ENSDF)		Vienna
17–19	Kellett	RCM	Final Research Coordination Meeting: Reference Database for Neutron Activation Analysis		Vienna

17–19	Humbert	RCM	Final Research Coordination Meeting: Atomic and Molecular Data for Plasma Modelling		Vienna
17–28	Abriola	CV	A. Gurbich: update the interface to be used in CD distribution of IBANDL, and IBANDL database maintenance	Institute of Physics and Power Engineering (IPPE), Obninsk, Russia	Vienna
17–8	Capote Noy	CV	G. Mitchell: estimate fraction of missing levels in neutron capture experiments, and application to resonance spacing of selected nuclei	Physics Department, NC State University, Raleigh, USA	Vienna
24–27	Capote Noy	CM	Consultants' Meeting: Prompt Fission Neutron Spectra of Major Actinides		Vienna
24–28	Dunaeva	CV	S. Taova: install improved version of EXFOR–Editor, check functionality and compatibility with NDS Dictionary database; discuss further plans for the development of next version of EXFOR–Editor	Russian Federal Nuclear Centre All–Russia Scientific Research Institute of Experimental Physics, Sarov, Russia	Vienna
24–28	Dunaeva	CV	G. Pikulina: install improved version of EXFOR–Editor, check functionality and compatibility with NDS Dictionary database; discuss further plans for the development of next version of EXFOR–Editor	Russian Federal Nuclear Centre All–Russia Scientific Research Institute of Experimental Physics, Sarov, Russia	Vienna
25–28	Mengoni	CV	N. Colonna: Au data from the measurements at n_TOF facility and MANREAD Data Assessment Initiative	INFN – Sezione di Bari, Bari, Italy	Vienna

December

02–03	Clark	TM	Technical Meeting: International Code Centres Network		Vienna
02–05	Mengoni	RCM	First Research Coordination Meeting: Nuclear Data Libraries for Advances Systems: Fusion Devices (FENDL)		Vienna

02–05	Clark	CV	J. Abdallah: computer codes for calculation of atomic and molecular data, plan for completion of new interface, procedure for adding small number of registered users ability to run complex jobs	Los Alamos National Laboratory, USA	Vienna
08	Mengoni	CM	Consultants' Meeting: Benchmark of Nuclear Spallation Models		Vienna
08–10	Mengoni	CV	J.–C. David: benchmark of nuclear spallation models	DAPNIA/SPhN, CEA–Centre d'Etudes de Saclay, France	Vienna
10–12	Clark	RCM	First Research Coordination Meeting: Characterization of Size, Composition and Origins of Dust in Fusion Devices		Vienna
10–12	Clark	CV	S. Ciattaglia: ITER needs for new data on dust – First Research Coordination Meeting: Characterization of Size, Composition and Origins of Dust in Fusion Devices	ITER Organization, St. Paullez-Durance, France	Vienna
10–12	Capote Noy	CV	S. Dietrich: high–precision neutron non–elastic cross–sections for deformed nuclei	Nuclear Data Group, Lawrence Livermore National Laboratory (LLNL), USA	Vienna
10–12	Capote Noy	CV	E. Soukhovitski: application of dispersive coupled–channels optical model for evaluation of non–elastic cross–sections of actinide nuclei	Joint Institute of Energy and Nuclear Research–Sosny, Minsk, Belarus	Vienna
15–19	Dunaeva	CV	P. Verona: status of EXFOR compilations; appropriate software (EXFOR–Editor) to undertake agreed tasks for internationally–supported EXFOR database	Institute for Nuclear Research, Kiev, Ukraine	Vienna
15–19	Capote Noy	CV	M. Sin: lecture at training course on "Modelling and evaluating nuclear reaction data for transport calculations"	Physics Dept., Bucharest University, Romania	Vienna
15–19	Capote Noy	CV	A. Trkov: lecture at training course on "Modelling and evaluating nuclear reaction data for transport calculations"	Jožef Stefan Institute, Slovenia	Vienna

