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## On-line News

### Ongoing Service

The Nuclear Data Section is currently compiling an accessible electronic library of all documents produced by the IAEA pertaining to our Nuclear Data Services. These documents include IAEA-NDS, INDC and other NDS technical reports. Many only existed on microfiche or in paper form. All known documents will eventually be converted to PDF and placed on our web site.

This project is still on-going and can be accessed on:

<http://www-nds.iaea.org/reports-new/>

### New Web Front Page

The new web front page of Nuclear Data Services was introduced in June 2008. This page presents nuclear data and services from different viewpoints that are oriented towards various categories of user. Modern approaches have been adopted with the available databases – Java and JavaScript will provide effective maintenance of the page in future. Along with page development, a common tool was developed that allows the quick creation of NDS web pages with standard elements. The tool can significantly simplify the development of new webpages, and has already been used to renew several NDS pages, such as network pages, the CD-ROM distribution page, and others.

The new web front page can be accessed on:

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

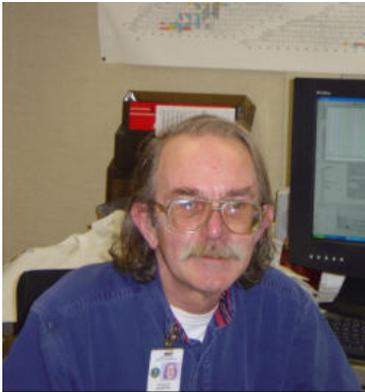
## Coordinated Research Projects

IAEA Coordinated Research Projects (CRPs) are a valuable mechanism for stimulating useful research in IAEA Member States. Both active and recently completed CRPs of the Nuclear Data Section can be found at:

<http://www.iaea.org/programmes/ripc/nd/crps.htm>

# Announcement

We were deeply saddened to learn of the death of Tom Burrows (National Nuclear Data Center, Brookhaven National Laboratory) from cancer on 1st July 2008.



Apart from his post-doctoral studies at the University of Kentucky, Tom spent his entire professional career at the National Nuclear Data Center, Brookhaven. He was an extremely competent nuclear data evaluator for ENDF and ENSDF, and rapidly established a worldwide reputation for being an exceptionally thorough, highly dedicated and hard working nuclear scientist with the added ability to produce and develop extremely useful software that assisted greatly in our nuclear structure evaluations. All members of the International Network of Nuclear Structure and Decay Data Evaluators were greatly appreciative of the meticulous care with which he improved and maintained vital data analysis codes. Furthermore, throughout his time at NNDC, he played a very important role as mentor to a generation of new nuclear structure evaluators discovering and working on the ENSDF project.

Tom will be greatly missed by all of us in the nuclear data community.

## Database News

**CINDA** — Bibliographical references to experimental nuclear reaction data, and calculations, reviews, compilations and evaluations of neutron reaction and spontaneous fission data.

- Extended by information from EXFOR
- Contains 425,420 lines, 58,901 publications and 189,139 blocks
- Available via retrieval systems on CD and the Web: <http://www-nds.iaea.org/cinda/>.

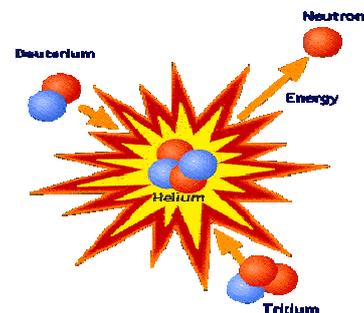
**EXFOR** — Comprehensive library of experimental nuclear reaction data induced by neutrons, charged particles and photons.

- Contains 17,301 entries and 117,349 data tables.
- New Web service: conversion of EXFOR data to

R33 (format for the IBANDL users' community).

