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INDC International Nuclear Data Committee

Report on the IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres

IAEA Headquarters
Vienna, Austria
12 – 14 October 2005

Prepared by

O. Schwerer
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IAEA Headquarters, Vienna, Austria
February 2006

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Abstract

Results of the IAEA Technical meeting on the Network of Nuclear Reaction Data Centres held at the IAEA Headquarters, Vienna, Austria, 12 to 14 October 2005, are summarized in this report. The meeting was attended by 16 participants from 11 co-operating data centres of six Member States and two International Organizations. The report contains a summary of the meeting, the conclusions and actions, and status reports of the participating data centres.

February 2006

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THE NETWORK OF NUCLEAR REACTION DATA CENTRES

National, regional and specialized nuclear reaction data centres, coordinated by the International Atomic Energy Agency, cooperate in the compilation, exchange and dissemination of nuclear reaction data, in order to meet the requirements of nuclear data users in all countries. At present, the following data centres participate in the network:

NNDC	-	US National Nuclear Data Center, Brookhaven, USA
NEA-DB	-	OECD/NEA Nuclear Data Bank, Issy-les-Moulineaux, France
NDS	-	IAEA Nuclear Data Section
CJD	-	Centr Jadernykh Dannykh (= Nuclear Data Centre), Obninsk, Russia
CAJaD	-	Russian Nuclear Structure and Reaction Data Centre, Moscow, Russia
CDFE	-	Centr Dannykh Fotojadernykh Eksperimentov (= Centre for Photonuclear Experiments Data), Moscow, Russia
CNDC	-	China Nuclear Data Center, Beijing, China
JAEA	-	Nuclear Data Center of the Japan Atomic Energy Agency (formerly Japan Atomic Energy Research Institute JAERI), Tokai-Mura, Japan
JCPRG	-	Japan Charged-Particle Nuclear Reaction Data Group, Hokkaido University, Sapporo, Japan
ATOMKI	-	ATOMKI Charged-Particle Nuclear Reaction Data Group, Debrecen, Hungary
UKRNDC	-	Ukrainian Nuclear Data Center, Institute for Nuclear Research, Kyiv, Ukraine
CNPD	-	Center of Nuclear Physics Data, Russian Federal Nuclear Center, RFNC-VNIIEF, Sarov, Russia
KAERI/NDEL	-	Nuclear Data Evaluation Laboratory, Korea Atomic Energy Research Institute, Yusong, Taejon, Republic of Korea

A detailed description of the objectives of the network, and the contributions of each centre to these activities, is given in the report "The Nuclear Reaction Data Centres Network", INDC(NDS)-401 (Rev. 4).

PAST NRDC MEETINGS

Vienna, 12-14 October 2005	Technical	INDC(NDS)-0480
Brookhaven, 4-7 October 2004	Centre Heads + Tech.	INDC(NDS)-464
Vienna, 17-19 June 2003	Technical	INDC(NDS)-446
Paris, 27-30 May 2002	Centre Heads + Tech.	INDC(NDS)-434
Vienna, 28-30 May 2001	Technical	INDC(NDS)-427
Obninsk, 15-19 May 2000	Centre Heads + Tech.	INDC(NDS)-418
Vienna, 18-20 May 1999	Technical	INDC(NDS)-407
Vienna, 11-15 May 1998	Centre Heads + Tech.	INDC(NDS)-383
Vienna, 26-28 May 1997	Technical	INDC(NDS)-374
Brookhaven, 3-7 June 1996	Center Heads + Tech.	INDC(NDS)-360
Vienna, 2-4 May 1995	Technical	INDC(NDS)-343
Paris, 25-27 April 1994	Center Heads + Tech.	INDC(NDS)-308
Vienna, 1-3 Sept 1992	Technical	INDC(NDS)-279
Obninsk, 7-11 Oct 1991	Center Heads + Tech.	INDC(NDS)-262
Vienna, 13-15 Nov 1990	Technical	Memo CP-D/210
Vienna, 2-4 Oct 1989	Centre Heads + Tech.	Memo CP-D/200
Vienna, 4-6 Oct 1988	Technical	Memo CP-D/190
Brookhaven, 27-29 Oct 1987	Center Heads + Tech. = 9th NRDC Meeting	INDC(NDS)-204
Vienna, 7-9 Oct 1986	Technical	Memo CP-D/159
Saclay, 9-11 Oct 1985	Center Heads + Tech. = 8th NRDC Meeting	INDC(NDS)-178
Vienna, 19-21 Sept 1984	Technical	Memo CP-D/131
Obninsk+ Moscow, 17-21 Oct 1983	7th NRDC Meeting	INDC(NDS)-154
Vienna, 3-7 May 1982	6th NRDC Meeting	INDC(NDS)-141
Brookhaven, 29.9 - 2.10.1980	5th NRDC Meeting	INDC(NDS)-125
Karlsruhe, 8-13 Oct 1979	4th NRDC Meeting	INDC(NDS)-110
Paris, 19-23 June 1978	3rd NRDC Meeting	NEA-NRDC-3 = INDC(NDS)-99
Kiev, 11-16 April 1977	2nd NRDC Meeting = 3rd CPND + 13th 4-C	INDC(NDS)-90
Vienna, 28-30 April 1976	2nd CPND Meeting	INDC(NDS)-77
Vienna, 26-27 April 1976	12th 4C-Meeting	INDC(NDS)-78
Vienna, 8-12 Sept 1975	CPND Meeting	INDC(NDS)-69+71
Brookhaven, 10-14 March 1975	11th 4C-Meeting	INDC(NDS)-68
Paris, 6-10 May 1974	10th 4C Meeting	INDC(NDS)-58
Vienna, 24-26 April 1974	CPND + PhotoND	INDC(NDS)-59+61
Moscow/Obninsk, 4-8 June 1973	9th 4C Meeting	INDC(NDS)-54
Vienna, 16-20 Oct 1972	8th 4C Meeting	INDC(NDS)-51
Brookhaven, 25-29 Oct 1971	7th 4C Meeting	INDC(NDS)-41
Paris, 5-9 Oct 1970	6th 4C Meeting	INDC(NDS)-28
Moscow, 17-21 Nov 1969	5th 4C Meeting	INDC(NDS)-16

LIST OF ACRONYMS

ATOMKI	Nuclear Research Institute, Debrecen, Hungary
BNL	Brookhaven National Laboratory, Upton, NY, USA
BROND-2	Russian evaluated neutron reaction data library, version 2
CAJaD	Center for Nuclear Structure and Reaction Data, Kurchatov Institute, Moscow, Russia
CDFE	Centr Dannykh Fotojad. Eksp., Moscow State University, Russia
CENDL-2	Chinese evaluated neutron reaction data library, version 2
CENPL	Chinese evaluated nuclear parameter library
CINDA	Specialized bibliography and data index on nuclear cross section data operated by the NRDC
CJD	Russian Nuclear Data Center at FEI, Obninsk, Russia
CNDC	China Nuclear Data Center, Beijing, China
CNPD	Center of Nuclear Physics Data at RFNC-VNIIEF, Sarov, Russia
CP...	Numbering code for memos exchanged among NRDC members
CPND	Charged-particle nuclear reaction data
CRP	Coordinated Research Programme of the IAEA Nuclear Data Section
CSEWG	US Cross-Section Evaluation Working Group
CSISRS	Cross-Section Information Storage and Retrieval System, the EXFOR-compatible internal system of NNDC
EFF	European evaluated nuclear data file for fusion applications
ENDF-6	International format for evaluated data exchange, version 6
ENDF/B-6	US Evaluated Nuclear Data File, version 6
ENSDF	Evaluated Nuclear Structure Data File
EXFOR	Format for the international exchange of nuclear reaction data
FEI	Fiziko-Energeticheskij Institut, Obninsk, Russia
FENDL	Evaluated nuclear data file for fusion applications, developed by IAEA-NDS
IAEA	International Atomic Energy Agency
IFRC	International Fusion Research Council
INDC	International Nuclear Data Committee
INIS	International Nuclear Information System, IAEA bibliographic system
IRDF	The International Reactor Dosimetry File, maintained by the IAEA-NDS
ITER	International Thermonuclear Experimental Reactor
JAEA	Japan Atomic Energy Agency (from 1 October 2005)
JAERI	Japan Atomic Energy Research Institute (until 30 September 2005)

JANIS	Java Nuclear Information System of NEA-DB
JCPRG	Japan Charged-Particle Nuclear Reaction Data Group, Sapporo, Japan (previously Study Group for Information Processing)
JEF	The Joint Evaluated File of neutron data, a collaboration of European NEA member countries and Japan
JEFF	Joint Evaluated Fission and Fusion Project coordinated by NEA-DB
JENDL-3	Japanese Evaluated Nuclear Data Library, version 3
KAERI/NDEL	Korea Atomic Energy Research Institute, Nuclear Data Evaluation Laboratory
KINR	Kiev Institute of Nuclear Research
LEXFOR	Part of the EXFOR manual containing physics information for compilers
NDS	IAEA Nuclear Data Section, Vienna, Austria
NDS	The journal Nuclear Data Sheets
NEA	Nuclear Energy Agency of the OECD, Issy-les-Moulineaux, France
NEA-DB	NEA Data Bank, Issy-les-Moulineaux, France
NEANDC	NEA Nuclear Data Committee
NND	Neutron Nuclear Data
NNDC	National Nuclear Data Center, Brookhaven National Laboratory, USA
NNDEN	Neutron Nuclear Data Evaluation Newsletter
NRDC	The Nuclear Reaction Data Centers
NRDF	Japanese Nuclear Reaction Data File
NSDD	Nuclear structure and decay data
NSC	Nuclear Science Committee of the NEA
NSR	Nuclear structure references, a bibliographic system
OECD	Organization for Economic Cooperation and Development, Paris, France
PC	Personal Computer
PhND	Photonuclear data
RIKEN	Nuclear Data Group, RIKEN Inst. of Phys, and Chem. Res., Wako-Shi, Saitama, Japan
TRANS	Name of transmission tapes for data exchange in the EXFOR system
UKRNDC	Ukrain Nuclear Data Center at KINR, Kyiv, Ukraine
USDOE	U.S. Department of Energy
VNIIEF	Russian Federal Nuclear Center, Sarov, Russia
4C...	Numbering code of memos exchanged among the four Neutron Data Centers

Technical Meeting on Coordination of the Network of Nuclear Reaction Data Centres
12 – 14 October 2005, IAEA Headquarters, Vienna, Austria

AGENDA

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2.2 Report on implementation of "New CINDA" (conversion old -> new; import from EXFOR) ***WP 2005-16,17***

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3. Common EXFOR/CINDA dictionary system

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4. EXFOR, general

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  Total kinetic energy distribution; Neutron yield as a function of fragment energy and alpha energy
- 5.45 Clarifications on coding of differential data
  - Energy spectrum as function of sum of kinetic energies of several particles ***WP 2005-29***
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International Atomic Energy Agency

Technical Meeting on

"Network of Nuclear Reaction Data Centres"

IAEA Headquarters, Vienna, Austria

12 – 14 October 2005

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MEETING SUMMARY

Introduction

The IAEA Technical Meeting on the Co-ordination of the Network of Nuclear Reaction Data Centres was held at the IAEA Headquarters, Vienna, Austria, from 12 to 14 October 2005. Sixteen participants of eleven co-operating data centres from China, Hungary, Japan, Russian Federation, Ukraine, USA, NEA and IAEA attended the meeting.

Meetings of this network are held annually, with full meetings involving centre heads and technical staff every two years (the last full meeting was held in October 2004 at NNDC in Brookhaven, USA). The present meeting focused on technical questions concerning the EXFOR and CINDA databases and the common dictionaries, the review of the compilation scope and responsibilities and quality control, the new common EXFOR master file, and specialized software used and developed at the centres. Technical discussions were based on the 34 working papers (WPs) submitted to the meeting. The most important results of the technical sessions are summarized in the list of Conclusions and Actions (pp. 17 ff.).

Brief Minutes

Dr. N. Ramamoorthy, the Director of the IAEA Division of Physical and Chemical Sciences, welcomed the participants on behalf of the IAEA. The meeting was opened by A. Nichols, Head of the IAEA Nuclear Data Section. The agenda was adopted. A. Nichols chaired the general sessions, while O. Schwerer chaired the technical sessions.

Each of the 11 attending centres presented a brief status report (see reports P1 – P11). Reports of two centres who are members of the network but could not attend the meeting were also distributed (reports P12, P13).

All Actions of the previous meeting were reviewed and those not yet fulfilled were, with modifications, included in the new list of Actions.

The status of implementation of the new CINDA database was reviewed. A revised CINDA manual was presented by NEA-DB, and was slightly modified. NDS will also maintain a common master file for CINDA. NEA-DB is preparing the next CINDA book and is collecting additional information for the introductory pages from network centres.

The reformed EXFOR/CINDA dictionaries were approved.

The scope of the EXFOR compilation and responsibilities were reviewed with minor modifications and clarifications. Special emphasis was put on the coverage of major journals and speeding up the compilation of new literature. The implementation of the new common EXFOR master file, as of 1 July 2005, was noted as an important step.

The problem of EXFOR compilations transmitted with physics and/or format errors to the network coordinator was discussed, and a Recommendation on this issue was adopted. At the same time, the meeting felt the need to discuss the uneven spread of compilation workload among the network centres.

NDS will develop an external flagging system to indicate which EXFOR data sets were adopted by evaluators. The meeting discussed also the issue of storing original EXFOR papers in pdf format locally in the compilation centres.

In the session on technical EXFOR issues, several proposals were approved, including a format for storing covariance files, an extension of the "multiple reaction" formalism, as well as several new data headings and quantities.

EXFOR editing software being developed at the Sarov centre was presented, and further development in cooperation with V. Zerkin (NDS) was encouraged. A data uploading facility will be developed by NDS and NNDC *(a first version is now in operation, note added by editor)*. V. Zerkin presented his CINDA editor.

A comparison of several data digitizing software packages, used and/or developed at network centres, was presented, with the main conclusion that the software quality is comparable and the main source of discrepancies is human error.

The meeting strongly encouraged steps to improve cooperation between centres in software development.

In the closing session, the 23 conclusions, the recommendation, and the 33 actions of the meeting were reviewed, and it was decided that the next NRDC meeting, which will be a full meeting with centre heads and technical staff, will be held in Vienna in September or October 2006. *(Note added by editor: after the meeting, the date has been set for 25 – 28 September 2006).*

Conclusions and Recommendations

General

C1 The **next NRDC meeting** will be a full meeting (centre heads and technical staff) and will be held in Vienna during 4 days in September or October 2006. *(Note added by editor: after the meeting, the date was set to 25 – 28 September 2006).*

CINDA

C2 NDS will maintain also a **common CINDA master file**

C3 NDS will from now on **convert** all received EXFOR TRANS file to a **CINDA** file and update CINDA with it and send it to the originating centre

C4 The revised **CINDA Manual**, as submitted by NEA-DB and revised at this meeting, is approved.

Common EXFOR/CINDA dictionaries

C5 The **reformed dictionaries** as described in memos CP-D/438-440 are accepted.

C6 On request, the **dictionaries** are available from NDS also in **database** form.

EXFOR, general

C7 **Compilation scope:** Data measured in **inverse kinematics**, which would be in the category of obligatory compilation if target and projectile were exchanged, must be compiled also (i.e. are added to the list of obligatory compilation, category "A").

C8 **Compilation responsibilities**: **ATOMKI** will also be in charge of experiments in cooperation with **Free Univ. Brussels**, Cyclotron Department (EXFOR code 2BLGVUB)

C9 **Compilation responsibilities**: Add "**Photonuclear Data** under coordination of CDFE" to UkrNDC and NNDC

C10 The clarification of **compilation responsibilities** as given in WP 2005-10 is adopted

C11 For all compilations of new literature, an **author proof** copy should be sent, and the approval, or "no reply to author proof", should be included under STATUS.

C12 The meeting took note of the release of the **common EXFOR master file** as of 1 July 2005. Any special operations on the master file, outside the normal TRANS operations, if at all necessary, must be communicated to the NRDC via memos.

EXFOR, technical

C13 The coding of **isotopic abundances** (proposed at the 2004 NRDC meeting) is **not** followed up for the time being, until the need is demonstrated.

C14 **Wildcards in SF7 for Dict. 236** are now acceptable to all. Details of implementation will be agreed (see Action A27)

C15 Extension of **multiple reactions** is accepted as proposed in WP 2005-26: *Components of a vector or tensor polarization quantity* will be added to the list of allowed cases in LEXFOR.

C16 The **new headings and units** proposed in WP 2005-27 are approved:
POL-BM-MIN, POL-MB-MAX, +ERR-SYS, -ERR-SYS (Dictionary 24);
PB (picobarn), FB (femtobarn) (Dictionary 25)

C17 **Neutron multiplicity** from fission will be coded with **NU** for **all** projectiles

C18 **Total kinetic energy distribution** will be coded with connecting the particles in SF7 with +, e.g. ,DE,LF+HF

C19 Quantities PR,NU/DE,FF and PR,NU/DE,A should have dimension FY because they are not differential by energy (they are dependent on secondary energy but not differential). Also the units in the affected entries (PT/FIS/MEV) must be corrected.

C20 The proposal on storage of **covariance files** is accepted (WP 2005-25). Retrieval interfaces at the centres will be developed as need arises.

Software

C21 V. Zerkin is encouraged to proceed with the concept of "**Projects" in CINDA** (WP 2005-21). This item will be reconsidered at the next meeting. *(See also Action A31.)*

C22 The meeting notes that all **digitizing software packages** recently compared by the centres (WP 2005-24) give satisfactory results, and that the major source of discrepancies is the "human factor". *(See also Action A32.)*

C23 The meeting encourages steps to improve **cooperation in software development**, beginning with the Exfor editor (Sarov + NDS). Centres are encouraged to inform each other about software developments where cooperation is possible and/or desirable.

Recommendation

Compilations with serious formal and/or physics mistakes are increasingly being transmitted to the network coordinator. As a consequence of this increasing number of errors over the previous 12 months, further considerable time and effort has to be spent by the coordinating centre, and other network centres, checking these entries, pointing out mistakes, and requesting corrections before these compilations can be added to the EXFOR database.

Therefore, the meeting recommends that all centres ensure that their EXFOR compilers are able to spend the necessary time to understand both the essentials of the article and the relevant EXFOR procedures, so that they are able to produce good quality initial compilations for the EXFOR database.