MEETINGS AND SCIENTIFIC VISITS IN 2009

Month/ Duration	Responsible Officer	Type	Meeting Title/Type of Visit	Home Institute	Location
January					
26–30	Humbert	CV	Y. Ralchenko: internet technologies and development of XML schema for atoms, molecules and solids (XSAMS)	National Institute of Standards and Technology, Gaithersburg, USA	Vienna
27–28	Nichols	CM	Consultants' Meeting: Measurements of Beta and Gamma Components for Decay Heat Calculations (TAGS)		Vienna
February					
09–13	Capote Noy	CV	A. Trkov: assemble and validate IAEA tungsten evaluation; parameters of Kornilov model and covariances of prompt fission spectrum ^{235}U	Jožef Stefan Institute, Ljubljana, Slovenia	Vienna
16.02–15.03	Humbert	SSA	R. Janev: compile and evaluate atomic and molecular data sets for incorporation into IAEA ALADDIN database	Macedonian Academy of Sciences, Skopje, Macedonia	Vienna
24.02–06.03	Capote Noy	CV	V. Maslov: prompt fission neutron spectra with emphasis on ^{238}U nucleus	Joint Institute for Power and Nuclear Research–Sosny, Minsk, Belarus	Vienna
March					
04–06	Clark	RCM	Final Research Coordination Meeting: Atomic Data for Heavy Element Impurities in Fusion Reactors		Vienna
09–13	Capote Noy	CV	E. Soukhovitski: review ISTC research project B–1319 and validate OPTMAN code	Joint Institute of Energy and Nuclear Research–Sosny, Minsk, Belarus	Vienna
11–13	Clark	RCM	Second Research Coordination Meeting: Data for Surface Composition Dynamics relevant to Erosion Processes		Vienna

12–13	Mengoni	CM	Consultants' Meeting on Spallation Reactions (related to the spallation benchmark initiative)		Vienna
16–27	Nichols	CV	M. Gupta: assess decay scheme data of specific actinides and their decay products by means of the DDEP evaluation methodology; identify shortlist of nuclides of specific interest to ^{232}Th, ^{233}U fuel cycle	S.D. (P.G.) College, Muzaffaranagar, India	Vienna
23–27	Abriola	TM	Technical Meeting: International Network of Nuclear Structure and Decay Data Evaluators (NSDD)		Vienna
23–27	Capote Noy	CV	M. Sin: nuclear reaction calculations; finalise paper on production of ^{230}U by deuteron induced reactions on ^{231}Pa	Physics Dept., Bucharest University, Romania	Vienna
25–26	Humbert	CM	Consultants' Meeting: International Database on Irradiated Nuclear Graphite Properties		Vienna
31.03–03.04	Mengoni	RCM	2nd Research Coordination Meeting on Minor Actinide Neutron Reaction Data (MANREAD)		Vienna
31.03–03.04	Mengoni	CV	R. Reifarth: status of availability and accuracy of nuclear reaction data for minor actinides isotopes	Gesellschaft fuer Schwerionen–forschung (GSI), Darmstadt, Germany	Vienna

April

14.04–19.06	Dunaeva	SSA	O. Schwerer: review, check, verify and correct EXFOR database entries compiled between 1960 – 1990		Vienna
27–30	Abriola	RCM	Final Research Coordination Meeting: Development of a Reference Database for Ion Beam Analysis		Vienna

May

25–26	Dunaeva	TM	Technical Meeting: Nuclear Reaction Data Centres International Network		Vienna
25–29	Capote Noy	CM	Consultants' Meeting: Phase Space Database for External Beam Radiotherapy		Vienna

25–29	Capote Noy	CV	I. Kawrakow: use of EGSnrc user codes for ion–chamber modelling and calculations of ion–chamber correction factors in high–energy photon beams	National Research Council of Canada, Ottawa, Canada	Vienna
25–29	Otsuka	CV	V. Varlamov: check extended functionality of EXFOR Editor 2.2 and DATA Editor 1.2; future development of digitizing programs	CDFE, Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russia	Vienna
25–29	Dunaeva	CV	S. Taova: update EXFOR Editor on NDS computer; and check functionality. G. Pikulina: further plans for development of next version of EXFOR Editor	Russian Federal Nuclear Centre All–Russia Scientific Research Institute of Experimental Physics, Sarov, Russia	Vienna
27–29	Dunaeva	TR	EXFOR Editor Training		Vienna