- Master file, trans files, dictionaries and software for compilers are regularly updated and available on the Web: <http://www-nds.iaea.org/exfor-master>
- Upload users' data on the Web: <http://www-nds.iaea.org/exfor/x4send.htm>
- Available via retrieval systems on CD and the Web: <http://www-nds.iaea.org/exfor/>

## Computer Codes and Data Libraries



The following databases and libraries are available cost-free on CD-ROM on request:

### EXFOR-CINDA Database and Retrieval Systems, version 1.98, data updated to June 2008:

- Integrated CINDA and EXFOR
- Advanced interactive search
- Help based on Dictionaries
- Interactive graphics with ZVView
- Can access and run from the CD without installation
- Works with local and remote databases
- Includes non-interactive EXFOR retrievals

#### Two CD-ROMs are available:

- for Windows with MS-Access databases
- for Applications on Linux, Windows and MacOSX (Macintosh) with MySQL databases

*Developed by V. Zerkin, Nuclear Data Section, IAEA, 2001-2008.*

## EndVer/GUI and EXFOR-CINDA package, July 2008:

An integrated software package for comparison of evaluated nuclear data files with experimental data from the EXFOR database (also contains interactive plotting).

Features:

- EndVer with software graphics and user interface
- Integrated EndVer-EXFOR-CINDA
- Ready for use on Linux, Windows and Mac-OSX
- PostScript graphics with PlotC4
- Interactive graphics with ZVView
- Non-interactive EXFOR retrievals
- Run from the CD without installation
- Advanced interactive search
- Help based on Dictionaries
- Works with local and remote Databases
- CINDA with charged particle and photonuclear reactions
- New: works for metastable materials

Developed by A. Trkov and V. Zerkin, Nuclear Data Section, IAEA, 2004-2008.

## WIMS Library Update

28 January 2008

Because of a bug in the NJOY processing multigroup data, the WIMS-D library based on ENDF/B-VII data contained errors. Only the Th-232 and Pa-231,233 data were affected.

Corrected [WIMSD libraries](#) based on the ENDF/B-VII.0 data have been uploaded and [Plots](#) were updated.

The differences between the original and corrected results for the standard benchmarks can be seen in [E70\\_bug.lst](#)

27 December 2006

New [WIMSD libraries](#) were added based on the ENDF/B-VII.0 library.

Some [programs, procedures and data files](#) were updated. [Plots](#) were also updated.

The [IAEA evaluated nuclear data files](#) were uploaded to the website.

New list files were added to the [XnWlup package](#).

9 August 2005

New [WIMSD libraries](#) were added, based on the JEFF-3.1 library.

Several [programs and procedures](#) were corrected or updated.

Release of [XnWlup package version 3.0](#).

[IRPhE D2O benchmarks](#) added to the benchmarking sequence.

[Plots](#) were added.

<http://www-nds.iaea.org/wimsd/>

# Selected Charts, Reports and Documents

**Chart of the Nuclides wall chart** prepared by Knolls Atomic Power Laboratory and distributed by Lockheed Martin (16<sup>th</sup> edition, revised to 2002). Available cost-free on request **only for teachers and scientists from developing countries**.

**Chart of the Nuclides book** Prepared by Knolls Atomic Power Laboratory and distributed by Lockheed Martin (16<sup>th</sup> edition, revised to 2002). This book form of the Nuclides Chart is available cost-free on request **only for teachers and scientists from developing countries**.

**Chart of Nuclides wall chart** Prepared by Karlsruhe, 6<sup>th</sup> edition (1995). Updates from 1998. Available cost-free on request **only for teachers and scientists from developing countries**.

**Chart of the Nuclides Book** Prepared by Karlsruhe, 7<sup>th</sup> edition (2006). Available cost-free on request **only for teachers and scientists from developing countries**.

**INDC(NDS)-0520** Summary Report of the Consultants' Meeting on XML Schema for Atomic and Molecular Data, Vienna, 1-2 October 2007, prepared by D. Humbert, January 2008.

This report is available as hard copy or on-line at: [http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0514** Summary Report of the Second Research Coordination Meeting on Reference Database for Neutron Activation Analysis, Vienna, 7-9 May 2007, prepared by M.A. Kellet and R.B. Firestone, March 2008. This report is available as hard copy or on-line at: [http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0521** Summary Report of the Second Research Coordination Meeting on Atomic Data for Heavy Element Impurities in Fusion Reactors, Vienna, 26-28 September 2007, prepared by R.E.H. Clark, January 2008.