Actions

General

A1	All	(Continuing) All recognized **policy papers** for consideration by the NRDC members need to be prepared and distributed four weeks before the Annual NRDC meeting. This will ensure adequate thought and discussion prior to the meeting.
A2	All	(Continuing) Review the **Citation Guidelines** (2004 version from NRDC internal webpage) and send updates to NDS.
A3	All	Update **CP memo distribution** with A.Mengoni@iaea.org (new), yolee@kaeri.re.kr (Lee Young-Ouk, new), katakura.junichi@jaea.go.jp

CINDA

A4	CNDC	(Continuing) Compile **all Chinese experimental works** (journals and conference proceedings) for CINDA and send to NDS in Reader format.
A5	CINDA centers	(Continuing) When coming across **report codes in dictionary 6** which differ significantly from what is shown on the cover, submit additional explanation to NDS for inclusion in dictionary 6
A6	NNDC, NEA-DB, CJD	(Continuing) Check and confirm/clarify report codes given in WP 2003-8, Sections 4 and 5, by end of 2005
A7	CINDA centers	(Continuning) Correct **errors in report coding**, as listed in Sections 6 and 7 of WP 2003-8
A8	CINDA centers except NNDC	(Continuing) Search for **illegal experimental entries for MANY** and replace them with individual entries, and for the many illegal entries for **FPROD** which may be used only for lumped fission products. (MANY is allowed only for evaluated and theoretical data)
A9	Henriksson, Zerkin	Clarify differences in the converted **area 2 CINDA file** by 14 November

A10	Henriksson	Communicate to other centres the information needed for the **introductory pages** for the CINDA book
A11	all	reply to above Action A10
A12	Henriksson	keep others informed about developments on **CINDA book**

Common EXFOR/CINDA dictionaries

A13	Zerkin	Prepare the **dictionary** system for distribution in form of **relational database**

EXFOR, general

A14	NDS	Develop an **external flagging** system to indicate which data sets were **adopted by evaluators**
A15	CNDC	Provide to NDS list of 10 **most important Chinese journals** relevant to nuclear data, emphasizing in particular journals published in Chinese language
A16	All	(Continuing) Check/retransmit those entries from the list of **pending retransmissions** (distributed by McLane at the 2001 NRDC meeting) which still need correction
A17	NDS	Redistribute this list
A18	All	(Continuing) All centers should give high priority to compiling **new publications**
A19	Nichols	(Continuing) Communicate with **major journals** concerning **data transfer** to the network for inclusion in EXFOR.
A20	All	Follow the procedures described in WP 2005-30 for **journal coverage**. Instead of the reaction code, it is sufficient to give data type (neutron, charged particle, photonuclear) and priority (A = obligatory, B = voluntary)
A21	All	Follow the procedures described in WP 2005-31 for compilation of **new publications** (but without including the e-mail address, para. 4)

A22	Schwerer	(Continuing) Review the EXFOR **Basics Manual** and submit revision when time permits. Also include the "C4" computational format.
A23	All	On the proposal of WP 2005-14: store locally pdf versions of **EXFOR relevant articles** and discuss within the centers what part of it can be shared with a central archive kept at NDS
A24	All	Go through WP 2005-15 and retransmit the **corrections** asap

EXFOR, technical

A25	Otsuka	Research the usage of quantity codes **AKE** and **KE** in EXFOR and come up with a proposal for consistent dictionary entries.
A26	Otsuka	Submit summary on **tensor polarization data** as a memo to remove inconsistencies in dictionary expansions
A27	NDS	Formulate detailed proposal for introducing **wild cards** in Dict.236 for SF7
A28	NDS	(Continuing) Check whether there is a LEXFOR entry on the process code FUS **(total fusion**, Dictionary 30); if not, provide such an entry.

Software

A29	Sarov, NDS	Distribute beta-version of **EXFOR editor** to interested centers for review, and continue development in cooperation with Zerkin/NDS.
A30	Zerkin + NNDC	Look into possibility of using the "human readable EXFOR" format (being developed) also for a **data uploading facility** for authors.
A31	All	Give feedback to NDS on the proposal of WP 2005-21 (concept of **Project** in CINDA)
A32	All centres producing digitizing software	Consider making the **digitizing software** (including documentation) available to the network

Services

A33	All	Consider the proposal of NNDC (WP 2005-7) to publish the **state of knowledge on 1-2 nuclides** and express opinions and proposals on it to NNDC and NDS by the end of 2005.

Review of Compilation Scope

(updated at the 2005 NRDC Meeting)

General categories

Category	**Data type**
A - Compulsory compilation	All experimental data for incident projectile energy ≤ 1 GeV and projectiles with A ≤ 12, unless listed in Cat. B; ***and data measured in inverse kinematics, which fulfill these criteria when target and projectile are exchanged.***
	For photonuclear data (no obligation for completeness), compilation is highly recommended.
B - Voluntary compilation	Neutron- or charged-particle data with E_{in} > 1GeV; Heavy ion data for projectiles with A>12; Vector and tensor polarization data; Kerma factors (integral data only)
C - Separate transmission	Other data types, as specified in the table below

Separate Transmission Series

CIC *)	**Center**	**Data types**
J	JCPRG	Charged-particle nuclear data for projectiles with nonpositive baryon number *(submitted in memo CP-E/053)*
V (extinct)	NDS	Evaluated neutron data

*) Center Identification Character

Review of Compilation Responsibilities
(updated at the 2005 NRDC Meeting)

Center	Basic responsibility	Additional compilation
NNDC	Neutron data and CPND from USA and Canada	***Photonuclear data (coordinated by CDFE)***
NEA-DB	Neutron data from NEA countries	CPND (coordinated by NDS)
NDS	Neutron data and CPND from "rest of the world" (areas not covered otherwise)	
CJD	Neutron data from former Soviet Union (except Ukraine)	
CAJAD	CPND from former Soviet Union (except Ukraine)	CPND from "rest of the world" (coordinated by NDS)
CDFE	Photonuclear data	
CNDC	Neutron data and CPND from China (entries submitted through NDS)	
JCPRG	CPND from Japan	
ATOMKI	CPND from ATOMKI and data measured in cooperation with Juelich ***or with Free Univ. Brussels*** (entries submitted through NDS)	
UkrNDC	Neutron data and CPND from Ukraine (entries submitted through NDS)	***Photonuclear data (coordinated by CDFE)***
RFNC	CPND on light nuclei, coordinated with other centers	

Special case: **Two or more institutions from different service areas:**

*If two institutions from different service areas are involved, the primary institution defines the responsible center. See **LEXFOR, Institutes** for definition of primary institution.*

LEXFOR / Institutes /Compilation Responsibility

If two or more institutions of different service areas are involved, the following rules shall determine the center responsible.

1. The institute containing the facility used, if at least one of the authors belongs to that facility, should determine the center responsible.
2. If an itinerant group uses the facility of another institution, the institute of the primary investigator of the itinerant group shall determine the center responsible.

3. In an ambiguous case, the institution from which one is most likely to obtain further information on the experiment should be used to determine the center responsible.

If a publication reports the results of different experiments, done at different laboratories, or, measured at one laboratory, and, subsequently, analyzed at another laboratory, and either the laboratories are in different areas, or the incident-projectile is of a different type (*i.e.*, neutron, charged particle, or photon), the results are compiled in separate entries by the center responsible for the data. The entries may be linked using the `STATUS` code `COREL`; see **Status** (Interdependent Data).

2004 NRDC Meeting, Conclusion C17:
If several institutes and several experimental facilities are involved in an experiment, the first author of the paper will determine the centre responsible for the EXFOR compilation.

Consolidated Summary:

If several institutes of different service areas are involved, the following rules determine the compilation responsibility:

1) The institute of the facility used, if at least one author is from this institute. If an itinerant group used the facility, the main investigator of this group determines the center responsible.
2) If facilities of different laboratories from different service areas are used, the institution from which it is most likely to obtain further information on the experiment should determine the center responsible. This will normally be the corresponding author, or, in case of doubt, the first author of the publication. In all such cases the other affected center and NDS must be contacted before compilation to avoid duplication.
3) If separate experiments from different service areas with clearly separated results are reported in the same paper, the results should be compiled in separate entries. This separation is obligatory for different projectile types (neutron, charged particle, photon). In all such cases cross references to the other entry must be given.

Coverage of major journals

At the previous meeting one of the Conclusions (C16) was:

Coverage of major journals by data centre:

PR/C	NNDC
NSE	NNDC
NP/A	NDS
YF and EPJ	CAJAD
YK	CJD
ANE	NEA
NST	NEA
NSTS	NEA
RCA	NEA
CNP	CNDC
NIM/A and B	ATOMKI
ARI	ATOMKI
PL/B	NDS
PRL	NNDC

Each responsible centre will rapidly assess the contents of an issue of the above journals, and communicate rapidly with relevant compilation centres and NDS to point out their need to compile asap. The NDS coordinator will oversee implementation and report on a quarterly basis to all responsible centres collectively.

These lists of references must be written in a way making it clear which centre is responsible for compilation. Therefore, we propose the following form for the Coverage control system:

1. Journal name, volume, Issue, Page, year, Laboratory. Or it can be NSR code and laboratory, data type (neutron / charged particle / Photonculear), importance of compilation (A (obligatory)/ B (voluntary) / C (separate transmission, like area J)).

2. NDS should receive these lists within one month after issue of publication.

Speeding up Compilation of new publications

1. For neutron data, the responsibility for compilation in areas 1,2,3,4 should be clear (remember that neutron data from Japan belong to area 2). Nevertheless, the responsible centers should inform NDS about their compilation plans.

2. For CPND, the reference has to be booked for compilation by the responsible Center within one month after publication (or after the center was informed by another center covering the particular journal). Usually, NDS sends the list of publications that are relevant for compilation within two weeks after publication.

3. To avoid duplications, it is preferable to send the plan of compilations to NDS in the form: reference, EXFOR number , laboratory, where experiment was done.

4. The references relevant to EXFOR have to be included in EXFOR within six months after publication. If there is no possibility to receive data from the author (no reply to e-mail) the compiler can digitize curves and point out under STATUS that there was no response from the author. The compiler should mention the name of the author he tried to contact.

5. After this period, NDS will take the responsibility for compilation of such papers (or assign it to another center).

6. Photonuclear data are coordinated by CDFE. At present, apart from CDFE, only NNDC and NDS have photonuclear data series (L and G, respectively). All correspondence about compilation of photonuclear data should go to CDFE with copy to NDS.

P1

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Memo CP-C/366.

DATE: October 10, 2005
TO: Distribution
FROM: D. Rochman
SUBJECT: Progress Report

EXFOR Compilation:

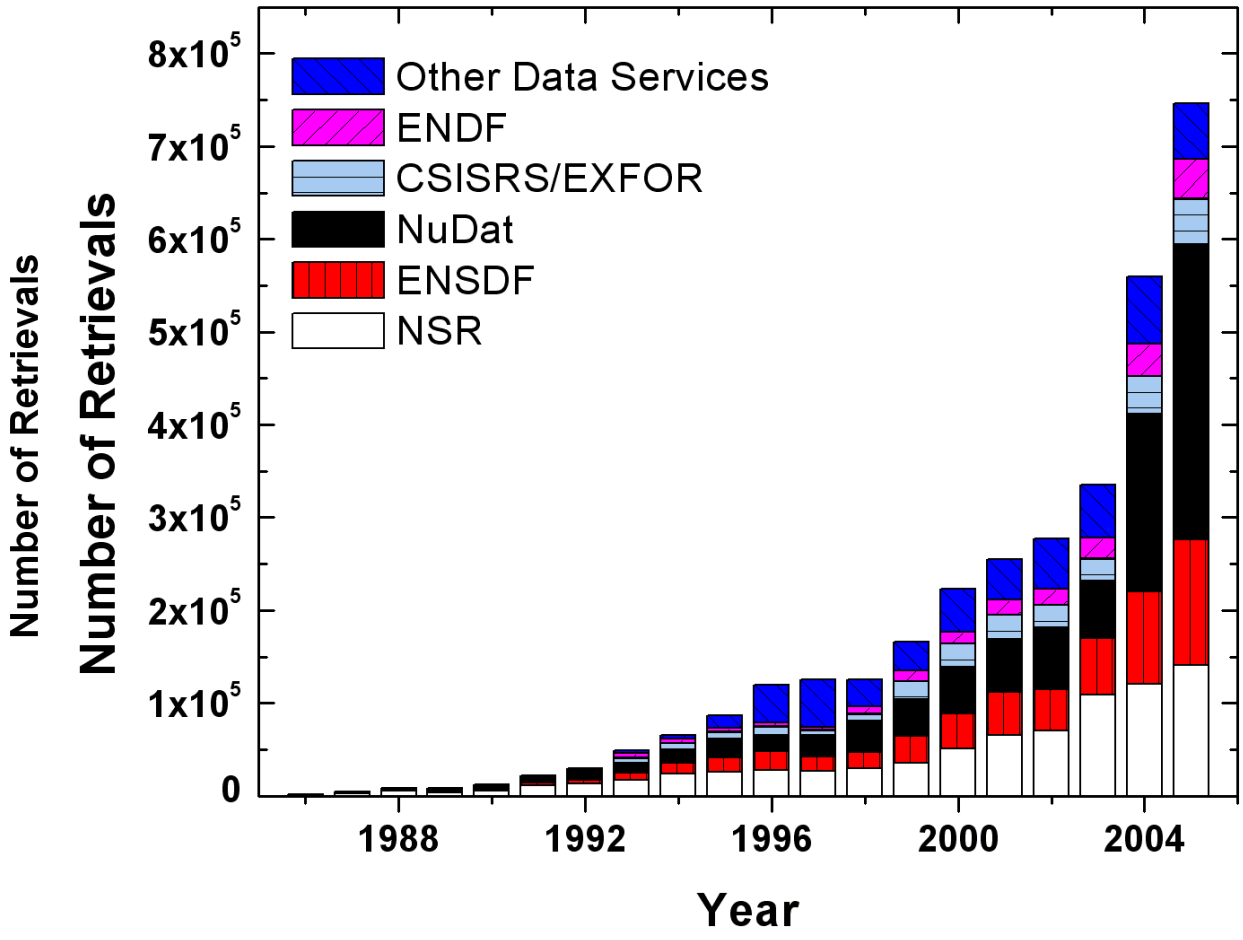
Our main effort on compilation was on EXFOR work. The last TRANS file for neutron-induced reaction was 1336 and the last TRANS file for charge-particle induced reaction was C074. Gamma-induced reactions were also compiled with two TRANS files (L007 and L008).
We try to spend the same amount of time on neutron and charge particle –induced reaction. The priorities are driven by the users' needs that we contact mainly with the EXFOR "Contact area" on the NNDC web site (www.nndc.bnl.gov/exfor). It is important for us to answer as fast as possible to the users' requests, with the best possible quality.
Another special effort was in the analysis of the EXFOR retrieval system. It is important to understand how people are using the web retrieval system to improve it and to make sure that we answer to the general needs.

CINDA:

It is important for us to provide an up-to-date CINDA database at NNDC. However, no compilations are done at NNDC for CINDA.

STATISTICS:

The number of retrievals for the EXFOR database is increasing over the last few years, as the total number of retrievals from the NNDC web site (see next figure). This is reflecting our new web interface, which has for purpose to make easier the access of the databases.



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ohnishi@nucl.sci.hokudai.ac.jp
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exfor@nea.fr
schwerer@iaea.or.at

PROGRESS REPORT FROM THE OECD/NEA DATA BANK

At the NRDC meeting at IAEA, Vienna, Austria

12 - 14 October 2005

NEA Web page: *www.nea.fr*
Contact: *db@nea.fr*

General

The Data Bank's primary role is to provide scientists in member countries with reliable nuclear data and computer programs for use in different nuclear applications. The services include also thermochemical data for radioactive waste management applications. The Data Bank organises seminars and workshops to present information on computer programs or groups of programs that are considered to be of special interest to users. Training courses on widely used computer programs are organised a few times a year to ensure a correct and effective use of these programs.

The Data Bank member countries are: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Republic of Korea, Mexico, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, and United Kingdom. Users of the Data Bank services include governmental research institutes, industry and universities.

By arrangement with IAEA, the Data Bank computer program service covers both Data Bank countries and member states of IAEA, except USA and Canada where a separate agreement covers nuclear data and computer program exchanges.

The NEA Data Bank also maintains a close cooperation with the NEA Nuclear Science Section, which provides useful feedback on the performance of computer programs and nuclear data through a number of benchmark studies, especially in the areas of reactor and fuel cycle physics, criticality safety, and radiation shielding.

Organisation

Total number of full time staff in the NEA Data Bank is 19. This is divided into 9 professional staff and 10 support staff. However, only 8 professional and 7 support staff members work directly with the Data Bank services (see Fig. 1). The remaining staff is allocated to work in other parts of the NEA.

Thierry Dujardin is Director for **Science and Development** with Claes Nordborg below him as head of the **Nuclear Science** Section, while the post as head of the NEA **Data Bank** is presently vacant. Within the Data Bank, Enrico Sartori is responsible for the **Computer Codes and Benchmarks** together with Juan Galan and Ivo Kodeli (employed by the IAEA). Hans Henriksson and Yolanda Rugama are responsible for the **Nuclear Data Services**. The **in-house computer system** is taken care of by Pierre Nagel. Finally, Federico Mompean is responsible for the **thermochemical data project**. Both Byung-Chan Na and Enrico Sartori work part-time for the Nuclear Science Section, whereas Federico Mompean work full time on data for radioactive waste management applications.

The total annual budget of the Data Bank is about 3.5 million Euros. The Data Bank provides expertise to other parts of the NEA, for example to the Radioactive Waste Management Division and to the Nuclear Science Section. These services are paid by the NEA main budget, leaving an annual budget for the Data Bank scientific services of about 2.7 million Euros.

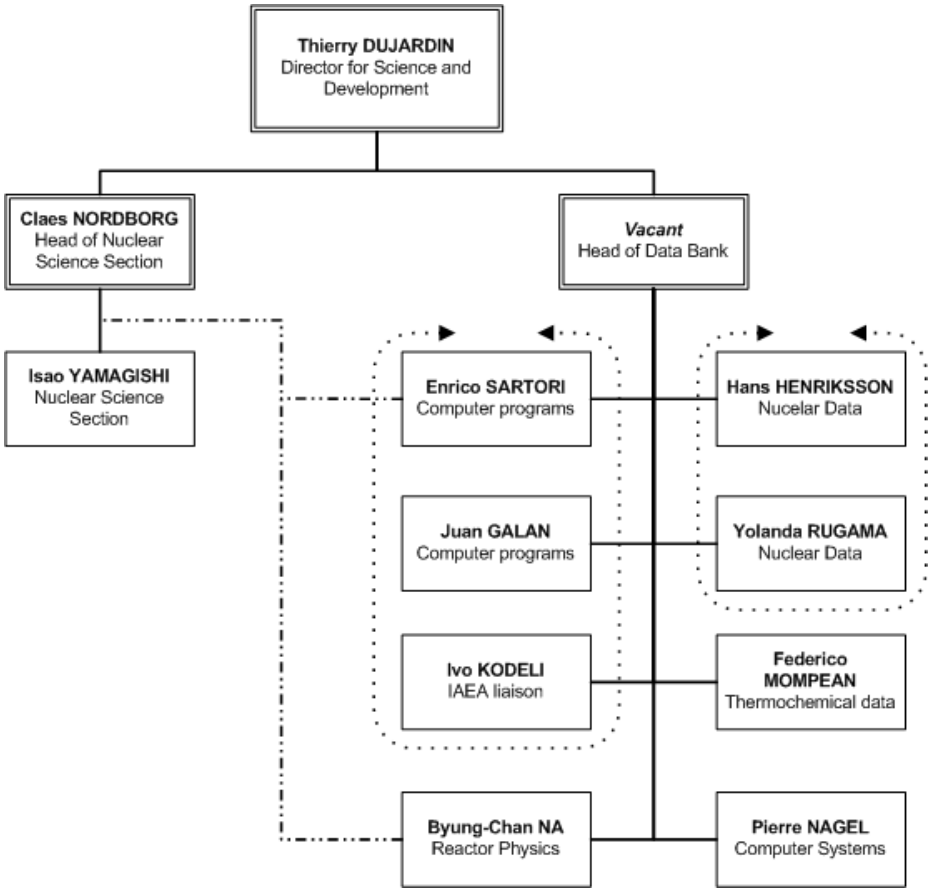

Figure 1 The NEA Data Bank organisation chart

Nuclear Data Services

The nuclear data services are mainly provided through direct on-line access to the CINDA, EXFOR and EVA databases containing bibliographic, experimental and evaluated nuclear data respectively. Access to all the databases is open. The number of retrievals from the NEA Web pages is between 700-1200 requests/month for EXFOR and CINDA, and about the same for evaluated data libraries in the EVA database. Lately, the display of data, directly from Web retrieval, has been upgraded and a test version is now accessible. This online plotting facility is linked to and performed in JANIS, the data display program that has been developed at the NEA.

In addition to these on-line services, the Data Bank also answers specific requests from customers. This concerns normally requests for very large datasets, which are too large for direct Internet download. The very large datasets are normally distributed on CD-ROM or DVD. Providing advice to nuclear data users is another important part of the nuclear data services.

EXFOR and CINDA

More than 100 new neutron reaction experiments and almost 500 charged particle experiments have been entered by the Data Bank into the EXFOR database since the beginning of 2004 (see Table 1). The database is updated continuously and the delay between article publication and inclusion in EXFOR has been reduced.