June

02–05	Humbert	CV	P. Krstic: improvement of Plasma–Surface Interface (PSI) data in ALADDIN database	Oak Ridge National Laboratory, USA	Vienna
08–12	Capote Noy	RCM	Second Research Coordination Meeting: Heavy Charged–Particle Interaction Data for Radiotherapy		Catania, Sicily
08–12	Clark	CV	R. Prakesh: collisional–radiative (CR) modelling capability and data needs; report on Indian activities related to spectroscopic analysis	Birla Institute of Technology (BIT), Jaipur, India	Vienna
22–26	Capote Noy	CV	A. Ignatyuk and Yu Hongwei: NEA Working Party on International Nuclear Data Evaluation (WPEC)	Institute of Physics and Power Engineering (IPPE), Russia China Institute of Atomic Energy (CIAE)	Port Jefferson, USA
29.06–18.12	Abriola	SSA	V. Pronyaev: monitor nuclear data services main web site, prepare and ensure publication of IAEA Nuclear Data Newsletter, produce improved databases and reports on selected nuclear data topics, input programmatic reviews, monitor MANREAD CRP	Centr. Jadernykh Dannykh, Fiziko–Energeticheskij Institut, Obninsk, Russia	Vienna

07–09	Humbert	CV	Y. Ralchenko: accelerate development of internet technologies relevant to atomic and molecular physics	National Institute of Standards and Technology, Gaithersburg, USA	Vienna
07–09	Humbert	CV	M. Shimada: present the ITER project focused on technical aspects of A+M PSI data exchange and processing	Fusion Science and Technology Dept., ITER Organization, Saint Paul Les Durance, France	Vienna
07–11	Capote Noy	CV	E. Soukhovitski: deliver optical model potential parameters describing nucleon scattering data on carbon up to 300MeV	Joint Institute of Energy and Nuclear Research–Sosny, Minsk, Belarus	Vienna
10–11	Humbert	CM	Consultants' Meeting: XML Schema for A+M Data		Vienna
28.09– 09.10	Dunaeva	CV	V. McLane: Update old data sets in the EXFOR database, do preliminary processing and discuss new REACTION code format		Vienna
07–11	Humbert	CV	R.E.H. Clark: atomic physics issues		Vienna
07–11	Humbert	CV	H.K. Chung: atomic physics issues	University of California, San Diego Centre for Energy Research, USA	Vienna
October					
06–07	Otsuka	CM	Consultants' Meeting: Benchmark of Spallation Models		Vienna
06–07	Otsuka	CV	F. Gallmeier: define how comparisons between benchmark spallation models organized; draw preliminary conclusions about predicting capability of different models for different types of data	Neutron Source Development Group, Oak Ridge National Laboratory (ORNL), USA	Vienna
19–30	Capote Noy	CV	G. Mitchell: prepare technical document on "Evaluation of missing and spurious neutron–capture resonances of even–even nuclei"	Physics Department, NC State University, Raleigh, USA	Vienna