This report is available as hard copy or on-line at: [http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0522** Summary Report of the First Research Coordination Meeting on Data for Surface Composition Dynamics Relevant to Erosion Processes, Vienna, 17-19 October 2007, prepared by R.E.H. Clark, February 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0523** *Summary Report of the First Research Coordination Meeting on Heavy Charged-Particle Interaction Data for Radiotherapy*, Vienna, 6-9 November 2007, prepared by H. Palmans and R. Capote Noy, April 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0524** *Summary Report of the Third Research Coordination Meeting on Parameters for Calculation of Nuclear Reactions of Relevance to Non-Energy Nuclear Applications*, Vienna, 10-14 December 2007, prepared by S. Goriely and R. Capote Noy, February 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0525** *IAEA Technical Meeting on Nuclear Data Library for Advanced Systems - Fusion Devices*, Vienna, 31 October-2 November 2007, prepared by R. Forrest and A. Mengoni, April 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0527** *Summary Report of an IAEA Technical Meeting on Technical Aspects of Atomic and Molecular Data Processing and Exchange, 19<sup>th</sup> Meeting of the A+M Data Centres and ALADDIN Network*, Vienna, 3-5 October 2007, prepared by D. Humbert, May 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

**INDC(NDS)-0529** *Report of the IAEA Nuclear Data Section to the International Nuclear Data Committee for the Period January 2006 - December 2007*, Vienna, edited by D.H. Abriola, April 2008.

This report is available as hard copy or on-line at:  
[http://www-nds.iaea.org/indc\\_sel.html](http://www-nds.iaea.org/indc_sel.html)

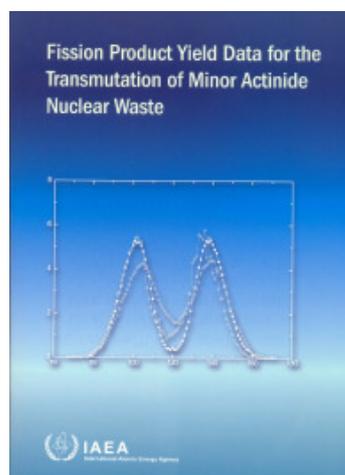
**Nuclear Wallet Cards 2005** 7<sup>th</sup> Edition by Jagdish K. Tuli, National Nuclear Data Center. These pocket size wallet cards are available as hard copy on request.

## **CINDA 2006: The Comprehensive Index of Nuclear Reaction Data, Archive 1935-2006**

The CINDA Archive Index consists of a set of six volumes, and is published on behalf of the IAEA Nuclear Data Section, the Russian Nuclear Data Section and the OECD/NEA Data Bank.

There are limited cost free sets available on request.

## **Fission Product Yield Data for the Transmutation of Minor Actinide Nuclear Waste**



This publication reports on a coordinated research project devoted to the development of methodologies designed to derive recommended fission yields for direct application in studies of the transmutation of nuclear waste. Emphasis is placed on the derivation of adequate systematics and models for the calculation of energy dependent fission yields up to 150 MeV incident neutron energy. A benchmark exercise revealed the worth and predictive capabilities of the proposed systematics and theoretical models. These methods of analysis have the potential to give reliable predictions after implementation of further improvements suggested in this report. A brief introduction and the various studies undertaken by individual participants are given at the beginning of the publication, followed by a detailed description of the resulting overall achievements, conclusions and recommendations of the coordinated research project, and a summary of the benchmark exercise and results. Additional material is contained on a CD-ROM, including various compilations of the fission product yields, unedited papers and full details of the benchmark exercise.

