INDC International Nuclear Data Committee

**Report of the IAEA Nuclear Data Section to the
International Nuclear Data Committee for the period
January 2010 – December 2011**

Edited by

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

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Abstract

This report contains details of the main activities of the IAEA Nuclear Data Section (NDS) during 2010 and 2011, 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 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 2012

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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 four Divisions of the Department of Nuclear Sciences and Applications. The 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 2010–2011. 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 2010–2011.

Robin A. Forrest
IAEA Vienna, Austria
April 2012

Nuclear Data Section

Organization Chart

(March 2012)

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
S. Simakov 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)
V. Semkova Nuclear Physicist (21727)	_____ Nuclear Physicist/Code developer (21708)	**H.-K. Chung** Atomic Physicist (21729)
N. Otsuka Nuclear Data Physicist (21715)	**K. Nathani** Clerk (21711)	**M. Verpelli** 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 2010–2011 was effectively a total of 17.25, consisting of 12 professionals (P-staff) and 5.25 support staff (G-staff).

The Unit Heads have been:

- Bastiaan Braams, Atomic and Molecular Data Unit (AMDU);

- Stanislav Simakov, Nuclear Data Services Unit (NDSU), started July 2010;

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

All of which have contributed to this report.

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

- Valentina Semkova (started October 2010).

- Marco Verpelli (started May 2011).

- Andras Vasaros provided IT systems support during the long-term absence of Liam Costello during most of 2011.

The budget and costs of NDS are outlined in Table 1 in Euro (2009 in 2009 prices, rest in 2011 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 2012–2013 are estimates. One worrying trend is that while there are small increases in the predicted total budget, the increase in support costs means that the actual money spent on delivering the technical programme will fall.

Table 1. Staff and budget - summary for 2009–2013 (derived from PROBIS).

	2009	2010	2011	2012	2013
Authorized Staff Level	17.25	17.25	17.25	17.25	17.25
Actual Staff Level	16.50	16.75	16.92	16.92*	16.75*
Admin. + Agency O/H Support Costs(€)	933 234	893 130	905 385	1 049 911*	1 049 911*
Technical Programme(€)	1 636 653	1 816 031	1 897 265	1 785 800*	1 790 346*
Total (€)	2 569 887	2 709 161	2 802 650	2 835 711*	2 840 257*

*estimated 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.

NDS staff produced and distributed four regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9100–9103) 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.

During 2010–2011, NDS staff distributed 11 charged-particle TRANS files (D071–D080, S014), containing 153 new entries and 186 revised entries, 11 neutron TRANS files (3143–3153) containing 67 new and 333 revised entries, 5 photonuclear TRANS files (G019–G023) containing 25 new and 33 revised entries. 143 new entries were compiled at NDS, 27 at UkrNDC, 24 at ATOMKI, 23 by NDPCI, 22 at CNDC, and 6 at KAERI.

152 TRANS files were received, checked (with feedback to the originating centres) and processed in 2010–2011, of which 138 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 1012 neutron entries (188 new, 824 revised), 1072 CPND entries (577 new, 495 revised) and 197 photonuclear entries (77 new, 120 revised).

The literature was thematically scanned and several working documents (Memos), that include lists of references missing in EXFOR, were prepared in order to respond to the needs of different Coordinated Research Projects, and Technical and Consultants' Meetings.

For the needs of Nuclear Data for Medical Applications, comparison was carried out between the 651 references cited in Volume 13 of Landolt-Börnstein (LB) New Series (Springer Verlag) and the EXFOR database. In total 173 missing articles were identified, analysed, and proposed for compilation by the NRDC Centres.

Comprehensive analysis of the articles reporting experimental data for neutron spectra induced by light charged particles was performed at NDS. Such data are extremely important both for model calculations and for applications. About 170 different data sets that have to be compiled were included in WP2011-13 (Memo CP-D/700).

Nuclear Resonance Fluorescence (NRF) phenomenon in actinides is now being implemented as a non-destructive assay of fissile materials. To follow the urgent needs of data for safeguards applications, NDS initiated the scanning of all published experiments and presented them at NRDC meeting 2011 (WP2011-14, Memo CP-D/703). Due to the active work of NRDC, all the known NRF data for actinides are now included in EXFOR.

The neutron cross section standards are extremely important for measurements and evaluations. A database to help in the evaluation of the standards (existing as an input file for the GMA code) has experimental results, uncertainties and covariances that were missed in EXFOR. The WP2011-15 and Memo CP-D/699 documents list such data with a prescription on how they should be compiled by NRDC.

The need for inclusion of delayed neutron data (emission probabilities and neutron spectra) in the database was pointed out during the "Beta-delayed neutron emission evaluation" consultants' meeting (INDC(NDS)-0599). Preparation of a document discussing the compilation of delayed neutron data in EXFOR is in progress and will be distributed to the NRDC community in the near future.

In response to the CRP on prompt fission neutron spectra (PFNS), PFNS data sets compiled in EXFOR were systematically checked and their improvement is in progress in collaboration with other neutron Data Centres (NNDC, NEA DB and CJD). Compilation of minor actinide PFNS measured within an ISTC project is also in progress in collaboration with JAEA Nuclear Data Centre and L. Drapchinsky (Radium Institute, St. Petersburg).

For evaluation of structure and decay data of super-heavy elements for the ENSDF library,

super-heavy element production cross sections were systematically compiled in collaboration with S. Babykina (Kurchatov Institute, Moscow) and M. Gupta (Manipal University).

The staff of NDS regularly collected, registered and responded to user feedback. The EXFOR database was also systematically scanned for physical incorrectness of compiled information. Thus the search was made for too high (> 20 MeV) and too low (< 10 keV) level energies, angular differential cross sections without level energy specification and MeV data erroneously compiled as GeV data. In total about 370 coding errors were identified and summarized in four technical documents (Memo CP-D/709, 712, 715 and 718) that were submitted to other NRDC centres for correction.

Valuable information on the energy distribution of neutrons from different types of neutron sources used for the measurement of spectrum averaged reaction cross sections was collected from the participants of the Consultants' meeting on "Neutron Source Spectra for EXFOR", 13-15 April 2010 (INDC(NDS)-0590). The compilation of incident neutron spectra in EXFOR will complement the already existing integral cross section data, so enabling them to be better used for data validation.

The process of EXFOR compilation is made more efficient by the use of a stand-alone local application (EXFOR coverage control system). Under this system, NDS staff scan about 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).

The EXFOR coverage control system, which was introduced in 2006, has proved to be of immense value in reducing compilation time. During 2010, NRDC compiled 80% of the articles published in 2010 (same year), showing a gradual increase in the compilation ratio compared to the years 2000, 2006, 2008 and 2009 of 20%, 34%, 52% and 71% respectively.

A collection of EXFOR-relevant papers in PDF-format has been initiated for internal use and presently includes about 18,000 articles which were either found on the Internet or have been scanned from hardcopies.

To inform users about newly compiled data in EXFOR, NDS started in 2011 the publication and electronic distribution of the "EXFOR News" after every database update: http://www-nds.iaea.org/nrdc/exfor_news/.

The recent advances in EXFOR and software tools for data retrieval from the NDS web site were featured in the latest issue of Nuclear Data Newsletter (No. 52 November 2011) as a core activity of the Nuclear Data Section.

The monthly analyses of the access statistics to the www-nds web site showed that the EXFOR and NRDC requests systematically occupy the highest positions, thus indicating the nuclear data services from NDS most required by Member states.

2.2. CINDA

The CINDA database was extended by information automatically imported from EXFOR (four updates) and from NSR (three updates). Manual compilation has practically stopped. An algorithm and software for importing data from NSR to CINDA were developed. All information, complete Master files and TRANS files in CINDA exchange format are available on the NDS web site. Full backup files (for MySQL database) were regularly produced and sent to NNDC, were they were loaded onto the database server and used for the Web retrieval system.

3. NUCLEAR DATA SERVICES

3.1. Web-based services and software

The main links to provide services are continuously updated on the NDS web server (http://www-nds.iaea.org/). An improved version of the NDS front page has been developed and implemented. Several new features and improvements have been introduced in the EXFOR/CINDA/ENDF retrieval systems: new functions, advanced plotting and new output formats.

A new class of Web service, termed 'remote Web applications', was developed and introduced for users. 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.

The content of the Structure and Decay Database 'LiveChart' were significantly extended by inclusion of new nuclear structure and decay data as well as new features. The web service capabilities now offer to users sophisticated tools for searching, filtering and visualisation.

Nuclear reaction database retrieval services
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:

- ENDF web retrieval interface has been extended to include:
    - TENDL-2010: TALYS-based Evaluated Nuclear Data Library 2010.
    - ROSFOND-2010: neutron library (683 materials), Obninsk, Russia, 2010.
    - JENDL-4.0 Japanese evaluated nuclear data library, 2010.
    - CENDL-3.1 Chinese evaluated neutron data library, issued in 2009.
    - EAF-2010: European Activation File (816 materials/60MeV), UK, issued in 2010.

- New output formats from EXFOR Web retrieval system (software was developed):
    - EXFOR in XML with interpretation to HTML using XLS.
    - X4Std (text and XML): output for advanced users writing own software for processing EXFOR files.
    - C5 computational format: C4 + statistical and systematic uncertainties.

- EXFOR data correction system was developed and released for Web users. System has simple but powerful language to describe re-normalization of old data according to new standards, half-lives etc. Archive of monitors currently contains 47 datasets.

- Interactive Web-tool for constructing a covariance matrix from EXFOR uncertainties was developed and released for users.

- NDS PDF collection of EXFOR papers was loaded to EXFOR database and became available for authorized users outside of the IAEA.

- CINDA Web interface was extended to search data imported from NSR, available in Internet, but not compiled to EXFOR; EXFOR retrieval system was linked to this search.

- Special feature for PIGE compilers was developed to allow data from EXFOR to be included in the IBANDL database automatically.

- ZVView package was extended to read directly ENDF MF33/LB5 data to enable the display of covariance matrices; Linux/Windows/Mac versions have been released; it has also been adopted for use in the EMPIRE code package.

- Web-ZVView (plotting on server side) was extended to plot covariance matrices from users' ENDF-MF33 sections and full ENDF files; it was also extended to read ENDF files from non-IAEA Web archives; the last version was adopted to work with mobile devices (e-reader Kindle-3, iPad, etc.).

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

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

- Web pages for support management of EXFOR compilation activity were regularly updated and further developed to search for works of a given author in the EXFOR database.

Server applications: Web tools for nuclear data developers

The main tasks of these tools are: checking format of users' data, run standard utilities on Web server, compare users' data with data in central databases. A technology to run legacy Fortran codes on Web server was developed. Three Web tools were developed and installed at both the IAEA-NDS and NNDC Web sites:

- Web tools for EXFOR compilers which allow the uploading of a user's EXFOR file and then to:
  - run checking codes (new x4check.java and ZCHEX program);
  - find duplications (reference, ENTRY and alteration flags);
  - run standard utilities (ORDER, XTRACT, X4TOC4, etc.);
  - do common plotting with EXFOR and ENDF data from the IAEA databases;
  - construct and plot experimental covariance matrices.

- Web tools for ENDF evaluators can be used with user's data:
  - to run remotely the programs CHECKR, FIZCON, STANEF, PSYCHE, INTER, PREPRO with setting of parameters (temperature, accuracy);
  - to search for similar data in EXFOR and ENDF databases;
  - to compare user's data with EXFOR and ENDF data from the IAEA databases (with common plotting using ENDVER and Web-ZVView packages).

- Web tools for ENSDF evaluators can be used with user's data:
  - to run ENSDF analysis codes FMTCHK, GTOL, LOGFT, PANDORA;
  - to run on Web server NDSPUB2 and produce PS/PDF for Nuclear Data Sheets using data from ENSDF and NSR relational databases.

Relational Database and Applications for Structure and Decay Data

The effort in designing services for users to navigate through a wide range of structure and decay data has continued. The goal is to equip them with tools enabling capabilities such as filtering and sorting, unveiling systematics and patterns, visualising and plotting.

The relational database that is the inner engine of those tools has grown, and now includes tables for:
- bands, from parsing the ENSDF comments records;
- data from INDC documents that the Publication Statistics application (see Publication

Management) showed to be of particular interest for users.
Examples are the data from:

  S.F. Mughabghab, Thermal neutron capture cross sections, INDC-NDS-440:
- Westcott g factors;
- Resonance Integrals;
- Thermal neutron cross sections;

  N.J. Stone, Table of Nuclear Magnetic Dipole and Electric Quadrupole Moments, INDC-NDS-594:
- Nuclear magnetic dipole moments;
- Nuclear electric quadrupole moments;

- data from the Atomic Mass Data Centre:
  - Atomic mass;
  - Binding energy;
  - Mass excess;
- fission yields taken from the JEFF 3.1.1 library.

The two applications based on this database have been improved based on feedback for users and experts.

LiveChart, a web-based interactive table of isotopes, now includes:
- more than 30 colour coded options;
- interactive plots of fission yields;
- filter options on decay mode, spin, and half-life;
- plots of energy levels.

The information displayed when selecting a nuclide reflects the enhancement of the database:
- quantities from the Atomic Mass Data Centre;
- levels from ENSDF;
- gamma transitions from ENSDF;
- decay radiations;
- bands from ENSDF;
- moments from N.J. Stone (INDC-NDS-594);
- thermal neutrons capture from Mughabghab (INDC-NDS-440);
- fission yields from JEFF 3.1.1;
- in addition, an interactive plotting engine shows the level band schemas and produces images in both JPG and EPS formats. The engine has many options to customise the data displayed and the graphics layout.

The Query Tool now allows filtering criteria on all of the quantities present in the database, enabling a user to impose conditions on, say, bands, decay modes, gamma transition mixing, and then plot the filtered quantities with the embedded ZVView engine. Questions concerning the systematics of data, such as plotting energy versus half-life for all levels decaying by β^-, can be quickly answered.

A qualitative analysis of the web accesses shows a broad spectrum of users, including:
- university web sites hosting on-line assignments;
- students exchanging the link on social media like Twitter, Facebook, Stumble upon;
- research centres.

The user's geographical distribution leans towards the western hemisphere plus Japan. The accesses have peaked after the Fukushima event, but the subsequent decrease settled to a higher level than before, showing that many users were retained.

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

Status of NDS electronic document project
The IAEA Nuclear Data Section, and (prior to NDS inception) the Nuclear Data Unit, has distributed documents which were defined as having originated under the auspices of the International Nuclear Data Committee (INDC) since 1962. These reports are categorized by geographical origin, as well as having chronologically assigned identification numbers (accession numbers) for internal NDS use – initially INDSWG (to 137), changing to INDC (from 138 onwards). The viability of converting all of these documents to electronic form was investigated in 2004. Some of the documents were already either in the INIS (International Nuclear Information System) database http://www.iaea.org/inis/ or individual laboratory electronic archives. For many others, a hardcopy (paper) or microfiche form of the document was identified and scanned - some of the older documents were of poor quality and in such cases pdf. files were produced to the highest standard possible.