03–07	Dunaeva	CV	G. Pikulina and S. Taova: install EXFOR Editor software on computers and at DAE–BRNS, Jaipur; check functionality; prepare recommendations for future improvements; train new compilers on use of software to compile scientific articles with EXFOR database	Russian Federal Nuclear Centre All–Russia Scientific Research Institute of Experimental Physics, Sarov, Russia	Jaipur, India
12–13	Chung	CM	Consultants' Meeting: International Database on Irradiated Nuclear Graphite Properties		Vienna
16–20	Braams	CV	R.E.H. Clark: review current research on two CRP's and review Code Centre activities		Vienna
16–27	Abriola	CV	A. Gurbich: final assembly and writing of the appropriate chapters of the final report on IBANDL and carry out IBANDL database maintenance work	Institute of Physics and Power Engineering (IPPE), Obninsk, Russia	Vienna
18–20	Braams	RCM	First Research Coordination Meeting: Light element (H, He, Li, Be) atom, molecule and radical behaviour in the divertor and edge plasma regions		Vienna
16–20	Braams	CV	J. Curry: participate at the RCM on Light Elements and present experimental and database work carried out at NIST	National Institute of Standards and Technology, Gaithersburg, USA	Vienna
22–29	Abriola	CV	B. Pritychenko: install and load NSR database on NDS MySQL database server, discuss NSR compilations and revise technical procedures	NNDC, Brookhaven National Laboratory, Upton, USA	Vienna

Scientific Papers and Publications 2008 and 2009

<u>Journals</u>

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by C. Domingo Pardo, **A. Mengoni**, *et al.*, (the n_TOF collaboration), *Phys. Rev.* **C76** (2007) 045805.

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by F. Gunsing, **R. Capote**, **A. Mengoni**, *et al.*, *Nucl. Instrum. Methods Phys. Res*. **B261** (2007) pp. 925–929.

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Measurement of the stellar cross sections for the reactions ^{9}Be(n,γ)^{10}Be and ^{13}C(n,γ)^{14}C via AMS
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Note: NDS staff members show in bold.

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Series and Number	Titles
Periodicals	Bulletin on Atomic and Molecular Data for Fusion N°s 67, 68.
Newsletter	Nuclear data newsletter N°s 45, 46, 47, 48.

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INDC(NDS)-514	Summary Report of the Second Research Coordination Meeting on Reference Database for Neutron Activation Analysis
INDC(NDS)-520	Summary Report of the Consultants' Meeting on XML Schema for Atomic and Molecular Data
INDC(NDS)-521	Summary Report of the 2nd Research Coordination Meeting on Atomic Data for Heavy Element Impurities in Fusion Reactors
INDC(NDS)-522	Summary Report of the 1st Research Coordination Meeting on Data for Surface Composition Dynamics Relevant to Erosion Processes
INDC(NDS)-523	Summary Report of the 1st Research Coordination Meeting on Heavy Charged-Particle Interaction Data for Radiotherapy
INDC(NDS)-524	Summary Report of the 3rd Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-Energy Nuclear Applications, Reference Input Parameter Library: Phase III
INDC(NDS)-525	Summary Report of the Technical Meeting on Nuclear Data Library for Advanced Systems – Fusion Devices
INDC(NDS)-526	Re-evaluation of Microscopic and Integral Cross-Section Data for Important Dosimetry Reactions
INDC(NDS)-527	Summary Report of the Technical Meeting on Technical Aspects of Atomic and Molecular Data Processing and Exchange, 19th Meeting of the A+M Data Centres and ALADDIN Network
INDC(NDS)-528	Summary Report of the 1st Research Coordination Meeting on Minor Actinide Nuclear Reaction Data (MANREAD)
INDC(NDS)-529	Report of the IAEA Nuclear Data Section to the INDC for the period January 2006–December 2007