For orders and information on IAEA publications please contact:

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P.O. Box 100

A-1400 Vienna, Austria

Tel.: (43) 1 2600 22529/22530

Fax: (43) 1 2600 29302

# Meeting Reports

## Biennial Meeting of the International Nuclear Data Committee 22-25 April 2008, IAEA Headquarters, Vienna, Austria

The 27<sup>th</sup> meeting of the International Nuclear Data Committee (INDC) was convened at IAEA Headquarters in Vienna from 22 to 25 April 2008. Primary aims of the meeting were as follows:

- (a) review the nuclear data activities of the Nuclear Data Section (NDS) covering the period 2006-2007;
- (b) evaluate the NDS nuclear data programme of work for the 2008-2009 two-year cycle;
- (c) advise on future longer-term nuclear data activities (2010, 2011, etc.).

Atomic and molecular data activities are handled separately by the Atomic and Molecular Data for Fusion Sub-committee of the International Fusion Research Council.



INDC in plenary session.

Current membership of the INDC consists of nuclear data specialists from Argentina, Bulgaria, Canada, China, Czech Republic, France, Germany, India, Italy, Japan, Republic of Korea, Russian Federation, Thailand, the UK and the USA, with addition advisors in attendance in April 2008 from France, Germany, Thailand and the USA, along with representatives from the NEA-OECD Data Bank and JRC Institute for Reference Materials and Measurements, Geel, Belgium. After NDS staff had provided extensive summary reports for 2006-2007 and 2008-09, the advisory work load of the INDC during the remainder of the meeting was shared between two agreed Working Groups that reviewed and assessed:

- (a) Nuclear data developments,
- (b) Data dissemination, international coordination and training.

The high quality of the Section's work was noted and much appreciated. INDC members recognized the technical work undertaken in the Coordinated Research Projects and Data Development Projects, and that INDC recommendations have been taken into account for all items assessed in 2004 and 2006. However, nuclear data needs that were identified during these earlier meetings were judged largely to exceed the resources available to the NDS. Nuclear energy is viewed with new interest throughout the world, in particular in developing countries, so that increasing demands on NDS services seem inevitable. NDS will need appropriate staffing to meet these demands, and the INDC urged that an increase in resources be considered.

The more noteworthy features of the deliberations of the INDC in April 2008 were as follows:

1). **Specific recommendations for new Coordinated Research Projects:**

Prompt fission spectrum improvements for  $^{235,238}\text{U}$ ,  $^{239}\text{Pu}$  (U/Pu-cycle) and  $^{232}\text{Th}$ ,  $^{233}\text{U}$  (Th/U cycle);  
Neutron scattering for iron, deuterium and beryllium;  
Production of non-standard positron emitters for medical applications.

2). **Proposals for Data Development Projects:**

Benchmarking of nuclear data for the Th/U fuel cycle;  
Next generation of neutron cross-section standards;  
 $^{238}\text{U}$  inelastic scattering and capture;  
IRDF database;  
TAGS measurements and decay data.

3). Neutron cross-sections for the minor actinides (MANREAD), Fusion Evaluated Nuclear Data Library (FENDL), Reference Input Parameter Library (RIPL), charged-particle induced gamma-ray emission for surface analysis (PIGE), thermal scattering law data libraries, and uncertainty covariances were also discussed in detail.

4). **Data dissemination**

Electronic versions of documents (scanning of INDC reports) are available on line through the NDS web page - a search option should be provided, with title, author, abstract and key words (to be completed as soon as possible).

ICTP/IAEA-NDS Workshops - a link on the NDS web page should be provided to the lecture notes and slides available through the ICTP site.

Appreciable improvements have been made to the EXFOR/ENDF/CINDA interfaces, with three different levels of retrieval, display and plotting capabilities. Furthermore, the NDS Newsletter has been redesigned, based on a previous recommendation from the INDC - more visual information should be added, such as photographs of persons, events, etc.

5). **International nuclear data networks**

NRDC (Nuclear Reaction Data Centres): a considerable improvement in the performance of EXFOR compilation activities was noted. Despite these improvements, the compilation activities still suffer from slow responses from some NRDC members. Additional effort should be provided by the sponsoring institutes within the NRDC to speed up coverage and the compilation process.

