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I N D C INTERNATIONAL NUCLEAR DATA COMMITTEE

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

National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY, USA

4 - 7 October 2004

Prepared by O. Schwerer and H. Henriksson[1]

IAEA Nuclear Data Section
Vienna, Austria

[1]NEA Data Bank, Issy-les-Moulineaux, France

January 2005

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Abstract

This report summarizes the IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres (biennial Data Centre Heads Meeting), held at the Brookhaven National Laboratory, Upton, NY, USA from 4 - 7 October 2004. The meeting was attended by 20 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, status reports of the participating data centres, and a revised technical protocol for the co-operation of the network.

January 2005

TABLE OF CONTENTS

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
JAERI	-	Nuclear Data Center of the Japan Atomic Energy Research Institute, 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, 17-19 June 2003	Technical	INDC(NDS)-446
Paris, 27-30 May 2002	Centre Heads + Tech. = 16th NRDC Meeting	INDC(NDS)-434
Vienna, 28-30 May 2001	Technical	INDC(NDS)-427
Obninsk, 15-19 May 2000	Centre Heads + Tech. = 15th NRDC Meeting	INDC(NDS)-418
Vienna, 18-20 May 1999	Technical	INDC(NDS)-407
Vienna, 11-15 May 1998	Centre Heads + Tech. = 14th NRDC Meeting	INDC(NDS)-383
Vienna, 26-28 May 1997	Technical	INDC(NDS)-374
Brookhaven, 3-7 June 1996	Center Heads + Tech. = 13th NRDC Meeting	INDC(NDS)-360
Vienna, 2-4 May 1995	Technical	INDC(NDS)-343
Paris, 25-27 April 1994	Center Heads + Tech. = 12th NRDC Meeting	INDC(NDS)-308
Vienna, 1-3 Sept 1992	Technical	INDC(NDS)-279
Obninsk, 7-11 Oct 1991	Center Heads + Tech. = 11th NRDC Meeting	INDC(NDS)-262
Vienna, 13-15 Nov 1990	Technical	Memo CP-D/210
Vienna, 2-4 Oct 1989	Centre Heads + Tech. = 10th NRDC Meeting	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, N.Y., 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	A specialized bibliography and data index on neutron nuclear data operated jointly by NNDC, NEA-DB, NDS and CJD
CJD	Russian Nuclear Data Center at F.E.I., Obninsk, Russia
CNDC	Chinese Nuclear Data Center, Beijing, China
CNPD	Center of Nuclear Physics Data at RFNC-VNIIEF, Sarov, Russia
CP...	Numbering code for memos exchanged among the NRDC
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, a bibliographic system
IRDF	The International Reactor Dosimetry File, maintained by the IAEA-NDS

ITER	International Thermonuclear Experimental Reactor
JAERI	Japan Atomic Energy Research Institute
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
JENDL-3	Japanese Evaluated Nuclear Data Library, version 3
KAERI	Korea Atomic Energy Research Institute
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, Paris, France
NEA-DB	NEA Data Bank, Paris, 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

2004 NRDC Meeting
NNDC, Brookhaven National Laboratory, 4 - 7 October 2004

AGENDA

1. General

1.1 Opening, Election of chairperson, adoption of the agenda
1.2 Brief Status Reports of Centres
1.3 Review of Network document and Protocol (INDC(NDS)-401 and ***WP2004-2***)
1.4 Review of general Actions from last meeting (A1-A10) (and, if relevant, general actions of 2002 meeting) ***WP2004-1***

2. CINDA and common CINDA/EXFOR dictionaries

2.1 Review of Actions (A11 - A25) ***WP2004-1***
2.2 Status of CINDA 2001 and new proposals
- 2.21 New dictionaries as proposed in CP/D-405 (***WP2004-3***)
- 2.22 Issues on conversion to CINDA 2001 (CP-N/28+CP-D/412 = ***WP2004-4***)
- 2.23 Proposed improvements and extensions (CP-D/413 + reply = ***WP2004-5***)
- 2.24 Clarifications on new CINDA Manual (Kellett / McLane) (***WP2004-6,7***)
- 2.25 Conversion schedule and future CINDA cooperation (Revision of old **WP 2003-26**)

2.3 Specific questions in CINDA compilation (e.g., production cross sections)
2.4 Future of CINDA book
2.5 New nuclides dictionary 227 (***WP2004-8)***
2.6 New compounds dictionary 209: -CMP and -OXI need not be included?

3. Manuals

3.1 EXFOR Manual: O. Schwerer's revision of 16 August (with 1 minor correction by V. McLane): see http://www-nds.iaea.org/reports/nds-207.pdf,
Word version: NDS open area, subdirectory TRANS.MANUALS
3.2 LEXFOR: V. McLane's Revision of September 2004
3.3 CINDA Manual: see item 2.24 above, but also M Kellett's revision of the old "CINDA Reader's Manual" (with old CINDA quantity definitions) of April 2003, see http://www-nds.iaea.org/nrdc-int/cinda_reader.pdf
3.4 EXFOR Basics
3.5 Citation Guidelines

4. EXFOR, general

4.1 Review of Actions (A26 - A39) ***WP2004-1***
4.2 Transmission and compilation statistics
O. Schwerer: File contents and transmission statistics 2003/2004 ***(WP2004-9)***
B. Pritychenko: Analysis of EXFOR Compilation Effort
4.3 Compilation scope, possible introduction of new CIC series (***WP 2004-10***)
4.4 Common master file and future distribution protocol (***WP 2004-11***)
4.5 Storing of large covariance files: where and how
4.6 Improving ways for renormalizing old data

5. EXFOR, technical

5.1 Review of Actions (A40 - A45) ***WP2004-1***
5.2 Wild cards for SF7 in Dict.36 (* and *F)
5.3 Quasi-metastable states (***WP 2004-12***)
5.4 Additional detector codes (***WP 2004-13*** **=** CP-D/403 + CP-E/042***)***
5.5 Differential data and angular correlations (***WP 2004-14)***
5.6 Effective mass correlation (***WP 2004-15*** **=** CP-E/52)
5.7 Astrophysical S-factor (***WP 2004-16*** **=** CP-E/50)
5.8 SIG,HF and SIG,LF (***WP 2004-17*** **=** CP-A/153 and CP-D/399, + separate Appendix)
5.9 TT as general modifier and revised LEXFOR on TTY (***WP 2004-18*** **=** CP-C/347)
5.10 Particle specification and long reaction strings (***WP 2004-19*** **=** CP-C/349)
5.11 Probability for emission of N particles (***WP 2004-20)***
5.12 Order of SF1, SF2 in REACTION code (***WP 2004-21)***

6. Software

6.1 Future maintenance of CHEX, ORDER, XTRACT etc.

7. Information on Migration Project

8. Special Presentations

8.1 Dave Winchell (NNDC): Compilation of NSR and XUNDL

9. Other business and/or Bilateral Discussions

10. Closing items

10.1 Review of Conclusions and Actions of the present meeting
10.2 Next meeting

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MEETING SUMMARY

Introduction

The IAEA Technical Meeting on the Co-ordination of the Network of Nuclear Reaction Data Centres (NRDC) was held at Brookhaven National Laboratory (BNL), Upton, NY, USA from 4 - 7 October 2004. Twenty participants representing eleven co-operating data centres from China, Hungary, Japan, Russia, Ukraine, USA, NEA and IAEA attended the meeting.

Technical meetings of this network are held annually, with full meetings (as this one), involving both centre heads and technical staff, every two years (last full meeting was held in May 2002 at NEA in Paris, France). Main topics of the present meeting included a revised NRDC Protocol, a new EXFOR/CINDA dictionary structure, a new definition of the EXFOR compilation scope, and the revised EXFOR Manual. Other agenda items included new procedures for key journal coverage, the future of the CINDA book as well as the conversion of the CINDA database to the new CINDA2001 format, a review of the EXFOR compilation efforts and statistics, as well as technical issues concerning EXFOR (new or modified quantity definitions, coding rules and dictionary codes). Twenty-two working papers (WPs) were submitted to the meeting. The main results are summarized in the list of 31 Conclusions and 27 Actions given on pp. 18-24.

Brief Minutes

The meeting was opened by Alan Nichols, Head of the IAEA Nuclear Data Section (NDS), on behalf of the IAEA, and by Pavel Obložinský on behalf of the National Nuclear Data Center (NNDC). Peter Bond, Deputy Director of BNL, and Ralph B. James, Associate Director for Energy, Environment and National Security at BNL, welcomed the participants on behalf of Brookhaven National Laboratory, and gave a summary of the history and mission of the laboratory.

Claes Nordborg was elected chairman of the meeting, to be assisted by O. Schwerer and H. Henriksson as meeting secretaries. The agenda was approved with the only change to move item 5 (technical EXFOR items) to a special session at the end of the meeting to be chaired by O. Schwerer.

Each of the 11 centres attending presented a brief status report (see reports P1 - P11). Reports of two centres not able to attend were submitted in writing (reports P12 - P13).

A revised NRDC Protocol was agreed as submitted with minor changes (see Annex 1). It will become part of the new series of NRDC manuals and also replaces the short NRDC protocol which had been part of the Network Document (INDC(NDS)-401 Rev.4).

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

The new CINDA2001 database (which will extend the CINDA scope to include, besides neutron data, charged-particle and photonuclear data) was discussed and a

new procedure for the conversion from the old to the new format was agreed, together with the deadline of May 2005 for compilation in the new format. The future of the CINDA book will be decided depending on the results of a questionnaire NEA-DB will issue in spring 2005.

A new structure of the EXFOR/CINDA dictionaries was approved as submitted, except for minor modifications of the contents of the new dictionary 47 (see Annex 2).

The revised EXFOR manual (edited by O. Schwerer based on an earlier draft by V. McLane) was approved as submitted. A final version of the CINDA 2001 manual and a next version of the LEXFOR manual are still to be finalized, and will be released in 2005.

The EXFOR compilation scope was redefined (included in the new Protocol, see Annex 1). Compulsory compilation will include data for projectiles with $A \leq 12$ and energies below 1 GeV, including also neutron-induced gamma spectra data. Data for heavier projectiles and/or higher incident energies as well as special data types such as vector and tensor polarization data or kerma factors may be compiled on a voluntary basis and be included in regular transmissions. Other data (e.g. for other projectiles such as pions) may be compiled if they are compatible with the general structure of EXFOR, but may be transmitted only in separate, newly defined EXFOR transmission series (whose scope must be declared explicitly to the network).

The meeting discussed the EXFOR compilation efforts and transmission statistics. O. Schwerer presented the current file statistics. The database (as of September 2004) contains 14535 works, giving about 100000 data tables and 8.1 million data points. The database growth in the 2003/2004 period was about 1400 works or 10% (old and new literature), which includes data compiled earlier that were released only in the reporting period. He mentioned that the current compilation emphasis on data for medical applications, ion beam analysis and astrophysics, where there are big gaps in the coverage of old literature, is sometimes competing for the limited manpower with the compilation of new, but more exotic data types without immediate application.

B. Pritychenko presented an analysis of the EXFOR compilation effort by publication year vs. compilation year. Reasons for and possible means to reduce delays between publication of data and their appearance in the database were discussed and the role of NDS as coordinator was stressed. Since a majority of important data is published in a relatively small number of different journals, the idea of dividing the compilation effort not by geographical area but by journal was discussed. Because the connection between data centres and authors is important but, on the other hand, the same authors tend to publish in different journals, it was decided to reorganize the scanning of journals without changing the EXFOR compilation responsibilities (Conclusion C16). Each of the key journals will be covered by one of the centres who will rapidly communicate with relevant compilation centres.

The meeting discussed the comparison of the EXFOR master files existing at various centres. After making the necessary corrections, NDS will make a final master file available by 1 July 2005, and a new procedure for updates after that date was approved.

In view of staff changes at NNDC, it was decided to move the responsibility for maintaining the EXFOR processing software (so far done at NNDC) to NDS in early 2005.

NNDC informed the meeting that their migration of the EXFOR and CINDA databases from VMS to relational databases will be finished by the end of 2004.

D. Winchell gave a special informational presentation on "Compilation of NSR and XUNDL", two databases maintained at NNDC.

A number of technical items, concerning mainly EXFOR/CINDA coding rules, definitions of quantities and dictionary updates, were discussed and relevant decisions made in a special technical session on the last day of the meeting (see list of Conclusions and Actions, pp. 18-24).

The next NRDC meeting, which will be a meeting of technical staff only, was tentatively scheduled for 17-19 October 2005 in Vienna.

CONCLUSIONS AND ACTIONS

Conclusions

General

C1 The short version of the NRDC Protocol (Annexes 3 and 4 in the Network Document) will be replaced by a reference to the full-length Protocol (Part IV of the new NRDC Manual, see Annex 1).

C2 The next Technical NRDC Meeting is tentatively scheduled for 17 – 19 October 2005 in Vienna. The next full meeting (with centre heads) will take place in Vienna in 2006.

CINDA

C3 The conversion to CINDA2001 will be done in the following steps, with an overall deadline of May 2005:

1. Convert ALL EXFOR (also neutron data) to CINDA2001 format
2. Convert all CINDA entries which do not have an EXFOR line to the new format
3. Take remaining CINDA entries (those with EXFOR lines) and compare them with the file generated before and add any missing references to existing blocks and add any missing blocks with EXFOR lines, printing out a message saying that there was no match.
4. The responsible centers will go through the messages with no matches and correct the file.
5. Ranges of subentries can be put in with reference types 5 (for the first subentry) and 6 (for the last subentry in the range). (Note: Multiple EXFOR lines, and multiple ranges within a block, are legal.)

C4 New deadline for CINDA compilation in new format: May 2005.

C5 WP2004-5 on CINDA 2001 format, "Improvements": Items 1-3 are agreed, 4-5 are not needed because they can be taken care of by software.
Agreed items:
(1) To extend Sequence number to (at least up to) 3 digits. The reason is that some of EXFOR Entries have more than 99 Subentries, but the data naturally have to be in one CINDA block
(2) For Hierarchy Codes 8 and 9 Energy fields are not used, then if Hierarchy Code will be moved just after Sequence Number, the place of Energy can be used for products and institutes.
(3) For Block-related information (Hierarchy 8 and 9) Sequence Number counting should be negative (-1, -2, -3, etc.)

C6 WP2004-5: Proposed "Extensions" were found interesting but not of immediate priority.

C7 Clarification on coding of Production cross sections in CINDA2001: if there is an old CINDA quantity, there is a translation to the new CINDA quantity according to dictionary 47, e.g. NEM -> (N,X+N). For heavy single products,

however, hierarchy 8 records are to be used to define the product. Though this is not elegant, the output can be formatted differently.

C8 Future of the CINDA book: NEA will send out a questionnaire on whether or not the book is still wanted, the results of which are expected by spring 2005. If the book is continued to be produced, NEA-DB will take care of updating the book program to the new CINDA format. Anyway the next issue will probably still be based on the old format.

Common CINDA/EXFOR dictionaries

C9 The proposal of WP 2004-3 (new dictionary structure) is approved in principle, except for the agreed changes in dictionary 47 (see following conclusion).

C10 Some changes to the conversion dictionary 47 were approved (see Appendix 1).

C11 Compound dictionary 209: -CMP and –OXI (for general compounds and oxides, respectively) will be used as before.

C12 Wildcards for REACTION SF7 will be introduced in the new quantities dictionary 236, the redundant quantities with explicit SF7 can be deleted. Old dictionary 36 will continue to be available (but not updated).

Manuals

C13 The revision of the EXFOR Manual as submitted by Schwerer is approved.

EXFOR, general

C14 WP2004-10 on compilation scope is accepted in general. Nordborg will discuss the scope of the O series with CAJAD, exotic data will be moved to a new CIC. JCPRG will start a new J series for exotic projectiles.

C15 Neutron-induced gamma spectra data should be compiled (compulsory).

C16 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.

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.

C18 On Renormalization of old works to new standards: The meeting could not find a practical solution within the EXFOR system beyond the present compilation practices (compilers have to take care to include all information about the standards used as given in the publication, and to include also the ratio to the standard if given by authors)

EXFOR, technical

C19 Coding of quasi-metastable states (WP2004-12) is approved.

C20 New detector codes (WP2004-13):
GE approved, to be used if specific type is not known
SI approved, to be used if specific type is not known
PS is introduced as general code to be used like COIN
MWPC: expansion: take out “position sensitive”
PSSCN: obsolete
PSSSD: obsolete
PSPC, PSSI: not introduced
SWPC: expansion: take out “position sensitive”

C21 The proposal on coding of differential data (WP2004-14) is approved with the understanding that a sentence will be added about differential cross sections at

one point (angle) which cannot be defined as an (angular) distribution.

C22 The quantity ,SGV,,SFC (thermonuclear s-factor) is deleted because it is identical with ,SIG,,SFC (astrophysical s-factor). The affected entries have to be retransmitted.

C23 The proposal of SIG,HF and SIG,LF (WP2004-17) is withdrawn

C24 TT is approved as a general modifier as proposed in WP2004-18

C25 The definitions of thick/thin target yields as submitted in the new LEXFOR manual (superseding WP2004-18) are approved.

C26 Long reaction strings: the solution proposed at the 2002 Paris meeting (Conclusion 20 of 2002 NRDC meeting) will be implemented (continuation records following the same rules as for DECAY-DATA). All affected programs will have to be updated.

C27 The probability for emission of N particles (WP 2004-20) will be given in units NO-DIM.

C28 The probability of e.g. producing N protons is to be coded
….(P,X)NPART,NUM,PY,P
(but not …(P,X)1-H-1,NUM,PY)).

C29 Order of REACTION SF1, SF2 (target vs. projectile): It is agreed that data will continue to be coded in the way they were measured (no change of present rules). It is however important that retrieval codes will be updated to find also data with target and projectile exchanged.

C30 Quantity MCO is not needed (can be coded with DP) and will be deleted.

C31 Quantity EMC is obsoleted and the one existing entry will be deleted. (JCPRG may come up with a new proposal later, they have many similar new data not yet compiled)

Actions

General

A1	Schwerer	Review protocol wording (WP 2004-2) for outdated technical terms (e.g., "tapes")
A2	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.
A3	NDS	Provide more user-friendly access to the information collected in the “internal” NRDC web page.

CINDA

A4	CNDC	(Continuing) Compile all Chinese experimental works (journals and conference proceedings) for CINDA and send to NDS in Reader format. Send first transmission within a month after the meeting.
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	McLane, NEA-DB, CJD	(Continuing) Check and confirm/clarify report codes given in WP 2003-8, Sections 4 and 5
A7	CINDA centers	(Continuing) Correct errors in report coding, as listed in Sections 6 and 7 of WP 2003-8
A8	All CINDA centers except NNDC	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.
A9	NEA-DB, NNDC	Send to NDS their area’s CINDA master file in the new format by the end of 2004.
A10	NDS	Check Zerkin’s output of CINDA conversion program

Common CINDA/EXFOR dictionaries

A11	NDS	(Continuing) Remove the restrictions “for photonuclear data (only)” from all dictionaries at their earliest convenience.

A12	McLane	Update the output for the new nuclides dictionary 227 according to WP 2004-8 and provide it together with the related computer code to NDS.

Manuals

A13	NEA	Issue final CINDA 2001 manual reflecting the conclusions of the Ipresent meeting. After this, it will be maintained by NDS.
A14	All	Give feedback to McLane about the new LEXFOR Manual distributed at the meeting (which contains the new proposals from this meeting's agenda) by the end of this year. (From January 2005, NDS will take over responsibility for LEXFOR.)
A15	Schwerer	Review the EXFOR Basics Manual and submit revision when time permits. Also include the "C4" computational format.
A16	All	Review the Citation Guidelines (2004 version from NRDC internal webpage) and send updates to NDS.

EXFOR, general

A17	All	(Continuing) Check/retransmit those entries from the list of pending retransmissions (distributed by McLane at the 2001 NRDC meeting) which still need correction
A18	All	(Continuing) All centers should give high priority to compiling new publications.
A19	Nichols	Communicate with major journals concerning data transfer to the network for inclusion in EXFOR. Complete initial communication by end of 2004.
A20	NDS	Compare EXFOR master files received from other centres with the NDS file, and as far as possible correct them (with help of other centers) by 1 July 2005.
A21	NDS	Make available to all centres the "final" EXFOR master file, together with a matching set of dictionaries, by 1 July 2005.
A22	JCPRG	Before transmitting the first J-series transmission, distribute a memo defining the scope.
A23	All	Review the new agreement with regards to "exotic data" and compilation scope (see WP 2004-10 and Conclusion C14), to discuss at next meeting.
A24	NDS	How to store and transmit covariance data – issue instructions/guidance by end of 2004. All centres are invited

to submit proposals.