This work was undertaken in cooperation with International Nuclear Information System (INIS) staff who have suitable equipment and expertise to handle microfiche and bulkier texts. At the time of reporting to the previous meeting of the INDC (May 2010), 59% of the documents identified in the series had been scanned and made available. The more urgent demand on INIS services by other offices of the IAEA meant that the NDS scanning project had low priority. Consequently in 2010 the possibility of accelerating completion of the project by, where feasible, continuing the scanning work within the NDS was explored. As a fast-feed scanner was available in NDS, much more of this work was subsequently undertaken in the Section and by end-2011 the remaining 40% of the project was completed. The total number of documents in this series has now reached over 2500 and the table below shows the exact status of documents involved - when not possible to locate a document, a remark to this effect has been included on the Website http://www-nds.iaea.org/publications/indc_groups.php

During the course of this work, the Website, with links to published documents, has also been upgraded. All available cross references have been included on the Website, and consistency achieved whenever possible in the presentation of the contents of the site.

Table 2. Electronic documents.

missing = details recorded, unable to locate a copy of the document; not known = no details recorded of document assigned to this reference

Country	Scanned	Missing	Remarks
ARG	13	0	
AUL	36	9	9 not known (nos. 29, 34, 35, 36, 39, 40, 41, 42, 43)
AUS	21	0	
BAN	4	0	
BLG	1	0	
BLR	21	0	
BOL	1	0	
BUL	16	0	
BZL	35	2	2 not known (nos. 26, 27)
CAN/CND	31	2	1 not known (no. 10); 1 missing (no. 16); 1 recorded twice (19/*4)
CCP	461	0	5 not known (nos. 14, 206, 308, 340)
CHL	4	0	
CPR	61	0	
CSR	16	0	
CUB	7	0	
CZR	1	0	
DEN	4	0	

EAN	10	0	
EGY	8	0	
ENE	13	9	9 missing (nos. 2, 7, 8, 9, 10, 11, 12, 16, 17)
EUR	36	1	1 missing (no. 11)
FIN	2	0	
FR	66	6	1 not known (no. 3); 5 missing (nos. 18, 26, 39, 63, 66)
GDR	60	4	2 not known (nos. 29, 49); 2 missing (nos. 4, 37)
GER	58	0	
GRC/GRE	3	0	
HUN	36	0	
IAE	46	0	
IND	67	0	1 report recorded twice
INS	1	0	
IRN	4	0	
IRQ	1	0	
ISL	5	0	
ITY	15	1	1 missing (no. 2)
JAP/JPN	203	2	Not feasible to scan 2 Nuclide Charts nos. 57, 99
KOR	4	1	1 missing (no. 3)
KWT	2	0	
MOR	3	0	
NDS	486	0	19 missing (nos. 17, 32, 33, 35, 37, 64, 109, 144, 229, 242, 252, 258, 270, 302, 305, 332, 370, 380, 386); 2 with no accession number (nos. 259, 550)
NEA	7	3	3 missing (nos. 2, 3, 4)
NED	10	0	
NOR	3	0	
PAK	13	0	
POL	18	0	
POR/PRT	3	0	
ROM/RUM	23	0	
SAF	11	0	
SEC	106	3	1 not published (no. 3), 2 not known (nos. 102, 103)
SLK	2	0	
SLN/SLO	3	0	
SPN	3	0	
SUD	4	0	
SWD	29	0	
SWT	18	0	
TAI	4	0	
TUK/TUR	6	0	
UK	83	2	1 missing (no. 26); 1 not known (no. 45); nos. 59-88 not allocated
UKR	5	0	
UNI	0	7	Included in list for completeness only - not digitalized (CINDA/RENDA)
URU	1	0	
USA	129	36	6 missing (nos. 18, 28, 35, 49, 95, 98), 6 not known (nos.55, 71, 82, 87, 90, 92)
VN	11	0	
YUG	11	0	

Number of documents listed has been corrected, revised and updated since the table was first presented to the INDC Meeting in 2006, for example, to take into account pre-INDC (INDSWG) referenced material not included originally.

CD-ROM Services
- CD-ROM "EXFOR-CINDA Database and Retrieval System for Windows" two issues;
- CD-ROM "ENDVER/GUI" for Linux/Windows/Mac: two issues;
- CD-ROM "EXFOR-CINDA for Applications" for Linux/Windows/Mac: two issues.

- DVD/ROM with three CD-ROMs above and CD-ROM with collection of 25 ENDF libraries was prepared and issued. This single DVD/ROM will replace CD-ROMs distribution listed above.

During 2010-2011 in total 1588 PC media (CD-ROMs and DVDs) were delivered as well as 239 hardcopy documents (INDC reports, Charts of Nuclides, Nuclear Wallet Cards, etc.).

Publications management

The INDC reports, containing more than 2500 documents at the moment, are a unique source of knowledge for nuclear data related topics. The efforts in producing these high quality papers need to be matched with an equally high quality service to make them available in the best way to users.

To achieve this the management of INDC reports after publication, as well as other types of documents like NDS staff papers or IAEA-NDS report series, was analyzed. The objective was to improve the dissemination of this archive of documents, and to build back-end services to manage the storage, the insertion and updating, and to better understand users' needs and preferences.

The tasks to achieve those goals were defined as:
1. Storage of document bibliographic data in a relational database.
2. Document visibility under Google Scholar, a widely used, freely accessible web search engine that indexes scholarly literature.
3. A dedicated web site providing easy and clear user navigation.
4. Single search engine across the entire set of documents, allowing search by keyword, author and serial number. In this way it will be possible to search documents by a topic of interest without going through the entire list of publications.
5. Web based application to manage the database and to load the documents on the server.
6. Dynamic web pages reflecting the database updating.
7. Server side application to collect download statistics.

The implementation of the above tasks was achieved by:
1. Creating a relational database to store the bibliographic data. The design was initially modeled according to the Jabref database – one of the standards in bibliographic databases – and then modified to accommodate additional functionalities, including multiple codes for documents, or user access rights. The database engine chosen was MySQL, consistent with all the other relational databases at NDS.
2. Creating a dynamic *landing page* for each report. This page summarizes the report data and contains the required meta-tags to be indexed by Google Scholar.
3. A single, portal-like, web entry point for all NDS publications, highlighting the most recent updates. Each document category has a dedicated page with search capability through author, title, and abstract.
4. The main page has an embedded, seamless integrated search engine allowing direct database searches by keywords.
5. A web application, password protected, allows authorized users to insert and modify bibliographic data, and to upload pdf files on the server. Through this means staff responsible for managing publications are independent from the system administrator.
6. The web pages presenting the bibliographic data, and giving access to pdf documents, are dynamically generated by reading the MySQL database. The underlying technology is PHP.
7. A server side script scans the web server log to count the successful downloads of each report, and a web page – visible only from the NDS premises - shows the report.

The publications web page was made available for public use during September 2011, and has since been improved to incorporate suggestions from internal as well as external users. Web-access statistics have shown that the publications web site has grown to become one of the most accessed sections of the www-nds web site.

The download statistics provides feedback to authors, which has been used to improve the offering of other NDS services. As an example, some data from the most accessed documents were made available in an easier way in other NDS data-retrieval engines.

3.3. Statistics

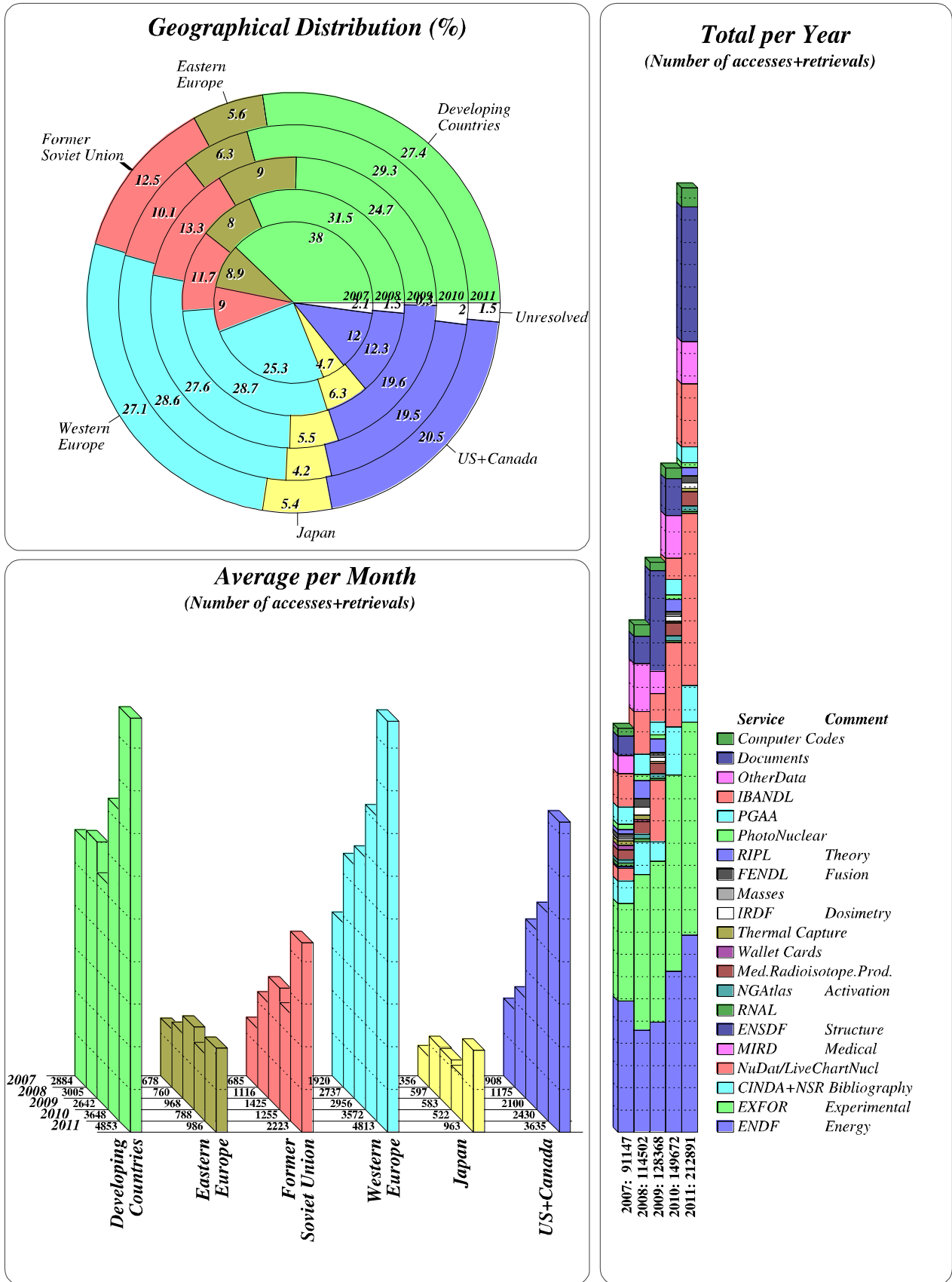Full statistics of usage of the web retrieval system are presented in Fig. 1.

Fig. 1. Nuclear data access and retrievals from IAEA-NDS 2007–2011.

The total number of data retrievals has increased by 17% and 42% compared to the previous year in 2010 and 2011 respectively. While the increases in EXFOR (22% and 9%) and ENDF (46% and 23%) requests have risen steadily, LiveChart has increased from nothing in 2009 to have an increase of 104% in 2011. Similarly the number of documents downloaded in 2011 reached 30300. It is likely that the worldwide search for data following the Fukushima Daiichi accident has been responsible for many of the rapid rises seen during 2011.

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 Meeting of the NRDC Data Centres Heads was held at Hokkaido University Sapporo, Japan, from 20–23 April 2010 (see INDC(NDS)-0573). This combined meeting was attended by 27 participants from 12 cooperating data centres from seven Member States and two international organizations. Main topics were assignment of EXFOR compilation responsibility to KAERI for experimental data measured in Korea, assignment of EXFOR compilation responsibility by the location of experimental facility (not by the location of publishers) and future CINDA compilation. In total 46 working papers were presented at the meeting, and the results of the discussions were summarized as 32 Conclusions and 63 Actions.

The Technical Meeting of the International Network of Nuclear Reaction Data Centres was held at IAEA Headquarters in Vienna, Austria, from 23–24 May 2011 (see INDC(NDS)-0593). The meeting was attended by 25 participants from 13 cooperating data centres from nine Member States and two international organizations. Main topics were compilation of neutron cross section covariances, neutron source spectra and nuclear resonance fluorescence (NRF) data. In total 43 working papers were presented at the meeting and the results of the discussions were summarized as 19 Conclusions and 56 Actions.

Another role of NDS in the coordination of NRDC is organization of Workshops to train compilers and transfer professional knowledge and technical skills. For the reporting period two Workshops were organised by NDS:

- 2010 EXFOR Compilation Workshop was held at IAEA Headquarters in Vienna, Austria, from 30 August - 3 September 2010. The workshop was attended by 17 participants. The major revisions of two EXFOR manuals (EXFOR Formats Manual and EXFOR Compiler's Manual - LEXFOR) were discussed. The latest developments in software tools (Editors, uploading system, covariance processing) were presented and practical exercises were given.
- 2011 EXFOR Compilation Workshop was held at IAEA Headquarters in Vienna, Austria, from 25 to 27 May 2011. The workshop was attended by 23 participants. Lectures were given for two specific research fields - systematics of reaction cross sections and neutron activation cross section measurements. Two data centres

presented compilation and evaluation activities related to EXFOR. Also new functions of EXFOR compilation tools (Digitizer and Editor) were presented with exercises.

Bilateral visits:

- V. Zerkin (IAEA-NDS) to NNDC. To develop software for the management and web-retrieval of ENDF, CINDA and EXFOR relational databases.
  6–26 November 2010.
- N. Otsuka (IAEA-NDS) to NNDC. Discussion on compilation of nuclear reaction cross section and covariances related EXFOR.
  17–26 November 2010.
- V. Zerkin (IAEA-NDS) to NNDC. To deploy and further develop software for the management and web-retrieval of ENDF, CINDA and EXFOR databases as well as remote processing of users data.
  8–26 August 2011.
- N. Otsuka (IAEA-NDS) to CNDC. Participation to the EXFOR workshop organized by the Chinese Nuclear Data Centre.
  5–9 September 2011.

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, 4–8 April 2011 (INDC(NDS)-0595). This meeting was attended by 35 scientists from 20 Member States involved in the compilation, evaluation and dissemination of nuclear structure and decay data. The first two days were dedicated to a combination of organisational, administrative, technical reviews and discussion papers, addressing particular topics in which progress has been made and problems that have been encountered over the previous two years. Specific mass chain activities, horizontal evaluations and technical issues were debated over the final three days. Problems are still being experienced in maintaining suitable numbers of mass chain evaluators (expressed as FTE – Full Time Effort). The most important issue of the meeting was the uncertain future of the Network due to the ageing of a majority of the existing evaluators. Member States should support the continued efforts of the Network to train new evaluators by providing the proper working environment in their respective institutions. Thanks to IAEA efforts, six new evaluators are being supported and are actively performing evaluations. NDS staff will continue to support new evaluators and collaborate in mass chain evaluations.

Bilateral visits:

- M.A. Kellett (IAEA-NDS) to CIEMAT. Attendance at the 3rd Workshop of Radioactive Decay Data Evaluators.
  9–11 June 2010.
- D.H. Abriola (IAEA-NDS) to NNDC. Attendance at USNDP meeting and carry out ENSDF evaluation work.
  20 Oct–3 Nov 2010.
- B. Pritychenko, NNDC to NDS. Install and load NSR database on NDS MySQL database server, discuss NSR compilations and revise technical procedures.
  19–26 November 2010.
- B. Singh, McMaster University to NDS. Collaborate on the update of the most neutron deficient nuclides of A=148: ^{148}Tm, ^{148}Er and ^{148}Ho for ENSDF database.
  14–16 June 2011.