Except for Japan, other NRDCs are not compiling CINDA updates any more, although NDS is adding entries via EXFOR. The Working Group believes that CINDA provides a focussed source of bibliographic information of nuclear data, and that CINDA compilations limited to EXFOR entries should be continued within available resources.

NSDD (Nuclear Structure and Decay Data): the evaluated nuclear structure data file (ENSDF) is the most broadly used nuclear database worldwide. Despite the recognized importance of high quality nuclear structure and decay data for applications, the number of new structure evaluations has decreased dramatically in several countries. The INDC appreciates the ongoing effort of the NDS to address this issue, and recommends that these efforts continue; furthermore, the INDC noted that in-house expertise has been established within the NDS through a recent adjustment in recruitment policy.

6). **Training and workshops**

ICTP/IAEA workshops: approval had been given for the ICTP workshop on 'Nuclear Data for Advanced Reactor Technologies' held in May 2008.

INDC endorses the nuclear data workshop proposed for 2009, which is awaiting clearance by the IAEA and ICTP: Workshop on nuclear reaction data for astrophysics (Sec. note: but rejected by ICTP).

The following topics were suggested for ICTP workshops for 2010 - 2011:

- 2010: Nuclear reaction data for advanced reactor applications
- 2010: Nuclear structure and decay data
- 2011: Nuclear data for materials research
- 2011: Nuclear data for medical applications

A smaller workshop has been arranged by the NDS to be held in Vienna entitled: Modelling and evaluating nuclear reaction data for transport calculations: EMPIRE 15-19 December 2008. Workshops of a similar size should be organised by the NDS at the IAEA during 2010 - 2011, based on nuclear data for non-energy applications.

### **Joint ICTP-IAEA Advanced Workshop on Model Codes for Spallation Reactions 4-8 February 2008, ICTP, Trieste, Italy**

The International Atomic Energy Agency (IAEA) and the Abdus Salam International Centre for Theoretical Physics (ICTP) organised an expert meeting on model codes for spallation reactions at the beginning of February 2008. Spallation reactions play an important role in a wide range of applications from neutron sources for condensed matter and material studies, transmutation of nuclear waste and rare isotope production to astrophysics, simulation of detector set-ups in nuclear and particle physics experiments, and radiation protection near accelerators or in space. The tools developed for these domains use nuclear model codes to compute the production yields and characteristics of all the particles and nuclei generated in such reactions. Codes are generally Monte-Carlo implementations of Intra-Nuclear Cascade (INC) or Quantum Molecular Dynamics (QMD) models, followed by de-excitation (principally evaporation/fission) models.

Experts were invited to the ICTP-IAEA workshop to discuss the physics contained within the different models in order to understand their strengths and weaknesses. Such codes need to be validated against experimental data in order to determine their accuracy and reliability with respect to all forms of application. The aim of the workshop was to demonstrate and discuss the INC/QMD event generators, e.g. model-dependent critical parameters, their validity and deficiencies. Complementary presentations of recent 'thin' target experiments were made, e.g. double-differential cross section, reaction rates, excitation function and residual measurements, and provided code developers with a set of verified experimental data to be benchmarked.

Agreement was reached during the course of the workshop to organize an international benchmark of the different models developed by different groups worldwide. The specifications of the benchmark, including the set of selected experimental data to be compared to the models, were also defined during the workshop. Anyone responsible for a model that describes spallation reactions can participate in the benchmark provided that he/she complies with all the rules listed below:

- The code used by the participants should be able to treat the complete reaction mechanism, i.e. contain a description of the first stage of the reaction by an intranuclear cascade, QMD or BUU model followed by a de-excitation stage, with an optional intermediate pre-equilibrium stage. Code developers working on a model describing only one stage of the interaction could contact the organizers to have their code coupled to a code describing the other stage of the reaction mechanism, if this is possible.
- Participants should provide a short but complete write-up of their model(s) with references to the most relevant published papers, and give a comprehensive description of all the physics ingredients and parameters used for the present benchmark.
- Participants should provide the organizers with the source code in the version used for the benchmark. The organizers commit themselves not to distribute the source codes to anyone else.
- Participants should calculate the complete mandatory set of experimental data which has been chosen to be as limited as possible, while covering the full range of energy, mass and reaction channels.
- An additional set of experimental data will be provided for participants who wish a more thorough comparison of their model.
- Additionally, information will be requested that characterizes the remnant nucleus at the end of the first stage of the reaction (INC, INC+PE, QMD or BUU) to serve as inputs for the de-excitation stage.
- Calculations with one model should be undertaken with the same set of parameters (default preferentially). Participants can provide calculations with several versions of the models, but should calculate complete sets of mandatory data and provide detailed descriptions of the parameters for each version.
- Participants should provide the organizers with the results of the calculations in the requested format. Results should be given along with the statistical uncertainty of the calculation.

The benchmark is restricted to nucleon-induced reactions on nuclei from carbon to uranium between 20 MeV and 3 GeV. Although intranuclear cascade models are based on physics assumptions not valid below a hundred MeV, most data comparisons will be above 100 MeV with a few sets at low incident energies. This situation arises because

- 20-150 MeV libraries are not available for all isotopes;
- when using libraries below 150 MeV, residue production can be calculated only through activation libraries not available or not totally reliable over the complete energy range for all isotopes;
- libraries do not allow correlations between particles to be taken into account.

The goal of the benchmark is to test the physics models used or potentially usable in future high-energy transport codes to compute the production yields and properties of particles and nuclei emitted in a fundamental spallation interaction. Therefore, only comparisons with elementary experimental data on thin targets will be considered. The deadline for providing the calculated sets of data will be 31 January 2009.

The benchmark has been organized during the course of 2008, under the auspices of the IAEA, and the first results will be discussed at the next Accelerator Applications Conference (AccApp'09) to be held in Vienna, May 2009. Full details of the joint ICTP-IAEA workshop can be found within IAEA report INDC(NDS)-0530, August 2008, prepared under the authorship of D. Filges, S. Leray, Y. Yariv, A. Mengoni (Nuclear Data Section, NAPC), A. Stanculescu (Nuclear Power Technology Development Section, NENP) and G. Mank (Physics Section, NAPC). Participants can register using the Participant Registration link on the Benchmark website, giving their name, institution and the model(s) they will use for the benchmark:

[www-nds.iaea.org/spallations](http://www-nds.iaea.org/spallations).

Participation will be subject to acceptance by the Organizing Committee.

### **Workshop on Nuclear Structure and Decay Data: Theory and Evaluation 28 April – 9 May 2008, ICTP Trieste, Italy**

A two-week Workshop on Nuclear Structure and Decay Data (NSDD) was organised and held at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 28 April to 9 May 2008. This workshop was organised and co-directed by Alan Nichols (IAEA-NDS), Jagdish Tuli (NNDC, BNL, USA) and Alberto Ventura (ENEA, Bologna, Italy), and constituted a further development of previous NSDD workshops held in 2002, 2003, 2005 and 2006, all under the auspices of the IAEA Nuclear Data Section.

The primary aim is to familiarize nuclear physicists and engineers from both developed and developing countries with:

- (i) modern nuclear models,
- (ii) relevant experimental techniques,
- (iii) statistical analysis procedures to derive recommended data sets,
- (iv) evaluation methodologies for nuclear structure and decay data,
- (v) international efforts to produce and maintain the Evaluated Nuclear Structure Data File (ENSDF).

Reliable nuclear structure and decay data are important in a wide range of nuclear applications and basic research. Participants were introduced to both theory and measurements of nuclear structure data, and the use of computer codes to evaluate decay data. Detailed presentations were given by invited lecturers, along with demonstrations of computer exercises and the supervision of extensive workshop tasks. Participants were also invited to contribute their own thoughts and papers of direct relevance to the workshop.