Table 1 EXFOR compilations from the NEA area 2 and area O during 2004-2005

EXFOR works compiled for area 2 and area 0

AREA 2	**Trans**	**No of works**	
2004	2163	13	
	2164	4	
	2165	20	
	2166	6	
	2167	14	57
2005	2168	7	
	2169	20	
	2170	8	
	2171	5	
	2172	8	48
	Total	**105**	
AREA O	**Trans**	**No of works**	
2004	o015	68	
	o016	99	
	o017	106	
	o018	12	
	o019	101	
	o020	4	
	o021	25	415
2005	o022	34	
	o023	38	72
	Total	**487**	
	Grand total	**592**	

The CINDA database has been subject to a major extension thanks to a new format and the translation of the EXFOR database so that CINDA now also includes charged particle data. At the NEA, the new CINDA format, CINDA2001, has been adopted in a local database. The CINDA data from Area 2 has been converted and was sent to NDS in Vienna for the final CINDA master version. The new database contains over 150 000 lines of references separated into about 60 000 blocks, only for Area 2.

The CINDA database is available at the NEA both on DVD, together with JANIS, and on-line through the Web. Due to the extension of CINDA to include charged particle data, the NEA has decided to produce the CINDA Book. This archive version will be printed early 2006, pending decisions at the NRDC meeting 2005.

Data display tools: JANIS

The nuclear data display software, JANIS (Java Nuclear Information System), developed at the NEA Data Bank, has been available for all interested users free of charge since its first release in 2001. JANIS accesses locally stored data as well as remote data of most evaluated data libraries together with the

EXFOR and CINDA databases on the NEA server. JANIS was presented at the last two International Nuclear Data conferences (ND2001 in Tsukuba, Japan and ND2004 in Santa Fe, USA), as well as at various nuclear data workshops, such as the International Workshop on "Nuclear Data Needs for Generation IV Nuclear Energy Systems" in Antwerp, Belgium, April 5-7, 2005.

JANIS comprises a number of functionalities. The main browser window shows the nuclide chart where basic isotope data can be shown, from NUBASE or overall information of an isotope from evaluated data libraries. Data from the main evaluated libraries, ENDF/B, JEFF, JENDL, BROND etc. as well as the EXFOR database can be displayed and inter-compared. The CINDA database is also included and made searchable in JANIS. The formats supported are ENDF-6 (along with the linearised pointwise option PENDF and the group-wise option GENDF) and the computational format derived from EXFOR. An example is shown in Fig 2 on how JANIS displays data on the total cross section of ^{99}Tc from JEFF-3.1 and where the user has compared the results with JEFF-3.0 as well as with a set of data form EXFOR.

A variety of output formats exist in JANIS. For the graphical display, the PS/EPS and PNG formats are possible, and tabular data can be stored in CSV format (Comma Separated Values) for further use in other software (e.g. MS Excel).

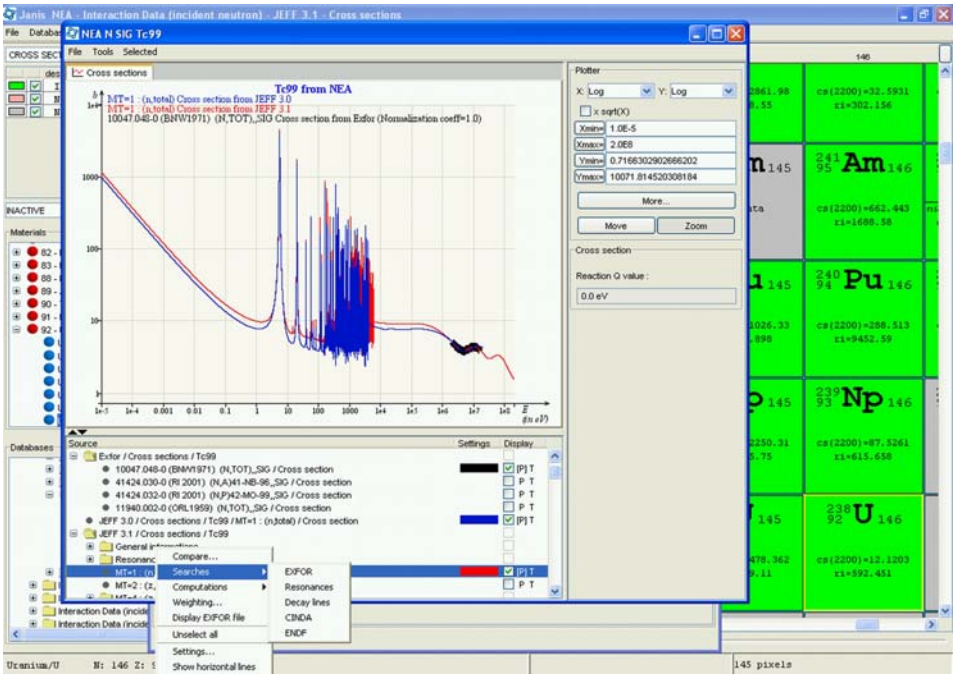

Figure 2. JANIS plot window with the 'Chart of Nuclides' window in the background. The total cross section of ^{99}Tc in JEFF-3.0 and JEFF-3.1 is plotted and compared with EXFOR data.

The latest version of JANIS (JANIS-2.2) was released in May 2005. The program is free of charge and can be downloaded or launched using 'JAVA Web Start' from the JANIS home page: http://www.nea.fr/janis, where the complete manual can be found as well. Recently, a test version of JANIS is launched when retrieving data from EXFOR or evaluated data libraries on the NEA Web page, see e.g. http://www.nea.fr/html/dbdata/x4/x4retbeg-H2.html for EXFOR retrievals. Feedback is appreciated and can be posted at janisinfo@nea.fr.

The Joint Evaluated Fission and Fusion (JEFF) Project and JEFF-3.1

The JEFF-3.1 Nuclear Data Library is the latest version of the Joint Evaluated Fission and Fusion Library. The full picture of the evolution of the JEFF project is presented in Fig. 3. The complete suite of data was released in May 2005, and contains general purpose nuclear data evaluations compiled at the OECD Nuclear Energy Agency (NEA) Data Bank in co-operation with several laboratories in the Data Bank member countries. Within the framework of the JEFF-3 project, the JEFF Working Group on Radioactive Data and Fission Yields decided to produce improved versions of the decay-data and fission-yield libraries with a release in conjunction with the JEFF library. Activation data has also been included in the latest version.

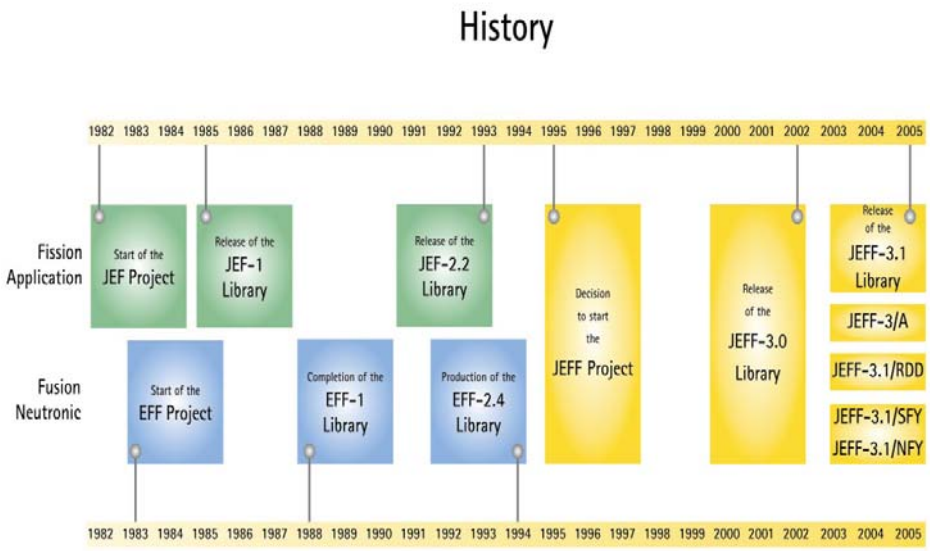

Figure 3. JEFF history from the start with the two fission and fusion projects JEF and EFF in the 1980s up to the release of JEFF-3.1 in May 2005.

JEFF-3.1 combines the efforts of the JEFF and EFF/EAF Working Groups who have contributed to this combined fission and fusion file. The neutron data library covers 381 isotopes or elements, which is an increase from 340 in JEFF-3.0. There are 26 isotopes in the proton data library, and 9 materials are covered in the thermal scattering law file. A great achievement was to include covariance data for many isotopes in the neutron data library. All actinides have now extended information on delayed neutron data in that they all are presented in eight-group formalism. The special purpose library on activation data contains 774 target nuclei with over 12600 neutron induced reactions. Included is also radioactive decay data with about 3852 isotopes and spontaneous and neutron induced fission yield data. Processed data for MC applications will be made available later on as well as full documentation of JEFF-3.1. The data can be downloaded from the NEA web site, www.nea.fr/html/dbdata/JEFF, and CDs are distributed on request.

The NEA High Priority Request List (HPRL)

The NEA Data Bank is responsible for the HPRL, which is a collection of requests to provide targets for the improvement of nuclear data, primarily for application in the nuclear industry through the evaluated data projects, and is a compilation of the highest priority nuclear data requirements. The purpose of the list is to provide a guide for those planning measurement, nuclear theory and evaluation programmes. The HPRL is a place where data users meet data producers.

The HPRL is in a stage of renewal. A totally new list is going to be presented in the autumn of 2005, and each year there will be a review of the requests by external referees coordinated by the subgroup C of the OECD NEA Nuclear Science Committee's Working Parties on International Evaluation Co-operation (WPEC). This group consists of both data users and producers from industry, representing Europe, Japan, Russia and USA.

The NEA is at the moment collecting new requests for experimental nuclear data. The requests are divided in high priority ones, where a quantitative justification is needed, and general requests where a more qualitative justification is sufficient. All requests need to be tied to a certain project including a project life span, that is to be stated. The list will be maintained by the NEA Data Bank and is presented on the NEA home page: http://www.nea.fr/html/dbdata/hprl/

Data from Integral Experiments

The Data Bank and the NEA Nuclear Science division work closely together on the preservation of data from integral experiments to assist users in having well documented data available for benchmark testing, especially in the context of the development of future nuclear energy systems. The Nuclear Science Committee (NSC) is responsible for the overall guidance of the project, whereas the Data Bank provides the infrastructure for the safeguarding of information in databases and for services to member countries.

In order to provide feedback to nuclear data evaluators, integral experimental data of benchmark quality has been compiled, evaluated, reviewed and published. The most relevant ones for nuclear data are:

- International Criticality Safety Benchmark Experiments (ICSBEP)
- Radiation Shielding and Dosimetry Benchmark Experiments (SINBAD)
- International Reactor Physics Experiments Evaluations (IRPhE).

Computer Program Services

The computer program services (CPS) group provides more than 2000 documented software packages and group cross-section data sets related to nuclear energy applications. The services include collection of programs, compilation and verification in an appropriate computer environment, and that the computer program package is complete and adequately documented. (see www.nea.fr/html/dbprog). The activities comprise acquisition of computer codes and experimental system data needed over a wide range of nuclear and radiation applications. Independent verification and validation of these is offered using quality assurance methods, adding value through international benchmark exercises, workshops and meetings and by issuing relevant reports with conclusions and recommendations. The CPS disseminates the different products to authorised establishments in member countries and integrates user feedback (more than 600 establishments are served in member countries and about 80 from other countries through agreement with the IAEA).

Of particular interest to the nuclear data community are a set of nuclear model codes and experimental data processing/unfolding codes. These have been contributed by member countries and then tested with the

aim of supporting work in nuclear data evaluations. Also computer codes for checking evaluated data files and/or processing them into application libraries (multi-group or continuous energy) have been gathered and made available within the CPS to authorised users. The list and abstract of these codes can be found in:

- Cross Section and Resonance Integral Calculations
  http://www.nea.fr/html/dbprog/categ-a.html
- Spectrum Calculations, Generation of Group Constants and Cell Problems
  http://www.nea.fr/html/dbprog/cpsabs_b.html
- Experimental Data Processing
  http://www.nea.fr/html/dbprog/cpsabs_o.html

Workshops and seminars

The NEA Data Bank organises seminars and workshops to present information on computer programs or groups of programs that are considered to be of special interest to users, such as the NJOY workshop in May 2005 at the NEA. Training courses on widely used computer programs are organised a few times a year to ensure a correct and effective use of them.

The Thermochemical Database (TDB)

The Thermochemical Database (TDB) project is a co-operative effort between the NEA Data Bank and the NEA Radioactive Waste Management Committee to produce internationally recommended chemical thermodynamic data needed for the safety assessment of radioactive waste disposal systems. The Project is currently supported by 16 organisations from 12 OECD member countries.

An update to earlier reviews of thermochemical data for Uranium, Neptunium, Plutonium, Americium, and Technetium was published in 2003. Reviews of data for Zirconium, Selenium, Nickel and selected organic compounds have been published in 2005. A new phase of the project was started in 2003 covering evaluation of inorganic complexes and compounds of Thorium, Iron, Tin and Molybdenum.

P3

IAEA Nuclear Data Section: Progress Report, 2004/05

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

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

Web: http://www-nds.iaea.org/
e-mail: services@iaeand.iaea.org

1. Staff

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

2. Data Compilations

2.1 EXFOR and Dictionaries

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

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

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

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

those new dictionaries (particularly the new quantity dictionary 236 and new nuclides dictionary 227). The feedback of Otsuka (JCPRG) on the dictionary transmissions is much appreciated.

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

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

2.2 CINDA

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

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

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

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

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

2.3 Evaluated data libraries, files and programs

Various new evaluated data libraries, files and programs for data checking, processing and graphical presentation were added to the NDS IAEA Web-site and distributed on CD-ROM:

- ENDF retrieval interface was extended by IRDF-2002 and JEFF-3.1 data
- ENDF-WINENDF update, July 2005-09-29

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

3. Services

Web Services

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

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

CD-ROMs

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

Mail services

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

4. Nuclear Data Development

Although nuclear data developments are outside the immediate operations of the NRDC, we give a brief summary below.
Co-ordinated Research Projects (CRPs):

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

Data development projects:

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

5. Publications

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

Nuclear Reaction Data Centre Network: A success story
by O. Schwerer, V. McLane, H. Henriksson and S. Maev, Part 1, pp. 83-86

NEA Working Party on International Nuclear Data Cooperation – Recent achievements and plans
by P. Obložinský, J. Katakura, A.J. Koning, A.L. Nichols and C. Nordborg, Part 1, pp. 128-131

Nuclear decay data: On-going studies to address and improve radionuclide decay characteristics
by A.L. Nichols (invited paper), Part 1, pp. 242-251

Neutron cross-section evaluations for ^{70,72,73,74,76}Ge
by O. Iwamoto, M. Herman, S.F. Mughabghab, P. Obložinský and A. Trkov, Part 1, pp. 434-437

Review of neutron cross-section evaluations for fission products
by P. Obložinský, M. Herman, S. Mughabghab, I. Sirakov, J. Chang, T. Nakagawa, K. Shibata, M. Kawai, A. V. Ignatyuk, V. G. Pronyaev, V. Zerkin, S. Qingbiao and Z. Youxiang, Part 1, pp. 438-441

SIGACE code for generating high-temperature ACE files; validation and benchmarking
by A.R Sharma,. S. Ganesan and A. Trkov, Part 1, pp. 499-502

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

EXFOR-CINDA-ENDF: Migration of databases to give higher quality nuclear data services
by V.V. Zerkin, V. McLane, M.W. Herman and C.L. Dunford, Part 1, pp. 586-589

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

Recent developments of the nuclear reaction model code EMPIRE
by M. Herman, P. Obložinský, R. Capote, M. Sin, A. Trkov, A. Ventura and V. Zerkin, Part 2, pp. 1184-1187.

Improvement of the fission channel in the EMPIRE code
by M. Sin, R. Capote, M. Herman, P. Obložinský, A. Ventura and A. Trkov Part 2, pp. 1249-1252

Review of experimental data on alpha-induced reactions on some nuclei (Mg-24, Si-28, S-32, Ar-36, Ca-40) in terms of astrophysical applications
by S.A. Dunaeva, V. McLane, M. Savin and S. Taova, Part 2, pp. 1386-1389

b) Other publications:

Table of radionuclides, Vol. 1 – A = 1 to 150
by M.-M. Bé, V. Chisté, C. Dulieu, E. Browne, V. Chechev, N. Kuzmanko, R. Helmer, A. Nichols, E. Schönfeld and R. Dersch, Monographie BIPM-5 (2004) Bureau International des Poids et Mesures.

Table of radionuclides, Vol. 2 – A = 151 to 242
by M.-M. Bé, V. Chisté, C. Dulieu, E. Browne, V. Chechev, N. Kuzmanko, R. Helmer, A. Nichols, E. Schönfeld and R. Dersch, Monographie BIPM-5 (2004) Bureau International des Poids et Mesures.

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

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

On the thermal scattering law data for reactor lattice calculations
by A. Trkov, M. Mattes, Eds.: I. Jencic, M. Tkavc, Proc. Int. Conf. Nuclear Energy for New Europe 2004, pp. 201.1-201.8, Nuclear Society of Slovenia (2004).

IAEA nuclear data for applications: cross section standards and the reference input parameter library (RIPL)
by R. Capote, A.L. Nichols and V.G. Pronyaev presented at Enlargement Workshop "Neutron Measurements, Evaluations and Applications, NEMEA-2", Bucharest, Romania, 20-23 October 2004. Proceedings to be published by IRMM.

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

Neutron activation cross section measurements from threshold to 20 MeV for the validation of nuclear models and their parameters
A.J. Plompen, R. Capote Noy, et al. A report by the Working Party on International Evaluation Co-operation of the NEA Nuclear Science Committee (WPEC-19). Proceedings to be published by NEA.

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

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

IAEA Co-ordinated Research Project on fission product yield data for minor actinides up to 150 MeV
by M. Lammer and A.L. Nichols, presented at 3rd International Workshop on Nuclear Fission and Fission-product Spectroscopy, Fission 2005, 11-14 May 2005, Cadarache, France. To be published in proceedings.

Nuclear decay data: observations and reflections
by A.L. Nichols (invited paper), presented at 15th Int. Conf. on Radionuclide Metrology and

its Applications (ICRM 2005), 5-9 September 2005, Oxford, UK; to be published in *Appl. Radiat. Isot.*

Revisiting the ^{238}U thermal capture cross section and gamma-ray emission probabilities from ^{239}Np decay
by A. Trkov, G.L. Molnár, Zs. Révay, S.F. Mughabghab, R.B. Firestone, V.G. Pronyaev, A.L. Nichols and M.C. Moxon, *Nucl. Sci. Eng.* **150** (2005) 336-348.

Status and perspective of nuclear data production, evaluation and validation
by A. Trkov (invited paper), *Nucl. Eng. Technol.* **37** (2005) 11-24.

Level densities of transitional Sm nuclei
by R. Capote, A. Ventura, F. Cannata and J. M. Quesada, *Phys. Rev.* **C71** (2005) 064320.