EXFOR, technical

A25	McLane	Send memo on proposed coding of isotopic abundance (for minor isotopes, where the value may have changed)
A26	McLane	(Continuing) Check whether there is a LEXFOR entry on the process code FUS (total fusion, Dictionary 30); if not, provide such an entry.

Software

A27	McLane	Send all EXFOR processing codes (except CHEX) to NDS. They are all now in standard Fortran90 (ANSI standard). CHEX will follow sometime later (spring 2005). (From end of January 2005, NDS will maintain all these codes.)

Meeting of the Network of Nuclear Reaction Data Centers, BNL, October 4-7, 2004

National Nuclear Data Center: Status Report

P. Obložinský
NNDC, Brookhaven National Laboratory

Personnel

Personnel changes since the last NRDC meeting in May 2002:

- Mike Herman (PhD, nuclear reaction physics) was hired in March 2003. His duties include ENDF database management, maintenance of the reaction code Empire and nuclear reaction cross-section evaluations for ENDF.
- Yako Sanborn retired in October 2003. Boris Pritychenko (PhD, nuclear structure physics) with strong background in computer programming was hired in September 2004. His duties include responsibility for the new NNDC Web site, Linux management and application development.
- Vicki McLane is expected to retire at the beginning of next year. Dimitri Rochman (PhD, nuclear reaction physics) has been hired and is expected to be starting his term in November 2004.

At present, the NNDC staff represents 12.25 FTE (8.0 scientists, 1.75 professionals, and 2.5 support staff).

In the last fiscal year (Oct 2003 – Sep 2004), 13 scientists visited the NNDC at least for 1 week, 53 weeks in total, see Table 1. This represents a considerable increase over the past, dominated by 9 visits devoted to nuclear reaction modeling and cross-section evaluation, followed by nuclear structure evaluation (2 visits), and database development (2 visits).

The list of NNDC visits to other centers is given in Table 2.

Table 1. Summary of Visitors to NNDC (Oct 2003 - Sep 2004)

No. of visits	Duration	Topic
9	39 weeks	Nuclear reaction modeling and evaluation
2	9 weeks	Nuclear structure evaluation
2	5 weeks	Nuclear reaction database migration
Total: 13	53 weeks	

Table 2. Visits by NNDC Staff to Other Centers (July 2003 - Sep 2004)

Staff Member	Host	Duration	Topic
Alejandro Sonzogni	IAEA/NDS	1 week	Database migration
Michal Herman	IAEA/NDS	3 days	ENDF database migration
Victoria McLane	IAEA/NDS	1 week	EXFOR training session.

Computer Facilities

The NNDC has completed migration from the Compaq Alpha Server to a multi-server Linux system consisting of:

1. Three units of dual-processor Intel Xeon Red Hat Advanced Servers (2.8 GHz) functioning as
    - working server,
    - primary database server, and
    - secondary database server.
2. Intel Xeon single processor (2.0GHz MP) Web server; owned by us, but operated by the BNL Information Technology Division.

All PCs have been replaced with INTEL Pentium 4 processors running Windows XP and using flat panel monitors.

Bibliographies

The NSR compilation activity has continued. Over 4,200 references were entered in FY2004.

The CINDA compilation activity continues with respect to those references associated with the experimental neutron data compiled at the Center. In the period from July 2003 to September 2004, 3 CINDA transmissions were sent (see Table 3) containing a total of 1,184 records.

Table 3. NNDC CINDA Transmissions (July 2003 – Sep 2004)

Transmissions			Lines In database	Blocks in database
Exchange	Date	# lines		
179	20030829	681		
180	20040518	226		
181	20040922	277		
NNDC Totals		1184	91461	40531

Experimental Nuclear Reaction Data

The NNDC continues to compile neutron and charged-particle reaction data produced in the U. S. and Canada. In the period from July 2003 through September 2004, 12 final neutron data transmission tapes and 14 charged-particle transmission tapes were sent containing new and corrected entries; 3 preliminary transmissions have been sent (Tab. 4).

Evaluated Nuclear Reaction Data

CSEWG. The NNDC continues to coordinate the work of the Cross Section Evaluation Working Group. CSEWG is focusing on the development of a new version of the ENDF/B library, ENDF/B-VII. The NNDC contributions:

- Preliminary ENDF/B-VII Web page was developed,
- Assembly of ENDF/B-VII and data verification started, and
- ENDF-6.13 Utility Codes were distributed.

Empire. Improved version of the nuclear reaction model code, Empire-2.19, was developed (collaboration with Uni Bucharest, IAEA and JAERI). In particular,

- Fission channel was considerably improved,
- Pre-equilibrium alpha emission was introduced (Iwamoto-Harada), and
- Photon production capabilities were validated.

Evaluations. The NNDC was involved in several cross-section evaluation projects:

- Collaboration with KAERI on neutron cross-section evaluations for 24 selected fission products was completed. In the last year, remaining 5 isotopes of Dy were finalized and submitted to ENDF/B-VII.
- Review of 218 fission products cross was completed as an international project chaired by the NNDC (WPEC Subgroup 21). The project reviewed all evaluations in the fission products region (Z = 31 - 68) and recommended best evaluations.
- Neutron cross-section evaluations for 5 isotopes of Germanium were completed, focusing on photon production. This was in response to the needs of MCNP community.
- Atlas of Neutron Resonances is under preparation by S. Mughabghab. It represents a complete re-evaluation of “BNL-325” published in 1981 and 1984.
- The NNDC continued to cooperate with Russian Nuclear Data Center VNIIEF on “Compilation and Evaluation of Alpha-Induced Nuclear Reaction Cross Sections for Astrophysics” (grant from the Civilian Research and Development Foundation).

Nuclear Structure Data

NNDC continues to publish the ***Nuclear Data Sheets***, with 12 issues per year. As of September 2004, issues through Volume 102, #4 have been sent to Academic Press.

The experimental nuclear structure and decay data database (XUNDL) now contains more than 1,300 data sets, compared to about 1,000 one year ago. The compilation is done in a very efficient way by McMater University, Canada. The NNDC maintains and distributes the database.

Database Migration

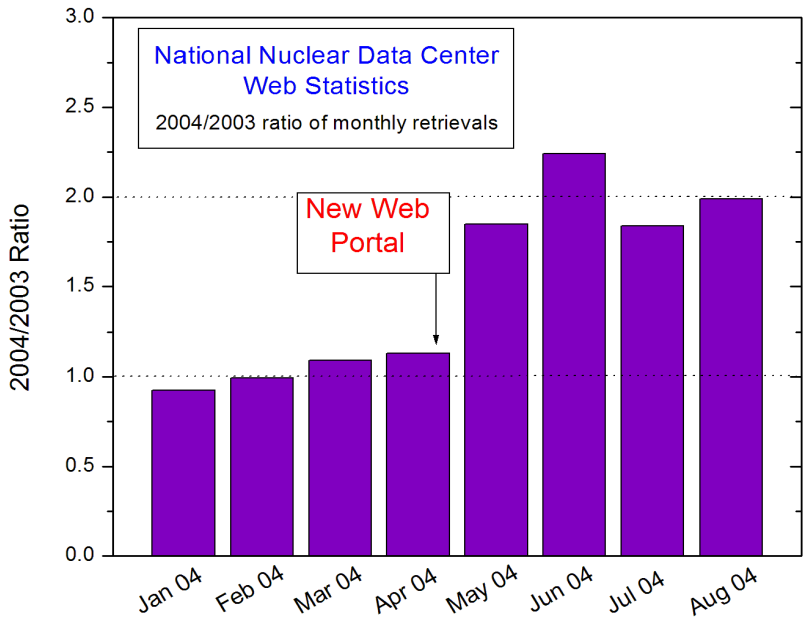
The database migration project, conducted in 2000 – 2004, has been essentially completed in April 2004.

The administrative functions for CSISRS (EXFOR), CINDA, ENDF, ENSDF, NUDAT, and NSR have been transferred to the new Linux/Sybase system. This involves installation of new software and modification of legacy codes, where appropriate, to work with the relational database. The VMS-based version of the database has been shut down as of October 1, 2004. The CINDA database will be fully installed by V. Zerkin in November 2004.

Customer Services

As a part of the migration project, the NNDC launched its completely re-designed Web site in April 2004. At the same time, Online Service was shut down.

The number of retrievals continues to increase. There was a large jump in retrievals at the time of the inauguration of the new Web site in April. A figure below shows ratio of monthly retrievals for respective months in 2004 and 2003. It is seen that new Web Portal resulted in almost 100% increase of retrievals. In absolute terms, currently there are about 50,000 retrievals per month.



The most popular databases are NuDat, NSR and ENSDF, followed by CSISRS and ENDF. CINDA continues to show fairly low retrieval statistics.

The NNDC continues to host the USNDP Web site and CSEWG Web site.

Table 4. NNDC Transmissions (July 2003 – Sep 2004)

Tape	Preliminary posted	Final			Change in*	
		Posted	# data points	# entries	# data points	# subentries
Area 1 (neutron)						
1315	20030530	20030729	19,320	19	7,419	3
1316	20030910	20031023	8,001	13	0	0
1317	20031105	20031219	19,288	28	881	5
1318	20040115	20040406	12,666	21	171	1
1319	20040426	20040514	137,863	10	10,638	7
1320	20040427	20040514	241,189	1	80,012	0
1321	20040510	20040517	96,002	25		
1322	20040512	20040517	182,329	14	175,051	0
1323	20040517	20040602	18,191	23	4,741	2
1324	20040602	20040702	187,077	14	176,722	2
1325	20040702	20040722	107,443	19	1342	5
1326	20040727	20040826	83,713	24	55823	2
1327	20040830					
Area 1 Total			1,113,083	212	512,800	27
Area C (charged particle_						
C057	20020827	20021018	7,919	19	716	11
C058	20030225	20030328	4,924	10	964	7
C059	20030605	20030729	5,965	21	(382)	3
C060	20030819	20030919	3,515	26	2,837	19
C061	20030929	20040112	6,017	28	890	16
C062	20040112	20040223	4,850	20	6,549	25
C063	20040225	20040405	4,027	23	23,915	26
C064	20040406	20040510	10,497	42	8,447	7
C065	20040420	20040513	27,707	26	13,376	10
C066	20040601	20040701	11,529	12	716	11
C067	20040722	20040830	6,526	17	964	7
C068	20040903					
Area C Total			93,476	244	57,312	142
Area T (charged particle - originally compiled at another center)						
T013	20030806	20030908	22,536	27	18,067	18
T014	20031009	20031218	11,172	14	7,152	5
T015	20040120	20040318	43,036	14	41,478	8
T016	20040322	20040422	8,051	20	5,832	14
T017	20040625	20040730	9,007	20	6,851	18
T018	20040903					
Area T Total			93,802	95	79,380	63
NNDC Total					649,492	232

* Change takes into account deletions vs. insertions.

P 2

REPORT FROM THE NEA DATA BANK

to the NRDC meeting at BNL, USA

4 - 7 October 2004

General

The NEA Data Bank services celebrate its 40th anniversary in 2004. During all these years, the Data Bank's primary role has been 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 Figure 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 i**n-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.

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.

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 now open, since the Data Bank abandoned the password restrictions two years ago on the EXFOR and EVA databases. 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 250 new experiments have been entered by the Data Bank into the EXFOR database since the beginning of 2003. During the same period, close to 3 300 bibliographic references were entered into the CINDA database. Concerning the on-line nuclear data services to member countries, the Data Bank has noted a significant increase in the demand for experimental and evaluated data, since the abolition of password protections of the databases in July 2002. The NEA Data Bank will send out a questionnaire to find out the real need for continuing to produce a printed version of CINDA, considering that the CINDA database is available both on CD-ROM and on-line through the Web.

The new CINDA format, CINDA2001, has been adopted in a local test database. The NEA has developed a program to facilitate the transition of the remaining CINDA entries by using the EXFOR works connected to each CINDA entry. This work is in the final stage, awaiting an agreement on the details of the latest CINDA2001 format and dictionaries. It has been shown that of the about 139 000 blocks that exist in CINDA, over 76 % can be transferred to CINDA2001 quite easily. The majority of the remaining part does not contain any EXFOR related works and it is therefore difficult to add information in the new CINDA2001 format for those cases.

JANIS - 2

The first version of the nuclear data-plotting JANIS (Java Nuclear Information System) software was released in October 2001. A presentation of the software was made at the International Nuclear Data conference (ND-2001) at Tsukuba, Japan. This first version has proven to be very useful to a variety of users.

A new version of the JANIS (JANIS-2.0) software, developed at the Data Bank, was released in January 2004. This extended and improved version now includes bibliographical data (CINDA), experimental data (EXFOR) and evaluated data (EVA). The software has become very popular in the nuclear community and the stock of 1000 copies was distributed during the first two months after release. A new version (JANIS-2.1) was released in August 2004 and has been distributed among all registered JANIS users world-wide.

The latest updates to JANIS include additional data, such as activation data, remote connection with Servlet technology and improved computational possibilities (user-friendly equation string interface and an extension to allow combination of various types of data like cross sections and energy-angle distributions. JANIS 2.1 is distributed only on DVD to permit inclusion of the main databases on one single medium for local access. The software can also be downloaded directly from the NEA web server. See *www.nea.fr/janis/* for further information.

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

The JEFF-3.0 General Purpose Library, intended for use in Fission and Fusion neutronic applications, was released in April 2002. This library contains recommended nuclear data for use in neutron transport calculations. Evaluated nuclear data are given for 340 isotopes or elements and for five molecular/lattice structures in the case of thermal scattering data.

The development of the JEFF project is progressing in line with the revised mandate adopted by the Executive Group in June 2003. Studies performed at several participating institutes are providing feedback on the JEFF-3.0 library. Extensive processing and validation studies have been undertaken and have highlighted files that are in need of revisions. In parallel, evaluation work is progressing with the aim of providing new or revised evaluations for inclusion in the JEFF-3.1 library. It is planned to issue the JEFF-3.1 library in 2005.

Work on the JEFF-3.1 special purpose libraries on radioactive decay and fission yield data is well under way, with the goal of releasing already tested libraries in 2005, in conjunction with the release of the general purpose library.

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.

The following databases were all updated with new material in 2004:

- Radiation Shielding (SINBAD)
- Reactor Fuel Performance (IFPE)
- Criticality Safety Benchmark Experiments (ICSBEP)
- Code Validation Matrix of Thermal-Hydraulic Codes for LWR LOCA and Transients (CCVM)
- Reactor Physics Experiments (IRPhE)

The demand for integral nuclear data is high. More than 1 800 data sets were distributed in 2003, of which about 290 went to non-OECD countries, according to the cooperative agreement with the IAEA

Computer Program Services

The computer program services have during its 40 years of existence distributed in total about 67 000 programs upon request. In 2003, the Data Bank acquired 70 new or revised versions of computer codes. During the same period, the NEA distributed more than 1 900 programs, to users in member countries. The Data Bank had also issued five electronic newsletters and one new edition of the program abstracts on CD-ROM. Five training courses and two workshops, covering the most sought after computer codes, were organized in 2003.

Acquisition of new or revised versions of computer codes has been rather low in 2003, partly because of the interruption in the exchange of codes with the US during the negotiation of the renewal of the cooperation agreement between the US DOE and the NEA Data Bank. It is hoped that the new agreement will soon be in place.

The Thermochemical Data Base (TDB)

The Thermochemical Data Base (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.

An update to earlier reviews of thermochemical data for U, Np, Pu, Am, and Tc had been published in 2003. Reviews of data for Zirconium, Selenium, Nickel and selected organic compounds are underway and are expected to be published in late 2004 and 2005. A new phase of the project was started in 2003 covering evaluation of inorganic complexes and compounds of Thorium, Iron, Tin and Molybdenum.

In-house computer configuration

The overall security of the Data Bank's in-house computer system has been improved in relation to the Internet, by using separate firewall switches for the web and mail servers. Special filters have also been installed to identify spam email. An outline of the present configuration can be found in Figure 2.

Figure 1

Organisation chart of the professional posts in the NEA Data Bank and Nuclear Science divisions

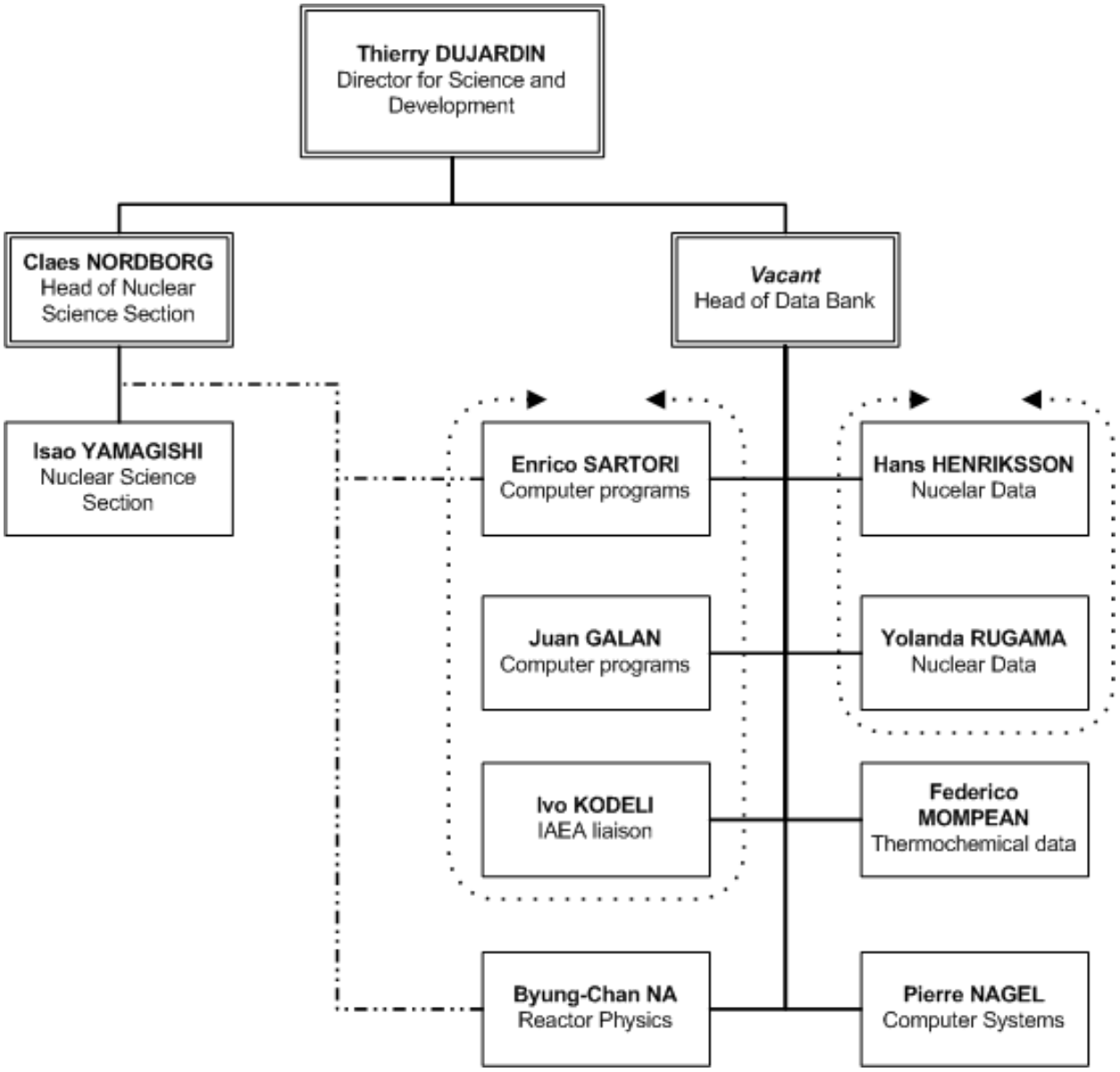
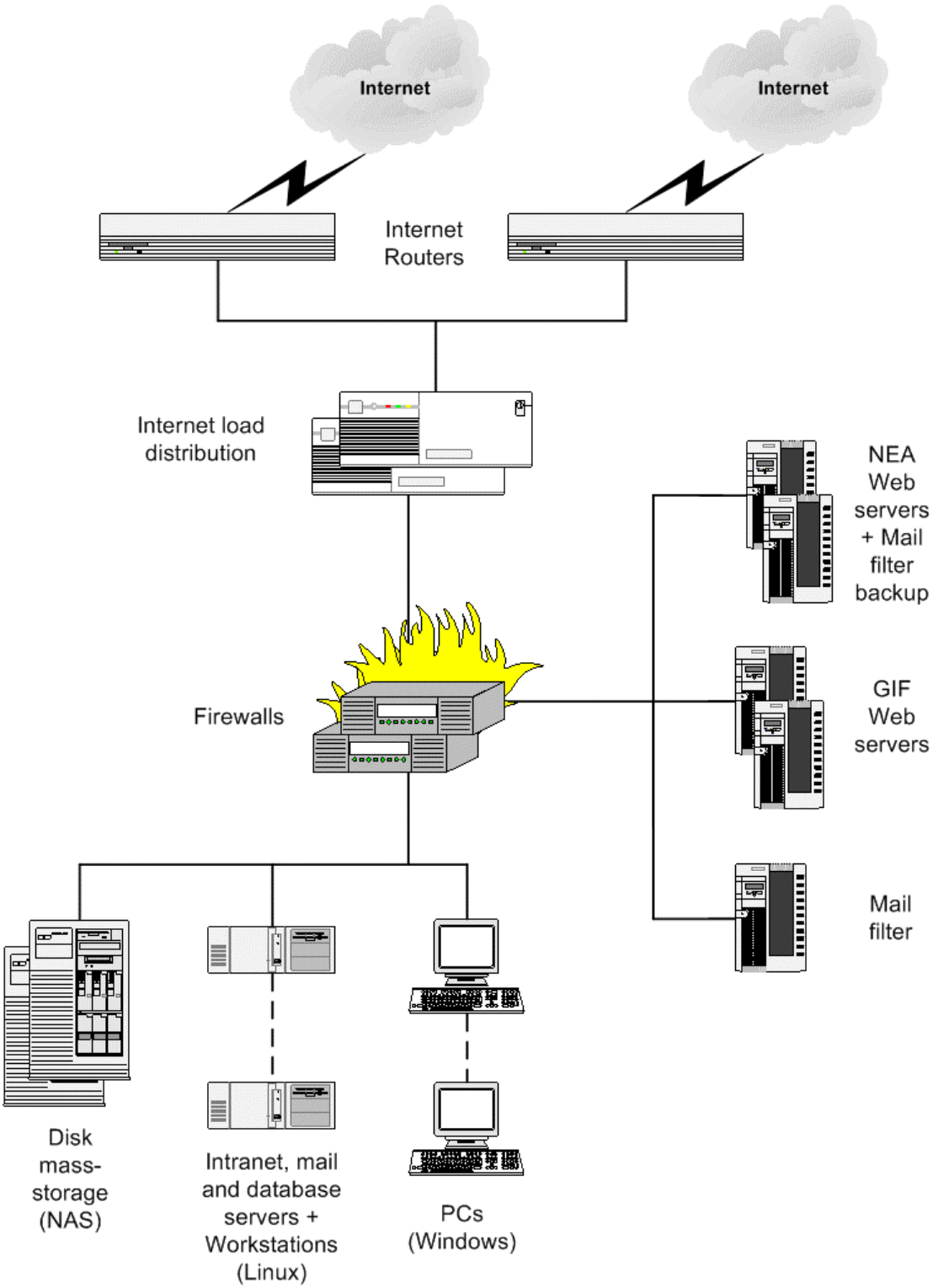