- D.H. Abriola (IAEA-NDS) to McMaster University. Collaborative work with B. Singh on beta-delayed neutron emission evaluation.
  7–11 November 2011.
- D.H. Abriola (IAEA-NDS) to NNDC. Attendance at USNDP meeting, and carry out ENSDF work.
  13–23 November 2011.
- B. Pritychenko, NNDC to NDS. Install and load NSR database on NDS MySQL database server and revise technical procedures.
  21–25 November 2011.

5.   ATOMIC AND MOLECULAR DATA

The primary objective of the Atomic and Molecular Data Unit (AMDU) is to establish and maintain internationally recommended databases on atomic, molecular and plasma-material interaction (A+M+PMI) properties and processes for use in fusion energy research and other plasma science and technology applications. These databases and other information are accessible through the Unit's web pages at http://www-amdis.iaea.org/. (AMDIS stands for Atomic and Molecular Data Information System.)

The unit maintains a numerical database (ALADDIN) and other numerical datasets, a search engine (GENIE) to find and access numerical data hosted elsewhere, a bibliographical database (AMBDAS) and since 2010 a Wiki-style Knowledge Base on A+M+PMI data for fusion. Coordinated Research Projects (CRPs) are organized to encourage worldwide collaboration in the production and validation of new data. Technical Meetings and Consultants' Meetings are held to support the activities of the unit and coordinate database activities throughout Member States. Among the recurring meetings of that kind are the coordination meetings of the international Atomic and Molecular Data Centre Network (DCN), those of the Code Centres Network (CCN) and meetings devoted to the development of XML standards for exchange of A+M and PMI data.   Once every two to three years the unit organizes a workshop addressed primarily to young researchers in the area of plasma modelling with use of A+M+PMI data, and at times the unit cooperates in more advanced workshops. 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 Centres Network. The IFRC Subcommittee on Atomic and Molecular Data and the Data Centre Network each meet biennially, in alternate years.

The present summary of work of the A+M Data Unit draws upon an AIP Conference Proceedings paper [APiP 2011, in press] that offers some historical perspective and original references.

5.1.   Numerical databases

ALADDIN is the principal numerical database maintained by the unit. The interface is split into two broad categories of data: atomic and molecular collisions, which include photon impact processes, electron impact processes and heavy particle collisions, and particle-surface interaction, which include reflection, penetration, physical sputtering, chemical sputtering and radiation-enhanced sublimation. Data in ALADDIN come largely from coordinated research projects, consultancies and other activities of the A+M Data Unit and are recommended data at the time of their compilation.

Several further numerical datasets are accessible through the A+M Data Unit home page. These are data for specific atomic or molecular systems that do not fit well into the

ALADDIN framework. There are links to important external databases including Open-ADAS: the core atomic data (without analysis programs) developed in the ADAS project. New in 2010-2011, for each atomic and ionic system up to Z=79 (Au) rate coefficients calculated by FLYCHK are provided as a function of temperature in the coronal (low density) limit for processes of direct collisional ionization, excitation autoionization, radiative recombination and dielectronic recombination. The FLYCHK radiative cooling rate coefficients for line radiation and recombination radiation are also given. Another dataset that was added in 2010-2011 provides the results of detailed structure calculations using the LANL atomic physics codes for atoms and ions of argon, chlorine and silicon.

The "General Internet Search Engine for Atomic Data", GENIE, provides a common query interface to multiple databases for atomic structure and spectroscopy and for electron-atom collisions. Currently 9 structure and spectroscopy databases and 6 collisional databases may be accessed by GENIE; two of these were added in 2010-2011. GENIE does not translate the output from the various databases into any common format and it may be most valuable as a tool for data discovery. Like our bibliographical and numerical databases it is accessible without log-in or password.

Looking ahead, there is a recognized need for on-going critical evaluations of data available through many sources, not just ALADDIN and including data not hosted at IAEA. This issue was a centrepiece of the discussions at the 21st meeting of the Data Centre Network that took place in September 2011. In the follow-up to those discussions we are now working with partner centres, especially in Korea and Japan but extending to all our partners, to coordinate data evaluation efforts, establish guidelines for evaluation of theoretical data, create a series of meetings and workshops on data evaluation, and generally increase cooperation among people engaged in data evaluation. A consultants' meeting was held in February 2012 and a larger technical meeting is planned for September.

Another area that requires increased emphasis in 2012-2013 is that of tritium retention in materials and associated effects of material microstructure and radiation damage. We are working to host new datasets in the area of microstructure of plasma-facing materials and we plan a new CRP focussed on tritium retention in irradiated tungsten and tungsten alloys to support design efforts in Member States for next-step fusion devices.

5.2. Bibliographical database

AMBDAS, the Atomic and Molecular Bibliographic Data System, contains about 50000 entries going back to 1950 of articles and reports on atomic, molecular and particle-material or plasma-surface interaction data relevant to fusion energy research. The broad categories in AMBDAS are structure and spectra, atomic and molecular collisions and surface interactions. Entries are classified by process and reactants and classified as experimental or theoretical. Relevant energy values or energy ranges are also provided. Since 2010 the entries in AMBDAS are linked to the on-line version of the paper via its digital object identifier (doi) where it is available.

In 2010 and 2011 AMBDAS was updated with new data on structure and spectra, but the bibliographical database effort is under pressure. The easy access to bibliographical data through the web has changed the role of dedicated databases, and the Controlled Fusion Atomic Data Center at Oak Ridge that provided us and the community with bibliographical data on collision processes has ceased operation. With our data centre partners we judge that a bibliographical database for literature that presents numerical A+M+PMI data remains valuable. We hope to integrate a recently developed database from the Korean National Fusion Research Institute into our bibliographical database in 2012 and to work through the

Data Centre Network to support the maintenance of AMBDAS in the future.

5.3. Knowledge Base Wiki

The success and impact of Wikipedia has inspired us to start in 2010 a wiki-based Knowledge Base on data sources, data production, data needs, applications of data and related information about atomic, molecular and plasma-material interaction data in fusion energy research and related fields. This knowledge base quickly became one of the most visited area of the A+M web pages, which attests to the attractive format and easy access that is offered by this mode of presenting data and other information. The information on the wiki is addressed to fusion plasma researchers and atomic, molecular and materials physicists in a way that complements our traditional databases with the aim to encourage collaboration and relevant new research. The wiki is public on the web, but editing is restricted to those that have obtained a password.

5.4. Coordinated Research Projects

The A+M Data Unit has an active programme of CRPs. Two CRPs had their final Research Coordination Meeting (RCM) in 2010-2011, three CRPs were active in 2010-2011 and will meet again in the next biennium and one CRP was approved in 2011 to start in 2012.

The CRP on Data for Surface Composition Dynamics Relevant to Erosion Processes (2006–2011) held its third and final Research Coordination Meeting 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) held its second RCM in June 2010 and its third and final RCM in November 2011. 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 CRP on Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions (2009–2014) held its second RCM in May 2011. 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.

The CRP on Spectroscopic and Collisional Data for Tungsten from 1 eV to 20 keV held its first RCM in December 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 new 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.

The CRP on Atomic and Molecular Data for State-Resolved Modelling of Hydrogen and Helium and Their Isotopes in Fusion Plasma (2011-2015) held its first RCM in August 2011. This CRP is devoted to the development of fundamental and derived data for collisional, photon-induced and radiative processes that are resolved with respect to vibrational (in the case of molecules) excited state of the incoming and outgoing particles. The species of interest are H, H^+, H^-, He, He^+, He^{2+}, He^-, H_2, H_2^+, H_3^+, HeH^+, He_2^+ and their isotopic variants. Fundamental data include cross sections for collisions with electrons and collisions among themselves, photon-induced processes, lifetimes of excited states and line shapes of the principal emissions. Derived data are effective cross sections and rate coefficients for collisional-radiative modelling of the divertor and edge region and the neutral beam heating system of fusion energy experiments.

The Committee on Coordinated Research Activities has approved a new CRP on Data for Erosion and Tritium Retention in Beryllium Plasma-Facing Materials (2012-2016). This CRP is intended to enhance the knowledge base on fundamental plasma-wall interaction processes involving beryllium. The key processes are physical and chemical sputtering by H, He and Be, which release beryllium impurities into the plasma, trapping and reflection of hydrogen (H, D, T) on beryllium surfaces in the plasma environment, the transport of hydrogen in beryllium and means to extract trapped tritium. In addition the CRP will address data for mixed materials, especially Be-(H, D, T, He), Be-C, Be-N, Be-O and ternary and higher mixtures, and data for the principal plasma impurities as projectiles. The most important projectiles are therefore H, D, T, He, Be, C, N, O, Ne and Ar.

5.5. Data and Code Centre Networks and other meetings

The Data Centre Network (DCN) meets every two years to discuss data needs and coordinate activities. The most recent meeting took place in September 2011 at the IAEA in Vienna and discussed issues of data exchange, bibliographical data compilation, data evaluation and priorities for new data development. Among the outcomes of the meeting are an affirmation of the role of XSAMS as a new standard for data exchange in the A+M field, priority for A+M collision data in the upkeep of the bibliographical database and prospects to work closely with NFRI to incorporate their data, and plans for a coordinated set of activities in 2012-2013 on data evaluation.

The Code Centre Network (CCN) was formed recently and had its second meeting in September 2010 at the IAEA in Vienna. The participant list had been extended with several fusion researchers engaged in plasma modelling with use of A+M+PMI data and this provided a valuable exchange of views and priorities with the A+M codes community. Participants agreed that data and associated documentation are the key issues, rather than the sharing of the codes. In particular the production of high-quality data is best done by, or in close collaboration with, the authors of the atomic data codes.

Three meetings were organized by the Section to support the development of XSAMS and *inter alia* expand awareness of XSAMS in the community. In March 2010 an IAEA Consultants' Meeting on XSAMS was organized at National Institute for Fusion Science in Japan and in October 2011 one was organized at National Institute of Standards and Technology in the USA; both of these sites have very important database work. The third meeting was held in November 2010 at IAEA in Vienna. XSAMS version 0.1.1 was released in January 2011.

The unit cooperated in the organization of a Technical Meeting on Analysis of ITER

Materials and Technologies that was held in the Principality of Monaco in November 2010; the Physics Section had the lead role in organizing this meeting. In a new activity in 2011 the unit cooperated in the organization of a very successful code-oriented workshop: the 7th non-local thermodynamic equilibrium (NLTE) code comparison workshop. Preparations are underway for a similar event in 2012 on lineshape calculations. A technical meeting on ab initio-based methods for plasma-material interaction was organized also in December 2011 in order to bring together some of our data suppliers for PMI and experts in large-scale computations for materials science.

5.6. Other A+M activities

Other significant work during 2010-2011 includes the provision of improved access to the databases, preparation of various publications and presentations at scientific conferences.

The AMDU continues to publish documents from the Atomic and Plasma-Material Interaction Data for Fusion (APID) series of technical reviews. Volumes 15 and 16 appeared on the web in 2011 and volume 17 is in preparation. The AMBDAS database is supported in hard copy by the International Bulletin that contains bibliographical information for fusion-related A+M data and Volume 69 was published in 2010. The two professional staff of the AMDU attended and presented papers at several international scientific conferences in 2010 and 2011. Staff also collaborate directly with several research institutes to generate data of interest to the fusion and plasma physics research communities.

6. NUCLEAR DATA DEVELOPMENT

Nuclear data development activities are primarily aimed at improving the quality and quantity of nuclear data available for distribution to all Member States through the following functions:

- Coordinated Research Projects;
- Data Development Projects;
- Individual research contracts, Contractual and Special Service Agreements with experts in specific fields;
- Specialised technical meetings;
- Work undertaken directly by NDS staff.

Immediate outputs of these activities include:

- Creation of new databases designed and dedicated to various energy and non-energy 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;
- 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 11 years of such activities (2001–2011), the present (2012) as well as giving some consideration of the future (2013-2016). As can be seen from this figure sufficient CRP commitments presently exist, 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 2010–2011 there were 11 CRPs at different stages of development. Five of them were A+M projects while the remaining six 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 six CRPs were completed over the 2010–2011 time period. Two new CRPs were approved in 2010, for which contracts/agreements were awarded, and their first RCMs convened in 2011. By the end of 2011 four A+M data and four nuclear data CRPs were active.

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)	Trkov Capote Noy	Completed (2010) IAEA STI/PUB/1435 and webpage	6.1.1
2	RIPL-3	2003–2008	11 (5)	Capote Noy	Completed (2009) Nucl. Data Sheets paper and webpage	6.1.2
3	Nuclear data for the production of therapeutic radionuclides	2003–2007	9 (4)	Capote Noy	Completed (2012) IAEA TRS 473 and webpage	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 undergoing final editing	6.1.5
6	Updated decay data library for actinides	2005–2010	7 (4)	Kellett	Completed/ document in press	6.1.6
7	Heavy charged-particle interaction data for radiotherapy	2007–2010	12 (2)	Capote Noy	Completed/ document in preparation	6.1.7
8	Minor actinide neutron reaction data (MANREAD)	2007–2011	12 (4)	Otsuka	Completed/ document in preparation	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 Monitor Reactions and Nuclear Data for Medical Isotope Production	2012–2015	~15 (6)	Capote Noy	Planned	6.1.11
12	Nuclear data for Particle Induced Gamma Ray Emission (PIGE) analysis	2011–2014	-	Abriola	On-going	6.1.12
13	Validation of the International Dosimetry Library IDL-1.0	2013–2017	-	Simakov Capote Noy	Planned	6.1.13
14	Beta-delayed Neutron Emission Evaluation	2013–2017	-	Abriola	Planned	6.1.14

CRPs - Technical reports	9 2001	11 2002	12 2003	9 2004	12 2005	10 2006	12 2007	12 2008	12 2009	11 2010	8 2011	(8) 2012	(8) 2013	(6) 2014	(6) 2015	(3) 2016
TECDOC-1285 (Herman) **Reference neutron activation library**	■	■														
STI/PUB/1286 (Lammer/Nichols) **Fission product yield data for the transmutation of minor actinide nuclear waste**	■	■	■	■	■											
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**		■	■	■	■											
STI/PUB/1435 (Trkov/Capote/Nichols) **Evaluated nuclear data for nuclides within Thorium Uranium fuel cycle**		■	■	■	■	■	■	■								
APID, vol. 15 (Clark) **Tritium inventory in fusion reactors**		■	■	■	■											
Nuclear Data Sheets 110 (2009) (Capote Noy) **RIPL-3**			■	■	■	■	■	■								
Technical Report Series 473 (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. 16 (Braams) **A+M data for plasma modelling**					■	■	■	■	■							
APID, vol. 17 (Braams) **Atomic data for heavy element impurities in fusion reactors**					■	■	■	■	■							
Technical report (Capote Noy) **Heavy charged-particle interaction data for radiotherapy**							■	■	■	■						
APID, vol. 18A (Braams) **Data for surface composition dynamics - erosion processes**							■	■	■	■	■					
Technical report (Otsuka) **Minor actinide neutron reaction data**							■	■	■	■	■					
Technical report (Forrest) **ND libraries for advanced systems: fusion devices (FENDL-3)**							■	■	■	■	■					
APID, vol. 18B (Braams) **Size, composition and origins of dust in fusion devices**									■	■	■	■	■			
APID, vol. (Braams) **Light element atom, molecule and radical behaviour in divertor region**									■	■	■	■	■			
Technical report (Capote Noy) **Prompt fission neutron spectra of actinides**									■	■	■	■				
APID, vol. (Braams) **Atomic and molecular data for H and He**											■	■	■	■	■	
Technical report (Abriola) **Reference database f Particle-Induced Gamma-ray Emission (PIGE)**											■	■	■	■	■	
Technical report (Capote Noy) **Nucl data f. charged-particle monitor reactions & med. isotope production**												■	■	■	■	
APID, vol. (Braams) **Data for erosion and tritium retention in beryllium**												■	■	■	■	■
Technical report (Abriola) planned **Beta-delayed neutron emission evaluation**												■	■	■	■	■
? (Capote/Simakov?) planned **International Dosimetry Library (IDF)**														■	■	■

Fig. 2. Coordinated Research Projects - previous 11 years and the immediate future.