Dispersive coupled channel analysis of nucleon scattering from ^{232}Th up to 200 MeV
by E.Sh. Soukhovitskii, R. Capote, J.M. Quesada and S. Chiba, *Phys. Rev.* **C72** (2005) 024604

Micro ionization chamber dosimetry in IMRT verification: clinical implications of dosimetric errors in the PTV
by F. Sánchez-Doblado, R. Capote, J.V. Roselló, A. Leal, J.I. Lagares, R. Arráns and G.H. Hartmann, *Radiother. Oncol.,* **75** (2005) 342-348**.**

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

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

- Workshop on Nuclear Data for Activation Analysis, 7-18 March 2005, ICTP Trieste, Italy
- Workshop on Nuclear Structure and Decay Data: Theory and Evaluation, 4-15 April 2005, ICTP Trieste, Italy.
- Workshop on Data Libraries for Monte-Carlo Calculations (MCNPX), IAEA Headquarters, Vienna, Austria, 12-16 September 2005

7. Visits and Inter-centre Cooperation

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

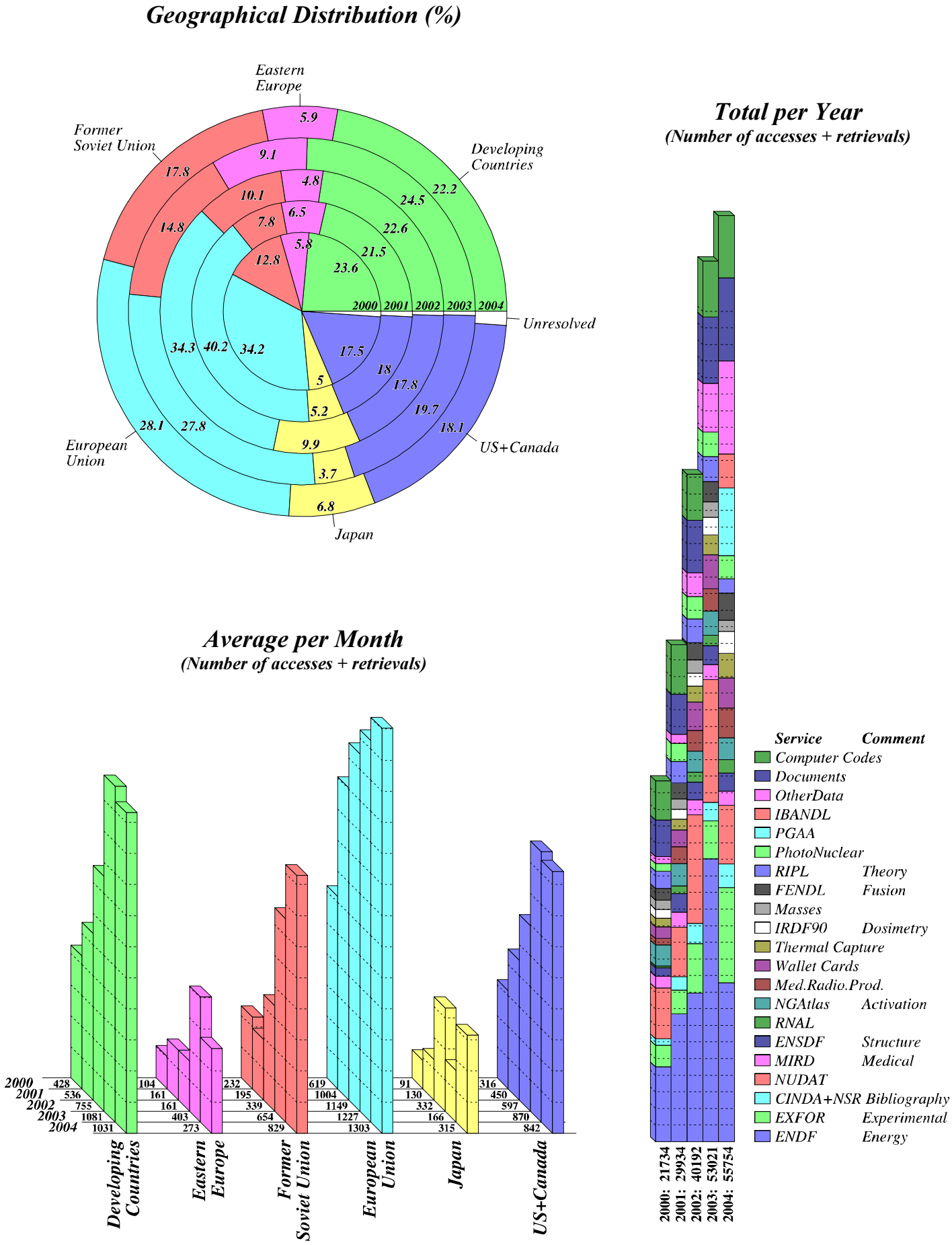

Fig.1. Statistics of accesses and retrievals from IAEA-NDS, IPEN (Brazil) and BARC (India)

PROGRESS REPORT

to NRDC Meeting (12 - 14 October 2005, Vienna)

M.V.Mikhaylyukova, V.N.Manokhin, S.A.Maev

Russian Nuclear Data Center

(CJD, IPPE, Obninsk)

Introduction.

During the period passed after previous Meeting the current work was continued concerning EXFOR compilation and fulfillment of NRDC-2004 Recommendations and Actions. Much efforts were applied for restoring CJD Web-site and guarantee access to it from the users. A large part of activity was related to the nuclear data evaluation. The details are given below.

1. Staff

During the last year:

A. Two staff members joined the center.

Vladimir Pronyaev (pronyaev@ippe.ru) joined the center as leading scientist working in the field of development of theory of nuclear reactions, nuclear model calculation and evaluation of neutron data, analysis of nuclear data uncertainties.

Aleksej Storozhenko joined the center as senor researcher for nuclear data calculation and evaluation.

B. Six staff members left our Center:

Nikolay Kulagin, who was responsible for the software of the RNDC computer network, Internet information service;

Sergey Krivchikov, responsible for development and maintenance of CJD Web-site and personal computers software maintenance;

Saria Nasyrova, responsible for data processing for the activation and radiation damage data libraries.

Others are 3 technical staff members.

2. CINDA activity.

The CINDA activity is continued. However, since October 2004 up to present time the CJD didn't transmit any CINDA batches because of stopping CINDA compilation into old format and absence of editor code for new CINDA format.

3. EXFOR activity.

All journals available at the Institute library are checked for the presence of the experimental data.
Exfor Trans 4133 was transmitted to NDS as final.

Exfor Trans 4134 is now declared as final.

Exfor Trans 4135 is declared as prelim now.

TRANS	TRANS-Flag	Entries Total	Entries New	Entries Revised	Subents Total	Subents New	Subents Revised
4133		23	4	19	149	53	96
4134	Final	18	11	7	67	40	27
4135	Prelim	50	6	44	126	19	127
Sum		91	21	70	342	112	250

The number of experimental works was decreased in Russia, the most of them were made under financial support of different funds: ROSATOM, ISTC, RFBR or INTAS.

The efforts were made to establish cooperation with authors to get numerical data (Khryachkov's data).

At present time we have begun to scan experimental data from graphics. It will let us to increase the number of compiled articles for EXFOR library.

4. Computer and software matters. WEB-site service.

During 2004-2005 years the large efforts were devoted to development and better functioning of the Internet Web-site of Russian Nuclear Data Center. The RNDC Web-site http://www.ippe.ru/podr/cjd/ is now available to users via Internet access.
Some upgrade of computer's hardware and software was made.
Secure FTP shell was successfully installed for secure access to NDS open area for up- and downloading.
The last version of ENDVER is installed in many PC of Nuclear Data Department. The number of scientists and researchers using the Retrival System for EXFOR data base developed by V.Zerkin is increased substantially. A lot of CD-disk copies were prepaired by CJD and distributed to other IPPE departments.

5. Nuclear data evaluation activity.

The main efforts of CJD in the data evaluation activity are directed to analysis of available evaluated data files and selection of the best ones with point of view of microscopic and integral experimental data and nuclear theory model calculations. This work is being done mainly by A.Ignatyuk, V.Manokhin and V.Pronyaev in close cooperation with M.Nikolaev's group.

A.Blokhin's group is engaged activity in nuclear data evaluation and practical calculation of the activation and radiation damage of structural materials for fission and fusion reactors.

6. Publications.

Two issues of journal "Yadernye Konstanty" were published during 2004 year. The electronic copies of this issues were sent to NDS for translation in English and publishing as NDS reports. During 2005 year issue 1 is prepaired for publishing.

7. Acknowlegments.

We greatly appreciate the help of Otto Schwerer and Liam Castello to overcome our problems for secure access to the NDS open area and Naohiko Otsuka also for help in the successful compilation.

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ACTIVITY of CAJAD
for the
IAEA Technical Meeting:
Vienna, Austria, 12-14 October 2005

S.Babykina
Nuclear Structure and Reaction Data Center,
Kurchatov's Institute,
Moscow

Our **Exfor activity** had two main direction-

1. **Compilation A -Library**.

After last meeting 2004 we prepared **A060 Trans file.** This Trans file contains astrophysical data, fission data, monitor reaction data. The files include new entries . Lately in Russia on account of decrease of interest to the nuclear physical investigations the number of publications sharp reduced.

2. **Team-work** with NEA DATA-BANK.

During 2004 year 100 Entries were prepared and included in O-library. These Entries contain mainly differential data for elastic and inelastic scattering and production cross section radioactive and stable isotopes. This work is orientated mainly for nuclear wastes transformation , medical applications and material analysis.

3. Checking Codes.

We use to check our TRANSES and ENTRIES two checking codes-

- our checking code
- CHEX

It is very useful, because the codes are not similar and different errors are finding.

4. According to the conclusion 16 last meeting EPJ/A and YF journals review was performed by CAJAD. The list of papers was send to NDS for following distribution between the responsible Centers. The list of papers for compilation from later numbers EPJ/A and YF represent right now.

Eur. Phys. J. A 25, supplement, 217-219 (2005) –for JCPRG-

Reaction cross-sections for stable nuclei and nucleon density distribution of proton drip-line nucleus B-8

M. Takechi[1;a], M. Fukuda[1], M. Mihara[1], T. Chinda[1], T. Matsumasa[1], H. Matsubara[1], Y. Nakashima[1], K. Matsuta[1],T. Minamisono[2], R. Koyama[3], W. Shinosaki[3], M. Takahashi[3], A. Takizawa[3], T.Ohtsubo[3], T. Suzuki[4], T. Izumikawa[5],S. Momota[6], K. Tanaka[7;b], T. Suda[7], M. Sasaki[8], S. Sato[9], and A. Kitagawa[9]

[1] Department of Physics, Osaka University, Osaka 560-0043, Japan

Eur. Phys. J. A 25, supplement, 221-222 (2005) –for JCPRG

Nucleon density distribution of proton drip-line nucleus Ne-17

K. Tanaka[1;a], M. Fukuda[1], M. Mihara[1], M. Takechi[1], T. Chinda[1], T. Sumikama[1], S. Kudo[1], K. Matsuta[1],T. Minamisono[1], T. Suzuki[2;b], T. Ohtubo[2], T. Izumikawa[2], S. Momota[3], T. Yamaguchi[4;b], T. Onishi[4], A. Ozawa[4;c],I. Tanihata[4], and Zheng Tao[4]

[1] Department of Physics, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan

[2] Department of Physics, Niigata University, Niigata 950-2181, Japan

[3] Kochi University of Technology, Tosayamada, Kochi 782-8502, Japan

[4] RIKEN, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan

Eur. Phys. J. A 25, supplement, 255-258 (2005)—for JCPRG

First experiment of He-6 with a polarized proton target

M. Hatano[1;2], H. Sakai[1;2;3;a], T. Wakui[3], T. Uesaka[3], N. Aoi[2], Y. Ichikawa[1], T. Ikeda[4], K. Itoh[4], H. Iwasaki[1],T. Kawabata[3], H. Kuboki[1], Y. Maeda[1], N. Matsui[5], T. Ohnishi[2], T.K. Onishi[1], T. Saito[1], N. Sakamoto[2], M. Sasano[1],Y. Satou[5], K. Sekiguchi[2], K. Suda[3], A. Tamii[6], Y. Yanagisawa[2], and K. Yako[1]

[1] Department of Physics, University of Tokyo, Hongo 7-3-1, Bunkyo, Tokyo 113-0033, Japan

[2] RIKEN, Hirosawa 2-1, Wako, Saitama 351-0198, Japan

Eur. Phys. J. A 25, supplement, 645-646 (2005)—for NEADB+CAJAD

12C + 12C cross-section measurements at low energies

L. Barr¶on-Palos[1;a], E. Ch¶avez L.[1], A. Huerta H.[1], M.E. Ortiz[1], G. Murillo O.[2], E. Aguilera R.[2], E. Mart¶.nez Q.[2],E. Moreno[2], R. Policroniades R.[2], and A. Varela G.[2]

[1] Instituto de F¶.sica UNAM, Ap. Po. 20-364, Ciudad Universitaria, 01000 Mexico, D.F., Mexico

[2] Instituto Nacional de Investigaciones Nucleares, Departamento del Acelerador, Salazar, Edo. Mex., C.P. 52045, Mexico

Eur. Phys. J. A 25, n.2, 193-198 (2005) –for NEADB+CAJAD

Production cross-sections from neutron-deficient Mo-92 at 500 A MeV

B. Fern¶andez-Dom¶.nguez[1;a], R.C. Lemmon[2], B. Blank[3], M. Chartier[1], D. Cortina-Gil[4], J.L. Durell[5], H. Geissel[6],J. Gerl[6], S. Mandal[6], F. Rejmund[7], and K. SAummerer[6]

[1] University of Liverpool, Oliver Lodge Laboratory, Physics Department, Oxford Street, Liverpool L69 7ZE, UK

[2] CLRC, Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, UK

[3] CENBG, Le Haut Vigneau, F-33175 Gradignan Cedex, France

[4] Universidad de Santiago de Compostela, E-15706 Santiago de Compostela, Spain

Physics of Atomic Nuclei -- August 2005 -- Volume 68, Issue 8, pp. 1303-1313 --- for CAJAD

Scattering of alpha particles on 11B Nuclei at Energies 40 and 50 MeV

N. Burtebaev,1 M. K. Baktybaev,1 B. A. Duisebaev,1 R. J. Peterson,2 and S. B. Sakuta3

1Institute of Nuclear Physics, National Nuclear Center, Almaty, Republic of Kazakhstan

2University of Colorado, USA

3Russian Research Centre Kurchatov Institute, pl. Akademika Kurchatova 1, Moscow, 123182 Russia

Center of Nuclear Physical Data (CNFD), RFNC-VNIIEF

Technical paper for the IAEA Technical Meeting, October 12-14, 2005,
IAEA, Austria, Vienna

S.M. Taova
Russian Federal Nuclear Center-VNIIEF
Russia, 607190, Sarov, Nizhni Novgorod region, Mira Ave., 37

Compilation activity

In 2005 there was successfully finished the project # RP2-2403-SR-02 "Compilation and Evaluation of Alpha-Induced Nuclear Reaction Cross Sections for Astrophysics" of the U.S. Civilian Research and Development Foundation (CRDF). The final report on the project was approved in July. Compilation of data on the project was finished completely. Three transmission tapes TRANS (F020, F021, F022) were prepared and included into the EXFOR data library.

The materials are prepared to prolong the project. It is assumed to continue in the new project the works on getting parameters of the Woods – Saxon potential for the $^{12}C + \alpha$, $^{16}O + \alpha$, $^{20}Ne + \alpha$ systems in order to calculate radiation capture cross-sections for this chain of nuclear reactions. For this purpose it is planned to compile and present for general use the complete sets of all available experimental data for α-induced reactions within the energy range of interest.

Today the works on modifying software on processing and introduction of experimental information to EXFOR library are being carried out. A complex of programs using a single interface and including procedures of introduced data editing, sorting and processing is being created.

Evaluation activity

Within the frames of ISTC Project # RP2-2403-SR-02 for the $^{24}Mg+\alpha$, $^{28}Si+\alpha$, $^{32}S+\alpha$, $^{36}Ar+\alpha$ and $^{40}Ca+\alpha$ systems there were obtained parameters of the optical potential aimed at calculating cross-sections of nuclear reactions using Hauser-Feshbach statistical model. To determine parameters of the Woods – Saxon potential with surface absorption a system approach, whose basic principles are described in a final report, was used. The SCAT2 program code was used in this work to describe the differential cross-sections of elastic scattering to find parameters of the optical potential.

A modern version of the program using the possibilities of the Windows graphic interface was created by the Center programmers. This made it possible to essentially simplify the work with the application and make it more efficient. The input and output of results in SCAT2 changed considerably: today all the results of program operation are displayed in the form of tables and plots. There appeared the possibility of introducing experimental data and finding their deviation from the calculated ones. The real part of potential can be introduced to the table or plot.

Data base development

A new SaBa database version – the library of evaluated and experimental data on charged particles interaction with light nuclei – is now available for Russian users.

The development of SaBa library is going on. Within the frames of ISTC Project K-1128 "Experimental and Theoretical Researches of Nuclear Reactions Induced by Protons and α-

particles on Light Nuclei for Astrophysics" the introduction of new modes related to data processing on differential cross-sections is planned.

After a big repair an electrostatic tandem accelerator of ions EGP-10 was put into operation in INRR. A new mode allowing operation with a micro-beam is introduced. Putting into operation of this accelerator will make it possible to renew investigations in studying interaction of charged particles with light and medium nuclei.

P7

Progress Report of Nuclear Data Group

Atomki, Debrecen,
Hungary

S. Takács, F. Tárkányi,

I. Data evaluation work

1., *Charged-particle cross section database for medical radioisotope production Diagnostic radioisotopes and monitor reactions*

Second part of the charged particle cross section database for medical radioisotope production was upgraded. (Chapter 5, Gamma emitters)

The update and upgrade of 16 charged particle induced reactions in which gamma emitter radioisotopes are produced were completed.

The list of reactions:

^{67}Zn(p,n)^{67}Ga	^{68}Zn(p,2n)^{67}Ga	^{82}Kr(p,2n)^{81}Rb	^{nat}Kr(p,x)^{81}Rb
^{111}Cd(p,n)^{111}In	^{112}Cd(p,2n)^{111}In	^{123}Te(p,n)^{123}I	^{124}Te(p,2n)^{123}I
^{124}Te(p,n)^{124}I	^{124}Xe(p,2n)^{123}Cs	^{124}Xe(p,pn)^{123}Xe	^{127}I(p,5n)^{123}Xe
^{127}I(p,3n)^{125}Xe	^{203}Tl(p,2n)^{202m}Pb	^{203}Tl(p,3n)^{201}Pb	^{203}Tl(p,4n)^{200}Pb

Experimental microscopic cross section data published earlier and not yet included in the previous evaluation work or new data measured recently were collected and added to the primary database in order to improve the quality of the recommended data. The newly compiled experimental data influenced the decision made earlier and resulted in new selected cross-section data sets. A spline fitting method was applied to the selected data sets and updated recommended data were produced in those cases.

A validation test of the upgraded recommended cross-section database for production of gamma emitter radioisotopes was also performed by collecting experimental integral thick target yields and critically compared with yields deduced from the new recommended cross sections. The yield values calculated from the recommended cross sections were compared with the data of the frequently used compilation work of P.P. Dmitriev, (*Radionuclide Yield in Reactions with Protons, Deuterons, Alpha Particles and Helium-3, Moscow, Ehnergioatomizdat (1986), and INDC(CCP)-263/G+CN+SZ (1986)*) in those cases for which data were available.

The upgraded data, figures and tables were sent to NDS to update the web version (http://www-nds.iaea.org/medical) of the database regarding the gamma emitter reactions. The new updated recommended data were compiled in EXFOR format, in entry no. D4147. The results were also published in a NIM/B article [1].

2. *Nuclear Data for Production of Therapeutic Radionuclides*

We participate in the CRP which was started in 2003 with the aim of to improve the accuracy and completeness of the data needed for the optimum production of therapeutic radioisotopes, to undertake new measurements, to compile and evaluate all experimental data

available on this area, to determine optimum conditions for the production of the selected radioisotopes and to produce accurate cross sections and comprehensive decay schemes for the investigated radionuclides.

II. EXFOR compilation

We continued the compilation work of charged particle induced nuclear reactions in EXFOR format. During the last period 11 new entries were produced with 82 subentries containing data.

Three journals were scanned for publications according to the agreement of the last meeting (NIM/A, NIM/B, ARI) for the years of 2004-2005 and the relevant list of articles were sent to NDS.

III. Experimental work

We continued to measure experimental cross sections of light charged particles (proton, deuteron, ^{3}He and alpha) induced reactions on various targets. Data are assessed or under process. Results were reported in scientific journals or relevant conferences. See list of publications.

IV. List of publications

1. S. Takács, F. Tárkányi and A. Hermanne, *Validation and upgrading of the recommended cross-section data of charged particle reactions: Gamma emitter radioisotopes,* NIM/B, In Press, Available online

2. Ditrói F., Tárkányi F., Csikai Gy., Uddin M. S., Hagiwara M., Baba M.: *Investigation of activation cross sections of the proton induced nuclear reactions on natural iron at medium energies.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1011

3. Ditrói F., Takács S., Tárkányi F.: *Evaluation of reaction cross section data used for thin layer activation technique.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1654.