Figure 2

NEA Data Bank computer system configuration



IAEA Nuclear Data Section: Progress Report, 2003/04

IAEA Technical Meeting, 4 - 7 October 2004
Co-ordination of the Network of Nuclear Reaction Data Centres,
Brookhaven, USA

Summary of nuclear data studies by staff of the IAEA Nuclear Data Section
1 July 2003 – 30 September 2004.

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

Editor: O. Schwerer

1. Staff

The authorized staff level of the Nuclear Data Section remains at a total of 18 professional and support staff. Three new staff members joined during the reporting period: Roberto Capote Noy (effective from 2 February 2004), Marco Verpelli (effective from 7 September 2003) and Svetlana Dunaeva (effective from 12 October 2003), succeeding former staff members Mike Herman, Kevin McLaughlin and Meinhart Lammer, respectively.

2. Data compilations

2.1 CINDA

NDS staff scan over 40 journal titles (mainly through the Internet) for the purpose of CINDA-compilation coverage control. There were 3146 CINDA entries prepared in 2003/04, and transmitted either as direct input to the CINDA file (work in the area of NDS responsibility), or for further processing after submission by other responsible data centres.

A database for CINDA coverage control has been installed that includes papers of significance or may be significant in the future for EXFOR or CINDA compilations. Over 21 journal titles and 400 journal issues from 2000 to 2004 are included at present. Journals references that should be compiled elsewhere were dispatched to the relevant centres (Japan, Russia, Hungary, NEADB). Also, copies of the articles were sent for compilation if another centre requested.

Also, three lists of papers were revised for completeness of compilation:

1. Ion Beam Analysis;
2. Publications of S. Qaim (Institut für Nuklearchemie, Forschungszentrum Jülich GmbH);
3. List for CRP on “Cross Sections for the Production of Therapeutic Radioisotopes”.

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

2.2 EXFOR and Dictionaries

Over the previous year, NDS staff have distributed two neutron TRANS files (3115, 3116) containing 12 new and 30 revised entries. Furthermore, 8 CPND TRANS files (D027 - D034) were distributed, containing 127 new entries (100 compiled at NDS, 27 at ATOMKI) and 8 revised entries. The compilations consisted of both new literature and important old references for ion beam analysis (about 30) and medical applications (about 35). Numerous curves from twenty-nine papers were also digitized at NDS that are the responsibility of NNDC, and sent to NNDC for compilation.

Altogether 74 TRANS files (not counting those for which a preliminary version had been submitted before the last meeting) were received and processed (compared to 42 for the 2002/2003 period), containing 567 neutron entries (239 new, 328 revised), 1528 CPND entries (1149 new, 379 revised) and 19 photonuclear entries (14 new, 5 revised).

Since the 2003 NRDC meeting, NDS staff have produced and distributed four regular transmissions of the EXFOR/CINDA dictionaries (TRANS 9083-9086) in EXFOR, DANIEL and archive format. In addition, a first version of the new dictionaries for CINDA 2001 was submitted and added to the NDS open area (transmission 9185, see memo CP-D/405), and was updated with transmission 9086.

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/B-VI Library, release 8 (last for ENDF/B-VI library)
- POINT2003, a temperature-dependent version of the ENDF/B-VI library, release 8
- FOND-2.2 Evaluated Neutron Data Library; Russian library for generating ABBN group constants
- updates to EPDL97 library of photon and electron interactions with atoms, and atom relaxation libraries
- theoretical evaluation of neutron- and proton-induced fission cross sections for Pb-Pu targets over the energy range from 20 to 200 MeV
- WIMSD-IAEA-69 and 172-group libraries in WIMS-D format
- IBANDL Ion Beam Analysis Nuclear Data Library
- PGAA database for prompt gamma-ray neutron activation analysis
- Charged-particle cross section database for medical radioisotope production, Update January 2004 (with links to ENDF-formatted data)
- NUDAT-2.0, interactive searching and plotting of nuclear structure and decay data
- EXFOR - CINDA Database and Retrieval System, version 1.62, data updated June 2004 (CD-ROM)
- EXFOR - CINDA for Applications Databases and Retrieval Systems on Linux and Windows, version 1.62, June 2004 (CD-ROM)
- ENDVER/GUI and EXFOR-CINDA package. Integrated Tools for ENDF-Evaluators, Version 1.0, June 2004

3. Services

At the end of June 2004, the NDS Web service was moved from our DEC Alpha/Open VMS to an Intel/Linux machine. All products were ported to the new environment. The most difficult element was the migration of all major databases and services, which was undertaken in close co-operation with NNDC (USA) - see Section 4 - and was carried out over a four-year period. As a result, all major databases and services were implemented on Linux, and opened for public access on both the NNDC and NDS Web sites.

Hardcopy and electronic versions of the biannual Nuclear Data Newsletters were published and distributed, advertising new NDS products and services. Twenty-two INDC-NDS and country reports were also prepared as hardcopy and electronically, including two issues of the Nuclear Constants journal translated from Russian to English. Twenty-seven country-based INDC reports were scanned, converted to pdf format, and added to the NDS web site.

4. Development of New Generation of Nuclear Databases and Services

Significant benefits were judged to accrue from moving the major nuclear databases and services from VMS/DBMS to other platforms. The "Migration" project was first considered in 1999 by NDS, and initiated in close co-operation with NNDC (USA). NDS was responsible for the primary nuclear reaction databases (EXFOR, CINDA and ENDF), while NNDC staff implemented the nuclear structure and decay databases (ENSDF, NSR and NuDat). New architecture based on relational-database and new Web technologies was successfully developed. The project also included significant revisions of the functionality of the existing data services to extend and implement at an advanced level, with the final goal of reaching a higher level of accessibility, functionality and service.

The "Migration" project at NDS aimed to create platform-independent nuclear reaction databases and services. This work has successfully been implemented on three nuclear reaction databases: bibliographic (CINDA in new format), experimental (EXFOR) and evaluated (ENDF) data. All three databases and software are being developed and tested on several platforms: Linux, Windows (even VMS), MySQL, SyBase and MS-Access. Web interfaces to all three databases were opened for public access on NDS and NNDC Web sites in 2004.

During the past year the following items were developed:

- ENDF loading/updating software
- ENDF Web retrieval system using Java-Servlet technology (with many improvements including Dictionaries and common plots with EXFOR)
- Web interfaces to EXFOR, CINDA and ENDF installed and tested with MySQL (NDS) and SyBase (NNDC)
- Tool for EXFOR compiler on CD-ROM for Windows distributed among workshop participants
- Charged-particle data imported from EXFOR to CINDA
- New CD-ROM "EXFOR-CINDA for Applications" for Linux and Windows with stand-alone database and retrieval system based on MySQL; contains a non-interactive retrieval utility for use from external software packages
- CINDA compilation and updating programs

Tasks for next year:

- develop ENDF CD-ROM Retrieval system
- finish CINDA compiler's tool to input data to database
- continue development of EXFOR-CINDA-ENDF Relational (utilities, documentation, etc), and prepare the system for deployment to other Nuclear Data Centres.

5. 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 Transmutation of Minor Actinide Nuclear Waste:* completed, database and document preparation in progress
- *Improvement of the Standard Cross Sections for Light Elements:* ongoing
- *Nuclear data for radiotherapy using radioisotopes or external radiation sources:* ongoing
- *Data for the Th-U-fuel cycle:* ongoing
- *Nuclear data for emerging technologies (RIPL-III):* ongoing

Data development projects:

- FENDL-2 (update)
- IRDF-2002 (update of IRDF-90 V.2) – completed; database and document preparation in progress
- Validation of photonuclear library
- Cross-section database for Ion Beam Analysis (IBANDL implemented, CRP proposed)

6. Publications

Some Recent Activities of the International Atomic Energy Agency in the Field of Nuclear Data by D.D. Sood and A. Trkov, *J. Radioanal. Nucl. Chem.* **255** (2003) 13-19.

Effects of the Neutron Spectrum on the Neutron Activation Analysis Constants for ^{94}Zr and ^{96}Zr by B. Smodis, A. Trkov and R. Jacimovic, *J. Radioanal. Nucl. Chem.* **257** (2003) 481-487.

Development of Nuclear Technique for the Detection of Landmines by D.D. Sood, U. Rosengard and A. Trkov; pp. 13-24 in Proc. SPIE, vol. 5089, 21-25 April 2003, Orlando, Florida, USA.

IAEA Co-ordinated Research Project: Update of X-ray and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications by A.L. Nichols, presented at Int. Conf. on Radionuclide Metrology (ICRM2003), 2-6 June 2003, Dublin, Ireland; also published in *Appl. Radiat. Isot.* **60** (2004) 247-256.

IAEA Nuclear Data Section: Provision of Atomic and Nuclear Databases for User Applications by D.P. Humbert, A.L. Nichols and O. Schwerer, presented at Int. Conf. on Radionuclide Metrology (ICRM2003), 2-6 June 2003, Dublin, Ireland; also published in *Appl. Radiat. Isot.* **60** (2004) 311-316.

Nuclear Data Requirements for the Actinides and Fission Products Build-up and Burn-up by V.G. Pronyaev and A. Trkov, Proc. XII International Conference on Selected Problems of Modern Physics, 8-11 June 2003, Joint Institute of Nuclear Research, Dubna, Russian Federation.

Quantifying Uncertainties by V.G. Pronyaev, Proc. XII International Conference on Selected Problems of Modern Physics, 8-11 June 2003, Joint Institute of Nuclear Research, Dubna, Russian Federation.

Contribution to Plutonium Futures: Work of the IAEA (G. Andrew) by A.L. Nichols and A. Trkov, Proc. Conf. on Plutonium Futures, 6-10 July 2003, Albuquerque, New Mexico, USA.

Updates to the Atomic and Molecular Data Unit Databases by R.E.H. Clark, paper presented at the International Conference on Photonic, Electronic and Atomic Collisions, 23-29 July 2003, Stockholm, Sweden.

IAEA Nuclear Data Activities: Services and Emerging Databases by A.L. Nichols and O. Schwerer, presented at V Latinamerican Symposium on Nuclear Physics, 1-5 September 2003, Santos, Brazil.

Temporal Variation of the Neutron Flux in the Carousel Facility of a TRIGA Reactor by A. Trkov, Proc. Nuclear Energy for New Europe 2003, 8-11 September 2003, Portoroz, Slovenia.

IAEA Activities Related to Nuclear Data for P&T and ADS by A. Trkov, presented at ADOPT – Int. Workshop on P&T and ADS Development, 6-8 October 2003, Mol, Belgium; proceedings: http://www.sckcen.be/sckcen_en/activities/conf/conferences/20031006/cd/.

IAEA Nuclear Data Section: Data Development Activities and Services by A.L. Nichols, V.G. Pronyaev and O. Schwerer, pp. 20-30 in Proc. EU Enlargement Workshop on Neutron Measurements and Evaluations for Applications (NEMEA), 5-8 November 2003, Budapest, Hungary, Editor: A.J.M. Plompen, EUR 21100 EN, ISBN 92-894-6041-5, 2004.

7. Workshops 2003/2004 (since 2003 NRDC meeting)

- Atomic and Molecular Data for Fusion Energy Research, 8-12 Sept 2003, ICTP Trieste, Italy.
- Nuclear Structure and Decay Data: Theory and Data Evaluation, 17-28 Nov 2003, ICTP Trieste, Italy.
- Relational Databases for Nuclear Data Development, Dissemination and Processing: EXFOR Implementation, Maintenance and Compilation, 1-5 December 2003, IAEA Vienna, Austria.

- Workshop on Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety, ICTP Trieste, Italy, 16 February - 12 March 2004

8. Visits and inter-centres co-operation

The following visits have taken place and contributed towards data centre co-operation:

- V. Zerkin (IAEA/NDS) to BNL/NNDC, 20-31 October 2003: Develop Software for the Management and Compilation of CINDA and EXFOR,
- V. Zerkin (IAEA/NDS) to BNL/NNDC, 15 March – 02 April 2004: Development of Software for Management and Web-Retrieval of ENDF and EXFOR Relational Databases,
- A. Sonzogni (NNDC) to NDS, 13 - 16 April 2004: Advise on the new relational version of the NuDat nuclear database.

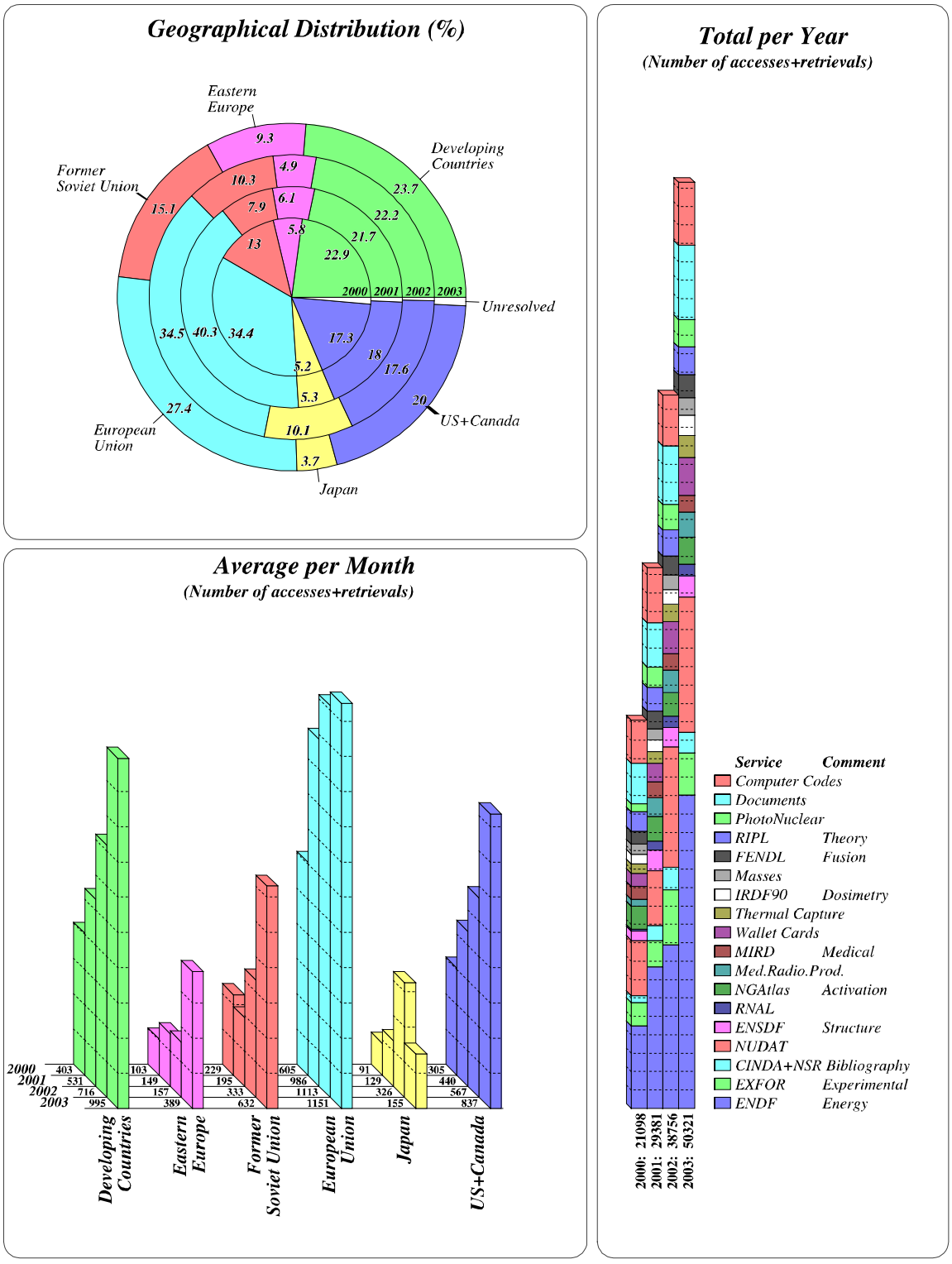


Fig. 1. Statistics of accesses and retrievals from NDS and IPEN (NDS-mirror in Latin America) Web sites.