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

Status: completed – database assembled/document published.

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.

Activity:
- A follow-up CM was held at IAEA, Vienna, 20-22 December 2010 (INDC(NDS)-0586). Available nuclear data evaluations for $^{230\text{-}232}$Th, ^{231,233}Pa and ^{232,233,234}U were reviewed including ROSFOND2010, CENDL-3.1, JENDL-4, JEFF-3.1.1, MINSKACT, and ENDF/B-VII.0 libraries. Benchmark results of available evaluations for ^{232}Th and ^{233}U were also discussed. Technical discussions and identified deficiencies are summarized; corrective actions were proposed where deemed necessary. Reviewed and corrected files for ^{232}Th and ^{233}U nuclei were adopted for US ENDF/B-VII.1 (2011).

Outputs:
- Final versions of evaluated data files are available on web page http://www-nds.iaea.org/Th-U/, together with documentation.
- Final report published as document **STI/PUB/1435** (IAEA, May 2010); "Evaluated Nuclear Data for Nuclides within the Thorium-Uranium Fuel Cycle", R. Capote, L. Leal, Liu Ping, Liu Tingjin, P. Schillebeeckx, M. Sin, I. Sirakov, A.L. Nichols, and A. Trkov.

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 ^{232}Th and ^{231,233}Pa were adopted for US ENDF/B-VII.0 (2006).
- The reviewed and corrected data files for ^{232}Th, ^{231,233}Pa were adopted for US ENDF/B-VII.1 (2011).

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.

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 last updated in January 2011. 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.0, ENDF/B-VII.1, JENDL-4, CENDL-3.1 and JEFF-3.1.1 nuclear applications libraries. The RIPL TECDOC documenting the RIPL-2 database (RIPL-2: **IAEA-TECDOC-1506**, Aug. 2006) has been cited 152 times (January 2012, Google scholar). The comprehensive reference paper published in Nuclear Data Sheets [1] on Dec. 2009 documenting the whole RIPL project has been cited 56 times (January 2012, Google scholar).

Additionally widely used computer code systems TALYS [2] and EMPIRE [3] designed for nuclear reaction modelling and nuclear data evaluation which input data are based on the RIPL database have been cited 137 and 125 times, respectively as of January 2012.

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.
[2] A.J. Koning, S. Hilaire, and M.C. Duijvestijn, AIP 769 (2005), International Conference on Nuclear Data for Science and Technology (Eds: R.C. Haight, M.B. Chadwick, T. Kawano, and P. Talou), TALYS: Comprehensive Nuclear Reaction Modeling.
[3] M. Herman, R. Capote, B.V. Carlson, P. Oblozinsky, M. Sin, A. Trkov, H. Wienke, and V. Zerkin, EMPIRE: Nuclear Reaction Model Code System for Data Evaluation, *Nucl. Data Sheets* **108** (2007) 2655-2715.

6.1.3. Nuclear Data for the Production of Therapeutic Radionuclides

Status: completed – database assembled/document published as IAEA **Technical Report Series No.473** (2012).

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 2008–2010.

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.

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.

Monitor reactions webpage www-nds.iaea.org/medical/monitor_reactions.html has become a reference for cross section and decay data of charged-particle reaction measurements.

6.1.4. Development of a Reference Database for Ion Beam Analysis

Status: completed – document in press

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:
- Technical Report finalized and submitted for publication.
- Maintenance activities through expert contracts.

Outputs:
- New 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 was submitted for publication.

6.1.5. Reference Database for Neutron Activation Analysis

Status: completed – document undergoing final editing

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:
- Correction of the database of integral constants, e.g. k_0, σ_0, Q_0, etc.
- Compilation and comparison of available differential cross section data to produce a library consistent with integral k_0-values.
- Comparison and update of γ-ray transition probabilities in EGAF.

Outputs:
- Recommended database of integral constants relevant to the k_0 neutron activation analysis technique.
- Validation of the *k_0-IAEA* spectrum analysis software and associated updates.
- Analysis and comparison of SMELS reference material neutron activation.
- Update of the most relevant 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 press

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:
- Review and analysis of finalised decay scheme evaluations.
- Verification of evaluation contents and data consistency checks.
- Preparation of appropriately formatted files for users, i.e. ENSDF and ENDF.
- Production of data tabulations for inclusion in the final report.

Outputs:
- New measurements undertaken and published by participants through this CRP.
- Specific evaluations undertaken and published by participants.
- Final data library in various user-relevant formats, i.e. simple tabulations, ENSDF and ENDF.

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: completed – document in preparation

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 was held at the Heavy Ion Therapy Center (HIT), Heidelberg, Germany on November 22 – 26, 2010.
- Benchmark of spallation reaction models and subsequent analysis concluded, 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.

References:
[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: completed – documentation in preparation

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].
- Third RCM was held at the IAEA Vienna, Austria, 19-22 October 2010 [4].
- CRP participants Meeting in Brussels, 17-21 October 2011, to draft the Final Report.

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] F. Gunsing and N. Otsuka (ed.), Summary Report of Third RCM on MANREAD, IAEA Vienna, Austria, INDC(NDS)-0585, December 2010.
[5] Web site: http://www-nds.iaea.org/manread/public.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 [3].
- Third RCM was held at the IAEA Vienna, Austria, 6–9 December 2011.

Outputs:
- Summary report of first RCM available (see reference 2)
- Summary report of second RCM available (see reference 3)
- Starter files available on web site: http://www-nds.iaea.org/fendl3/
- Documents from the third RCM available on web site.

References:
[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.
[3] M.E. Sawan, Summary report from the Second Research Coordination Meeting on Nuclear Data Libraries for Advanced Systems- Fusion Devices (FENDL-3), IAEA Vienna, Austria, 23–26 March 2010, INDC(NDS)-0567, June 2010.

6.1.10. Prompt Fission Neutron Spectra for Actinides

Status: 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 [2].
- Second RCM was held at the IAEA Vienna, Austria, 13-16 December 2011 [3].

The CRP is going well. The following evaluations will be delivered: PFNS for n+^{233}U, ^{235}U, ^{238}U, ^{239}Pu, ^{237}Np and ^{232}Th for incident neutron energies from thermal up to 20 MeV, and for outgoing energies from 1 keV to 20 MeV. Both mean values and uncertainties will be produced.

An extension of the CRP for one year (2013) will be requested considering new experimental and theoretical results in the field that will significantly impact the quality of undertaken evaluations.

References:
[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.
[2] R. Capote Noy, Summary Report of the First Research Coordination Meeting on Prompt Fission Neutron Spectra of Major Actinides, IAEA Vienna, Austria, 6-9 April 2010, INDC(NDS)-0571, December 2010.

[3] R. Capote Noy and Patrick Talou, Summary Report of the 2nd Research Coordination Meeting on Prompt Fission Neutron Spectra of Major Actinides, IAEA Vienna, Austria, 13-16 December 2011, INDC(NDS)-0608 (to be published in 2012).

6.1.11. Charged-Particle Monitor Reactions and Nuclear Data for Medical Isotope Production

Status: Will start in late 2012.

Suggested Objectives:
- Update of existing beam monitor data, including uncertainties and extension of energy range where appropriate. Inclusion of additional monitor reactions.
- Undertake evaluations of reaction data for emerging diagnostic and therapeutic radionuclides as identified in the report INDC(NDS)-0591.
- Identification and correction of deficiencies in existing recommended data.
- Re-evaluation of decay data as identified in the report INDC(NDS)-0591.
- Measurement of new decay and cross section data as identified in the report INDC(NDS)-0591.
- 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:
- A related CM was held at the IAEA Vienna, 3–5 September 2008 (INDC(NDS)-0535).
- A planning CM was held at the IAEA Vienna, 21-24 June 2011 (INDC(NDS)-0591).

Measurements of new decay and cross section data and accurate integral yields for validation purposes were recommended.

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

Status: On-going

Overall objective:
To create a data library for Ion Beam Analysis that contains reliable and usable data on charged particle γ-ray emission cross sections that will be made freely available to the user community.

Specific research objectives:
- Identify the most important nuclear reactions for PIGE.
- Search the literature and electronic databases and convert relevant nuclear reaction data to a format suitable for use in PIGE simulation programs.
- Compare data from different sources and carry out measurements when there are no data available or unresolved discrepancies exist.

- Incorporate all measured data into the database, and make them available to the IBA community.

Outputs:
- CM was held at the IAEA Vienna, Austria, 1-2 March 2010 [1].
- First RCM was held at the IAEA Vienna, Austria, 16–20 May 2011 [2].

References:

[1] D. Abriola and A. Pedro de Jesus, Summary Report of Consultants' Meeting on Assessment of Nuclear Data Needs for Particle Induced Gamma Ray Emission (PIGE), IAEA Vienna, Austria, 1–2 March 2010, INDC(NDS)-0568, March 2010.

[2] D. Abriola and A. Pedro de Jesus, Summary Report of the 1st Research Coordination Meeting Development of a Reference Database for Particle-Induced Gamma ray Emission (PIGE) Spectroscopy, IAEA Vienna, Austria, 16–20 May 2011, INDC(NDS)-0589, July 2011.

[3] Web site: http://www-nds.iaea.org/pige/.

6.1.13. Validation of the International Dosimetry Library (IDL-1.0)

Status: planned.

Suggested Objectives:
- To create reference neutron fields and corresponding experimental database of integral measurements for fission and fusion applications.
- To assess newly released high-fidelity evaluations with covariances in order to improve the existing dosimetry library for fission and fusion applications.
- To use selected integral data (e.g. kayzero), in order to reduce the uncertainty in existing evaluated cross sections and improve the consistency of the library (for many reactions in the low energy region uncertainties are still too large - capture and inelastic).
- To identify and correct possible deficiencies in the released library.
- To complete the documentation of the validation of the IDL-1.0 library for fission and fusion applications.

Activities:
- A related CM was held at IAEA Vienna, 5-7 May, 2010: INDC(NDS)-0575.
- A new dosimetry library for fission and fusion applications (IDL-1.0) has been developed and released in February 2012.

6.1.14 Beta-delayed Neutron Emission Evaluation

Status: planned.

A related CM was held at IAEA Vienna, 10-12 October, 2011 [1], the consultants pointed out the need of a CRP on the topic.

Suggested Objectives:
- To create a reference database of evaluated data for beta-delayed neutron emision.
- The database should contain evaluated half-lives, emission probabilities and neutron spectra for individual precursors.
- The evaluation methodology should be described.

- Agregate quantities like group values shoud be derived and stored in the database.
- The CRP should produce a priority list for evaluations and new experiments and improvements in the theoretical predictions.

References:
[1] D. Abriola, B. Singh and I. Dillman, Summary Report of Consultants' Meeting on Beta-delayed neutron emission evaluation, IAEA Vienna, Austria, 10–12 October 2011, INDC(NDS)-0599, December 2011.
[2] Web site: http://www-nds.iaea.org/beta-delayed-neutron/

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

One 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.

Summary report was published in March 2011 [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 (2010 and 2011), and work undertaken directly by NDS staff. A CM is being organized for November 2012. Invited talks by A.D. Carlson were delivered at the NDST 2010 [3], and at the Fourteenth International Symposium on Reactor Dosimetry held in May 22-27, 2011, at Bretton Woods, New Hampshire, USA [4].

References:
[1] V.G. Pronyaev, A.D. Carlson, R. Capote Noy, and A. Wallner, Summary Report Consultants' Meeting on International Neutron Cross Section Standards: Extending and Updating, IAEA Vienna, Austria, 13–15 October 2010, INDC(NDS)-0583.
[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.
[3] A.D. Carlson, V.G. Pronyaev, F-J. Hambsch, F. Käppeler, W. Mannhart, A. Mengoni, R.O. Nelson, P. Talou, S. Tagesen and H. Vonach, "An Update of the Nuclear Data Standards Activities", J. Kor. Phys. Soc., Vol. 59, No. 2, August 2011, pp. 1390-1395.
[4] A.D. Carlson, V.G. Pronyaev, R. Capote, F.-J. Hambsch, F. Käppeler, C. Lederer, W. Mannhart, A. Mengoni, R.O. Nelson, P. Schillebeeckx, P. Talou, S. Tagesen, H. Vonach, A. Vorobyev, and A. Wallner, "New Work on Updating and Extending the Nuclear Data Standards", Journal of ASTM International, Vol. 9 (2012) in press; Available online at http://www.astm.org.

6.2.2. Extension of the IRDF-2002 dosimetry library, the International Dosimetry Library (IDL)

Extension of the IRDF-2002 dosimetry library has been pursued as agreed in previous INDC meetings. A total of 37 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), INDC(NDS)-0546 (April 2009), and INDC(NDS)-0584 (November 2010). Additional work has been undertaken to include the IAEA standards in coordination with ORNL (US) and IPPE (Russia).

A CM was held in May 2010 to discuss the assembly of the new International Dosimetry Library (IDL-1.0) for fission and fusion applications [1]. All new evaluations have been processed through PREPRO-2010 to produce 640-group libraries, results are being assessed and documentation is in preparation to be published as an INDC(NDS) report in 2012. Evaluated data files have been assembled, checked and uploaded onto the NDS web server http://www-nds.iaea.org/wolfram/IRDFFbeta1/ .

A new CRP is being proposed to start in 2012 for IDL-1.0 validation.

References:
[1] M.A. Kellet, Summary Report of Consultants' Meeting on Improvements and Extension to IRDF (International Reactor Dosimetry File), IAEA Vienna, Austria, 5–7 May 2010, INDC(NDS)-0575, December 2010.

6.2.3. Ion Beam Analysis Nuclear Data Library (IBANDL)

The Ion Beam community repeatedly showed deep appreciation for the theoretical evaluations present in IBANDL and expressed the need to have more evaluations. There were concerns that the evaluations were the product of a single scientist, namely A. Gurbich (IPPE). The IAEA-NDS took this concern seriously and started a program to transfer the science and art of charged particle reaction evaluation. A. Gurbich visited NDS from 31 May to 4 June 2010 to share the knowledge in theory, techniques and codes used for the evaluation of nuclear cross sections for Ion Beam Analysis with M. Kokkoris (NTUA, Athens Greece) and D. Abriola (NDS). During this visit the techniques to deal with the simplest case of non-overlaping resonances and targets with zero spin ground states were considered. During part of a second visit (22 November-23 December 2010) cases with overlapping resonances and non-zero spin ground states were included and in part of a third visit from 15-19 August 2011 the focus was on transfer reaction on zero spin targets. Besides these evaluation activities during the visits updates were made to the interface to be used in the CD-ROM distribution of IBANDL, and also IBANDL maintenance was performed.