4. Hermanne A., Tárkányi F., Takács S., Szûcs Z., Shubin Yu. N., Dityuk A. I.: *Experimental study of the cross-sections of alpha-particle induced reactions on 209Bi.* Applied Radiation and Isotopes 63 (2005)1.

5. Hermanne A., Tárkányi F., Takács S., Szûcs Z.: *Experimental study of the cross sections of alpha-particle induced reactions on 209Bi.* International Conference on

Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)957.

6. Hermanne A., Tárkányi F., Takács S., Shubin Yu. N.: *Experimental determination of cross section of alpha-induced reactions on natPd.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)961.

7. Hermanne A., Tárkányi F., Takács S., Shubin Yu. N.: *Experimental determination of cross section of alpha-induced reactions on natPd.* Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 229 (2005)321.

8. Spahn I., Takács S., Shubin Yu. N., Tárkányi F., Coenen H. H., Qaim S. M.: *Cross-section measurement of the 169Tm(p,n) reaction for the production of the therapeutic radionuclide 169Yb and comparison with its reactor-based generation.* Applied Radiation and Isotopes 63 (2005)235.

9. Tárkányi F., Ditrói F., Csikai Gy., Takács S., Uddin M. S., Hagiwara M., Baba M., Shubin Yu. N., Dityuk A. I.: *Activation cross-sections of long-lived products of proton-induced nuclear reactions on zinc.* Applied Radiation and Isotopes 62 (2005)73.

10. Tárkányi F., Takács S., Ditrói F., Csikai Gy., Hermanne A., Uddin M. S., Hagiwara M., Baba M., Shubin Yu. N., Dityuk A. I.: *Measurement of activation cross sections of the proton, deuteron, and alpha particle-induced nuclear reactions on platinum.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1015.

11. Tárkányi F., Ditrói F., Takács S., Király B., Hermanne A., Uddin M. S., Hagiwara M., Baba M., Shubin Yu. N., Dityuk A. I.: *Cross sections of proton induced nuclear reactions on iridium.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1023.

12. Tárkányi F., Ditrói F., Takács S., Csikai Gy., Mahunka I., Uddin M. S., Hagiwara M., Baba M., Ido T., Hermanne A., Sonck M., Shubin Yu. N., Dityuk A. I.: *Excitation functions for production of 88Zr and 88Y by proton and deuteron irradiation of Mo, Nb, Zr and Y.* International Conference on Nuclear Data for Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1658.

13. Tárkányi F., Ditrói F., Takács S., Mahunka I., Csikai Gy., Uddin M. S., Hagiwara M., Baba M., Ido T., Hermanne A., Shubin Yu. N., Dityuk A. I.: *Excitation functions of proton-induced reactions on natSn and natCd: Relevance to the production of 111In and 114mIn for medical applications.* International Conference on Nuclear Data for

Science and Technology. Santa Fe, NM, USA, 26 Sept. - 1 Oct., 2004. Proceedings. Eds: Haight, R.C., Talou, P., Kawano, T. et al. AIP (AIP Conference Proceedings 769) 0 (2005)1662.

14. Uddin M. S., Hagiwara M., Baba M., Tárkányi F., Ditrói F.: *Experimental studies on excitation functions of the proton-induced activation reactions on silver.* Applied Radiation and Isotopes 62 (2005)533.

15. Uddin M. S., Hagiwara M., Baba M., Tárkányi F., Ditrói F.: *Experimental studies on excitation functions of the proton-induced activation reactions on yttrium.* Applied Radiation and Isotopes 63 (2005)367.

16. Uddin M. S., Hagiwara M., Tárkányi F., Ditrói F., Baba M.: *Investigation of the proton-induced activation reactions on natural molybdenum.* Proceedings of the 2003 Symposium on Nuclear Data. Tokai, Japan, 27-28 Nov., 2003. Eds.: T. Ohsawa, T. Fukahori. Vienna, IAEA (JAERI-Conf 2004-005, INDC(JPN)-191/U) 0 (2005)1.

17. Uddin M. S., Baba M., Hagiwara M., Tárkányi F., Ditrói F.: *Measurements of cross-sections of the proton-induced activation reactions.* Proceedings of the 2004 Symposium on Nuclear Data. Tokai, Japan, 11-12 Nov., 2004. Eds.: Y. Tahara, T. Fukahori. Vienna, IAEA (JAERI-Conf 2005-005, INDC(JAP)-195/U) 0 (2005)1.

The Progress Report of CNDC to NRDC Meeting

(12 – 14 October 2005, Vienna, Austria)

Yu Hongwei
China Nuclear Data Center
China Institute of Atomic Energy

1 General

Chinese Nuclear Data Committee assumes responsibility the management of CENDL project. The committee meetings are generally held once per year. China Nuclear Data Center serves as the secretariat of Chinese Nuclear Data Committee. At present, the CNDC staffs are 18, the CNDC consists of the following four group:

- Nuclear Data Evaluation Group
- Nuclear Theory Group
- Macroscopic Data Group
- Data Library Group

2 Nuclear Data Evaluation

CENDL-3.0:

From 1996 to 2001, we have completed the evaluation of CENDL-3.0, total 209 nuclides are include CENDL-3.0, among them, the data of 169 nuclides were newly evaluated. The data are contained in the energy range from 10.5 eV to 20 MeV. The fission product nuclide file of CENDL-3 has been officially released on October 6, 2001. It includes 2 evaluations from CENDL-2.1($^{107, 109}$Ag)and 101 new evaluations for 100 isotopes. The other file of CENDL-3.0 have been tested and improved for the problems found in the test within china.

• CENDL-3.1

The CENDL meeting was held on 17-18 March 2005, the meeting decided the next release version of CENDL is CENDL-3.1 library, the release of CENDL-3.1 is foreseen in the end of 2005. The data file will contain the update of CENDL-3.0 .

• New evaluations

The following nuclear data evaluations have been completed: ^{9}Be, ^{12}C, ^{31}P , ^{51}V, ^{nat,106,108,110,111,112}Cd, ^{55}Mn, ^{3}He, ^{127,129,132,132m,133,133m,134,134m,135,136,136m,137,138,139,140}I, ^{84,86,88,90,92,94,96}Rb, ^{87,88,90,91,92,93,94,95,96,97,98,99,100}Y, ^{92,94,96,98,100,102,104,106}Mo, ^{233,234,235,236,237,241,242,243,244}U, ^{244,245,246}Pu, ^{240,241,242,243,244,245,246}Am, ^{236,237,238,239}Np and ^{232,233,234}Th.

• Nuclear data for ADS

In order to satisfy the need of ADS project of China, a code MEND for calculating the nuclear data in medium energy region has been developed, The following nuclear data have been calculated and evaluated:

Nuclear data for incident neutron from 20 to 250MeV: ^{50,52,53,54}Cr, ^{54,56,57,58}Fe,

^{90,91,92,94,96}Zr, ^{180,182,183,184,186}W, ^{204,206,207,208}Pb, ^{238}U.

Nuclear data for incident proton from threshold energy to 250MeV: ^{54,56,57,58}Fe, ^{180,182,183,184,186}W, ^{204,206,207,208}Pb, ^{209}Bi,^{238}U.

• Structure and decay data

The nuclear structure and decay data evaluation group in China Nuclear Data Center (CNDC) has permanent responsibility for evaluating and updating NSDD for A=51,195-198; temporary for A= 61,67 and 170. The evaluation of ^{233}Pa decay data was finished.

3. CINDA and EXFOR Compilation

CINDA: According to the conclusion of the last NRDC meeting, CNDC scan the journal of CNP(Chinese J.of Nuclear Physics). AS the journal of CNP stopped publication in 1998, the journal of CNP from 1979 to 1998 have been scanned, the CINDA compilation of the journal of CNP have been done and send to NDS.

EXFOR: 3 entries (one of them cooperation with Ms. S.Dunaeva) measured in China have been compiled and send to NDS, 17 entries will be send to NDS soon.

4. Nuclear physics basic database

The project is supported by Ministry of science and technology of china, it contains the following data base:

• Nuclear structure and Nuclear Decay database
• Nuclear Model Parameters and computing programs library
• Special Purpose database
• Experimental Database
• Evaluation Nuclear data library

5. Nuclear Data Service:

• A Powerful software TT was developed for nuclear data retrieve and evaluation under Windows and Linux platforms.
• IAEA NDS Mirror site will constructed in CNDC

6. The meeting and symposium:

(1) The symposium on Nuclear Data Future need, Jan. 2005,Nanjing
(2) The symposium on Nuclear Data library, Mar. 2005, Beijing
(3) The symposium on Structure and decay data, Jun. 2005,Guizhou
(4) 2005 China Nuclear data conference, Aug. 2005, Xining

7. International Co-operation:

At present, The scientists of CNDC participate in three IAEA Coordinated Research Projects: Evaluated Nuclear Data for Thorium-Uranium Fuel Cycle; Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Applications (RIPL-3); Updated Decay Data Library for Actinides.

In the past year, 5 scientists visited the CNDC, 2 scientists of CNDC visited the NNDC devoted to the merging of fission product nuclide files.

P9

Japan Charged-Particle Nuclear Reaction Data Group (JCPRG)

Nuclear Reaction Data File Steering Committee

Progress Report to the
IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres
12-14 October 2005

0. General

Since the last NRDC meeting (October 2004, Brookhaven), we have carried out the following activities:

1. Compilation of CPND measured in Japan for NRDF and EXFOR
2. Compilation of CPND published in Japan for CINDA
3. Maintenance of data input system.
4. Maintenance of NRDF retrieval system.
5. Development of EXFOR and ENDF retrieval system
6. Development of digitization system
7. Data services

These activities are carried out under the supervision of NRDF Steering Committee, which consists of 9 senior researchers (8 nuclear physicists and 1 information scientist). Under this committee, 9 group members (5 postdoctoral researchers, 3 graduate students and 1 technical staff) work for the compilation. Additionally, 6 postdoctoral researchers, including some of the above, are working on system maintenance and development. These activities and data services are coordinated by 1 secretary.

Furthermore, our activities have been activated by V. McLane, who stayed at Hokkaido University from 6 February 2005 to 5 March 2005. During her stay, some US data in NRDF have been translated to EXFOR and submitted (TRANS.T020). She also held two workshops on EXFOR compilation for graduate students. Additionally, she gave an oral talk in the international symposium "Recent Advances in Astrophysics and Planetary Science" held at Hokkaido University.

The regular JCPRG budget ended at March 2001. We are applying to the Japanese government for a competitive budget for our further activity.

1. Compilation of CPND for NRDF and EXFOR

From April 2004 to March 2005, CPND in 45 references (540 records, 2.12 MB) have been newly compiled for NRDF. The data had been measured in Japan and published in JPJ, NST, PR/C, PRL, PL/B, NP, ARI, NP/A, NIM/A, EPJ/A and RCA.

Since 2004 NRDC meeting, we have made 111 new entries and have revised 37 old entries. These were transmitted as 7 trans files (E029-E033, J001-J003 and R015) to NDS open area. JCPRG is grateful for valuable comments from NDS and CAJaD on our transmissions. CHEX and TEST-EXF are useful for us.

Some numerical data of Japanese work received from NNDC are now in process of compilation.

According to the agreement (Conclusion 2004-14) at 2004 NRDC meeting, the scope of area J is defined as "Charged-particle nuclear data for projectile with non-positive baryon number" (See also Action 2004-24, CP-E/053). We thus moved 5 old entries from area E to area J. In addition, 4 new entries have been compiled in area J.

Author proofs have been made for several entries related to Cyclotron Radioisotope Center (CYRIC) in Tohoku University and Department of Applied Quantum Physics and Nuclear Engineering in Kyushu University. We appreciate the authors' cooperation.

2. Compilation of CPND for CINDA

We prepare CINDA batches for CPND published in Japan every half a year. Each batch covers 6 issues of each of 3 Japanese journals JPJ, PTP and NST. Some relevant proceedings and reports are also compiled. The first batch (86 new records) was submitted to NEA in July 2004, though the batch will be corrected according to the decision at 2004 NRDC meeting. The total number of records submitted to NEA-DB is then 141. Neutron related bibliographies are compiled by JAERI Nuclear Data Center as before.

3. Maintenance of NRDF and EXFOR editor "HENDEL"

A Web-based nuclear data input system is maintained and revised. Internal dictionaries for the system were immediately updated with that for NRDF or EXFOR. Various problems have been gradually fixed and corrected. All of our recent entries for NRDF and EXFOR are now generated by this system. This system thus provides us with a good environment for the compilation.

This system is available at our web site: http://jcprg.hucc.hokudai.ac.jp/editor/ . One can login as a guest user using the user id (*guest*) and password (*jcprgx4*) and then one can edit any entries with a centre identification character, X. We can issue other centre identification character and user id at request.

4. Maintenance of NRDF Retrieval System "DARPE"

The NRDF database is available at our web site: http://www.jcprg.org/nrdf/. New data, which has been finalized not yet for EXFOR but for NRDF, can be obtained from this site. This retrieval system is written in a Perl script without any database management system.

5. Development of EXFOR and ENDF Retrieval System "SPES"

The new EXFOR and ENDF retrieval system named "SPES" is being developed by the cooperation between JCPRG and JAERI. In this system, we can retrieve the required data from EXFOR and ENDF at the same time, and then draw 2D or 3D viewgraphs of cross sections or angular distributions in the same panel. Users can upload their own data files, and plot them with the data from EXFOR and/or ENDF. This system is composed of the programs written in Perl and a database management system, MySQL. We will finish the development by the next spring. A prototype of ENDF plotting tool for (PENDL) is also available at http://www.jcprg.org/endf/.

6. Development of Digitization System "GSYS"

A new digitizing system "GSYS" based on Java has been developed. This new system works on any kind of the operating system. With GSYS, one can easily read-in and digitize the graphical data with high accuracy. GSYS is freely available at http://jcprg.hucc.hokudai.ac.jp/gsys/gsys-e.html. Recently, we are trying to add the "feedback" function, which makes it possible to load the numerical data and plot the data as markers on an image. This function is very helpful to compare the numerical data with the original data on the graphical image visually and modify the numerical data if needed. The latest "GSYS" with the feedback function will be available in the near future.

7. Data services for Japanese Users

We provide Japanese researchers in nuclear physics and nuclear engineering with nuclear data as well as nuclear reaction data (NRDF and EXFOR). For more information, we published "Annual Report of Nuclear Reaction Data File Vol.18" in March 2005.

Recently we have established mutual communication with JENDL evaluators in Japan (e.g. JAERI Nuclear Data Center). They found many mistakes in EXFOR. We forwarded them to responsible centres. The list can be seen at http://jcprg.hucc.hokudai.ac.jp/exfor/feedbacks.html .

ANNEX: Organization and members of JCPRG

NRDF Advisory Committee

Yasuhisa ABE (*Yukawa Institute for Theoretical Physics, Kyoto Univ., Kyoto*)
Yoshinori AKAISHI (*High Energy Accelerator Research Organization (KEK), Tsukuba*)
Yasuo AOKI (*Univ. of Tsukuba, Tsukuba*)
Junsei CHIBA (*Institute for Particle and Nuclear Studies, KEK, Tsukuba*)
Akira HASEGAWA (*Japan Atomic Energy Research Institute, Tokai*)
Masayasu ISHIHARA (*Institute of Physical and Chemical Research, Wako*)
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Mitsuji KAWAI (*Kyushu Univ., Fukuoka*)
Jun-ichi KATAKURA (*Japan Atomic Energy Research Institute, Tokai*)
Shunpei MORINOBU (*Kyushu Univ., Fukuoka*)
Tetsuo NORO (*Kyushu Univ., Fukuoka*)
Hajime OHNUMA (*Chiba Institute of Technology, Narashino*)
Koichi OKAMOTO (*Japan Atomic Industrial Forum Inc., Tokyo*)
Hikonojo ORIHARA (*Tohoku Institute of Technology, Sendai*)
Teijiro SAITOH (*Laboratory of Nuclear Science, Tohoku Univ., Sendai*)
Hajime TANAKA (*Hokkaido Univ., Sapporo*)
Yoshihiko TENDOW (*Institute for Physical and Chemical Research (RIKEN), Wako*)

NRDF Steering Committee

Kiyoshi KATŌ (*Chairman, Hokkaido Univ., Sapporo*)
Shigeyoshi AOYAMA (*Niigata Univ., Niigata*)
Masaki CHIBA (*Sapporo-Gakuin Univ. Ebetsu*)
Yoshiharu HIRABAYASHI (*Hokkaido Univ., Sapporo*)
Toshiyuki KATAYAMA (*Hokusei-Gakuen Univ., Sapporo*)
Hiroshi MASUI (Kitami Institute of Technology, Kitami)
Hiroshi NOTO (*Hokusei-Gakuen Univ., Sapporo*)
Akira OHNISHI (*Hokkaido Univ., Sapporo*)
Shigeto OKABE (*Hokkaido Univ., Sapporo*)

NRDF Annual Report Editorial Committee

Hiroshi NOTO (*Chairman, Hokusei-Gakuen Univ., Sapporo*)
Yoshiharu HIRABAYASHI (*Hokkaido Univ., Sapporo*)

Secretariat

Hitomi YOSHIDA (*Hokkaido Univ., Sapporo*)

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1) Compilation of CPND for NRDF and EXFOR (compilation, checking, digitization):
Masayuki AIKAWA (*Université Libre de Bruxelles, Bruxelles*)
Takako ASHIZAWA (*Hokkaido Univ., Sapporo*)
Chikako ISHIZUKA (*Hokkaido Univ., Sapporo*)
Masatsugu ISSE (*Hokkaido Univ., Sapporo*)
Chie KUROKAWA (*Hokkaido Univ., Sapporo*)
Naohiko OTSUKA (*Japan Atomic Energy Research Institute, Tokai*)
Ryusuke SUZUKI (*Hokkaido Univ., Sapporo*)
Tomoaki TOGASHI (*Hokkaido Univ., Sapporo*)
Kohsuke TSUBAKIHARA (*Hokkaido Univ., Sapporo*)

2) Compilation of CPND for CINDA:
Sergei KORENNOV (*Hokkaido Univ., Sapporo*)
Naohiko OTSUKA (*Japan Atomic Energy Research Institute, Tokai*)

3) Maintenance of NRDF and EXFOR editor:
Naohiko OTSUKA (*Japan Atomic Energy Research Institute, Tokai*)

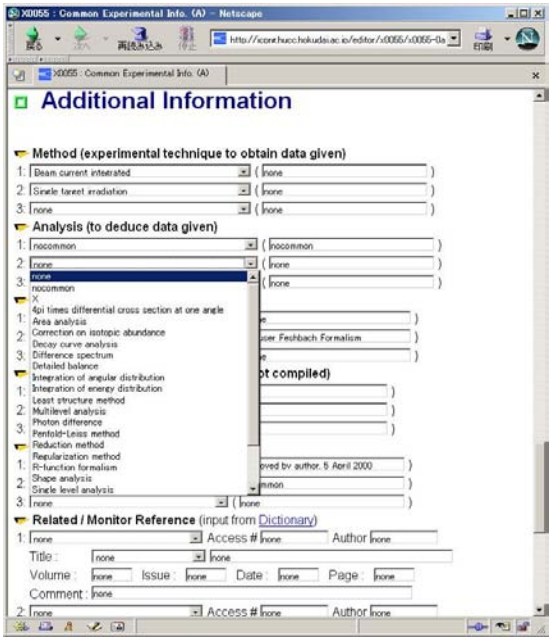
4) Maintenance of NRDF retrieval system:
Sergei KORENNOV (*Hokkaido Univ., Sapporo*)
Naohiko OTSUKA (*Japan Atomic Energy Research Institute, Tokai*)

5) Development of EXFOR and ENDF retrieval system
Sergei KORENNOV (*Hokkaido Univ., Sapporo*)
Naohiko OTSUKA (*Japan Atomic Energy Research Institute, Tokai*)
Takuma SUDA (*Hokkaido Univ., Sapporo*)