INDC(NDS)-530	Joint ICTP-IAEA Advanced Workshop on Model Codes for Spallation Reactions
INDC(NDS)-531	Summary Report of the Consultants' Meeting on IAEA International Database on Irradiated Nuclear Graphite Properties, 10th Meeting of the Technical Steering Committee
INDC(NDS)-532	Summary Report of the Consultants' Meeting on XML Schema for Atomic and Molecular Data
INDC(NDS)-533	Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, 2008
INDC(NDS)-534	Handbook of Nuclear Data for Safeguards: Database Extensions, August 2008
INDC(NDS)-535	Summary Report of the Consultants' Meeting on High-Precision Beta-Intensity Measurements and Evaluations for Specific PET Radioisotopes
INDC(NDS)-536	Summary Report of the Technical Meeting on the International Network of Nuclear Reaction Data Centres
INDC(NDS)-537	Summary Report of the Consultants' Meeting on XML Schema for Atomic and Molecular Data
INDC(NDS)-538	Summary Report of the Technical Meeting: 16th Meeting of the IFRC Subcommittee on Atomic and Molecular Data for Fusion
INDC(NDS)-539	Summary Report of the Third Research Coordination Meeting on Updated Decay Data Library for Actinides
INDC(NDS)-540	Summary Report of the Consultants' Meeting on International Neutron Cross-Section Standards: Measurements and Evaluation Techniques
INDC(NDS)-541	Summary Report of the Consultants' Meeting on Prompt Fission Neutron Spectra of Major Actinides
INDC(NDS)-542	Summary Report of the Third Research Coordination Meeting on Reference Database for Neutron Activation Analysis
INDC(NDS)-543	Summary Report of the Technical Meeting on Reference Data Libraries for Nuclear Applications – ENSDF
INDC(NDS)-544	Summary Report of the final Research Coordination Meeting on Atomic and Molecular Data for Plasma Modelling

INDC(NDS)-545   ADS-2.0: A Test Library for Accelerator Driven Systems and New Reactor Designs

INDC(NDS)-546   Evaluation of Cross-Section Data from Threshold to 40–60 MeV for Specific Neutron Reactions Important for Neutron Dosimetry Applications

INDC(NDS)-547   Summary Report of the 1st Research Coordination Meeting on Nuclear Data Libraries for Advanced Systems – Fusion Devices (FENDL-3)

INDC(NDS)-548   Summary Report of the Technical Meeting: International Code Centres Network

INDC(NDS)-549   Summary Report of the Consultants' Meeting on XSAMS: XML Schema for Atomic and Molecular Data and Particle Solid Interactions

INDC(NDS)-550   Summary Report of the 1st Research Coordination Meeting on Characterization of Size, Composition and Origins of Dust in Fusion Devices

INDC(NDS)-551   Summary Report of the Consultants' Meeting on Total Absorption Gamma-ray Spectroscopy (TAGS), Current Status of Measurement Programmes for Decay Heat Calculations and Other Applications

INDC(NDS)-552   Summary Report of the final Research Coordination Meeting on Atomic Data for Heavy Element Impurities in Fusion Reactors

INDC(NDS)-553   Summary Report of the 2nd Research Coordination Meeting on Data for Surface Composition Dynamics Relevant to Erosion Processes

INDC(NDS)-554   Nuclear Level Densities of ^{116}Sb, ^{118}Sb, ^{122}Sb, ^{124}Sb, ^{165}Er and ^{181}W Derived from Neutron Evaporation Spectra in the (p,n) Reaction

INDC(NDS)-555   Summary Report of the Third Research Coordination Meeting on Development of a Reference Data Base for Ion Beam Analysis

INDC(NDS)-556   Summary Report of the Consultants' Meeting on IAEA International Database on Irradiated Nuclear Graphite Properties, 11th Meeting of the Technical Steering Committee

INDC(NDS)-557   Summary Report of the 2nd Research Coordination Meeting on Minor Actinide Nuclear Reaction Data (MANREAD)

INDC(NDS)-558   Summary Report of the Technical Meeting of the International Network of Nuclear Reaction Data Centres

INDC(NDS)-559   Summary Report of the Technical Meeting of the International Structure and Decay Data Evaluators

INDC(NDS)-561   Missing Level Corrections using Neutron Spacings

INDC(NDS)-565   Summary Report of the Consultants' Meeting on XML Schema for
                  Atomic and Molecular Data

Report	**Country of Origin**	**Numbers of Reports**	**Total Reports**
INDC(EGY)	Egypt	0008	1
INDC(ITY)	Italy	0015, 0016	2
INDC(CCP)	Russian Federation	0445, 0446, 0447, 0448, 0449, 0450, 0451	7
INDC(UK)	United Kingdom	0092	1
INDC(SEC)	Nuclear Data Section (Sec)	0108	1