CJD: PROGRESS REPORT, 2002-2004

IAEA Technical Meeting

"Co-ordination of the Network of Nuclear Reaction Data Centers"

(NNDC, Brookhaven, USA, 4 – 7 October 2004)

A.I.Blokhin, V.N.Manokhin, S.A.Maev, M.V.Mikhailukova, K.I.Zolotarev, N.A.Demin

1. Staff

Four new staff members joined during the reporting period:
Krivchikov S., post-graduate student/engineer, involved in a software development (from April 2003);
Vitvitsky R., post-graduate student/engineer, involved in a hardware development (from April 2003);
Demin N.A., PhD, scientist, a specialist in the radiation damage analysis (from September 2003);
Zolotarev F.K., post-graduate student/junior scientist, involved in nuclear data evaluation (from May 2004);

2. Data Compilation

2.1. EXFOR activity.

1. **2002-2003 (June 1):** TRANS 4127-4129 were prepared with 112 entries (17 new, 95 corrected).

2. **2003-2004 (September 1):** Three final EXFOR TRANS 4130, 4131, 4132 were sent to the NDS.
   Total numbers of ENTRIES – 55, new ENTRIES - 24, corrected ones – 31.
   Total record numbers – 21370.

3. **2004 (September 30):** EXFOR TRANS 4133 was prepared for distribution.

4. Considerable efforts were made to establish cooperation with the authors to get numerical data. On the basis of such cooperation numerical data were obtained from Khlopin Radium Institute (St.-Petersburg) on fission cross sections of heavy elements in the energy region 1 – 200 MeV, and neutron emission data from spontaneous fission of Am- and Cm isotopes. The data were obtained from Filatenkov's group and Laptev&Vorobiov's team and were introduced in EXFOR ENTRIES 41424, 41425, 41429, 41431 and 41428.
   A similar activity were made concerning the transmission data in the resonance neutron energy region for many nuclides with A=120 – 180 obtained by Grigoriev's group (IPPE+JINR cooperation), the photo-fission cross sections for 23 fissile nuclides measured by Soldatov's group (IPPE), some data concerning the high energy measurements from Gatchina.

2.2 CINDA activity.

1. **2002-2003 (June 1):** Three CINDA batches (CJD044-CJD046) with 2031 entries were transmitted to the NDS.

2. **2003-2004 (September 1):** Four CINDA batches (CJD047, CJD048, CJD049, CJD050) were prepared and distributed to the NDS (3575 CINDA entries in EXCHANGE format and 689 entries in READER format). This was possible exclusively due to the fruitful cooperation with NDS Data Section and its computer facilities.

3. During 2003-2004 CJD obtained 15 files in the EXCHANGE and READER formats from the foreign Nuclear Data Centers:

   from NNDC – 2 in EXCHANGE format, 1 in READER format (926 lines);

   from NDS – 3 in EXCHANGE format (156 lines);

   from NEA DB - 6 in EXCHANGE format, 1 in READER format (4742 lines).

4. During 2002-2004 we were engaged in checking Cinda Entry`s coded as "many". Some of them were compiled again in order to split by elements. We found that it was very useful. In process of this work some essential errors were corrected. We are going to do further checking and re-compilation, if necessary, in order to greatly diminish the number of works with code "many". In some cases the corresponding corrections were made in EXFOR entries.

3. Publications

In during 2002-2004 the three issues of the journal "Yadernye Konstanty" were prepared and printed.

4. NUCLEAR DATA EVALUATION Activity

Work performed with the participation of CJD

5. New data library ACDAM for the activation/damage calculations is compiled in the Russian Nuclear Data Center and consists from three parts:
   - ***Activation/transmutation neutron cross-section base***
   - *Decay Data Library (DeDaL)*
   - `Damage Data Library (DDL)`

Activation/transmutation neutron cross-section base

The main part of the data is FENDL-2/A with selections from:

- evaluated nuclear data libraries EAF-99+ADL-3, BROND-2(3), ENDF/B-

VI.3, IRDF-90, JENDL-3 (fission products), CENDL-2 (fission products);
- experimental data with using of mathematical methods of evaluations;
- empirical dependence of form of neutron threshold reaction excitation functions;
- theoretical model calculations;
- systematics of c-s around 14-MeV neutron energy;

Content:
From the element H (A=1) to Po (A=210), in the neutron energy range 10^{-5} to 20-MeV and it includes 704 target isotopes with data presentation: in ENDF-6 format.

Decay Data Library (DeDaL)

The DeDaL library is completely based on the EAF-99 Decay Data Library with the minor corrections for some nuclides.

Damage Data Library (DDL)

The DDL library is based on processing of the general purpose data files from the ENDF/B-VI.3 and BROND-2(3) libraries.
Content: DDL library is prepared for 60 elements/isotopes in the neutron energy range 10^{-5} to 20- MeV. The data for main structural elements and basic impurities involved in alloys and steels are included in the DDL in ENDF-6 format.
This work was presented on the ICFRM-11 Conference and will be published in Journal VANT, issue "Materials science and new materials" (2004) as: A.I.Blokhin, N.A.Demin, V.N.Manokhin,V.M.Chernov "New nuclear data base for transmutation, activation, gas production and radiation damage calculations for fusion reactor structural materials".

6. New version of the Russian Reactor Dosimetry File is prepared and now it is under the compilation and benchmark testing. New evaluations were made for the 26 reactions with the covariance matrices. Some of them were included into the IRDF-2002 compiled by the NDS.
7. **V-nat, V-51, V-50:** Neutron energy E_n<20 MeV; work done in collaboration with the Kurchatov Institute (Moscow) and the Institute of experimental physics (Sarov), in the frame of the ISTC project#910.
8. **Zr-90, Zr-91, Zr-92, Zr-94, Zr-96:** Neutron energy E_n<20 MeV; work done in collaboration with the Institute of Experimental Physics (Sarov), in the frame of the ISTC project#731.
9. **Pb-204, Pb-206, Pb-207, Pb-208, Bi-209:** Neutron energy E_n<20 MeV; This work was done in collaboration with the Institute of Experimental Physics (Sarov), in the frame of the ISTC project#731.
10. Enrichment of secondary gamma-ray production data produced by neutrons with energy E_n<20 MeV. Secondary gamma-ray production data are newly re-evaluated and incorporated for some nuclides needed for in the fusion application, namely for: **Al-27, Fe-nat, Cu-63, Cu-65, Zr-nat, Zr-90, Zr-91, Zr-92, Zr-94, Zr-96, Pb-nat, Pb-204, Pb-206, Pb-207, Pb-208, Bi-209;** This work was done in collaboration with the Institute of Experimental Physics (Sarov), in the frame of the ISTC project#731.
11. CJD was engaged in re-evaluation and preparation of evaluated neutron data for fission products: Ru, Pd, Mo, Nd and Sm and other isotopes for BROND-3 Library. The correction, processing and testing of new files is under way.

5. Cooperation

1. A participation in the CRP "The International Reactor Dosimetry File: IRDF-2002" organized by the IAEA NDS. Some evaluated nuclear cross sections from the Russian Reactor Dosimetry File were proposed for a new nuclear data library IRDF-2002 (see Appendix A).
2. In during of few years the cooperation between the CJD and the NuDaCe (ENEA, Bologna) continues in a field of nuclear data processing and testing. In 2004 some activity concerning the analysis the JEFF-3.0 Library was performed. In Appendix B we presented some results.

We greatly appreciated the help of V.Pronyaev, O.Schwerer, V.Zerkin and S.Dunaeva to overcome our technical problems for successful compilation into CINDA and EXFOR systems.

Appendix A.

Evaluated cross section data from russian reactor dosimetry file

K.I. Zolotarev

Cross section data for dosimetry reactions: $^{19}F(n,2n)^{18}F$, $^{24}Mg(n,p)^{24}Na$, $^{27}Al(n,p)^{27}Mg$, $^{46}Ti(n,2n)^{45}Ti$, $^{46}Ti(n,p)^{46m+g}Sc$, $^{47}Ti(n,x)^{46m+g}Sc$, $^{48}Ti(n,p)^{48}Sc$, $^{48}Ti(n,x)^{47}Sc$, $^{49}Ti(n,x)^{48}Sc$, $^{51}V(n,a)^{48}Sc$, $^{54}Fe(n,a)^{51}Cr$, $^{54}Fe(n,2n)^{53m+g}Fe$, $^{56}Fe(n,p)^{56}Mn$, $^{59}Co(n,a)^{56}Mn$, $^{58}Ni(n,p)^{58}Co$, $^{63}Cu(n,a)^{60m+g}Co$, $^{75}As(n,2n)^{74}As$, $^{93}Nb(n,n')^{93m}Nb$, $^{103}Rh(n,n')^{103m}Rh$, $^{115}In(n,n')^{115m}In$, $^{139}La(n,\gamma)^{140}La$, $^{141}Pr(n,2n)^{140}Pr$, $^{186}W(n,\gamma)^{187}W$, $^{204}Pb(n,n')^{204m}Pb$ and $^{237}Np(n,f)$ were taken to the International Reactor Dosimetry File IRDF-2002 [1] from the new version of Russian Reactor Dosimetry File. This version is the improved and extended version of the previous version of Russian Reactor Dosimetry File - RRDF-98 [2].

New evaluations of cross sections for the reactions $^{27}Al(n,p)^{27}Mg$, $^{56}Fe(n,p)^{56}Mn$, $^{58}Ni(n,p)^{58}Co$, $^{103}Rh(n,n')^{103m}Rh$, $^{115}In(n,n')^{115m}In$, $^{139}La(n,\gamma)^{140}La$, $^{139}La(n,\gamma)^{140}La$, $^{204}Pb(n,n')^{204m}Pb$, and revisions of cross section data from RRDF-98 file for the reactions $^{19}F(n,2n)^{18}F$, $^{46}Ti(n,2n)^{45}Ti$, $^{46}Ti(n,p)^{46m+g}Sc$, $^{47}Ti(n,x)^{46m+g}Sc$, $^{48}Ti(n,p)^{48}Sc$, $^{48}Ti(n,x)^{47}Sc$, $^{49}Ti(n,x)^{48}Sc$, $^{51}V(n,a)^{48}Sc$, $^{54}Fe(n,a)^{51}Cr$, $^{54}Fe(n,2n)^{53m+g}Fe$, $^{59}Co(n,a)^{56}Mn$, $^{63}Cu(n,a)^{60m+g}Co$, $^{75}As(n,2n)^{74}As$, $^{141}Pr(n,2n)^{140}Pr$, $^{237}Np(n,f)$ were carried out at the Institute of Physics and Power Engineering (IPPE), Russia, Obninsk in 2001-2003 years.

1. Summary Report of the Final Technical Meeting on "The International Reactor Dosimetry File: IRDF-2002" prepared by P.J. Griffin and R.P. Paviotti-Corcuera, Report INDC (NDS)-448, IAEA, Vienna, 2003.
2. Zolotarev, K.I., Ignatyuk, A.V.., Manokhin, V.N., et al: "RRDF–98, Russian Reactor Dosimetry File", Report (NDS)-193, Rev.0 , IAEA, Vienna, 1999.

Appendix B.

Processing of the JEFF-3.0 library for the MCNP calculation.

A.Blokhin, M.Pescarini, R.Orsi.

1. It was performed a preliminary investigation on the JEFF-3.0 library of evaluated nuclear data files, compiled by the NEA DATA BANK. 340 elements/isotopes were tested through proper data processing with the NJOY system. The tests, where addressed to verify the self-consistency and the regular generation of processed files. In the frame of this work many problems emerged and, in particular, it was considered necessary to intervene into the evaluated data files to perform the needed corrections. The following nuclides, in particular, presented problems.

    - Na-22, Ar-36,38 and 40, Co-58 and 58m and Ni-59 present not complete evaluated data sets: namely some DADE, double differential cross sections in energy and angle for secondary neutrons and charge particles are not present;
    - The format of various cross sections files like K-nat, Ni-60, Eu-151, Os-nat, Pb-207, U-238, Pu-238,239 and 242, Cm-242 and Cf-252 were not completely correct;

Part of the needed corrections, referring to the previous two points, is contained in the NEA DATA BANK Internet site at the section "JEFF-3.0 library feedback". The nuclides K-nat, Ni-60 and Eu-151 were treated in ENEA Bologna in order to solve the problems emerged.

2. As a first step, in order to test the JEFF-3.0 library, it was decided to produce a library in ACE format, at the temperature of 300 K, for all the 340 nuclides of the evaluated library. It was decided to follow this program of work.

    - First - It was considered to generate an ACE library, based exclusively on the original files contained in the JEFF-3.0 library: without, in particular, any correction introduced at the level of evaluation;
    - Second - It was considered the possibility to produce another ACE library containing all the corrections suggested for a part of the 340 nuclides;
    - Third - It was decided to process the nuclides having URR (unresolved resonance region) data not only with the traditional UNRESR NJOY module but, in addition, with the PURR module, in order to obtain sets of probability tables to be used in transport calculations with the MCNP-4C2 and MCNPX systems. The p-tables data allow, in particular, to take better into account the self-shielding effects of resonance absorption in the fast neutron energy range in Monte-Carlo calculations.

    .

3. According to the recommendations of the NEA DATA BANK, the data processing of the JEFF- 3.0 library was performed with the latest version of the NJOY-99.90 system.

4. 17 evaluated data files presented the following problems.

    - Be-9 – not correct threshold energy for the Q-value;
    - F-19 – normalization problems for DE cross sections in (n,np) reaction and for DADE cross sections in (n,a) reactions;
    - Na-23 – not correct reference system presentation of the (n, n'-cont) reaction,

namely CM instead of LAB system;

- Al-27 – not correct format presentation for DADE cross sections;
- Si-29 – energy grid not always monotonic;
- Si-30 – not correct threshold energy for the Q-value;
- P-31 – not correct threshold energy for the Q-value;
- Ca-nat – energy grid not always monotonic;
- Sc-45 – not correct reference system presentation of the (n, n'-cont) and (n,2n) reactions, namely CM instead LAB system; not correct presentation of DE cross sections in (n,na) and (n,np) reactions;
- Ti-nat – energy grid not always monotonic;
- Mo-97 – not correct DADE cross sections for (n,xp) reaction;
- Mo-100 – not correct DADE cross sections for (n,xp), (n,xd), (n,xt) reactions;
- Ba-135 – not correct DADE cross sections for (n,na) reaction;
- U-233 – energy grid not always monotonic;
- U-234 – not correct energy balance for the total gamma-production;
- Pu-239 – not correct reference system presentation of the (n, n'-cont) reaction, namely CM instead LAB system;
- Cf-249 - not correct reference system presentation of the (n, 2n), (n,3n) and (n,fiss) reactions, namely CM instead LAB system.

Concerning the format presentation of the DADE cross sections, it was verified that the NJOY system is able to cancel the negative probabilities in the DADE data but the adjustments operated not always produce realistic (physical based) cross section trends. For this reason it is recommended to intervene inside the original evaluated data file to avoid, through proper re-evaluation, that negative values for the DADE data may be produced.

P 5

ACTIVITY of CAJAD
for the
IAEA Technical Meeting:
Brookhaven, USA, 4-7 October 2004

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 2003 we prepared **A056 , A057, A058 and A059 Trans files**. These Trans files contains astrophysical data, fission data, monitor reaction data. The files include new entries and some corrected old entries.

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

During 2003 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, data for material analysis by charged beams. This work is orientated mainly for nuclear wastes transformation, medical applications and material analysis.

All our activity connects with compilation papers, which have been published in scientific journals. Often authors use 'strange' units of measurement for experimental data, give 'strange' definition physical processes. (see O1072, for example). What has to compiler does in this cases? These complex cases often present in the papers in last time.

3. Checking Codes.

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

- our checking code
- CHEX from V. McLane

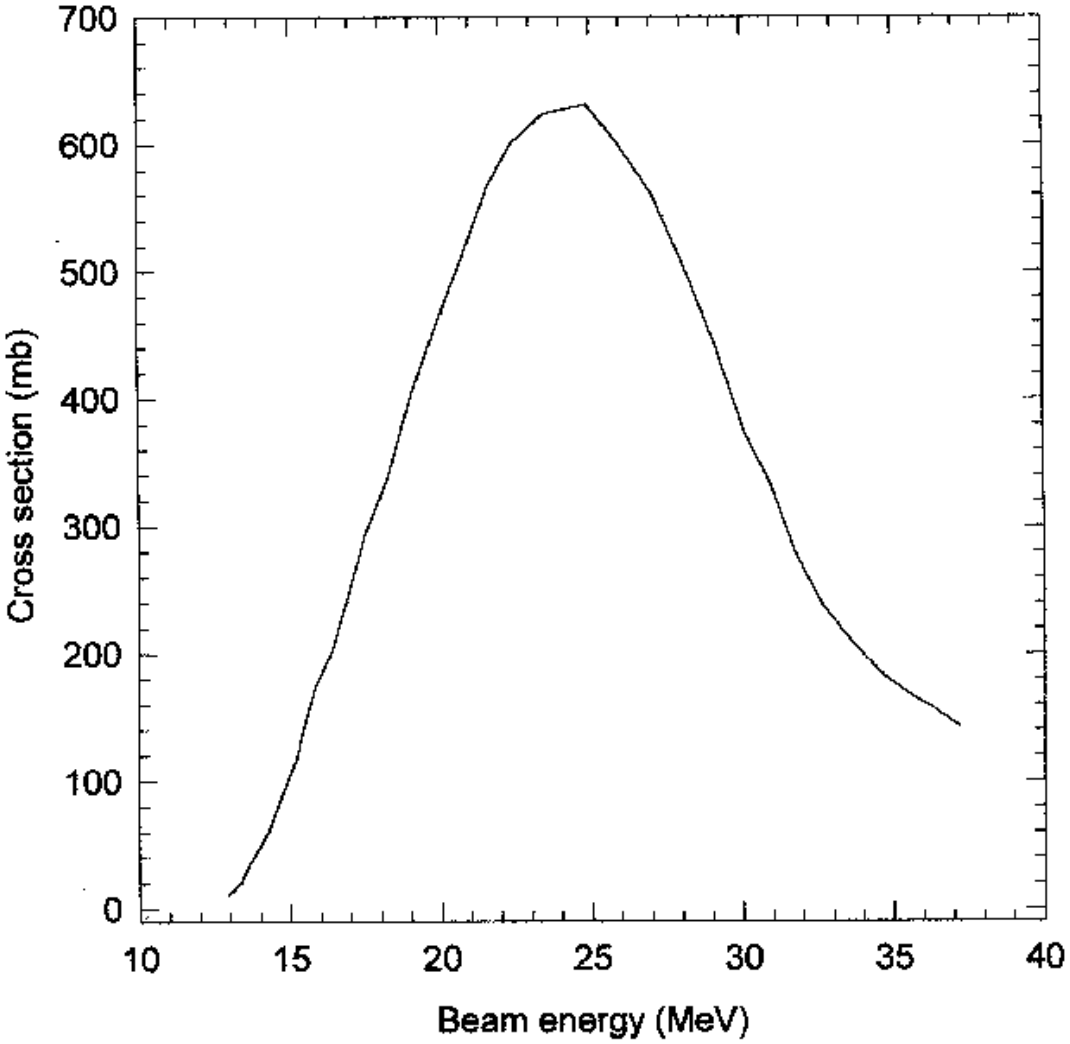
It is very useful, because the codes are not similar and different errors are finding.

4. Evaluations

Some evaluations of production cross-sections for reactions, which were not measured yet. Energy region is limited by beam energy of usual cyclotron (< 30 MeV). The evaluations use nuclear reactions systematic

One example of similar evaluation is given on next page.

$^{103}Pd(p,2n)^{103}Ag$



Center of Nuclear Physical Data (CNPD)

Status report for the IAEA Technical Meeting, Brookhaven, Upton, USA, October 4-7, 2004

S.V. Taova

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

Compilation activity

This year the compilation of experimental data was performed in frame of 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). There have been compiled data on alpha-induced reactions for the nuclei with $8 \leq Z \leq 32$ (^{24}Mg, ^{28}Si, ^{32}S, ^{36}Ar, ^{40}Ca) and $E_{c.m.} \leq 20$ MeV. Five transmission tapes (TRANS F015, F016, F017, F018 and F019) have been prepared. More than 120 entries were included into the EXFOR data library.

Besides, a great amount of work on data digitizing was performed. The processed data were included to the entries with the "T" identifier.

Brief review and analysis of the compiled works are presented in the technical paper for the International Conference "Nuclear Data for Science and Technology", Santa-Fe, USA, [1].

Evaluation activity

Processing of compiled data allowed obtaining parameters of Woods-Saxon potential with volume absorption in the α-particle energy range lower and higher than the Coulomb barrier for the ^{36}Ar+α and ^{40}Ca+α systems. They were obtained as a result of existing optical potentials modification and are intended to be used in a statistical Houser-Feshbach model widely applied in astrophysical calculations of nuclear reaction cross-sections.