6) Development of digitization system
Koji ARAI (*Nagaoka National College of Technology, Nagaoka*)
Ayumi MINOGUCHI (*Hokkaido Univ., Sapporo*)
Ryusuke SUZUKI (*Hokkaido Univ., Sapporo*)

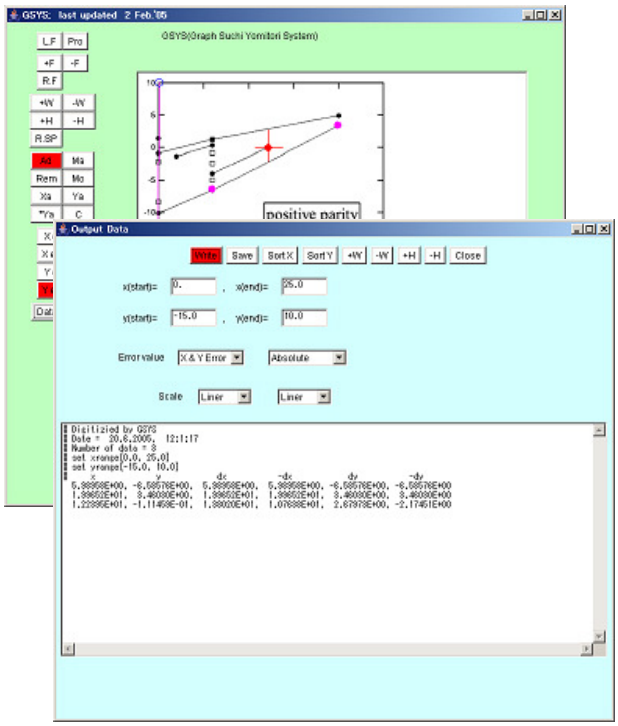
7) Data Services
Hitomi YOSHIDA (*Hokkaido Univ., Sapporo*)

Screen Shot of Our Products

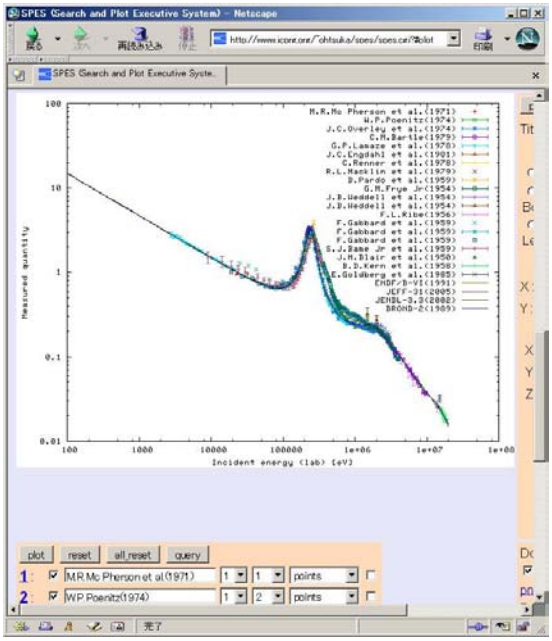


HENDEL (Nuclear data editor)
http://jcprg.hucc.hokudai.ac.jp/editor/

DARPE (NRDF search / plot)
http://www.jcprg.org/nrdf/



GSYS (Graph Digitizer System)
http://jcprg.hucc.hokudai.ac.jp/gsys/gsys-e.html



SPES (EXFOR and ENDF search/plot)
(under construction)

Nuclear Data Processing Activity at MSU SINP CDFE in 2004 – 2005.

I.N.Boboshin, V.V.Varlamov, S.Yu.Komarov, N.N.Peskov, M.E.Stepanov, V.V.Chesnokov

Progress Report to
the IAEA Technical Meeting on Coordination of the Network of Nuclear Reaction Data Centres (12 – 14 October 2005, IAEA NDS, Vienna, Austria).

This report contains the **short review** of the works carried out by the Lomonosov Moscow State University Skobeltsym Institute of Nuclear Physics Centre for Photonuclear Experiments Data (Centr Dannykh Fotoyadernykh Eksperimentov – CDFE) concern the IAEA Nuclear Reaction Data Centres Network activities for the period of time from the IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres (04 - 07 October 2004, NNDC, BNL, Brookhaven, USA) till the fall of 2005 **and main results** obtained.

EXFOR compilations

Three new CDFE EXFOR **TRANSes** M036, M037, and M038 (PRELIM) have been produced and transmitted to the IAEA NDS. Many old data have been corrected in accordance with comments of Otto Schwerer, Dimitri Rochman, and Naohiko Otsuka. On the whole the CDFE TRANSes mentioned contain (**Annex 1**) 26 retransmitted and 21 new (M0658 - M0679 (without M0669)) ENTRYs with 101 new data SUBENTs.

Upgrading of databases

The CDFE relational nuclear data **databases** (new Web-site address - **http://cdfe.sinp.msu.ru –** (instead of old one - http://depni.sinp.msu.ru/cdfe)) have been **upgraded** significantly:

- the "2004" part (the "2005" is in processing) has been added to the CDFE "Photonuclear Data Index"; as whole the **"Photonuclear Data Index 1955 -2004"** database has been added by a significant amount of entries from /1/; for articles included into international EXFOR nuclear reaction data fund all data sets are available in forms of table and graphs;
- the database **"Giant Dipole Resonance Parameters"** has been upgraded significantly: many new data sets have been added;

- many full texts (in *.pdf format) have been connected to the CDFE M-series documents of the relational **"Nuclear Reaction Database (EXFOR)"**; the complete database of those files has been transmitted to the IAEA NDS in accordance with Otto Schwerer's Memo CP-D/426 from 1 April 2005; because now all three international complete CDFE databases (EXFOR, ENSDF and NSR) are combined /2/ into unified information system all those full texts are available both through EXFOR and NSR databases.

Photonuclear data evaluations

As an continuation of consistent analysis and evaluation of total and partial photonuclear reactions cross sections many data for various multiplicitiy photoneutron reaction cross sections have been obtained /3/ using the Giant Dipole Resonance statistical model for all stable isotopes of nuclei with Z = 30 – 92. The cross section energy dependency (excitation function) and integrated cross section data have been evaluated for incident gamma-quanta energies from the correspondent threshold up to 50 MeV for total absorption (γ,abs) and partial photoneutron (γ,n), (γ,2n), (γ,3n), (γ,4n), and (γ,5n) reactions.

Some evaluated photonuclear reaction cross section data have been reported /4,5/ on the International Conference on Nuclear Data for Science and Technology at Santa Fe, New Mexico, USA.

Nuclear structure data

Concern the CDFE nuclear structure database production activity at first time nuclear level quadrupole moments **("Q-moments")** data produced "by hands" using text parts (CONTINUATION etc.) of ENSDF data sets have been included into the CDFE "**Relational ENSDF**" database. Now those values could be used in all possible database queries.

The parameters of deformation of many nuclei obtained using nuclear level quadrupole moments ("Q-moments") data obtained from ENSDF, information from Atomic data and nuclear data tables /6/ and some other sources /7/ are used now in development of **"Chart of nuclide quadrupole deformations"**.

Some evaluated nuclear structure data (energies and occupation probabilities of single-particle nuclear states) have been reported /8/ on the International Conference on Nuclear Data for Science and Technology at Santa Fe, New Mexico, USA.

Short-term programmes

The main items of CDFE future short-term programmes, priorities and new tasks are listed in the **Annex 2**.

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Annex 1. The CDFE new EXFOR TRANSes M036, M037, and M038 (PRELIM) contents (*old corrected* and new ENTRYs)

TRANS M036		**TRANS M037**		**TRANS M038 (PRELIM)**	
M0635	*115*	*M0054*	*2*	*M0084*	*3*
M0651	*13*	*M0084*	*3*	*M0090*	*5*
M0657	*13*	*M0090*	*5*	*M0448*	*5*
M0658	2	*M0237*	*2*	*M0485*	*2*
M0659	2	*M0240*	*3*	*M0629*	*6*
M0660	2	*M0366*	*2*	*M0650*	*9*
M0661	13	*M0428*	*12*	M0675	2
M0662	3	*M0448*	*5*	M0676	4
M0663	2	*M0469*	*3*	M0677	7
M0664	2	*M0485*	*2*	M0678	4
M0665	4	*M0495*	*11*	M0679	11
M0666	2	*M0593*	*13*		
M0667	9	*M0627*	*4*		
M0668	2	*M0636*	*10*		
		M0639	*2*		
		M0658	*2*		
		M0659	*2*		
		M0670	5		
		M0671	13		
		M0672	2		
		M0673	3		
		M0674	11		
Total new: 11	Total new: 41	Total new: 5	Total new: 34	Total new: 5	Total new: 26
				Sum new: 21	Sum new:101

Annex 2. The main items of the CDFE future short-term programmes, priorities and new tasks.

1. Continuation of photonuclear data compilation using EXFOR format, new TRANSes (M039, M040, etc.) production.
2. Upgrading and addition of the CDFE bibliographical data collection. Including the 2005 photonuclear data into the relational database "Photonuclear Data Index" (PNDI).
3. Investigation of possibility of including photonuclear data from the CDFE "Photonuclear Data Index" to CINDA.
4. Continuation of joint evaluation of photonuclear reaction cross sections obtained using various methods, first of all in experiments with bremsstrahlung and quasiminoenergetic annihilation photons, with the aim of definition and excluding of systematical discrepancies.
5. Upgrading, addition and correction, Search Engines improvement of the existed CDFE EXFOR relevant databases:
   - "Giant Dipole Resonance Parameters. Photonuclear Reaction Cross Sections";
   - "Relational Nuclear Reaction Database (EXFOR)";
   - "Relational ENSDF":
6. Improvement of new unified joint interface for all three complete databases "NSR", "EXFOR" and "Relational ENSDF" that gives to one possibility of working with all three systems (and some other CDFE Web-site relational databases) at the same time.

Ukrainian Nuclear Data Center (UNDC)

Technical paper for the IAEA Technical Meeting, October 12-14, 2005, IAEA, Austria, Vienna

INSTITUT FOR NUCLEAR RESEARCH
Pr.Nauky, 47, Kyiv , Ukraine

GRITZAY Olena O., KALTCHENKO Alexandr I., VLASOV Mercury F., KRAVCHENKO Serghiy A., KLIMOVA Natalia A

During the last year the Ukrainian Nuclear Data Centre has performed following activities:

1.EXFOR Compilation activities.

Two neutron data compilations were made, one of them was transferred to the NDC, another one will be given during the NRDC meeting. Besides, one Subentry was added to the Entry with access number 41012.

Last year UNDC began to compile the experimental data for charged particles. Three works were transmitted to the NDC, two works will be brought to the NRDC meeting. There were found twenty four experimental works on charged particles made by Ukrainian scientists. They will be compiled during the next year.

Three works on photo-nuclear data were compiled. Two of them were included to the EXFOR database, the last one will be given to NDC during the meeting

2.Calculations on nuclear data libraries

The UNDC prepares the calculations of cross-sections and other functionals on the ENDF database on requests from scientific organizations in the Ukraine. During the last year about 20 calculations were performed.

3. Computer and software matters. WEB-site service.

During the last year the large efforts were made for improvement of the Internet Web-site of Ukraine Nuclear Data Center (www.ukrndc.kinr.kiev.ua).

P12

Nuclear Data Evaluation Activities of Japan Atomic Energy Agency

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General

Japan Atomic Energy Agency (JAEA) has been established in October 1, 2005. The Agency has succeeded the activities of Japan Atomic Energy Research Institute (JAERI) and Japan Nuclear Fuel Cycle Development Cooperation (JNC). The number of the staff members amounts more than 4000. The activities of JAEA cover from basic nuclear sciences to big project such as FBR development and J-PARC (Japan Proton Accelerator Research Complex) project.

The activities of Nuclear Data Center in JAERI have been taken over by Nuclear Data Center (The English name has not been officially fixed yet at this time.) in JAEA.

Activities of Nuclear Data Evaluation

We have some nuclear data evaluation activities. The first and important one is JENDL-4 project. The JENDL-4 library is planned to be released in 2010. The second one is development of High Energy File. The data of the high energy file is going to be used for shielding design of high energy proton accelerator of J-PARC and development of ADS system. The nuclear reaction codes are being developed for evaluation work. The brief summary of those activities is given below.

1) JENDL-4 Project

The evaluation work for the JENDL-4 library has been continued. In the evaluation work the data of FP and MA nuclides are mainly reviewed

and are going to be revised. The resonance parameters of FP nuclides are reviewed and update based on recent measured data. The fission cross sections of Cm, Cf and Pu isotopes are updated based on measured data. The covariance data of those isotopes are also evaluated. The covariance data of minor actinides are also requested for ADS (Accelerator Driven System) development and evaluated for the isotopes of Np, Am and so on.

2) High Energy File

The JENDL High Energy File containing the data of 66 nuclides was released in March 2004 as JENDL/HE-2004. The data included are reaction data of protons and neutrons with energy up to 3 GeV. The final version of the high energy file is planned to be released in 2007 which includes the data of 122 nuclides.

3) Code Development

Nuclear model codes are being developed for the evaluation work of JENDL-4. The codes are developed based on spherical optical model, DWBA and coupled-channel optical models (CCOM, CCDM, CCPM, CCSM and POD).

Other activities

1) Development of Data Utilization System

We are developing the Data Utilization System. The development is conducted by the research contract with the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The utilization system provides two functions: 1) retrieval of measured and evaluated data, 2) processing of evaluated data for application. The development is planned to be finished in FY2006. The main work of the MEXT project is the development of detector system to measure the nuclear data of minor actinides. The development of the detector system has almost finished and the test of the system is being performed. The measured data are planned to be obtained late this year. The measurements of fission and capture cross section of ^{237}Np and ^{241,243}Am are planned to be obtained until the end of FY2006.

2) (α,n) Reaction Data

The data of (α,n) reaction has been evaluated and released in 2005 as JENDL/AN-2005. The data included in the file are expected to be used for analysis of spent fuel. The design and safety analysis of transport cask and fuel storage require the data of neutron generation. The high burn-up of right water reactor fuel and the utilization of MOX fuel are expected to produce more α-emitting nuclides than usual fuel. The (α,n) reaction data will be used for such analyses.

P13

Status of KAERI/NDEL, 2004-2005

Young-Ouk LEE (yolee@kaeri.re.kr)
Korea Atomic Energy Research Institute

Nuclear Data Evaluation Laboratory of Korea Atomic Energy Research Institute (KAERI/ NDEL) has 9 Staffs and 1 Secretary. (Evaluation 5, Processing and Benchmark 4)

The main project is "Establishment of Nuclear Data for Future Nuclear R&D" funded by government as a long term nuclear energy development program. KAERI/NDEL is performing nuclear data evaluation, multi-group library processing, and validation. For measurement of nuclear reaction data, KAERI/NDEL is contacting with Pohang Accelerator Laboratory and Van de Graff laboratory of Korea Institute of Geology and Mineral.

In January 2005, Young-Ouk LEE has become the head of KAERI/NDEL after Jonghwa CHANG, who moved to the Nuclear Hydrogen Project of KAERI.

1. Facility

1.1. Pohang Accelerator Laboratory

Major upgrade plan of The Pohang TOF has initiated which includes extension of Fight length to 20m and improvement of electric gun and pulsing system.

1.2 Korea Institute of Geology and Mineral

The 1.4 MV Van de Graaf of KIGAM is equipped with a pulsing and bunching system to measure neutron capture cross section at 1 – 2 MeV range.

2. Measurement

Neutron total cross sections of natural Mo, Cd and Bi were measured in the energy range 0.01 - 100 eV at Pohang TOF. Photo-neutron production cross sections and isomeric cross section ratio were measured by gamma activation analysis at Pohang facility.

Neutron capture cross sections of ^{155,156,157,158,160}Gd were measured in the energy range 10 –100 keV, and 550 keV at Pelletron accelerator of Tokyo Institute of Technology, Japan.

3. Evaluation

3.1. Resonance Parameter Analysis

The resolved resonance parameters, unresolved parameters, and the bound level parameters for ^{232}Th, ^{107}Pd, ^{166}Er are evaluated using the weight average method, the Porter-Thomas distribution and the Bayesian approach, based on the Mughabghab compilation of 1981 and many recent measurements.

3.2. Cross-section Evaluation

Neutron cross sections of ^{95}Mo, ^{101}Ru, ^{103}Rh, ^{105}Pd, ^{109}Ag, ^{131}Xe, ^{133}Cs, ^{141}Pr, ^{143,145}Nd, ^{147,149,150,151,152}Sm, ^{160,161,162,163,164}Dy are evaluated in the frame work of ENDF/B-VII in cooperation with BNL. Evaluation of actinides such as ^{232}Th, ^{231}Pa, ^{233}Pa, ^{233}U, ^{234}U, ^{236}U are ongoing using measured data and EMPIRE-II up to 20 MeV.

4. Services

The nuclear data web server http://atom.kaeri.re.kr/ is continuing service for the internet community.

Working Papers

WP 2005-1 Conclusions and Actions of the 2004 NRDC Meeting

WP 2005-2 Software for input, processing and recording factographic data

WP 2005-3 CINDA 2001 Manual, revised draft by H. Henriksson (May 2005)

WP 2005-4 Proposal for an EXFOR Editor (CP-C/361)

WP 2005-5 Easier comparison evaluated /experimental data, tabulated format (CP-C/362)

WP 2005-6 Proposition for a new field in the EXFOR format for "trusted data" (CP-C/363)

WP 2005-7 Publication based on experimental data from the EXFOR database (CP-C/364)

WP 2005-8 EXFOR compilation and transmission statistics

WP 2005-9 Review of Compilation Scope

WP 2005-10 Review of Compilation Responsibilities

WP 2005-11 Quantity vs. Quality in EXFOR Compilation

WP 2005-12 Dictionary Transmission 9089 and Related Modifications

WP 2005-13 New common EXFOR master file

WP 2005-14 Central storage of EXFOR source papers (CP-D/426)

WP 2005-15 Problematic entries - Requested corrections

WP 2005-16 Procedure of loading the new CINDA database at IAEA-NDS (CP-D/442)

WP 2005-17 CINDA conversion details, area 2 (CP-N/35)

WP 2005-18 Plot possibilities with JANIS (CP-N/36)

WP 2005-19 CINDA book production (CP-N/37)

WP 2005-20 IAEA-NDS EXFOR Web-retrieval statistics

WP 2005-21 Concept of Projects in CINDA (CP-D/443) ***(Annex 1, p. 79)***

WP 2005-22 CINDA editor

WP 2005-23 How to plot together exp.and eval.data using the NDS-NNDC web interface

WP 2005-24 Quality and consistency of digitized data

WP 2005-25 Separate Covariance Files in EXFOR (CP-D/421) ***(Annex 2, p. 81)***

WP 2005-26 Multiple reaction formalism (CP-E/074)

WP 2005-27 Proposed new data headings and units (CP-E/076)

WP 2005-28 Proposals and clarifications for fission data (CP-E/079)

WP 2005-29 Energy spectrum as fct.of sum of kinet.energies of several particles

WP 2005-30 Coverage of major journals ***(see p.27)***

WP 2005-31 Compilation of new publications ***(see p. 28)***

(continued next page)

WP 2005-32 Dictionaries, CHEX and related software in IAEA-NDS

WP 2005-33 Meeting EXFOR-CINDA (26-28 April 2005), Summary (CP-D/433)

WP 2005-34 CINDA Manual as revised at the meeting (CP-N/40) ***(Annex 3, p. 85)***

Note: All working papers are available from the NDS web site under http://www-nds.iaea.org/nrdc-int/2005nrdc/wps.html

Concept of Projects in CINDA

V.Zerkin, IAEA-NDS

Information in CINDA is presented by Lines which are united in Blocks. Blocks are defined as unique combination of (Target, Reaction, Quantity, Lab, BlockNo). One of the major parameter in the Line (and important for us now) is Reference. BlockNo is assigned by a Compiler when s/he wants to separate a works which done in the same Lab but for some reasons have to be presented separately. (The reason can be: another equipment, purpose of experiment, method of obtaining results, time, etc.) This structure can be presented as nested information (see Present schema).