6.2.4. Collection and Compilation of Experimental Decay Heat Measurements of Actinides

The objective is to set up an actinides Decay Heat (DH) database, including a ^{233}U DH benchmark / standard. The least square formalism of fitting experimental data used in the ANSI standard to ^{235}U and ^{239}Pu has been extended employing covariance techniques [1]. The same approach will be used for ^{233}U.

The plan of work proposed is as follows:

1. Literature survey to collect 'raw' data from all technical papers on experimental DH measurements up to 1989 (evaluated in [1]) and other similar measurements since that time to the present.
2. Compile a varying range of data which may differ in the amount of detail available and accuracy, into tabular form.
3. Develop software to put these data in a (common format) suitable form for retrieval and analysis (database).
4. The resulting database will be made available by both, NDS and Manipal University.

References:

[1]   Tobias, A., "Derivation of Decay Heat Benchmarks for U235 Pu239 by Least Squares Fit to Measured Data", CEGB Report No. RD/BI 6210/R89, May 1989.

6.2.5. 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.

A major release of the GANDR system (GANDR v.4.4) was undertaken in November 2011 (see http://www-nds.iaea.org/gandr). A new major version of the EMPIRE system will be released in January 2012.

An international workshop (9 students, 3 lecturers) devoted to training on the use of the GANDR system for nuclear data evaluations was held at IAEA HQ in Vienna 28 November to 2 December 2011. A national Indian workshop on the use of the EMPIRE and GANDR systems for nuclear data evaluation will be held in Mumbai, India in February 2012.
The reference publication for the EMPIRE system [1] has been cited 125 times (Google scholar) as of January 2012.

References:

[1] M. Herman, R. Capote, B.V. Carlson, P. Oblozinsky, M. Sin, A. Trkov, H. Wienke, and V. Zerkin, EMPIRE: Nuclear Reaction Model Code System for Data Evaluation, *Nucl. Data Sheets* **108** (2007) 2655-2715.

6.2.6. Neutron data evaluation work up to 150 MeV: W isotopic chain and ^{55}Mn nucleus

Neutron data evaluation work is being supported through NDS staff, consultancy visits and service agreements. Such work is important as a testing ground of developed methodologies for nuclear data evaluation and for validation of public nuclear reaction evaluation tools (e.g. EMPIRE and GANDR code systems). Evaluation of $^{180-186}$W isotopes was concluded in 2009, results are thoroughly documented in NDS web page http://www-nds.iaea.org/wolfram. Minor modifications of this evaluation were recently undertaken; evaluations were adopted by the US ENDF/B-VII.1 library (December 2011). Adopted evaluations are fully documented in refs. [1, 2].

Work is on-going to produce an evaluated nuclear data file in ENDF-6 format for the ^{55}Mn 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. A new evaluated nuclear data file of neutron induced reactions on ^{55}Mn up to 60 MeV including covariances was produced within this project, and adopted by the US ENDF/B-VII.1 library (Dec. 2011). The adopted evaluation is fully documented in refs. [1,2].

References:
[1] M.B. Chadwick, M. Herman, P. Oblozinsky, M.E. Dunn, Y. Danon, A.C. Kahler, D.L. Smith, B. Pritychenko, G. Arbanas, R. Arcilla, R. Brewer, D.A. Brown, R. Capote, *et al*., "ENDF/B-VII.1 Nuclear Data for Science and Technology: Cross Sections, Covariances, Fission Product Yields and Decay Data", *Nucl. Data Sheets* **112** (2011) 2887–2996.
[2] A. Trkov, R. Capote, *et al*., "Covariances of Evaluated Nuclear Cross Section Data for ^{232}Th, ^{180,182,183,184,186}W and ^{55}Mn", *Nucl. Data Sheets* **112** (2011) 3098–3119.

6.2.7. Missing Level corrections using experimental neutron spacings

A data development project concluded in 2011. Random Matrix Theory methods were developed and properly documented to correct raw resonance data for missing resonances. FORTRAN codes developed within the project are available at http://www-nds.iaea.org/missing-levels/. Documentation has been published as INDC(NDS)-0561 (Nov. 2009) and INDC(NDS)-0598 (Sep. 2011). Developed FORTRAN codes could be used by both evaluators and experimentalists to estimate the number of missing resonances in capture experiments and evaluations including even-even and odd targets.

6.2.8. Input to JEFF project

The on-going collaboration between the OECD/NEA Databank and NDS continues, in part, through contributions made to the JEFF Project. A number of cross section evaluations produced through data development projects and/or in collaboration with NDS staff, have been adopted and are being considered for future versions of the library. NDS staff also contribute technically, specifically to the JEFF Decay Data and Fission Yields' sub-group.

7. TECHNOLOGY TRANSFER

Technology transfer activities during 2010-2011 include maintenance of mirror site facilities and provision of training workshops. In addition to the workshops described below two others on EXFOR compilation are described in Section 4.1. As noted in Section 4.2 NDS staff continue to be active in providing support to new ENSDF evaluators.

7.1. Technical cooperation: regional centres for nuclear data services

Mirror servers help to fulfil the needs of developing countries to provide data services to their users. The mirror server at the Bhabha Atomic Research Centre (BARC), Mumbai,

India has been extensively used and plans to continue to support it are being framed in a new legal agreement. The server at PIEN, São Paulo, Brazil has been less used and will probably be closed during 2012. A request for a new mirror server at the China Nuclear Data Centre has been followed up and a legal agreement has been recently signed. This will enable the new service to start during 2012.

NDS has full administrator access to these mirror servers and collects access logs to add to the NDS statistics. While these are described as mirror sites, in fact only a subset of the most popular services (EXFOR, LiveChart…) are held independently on the servers, the remainder are still served by the main NDS site through links.

7.2.   Workshops

NDS sponsored and organised six workshops in 2010–2011, of which two were fully supported by ICTP (7.2.1 and 7.2.4), two were hosted activities at ICTP (fully funded by the IAEA/NDS - 7.2.2 and 7.2.3), one (7.2.5) was related to atomic and molecular data and one was held in Vienna (7.2.6). These workshops are described below.

7.2.1. Joint ICTP-IAEA Workshop on Nuclear Reaction Data for Advanced Reactor Technologies

(ICTP, Trieste, Italy, 3–14 May 2010).

Workshop Directors:

R. Capote (NDS), A. Stanculescu (IAEA-NPTD), and V.G. Pronyaev (IPPE, Russia).

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 working in the field of nuclear data measurements, calculations, evaluations and applications for advanced reactor and closed fuel cycle technologies. The lectures included the presentation of basic principles of nuclear data measurements with data reduction techniques and estimation of experimental data uncertainties. The basic nuclear reaction models are derived from common principles and EMPIRE and TALYS model codes used in cross section calculations were presented.

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:
- neutron cross section measurements, data reduction and uncertainty estimation
- nuclear reaction theory, nuclear models and codes for cross section calculations
- cross section evaluations using non-model and model fits of experimental data
- nuclear data libraries, data retrieval and processing
- reactor calculations with calculated parameter uncertainty estimation
- strategies for advanced reactor and closed fuel cycle 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 34 students representing 23 Member States. Total of 10 lecturers external to the IAEA and three IAEA staff members made presentations to the workshop.

The workshop was judged to be successful from both the students' and lecturers' points of view. Leading developers of EMPIRE and TALYS nuclear-reaction codes participated as lecturers, giving the opportunity to students of interacting directly with them.

7.2.2. Nuclear Structure and Decay Data: Theory and Evaluation
(Hosted at ICTP Trieste, Italy, 11-15 October 2010)
Workshop Directors: D.H. Abriola (NDS), J.K. Tuli (NNDC).

The sixth workshop in this field was organized by the NDS in collaboration with NNDC, USA. The programme was based on the previous five successful workshops (November 2002, one-week trial, IAEA Vienna, Austria; November 2003, April 2005, February-March 2006 and April-May 2008 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 and analysis programs (J.K. Tuli-NNDC).
- NSDD network, relevant IAEA activities, access to appropriate web pages and Nuclear Reactions (D. Abriola-NDS).
- Nuclear models (P. Van Isacker-Ganil).
- Radioactive Decays (E. Browne-Moreno-LBNL)
- Adopted Levels (B. Singh- Mc Master).
- Databases and Web resources (A.A. Sonzogni,).

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.
- As part of the Workshop activities (organized by B. Singh) five student groups were formed under the leadership of a different mentor, 10 isotopes which needed new evaluation were assigned to the different groups.
- Students were given the opportunity to review the workshop through a written questionnaire and direct discussions.

Remarks/Outcomes:
- 19 participants received training from 6 lecturers and demonstrators.
- Five participants were already involved in mass-chain evaluations, they acted as 'deputy mentors' during the workshop activities and further improved their skills.

- The evaluation work undertaken within Workshop activities was later completed and included into the ENSDF database.
- Some participants expressed a strong interest in undertaking NSDD evaluation work.

These NSDD workshops have been particularly successful in achieving significant technology transfer and the identification and motivations of new potential ENSDF evaluators.

7.2.3. IAEA Workshop on Monte Carlo radiation transport and associated data needs for medical applications

(Hosted at ICTP, Trieste, Italy, 17–28 October 2011).

Workshop Director:

R. Capote Noy (NDS)

Objective:

Monte Carlo (MC) techniques have been used extensively in medical physics applications, and offer the most powerful tool for modelling radiation transport in different media. The availability of general purpose MC codes (e.g. EGSnrc, Penelope and Geant4) combined with the ever-increasing computer speed and decreasing costs have led to a boom in MC studies in recent years. MC techniques will dominate the field of radiation dosimetry and benchmark dose calculations in radiotherapy for many years to come.

The purpose of the workshop was to provide extensive and up-to-date training in the use and understanding of Monte Carlo methods of relevance to medical applications in therapy and diagnostics. The Workshop constituted a unique opportunity for scientists, engineers and medical physicists working in the field of radiation transport to gain extensive and up-to-date training on the use and understanding of cutting edge techniques for medical physics applications. Lecturers were top scientists in medical physics and the main developers of EGSnrc and BEAMnrc Monte Carlo codes (these two codes are considered *The 'Gold Standard' for Radiation Transport in Medicine*; the EGSnrc code receives more than 90% of citations on Monte Carlo in the leading medical physics journals).

Main Topics:

The course was based on EGSnrc system, a package developed by a National Research Council (NRC) of Canada for the coupled transport of electrons, photons and positrons. The BEAMnrc code was also covered allowing participants to learn how to model specific linear accelerators and other radiation sources employed in both diagnosis and radiotherapy. Use of the IAEA phsp (phase-space) database within the EGSnrc/BEAMnrc system was also covered.

Actions:

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

Remarks/Outcomes:

It was one of the largest IAEA workshops that has ever been held. The IAEA received over 110 applications, making it one of the most sought after IAEA workshops ever put together by the NDS. The final list of attendees - approximately 55 in total came from a wide variety of both developed and developing countries. Those coming from the developed world fully support themselves, while the IAEA fully or partially supported about 25 students. Such a diverse, yet highly qualified assortment of scientists and engineers is clearly driven by more than just the prestige of Monte Carlo training, but also appreciated the chance to be part of a community of experts dedicated to changing the face of radiation medicine worldwide. A total of 7 lecturers external to the IAEA made presentations to the workshop.

The workshop was judged to be extremely successful from both the students' and lecturers' points of view.

7.2.4. Nuclear Data for Science and Technology: Analytical Applications
(ICTP Trieste, Italy, 8–12 November 2010)
Workshop Directors: M.A. Kellett and D.H. Abriola (both NDS).

A one-week workshop was organized by the NDS in collaboration with ICTP, Italy. The programme was organised to cover the physics and nuclear data behind two of the main analytical techniques in use today, i.e. neutron activation analysis (NAA) and ion beam analysis (IBA), which for their efficient use require appropriately trained physicists.

Objectives:
- Brief the participants on the nuclear data and experimental methodologies of the NAA and IBA analytical techniques, with emphasis on their practical applications.
- Train participants in the use of associated software analysis tools.

Topics:
- Experimental techniques in NAA and IBA (RBS and PIGE).
- Analysis software availability and use.
- Nuclear data requirements for analytical science: NAA and IBA.
- Available nuclear data for IBA analysis – the IBANDL database.
- On-line retrieval of nuclear data.
- Nuclear data compilation and dissemination.
- Presentations of participants' own work.

Actions:
- Workshop material was presented as lectures each morning and computer-based exercises each afternoon.
- Hands-on introduction of participants to the k_0-*IAEA* software for neutron activation analysis, the *SIMNRA* software for NRA spectral analysis and the online services of the NDS, including EXFOR, ENDF and IBANDL databases.

Remarks/Outcomes:
- 23 participants from 18 countries received training from 6 lecturers and/or demonstrators.

- The workshop facilitated participating physicists to better understand and appreciate the full potential and weaknesses of these techniques and to improve their knowledge and ability to fully utilize them.

The overall opinion of the participants was that they had thoroughly enjoyed the workshop and learnt much about the two analytical applications: NAA and IBA.

7.2.5 The 7th Non-Local Thermodynamic Equilibrium Code Comparison Workshop, NLTE7

(K+K Maria Theresia Hotel, Vienna, 5-9 December 2011)

Workshop Organizers: H.-K. Chung (NDS, local organizer), C. Bowen (CEA, France), R.W. Lee (LCLS, USA), Yu. Ralchenko (NIST, USA)

Objective:
The purpose of the NLTE code comparison workshops is to bring together developers of codes for atomic kinetics in intermediate density plasmas and to perform detailed comparison of calculations on well-defined test cases. The test cases are advertised well in advance of the workshop and participants discuss their methods and results during and after the workshop.

Main Topics:
Five sets of cases were defined for comparison.
- Ne: Electron temperature T_e = 10 eV or 30 eV, density n_e = 10^{14}, 10^{18} or 10^{20}/cm^3. The neon case was designed to explore convergence of collisional-radiative models with the highest principal quantum number included in a model; participants were asked to perform calculations for several specific values of this parameter.
- Ar: T_e = 10, 20, 40, 60, 80 or 100 eV, n_e = 10^{10} or 10^{20}/cm^3. Participants were asked to include specific charge states and levels in the calculation in order to permit in-depth analysis of the role of dielectronic recombination and excitation-autoionization.
- Ar: time dependent: T_e = 50 eV, n_e = 10^{14}, 10^{18} or 10^{20}/cm^3. This case mimics system relaxation after X-ray free electron laser photoexcitation. Participants modelled the time-dependent population redistribution recombining from the K-shell hole vacant neon-like argon state and the associated spectra.
- Kr: The objective of the krypton case is to compare approaches to the analysis of experimental spectra. Temperature and density were not specified; instead, participants were asked to analyse and try to explain a set of well-resolved time-integrated spectra from the LULI2000 facility.
- W: T_e = 2.5, 3.9, 5, 9 or 12 keV, n_e = 10^{14}/cm^3. This case concerns tungsten in relevance to the ITER project. Participants were asked to calculate ionization balance, radiative power loss and soft X-ray emission spectra.

Actions:
More than 25 participants submitted results from 19 codes for more than 50 test cases in the workshop. All the results were collected in a database at NIST and made available to the participants about two weeks prior to the meeting. First, each code was described by the code developers and then two experimentalists were invited to give presentations on

the dense plasmas ionized by the X-ray free electron laser and gas jet plasmas ionized by the long-pulse laser. Later, detailed comparisons were carried out in order to understand the discrepancies of results with respect to applied methods and assumption. For each test case, a coordinator had been chosen to analyse the submitted data and to lead the corresponding discussion session.