It was planned to obtain estimated data using the EMPIRE-2 code. However some of the drawbacks revealed (isospin mixing is not taken into account in this code) necessitated addressing Prof. T. Rauscher, leading programmer of the NON-SMOKER code. There has been made an arrangement with him to perform the calculations with the optical model parameters obtained.

The results of work on obtaining optical model parameters are presented in the technical paper for the International Conference "Nuclear Data for Science and Technology", Santa-Fe, USA, [2].

Data base development

This year there has been completed the creation of a new "SaBa" database version – library of evaluated and experimental data on charged particles interaction with light nuclei.

The data on more than 120 reaction channels are available in it today. The library is oriented to solve astrophysics problems and contains information useful for the developers of astrophysics applications. The following essential changes occurred in the library.

1. The interface is updated.
2. The library was supplemented with new data. There appeared the opportunity to compare the cross-sections values stored in SaBa to the data from ECPL and FENDL libraries.
3. The rate values of all reactions presented in SaBa were calculated and introduced. For these values there also exists the possibility of comparing them to the data from NACRE library.
4. There appeared new means making it possible to qualitatively realize fitting of experimental data:
    - the resonance part fitting is realized;
    - the extrapolation to the area of low energies is performed.
5. There was realized the possibility of experimental data introduction by the user immediately.

Now the testing takes place and the execution of documentation is coming to an end. At the beginning of the coming year we shall be ready to expose the library for free access.

1. S.Dunaeva, V.McLane, M.Savin, S.Taova. Review of experimental data on alpha induced reactions of some nuclei (Mg-24, Si-28, S-32, Ar-36, Ca-40) in terms of astrophysical applications.
2. A.Zvenigorodskii, L.Generalov, S.Taova. Optical model parameters of alpha induced reactions on Ar-36.

Progress Report (2002-2004)

To the NRDC Meeting (4-7 October 2004, Brookhaven, USA)

ATOMKI NUCLEAR REACTION DATA GROUP

Institute of Nuclear Research of the Hungarian Academy of Sciences (ATOMKI)
Debrecen, Hungary

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Introduction

The main task and profile of the Atomki Nuclear Reaction Data Group is the measurement, compilation, evaluation and application of the low and medium energy charged particle nuclear reaction data. The work is done on the frame of international collaborations. The measurement, compilation and evaluation works are connected to international projects and to the every day applications at the home institute and at institutes of collaborating partners.

Experimental works

Cross sections for production of different residual radionuclei induced by low and medium energy light ion beams are important for a variety of applications and of research studies. The experimental data is the basis for applications demanding accurate data and for model calculations to test the capability of the models and to adjust the optimal parameters. During the last years we have continued the systematic measurement of excitation functions of charged particle reactions for many different applications (see list of references).

These experiments were done at the MGC 20E cyclotron and VdG-5 accelerator in Debrecen and at cyclotrons of foreign laboratories in the frame of well established long term collaboration, in:

- the Institute of Nuclear Chemistry (FZ Jülich, Germany),
- the Cyclotron Laboratory of the Free University of Brussels (VUB, Brussels, Belgium),
- the Cyclotron Radioisotope Center of the Tohoku University (CYRIC, Sendai, Japan),
- the Cyclotron Laboratory of the Abo Akademi (Turku, Finland),
- the Division of Advanced Technology for Medical Imaging of the National Institute of Radiological Sciences (Chiba, Japan),
- the Radionuclide Production Laboratory of the Themba Laboratory for Accelerator Based Sciences (Somerset West, South Africa).

The theoretical calculation of the measured data was done in collaboration with scientist from

- Institute of Theoretical Physics, IPPE, Obninsk, Russia.

The results published in the period covered can be obtained in the references.

Main application fields of the new data measurements

Production of medical radioisotopes for diagnostic and for therapy

In the field of the production of diagnostic and the therapeutic radioisotopes the nuclear reaction data are mostly used to optimise the production circumstances (high yield, minimal impurity level, low cost). Recommended database were developed for production of the most widely used radioisotopes in the fame of an IAEA CRP. The recommended data sets, however requires validation and additional measurements in selected energy regions. The cross-section database for the newly introduced positron and gamma emitters is usually very poor. In many cases basic data are missing, therefore new measurements vitally important.

The database in the field of the production of therapeutic radioisotopes with charged particle induced reactions even less developed. In most of cases either no experimental data are available or only contradicting data sets were published, except a few well-measured reactions. To improve the situation a Co-ordinated Research Project were started in 2003 with title "Nuclear data for production of therapeutic radionuclides".
The Debrecen group performs intensive experimental work in both application fields.

Excitation functions of monitor reactions

The importance of the monitor reactions is well known in the field of neutron and charged particle induced reactions. They are broadly used both in irradiations for practical applications and for basic research. We continue our systematic work to extend the list of the charged particle monitor reactions, to validate the existing database for series of reactions with integral measurements and to compare the different monitor reactions.

Activation cross sections for accelerator technology

Several applications make use of nuclear data up to 100 MeV including accelerator technology (shielding, low activation materials, collimators, target backings, secondary neutron sources etc.). With regard to input beam the proton and deuteron induced reaction are most widely used. Recent model intercomparisions underline the importance of the experimental data. The main goal of our investigations is to complete the experimental data base for the not measured, missing elements, and for the production of short half radioisotopes on important elements where the database for longer lived products are well measured.

Compilations and evaluations

EXFOR compilations

During the 2002-2004 period 47 charged particle entries were compiled at ATOMKI with experimental data inputs mostly from Hungary (ATOMKI) and Germany (FZ Jülich).

The compilation activity shows raising tendency. Practically all old missing works from Debrecen and Jülich (about 90%) were compiled. The extensive experimental work in both institutes gives permanent task for further compilation activity. New compilation list will appear soon in connection with the Therapeutic CRP.

Upgrading of the charged particle cross-section database for medical radioisotope production: diagnostic radioisotopes

The Debrecen group is participating in the upgrading of the IAEA recommended cross-section data base for charged particle induced reactions relevant to production of radioisotopes used for medical diagnostic and for related reactions to monitor beam parameters. During 2002-2004 the upgrading of the database for production of PET radioisotopes was completed. Presently the upgrading of the reaction cross section data for production of diagnostic gamma emitters is in progress.

Development of database for production of therapeutic radionuclides

The main contributions of the Debrecen group to the development of the database are the new measurements and the compilation of the cross section data sets of the dedicated charged particle reaction (compilation, critical selection, comparison with the integral data etc.)

Cross-section database for production of ^{103}Pd from Rh, ^{123,124}I from Te, ^{201}Tl from Tl

In the production process of medical radioisotopes the so-called "targetry" plays a very important role. For standardisation of high intensity solid targets a co-ordinated project was initiated by the IAEA: "Standardised High Current Targets for Production of Diagnostic and Therapeutic Radionuclides". The project deals with all aspects of the production of ^{103}Pd, ^{123,124}I and ^{201}Tl radioisotopes by using Rh, Te and Tl targets. Compilation and evaluation was done by the Debrecen group for the participating stable isotopes of targets and for the backing materials. The database will be published in the near future in the IAEA Technical Report Series.

Charged particle cross-section database for thin layer activation technique

To deduce depth-activity curves either new measurements has to be done on the investigated material or the knowledge of the nuclear reaction data and of the elemental composition are required. The detailed measurements for each target are very time consuming; therefore in most cases it is more fruitful to obtain the activity

distribution with calculation and to perform checking and validation only at few points with more simple experiments. Unfortunately presently no evaluated cross section database exists for thin layer activation studies. Therefore for practical use in the ATOMKI an independent database for TLA is under development by using evaluated cross section data. Presently it contains p, d, ^{3}He and alpha-particle induced reactions up to 30-40 MeV on the following elements:
Al, Ti, Fe, Ni, Cu, Zn, Zr, Nb, Y, Mo, Rh, Pd, Cd, W, Ta, Pt, Ir.

Nuclear data service

The ATOMKI Group continues to distribute compiled or evaluated cross section / thick target yield data for low and medium energy charged particle induced nuclear reactions mainly connected to cyclotron applications.

Staff

The staffs connected to the experimental data measurement consist of seven physicists and two chemists. Out of them three physicists are working in part time on data compilation and evaluation. All are engaged in practical application of the ATOMKI cyclotron

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Vermeulen C., Steyn G. F., Nortier F. M, Van der Walt T. N., Szelecsényi F., Kovács Z., Qaim S. M.:
Excitation functions and production rates of radionuclides produced in the proton bombardment of ^{nat}Pr and ^{nat}La.
Proceedings of the International Conference on Nuclear Data for Science and Applications, September 27-October 1, Santa Fe, USA (submitted).
(related project: production of medical radioisotopes: diagnostic radioisotopes)

Szelecsényi F., Steyn G. F., Kovács Z., Van der Walt T. N., Suzuki K., Okada K., Mukai K.:
New cross-section data for the ^{66}Zn(p,n)^{66}Ga, ^{68}Zn(p,3n)^{66}Ga, ^{nat}Zn(p,xn)^{66}Ga, ^{68}Zn(p,2n)^{67}Ga and ^{nat}Zn(p,xn)^{67}Ga nuclear reactions up to 100 MeV.
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms (submitted).
(related project: production of medical radioisotopes: diagnostic radioisotopes)

Szelecsényi F., Steyn, G. F., Kovács Z., Vermeulen, Van der Meulen N. P., Van der Walt T. N., Suzuki K., Okada K., Mukai K.:
Investigation of the ^{66}Zn(p,2pn)^{64}Cu and ^{68}Zn(p,x)^{64}Cu nuclear processes up to 100 MeV: production of ^{64}Cu.
Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms (in press).
(related project: production of medical radioisotopes: diagnostic and therapeutic radioisotopes)

Progress of Nuclear Data Evaluation and Related Studies in CNDC and CNDCN

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The following progress are obtained in collaborating with China Nuclear Data Coordination Network(CNDCN).

1. Nuclear data evaluation works

- Neutron data evaluation

Light nuclides: The updated evaluations of H, D, and T have been finished. The whole set of neutron data including the MF-6 of ^{9}Be, ^{12}C have been calculated and evaluated based on new reaction model LUNF series codes for light nuclei and experimental data. **Structure nuclides:** ^{28,29,30,nat}Si, ^{50,52,53,54,nat}Cr, ^{64,66,67,68,70,72,73}Zn, ^{182,183,184,186,nat}W, ^{197}Au 22 structure material nuclides have been calculated and evaluated on the basis of the experimental data, the output file contained MF=1-6 in ENDF/B-6 format. **Fission product nuclides:** ^{75,77,79}As, ^{70,71,72,73,74,75,76,77,78,nat}Ge, ^{174m}Lu, ^{148m}Pm, ^{85,87,nat}Rb, ^{69,71,nat}Ga, ^{86}Kr, ^{129}I, ^{89}Sr, ^{125}Sb, ^{123,133,135}Xe, ^{89}Y, ^{92,94,95,96,97,98,100,nat}Mo, ^{113,115,123,nat}In, ^{120,122,124,125,126}Sn, ^{93}Nb evaluations have been completed. The 101 FP evaluations of CENDL-3.0 have been selected to join in the international comparison of FP and recommend by WPEC Subgroup 21. **Actinides:** On the basis of the new model code FUNF for fission nuclei and the new experimental data adjusting the model parameters carefully, the new evaluations of ^{233,234,235,236}U, ^{241,242}Am, ^{236,237,238,239}Np and ^{232,233,234}Th have been performed.

- **Structure and decay data**

CNDC and CNDCN have taken permanent responsibility for evaluating and updating NSDD for A=51, and 195-198.The mass chain A=197 have been revised using available experimental decay and reaction data, and A=196 is being updated. Updated evaluation of A=197 has been sent to NNDC, USA and will be published in NDS in 2004. The evaluations of mass chain A=52-56 were being updated at Jilin University. Decay data of ^{232}Th, ^{231,233}Pa, ^{232,233,234,236}U have been intercompared and checked. The decay data of ^{233}U were being evaluated on the basis of the new measured data.

2. Nuclear model study and related codes development

- **Nuclear reaction model study**

A new model was improved and completed for 1p shell light nuclides, which contains the dynamics and kinematics of nuclear reactions.

A method to set up file-6 of light nuclei for evaluated neutron data in ENDF/B-6 format below 20 MeV has been established and the energy balance was strictly considered. This method has been used in the evaluation of n+^{12}C.
The possibility of ^{5}He emission has been investigated in the light nuclear reactions, and the formulation for calculating of the ^{5}He emission was developed. Also the double differential cross sections of ^{5}He emission, as well as the spectra of neutron and alpha particle from the breakup of ^{5}He, were set up and used in the series codes of LUNF.

- **Covariance study**
  A code for evaluating the covariance matrix of experimental data was developed. The covariance data are output in ENDF/B-6 format. The code together with the spline fitting code for multi-sets of correlative data was used to practically evaluate the covariance data for ^{58,60,61,62,64,nat}Ni and ^{63,65,nat}Cu and the reasonable results have been got. A program RAC for calculating covariance data of light nuclide was developed, based on the R matrix theory. The program has been tentatively used to calculate the covariance data for ^{6}Li and ^{10}B, the reasonable results have been got for the cross sections up to 5 MeV.
- **The systematic study of fission yield data**
  Based on the mass distribution data up to 200 MeV measured by Zoller, the systematic on dependence of chain yield on incident neutron energy for each mass number A was studied. And also the systematics of mass distribution on mass A and incident neutron energy was investigated by using 5 (or 3) Gaussian model. The calculated results could reproduce the experimental data used well. The investigation also shows that the correlation between the parameters of the systematic and the yields calculated with the systematics is quite complicated and, in general, is quite strong.
- **The study on the dependence of yield on energy**
  Taken some typical important fission products from $^{235, 238}$U fission, and the dependences of fission yield on incident neutron energy were studied. The covariance data were evaluated for each set of experimental data and the correlation among the data due to the error of fission rate (or normalization), detector efficiency, decay data etc. was taken into account in the fitting and the covariance matrix was obtained for the fit. The results show that the data for most of product nuclides, can be fitted with a linear function. But for some special product nuclides, the data have to be fitted with a spline function.
- **UNF, PREUNF**
  The UNF code (Version 2003) for nuclear data model calculations with the unified Hauser-Feshbach and exciton model has been completed. An interface code PREUNF with RIPL database has been developed, and used as the key code in the CENDL-3 nuclear data evaluations.
- **FUNF, PREFUNF**
  The updated version of code FUNF, used for actinides model calculation, was improved compare with previous version. The code has been validated by using for some actinides calculations. The related interface code PREFUNF with RIPL database has been finished too.
- **APMN**
  APMN is a program for automatically searching a set of optimal optical potential parameters in $E \leq 300$ MeV energy region by means of the improved fastest falling method, which is suitable for non-fissile medium-heavy nuclei with the light

projectiles. One set of optical potential parameters may be suitable from 1 to 40 target nuclei obtained based on their experimental data simultaneously.

- **TT**
  Powerful software designed for nuclear data evaluation under Windows™ and Linux platforms. The main function of TT included the retrieving and plotting the evaluated data from the ENDF/B-6 format libraries and EXFOR database. The cross sections (MF=3), angular distributions (MF=4) can be plotted. TT also can be used for plotting the free format data.

3. Nuclear data benchmark testing and validation works

The benchmark testing of CENDL-3 was continued. The testing of Pu, U isotopes, ^{232}Th , ^{237}Np, Cu, Al, Pb, Fe, D, C and some actinides of CENDL have been performed with available benchmarks. The NJOY system was used for generating the libraries for calculations. According to the benchmark testing results, improvements have been introduced into revaluations of some nuclei.

The multigroup cross section libraries based on the CENDL-3, several multigroup cross section libraries of WIMS: WIMS 69, WIMS 82, CPM 69, CWIMS 69 and 123 groups library used for SCALE-4 were set up for the reactor physic performances and ADS project. A MCNP Monte Carlo library of CENDL-3 were generated and used in the benchmark testing of CENDL-3.

4. The nuclear data work for ADS project

A library of continuum cross sections (at temperature 500K□850K□1200K□1500K□2000K) for MCNP code was established, which contains light nuclides H□^{9}Be, O, Al , material nuclides Cu, Fe, Cr and fissile nuclides ^{233,234,235,236,238,239}U, ^{238,239,240,241,242}Pu.

A code MEND used for nuclear data calculations in the medium-high energy is being developed. Investigate the international experimental, theoretical nuclear data and relevant evaluation tools for the study of nuclear data in medium-high energy. The fission spectrum and number of prompt neutron per fission were calculated using the Quantum Molecular Dynamics (QMD), Statistical Decay Model (SDM) and fission statistical models in energy 100~3000MeV for nuclides ^{232}Th, ^{233,235,236,238}U, ^{235}Np, ^{242,243}Am, $^{240\sim250}$Cm, ^{249}Cf, ^{247}Bf and $^{237\sim242,244,246}$Pu

5. Nuclear data library works

- The third version of China Evaluated Nuclear Data Library (CENDL-3) contains the data about 200 nuclides in the energy range from 10^{-5}eV to 20MeV. The benchmark testing and validation for most important structure material, actinides nuclides have been done. Related technical documents for CENDL-3 are being prepared.
- By the support of Ministry of Science and Technology of China, Nuclear Basic Data Library is being constructing. This library contains the basic information, characters of nucleus and nuclear reaction model parameters, a series of special nuclear databases. This project will be finished in two or three years and will be available for the world through the Internet.

Japan Charged-Particle Nuclear Reaction Data Group (JCPRG)

Executive Committee

Progress Report to the
IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres
4-7 October 2004

0. General

Since the last NRDC meeting in June 2003, we have carried out the following activities:

1. Compilation of CPND for NRDF and EXFOR
2. Compilation of CPND bibliographies for CINDA
3. Improvement of Web-based data input system "HENDEL"
4. Improvement of NRDF retrieval system "DARPE"
5. Development of utilization system for EXFOR and evaluated libraries
6. Data services for Japanese users

The regular JCPRG budget has ended at March 2001. We are applying a competitive budget for our further activity. Executive committee is organized by 7 researchers and 1 secretary. 6 postdoctoral researchers in Meme Media Lab. of Hokkaido Univ., 6 graduated students in Nuclear Physics Laboratory of Hokkaido Univ. and 1 technical staff work part-time. 1.5 equivalent man year is dedicated to NRDC Network activities.

1. CPND Compilation for NRDF and EXFOR

In 2003 JFY, we newly compiled 85 references (984 records, 6.85 MB) for NRDF based on CPND obtained with the accelerators in Japan and published in PRL, PR/C, PR/D, PL/B, NP/A, PTP, NST, EPJ/A, NIM/A, NIM/B, NIM, JPJ, NSE, ARI, RCA, JNRS, ZP/A, JIN, RI, and BCJ, some of which are specially checked for references identified as missing in EXFOR during the Coordinated Research Project on Medical Radioisotope Production and Technical Meeting on Ion Beam Analysis (c.f. Action 27, 2003).

Since the last NRDC meeting (June 2003, Vienna), 69 new entries were made by translation from NRDF to EXFOR, and also 82 old entries were revised. These were transmitted by 7 trans files (E023 to E028 and R014) to NDS open area. JCPRG is grateful for many comments from NDS, NNDC and CAJaD on our files.

As the first case of author proofs, several EXFOR entries for new works by Cyclotron Radioisotope Center (CYRIC), Tohoku Univ., Sendai are reviewed by authors. We appreciate their cooperation.

2. CPND Bibliography Compilation for CINDA

We start the compilation of bibliographies for Japanese CPND works. We are regularly scanning 4 Japanese journals JPJ, PTP, NST and NSTS. Neutron bibliographies are compiled at JAERI for JPJ, PTP and NST as before. The first batch (86 new records) was submitted to NEA in July 2004. This batch will be corrected according to the decision of 2004 NRDC meeting.

3. Web-Based Data Input System "HENDEL"

A web-based nuclear data input system HENDEL (Hyper Editor for Nuclear Data Exchange Libraries) has been improved so as to cover whole aspects of NRDF and EXFOR (c.f. WP2002-31). Since the last meeting, some upgrades have been done:

- With the aid of V. Zerkin, Linux version of CHEX is installed to this system. CHEX results are automatically generated whenever we generate EXFOR files by HENDEL.
- Multiple reaction formalism is covered.
- Some separated input forms for NRDF and EXFOR (e.g. detector) are now unified.