The same Reference can appear in several Blocks, this means that the work behind all these Blocks was done by (almost) the same authors, most likely using the same methodology and has other similarity. So, the number of Blocks have something common in background (at least from the view point of Compiler which united publications into each Block), but being stored in the present structure they are not related to each other and do not have a visible connection. As result, the CINDA compilation is a complex thing: the observation of the data in database is difficult, assignment of the BlockNo is a magic, Comments are often repeated, and whole process is not conceptually clear and difficult for understanding, especially by a new compiler.

Lets look to the matter from another direction. Usually, a group of authors is doing the work under a PROJECT (it can be a project in one Lab or in inter-Lab project) with some background, purpose, equipment, method, etc. They publish results in several places (Lab-reports, conferences, journals, books, etc.), which can have various data for several reactions. (In some sense, PROJECT is similar to ENTRY in EXFOR.) Obviously, if we introduce an essence <Project> and restructure our schema we can have some advantages:

1. Easier to observe information in CINDA: Blocks (=Reaction-codes) are grouped under Publication (Reference);
2. Easier to deal with blocking (to define whether or not a publication should go to a new Project)
3. Usage of XML: viewers (Internet Explorer: see Fig.3), editors, no limits, “industrial standard”, etc.

At present CINDA Projects can be “calculated” on top of existing CINDA relational database. Software is written. For now, features working with Projects are (and will probably be) included to the CD-ROM “EXFOR-CINDA for Windows” with MS-Access database and retrieval system.

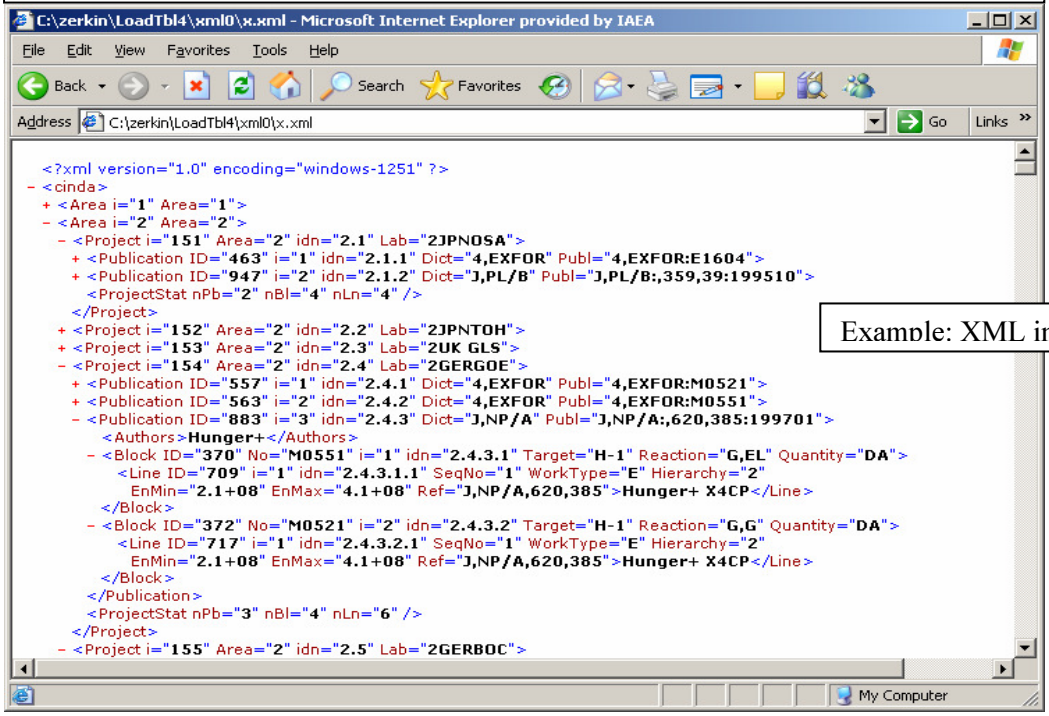
The Project concept with connection to XML format and related software, compilation process, retrieval and presentation is under development at NDS.

```
CINDA
{
        Block-1: (Target, Reaction, Quantity, Lab, BlockNo)
        {
                Line-1: Line-1-info, Reference-1;
                Line-2: Line-2-info, Reference-2;
                . . . . . .
                Line-n: Line-n-info, Reference-n
        }
        Block-2: (Target, Reaction, Quantity, Lab, BlockNo)
        . . . . . .
        Block-m: (Target, Reaction, Quantity, Lab, BlockNo)
}
```

Present schema

```
CINDA
{
        Project-1: (Lab, Area, ProjectNo)
        {
                Reference-1 (Code)
                {
                        Block-1: (Target, Reaction, Quantity)
                        {
                                Line-1: Line-1-info;
                                Line-2: Line-2-info;
                                . . . . . .
                                Line-n: Line-n-info;
                        }
                        Block-2: (Target, Reaction, Quantity)
                        . . . . . .
                        Block-m: (Target, Reaction, Quantity)
                }
                Reference-2 (Code)
                . . . . . .
                Reference-k (Code)
        }
        Project-2: (Lab, Area, ProjectNo)
        . . . . . .
        Project-t: (Lab, Area, ProjectNo)
}
```

Proposed schema



Example: XML in IE

Annex 2

WP 2005-25

Nuclear Data Section
International Atomic Energy Agency
P.O.Box 100, A-1400 Vienna, Austria

Memo CP-D/421

Date: 9 March 2005
To: Distribution
From: O. Schwerer

Subject: **Separate Covariance Files in EXFOR**

As discussed at the last NRDC meeting (see Action A24), I submit a proposal on the storage of covariance information for EXFOR data in ENDF-6 File 33 format. The idea is that, in cases where the authors present their covariance information in the internationally agreed File 33 format, it is not meaningful to convert the data into another, not so well known format.

The general format of separately stored covariance data is described in the EXFOR Formats Manual, Appendix B. (This is not a strictly defined data format but gives the possibility to define the actual format of the table in the comment records.)

The purpose of the present proposal is to extend the "Appendix B" option by including File 33 formatted data with proper cross-reference to the related EXFOR subentry, while keeping the existing option of a user-defined table format.

For the File 33 option, I think it is meaningful to allow also the inclusion of the actual cross section data in File 3 format, for easy processing. Please give your feedback also on this option (or should it even be obligatory?)

Appended is my draft of a revised "Appendix B", including examples of both the free format (taken from LEXFOR) and a new example for File 3+33 formatted data.

(Revised Appendix B of EXFOR Formats Manual)

COVARIANCE DATA FILE FORMAT

Covariance data may be stored on a separate covariance file. This is mandatory if

a) the file is too big to be included conveniently as free text within the EXFOR entry (under the keyword COVARIANCE); and/or
b) the file is in a format which does not fit within columns 12 - 66 available for free text (e.g. ENDF-6 File 33 format).

The covariance file is named

aaaaasss.cov

with *aaaaa* being the accesssion number, *sss* the subentry number of the corresponding subentry (e.g. 35001002.cov).

There are three record types in the covariance file:
- comment records,
- data records,
- end records.

The actual covariance data can be given either in a free format, defined in the comment records, or in ENDF-6 File 33 format. In the latter case, the cross section may be included also (in File 3 format) for easy processing.

Comment record format

Column	1	C
	2 – 9	Data set number (subaccession number)
	10	(blank)
	11 - 80	Comment which includes covariance type and format

Data record format

a) Free format:

Column	1	D
	2 - 9	Data set number (subaccession number)
	10	(blank)
	11 - 80	Data in format given on comment record

b) ENDF 6 File 3/33 format:

First record:

Column	1	F
	2 - 9	Data set number (subaccession number)
	10	(blank)
	11 - 14	MAT number used
	15	(blank)
	16 - 25	File numbers given, separated by commas (e.g. 3,33)
	26 - 80	Comment

Following records:

Column	1 - 80	As in ENDF-6

End record format

Column	1	E
	2 - 9	Data set number (subaccession number)
	10 - 80	(blank)

See also **LEXFOR, Covariance**.

Example 1: Covariance data in free format as defined in comment records

```
C10034002  Values given only for elements below diagonal of symmetric
C10034002  matrix on same energy grid as data format.
C10034002  FORMAT(9E5.2)
D10034002   1.0
D10034002   0.98  1.0
D10034002   0.90  0.97  1.0
D10034002   0.70  0.82  0.93  1.0
D10034002   0.54  0.68  0.83  0.96  1.0
D10034002   0.64  0.75  0.85  0.92  0.95  1.0
E10034002
```

Example 2: Cross section and Covariance data in ENDF-6 File 3/33 format

```
C35001002 Covariance file for subentry 35001002
C35001002  The file is in ENDF File 33 format, also cross section as File 3
F35001002 6210 3,33      Cross section and covariances in ENDF-6 format
 0.000000+0 0.000000+0          0          0          0          06210 0  0    0
 6.215100+4 1.496234+2          0          0          0          06210 3102    1
 8.256831+6 8.256831+6          0          0          1         316210 3102    2
         31          2                                           6210 3102    3
 0.110000+4 0.244474+2 0.135000+4 0.236065+2 0.162500+4 0.218757+26210 3102    4
 0.187500+4 0.196988+2 0.225000+4 0.153861+2 0.275000+4 0.153043+26210 3102    5
 0.350000+4 0.127367+2 0.450000+4 0.100073+2 0.625000+4 0.865960+16210 3102    6
 0.875000+4 0.656557+1 0.112500+5 0.501474+1 0.137500+5 0.457034+16210 3102    7
 0.175000+5 0.387133+1 0.225000+5 0.394818+1 0.275000+5 0.314252+16210 3102    8
 0.350000+5 0.258191+1 0.450000+5 0.232481+1 0.550000+5 0.184880+16210 3102    9
 0.700000+5 0.157094+1 0.900000+5 0.117749+1 0.110000+6 0.997426+06210 3102   10
 0.135000+6 0.992993+0 0.162500+6 0.757935+0 0.187500+6 0.734009+06210 3102   11
 0.225000+6 0.678500+0 0.275000+6 0.492988+0 0.350000+6 0.418481+06210 3102   12
 0.450000+6 0.372564+0 0.550000+6 0.284066+0 0.700000+6 0.247658+06210 3102   13
 0.900000+6 0.194466+0 0.000000+0 0.000000+0 0.000000+0 0.000000+06210 3102   14
 0.000000+0 0.000000+0          0          0          0          06210 0  0   15
 6.215100+4 1.496234+2          0          0          0          0621033102   16
 0.000000+0 0.000000+0          0          1          0          0621033102   17
 0.000000+0 0.000000+0          1          5        528          32621033102   18
 0.100000+4 0.120000+4 0.150000+4 0.175000+4 0.200000+4 0.250000+4621033102   19
 0.300000+4 0.400000+4 0.500000+4 0.750000+4 0.100000+5 0.125000+5621033102   20
 0.150000+5 0.200000+5 0.250000+5 0.300000+5 0.400000+5 0.500000+5621033102   21
 0.600000+5 0.800000+5 0.100000+6 0.120000+6 0.150000+6 0.175000+6621033102   22
 0.200000+6 0.250000+6 0.300000+6 0.400000+6 0.500000+6 0.600000+6621033102   23
 0.800000+6 0.100000+7 0.000000+0 0.000000+0 0.000000+0 0.000000+0621033102   24
……..
……
 0.300769-2 0.190133-2 0.194659-2 0.199179-2 0.196701-2 0.199724-2621033102  103
 0.208640-2 0.362495-2 0.197938-2 0.202161-2 0.201359-2 0.205954-2621033102  104
 0.216937-2 0.302796-2 0.208438-2 0.207471-2 0.212723-2 0.225324-2621033102  105
 0.345695-2 0.212488-2 0.218017-2 0.231748-2 0.376135-2 0.218460-2621033102  106
 0.232702-2 0.326855-2 0.242255-2 0.444583-2                                 107
 0.000000+0 0.000000+0          0          0          0          06210 0  0  108
E 35001002
```

CINDA2001

MANUAL

Prepared by Victoria McLane
National Nuclear Data Center

Preliminary Version
June 2000

Updated by Mark A. Kellett, January 2004
based on June 2003 NRDC meeting decisions.

Revision 3, December 2004
to correct HIERARCHY and REFERENCE codes.

Revision 4, May 2005
changes in the CINDA format hierarchy code, and corrections given in Vienna, 2005.

Revision 5, November 2005
Modifications in the format agreed on
the NRDC meeting, Vienna, 2005.

CINDA Bibliographic System

HISTORY

CINDA2001 was designed to replace the CINDA database which was originally designed in 1958[1] as a Card Index to Neutron Data. CINDA was adopted in the 1970's by the four Neutron Data Centers as an international index to the neutron data; the compilation scheme remained essentially unchanged until 1998.

In the meantime, the Nuclear Reaction Data Network had evolved from the original four centers to a group of thirteen centers involved in the compilation of nuclear reaction data for incident charged particles and photons, in addition to neutrons. The need for an index that would allow the inclusion of all reaction data, and the need to update the format for the year 2000 lead to a complete redesign of the bibliographic system.

The new system is more compatible with EXFOR/CSISRS[2], and has adopted many of the same the codes used in this database, thereby eliminating the need for users of nuclear reaction data to learn different sets of notation when accessing the bibliographic and data files.

INTRODUCTION

CINDA2001 is a computerized bibliographic file containing references to information on nuclear reactions. Included are references to measurements, calculations, evaluations, and reviews of nuclear reaction and other related data. In the case of experimental or evaluated data, references to the databases where the actual values may be obtained are also included.

Identical copies of this database are maintained by the four core centers in the Nuclear Data Center Network.[3] These master files are updated periodically and exchanged among the centers. Retrievals from CINDA2001, as well as the experimental and evaluated databases, are available through the Internet using World Wide Web or by direct access using TCP/IP's TELNET command.[4]

[1] CINDA was designed by Herbert Goldstein, a professor in the Department Of Applied Physics and Engineering at Columbia University, see Nuclear Development Corporation of America report NDA 2-80 (1958).

[2] For a description, see the "EXFOR exchange Formats Manual", V. McLane, IAEA-NDS-207 (2004)

[3] These core centers are: the US National Nuclear Data Center, the NEA Data Bank, the IAEA Nuclear Data Section, and the Russian Nuclear Data Center at Obninsk. See Appendix A for complete information on the Nuclear Reaction Data Centers.

[4] See Appendix A for access to your nearest data center.

The information in the CINDA2001 Database is obtained from scanning the available literature, both published and unpublished. Coverage is "complete" for neutron data from 1935 to the present. Coverage for charged-particle data is nearly complete from 1980 to the present, and less complete before 1980. Coverage for photon-induced data is taken from Photonuclear Data[5] which covers the period 1976 to the present.

This manual is intended to be a complete guide to the indexing of information in the CINDA2001 system.

CINDA2001 EXCHANGE FORMAT

The CINDA2001 exchange file consists of a series of records plus a header record, which gives information about the attached file. The format of the header record is:

Columns	Content	Use
1-5	ID	CINDA
6	*(blank)*	
7-15	Type of file	READER or EXCHANGE; left-adjusted
16-22	Exchange number	Area code, number of exchange for area; right-adjusted.
23-33	Date of exchange	8-digit right-adjusted integer: year, month, day (YYYYMMDD)
34-44	Number of records on file	Right-adjusted integer

Files transmitted will be either exchange files or reader files. The format of these files is the same, but the content will differ slightly; the differences are noted under the sections on the appropriate fields.

Exchange files consist of records produced for transmitting entries from a center's own area of responsibility.

Reader files contain records produced by the transmitting center for an area outside its responsibility and transmitted to the responsible center for addition to its database. After the update of its database, the records will be transmitted by the responsible center to all other centers.

Empty lines may be inserted in both types of CINDA files, as well as comment lines for the compiler or for the loading of the CINDA data base. The comment lines should start with the symbol '#'.

[5] V. V. Varlamov, V. V. Sapuchenko, M. E. Stepanov, **Photonuclear Data 1976-1995**, Photonuclear Experimental Data Center, Moscow University (1996).

The fields given in the CINDA2001 exchange format are as follows.

Columns	Contents	Formats	Example
1	Operation code	A1	As in CINDA
2-8	Z,A	I3,I3*, A1	Target Z, A, isomeric state: (ZZZAAAM)
9-23	Reaction	A15	Generally, EXFOR REACTION SF2-SF3
24-27	Quantity	A4	From DANIEL Dictionary 13.
28-34	Laboratory	A7	EXFOR code with area code
35-39	Block #	A1,I4	Area code, followed by center assigned block #
40-43	Sequence #	I4	Sequence within block
44	Hierarchy code	I1	Hierarchy for references (0-6)
45	Work type	A1	As in CINDA[6]
46-47	Reader code	A2	At discretion of center (blanks allowed)[7]
48-61	Energy range	2(E7.1)*	Min + max in format: `+n.n+ee`
62-90	Reference and date	A23,I6	Type: as in CINDA (A1), Reference code: as in EXFOR (A22), Date: year and month (YYYYMM)
91-128	Comment	A38	As in CINDA
129-136	Modification date	I8	Date of compilation/loading: year/month/day (YYYYMMDD)
137-139	Old CINDA quantity	A3	(Not compulsory) Quantity code as stated in the old CINDA format
140-395	Lab or product code	String	Possibility to add multiple labs or products, e.g. `;LAB=2ZZZGEL,1USABNL;PROD=12-C-14`

* The fields for Atomic mass, A, and Energy range can contain character codes, see below.

Updates to the formats must be agreed upon by the four core centers.
Any codes to be used in CINDA2001 are included in dictionaries contained in the DANIEL dictionary database. Updates to the dictionaries must be submitted before any code not given in these dictionaries may be used on a CINDA2001 exchange file.
Details for the coding and content of each of the above fields are given on the following pages.

[6] With the exception that the mixed mode codes will be eliminated. For example, entries for theoretical calculations will be separated from experimental data.

[7] That is, centers may choose not to use a reader code.

OPERATION CODE (Column 1)

The operation code is a signal to the database update code as to what operation must be performed. The following list contains the legal operation code and their use.

Code	Meaning	Exchange Use	Reader Use
A	Add record	Block number and sequence number must be specified	Block number may be specified; sequence number must be blank.
D	Delete record	Block number and sequence number must be specified	Block number and sequence number must be specified.
M	Modify record	Block number and sequence number must be specified	Block number and sequence number must be specified

The remainder of the record must be complete for both reader and exchange format.

TARGET NUCLEUS (Columns 2-8)

The target nucleus is given as 2 three-digit integers (Z and A), both right-adjusted in their field, plus an isomeric state code. All legal Z, A codes are found in DANIEL Dictionary 227. The isomeric state code is blank for a nucleus in the ground state, and consists of the metastable state number for metastable states (e.g. 1, 2… and not M as stated in the dictionary).

For compound nucleus properties, *e.g.*, resonance parameters, the nucleus entered is the target for the reaction(s) analyzed.

For a theoretical work giving systematic trends over many nuclei, the code MNY may be used in the A field; use Z equal to zero. The code MNY may be used either in place of, or in addition to, separate entries for the individual nuclei.

Naturally occurring elements

For naturally occurring elements that contain a mixture of isotopes, a zero is entered in the A-number field. For monoisotopic elements, the Z and A of the isotope are given. For nearly monisotopic elements, *i.e.*, for elements where the principal isotope is more than 99% of the natural isotopic mixture, the Z,A of that isotope may be given if the contribution from other isotopes to the reaction given is negligible.

Compounds and Mixtures

For compounds and mixtures, a 3-character compound code is given instead of the A number and is left adjusted in the field. Single element compounds, *e.g.*, molecular hydrogen, should not be coded as compounds. If information is deduced for a constituent element of a compound or mixture, it should be entered under that element.

The general code zzzCMP, where zzz is the major component of the compound, may be used if the compound is not given specifically in the dictionary. The name of the compound should be given in the comment. If more than one element may be considered a major component, choose the element with the highest Z number.