Twenty-five participants predominantly from developing countries were selected and able to attend the workshop, and their numbers were augmented by seven ICTP affiliates and associates. Significant quantities of written material were prepared by the lecturers prior to the workshop, representing important technical information for future reference and further NSDD workshops. The most recent set of these presentations, back-

ground papers and other relevant documents have been assembled for future use in the form of IAEA report INDC(NDS)-0533, June 2008, available only on the Web:

<http://www-nds.iaea.org/reports-new/indc-reports/indc-nds/indc-nds-0533.pdf>



Our intention is to use and develop this material in the years to come, particularly for workshops of this type. Another aim is to ensure that such presentations are not lost, and can be readily at hand for new mass-chain and decay-data evaluators to assist them in their preparation of recommended data for the ENSDF files.

The workshop constituted an important opportunity for scientist to gain extensive and up-to-date training on the evaluation of nuclear structure and decay data, as developed for ENSDF and *Nuclear Data Sheets* in order to assist the worldwide nuclear physics community. Reliable evaluated nuclear structure and decay data are of vital importance in a large number of nuclear applications such as power generation, materials analysis, dosimetry and medical diagnostics, as well as basic nuclear physics and astrophysics research. The overall opinion of the vast majority of the students was that they had thoroughly enjoyed the two-week workshop, made useful contacts, and learnt much about nuclear structure and decay data.

## **Joint ICTP-IAEA Workshop on Nuclear Reaction Data for Advanced Reactor Technologies**

### **19-30 May 2008, ICTP, Trieste, Italy**

The Joint ICTP-IAEA Workshop on Nuclear Reaction Data for Advanced Reactor Technologies was held at the ICTP, Trieste from 19 to 30 May 2008. The Workshop was organized and chaired by A. Mengoni (NAPC/NDS) and A. Stanculescu (NENP/NPTD). The lectures covered three different aspects of the Workshop's main theme: Nuclear Data Measurements, Theory/Modelling/Evaluation of Nuclear Data and Applications to Advanced Reactor Systems. All materials concerning the workshop (slides of the presentations, relevant documents/papers provided by the Lecturers computer codes distributed during the exercise sessions, etc.) are available online on the Nuclear Data Section Services website at the following link:

**[www-nds.iaea.org/workshops/smr1944](http://www-nds.iaea.org/workshops/smr1944)**

The programme of lectures provided participants with suitable tuition and training on the following topics:

- facilities and instrumentation for nuclear reaction data measurements;
- experimental techniques for measurements of nuclear reaction data;
- modern theoretical nuclear structure and reaction models;
- evaluation of nuclear data and creation of evaluated nuclear reaction data libraries;

- simulation tools for design studies of advanced nuclear systems;
- overview of strategies for advanced nuclear technologies.



Recent experimental work concerning measurements and instrumentation at the GELINA facility (Geel, Belgium), CERN n\_TOF facility (Geneva, Switzerland) and elsewhere were presented. The most recent computer codes regarding nuclear data calculations and evaluation tools were reviewed, distributed and ad-hoc computer exercises organized to demonstrate their practical use (e.g. TALYS code developed at NRG Petten in collaboration with CEA/Saclay).

The Workshop represents the continuation of a tradition of IAEA events on Nuclear Data for Reactor Technologies which has taken place at ICTP since the 1980s. The large number of applicants and the level of expertise of the young researchers who were accepted for participation in the Workshop (mostly post-docs and/or PhD students at advanced stage) showed a clear interest in the field particularly in developing countries. The participants pointed out that the idea of bringing together people with nuclear physics and nuclear engineering background was very successful. A strong recommendation was made to maintain a similar format for future Workshops, and should be considered in all such future proposals.

### **Consultants Meeting on High-precision Beta-intensity Measurements and Evaluations for Specific PET Radioisotopes, 3-5 September 2008, IAEA, Vienna, Austria**

A Consultants Meeting on ‘High-precision Beta-Intensity Measurements and Evaluations for Specific PET Radioisotopes’ was held at IAEA, Vienna, Austria from 3 to 5 September 2008, to review, assess and identify outstanding data requirements for an agreed set of radioisotopes suitable for positron-emission tomography (PET). Four consultants accepted invitations to assist staff of the Nuclear Data Section in their deliberations (R. Capote and A.L. Nichols):

Prof. Dr. S.M. Qaim, Institut für Nuklearchemie, Forschungszentrum Jülich, Germany;  
 Prof. Dr. Tadashi Nozaki, Japan;  
 Dr. G.F. Steyn, iThemba Laboratory for Accelerator Based Sciences, Somerset West, South Africa;  
 Dr. S.L. Waters, UK.