Now this system is accessible from our web site for comments from other centres (c.f. Action 35, 2003). User: *guest*, Password: *jcprgx4*. Manual is in preparation. You can learn by yourself from a sample input with entry id x0055 for now.

4. NRDF Retrieval System "DARPE"

The NRDF database is accessible from our web site. New data, for which NRDF files are reviewed by JCPRG executive committee but EXFOR files are not finalized, can be obtained from this site.

5. Utilization System for EXFOR and Evaluated Libraries

JCPRG is developing a new utilization system for the experimental data and evaluated data as a joint project with JAERI. For users' availability, internet browser environment, which most users are familiar with, is chosen as a client interface between the databases and users. Users are able to search any data they want and obtain image files of them, by submitting queries to the database server on the web page without any requirement of additional software installation. The prototype of the server side CGI script is now being tested. One module, which inputs EXFOR to the MySQL database, can be used as an efficient checker to find illegal codes in an EXFOR entry.

6. Data services for Japanese Users

We support Japanese researchers both in energy and in non-energy field for experimental nuclear data (NRDF and EXFOR). Recently number of EXFOR users is growing in Japan. For example, people who study nuclear radii by using diffraction patterns of proton scatterings cited EXFOR for high energy elastic scattering angular distribution data around 1 GeV (c.f. A. Kohama *et al*., Phys. Rev. **C69** (2004) 064316). Introductory seminar for nuclear database was done at RIKEN at January 2004. EXFOR+CINDA CD produced by NDS was distributed to some Japanese users.

ANNEX: Organization and members of JCPRG

Advisory committee:

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Naohiko OTSUKA (*Japan Atomic Energy Research Institute*)
Takako ASHIZAWA (*Hokkaido Univ.*, expert at graph image digitization)

2) Compilation of CPND bibliographies for CINDA:

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3) Improvement of web-based data input system:

Naohiko OTSUKA (*Japan Atomic Energy Research Institute*)

4) Improvement of NRDF retrieval system:

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6) Services for Japanese Users

Hitomi YOSHIDA (*Hokkaido Univ.*)

[1] Niigata Univ. since May 2004, [2] Tokyo Institute of Technology since June 2004, [3] Hokkaido Univ. since April 2004

MSU SINP CDFE 2003 – 2004 Progress Report.

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 the Network of Nuclear Reaction Data Centres (04 - 07 October 2004, NNDC, BNL, Brookhaven, USA

This report contains the **short review** of the works carried out by the CDFE concern the IAEA Nuclear Reaction Data Centres Network activities for the period of time from the IAEA Technical Meeting on "Coordination of the Network of Nuclear Reaction Data Centres" (17 - 19 June 2003, IAEA NDS, Vienna, Austria) till the fall of 2004 and main results obtained.

1. **Two new** CDFE EXFOR **TRANSes M034 and M035** have been produced and transmitted to the IAEA NDS. The TRANSes contain (**Annex 1**) 6 retransmitted and 13 new (M0645 - M0657) ENTRYs with 148 new data SUBENTs.

2. In cooperation with CAJaD (Dr. Feliks E.Chukreev) the CDFE relational nuclear data databases "Relational ENSDF" and "Nuclear Reaction Database (EXFOR)" and with very kind assistance of NNDC (Dr. David Winchell) the CDFE database "Nuclear Physics Publications ("NSR" Database) have been put upon the Web-site (**http://cdfe.sinp.msu.ru**) before were **upgraded** by adding a new data and software improvement.

3. At first time **nuclei levels isospin data** produced "by hands" using text parts (CONTINUATION etc.) of ENSDF data sets were included into the CDFE "**Relational ENSDF**" database. Now isospin values could be included into all possible queries.

4. The new advanced version of complete relational database "**Relational ENSDF**" **Search Engin**e has been developed (**Annex 2)**. This is very flexible and powerful system – informational "Russian matreshka": the user can open sequentially each needed part yourself, in parallel he can form the output table content. Now any fields of any ENSDF cards could be found in any combinations (several examples of Search Engine possibilities: **Annex 3 - Annex 11**).

5. All three complete CDFE databases EXFOR, ENSDF and NSR are combined now into unified information system:

- after processing of any queries to "**Relational ENSDF**" and "**Nuclear Reaction Database (EXFOR)**" one can obtain correspondent complete NSR documents;
- after processing of any query to "NSR" one can obtain an access to appropriate documents of both databases "EXFOR" and "ENSDF":
  - for EXFOR (**Annex 12**) the intermediate table "NSR => EXFOR"gives to one a list of full article Subentries and opportunity to obtain NSR documents for that article (come back to NSR);
  - for ENSDF (**Annex 13**) the intermediate table gives to one general description of article content including "Nucleus", "Experimental information", "ENSDF Source" set CDFE internal numbers and "References" to other NSR document codes concern the article content; these codes are links to correspondent NSR documents and therefore search process could be cycled.

6. As an continuation of consistent evaluation of total and partial photonuclear reactions cross sections obtained in the experiments with quasimonoenergetic annihilation photon beams at USA Livermore and France Saclay for 19 nuclei ^{51}V, ^{75}As, ^{89}Y, ^{90}Zr, ^{115}In, ^{116,117,118,120,124}Sn, ^{127}I, ^{133}Cs, ^{159}Tb, ^{165}Ho, ^{181}Ta, ^{197}Au, ^{208}Pb, ^{232}Th, ^{238}U (V.V.Varlamov, N.N.Peskov, D.S.Rudenko, M.E.Stepanov. Consistent Evaluation of Photoneutron Reaction Cross Sections Using Data Obtained in the Experiments with Quasimonoenergetic Annihilation Photon Beams at USA Livermore and France Saclay. Voprosy Atomnoj Nauki i Tekhniki. Seriya: Yadernte Konstanty, 1 – 2 (2003) 48 – 89) joint evaluation of cross sections for reactions (γ,n), (γ,2n), (γ,3n), (γ,Xn), (γ,sn) and (γ,abs) has been carried out. Data are in preparation n to including into EXFOR.

7. The CDFE "Atlas of Giant Dipole Resonances. Parameters and Graphs of Photonuclear Reaction Cross Sections" published by A.V.Varlamov, V.V.Varlamov, D.S.Rudenko, M.E.Stepanov at 1999 as INDC(NDS)-394, IAEA NDS was put upon the CDFE Web-site as the pdf-document.

The main items of CDFE future short-term programmes, priorities and new tasks are listed in the **Annex 14**.

Annex 1. The CDFE new EXFOR TRANSes M034 and M035 contents (old corrected and new ENTRYs)

TRANS M034		**TRANS M035**	
ENTRY's Number	**SUBENT Amount**	**ENTRY's Number**	**SUBENT Amount**
L0031	*15*	*M0524*	*5*
M0093	*3*	*M0541*	*11*
M0644	*5*	*M0542*	*14*
M0645	10	M0651	12
M0646	1	M0652	6
M0647	3	M0653	4
M0648	31	M0654	2
M0649	15	M0655	5
M0650	9	M0656	38
		M0657	12
Total new: 6	**Total new: 59**	**Total new: 7**	**Total new: 79**
		Sum new: 13	**Sum new: 131**

Note by NDS editor: *Annexes 2 - 13 on technical details of "Relational ENSDF" are not included in this report, see full copy of the CDFE Progress Report on the NDS-NRDC web page.*

Annex 14. The main items of the CDFE future short-term programmes, priorities and new tasks.

1. Upgrading and addition of the CDFE bibliographical data collection. Including the 2004 photonuclear data into the relational database "Photonuclear Data Index" (PNI).

2. Continuation of photonuclear data compilation using EXFOR format, new TRANSes (M036, M037,…) production.

3. 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.

4. Upgrading, addition and correction of the existed CDFE EXFOR relevant databases, improvement of Search Engines:

- "Giant Dipole Resonance Parameters. Photonuclear Reaction Cross Sections";
- "Relational Nuclear Reaction Database (EXFOR)";
- "Relational ENSDF":
  - Including into the search form additional data (electric and magnetic moments, widths, deformations etc. for levels, reduced probabilities, conversion intensities and coefficients etc. for gamma-rays, etc.) from ENSDF "CONTINUATION" records similar to that has been done before for level isospin values);
  - Full ENSDF data set presentation (comments, graphycs) in the output form;
  - Development of the "quick up-dating" procedures.

5. Development of new unified joint interface for all three complete databases "NSR", "EXFOR" and "Relational ENSDF". It will give to one possibility of working with all three systems at the same time.

P11

Ukrainian Nuclear Data Centre: Progress Report, 2003/04

IAEA Technical Meeting on the Network of Nuclear Reaction Data Centres,
4 - 7 October 2004, Brookhaven, USA

Summary of nuclear data activity by staff of the UKRNDC
1 July 2003 – 30 September 2004.

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Introduction

Ukrainian Nuclear Data Centre (UKRNDC) is subdivision within the Neutron Physics Department at the Institute for Nuclear Research of the National Academy of Sciences of Ukraine. UKRNDC has 6 permanent researchers. The staff is partly involved in the experimental investigations of neutron cross sections at Kyiv Research Reactor.

Compilation

We continue collection and compilation of experimental neutron data published by Ukrainian researchers. We also started to compile the experimental charged particle data. After compilation of numerical data and related information using EXFOR format they are sent to NDS IAEA to be included to EXFOR library (see Table 1).

Table 1. EXFOR's entries sent to NDS IAEA by UKRNDC.

#	EXFOR's entry	Reference	Date of compilation y/m/d
Neutron data			
1	32205	(J,NST,1,425,200208) (J,ZNJD,4,(2),53,2001)	2003/11/11
2	32206	(J,UFZ,39,785,1994)	2003/10/08
3	32212	(J,NST,1,389,200208)	2003/11/25
4	32213	(J,YF,61,(9),1562,199809)	2004/06/18
Charged particle data			
5	D5001	(J,YF,61,(9),1569,199809)	2004/04/10
6	D5002	(J,YF,61,(9),1562,199809)	2004/06/18

We started to collect the photonuclear data executed by Ukrainian scientists and we plan to begin their compilation in the near future.

Collaboration

- We continue our collaboration with the Laboratory of Engineering and Technology (LET) of the Chornobyl Center for Nuclear Safety, Radioactive Waste and Radioecology (CCNSRWR),

Slavutych in scientific support of Slavutych Nuclear Data Bank and its users. This work is supported by Science and Technology Center in Ukraine (STCU Project #1648, *"Development and support of Nuclear Data Base in Slavutych for decommissioning of Chornobyl NPP reactor units").* In frame of this activity the following actions were carried out:

- A series of lectures *("Using the NJOY code system for preparation of the MCNP libraries", "Data Table Formats used in the MCNP libraries")* was red for the LET staff.
- In cooperation with the LET staff the analysis of a list of nuclides, which require preparing of data libraries for calculations of the RBMK-1000 reactor radiation characteristics, was conducted [1].
- The neutron activation cross section calculations were carried out for 40 elements of the RBMK structure material (natural isotope abundance). These elements are H, Li, Be, B, C, N, O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Br, Zr, Nb, Mo, Ag, Cd, Ba, Sm, Eu, Dy, Hf, W, Pb, Bi. For input data the nuclear evaluated data libraries BROND-2, ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, CENDL-2 were used. The calculations were conducted with precision 0.1%, at three temperatures - 0К, 293К, 573К, with the help of a software package NJOY-99.81 and NJOY94 (module MIXR).
- The pointwise cross section (PENDF format) libraries and the ACE-format libraries for the elements which are the main constituents of the RBMK-1000 reactor fuel, namely, for ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu and ^{241}Pu isotopes, were produced. The input data were taken from five nuclear data libraries: BROND-2, ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, CENDL-2. Calculations were made for three temperatures, T=0K, 293K and 593K, by NJOY99.81 code on the computer with RISC/6000 processor under AIX operating system. Results of calculations are combined in two ACE-format libraries, ULIB and PULIB, separately for Uranium and Plutonium isotopes.

All calculations were performed at the UKRNDC computer base, scheme of which is shown at Figure 1.

We are very much obliged to our STCU Project #1648 collaborators, two of them are here: NNDC, USA and NDS, IAEA. Due to their support we were able to fulfil these works and can plan our activity for next year.

- We continue our collaboration with the Physical Department of the Kyiv National University. The teaching course "*Nuclear Data for Science and Technology*" (68 hours) was lectured in 2003-2004 for graduate course students of NPD KNU. This course included the following items: ENDF/B libraries, EXROR system, ENSDF library, the use of UTILITY and PREPRO codes in work with the ENDF libraries, the introduction to NJOY99 code system, the Network of Nuclear Reaction Data Centers and the use of on-line services.

- We started a collaboration with the Lawrence Livermore National Laboratory (STCU Project #P176, *"Experiments at Kyiv Research Reactor"*) to determine the neutron standard cross sections with high accuracy. In frame of this activity the measurements of total, total scattering and angle scattering neutron cross sections at reactor neutron filtered beams with energies in the range from 2 up to 144 keV on carbon samples will be performed.

Customer Services

- During 2003-2004 the data for users requests were prepared and adapted (from ENDF, ENSDF and EXFOR libraries) for our institute researchers and for ones from other institutes. The organizations, whose requests on nuclear data have arrived and were executed in the

accounting period:

1. Department of Nuclear Physics of the Institute for Nuclear Research (INR) NASU.
2. Department of Nuclear Physics of Kyiv National University.
3. Department of Physics of Biological Systems of the Institute of Physics NASU.
4. Department of the Theory of Nuclear Reactions INR NASU.
5. Department of Nuclear Reactions INR NASU.
6. Center of Environmental Problems INR NASU.
7. Kharkiv Institute of Physics and Technology.
8. Uzhgorod Institute of Nuclear Physics NASU.

- The UKRNDC site is operating and developing. Ukrainian customers, especially students and those physicists, who wish to prepare the pointwise and multigroup cross sections self-dependently, but do not have a good experience in it, use this site very often. Address of the UKRNDC site: *http://ukrndc.kinr.kiev.ua.*

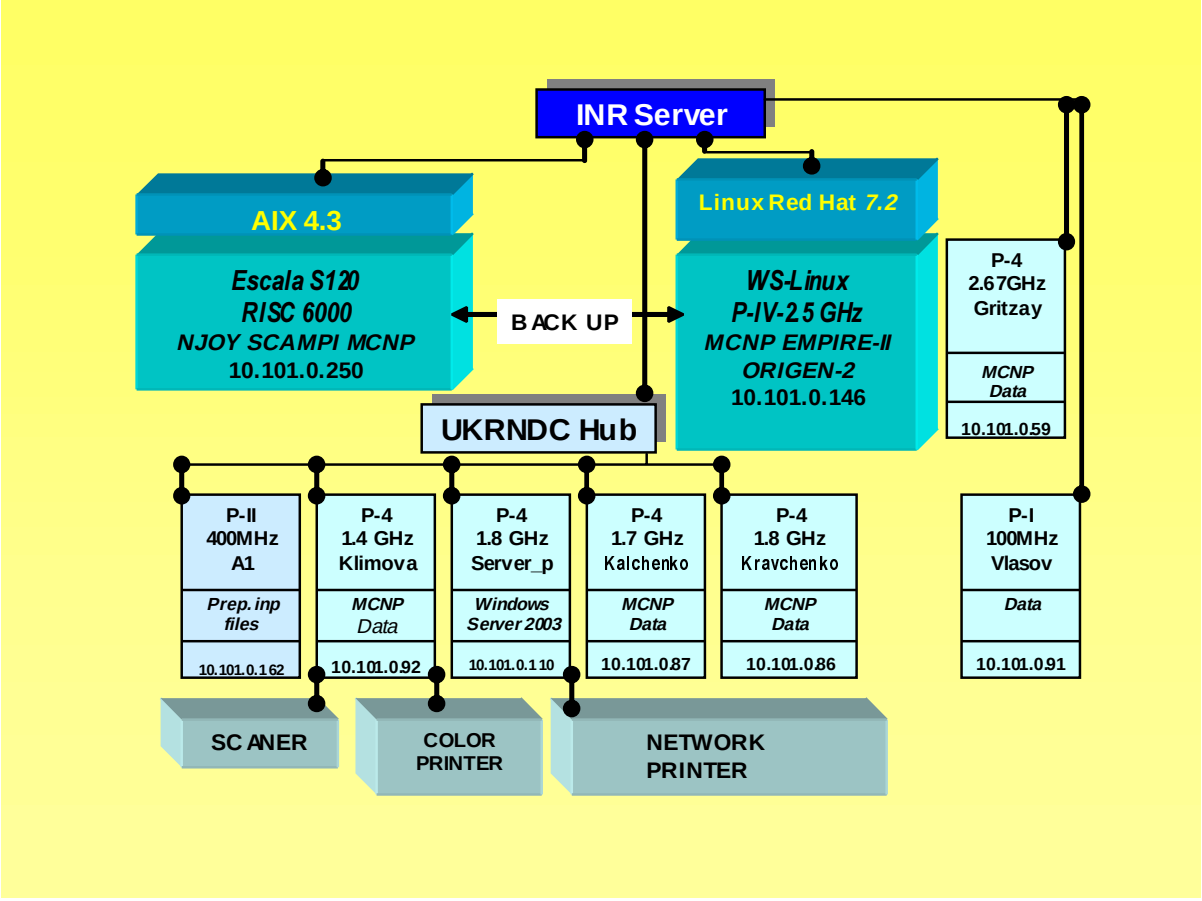

Figure 1. Scheme of the UKRNDC computer base.

Calculation

- Special library for simulation of neutron filters by means the code FILTER_L (ver. 5) was extended using ENDF/B-6 (rel.8), JENDL-3.3, JEFF-3.0.
- Analysis of self-shielding factors for Cr-52, using ENDF-VI (rel. 8), JEFF-3.0, JENDL-3.3, BROND-2, CENDL-2 libraries was fulfilled at several energy ranges. These calculations were carried out with the code complex DT_GRO, GROUPIE, SELF. The results were used to present the measured cross sections on Cr-52 samples [2] and will be used in further investigations.
- The ACE-format libraries for the elements which are generated during operation of the WWR-M reactor type, namely, for ^{24,25,26}Mg, ^{28,29,30}Si, ^{84,86,87,88,89,90}Sr, ^{89,90,91}Y, ^{90,91,92,93,94,95,96}Zr, ^{92,94,95,96,97,98,99,100}Mo, ^{96,98,99,100,101,102,103,104,106}Ru, ^{140,141,142,144}Ce, ^{106,108,110,111,112,113,114,115m,116}Cd, ^{120,122,123,124,125,126,127m,128,129m,130,132}Te, ^{124,126,128,129,130,131,132,133,134,135,136}Xe, ^{138,139,140}La, ^{141,142,143}Pr, ^{134,135,136,137,138,140}Ba, ^{142,143,144,145,146,147,148,150}Nd, ^{147,148,148m,149,151}Pm isotopes, were produced. Most of them are absent in the standard MCNP distribution. These libraries were used for calculation of the effective multiplication factor, k_{eff}, to estimate a level of the Kyiv Research Reactor safety [3].

Experimental Neutron Data Measurements

- The total neutron cross section and its self-shielding values for Cr-52 were measured at Kyiv Research Reactor using Neutron Filter Technique. The accuracy of measured cross sections was better than 2%, as it was requested 3% in *The NEA High Priority Nuclear Data List (1998).* These data for neutron energies 24 and 58 keV were compared with the data from ENDF libraries and presented at the ND2004.
- The total neutron cross sections for natural carbon were measured using neutron filtered beams with accuracy better than 1% at average energies 24, 59 and 148 keV at the Kyiv Research Reactor.

Visits and Conferences

- In December 1-5, 2003 N. Klimova visited NDS IAEA as EXFOR compiler to take part in the Workshop on Relational Databases for Nuclear Data Development - Dissemination and Processing.
- In September 26-October 1, 2004 O. Gritzay and O. Kalchenko took part in International Conference on Nuclear Data for Science and Technology, Santa Fe, NM, USA.