For data given for mixed fission products, *i.e.*, an aggregate of those fission products produced in a given fission reaction, the code FPR is given in place of the A value; use Z equal to zero.

REACTION (Columns 9-23)

The code for reaction is given as two fields: incident and outgoing. For complete evaluations covering many reactions, and given over a defined energy range, this field may be left blank.

The incident field contains one of the following:

1. A particle code from DANIEL Dictionary 33 which contains a non-blank character in the third position of the Allowed Subfield field, *e.g.*, P or HE3.

2. A chemical symbol and A-number (SS-AAAM) from DANIEL Dictionary 227; for a nucleus in a metastable state the code is followed by an M, *e.g.*, CL- 35 or AM-242M.

The outgoing field contains one of the following.

1. A particle code from DANIEL Dictionary 33 which contains a non-blank character in the fourth position of the Allowed Subfield field, *e.g.*, P or HE3.

2. A nuclide code, *i.e.*, chemical symbol and A-number (SS-AAA) taken from DANIEL Dictionary 227; for a nuclide in the metastable state the code is followed by the code M, *e.g.*, CL- 35 or AM-242M;

3. A process code taken from DANIEL Dictionary 30, *e.g.*, TOT or EL;

4. A combination of the above with the codes separated by a "+".
   The order of codes is: particles ordered from lightest to heaviest,[8] followed by nuclide codes ordered from lightest to heaviest, followed by process codes in alphabetical order. The exception to this rule is: when the order in which the reaction proceeds is given explicitly, the codes are given in that order.

[8] Lightest to heaviest is defined as in order of lightest Z, then in order of A.

5. For complex reactions with many outgoing particles, the code CMPLX may be used in this field in place of all other codes.

QUANTITY (Columns 24-27)

The legal quantity codes are given in DANIEL Dictionary 45 (partly from the old dictionary 13). These codes are listed in Appendix D. For complete evaluations, covering many reactions and quantities, this field contains the code EVL. A Quantity code with a '$' sign in front means that the code was inserted automatically by converting EXFOR entries to CINDA, but without correspondence in Dictionary 236 and/or in dictionary 45.

INSTITUTE (Columns 28-34)

The institute is given as a single integer for the area code followed by the six-character code consisting of a country code followed by an institute code. These codes are found in DANIEL Dictionary 3, CINDA Code field.

If more than one institute is involved in the work, the main institute is given. The main institute is defined as the institute at which the principal investigator resides, or the institute at which the work was done. Links to the other institutes are given on Institute Cross Reference Records (work type 9, see Work Type). An entry is made for each institute containing at least one reference.

BLOCK NUMBER (Columns 35-39)

The block number consists of the area code for the responsible center, followed by a four digit block number, *e.g.*, L1982. The area codes to be used are those assigned for EXFOR, e.g. area 1 is USA and Canada, area 2 is OECD member countries (excluding USA and Canada) etc. No area code is allowed (e.g. for old CINDA records, where block number was already assigned).

The block number is assigned only by the center responsible for the entry. Before blocking CINDA lines together, compilers must be fully certain that the lines do belong with each other. The blocks are based on the same isotope (Z, A, and state), reaction, lab and experiment, based on for example the same people involved in the presented work in the articles during a limited time period.

SEQUENCE NUMBER (Columns 40-43)

The Sequence Number is a 4-digit, right-adjusted integer denoting the sequence within a block. It is assigned ***only*** by the center responsible for the entry.

HIERARCHY CODE (Column 44)

The one-digit Hierarchy code is used to distinguish between different types of records, or to denote the importance of a reference. Valid hierarchy codes are defined in the following table.

Code	Use
1	Main publication. Assigned only to a publication known to be the definitive publication.
2	Published reference (journal or conference proceeding).
3	Other major reference, such as, complete laboratory report or a thesis.
4	Translation for reference with hierarchy 1-3.
5	Minor reference, such as, a progress report, a meeting abstract, or a private communication.
6	EXFOR or Evaluated Data index entry. A reference to an entry in a data library which gives the numerical data referenced in the block.
0	EXFOR data index line where accession number is not yet assigned, i.e. EXFOR compilation of the work is still in progress.

1. Hierarchy codes `0` and/or `6` for EXFOR data:
   Column 43 `0` or `6`
   Columns 60-66 `4,EXFOR`
   Columns 67-71 EXFOR Accession number (e.g. `11754`)
   or `00000`, if unassigned, when hierarchy code = 0
   Column 72 full stop (.)
   Column 73-75 EXFOR Sub-accession number, e.g. `002`, `045`, *etc.*
   or `000`, if unassigned, when hierarchy code = 0

WORK TYPE (Column 45)

The one-character Work Type code gives the type of work referenced, *e.g.*, experimental, evaluated. For a reference containing more than one type of work, a separate block should be entered for each type, for example, an experimental work in which extensive[9] model calculations were done.

READER CODE (Column 46-47)

A two-character Reader Code may be used, at the discretion of the entering center, to identify the compiler of the entry. This field may be left blank. A list of current and formerly used Reader Codes is given in Appendix B.

ENERGY RANGE (Columns 48-61)

[9] By extensive is meant that each work is extensive enough to warrant publication on its own. For example, a comparison of measured angular distributions with optical model calculations is not regarded as fulfilling this criterion. This comparison should be noted in the comment for the experimental data.

The energy range field consists of two floating-point numbers (2E7.1) which give the minimum and maximum energies for the data referenced. If the data is presented only at one energy, it is given in the first field; the second field is blank. If an upper limit only is known, it is given in the second field; the first field is blank.

If only the approximate range is known, only the exponents are entered.

A four-character code is used to define the energy for spectrum-averaged values. A list of all legal codes is given in Dictionary 48, e.g. MAXW, SPON, THR (see also old CINDA Readers manual, Part II.9). If the reference covers two or more distinct energy ranges that may be viewed as separate experiments or calculations, separate entries should be made. *Example*: a measurement at thermal energy of Maxwellian-averaged cross section and a separate measurement over the energy range 5 eV to 6 keV.

If no information on the energy is given, the code NDG (no data given) is used.

For quantities for which an incident energy is meaningless, *i.e.*, nuclear quantities, spontaneous fission and so on, both fields are left blank.

REFERENCE (Columns 62-90)

The reference consists of three fields: reference type, reference code, and reference date. The format of the reference field depends on the reference type.

Reference Type (Column 62)

The Reference Type consists of a one-character code which is:
either taken from DANIEL Dictionary 4,
or 4 for EXFOR data,
or 3 for Evaluated data libraries.

If Reference Type and Reference Code are present, column 61 should contain a comma (,).

Reference Code (Columns 64-84)

In general, references are coded as for EXFOR and use the same dictionaries and codes. See the EXFOR Manual for coding rules, and Dictionaries 5-7, 207 for document codes.

1. Reference Code for EXFOR data:
   columns 64-68 EXFOR
   columns 69-73 EXFOR Accession number (e.g. 11754)
   or 00000, if unassigned, when hierarchy code = 0
   column 74 full stop (.)
   column 75-77 EXFOR Sub-accession number
   or 000, if unassigned, when hierarchy code = 0

e.g. `4,EXFOR12345.123` (for hierarchy code = `6`) or `4,EXFOR00000.000` (for hierarchy code = `0`).

2. Reference Code for Evaluated data libraries:
   columns 64-69 evaluated file name (see DANIEL Dictionary 44)
   columns 70-84 version number, data set or material number,

   e.g. `3,JENDL-3.2 4725` where in this example `4725` is the material number of the coded target `47-AG-107`.

Reference Date (Columns 85-90)

The reference date is given as a 6-digit integer: 4-digit year, 2 digit month (YYYYMM). If the month is not known, it may be omitted. (Note that for conference proceedings the date of the conference is entered and not the date of issue of the proceedings.)

COMMENTS (Columns 91-128)

Comments for reference records should start with the first author's last name, terminated with a full stop (.) for a single author or a plus sign (+) for multiple authors. If no author is known, column 87 should contain a full stop.

The author's name is followed by additional, abbreviated information about the work.

The comment should contain information on whether and how the data is presented in the reference as in the previous CINDA.

Examples: NDG (no data given)
GRPH (graphs)
TBL (table)

For allowable character set and translation of Cyrillic characters, see EXFOR Manual, Chapter 1.

Comments for the data index lines should contain:
for EXFOR, the number of data lines, and type of data;
for evaluations, the evaluator.

MODIFICATION DATE (Columns 129-136)

The modification date is assigned by the compiler as the date of compilation. This may be updated by the compiling center as the date at which the entry is entered into the database. The modification date is given as an 8-digit integer: 4-digit year, 2 digit month, 2 digit day (YYYYMMDD).

Old CINDA quantity (Columns 137-139)

The quantity used in the old CINDA format can be stated here. This may be used to search for old CINDA lines where the new reaction string is missing.

The quantity is given as 3 characters (QQQ).

Additional information (Columns 140-395 (255 characters as max length))

This space is reserved for multiple labs and products.
Possibility to add multiple labs or products, e.g.

```
;LAB=2ZZZGEL,1USABNL;PROD=12-C-13/14,27-CO-55/56
```

Additional keywords for other information can be added after approval of NRDC.

Appendix A

Nuclear Reaction Data Centers

This appendix contains a list of the members of the Nuclear Data Center Network, along with information on how to contact them. Also list are the entry series for which each of the data centers is responsible.

Principal Centers and their services areas.[10]

United States and Canada	
National Nuclear Data Center, Bldg. 197D Brookhaven National Laboratory Upton, NY, 11973-5000 U.S.A.	Center codes: 1, C, L, P, T Telephone: +1 631-344-2902 Fax: +1 631-344-2806 Email: nndc@bnl.gov or nndc*nn*@bnl.gov[11] www.nndc.bnl.gov
O. E. C. D. Nuclear Energy Agency Member Countries	
NEA Data Bank 12, boulevard des Iles 92130 Issy-les-Moulineaux, FRANCE	Center codes: 2, O Telephone: +33 (1) 4524 1084 Fax: +33 (1) 4524 1128 Email:nea@nea.fr or *name*@nea.fr www.nea.fr
Countries of the former Soviet Union	
Federal Research Center IPPE Centr Yadernykh Dannykh Ploschad Bondarenko 249 020 Obninsk, Kaluga Region, RUSSIA	Center codes: 4, Q Telephone: +7 084-399-8982 Fax: +7 095-883-3112 Email: *name*@ippe.obninsk.ru rndc.ippe.obninsk.ru
Remaining countries	
IAEA Nuclear Data Section Wagramerstr. 5, P.O.Box 100 A-1400 Vienna, AUSTRIA	Center codes: 3, D, G, V. Telephone: +43 (1) 2360 1709 Fax: +43 (1) 234 564 Email: *name*@iaeand.iaea.or.at www-nds.iaea.or.at

10 The four principal centers are responsible for maintaining customer services for the area given.
11 *nn* = first and last initial of person to be contacted, *e.g.*, NNDCCD@BNL.GOV.

Other participating centers.

National Scientific Research Center Kurchatov Institute Russia Nuclear Center 46 Ulitsa Kurchatova 123 182 Moscow, RUSSIA	Center codes: A, B Email: Chukreev@cajad.kiae.su Feliks@polyn.kiae.su
Institute of Nuclear Physics Moskovskiy Gos. Universitet Vorob'evy Gory 119 899 Moscow, RUSSIA	Center code: M Email: varlamov@cdfe.npi.msu.su
China Nuclear Data Center China Institute of Atomic Energy P.O. BOX 275 (41) Beijing 102413, CHINA	Center code: S Email: cndc@mipsa.ciae.ac.cn
Japan Charged Particle Nuclear Reaction Data Group Division of Physics Hokkaido University Kita-10 Nisha-8, Kita-ku Sapporo 060-0810, JAPAN	Center code: E, R Email: kato@nucl.sci.hokudai.ac.jp www.jcprg.org
Dr. F. T. Tárkányi Cyclotron Application Department ATOMKI, Institute of Nuclear Research Bem Tér 18/c, P. O. Box 51 H-4001 Debrecen, HUNGARY	Contributes data under center code D Email: tarkanyi@atomki.hu
Russian Federal Center - VNIIEF Sarov, Nizhni Novgorod Region 607 190 pr. Mira 37, RUSSIA	Center code: F Email: dunaeva@expd.vniief.ru

Appendix B

CINDA Reader Codes

Code	Reader	Country
0	IAEA Nuclear Data Section: corrections	
2	NEA Data Bank	
3	I.L. Nitteberg	Norway
4	A. Ventura	Italy
5	H. Bruneder	Austria
6	F. Hijerup	Denmark
7	NEA Data Bank	
8	NEA Data Bank	
9	E. Ramstrom	Sweden
B	F. Poortmans	Belgium
E	C. Bastian	Euratom
F	F. Wasastjerna	Finland
L	F. Manero	Spain
N	T. Nakagawa (JAERI, Tokai), T. Fukahori (JAERI, Tokai), S. Chiba (JAERI, Tokai), O. Iwamoto (JAERI, Tokai), H. Kitazawa (National Defense Academy, Tokyo), M. Kawai (KEK,Tsukuba), T. Ohsaki (Tokyo Institute of Technology, Tokyo)	Japan
O	Russian Nuclear Center, Obninsk	Russia
S	K. Junker	Switzerland
W	M.F. James J.S. Storey M. Moxon	United Kingdom
Y	J. Frèhaut	France
Z	H. Behrens	Germany
(	H.A.J. Van der Kamp	The Netherlands
+	National Nuclear Data Center	U.S.A.
$	IAEA Nuclear Data Section	
&	Other than NNDC	U.S.A.
?	NEA Data Bank: automatic or semi-automatic generation of entries	

Example of the CINDA2001 Exchange format

~BlockID (unique) | Reaction | Seq. # | Hierarchy | Work -type | Reader | E-min | E-max | Ref -type | Reference | Date-ref | Comment | Date-mod | Misc info: multiple labs, products...

```
 I3  I3A      A15       A3    A6     A5  I4   IA   A7     A7    A      A23         I6    A38                                 A8
1-.-.-.-.-10.-.-.-.-20.-.-.-.-30.-.-.-.-40.-.-.-.-50.-.-.-.-60.-.-.-.-70.-.-.-.-80.-.-.-.-90.-.-.-.100.-.-.-.110.-.-.-.120.-.-.-.130.-.-.-.140.-.-.-.150
123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.123456789.12
A  0  1 N,TOT          CS  1USAPTN17730   13EC  7.0+08 3.6+09J,PR/D,8,136         197307Devlin+ MOM = 0.7-3.6 GEV/C.          19900117TOT
A  0  1 N,TOT          CS  1USAPTN17730   26EC  7.0+08 3.6+094,EXFOR10365.005     198304.26 PTS. SIGMA.                       19900117TOT;LAB=1USABNL,1USALAS
A  0  1 N,TOT          CS  1USAPTN17730   36EC  7.0+08 3.6+094,EXFOR10365.004     198304.26 PTS. SIGMA. N-P + N-N.            19900117TOT;LAB=2FR ILL,2GERJUL,2GERKFK
A  0  1 N,TOT          CS  1USALRL17000   15T+         6.0+07R,DOE-NDC-47,86      198804Brown+ NDG.                           19900117TOT
A  0  1 N,EL           DA  1USAUI 17000   13T+  5.0+07 2.0+08J,PR/C,36,2221       198712Schiavilla+ GRPHS.CORREL.BORN APPROX  19900117DEL
A  0  1 N,EL           DA  1USALRL17000   15T+         6.0+07R,DOE-NDC-47,86      198804Brown+ NDG.                           19900117DEL
A  1  1 N,X            EVL 1USAYAL10010   13D8         1.0+07J,ARN,2,365          195300Breit+SCATT LENGTH- SEE PAGE 384      19900117EVL
A  1  1 N,X            EVL 1USAUNC10010   13DC  2.5-02 1.0+07R,NDA-57-27          195609Monroe+.TOT,ABS.TABLE+CURVE           19900117EVL
A  1  1 N,X            EVL 1USAGEN10010   13D8  3.2-02 1.0+07R,APEX-467           195806Tralli+.18GROUPS ABS                  19900117EVL
A  1  1 N,X            EVL 1USAGEN10020   13D8 Maxw          R,APEX-467           195806Tralli+.ONLY 2.23 MEV LINE FOR SNG    19900117EVL
A  1  1 N,X            EVL 1USAPCT11500   13D+  2.5-02 1.4+07R,NP-8216            195810Lamarsh+ ALL DATA                     19900117EVL
A  1  1 N,X            EVL 1USAUNC10020   13D8  4.1-02 1.8+07R,TID-21294          196303Goldstein.TOT SEL                     19900117EVL
A  1  1 N,X            EVL 1USAAI 10030   13DC  1.0-03 1.0+07R,NAA-SR-M-8904      196308Alter+.TOT SCT NG                     19900117EVL
A  1  1 N,X            EVL 1USAAI 10030   23DC  1.0+04 1.4+07R,NAA-SR-TDR-,6545   196106Alter.TABULATED TOT,SEL,SIN           19900117EVL
A  1  1 N,X            EVL 1USAAI 10030   33DC  1.0+00 1.0+07R,NAA-SR-TDR-,5861   196011Alter.TABULATED TOT,SEL,SIN.MTECARLO  19900117EVL
A  1  1 N,TOT          CS  1USACOL10010   13E2 Maxw          J,PR,48,265          193508Dunning+ IONCH,TRANS,SIG SLOW+FAST N  19900117TOT
A  1  1 N,TOT          CS  1USACOL10010   26EC Maxw          4,EXFOR12634.002     198403.1 PT. SIGMA.                         19900117TOT
A  1  1 N,TOT          CS  1USAPTN10010   12E2  2.4+06       J,PR,52,911          193711Ladenburg+ TRANSMISSION, D-D NEUTS    19900117TOT
A  1  1 N,TOT          CS  1USAPTN10010   23EC  2.4+06       J,PR,52,1255         193712.FURTHER ANALYSIS                     19900117TOT
A  1  1 N,TOT          CS  1USAPTN10010   36E+  2.4+06       4,EXFOR13790.002     200208.1 PT. SIGMA.                         20020812TOT
A  1  1 N,TOT          CS  1USABRK10010   13E2 Maxw    2.5-02J,PR,55,339          193902Libby+ ORTHO+P-HYDROGEN, GAS TRANS    19900117TOT
A  1  1 N,TOT          CS  1USABRK10010   26E+  2.5-02       4,EXFOR13789.002     200208.1 PT. SIGMA.                         20020812TOT
##---Block from EXFOR=O0901 Z=15 A=CMP S= R=P,X Q=TT: Institute="2SF HLS" RS=15-P-CMP(P,X)0-NN-1,,TTY
A 15CMP P,X            TT  2SF HLSO0901   12Ex               J,NIM/B,28,199       198701Raisanen+                         X4A 20051017
A 15CMP P,X            TT  2SF HLSO0901   26Ex               4,EXFORO0901.076     200405.2pt       PR=NN-1                X4A 20051017
##---Block from EXFOR=22108 Z=73 A=181 S= R=N,P Q=CS: Institute="2ZZZGEL" RS=73-TA-181(N,P)72-HF-181,,SIG
A 73181 N,P            CS  2ZZZGEL22108   12Ex  1.3+07 2.0+07J,ARI,39,(5),407     198801Woelfle+                          X4A 20051017
A 73181 N,P            CS  2ZZZGEL22108   26Ex  1.3+07 2.0+074,EXFOR22108.006     198902.15pt      PR=Hf-181              X4A 20051017   ;PROD=72-HF-181
## New block:
A 99255 0,F            FY  3INDTRM34190   13R$ Spon          J,PRM,33,109         198907Prakash. GRPH:SCHEMATIC A-DIST,CFD    19900516NFY;PROD=23-V-66,24-CR-68/69/70
A 99255 N,0            RP  4CCPFEI44130   13TO  2.0+06 4.0+06J,YF,39,281          198402Kupriyanov+ SYSTEMATCS.TBL AVG WN/WF  19850319RES
A 99255 N,0            RP  4CCPFEI44130   24T$  2.0+06 4.0+06J,SNP,39,176         198402.ENGLISH OF YF 39 281                 19850319RES
```

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