Remarks/Outcomes:
The workshop was successful. Participants appreciated the in-depth discussions on the test case comparisons and particularly found the two topical speaker presentations very helpful. A few code presentations included inter-comparisons of results with others since the results of all the codes were already available before the workshop. The format of shorter code description and longer case comparisons of each presentation before the discussion sessions was considered highly effective and was recommended for future workshops.

Several aspects of collisional-radiative models were discussed: the treatment of dielectronic recombination and excitation autoionization processes, the convergence of high lying states at low to intermediate densities, the role of metastable states in both steady-state and time-dependent cases at low densities, general trends of results from averaged codes with respect to the more detailed codes and the systematic approaches to spectroscopic analysis. Based on the present case comparisons, the new test cases for the next workshops were discussed.

One week was obviously too short time to understand the complexities of the CR models and the current database of submissions will be available through the NIST webpage for participants. After participants finalize their submission by March, 2012, the database will be publicly available. The overall workshop proceedings will be published and the publication of detailed comparisons of specific cases will be considered by participating code developers and case coordinators.

7.2.6. IAEA Workshop on Development of Nuclear Data Libraries
(IAEA, Vienna, Austria, 28 November–2 December 2011).

Workshop Director: R. Capote Noy (NDS).

Objective:
To gain extensive and up-to-date training on the use and understanding of the GANDR code system for nuclear data evaluation based on Generalized Least-square method, and to generate nuclear data libraries of relevance to the application of modern nuclear technology. To gain knowledge on defining experimental uncertainties and correlations needed as input in the evaluation process.

Topics:
Experimental covariance information and EXFOR retrieval. Theory and hands-on training on the use of the GANDR system code for nuclear data evaluation. A total of 20 hours of lectures and 22 hours of computer exercises were provided.

Actions:

General approach was to hold lectures in the morning and hands-on training in the afternoon, 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 theoretical lectures and GANDR training, was attended by nine students representing seven Member States (China, Nigeria, Slovenia, India, Pakistan, Russian Federation and USA). A total of four lecturers, including three external to the IAEA (D.L. Smith, D.W. Muir and A. Trkov), made presentations to the workshop.

The workshop was judged to be successful from both the students' and lecturers' points of view. The use of the GANDR system as a nuclear data evaluation tool that properly combines experimental and model uncertainties is expected to grow in future years as results of such activities.

8.   COMPUTER SUPPORT

The highlights in IT services and systems development during 2010–2011 were as follows:

- Two powerful modern HP ProLiant DL380 Generation 7 servers were acquired, assembled and commissioned and will be used in the future as the web- and development servers at the IAEA Data Centre.
- Regular updates of NDS databases, applications and services provided by NDS were performed.

8.1.   Computer networks

The following NDS computers are located at the IAEA Data Centre:

- **www-nds.iaea.org** and **www-amdis.iaea.org**, the primary Nuclear Data Section and Atomic and Molecular data units servers.
- **nds121.iaea.org**, the NDS development server.
- Two new servers.
- **castor.iaea.org**, a Dell Precision, Linux-based computer hosting the GANDR project. (will be decommissioned during 2012)
- **nds120.iaea.org**; a 64-bit Linux computer used for Monte Carlo and other calculations (will be removed from the Data Centre during 2012).

To conform to IAEA security standards the NDS sub-network remains inside the IAEA Firewall within a special network zone known as the 'De-militarized Zone' (DMZ). This zone is designed for servers that are accessed from the Internet, and is secured by a network 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. 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. 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.

The Phase Space CRP has resulted in the acquisition of large amounts of new data, by the end of 2011 this amounted to almost 0.8 TB, and approximately a further 1.9TB is expected over the course of the project. This, in addition to almost 450GB of new or updated data (i.e. POINT, TENDL, NSR, EXFOR, ENDF, CINDA), has highlighted the need for considerable additional disk storage and powerful hardware on the main server. The new servers, each with a 4.5TB disk array, were installed in the IAEA Data Centre on floor C-01 in order to separate the NDS and AMDU webservers and migrate the data services to the new hardware. This will be completed during 2012.

8.2.2. Microsoft systems

All members of staff have an IAEA-standard PC running IAEA-standard Microsoft Windows. During 2011 all of the Windows PCs were upgraded from XP to Windows 7. In addition Microsoft Office was updated to 2010 and Internet Explorer to version 9. Access rights to the operating system on these desktops are strictly controlled by the IAEA IT services (MTIT) by means of user and group security profiles. NDS has been able to acquire enhanced access for certain members of staff to allow installation of non-IAEA standard applications (e.g. FORTRAN compilers, X-windows, etc.). NDS staff also use the IAEA-supplied laptops which run Microsoft Windows 7.

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 Compaq ML350 server located within the NDS is being used by the NDSU for storing and sharing work related to EXFOR (compilations, scanned documents, etc.).

8.2.3. VMS systems

NDS continues to maintain one Alpha server (Compaq AS2100) running Open VMS. The machine is located in NDS server room and not accessible from outside. It is maintained primarily for legacy reasons.

8.3. Software development

NDS staff have continued to collaborate with MTIT staff on the development of the IAEA Nuclear Information and Knowledge Portal (NUCLEUS). This allows public access to scientific, technical and regulatory data; in the case of content from NDS this is mostly via a set of convenient links to our own pages. The NUCLEUS portal can be accessed at http://nucleus.iaea.org/.

The ADLIST application was improved according to users' feedback, and preliminary work has started to integrate it in the IAEA-wide Contact Management System.

8.4. Hardware overview

Table 4 lists the main computer hardware in use during the reporting period of 2010–2011.

Table 4. NDS computer hardware for 2010–2011.

Item	Quantity
Servers (HP DL380 G7 Rack Mount Servers)	2
Servers (HP DL380 G5 Rack Mount Servers)	2
Compaq ML350 servers	2
Workstation (Dell Precision 64-bit Workstation)	1
IAEA Standard Desktop PCs	15
Laptops (HP Notebooks)	8
HP LaserJet M3027 MFP Scanner/Printer	1
Linux PC's for calculations	10
Tablets for testing applications (iPad & Galaxy Tab)	2
External Hard Drives (Backup)	8

9.   CONCLUDING REMARKS

The outcome of supporting of Member States by the provision of high quality atomic and nuclear data has been achieved by many outputs during 2010–2011. These include:

- A major update of the web site to include new web-services has been achieved, enabling the checking and processing of EXFOR, ENDF and ENSDF formatted files; construction of a covariance matrix from EXFOR uncertainties and conversion of EXFOR to new user formats.
- Extension of the comprehensive database for ion beam analysis (IBANDL) has continued.
- 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.
- A test version of the EXFOR renormalization system has been completed and can be accessed on the web site.
- Maintenance of the RIPL-3 database of parameters to aid in model calculations and data evaluations has been done to ensure its continuing relevance.
- Evaluated files from various data development projects have been adopted by the latest release of the ENDF library (ENDF/B-VII.1).
- Maintenance of ENSDF decay and structure data by the International Network of Nuclear Structure and Decay Data Evaluators under the coordination of the NDS. A wide range of data has been added to and can be displayed in the LiveChart web-based application.
- Comprehensive collection of experimental data in the EXFOR database used for the evaluation of much neutron cross section data has been maintained.
- All possible INDC reports have been converted to PDF and are available to download from the web site.
- Continued development of the bibliographical (AMBDAS) and numerical (ALADDIN) databases for Atomic and Molecular data for fusion has continued, while a Wiki-style knowledge base has been introduced.
- 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: CRP on Tritium Inventory in Fusion Reactors, APID, Vol. 15, 2011; CRP on Atomic and Molecular Data for Plasma Modelling, APID, Vol. 16, 2011; Evaluated Nuclear Data for Nuclides within the Thorium-Uranium Fuel Cycle, STI/PUB/1435, May 2010; Nuclear Data for the Production of Therapeutic Radionuclides, IAEA TRS-473, 2011; Nuclear Data Sheets for A=72, D. Abriola and A.A. Sonzogni, *Nucl. Data Sheets*, **111** (2010) 1–140; ENDF/B-VII.1 Nuclear Data for Science and Technology: Cross Sections, Covariances, Fission Product Yields and Decay Data, M.B. Chadwick, R. Capote Noy, *et al., Nucl. Data Sheets*, **112** (2011) 2887–2996; Covariances of Evaluated Nuclear Cross Section Data for ^{232}Th, ^{180,182,183,184,186}W and ^{55}Mn, A. Trkov, R. Capote, E.Sh. Soukhovitskii, L.C. Leal, M. Sin, I. Kodeli, D.W. Muir, *Nucl. Data Sheets*, **112** (2011) 3098-3119.

Specific advances were also made in the visual appearance of the new web pages containing IAEA atomic and nuclear databases improved or finalised in 2010–2011, these

include EXFOR; ENDF; NSR; Medical applications; Ion Beam Analysis data and RIPL-3.

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 key papers and conference presentations. The most important was the ND-2010 Conference at Jeju Island, Korea at which four IAEA staff attended and at which Section staff contributed to thirty-two papers. Others include Lake Tahoe, USA (DR2010); Athens Greece (ECAART-2010); Portorož, Slovenia (NENE2010); Vilnius, Lithuania (ICAMDATA 2010); Marbella, Spain (RPHDM2010); Channai, India (ANUP 2010); Itapema, Brazil (IBA2011); Bretton Woods, USA (ISRD-14); Ghent, Belgium (ANIMMA 2011); Crete, Greece (CRETE11); Belfast, UK (APiP 2011); Bourdeaux-Lac, France (IFSA 2011); Bovec, Slovenia (NENE 2011); Tsukuba, Japan (ICRM 2011); Almaty, Kazakhstan (ICNRP2011) and Sarov, Russia (Nucleus-2011).

The impressive technical outputs and positive impacts of the work of the Nuclear Data Section (NDS) illustrated above and in more detail throughout this report are indicative of the contributions made to Member States by the IAEA as a whole, and should be a source of pride and satisfaction to the Department of Nuclear Sciences and Applications and the IAEA.

MEETINGS AND SCIENTIFIC VISITS IN 2010

Month/ Duration	Responsible Officer	Type	Meeting Title/Type of Visit	Home Institute	Location
March					
01 – 02	Abriola	CM	Consultants' Meeting: Assessment of Nuclear Data Needs for Particle-Induced Gamma-Ray Emission Spectroscopy (PIGE)		Vienna
01 – 05	Kellett	CV	O. Bersillon: install and demonstrate the SDF2NDF code developed for the production of ENDF formatted data files from ENSDF formatted files and deliver user manual	Retiree, France	Vienna
08 – 12	Capote Noy	CV	M. Sin: undertake nuclear reaction data calculations of neutron-induced fission cross sections on actinide nuclei to assess covariance cross sections	Physics Department, Bucharest University, Romania	Vienna
23 – 26	Forrest	RCM	2nd RCM: Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3)		Vienna
23 – 26	Forrest	CV	A. Koning: advisory capacity at the 2nd RCM on Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3)	Nuclear Research and Consultancy Group (NRG), The Netherlands	Vienna
23 – 26	Capote Noy	CV	L. Leal: evaluation of Manganese (Mn) in the resolved resonance region	Nuclear Science and Technology Division, Oak Ridge National Laboratory, USA	Vienna
23 – 26	Forrest	CV	P. Pereslavstev: advisory capacity at the 2nd RCM on Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3)	Forschungszentrum Karlsruhe (FZK), Germany	Vienna
24 – 26	Braams	CM	XML Schema for Atoms, Molecules and Solids (XSAMS)		Toki, Japan

04 – 06	Capote Noy	CV	N. Kornilov: advisory capacity at the 1st RCM on Prompt Fission Neutron Spectra (PFNS)	Ohio University, Athens, USA	Vienna
04 – 06	Capote Noy	RCM	1st RCM: Prompt Fission Neutron Spectra (PFNS)		Vienna
04 – 16	Zerkin	CV	K. Zolotarev: advise on development of EXFOR system and discuss IRDF issues	Institute for Physics and Power Engineering, Obninsk, Russia	Vienna
20 – 23	Dunaeva	CV	S. Taova and G. Pikulina: update EXFOR Editor software for data compilations, check functionality and discuss future plans and		
20 – 23	Dunaeva	TM	International Network of Nuclear Reaction Data Centers (NRDC)		Sapporo, Japan
27 – 28	Braams	TM	17th Meeting of the IFRC Sub-Committee on atomicAtomic and Molecular Data for Fusion		Vienna

May

05 – 07	Kellett	CM	Improvements and Extensions to the International Reactor Dosimetry Files		Vienna
17 – 28	Dunaeva	CV	V. Semkova: discuss problems, scope, contents and objectives of EXFOR database; compile articles with the help of EXFOR Editor software and digitize curves with the help of Graf_New programme	Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia, Bulgaria	Vienna
25 – 28	Forrest	TM	28th Meeting of the International Nuclear Data Committee		Vienna
31 May – 4 June	Abriola	CV	A. Gurbich: advise on theory, techniques and codes used for evaluation of nuclear cross sections for Ion Beam Analysis	Institute of Physics and Power Engineering, Obninsk, Russia	Vienna
31 May – 4 June	Abriola	CV	M. Kokkoris: advise on theory, techniques and codes used for evaluation of nuclear cross sections for Ion Beam Analysis	University of Athens, Greece	Vienna

June

01 – 11	Dunaeva	CV	V. McLane: discuss software for the Checking of the Compilation Results (CHEX) in EXFOR and algorithm of EXFOR REACTION code		Vienna
14 – 18	Abriola	CV	A. Sonzogni: evaluate nuclear structure and decay data for the mass-chain A=144, compile the final results in the ENSDF database and submit them to the Nuclear Data Sheets for publication.	Brookhaven National Laboratory, NNDC, Upton, USA	Vienna
14 – 18	Abriola	CV	J. Tuli: planning of the IAEA Workshop on Nuclear Structure and Decay Data: Theory and Evaluation	Brookhaven National Laboratory, NNDC, Upton, USA	Vienna
21 June – 21 Sept	Forrest	SSA	A. Vasaros: act as programmer in A&M Data Unit, maintain and further develop LiveChart web based application, a well as other web based databases used in NDS/AMDU	Vienna	Vienna
21 – 23	Braams	RCM	2nd RCM: Characterization of Size, Composition and Origins of Dust in Fusion Devices		Vienna

July

12 – 16	Capote Noy	CV	A. Konobeyev: discuss the implementation of the Unified Monte Carlo Method for nuclear data evaluation	Institut fuer Neutronenphysik und Reaktortechnik, FZK, Karlsruhe, Germany	Vienna
26 July – 04 Aug	Abriola	CV	J.M. Figueira: advise on theoretical modeling and evaluation of elastic cross section data for system of interest to Ion Beam Analysis	TANDAR Laboratory, Buenos Aires, Argentina	Vienna
26 July – 20 Aug	Abriola	SSA	J.O. Fernandez Niello: undertake evaluations related to Ion Beam Analysis measured in the TANDAR Laboratory taking into account the previously existing data and investigate a possible energy-dependence of the nuclear potentials	Buenos Aires, Argentina	Vienna