References

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2. Olena O. Gritzay, Volodymir V. Kolotyi, Nataliya A. Klimova, Oleksandr I. Kalchenko, Mykola L. Gnidak, Oleksandr I. Korol’, Petro M. Vorona, “Total Cross Section And Self-Shielding Effects Of Cr-52 Isotope Measured At Kyiv Research Reactor Neutron Filtered Beams”,ND2004, 26 September-1 October, 2004, Santa Fe, NM, USA.
3. Olena Gritzay, Oleksandr Kalchenko, Nataliya Klimova, Volodymyr Razbudey, Andriy Sanzhur, Stephen Binney, “Monte-Carlo Calculation Of Core Reactivity And Fluxes For The Development Of BNCT Neutron Source At The Kyiv Research Reactor”,ND2004, 26 September-1 October, 2004, Santa Fe, NM, USA.

P12

Status Report of JAERI Nuclear Data Center

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1. General

Nuclear Data Center in JAERI serves as a secretariat of Japanese Nuclear Data Committee. The committee has three subcommittees and one standing group. They have 3 - 5 working groups. The number of each working group members is about 10. Total number of the committee members is 112 in 2004. They are from Universities, industrial companies and research organizations in Japan. We opened the meeting of the working groups 33 times in 2003 to discuss nuclear data related issues.

In August 2003, the head of Nuclear Data Center, JAERI changed from Akira Hasegawa to Jun-ichi Katakura. Hasegawa moved to Deputy Director of Department of Nuclear Energy Systems to which Nuclear Data Center belongs.

2. CINDA Compilation

The CINDA compilation activity has continued. The compilation covers the neutron reaction related work performed in Japan. In 2003, 196 entries were sent to NEA Data Bank.

3. Status of JENDL project

3.1. General purpose file

The latest version of Japanese Evaluated Nuclear Data Library (JENDL) , JENDL-3.3 was released in May 2002. After the release of JENDL-3.3 the discussion for the next JENDL library was started in Japanese Nuclear Data Committee. In the discussion the outline of the next version, JENDL-4, was proposed. Followings are the outline of JENDL-4.

(1) Scope: To solve the current concern on nuclear energy development such as high burn-up, MOX fuel utilization, evaluations of burn-up credit and their safety assessments. It also includes medical and fundamental scientific applications such as BNCT (Boron Neutron Capture Therapy), medical use of accelerator and nuclear synthesis in astrophysics.

(2) Incident particles and covered maximum energy: In addition to the traditional neutron-induced reaction, charged particle- and photon-induced reactions are considered. Spontaneous fission process is also considered. Standard maximum energy is 20 MeV, but it is extended when needed.

(3) Contents: To be enriched in the quality of actinides and FP nuclides. The quantity of covariance data, types of fission yields, secondary gamma production data and charged particle spectra will also be enriched. Total number of included nuclides, however, is not going to largely exceeded that of JENDL-3.3.

3.2 Special purpose file

In addition to the general purpose file, some special purpose files have been developed in JAERI.

(1) JENDL High Energy File

JENDL High Energy File 2004 was released this March. It includes high energy neutron- and proton-induced reaction data for 66 nuclides. The maximum energy of the incident particle is 3 GeV. This file is intended to be used for the design of the high energy proton accelerator and R & D of ADS system JAERI has planned.The high energy file was primarily intended to include the data for about 120 nuclides. The released 2004 file contains about a half of the intended data. The data of other nuclides will be included successively. The file for the IFMIF (International Fusion Material Irradiation Facility) project whose maximum energy is 50 MeV will be produced from the high energy file.

(2) JENDL Photonuclear Data File

JENDL Photonuclear Data File 2004 was released this March. It includes photon reaction data for 68 nuclides. The maximum incident energy is 140 MeV. The data of other nuclides intended to be included will be taken from the evaluated data by KAERI group. Total number of the nuclides included will be about 150.

(3) JENDL PKA/KERMA File

The file is intended to include the spectra of primary knock-on atoms (PKA) and KERMA factors. These data will be created from the file for the IFMIF project.

(4) JENDL (α,n) Reaction Data File

The data file of (α,n) reactions were released in February 2003. The file contains the data for 13 nuclides. At first it is expected to contain the data of total 32 nuclides. It becomes now difficult to complete the whole evaluations.

(5) JENDL Actinide File

Actinide data in JENDL-3.3 are being reevaluated to resolve the inconsistencies with PIE data and other benchmark test results. The results of the reevaluation will be reflected in JENDL Actinide File. In these reevaluation process, it is recognized that experimental data are not enough for making a reliable evaluated file. These data include thermal cross sections, resonance parameters, capture cross sections and the ν values of Am and Cm isotopes. New experimental data are truly needed.

(6) Other JENDL Special Purpose Files

Fusion File, Activation Cross Section File, Dosimetry File and FP Decay Data File are also developed as JENDL Special Purpose Files in Japan. The first version of each file has been released already. The revision of those files has not been scheduled yet.

4. Status of ENSDF evaluation

Japanese group is continuously responsible to make an evaluation of mass region from A=118 to 129 for the ENSDF file. In the years of 2003 and 2004, the evaluations of A=122 and 123 were sent to BNL.

5. Online Service

Nuclear Data Center, JAERI, maintains Web site. Most of the JENDL data are available from the Web site. During the period from August 30, 2004 to September 6, 2004,

88136 files (3347 MB) were retrieved. On the web site, we have WWW Chart of Nuclides whose data are annually updated.

6. Symposium on Nuclear Data

We had 2003 Symposium on Nuclear Data on November 27 - 28, 2003. The number of the participants were 121 including 7 foreigners. The main topics were nuclear needs for ADS system and innovative nuclear reactors. A tutorial session on nuclear data were arranged for the first time at the day before the symposium. We had 48 participants for the tutorial session. Most of the participants requested to have the similar session in the next year.

Status of KAERI/NDEL, 2003-2004

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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 3, Service 1)

The main project is “Evaluation of Nuclear Data for Nuclear R&D Projects” 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.

1. Facility

1.1. Pohang Accelerator Laboratory

The Pohang Time of Flight has extended the TOF length from 10.8 meter to 12.06 meter in order to improve the energy resolution.

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 Zr, Hf, Mo, Ta, Pb, Bi were measured in the energy range 0.01 - 100 eV at Pohang TOF during 2003 and 2004.

Neutron capture cross sections of 155Gd, 156Gd, 160Gd 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 individual resonance parameters, up to 100 eV, of Ag, Dy, Sm, Hf, Ta, W were derived from SAMMY analysis of the transmission experiment carried out at Pohang Time-Of-Flight facility

3.2. Cross-section Evaluation

Neutron cross section of 129I, 135Cs, 107Pd, 232Th, 231Pa, 233Pa, 233U, 234U, 236U are evaluated using measured data and EMPIRE-II up to 20 MeV.

3.3. High Energy Cross Section Evaluation

Reaction cross sections of 232Th, 233U, 234U, 236U, 243Am, 243Cm, 244Cm, 245Cm for neutron and proton incident energy range 20 - 250 MeV were evaluated using ECIS-GNASH.

4. Services

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

List of Working Papers presented at the meeting

WP 2004-1 Conclusions and Actions of the 2003 NRDC Meeting and General Actions of the 2002 NRDC Meeting

WP 2004-2 Revised NRDC Protocol (CP-D/410Rev.) ***(Annex 1)***

WP 2004-3 New dictionaries for EXFOR / CINDA2001 (CP-D/405)

WP 2004-4 Experiences and remarks on the transition to CINDA2001 (CP-D/412 and CP-N/28)

WP 2004-5 Proposed improvements and extensions of CINDA 2001 format (CP-D/413+reply)

WP 2004-6 CINDA 2001 Manual, version modified by M. Kellett (January 2004)

WP 2004-7 CINDA 2001 Manual, Rev. July 2003 by V. McLane

WP 2004-8 New Nuclides Dictionary 227: Status

WP 2004-9 EXFOR file contents and transmission statistics 2003/2004

WP 2004-10 EXFOR compilation scope

WP 2004-11 Access to EXFOR data source and related products at IAEA-NDS

WP 2004-12 Quasi-metastable states

WP 2004-13 Question on proposed new detector codes (CP-E/042, CP-D/403)

WP 2004-14 Differential data and Angular correlations

WP 2004-15 Effective mass correlation (CP-E/052)

WP 2004-16 Astrophysical S-factor (CP-E/050)

WP 2004-17 Reaction codes SIG,,HF and SIG,,LF (CP-A/153, CP-D/399, with Appendix)

WP 2004-18 TT as general modifier and revised LEXFOR on TTY (= CP-C/347)

WP 2004-19 Particle specification and long reaction strings (= CP-C/349 + comment)

WP 2004-20 Probability for emission of N particles

WP 2004-21 Order of SF1, SF2 in REACTION code

WP 2004-22 EXFOR compilation completeness check for Phys.Rev.C Vols. 65-70 ***(Annex 3)***

Note: All working papers are available from the NDS web site under http://www-nds.iaea.org/nrdc-int/2004nrdc/wps.html

Annex 1

Nuclear Reaction Data Centers
Exchange Formats Manual

Part IV

Protocol

for Cooperation between

the Nuclear Reaction Data Centers

Draft edited by

Victoria McLane

National Nuclear Data Center
on behalf of the

Nuclear Data Center Network
July 2003

Draft revised in August 2004 by

Otto Schwerer

IAEA Nuclear Data Section

With additional small changes reflecting
the decisions of the 2004 NRDC Meeting

December 2004

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Table of Contents

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INTRODUCTION

The general scope of the Nuclear Reaction Data Centers Network (NRDC) exchange is all experimental microscopic nuclear reaction data. Modifications to the general scope of the data exchange can be adopted only as a result of an agreement between the "Core" Centers of the NRDC.

The Core Centers will be defined by NDS based on contributions to network and user service capabilities. The currently defined Core Centers and their respective service areas are:

- The National Nuclear Data Center (NNDC) services the U.S.A. and Canada.
- Nuclear Energy Agency Data Bank (NEA-DB) services the non-American member Countries of the O.E.C.D.
- The Russian Nuclear Data Center (CJD), services the countries of the former U.S.S.R.
- The I.A.E.A. Nuclear Data Section (NDS) services I.A.E.A. Member States not included in the service areas of the above three centers.

The working language of the Network is English.

The Nuclear Data Section (NDS) will be responsible for ensuring that data compilations and exchanges are done in an efficient, productive and timely manner. The role of NDS will be to:

- assign clear responsibilities for the creation and correction of data compilations, and drive these activities forward,
- ensure implementation of compilation rules,
- decide on all issues relating to dictionary codes,
- be responsible for CINDA and EXFOR distribution to the other data centers

EXFOR PROTOCOL

Data files are exchanged regularly between the Nuclear Reaction Data Centers (NRDC) in the EXFOR format in accordance with the conventions laid down in the EXFOR Exchange Formats Manual.

NDS will maintain and distribute the EXFOR Master file.

All matters that affect EXFOR, in general, must be agreed to by the Nuclear Reaction Data Centers. Final decisions on proposals concerning compilation rules and new quantities can be made with Core Center agreement after discussions among all centers. NDS will be the final arbiter in case the Core Centers are unable to reach a decision.

All free text comments within all EXFOR entries shall be in English.

Scope of compilation

While the general scope of compilation is all experimental microscopic nuclear reaction data, the NRDC network may divide the scope into the following categories:

A) Data types which must be compiled,
B) Data types which may be compiled on a voluntary basis and are exchanged within the regular transmission files,
C) Additional data types which may be transmitted only on separate transmission files using different center identification characters.

The definitions of categories A, B and C must be agreed by the network, and all centers must define and announce their compilation scopes for categories B and C to the network.

The current definitions are given in Appendix B of this Protocol.

Data Compilation Responsibility

NDS will assign areas of responsibility for data compilation. If a center assigned to a particular area of compilation (*e.g.*, neutron data from a country or countries) is not carrying out their responsibilities, *i.e.*, compiling all new data for that area in a timely manner, the NDS coordinator will reassign all or part of those responsibilities to another volunteer center[1].

[1] As a consequence, the obligatory link between the geographical area of the Institute and the accession number, which has been in force for neutron data, may now be lifted for all data.

An area may be for a given projectile or set of projectiles, for a given country or group of countries, for a given data type or data types, or for any combination of these.

A center responsible for an area of compilation may agree with another network center to share the compilation work for that area on a regular basis. However, the responsibility for coverage and quality of the compilation remains with the responsible center. The currently assigned EXFOR compilation responsibilities are given in Appendix A of this Protocol.

If a center has a need for a particular data set to be compiled immediately, the center should send a request to the responsible center with a copy to NDS. If the responsible center cannot compile the data in time needed to meet the requirements of the center making the request, that center may compile the data as an area Z entry. The entry will then be sent to both the responsible center and NDS. If the responsible center does not intend to enter the data in a timely fashion, the NDS may then transmit the Z entry to all centers. The responsible center would then be responsible for deleting the Z entry if they replace it with an entry for their area.

For corrections to entries of another center, entries of different accession number areas may be transmitted on the same TRANS file.

Neutron, charged-particle, and photonuclear reaction data must be compiled in separate entries, with appropriate identification, even if they are reported in the same publication.

Neutron Reaction Data Compilation.

The responsibility for the collection, compilation and dissemination of neutron data information is shared among the four major neutron data compilation centers, each being responsible for a defined service area.

Within the scope of this protocol each center is expected to compile the data measured in its service area as fast and as thoroughly as possible. If two institutions from different service areas are involved, the primary institution defines the responsible center. See **LEXFOR, Institutes** for definition of primary institution.

Where the primary institute is not clear, the centers concerned should consult each other before compiling the data in order to avoid duplicate entry of the same data.

An effort must be made to compile all neutron reaction data published after 1 July, 1970. Earlier data will be compiled as time permits.

Although each center may compile data measured outside its service area, regular transmission of EXFOR data from any one center shall include data only from its own service area.

Each center shall keep an archival copy of the latest version of each of the EXFOR entries which it originated and shall be ready to provide the data to any center should it be required.

All matters concerning the exchange of neutron data must be agreed to by the four primary neutron data centers.

Charged-Particle Reaction Data Compilation.

The following nuclear reaction data centers have the responsibility for the collection, compilation, and dissemination of charged-particle data information from their respective countries.

- National Nuclear Data Center (NNDC): for the United States and Canada,
- Japan Charged-Particle Reaction Group (JCPRG): for data from Japan,
- ATOMKI: for data from Hungary and Jülich,
- Russian Nuclear Structure and Reaction Data Center (CAJaD): for countries of the former Soviet Union, except Ukraine, and for compilation of entries from countries not covered by other centers after coordination with NDS;
- IAEA Nuclear Data Section (NDS): all countries not covered by other centers.

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

If a center wishes to compile data outside its area of responsibility, the following procedures should be followed.

A center wishing to compile data (C1) will contact the center in whose area of responsibility the data were produced (C2), with copy to NDS, with a list of the data sets to be compiled. C2 will inform C1, as quickly as possible, with copy to NDS, whether the data either have been compiled or are in the process of being compiled by another center. If the data are not compiled or being compiled, C2 will either agree to compile them with priority, or ask that C1 compile the data and to and include it in the next regular C1 transmission file.

1) The center wishing to compile data should notify NDS of the data sets that they intend to compile.
2) NDS will check that the data set has not been compiled, and is not being compiled by another center, and will let the originating center know if they may go ahead with the compilation. All centers are responsible for checking that the data sets transmitted by them do not duplicate existing data.

Photonuclear Reaction Data Compilation.
The Centre for Photonuclear Experiments Data (CDFE) will be responsible for coordinating the compilation of photonuclear reaction data.

For photonuclear data there is no requirement for completeness.

EXFOR Transmissions

Assignment of Accession Numbers.

The methods of assigning accession numbers may be different at each center. That is to say, a center may assign them manually or automatically (by computer). A center may assign legal EXFOR accession numbers only to works within its agreed area of responsibility. Where the responsibility for compiling a given data set is not clear, the centers concerned

should consult each other before compiling the data in order to avoid duplicate entry of the same data. (See **LEXFOR, Institute**).

Procedure for transmitting new exchange files.

The originating center deposits new exchange files on the IAEA open area, subdirectory TRANS.PRELIM,[2] and notifies the other centers. The other centers will have one month to suggest modifications to the file.

As soon as possible after the month has passed, the originating center should:

1. Either make any suggested modifications to the file, or notify the other centers why the modifications have not been made.
2. Deposit the corrected file in the IAEA open area, subdirectory TRANS,[3] and notify the other centers.
3. Request NDS to delete the preliminary version from the IAEA open area.

NDS may correct or assign volunteers to correct preliminary transmissions that are not corrected and resubmitted as final transmissions in a timely manner, and will be responsible for distributing all final transmissions.

In general, it is the responsibility of the individual centers to transfer the files from the IAEA open area.

Procedure for files received with errors.

There are the following cases to be considered for files received with errors.

1. If a file can not be physically read, in part or whole, then the originating center should be requested to send another identical file, which should be done with minimum delay.
2. If there are errors (format, structure, *etc*.) in one or more entries, then the originating center should be notified of the errors by e-mail with the usual CP-Memo distribution.
3. Problematic entries which had to be removed from a preliminary transmission can be put into a special subdirectory of the NDS open area, `TRANS.PROBLEMS`. These entries will be reviewed by the other centers and can be finalized at the next NRDC meeting.

Alterations to EXFOR entries ("Retransmissions").

Alterations to EXFOR entries are, in general, transmitted only by the originating center and are included in the regular EXFOR transmissions. However, retransmission of entries belonging to a center that is no longer active in an area compilation may be done at another center by agreement of the cooperating centers.

Serious corrections (for example, those involving the COMMON or DATA sections, or essential BIB keywords such as REACTION, MONITOR, *etc*.) should be transmitted as quickly as possible. Less serious corrections can be made and transmitted as workloads permit.

[2] Suggested naming convention: PRELIM.*nnnn*, where *nnnn* is the file identification number.
[3] Suggested naming convention: TRANS.*nnnn*, where *nnnn* is the file identification number.

Notification of errors found in entries originating at another center should be communicated to all centers. The NDS should make sure these corrections are done in a timely manner. If they are not, the coordinator will ask one of the other centers to submit the corrected entries.

CINDA PROTOCOL

The CINDA2001 format shall be the method of exchange between the Nuclear Reaction Data Centers. The CINDA Formats Manual shall contain the coding rules for all CINDA exchanges.

NDS will maintain and distribute the CINDA Master file.

All matters that affect CINDA2001 formats, in general, must be agreed to by the Nuclear Reaction Data Centers. Final decisions on proposals can be made with Core Center agreement after discussions among all centers. NDS will be the final arbiter in case the Core Centers are unable to reach a decision.

The information compiled in CINDA shall consist of references to experimental nuclear reaction data and evaluated nuclear data libraries. The quantities to be entered shall be those that have been agreed upon for entry into EXFOR and into the ENDF-formatted evaluated libraries.

Updates to the CINDA2001 formats must be agreed upon by the core centers.

Data Compilation Responsibility

NDS will assign responsibilities for CINDA compilation.

A subset of the "core" centers will be responsible for all CINDA Transmissions. That is, the NNDC will be responsible for the US and Canada, the NEA Data Bank will be responsible for the NEA member countries, and the NDS will be responsible for the rest of the world. All other centers compiling new references will transmit the data through one of these three centers.

Updates sent by a center containing new entries and updates to entries that are the responsibility of the originating center shall be transmitted in a separate file (exchange file) from new entries and updates to entries that are the responsibility of another center. The latter shall be sent in reader files, separated by coordinating center. New blocks included on reader files shall have block numbers beginning with zero (0) and sequence numbers equal to zero.

CINDA Transmissions

A CINDA Transmission shall consist of the exchange file and one or more reader files.

The EXFOR Accession Number will, in general, be used as the CINDA block number (see EXFOR Protocol, page 4, for assignment of accession numbers).

The sequence number within a block shall be unique, *i.e.,* if a line is deleted, the sequence number should not be reassigned.

The originating center shall deposit new CINDA transmissions on the NDS open area, subdirectory CINDA.

In the case where there is problem with updates to files of a given center, the Nuclear Data Section shall notify the original center before releasing the files. If the original center does not respond in a timely manner, NDS shall have the authority to produce transmission files for that center and release them to all data centers.

In general, it is the responsibility of the individual centers to transfer the files from the NDS open area.