Three types of positron-emitting radionuclides were considered:

- standard radionuclides,
- non-standard radionuclides,
- very shortlived radionuclides formed in hadron therapy.

The database of the Decay Data Evaluation Project (DDEP) [1] as well as the MIRD [2] and NuDat 2.4 [3] retrievals from the ENSDF database [4] were employed as sources of decay data.

**Standard positron-emitting radionuclides**

C-11, N-13, O-15 and F-18 are the four commonly used positron-emitting radionuclides produced by cyclotrons. Decay data from all three sources were reviewed and found to be consistent. The data in the DDEP database were adopted because they represent the most recent and comprehensive evaluation.

Positron-emitting radionuclides Ga-68 and Rb-82 are of increasing importance, and are obtained from generator systems (Ge-68 and Sr-82, respectively). The Ge-68/Ga-68 data in the DDEP database were adopted; MIRD-ENSDF data were adopted for Sr-82/Rb-82.

**Non-standard positron-emitting radionuclides**

Direct production:

Positron-emitting radionuclides Na-22, Ni-57, Cu-64 and Ga-66 are produced by cyclotrons - their decay data were reviewed, some discrepancies noted, and detailed recommendations made for future work.

Positron-emitting radionuclides P-30, Cl-34m, K-38, Ti-45, V-48, Cr-49, Mn-51,52g,m, Fe-52, Co-55, Cu-61, As-72, Se-73, Br-75,76, Kr-77, Rb-81,82m, Sr-83, Y-86, Nb-90, Tc-94m, In-110m, I-120g,124 and Tb-152 are also produced by cyclotrons - again, their decay data were also reviewed, and recommendations made for further studies and attempted resolutions of individual inconsistencies.

Produced by generator systems:

Positron-emitting radionuclides Sc-44, Cu-62 and Pr-140 are produced by generator systems (Ti-44, Zn-62 and Nd-140, respectively):

- Ti-44/Sc-44: adopt the DDEP data;
- Nd-140/Pr-140: adopt the MIRD-ENSDF data;
- Zn-62/Cu-62: MIRD-ENSDF evaluation is very recent (August 2008); however, inconsistencies exist in the tabulated data for Cu-62 (since corrected).

**Very shortlived radionuclides formed in hadron therapy**

Some very short-lived positron-emitting radionuclides (C-10, O-14, F-17 and Ne-18,19) are formed in hadron therapy, along with C-11, N-13, O-15 and F-18. Decay data for C-10, O-14, F-17 and Ne-18,19 were reviewed, and MIRD-ENSDF data were recommended for adoption.

**Prioritisation:**

1. Cu-64, Y-86 and I-124 are considered the three most important non-standard radionuclides for PET applications.
2. Br-76, As-72, Se-73 and I-120g are becoming increasingly important for PET applications.
3. Cl-34m, Ni-57, Cu-62, Ga-66, Rb-81,82m and Sr-83 merit further work for potential applications.

Extensive recommendations were made, including the adoption and improvement of relevant decay data (half-lives and positron emission probabilities) that are detailed in IAEA report INDC(NDS)-0535.

**References**

- [1] See webpage [http://www.nucleide.org/DDEP\\_WG/DDEPdata.htm](http://www.nucleide.org/DDEP_WG/DDEPdata.htm) for DDEP.
- [2] Medical Internal Radiation Dose (MIRD) Database <http://www.nndc.bnl.gov/mird>
- [3] See webpage <http://www-nds.iaea.org/mudat2> for NuDat 2.4.
- [4] See webpages <http://www-nds.iaea.org/ensdf/> and <http://www.nndc.bnl.gov/ensdf/> for ENSDF.

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