August

23 Aug –	Braams	CV	D. Humbert: extension of the GENIE back-end interface to	Saclay, France	Vienna

03 Sept			access further database		
30 Aug – 03 Sept	Otsuka	CV	G. Pikulina: install the new version of the EXFOR Editor software on NDS computers, present new features and check functionality and compatibility with the NDS dictionary database	Russia Federal Nuclear Centre, All Russia Scientific Research, Institute of Experimental Physics, Sarov, Russia	Vienna
30 Aug – 03 Sept	Dunaeva	CV	S. Taova: discuss problems of EXFOR compilation at the EXFOR Editor Workshop	Russia Federal Nuclear Centre, All Russia Scientific Research, Institute of Experimental Physics, Sarov, Russia	Vienna
30 Aug – 03 Sept	Dunaeva	TR	EXFOR Editor Workshop		Vienna
30 Aug – 09 Sept	Dunaeva	CV	V. Semkova: updating the REACTION coding and functionality in the updated version of the EXFOR database	Physikalisch-Technicsche Bundesanstalt, Braunschweig, Germany	Vienna

September

06 – 07	Capote Noy	CV	S. Goriely: finalize the co-authored paper "Towards improved evaluation of neutron-induced fission cross section" to be submitted for publication to Phys. Rev. C	Institut dÁstrophysique, Brussels, Belgium	Vienna
13 – 16	Braams	CV	W. Eckstein: inventorize the areas of physical and chemical sputtering database, participate at the 3rd RCM on Surface Composition dynamics for erosion processes and laying down a detailed work plan for updating the sputtering database	Max-Planck-Institut fuer Plasmaphysik, Garching bei Muenchen, Germany	Vienna
13 – 15	Braams	RCM	3rd RCM: Surface Data for Composition Dynamics relevant to Erosion Processes		Vienna

20 – 30	Capote Noy	CV	D. Smith: establish and validate the Unified Monte Carlo Method as an alternative method for nuclear data evaluation in neutron induced reactions	Argonne National Laboratory, Coronado, USA	Vienna
22 – 24	Capote Noy	CV	D. Muir: discuss and outline a major extension to the GANDR system for the evaluation of nuclear data and nuclear data covariances	Jacksonville, USA	Vienna
22 Sept – 22 Dec	Forrest	SSA	A. Vasaros: include new data into LiveChart, finalize pocket ENSDF, introduce graphs of the Gamma decay schemes into LiveChart of Nuclides, make improvements to the ADLIST	Vienna	Vienna
23 – 24	Capote Noy	CV	A. Trkov: development of the GANDR evaluation system	Jozef Stefan Institute, Ljubljana, Slovenia	Vienna
24 Sept – 30 Oct	Forrest	SSA	V. Pronyaev: assist the Head of Nuclear Data Services Unit in technical issues of the post related to the CRPs, work of the Unit, EXFOR and recent and upcoming staff changes, assist in organization of the Consultants' Meeting on International Neutron Cross Section standards	IPPE, Obninsk, Russia	Vienna
27 – 28	BraamsChung	TM	International Code Centre Network		Vienna
27 – 30	Braams	CM	Database Needs for Plasma Modelling		Vienna
27 – 30	Capote Noy	TM	Neutron Cross Section Covariances		Vienna
October					
11 – 18	Otsuka	CV	F. Kaeppeller: entries for the Experimental Nuclear Reaction Data Library EXFOR	Forschungszentrum Karlsruhe (FZK), Germany	Vienna
13 – 15	Capote Noy	CM	International neutron cross section standards 2010 – Extending and Updating		Vienna
19 – 22	Otsuka	CV	Y. Nagai: advisory capacity at the 3rd RCM on MANREAD	Japan Atomic Energy Agency, Nuclear Science and	Vienna

				Engineering Department, Ibaraki, Japan	
19 – 22	Otsuka	RCM	3rd RCM: Minor Actinides Neutron Reaction Data (MANREAD)		Vienna
21 – 22	Otsuka	CV	R. Reifarth: advisory capacity at the 3rd RCM on MANREAD	Gesellschaft fuer Schwerionenforschung (GSI), Darmstadt, Germany	Vienna

November

17 – 19	Braams	TM	XML Schema for Atoms, Molecules and Solids (XSAMS)		Vienna
17 – 26	Braams	CV	Y.Yu. Ralchenko: advice on XML schema for atoms, molecules and solids and prepare plans and solicitations for the 7th NLTE workshop in 2011	National Institute of Standards and Technology (NIST), Gaithersburg, USA	Vienna
22 – 26	Capote Noy	RCM	3rd RCM: Heavy Charged-particle Interaction Data for Radiotherapy		Heidelberg, Germany
22 – 26	Capote Noy	CV	A. Botvina: advisory capacity at the 3rd RCM on Heavy Charged-particle Interaction Data for Radiotherapy	Frankfurt Institute for Advanced Studies, Germany	Heidelberg, Germany
22 – 26	Capote Noy	CV	N. Sobolevsky: advisory capacity at the 3rd RCM on Heavy Charged-particle Interaction Data for Radiotherapy	Institute for Nuclear Research of the Russian Academy of Sciences	Heidelberg, Germany
22 Nov – 23 Dec	Abriola	SSA	A. Gurbich: maintenance of IBANDL data library, new CD version, maintenance of SigmaCalc calculator, evaluation of nuclear cross sections for Ion Beam Analysis (IBA)	Institute of Physics and Power Engineering, Obninsk, Russia	Vienna
29 Nov – 03 Dec	Capote Noy	CV	N. Carjan: collaboration work on calculation of scission neutrons emitted at neutron induced fission of actinide nuclei	Centre d'Etudes Nucleaires de Bordeaux Gradignan (CENBG)	Vienna

29 Nov – 03 Dec	Abriola	CV	B. Pritychenko: install and load NSR database on NDS MySQL database server, discuss NSR compilation, revise technical procedures of database exchange	Brookhaven National Laboratory, NNDC, USA	Vienna

December

06 – 10	Capote Noy	CV	E. Souhovitskii: advise on optical model with isolated resonances to treat nucleon scattering on light elements of importance for medical applications	Joint Institute of Energy and Nuclear Research – Sosny, Minsk, Belarus	Vienna
06 – 10	Abriola	CV	M. Kokkoris: replicate and document the evaluation method and techniques for Ion Beam Analysis	Technical University of Athens, Department of Physics, Greece	Vienna
06 – 10	BraamsChung	CV	N. Endstrasser: advancing the design of dust in plasma experiments database	Max Planck Institute, Garching, Germany	Vienna
06 – 10	BraamsChung	CV	Suk-Ho Hong: advancing the design of dust in plasma experiments database	National Fusion Research Institute, Dajeon, Korea	Vienna
13 – 17	Capote Noy	CV	A. Nichols: preparation of Technical Meeting on Intermediate-term Nuclear Data Needs for Medical Applications: Cross Sections and Decay Data	UK	Vienna
13 – 15	Braams	RCM	1st RCM: Spectroscopic and Collisional Data for W frofrom 1 eV to 20 keV		Vienna
13 – 15	Braams	CV	P. Beiersdorfer: advisory capacity at the 1st RCM on Spectroscopic and Collisional Data for W frofrom 1 eV to 20 keV	Los Alamos National Laboratroy, Los Alamos, USA	Vienna
13 – 17	Capote Noy	CV	A. Nichols: preparation of Technical Meeting on Intermediate-term Nuclear Data Needs for Medical Applications: Cross Sections and Decay Data	UK	Vienna
20 – 22	Abriola	CM	Review Benchmarking of Nuclear Data for the Th/U Fuel Cycle		Vienna

| 23 Dec 2010 – 22 Mar 2011 | Forrest | SSA | A. Vasaros: act as programmer and software engineer of the Nuclear Data Section | Vienna, Austria | Vienna |

MEETINGS AND SCIENTIFIC VISITS IN 2011

Month/Duration	Responsible Officer	Type	Meeting Title/Type of Visit	Home Institute	Location
March					
28 Mar – 01 Apr	Abriola	CV	A. Sonzogni: advise on ENSDF A=144 evaluation	NNDC, BNL, USA	Vienna
28 Mar – 08 Apr	Abriola	CV	M. Gupta: advise on the inclusion of evaluated nuclear structure data for super heavy nuclides in NDS databases and discuss the application of the EMPIRE code to Heavy Ion reactions	Manipal University, Karnataka, India	Vienna
April					
04 – 08	Abriola	TM	Technical Meeting: Coordination of the International Network of Nuclear Structure and Decay Data Evaluators		Vienna
11 – 13	Kellett	CM	Consultants' Meeting: Status of Data Needs for Neutron Activation Analysis		Vienna
13 – 15	Capote Noy	CV	F. Kaeppeller: discuss the new neutron capture cross sections measurements and validation of evaluated data libraries	Forschungszentrum Karlsruhe, Germany	Vienna
13 – 15	Simakov	CM	Consultants' Meeting: Neutron Sources Spectra for EXFOR		Vienna
26 – 28	Forrest	CV	S. Yavshits: present ISTC project No.3751 results on main characteristics of nucleon-induced fission Hg-Cm nuclei in 20-1000 MeV energy region, discuss high energy nuclear data status as well as possible contribution of the project results to RIPL-3.	Khlopin Radium Institute, St. Petersburg, Russia	Vienna

02 – 13	Zerkin	CV	K. Zolotarev: advise on development of EXFOR data correction system and IRDF issues	Institute of Physics and Power Engineering, Obninsk, Russia	Vienna
16 – 27	Abriola	CV	A. Gurbich: advise on PIGE techniques and nuclear data needs, IBANDL maintenance, as well as maintenance of SigmaCalc calculator.	Institute of Physics and Power Engineering, Obninsk, Russia	Vienna
16 – 20	Capote Noy	CV	A. Ventura: advise on global parameterizations of the interactive Boson Model to be used in level density calculations	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Vienna
16 – 20	Abriola	RCM	1st RCM: Reference Database of Cross Sections for Particle-induced Gamma Ray Emission (PIGE) Spectroscopy		Vienna
23 – 24	Otsuka	TM	Technical Meeting: International Network of Nuclear Reaction Data Centres (NRDC)		Vienna
23 – 25	Braams	CV	J. Reader: present experimental and database work carried out at NIST on light element spectroscopy and advise on work at NIST concerning spectroscopy of tungsten.	National Institute of Standards and Technology, Gaithersburg, USA	Vienna
23 – 25	Braams	RCM	2nd RCM: Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions		Vienna
25 – 27	Otsuka	TR	EXFOR Editor Workshop		Vienna
30 – 31	Braams	CM	Consultants' Meeting: Data Needs for Erosion and Tritium Retention in Beryllium Surfaces		Vienna
31 May- 3 June	Capote Noy	CM	Consultants' Meting: Nuclear Reaction Model Code EMPIRE		Sao Jose dos Campos, Brazil

<u>June</u>

14 – 16	Abriola	CV	B. Singh: advise on evaluation of nuclear structure and decay data for the mass chain A=148	McMaster University, Hamilton, Canada	Vienna
21 – 24	Capote Noy	CM	Consultants' Meeting: Nuclear Data for Charged-particle Monitor Reaction and Medical Isotope Production		Vienna
27 – 29	Forrest	CV	J. Kopecky: advise on neutron activation reactions of importance for activation libraries, in particular FENDL-3.	Juko Research, Petten, Netherlands	Vienna

<u>August</u>

10 – 12	Braams	RCM	1st RCM: Atomic and Molecular Data for State-Resolved Modelling of Hydrogen and Helium and Their Isotopes in Fusion Plasmas		Vienna
15 – 19	Abriola	CV	A. Gurbich: replicate and document the evaluation method and techniques for Ion Beam Analysis	Institute of Physics and Power Engineering, Obninsk, Russia	Vienna
15 – 19	Abriola	CV	M. Kokkoris: replicate and document the evaluation method and techniques for Ion Beam Analysis	Technical University of Athens, Greece	Vienna
22 – 26	Capote Noy	TM	Technical Meeting: Intermediate-term Nuclear Data Needs for Medical Applications: Cross Sections and Decay Data		Vienna

<u>September</u>

06 – 09	Capote Noy	TM	Technical Meeting: U-238 Inelastic Scattering and Capture Cross Section Data		Vienna
07 – 09	BraamsChung	CV	N. Mason: advise on coordination of data exchange, data evaluation and database management	Open University, London, UK	Vienna
07 – 09	BraamsChung	CV	Y.Yu. Ralchenko: advise on improvements to the user interface of ALADDIN database and GENIE search engine	NIST, Gaithersburg, USA	Vienna
07 – 09	BraamsChung	TM	Technical Meeting: Coordination of Network of A&M Data Centres		Vienna

27 – 30	Capote Noy	CV	B. Carlson: validate EMPIRE implementation of the exclusive version of the DDHMS pre-equilibrium code for proton induced reactions up to 200 MeV		

October

03 - 05	ChungBraams	CM	Consultants' Meeting: XML Schema for Atoms, Molecules and Solids (XSAMS)		Washington, DC, USA
10 - 12	Abriola	CM	Consultants' Meeting: Beta-delayed Neutron Evaluation		Vienna
10 - 14	Capote Noy	CV	N. Carjan: improve the description of the nuclear shape near the scission point for calculations of prompt fission spectra	Centre d'Etudes Nucleaires, Gradignan, France	Vienna
17 – 28	Capote Noy	TR	Workshop: Monte Carlo Radiation Transportation and Associated Data Needs for Medical Applications		ICTP, Trieste, Italy

November

01 – 30	Capote Noy	SSA	D. Lopez Aldama: produce nuclear applications library for advanced fusion and reactor design	Cuba energia, Havana, Cuba	Vienna
02 – 04	Forrest	TM	Technical Meeting: Long-term Needs for Nuclear Data Developments		Vienna
14 - 18	Capote Noy	CV	E. Soukhovitskii: improve calculations of inelastic scattering of major actinides with emphasis of major actinides with emphasis on results of new optical model potential	Energy and Nucelar Research Institute, Misnk, Belarus	Vienna
21 – 25	Capote Noy	TR	Workshop: Development of Nuclear Data Libraries		Vienna
21 – 25	Abriola	CV	B. Pritychenko: install and load NSR database on NDS MySQL database server, discuss NSR compilation, revise technical procedures of database exchange	Brookhaven National Laboratory, USA	
30 Nov – 2 Dec	Braams	RCM	3rd RCM: Characterisation of Size, Composition and Origins of Dust in Fusion Devices		Vienna

30 Nov – 2 Dec	Braams	CV	M. Rubel: advise on progress in dust in plasma in the European Fusion Programme	KTH Royal Institute of Technology, Sweden	Vienna

December

05 – 07	Otsuka	CV	D.L. Smith: advise on nuclear reaction data uncertainties and covariances	Argonne National Laboratory, USA	Vienna
05 – 09	Chung	TR	7th NLTE Code Comparison Workshop		Vienna
05 – 09	BraamsChung	CV	Y.Yu. Ralchenko: advise on Non-local thermodynamic quilibrium (NLTE) kinetics of atoms and ions in plasma	NIST, Gaithersburg, USA	Vienna
05 – 09	BraamsChung	CV	A. De La Varga: advise on Non-local thermodynamic quilibrium (NLTE) kinetics of atoms and ions in plasma	Instituto de Fusion Nuclear, Madrid, Spain	Vienna
06 – 09	Forrest	RCM	3rd RCM: Nuclear Data Libraries for Advanced Systems – Fusion Devices (FENDL-3)		Vienna
06 – 09	Forrest	CV	L. Leal: advise on evaluation of cross section and covariance data for neutron induced reactions on Mn-55	Oak Ridge National Laboratory, Oak Ridge, USA	Vienna
12 – 13	Braams	TM	TM: Improving the Database for Physical and Chemical Sputtering		Vienna
12 – 16	Braams	CV	K. Nordlund: advise on deficiencies in the particle-surface interaction database	University of Helsinki, Finland	Vienna
12 – 16	Braams	CV	R. Schneider: advise on activities of the AMDU support database and knowledge base developments for plasma-material interaction	University Greifswald, Germany	Vienna
12 – 16	Braams	CV	P. Krstic: advise on interface between classical & quantum simulations for improvement of database on plasma-material interaction processes	Oak Ridge National Laboratory, Oak Ridge, USA	Vienna
13 – 16	Capote Noy	RCM	2nd RCM: Prompt Fission Neutron Spectra of Actinides		Vienna
14 – 15	Braams	TM	TM: Ab-initio-based Methods for Plasma-material Interaction in Fusion Devices		Vienna

Scientific Papers and Publications 2010 and 2011

2010

Elastic Scattering of ^{7}Li + ^{27}Al at Several Angles in the 7-11 MeV Energy Range
by D. Abriola, *et. al.,* 19th International Conference on Ion Beam Analysis, 7-11 September 2009, *Nucl. Instr. Meth. Phys. Res.* **B268** (2010) pp. 1793-1796.