CHANGES TO SCOPE, FORMAT AND CODING RULES OF CINDA OR EXFOR

No changes in the basic structure of CINDA or EXFOR will be allowed without NRDC agreement.

However, in particular the EXFOR format is continuously refined and expanded to include new types of data as the need arises. These refinements are introduced through dictionary updates, modifications of coding rules which may affect the formats or the file structure, or redefinition of the compilation scope.

Dictionary modifications or additions which appear to be trivial (inconsequential) will be added to the dictionaries as soon as possible after receipt, without formal approval procedures.

For all other proposed changes, it will be the responsibility of the center originating the proposal to obtain NRDC agreement, following the procedure outlined below.

The following procedure should be followed by each of the NRDC members in obtaining the agreement for changes or revisions:

1. The initial proposal should be disseminated to all centers. Wherever possible proposals affecting the content of the Manuals should contain proposals for specific wording to be inserted in the Manual. Adequate explanation and documentation to help in preparing LEXFOR entries should accompany any suggestions for additions to LEXFOR. Proposals for new dictionary quantity codes (Dictionaries 30-37) should be supported by an expansion, a full explanation of its use and limits, a list of corresponding Dictionary 36 entries, and, where appropriate, a reference to the data for which the code will be used. All communications with regard to such proposals shall be in the form of CP Memos.
2. In the case where there is discussion on a proposal, the initiating center shall then collect and digest all comments, suggestions and counter proposals.
3. In this review, the initiating center shall consider all facts would affect the CINDA/EXFOR associated computer codes.
4. A change in CINDA/EXFOR will not oblige centers to change existing entries (whether they have been transmitted or not) unless stated explicitly in the proposal and approved by the data centers.
5. The initiating center shall then distribute a technical evaluation of alternatives to the other centers.
6. After receiving the response to this technical evaluation:
   a) In the case of positive agreement, the initiating center shall submit a final proposal including all dictionary, CINDA Manual, EXFOR Systems Manual, and LEXFOR updates and mention which computer programs will need to be updated.
   b) If no positive agreement has been reached:
   - If the proposal implies a change in the basic structure of CINDA or EXFOR, or a change in the general scope, the proposal will be included in the agenda of the next NRDC meeting. In order to be adopted at an NRDC meeting, a proposal should be

sent out at least one month prior to the meeting date.
- In all other cases, NDS will seek to reach a consensus between the core centers, in which case the proposal is considered approved. If the core centers cannot come to an agreement, NDS acts as the final arbiter.

Whenever decisions are made at an NRDC meeting that require Manual changes, the dictionary and manual updates should be prepared and sent out as soon as possible after the draft minutes are received. The minutes of the meeting should include either the proposed dictionary and manual updates or a reference to the CP-Memo(s) in which they are given.

DICTIONARY PROTOCOL

Routine transmission of Dictionaries.

The IAEA Nuclear Data Section (NDS) is responsible for the coordination and the updating of the EXFOR dictionaries. For this purpose, an archival dictionary file is maintained at NDS in a special archive format (see Dictionary Exchange Formats Manual).

About every three months, or whenever a major alteration is made, NDS will transmit the complete dictionary file to the cooperating centers, either in the EXFOR or DANIEL format, as each center prefers.

It is the responsibility of each center to verify that information is compiled in accordance with the latest version of the dictionaries.

Addition of new codes.

The cooperating centers may propose new codes or any other dictionary alteration by means of CP-Memos. A proposal for a new code should include any associated information needed for the dictionary, along with an explanation of its use, and, where appropriate, references to data sets for which it will be used.

The center responsible for updating the dictionaries is also responsible for checking the consistency of proposed alterations with other codes and with the manuals. Some latitude is allowed in the formulation of a final dictionary entry, but the meaning must not be changed without the approval of the originating center. In questionable cases, the other centers should be consulted. The cooperating centers are responsible within their respective areas for keeping the laboratory (Dictionary 3) and bibliographic reference code (Dictionaries 5-7) dictionaries up to date.

Consequential updates, in particular, changes to the codes in Dictionaries 1, 2, 4, 16, 24, 25, 28-37 will be entered into the dictionaries only after approval by the centers.[4] Also, alterations of EXFOR dictionary entries that entail changes to data already transmitted cannot be implemented without specific NRDC approval. A proposed dictionary alteration that appears to be trivial (inconsequential) will be added to the dictionaries as soon as possible after receipt. NDS will be the final arbiter for all decisions concerning dictionary codes.

If a center uses a new dictionary code in a data transmission prior to its inclusion in the relevant dictionary, the center must be prepared to correct the entry and retransmit it, if the new code is not approved.

In general, a dictionary alteration becomes effective upon its transmission to the cooperating centers.

[4] See section on Changes to Scope and Format of EXFOR

COMMUNICATION BETWEEN CENTERS

Discussion among the cooperating centers on the subjects of data compilation, the EXFOR system and its further development, EXFOR Manual and Dictionaries, and EXFOR transmission files, are continued by means of memos, which are called:

- **CP Memos**: for the communication of proposals, programming details and other general considerations that touch upon the overall aspect of EXFOR. These memos are distributed to the cooperating centers. Other compiling groups are informed, as needed, by their center of contact. This series of memoranda is numbered as: Memo-CP-*n/m*.
- **Four-Center Memos**: for the communication of details dealing only with neutron data or other Four-Center (non-EXFOR) matters. This series is numbered as: Memo 4C-*n/m*.

  For both series of memos *n* is the center identification number, and *m* the chronological memo number within the center.

Such memos should conform to the following general format:

1. The memo shall be headed by the memo number, the date, originating staff member(s), and subject.

   For memos covering more than one topic, all subjects should be listed separately, and the contents of the memo should be summarized on a covering-page. Each subject should begin on a new page to facilitate distribution to the appropriate staff at each center for action. The memo number should appear on each page.

2. Items requiring agreement of the cooperating centers should be noted on the appropriate page.

3. All proposed changes and additions to the dictionaries, CINDA Manual, EXFOR Systems Manual, and LEXFOR should contain (where possible) a revised entry in the format of the appropriate document in addition to the usual documentation.

4. In case of disagreement, the originating center is responsible for collecting the points of agreement and issuing a final wording in the format of the appropriate document(s).

MANUALS

The center responsible for the updating of the Manuals is NDS.

The final proposed manual update submitted in a CP-Memo or in the minutes of an NRDC meeting, is entered into the manuals substantially unchanged. However, the responsible center is free to introduce editorial changes to maintain a consistency of style. The responsible center is also responsible for maintaining the internal consistency of the manuals, which means, *e.g.*, that they must check whether an agreed proposal entails changes (cross-references, *etc*.) in other parts of the manuals.

In general, a non-editorial change on a manual page, as compared to its previous version, is marked by a vertical line in the left-hand margin, and the date of the latest revision to that page is given at the bottom of each page.

Where there are different views on matters of minor importance, These may all be included in LEXFOR in so far as these views are in agreement with the agreed procedures and do not cause ambiguities in the definitions of codes.

Manual updates will be issued as soon as possible.

EXFOR PROCESSING AND RETRIEVAL CODES

Some EXFOR Processing and Retrieval programs are used by more than one data center. Each center using one of these programs is invited to contribute suggestions for updates to the program. The originating center will coordinate all program updates.

If another center wishes to update a code, that center should communicate their intention to the originating center before any updates are done. Any updates can be done after discussion with the originating center and upon mutual agreement. The updated code should be transmitted immediately to the originating center.

The originating center retains responsibility for the official version of the code and is free to reject unsanctioned updates. Only the originating center will transmit updated versions to the other centers.

Appendix A: Compilation Responsibilities

Center	Basic responsibility	Additional compilation
NNDC	Neutron data and CPND from USA and Canada	
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 Juelich and ATOMKI (entries submitted through NDS)	
UkrNDC	Neutron data and CPND from Ukraine (entries submitted through NDS)	
RFNC	CPND on light nuclei, coordinated with other centers	

Appendix B: Compilation Scope

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

*) Center Identification Character

Annex 2

Revised dictionary 47 as agreed at 2004 NRDC Meeting

XXX = no corresponding unique new quantity (= blank in actual dictionary)
* = changed compared to dictionary 47 as in transmission 9185 of 7 July 2004

Old Q	Reaction	New Q	Modifications agreed upon during NRDC2004
SEL	N,EL	CS	
DEL	N,EL	DA	
POL	N,X	POL	
POT	N,EL	**CS**	*
SIN	N,INL	CS	
DIN	N,INL	XXX	
SCT	N,SCT	XXX	
N2N	N,2N	XXX	
NXN	N,XN	XXX	
NEM	N,X+N	XXX	
NG	N,G	**CS**	*
RIG	N,G	RI	
SNG	N,G	XXX	
DNG	N,INL+G	XXX	
NEG	N,X+G	XXX	
NP	N,P	XXX	
NNP	N,N+P	XXX	
PEM	N,X+P	XXX	
ND	N,D	XXX	
NND	N,N+D	XXX	
DEM	N,X+D	XXX	
NT	N,T	XXX	
NNT	N,N+T	XXX	
TEM	N,X+T	XXX	
NHE	N,HE3	XXX	
NA	N,A	XXX	
NNA	N,N+A	XXX	
AEM	N,X+A	XXX	
NF	N,F	CS	
RIF	N,F	RI	
ALF	N,ABS	ALF	
ETA	N,ABS	ETA	
NU	N,F	NU	*If Energy = SPON -> 0,F*
NUD	N,F	NUD	
NUF	N,F	**NUF**	*
SFN	N,F	**XXX**	*
SFG	N,F	SPC	
FPG	N,F	**XXX**	*
FPB	N,F	**XXX**	*
NFY	N,F	FY	
FRS	N,F	**XXX**	*
CHG	N,F	**CHG**	*
TOT	N,TOT	CS	

SNE	N,NON	CS
NX	N,X	XXX
ABS	N,ABS	CS
RIA	N,ABS	RI
RES	N,0	RP
STF	N,0	RP
LDL	0,0	NQ
GN	G,N	XXX
GF	G,F	XXX
EVL	N,X	EVL
TSL	N,THS	TSL

Annex 3
WP 2004-22

EXFOR Compilation Completeness Check for Phys.Rev.C Vols. 65 -70

Submitted by V. McLane

Phys. Rev. 65 (2001)

Issue	Article	lab	inc.proj.	energy	Center	data form	status	AN
1	5801	TNL	He3	20 MeV	NNDC	graphs,RP	requested	
2	4003	INU	p	325-400 MeV	NNDC	graphs,tables		

Phys. Rev. 66 (2002)

Issue	Page	lab	inc.proj.	energy	Center	data form	status	AN
1	4312	Germany	7Li	35-67 MeV		graphs		
	4601	Belgium	n	62.7 MeV	NEADB	graphs,tables	in process	22812
	4602	India	alpha	19-50 MeV		tables	transmitted	A0452
	4606	INU	p	197 MeV	NNDC	graphs	transmitted	C0880
	5803	Germany	alpha	7-10.5 MeV		tables	transmitted	A0451
2	2801	TNL	p	127 keV	NNDC	RP	transmitted	C1045
	5801	Germany	n	3-225 keV	NEADB	tables	transmitted	22813
	8801	Germany	alpha	3 MeV		graphs,RP		
3	4314	Brazil	d	16 MeV		graphs		
	4602	South Africa	p	202 MeV		graphs	transmitted	O1045
	4608	France	6He	230 MeV		graphs		
4	1602	Australia	6,7Li	25-50 MeV		graphs	transmitted	A0590
	2201		gamma				transmitted	M0642
	4002	Japan	p	250 MeV		tables		
	4316		gamma				transmitted	M0644
	4607	Japan	p,3He,a	50-250 MeV		graphs	transmitted	O1003
	4608	Argentina	6,7Li	24-43 MeV		graph,table	transmitted	A0453
	7001	Germany	n	25 MeV		????	????	22814
5	1305	Germany	p	27 MeV		graphs,tables		
	4303	France	d	200 MeV		graphs		
	4602	Japan	d	270 MeV		graphs		
	4605	Germany	n	thermal	NEADB	tables	transmitted	22815
	5802	Belgium	alpha	1.7-2.9 MeV		RP		
	5804	TNL	3He	20 MeV		graphs	transmitted	C1002
	5805	ORL	n	46-498 keV		RP	transmitted	13691
	7601	TNL	d	0.52-1.49 MeV		tables	transmitted	C0943
6	4313	Japan	d	14 MeV		graphs		
	4603	Germany	n	3-225 keV	NEADB	tables	transmitted	22816
	5802	Germany	alpha	0.6-2.7 MeV		graphs,RP		

Phys. Rev. 67 (2003)

Issue	page	lab	inc.proj.	energy	Center	data form	status	AN
1	4604	Japan	d	13.5 MeV	JCPDG	graphs		
	4608	FSU	alpha,7Li	11,16.6 MeV	NNDC	graphs	transmitted	C1001
	5801	Greece	p	1.4-4.9 MeV	CAJaD	graphs,tables	transmitted	O1054
2	4307	KTY	n	2.4-3.9 MeV	NNDC	graph	requested	
	4601	ORL	n	35-1000 keV	NNDC	graphs,tables	in process	13907
	4602	NOT	alpha,6He	8-10 MeV	NNDC	graphs	2 reqs.	
	4607	India	alpha	30-50 MeV	CAJaD	graphs	transmitted	A0490
3	1601	Sweden	n	96 MeV	NEADB	graphs		
	4610	France	n	thermal	NEADB	graphs,tables		
4	1603	Russia	p	1.6-5.8 MeV	CAJaD	graph		
	4005	NIST	n		NNDC	?	transmitted	C1036
	4602	Belgium	alpha	11.6 MeV	?	table		
	4604	FSU	6Li	34,50 MeV	NNDC	graphs	transmitted	C0983
	4606	LAS	n	5-560 MeV	NNDC	graphs	transmitted	13887
	4607	Italy	6Li	31-39 MeV	?	table		
	4608	Kazakstan	p	30 MeV	CAJaD	graphs,table	transmitted	O1060
5	2801	Belgium	d	1.4 MeV	?	graph		
	4320	Netherlands	p	150 MeV	?	graphs		
	4321	Netherlands	p	150 MeV	?	graphs		
	4602	France,Brazil	6,7Li	10-25 MeV	?	graphs	transmitted	A0520
6	2801	TAM	7Li	63 MeV	NNDC	graphs	requested	
	2802	ORL	n	5-50 keV	NNDC	no data	2 reqs.	
	4601	Japan	3He	73 MeV	JCPDG	graphs		
	4612	Japan	3He	443 MeV	JCPDG	graphs		
	5804	Czek Rep.	3He	26 MeV	?	graphs,table		
	5805	Israel	p	991 keV	?	graph,table	transmitted	O0548

Phys. Rev. 68 (2003)

Issue	page	lab	inc.proj.	energy	Center	data form	status	AN	
1	4305	TAM	alpha	240 MeV	NNDC	graphs	requested		
	4618		gamma		CDFE		transmitted	M0652	
	5802	ORL	n	0.001-500 keV	NNDC	graphs,tables	transmitted	13896	RP
2	4312	LAS	n		NNDC	graphs	transmitted	13885	
	4603	Germany	n	6.12 MeV	NEADB	graphs,tables	transmitted	22823	
	4604	Belgium	n	25,65 MeV	NEADB	graphs,tables			
	5801	Germany	alpha		CAJaD		transmitted	O0810	
	5804	France	3He	0.25-36 MeV	CAJaD	graphs,tables	transmitted	O0757	
3	4004	TMF	p	225 MeV	NNDC	data form	transmitted	C0952	
	5801	Germany	n	25 keV	NEADB	tables.			
4	4605	China	6Li	25-39 MeV	CAJaD	graphs	transmitted	A0608	
	4608	Pakistan	n	thermal	NDS	in text	transmitted	31533	
	4610	TNL	n	10-19 MeV	NNDC	graphs	Ttransmitted	13903	
	5803	TNL	p	100-160 keV	NNDC	graphs	requested		
	8802	Germany	d	22 MeV	?	table			
5	4004	Netherlands	d	130 MeV	?	graphs			
	4601	FSU	6Li	30-33 MeV	NNDC	graphs	transmitted	C0956	
	4611	Russia/TMF	p	100-500 MeV	CAJaD	tables	transmitted	A0598	

	5803	Hungary	p	1-4 MeV	Atomki	tables	transmitted	O0849	
	7303	TAM	alpha	240 MeV	NNDC	graph	requested		
6	4602	Japan	alpha	386 MeV	JCPDG	graphs			
	4605	Sweden	n	96 MeV	NEADB	tables			
	5803	TMF	p	0.1-2.5 MeV	NNDC	table	transmitted	C1036	
	5804	TNL	p	252 keV	NNDC	graphs	transmitted	C0996	
	7601	India	7Li	12-24 MeV	CAJaD	graph	transmitted	A0601	

Phys. Rev. 69 (2004)

Issue	page	lab	inc.proj.	energy	Center	data form	status	AN	
1	4003	Sweden	p	0.9-1.1GeV	?	graphs			
	4312	Germany	d	17 MeV	?	graphs			
		LAS	n	thermal	NNDC	table	in process	13900	gam int.
	5802	Japan	3He	30-50 keV	JCPDG	tables			
	5803	ORL	n	3.4-700 eV	NNDC	tables	transmitted	13892	
2	1602	India	p	7.2-24 MeV	?	graph			
	2801	Belgium	p	9.8 MeV	?	data			
	4601	LAS	n	1-100 MeV	NNDC	graphs	transmitted	13901	
	4602	Finland,Belgium	a	12-14 MeV	?	graphs			
	4604	Russia	p	1 GeV	?	tables			
	4608	TNL	d	0.52-1.5 MeV	NNDC	graph,table	in process	C0978	
	4616	IU	p	100-200 MeV	NNDC	graphs	transmitted	C0729	
	4619	Germany	p	26 MeV	?	graphs			
	5803	Germany	n	30,500 keV	NEADB	table			
3	1302	TAM	p	1-3.5MeV	NNDC	graph	requested		
	4005	ORL	n	0.1-3.0 eV	NNDC	graphs,tables	transmitted	13895	partial
	4315	TAM	alpha	240 MeV	NNDC	grapha			
	4611	TAM	alpha	240 MeV	NNDC	graphs	requested		
4	1305	LRL	0	spon	NNDC	no useful data			
	4310	Germany	p	25 MeV	?	graphs			
	4313	Japan	p,3He,6,7Li	300-455 MeV	JCPDG	graphs			
	4602	Japan	p	345 MeV	JCPDG	graphs			
	4613	Belgium	6He	10 MeV	?	graphs			
	8801	YAL	3He	25 MeV	NNDC	RP table	transmitted	C1037	
5	1301	Japan	alpha	386 MeV	JCPDG	graphs			
	4312	TAM	alpha	240 MeV	NNDC	graphs	requested		
	4602	Greece	7Li	8-16 MeV	?	graphs			
	4609	Japan	p	345 MeV	JCPDG	graphs			
	5801	Germany	n	10-100 keV	NEADB	tables			
	5806	Italy	p	0.5-0.9 MeV	NEADB	graphs			
6	4323	KTY	n	2-3.5 MeV	NNDC	graphs	requested		
	4325	Netherlands	d	170 MeV	?	graphs,table			
	4327	Japan	3He	450 MeV	JCPDG	graphs			
	4605	U.K.	7Li	70 MeV	?	graphs			
	4609	Sweden	n	96 MeV	NEADB	graphs			
	5803	TMF	p	200-1103 keV	NNDC	table	in process	C1044	

Phys. Rev. 70 (2004)

Issue	page	lab	inc.proj.	energy	Center	data form	status	AN	
1	4001	Japan	p	270 MeV	JCPDG	graphs,tables			
	4004	NIS	n	11 meV	NNDC	text	in process	13908	
	4305	UK	7Li	58 MeV	?	graphs			rel.ang.corr.
	4307	TAM	alpha	240 MeV	NNDC	graphs	requested		
	4602	Brazil	n	thermal	NDS	text			
	4607	Sweden	n	96 MeV	NEADB	graphs,table			
	4609	Japan	p	12 MeV	JCPDG	graphs			
	4610	Germany	p,d	25/26 MeV	?	graphs,tables			
	5802	Greece	p	1.7-4.8 MeV	?	table			

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