Radiative recombination rate coefficients for highly-charged tungsten ions
by M.B. Trzhaskovskayaa, V.K. Nikulin, R.E.H. Clark, *Atomic Data and Nuclear Data Tables* **96** (2010) 1-25.

Measurements of emission spectra from hot, dense germanium plasma in short pulse laser experiments
by D.J. Hoarty, S.F. James, C.R.D. Brown, B.M. Williams, H.-K. Chung, J.W.O. Harris, L. Upcraft, B.J.B. Crowley, C.C. Smith, R.W. Lee, *High Energy Density Physics* **6** (2010) pp.105-108.

ERRORF – A code to calculate covariance of self-shielding factor and its temperature gradient
by N. Otuka, A. Zukeran, H. Takano, G. Chiba, M. Ishikawa, JAEA-Data/Code 2008-012, Japan Atomic Energy Agency, June 2008.

Covarancies of resonance self-shielding factor and its temperature gradient for uncertainty evaluation of Doppler reactivity
by A. Zukerman, G. Chiba, N. Otuka, M. Ishikawa, H. Takano, JAEA-Research 2008-091, Japan Atomic Energy Agency, February 2009.

Neutron-induced activation cross sections on hafnium isotopes from the threshold to 20 MeV
by V. Semkova, R. J. Tornin, N. Janeva, N. Koyumdjieva, A. Moens, A.J.M. Plompen, K. Volev, Procs. of Scientific Workshop on Neutron Measurements, Theory and Applications Nuclear Data for Sustainable Nuclear Energy, 28-30 April 2009, Geel, Belgium, Editor: F.-J. Hambsch, JRC Scientific and Technical Reports, EUR 23883 EN-2010, pp. 155-159, ISBN 978-92-79-11705-3, ISSN 1018-5593.

Nuclear Data Sheets for A = 72
by D. Abriola and A.A. Sonzogni, *Nucl. Data Sheets* **111** (2010) pp. 1-140.

Cyclotron production of the ^{105,106m}Ag, ^{100,101}Pd, ^{100,101m,105}Rh radionuclides by ^{nat}Pd(p,x) nuclear processes
by M.U. Khandaker, K. Kim, G. Kim, N. Otuka, *Nucl. Instr. Meth. Phys. Res*. **B268** (2010) pp. 2303-2311.

The ^{235}U(n,f) prompt fission neutron spectrum at 100 K input neutron energy
by N. Kornilov, F.-J. Hambsch, I. Fabry, S. Oberstedt, T. Belgya, Z. Kis, L. Szentmiklosi, S. Simakov, *Nucl. Sci. Eng.* **165** (2010) pp. 117-127.

Neutron activation cross sections for zirconium isotopes
by V. Semkova, E. Bauge, A.J.M. Plompen, D.L. Smith, *Nucl. Phys.* **A832** (2010) pp. 149-169.

High resolution measurements of the ^{241}Am($n,2n$) reaction cross section
by C. Sage, V. Semkova, O. Bouland, P. Dessagne, A. Fernandez, F. Gunsing, C. Nästren, G. Noguère H. Ottmar, A.J.M. Plompen, P. Romain, G. Rudolf, J. Somers, F. Wastin, *Phys. Rev*. **C81** (2010) 064604.

Neutron physics of the Re/Os clock. I. Measurement of the (*n,γ*) cross sections of ^{186,187,188}Os at the CERN n_TOF facility
by M. Mosconi, A. Mengoni, R. Capote, *et al*., (the n_TOF Collaboration), *Phys.* Rev. **C82**(2010) 015802.

Neutron physics of the Re/Os clock. II. The (*n,n'*) cross section of ^{187}Os at 30 keV neutron energy
by M. Mosconi, M. Heil, F. Käppeler, R. Plag. A. Mengoni, *Phys. Rev*. **C82** (2010) 015803.

Neutron physics of the Re/Os clock. III. Resonance analyses and stellar (*n,γ*) cross sections of ^{186,187,188}Os
by A. Mengoni, R. Capote, *et al*., (the n_TOF Collaboration), *Phys.* Rev. **C82** (2010) 015804.

IFMIF test facilities – 3 years of EVEDA
by F. Arbeiter, U. Fischer, P. Garin, R. Heidinger, V. Heinzel, A. Klix, A. Möslang, St. Simakov, K. Tian, P. Vladimirov, Jahrestagung Kerntechnik (Berlin 2010): INFORUM GmbH, 2010, compact 810.

Comparative study of the tungsten irradiation conditions in IFMIF and DEMO
by S.P. Simakov, P. Pereslavtsev, U. Fischer, A. Möslang, Jahrestagung Kerntechnik (Berlin 2010): INFORUM GmbH, 2010, compact 811.

Assessment of the tritium production in the HFTM specimen cells of IFMIF
by A. Klix, U. Fischer, S.P. Simakov, IEEE Transactions on Plasma Science (2010) **38** pp. 259-264.

Modelling d-Be and d-C neutron sources for SPIRAL-2
by Majerle, S.P. Simakov, Jahrestagung Kerntechnik (Berlin 2010): INFORUM GmbH, 2010, compact 812.

Measurements of X- and γ-ray emission probabilities in the β^{-} decay of ^{233}Pa
by F.G. Kondev, I. Ahmad, J.P. Greene, M.A. Kellett, A.L. Nichols, *Appl. Radiat. Isot.* **68** (2010) pp. 2382-2386.

Nuclear data evaluation methodology including estimates of covariances
by R. Capote, D.L. Smith, A. Trkov, EPJ Web of Conferences **8** (2010) 04001.

Nuclear reaction data file for astrophysics (NRDF/A) in Hokkaido University Nuclear Reaction Data Center
by K. Kato, M. Kimura, N. Furutachi, T. Togashi, A. Makinaga, N. Otuka, Procs. Tours Symp. Nuclear Physics and Astrophysics – VII, Kobe, Japan, 16-20 November 2009, AIP Conf. Proc. **1238** (2010) pp.199-204.

High temperature, high density opacity measurements using short pulse lasers
by D.J. Hoarty, S.F. James, C.R.D. Brown, B.M. Williams, T. Guymer, M. Hill, J. Morton, D. Chapman, R. Shepherd, J. Dunn, G. Brown, M. Schneider, P. Beiersdorfer, H.K. Chung, J.W.O. Harris, L.Upcraft, C.C. Smith, R.W. Lee, *J. Physics: Conference Series* **244** (2010) 012002.

Depression of reactivity by the collision energy in the single barrier H+CD$_4$ -> HD+CD$_3$ reaction
by Weiqing Zhang, Yong Zhou, Guorong Wu, Yunpeng Lu, Huilin Pan, Bina Fu, Quan Shuai, Lan Liu, Shu Liu, Liling Zhang, Bo Jiang, Dongxu Dai, Soo-Ying Lee, Zhen Xie, B.J. Braams, J.M. Bowman, M.A. Collins, Dong H. Zhang, Xueming Yang, *Procs. Nat. Acad. Sci.* **107** 29 (2010) pp.12782-12785.

Evidence for vinylidene production in the photodissociation of the allyl radical
by Chao Chen, B. Braams, D.Y. Lee, J.M. Bowman, P.L. Houston, D. Stranges, *Phys. Chem.*

Letters, **1** 12 (2010) pp. 1875-1880.

Ab-Initio-based potential energy surfaces for complex molecules and molecular complexes
by J.M. Bowman, B.J. Braams, S. Carter, C. Chen, G. Czakó, B. Fu, X. Huang, E. Kamarchik, A.R. Sharma, B.C. Shepler, Y. Wang, Z. Xie, *Phys. Chem. Letters* **1** 12 (2010) pp. 1866-1874.

Shared-proton mode lights up the infrared spectrum of fluxional cations H_5^+ and D_5^+
by T.C. Cheng, B. Bandyopadyay, Yimin Wang, S. Carter, B.J. Braams, J.M. Bowman, M.A. Duncan, *Phys. Chem. Letters* **1** 4 (2010) pp.758-762.

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by P.F. Conforti, M. Braunstein, B.J. Braams, J. M. Bowman, *Chem. Phys.* **133** 16 (2010) 164312.

$^{197}Au(n,\gamma)$ cross section in the resonance region
by C. Massimi, R. Capote, A. Mengoni, *et al.,* (the n_TOF Collaboration), *Phys.* Rev. **C81** (2010) 044616.

The $^{92}Zr(n,\gamma)$ reaction and its implications for stellar nucleosynthesis
by G. Tagliente, R. Capote, A. Mengoni, *et al*., (the n_TOF Collaboration), *Phys.* Rev. **C81** (2010) 055801.

Neutron-induced fission cross section of ^{234}U and ^{237}Np measured at the CERN Neutron Time-of-Flight (n_TOF) facility
by C.Paradela, R. Capote, A. Mengoni, *et al*., (the n_TOF Collaboration), *Phys.* Rev. **C82** (2010) 034601.

Description of analysing power and (p,n) reaction by a global dispersive coupled-channel optical model potential
by W.L. Sun, L.J. Hao, E.Sh. Soukhovitskii, R. Capote, J.M. Quesada, Nucl. Phys. Trends: The 7th China - Japan Joint Nuclear Physics Symposium, Tsukuba (Japan), 9–13 November 2009, Editors: A. Ozawa, W. Liu, AIP Conf. Procs. 1235, ISBN: 978-0-7354-0780-0.

Neutron cross sections for next generation reactors: New data from n_TOF
by N. Colonna, R. Capote, A. Mengoni, *et al*., (the n_TOF Collaboration), *Appl. Radiat. Isot.* **68** (2010) pp. 643-646.

Spectrum of prompt fission neutrons from $^{235}U(n,F)$
by V.M. Maslov, N.A. Tetereva, V.G. Pronyaev, A.B. Kagalenko, K.I. Zolotarev, R. Capote, T. Granier, B. Morillon, F.-J. Hambsch, J.-C. Sublet, *Atomic Energy* **108** 6 (2010) pp. 432-443.

Study of neutron-induced fission cross sections of U, Am, and Cm at n_TOF
by P.M. Milazzo, R. Capote, *et al*., (the n_TOF Collaboration), Procs. VIII Latin American Symposium on Nuclear Physics and Applications, Editors: R. Alcaron, H.F. Arellano, P.L. Cole, A.J. Kreiner, AIP Conf. Procs. 1265 (2010) pp. 477-482.

Astrophysics at n_TOF facility
by G. Tagliente, R. Capote, *et al*., (the n_TOF Collaboration), Procs. VIII Latin American Symposium on Nuclear Physics and Applications, Editors: R. Alcaron, H.F. Arellano, P.L. Cole, A.J. Kreiner, AIP Conf. Procs. 1265 (2010) pp. 160-165.

Development of Web-based user interface for evaluated covariance data files
by T. Togashi, K. Kato, R. Suzuki, N. Otuka, published in the proceedings of the 2009 Annual Symposium on Nuclear Data, 26-27 November 2009, Ricotti, Tokai, Japan, (JAEA-Conf. 2010-005) pp. 69-74.

Analysis of proton-induced reactions by using simulation
by H. Iwamoto, Y. Iwamoto, Y. Hirata, N. Otuka, K. Niita, published in the proceedings of the 2009 Annual Symposium on Nuclear Data, 26-27 November 2009, Ricotti, Tokai, Japan, (JAEA-Conf. 2010-005) pp. 81-86.

Radiation deep penetration calculations for the IFMIF testcell wall
by S.P. Simakov, J. Li, U. Fischer, *Fusion Eng. Design,* **85** (2010) pp. 1924-1927.

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Newsletter	Nuclear data newsletter N°s 49, 50, 51, 52.
Technical Reports:	Nuclear Data for the Production of Therapeutic Radionuclides, Technical Reports Series No. 473, IAEA, Vienna, Austria, 2011.
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INDC(NDS)-562	Summary Report of the Consultants' Meeting on XSAMS: XML Schema for Atomic and Molecular Data and Particle Solid Interactions
INDC(NDS)-563	Summary Report of the Technical Meeting on Technical Aspects of Atomic and Molecular Data Processing and Exchange, 20th Meeting of the A+M Data Centres and ALADDIN Network
INDC(NDS)-564	Summary Report of the 1st Research Coordination Meeting on Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions
INDC(NDS)-566	Summary Report of the Consultants' Meeting on IAEA International Database on Irradiated Nuclear Graphite Properties, 12th Meeting of the Technical Steering Committee
INDC(NDS)-567	Summary Report of the 2nd Research Coordination Meeting on Nuclear Data Libraries for Advanced Systems – Fusion Devices (FENDL-3)
INDC(NDS)-568	Summary Report of the Consultants' Meeting on Assessment of Nuclear Data Needs for Particle Induced Gamma Ray Emission (PIGE)
INDC(NDS)-569	Report of the IAEA Nuclear Data Section to the International Nuclear Data Committee for the period January 2008 – December 2009
INDC(NDS)-570	Summary Report of the Consultants' Meeting on XSAMS: XML Schema for Atoms, Molecules and Solids

INDC(NDS)-593   Summary Report of the Technical Meeting of the International Network of Nuclear Reaction Data Centres

INDC(NDS)-594   Table of Nuclear Magnetic Dipole and Electric Quadrupole Moments

INDC(NDS)-595   Summary Report of an IAEA Technical Meeting on Co-ordination of the International Network of Nuclear Structure and Decay Data Evaluators

INDC(NDS)-596   Summary Report of the Technical Meeting on Intermediate-term Nuclear Data Needs for Medical Applications: Cross Sections and Decay Data

INDC(NDS)-597   Summary Report of the Technical Meeting on Inelastic Scattering and Capture Cross Section Data

INDC(NDS)-598   Missing Levels with Two Superimposed Sequences

INDC(NDS)-599   Summary Report from the Consultants' Meeting on Beta-delayed Neutron Evaluation

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INDC(NDS)-606   XML Schema for Atoms, Molecules and Solids (XSAMS), Summary Report of an IAEA Consultants' Meeting

INDC(NDS)-611   FENDL-3.0: Processing the evaluated nuclear data library for fusion applications

Report	**Country of Origin**	**Numbers of Reports**	**Total Reports**
INDC(ITY)	Italy	0017, 0018	2
INDC(BLR)	Belarus	0021	1
INDC(CCP)	Russian Federation	0452, 0453	2
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INDC(UK)	United Kingdom	0093	1
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