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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Report on the

9th IAEA Consultants' Meeting of

THE NUCLEAR REACTION DATA CENTRES

hosted by the US National Nuclear Data Center
at the Brookhaven National Laboratory
27 - 29 October 1987

Including the 20th FOUR-CENTRES MEETING of the NEUTRON DATA CENTRES

and the 10th MEETING ON CHARGED PARTICLE NUCLEAR DATA COMPILATION

April 1988

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

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Edited by H.D. Lemmel
with contributions from N. Holden and J.J. Schmidt

April 1988

Abstract:

This report summarizes the 1987 co-ordination meeting of the national and regional nuclear reaction data centers, convened by the IAEA at regular intervals. The main topics are

- the international exchange of nuclear reaction data by means of the "EXFOR" system, and the further development of this system,
- the "CINDA" system as an international index and bibliography to neutron reaction data,
- the sharing of the workload for speedy and reliable data compilation,
- the exchange and documentation of evaluated data libraries in ENDF format,

with the goal of rendering data center services to data users in IAEA Member States by means of computer retrievals and printed materials.

Printed by the IAEA in Austria
April 1988

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TABLE OF CONTENTS

Working Papers. Of the working papers (see p.12) the following are included in the present document:

Introduction

This report summarizes the 9th IAEA Consultants' Meeting of the Nuclear Reaction Data Centers (NRDC), which was hosted by the US National Nuclear Data Center at the Brookhaven National Laboratory. The meeting was scheduled for 27-29 October; but due to the heavy agenda the meeting continued on 30 October.

For the network of the eight co-operating centers see page 7. At the present meeting three additional centers were represented as observers.

- the Photon and Charged Particle Data Center of the US National Bureau of Standards, Gaithersburg, MD.,
- the Los Alamos National Laboratory in Los Alamos, NM.,
- the Lawrence Livermore National Laboratory in Livermore, CA.

See the list of participants on page 9.

The present NRDC meeting was the ninth in a series of which the last, which took place in 1985 at the OECD/NEA Data Bank, is documented in INDC(NDS)-178. The present meeting was also successor to a "Technical NRDC Meeting" which took place at the IAEA in Vienna in 1986 and which is documented in Memo CP-D/159.

The agenda of the meeting concentrated on

- matters of co-ordination, determination of priorities and workload distribution among the centers for the compilation and evaluation of nuclear data in view of the changing data needs and increasing accuracy requirements for the various applications of nuclear technologies, and on
- technical matters concerning the further development of the jointly operated computerized systems

  CINDA - bibliography and data index for neutron data, published by IAEA on behalf of the co-operating centers;

  EXFOR - system for experimental data of nuclear reactions induced by neutrons, photons, charged particles or heavy ions;

  ENDF - system for evaluated neutron data, originally designed for fission reactor calculations, now being widened in scope for other applications such as fusion, radiotherapy, neutron-source reactions and others;

  WRENDA - compilation of requests for such nuclear data that are known with insufficient accuracy compared to the accuracy requirements in nuclear technologies.

Some of the highlights of the meeting are:

- Release for distribution of new data libraries incl. ENDF/B-6 standard reference data, the USSR data library BROND, fission-product yield data libraries from China and Japan, and others;

- Co-operation in data evaluation for the production of radio-isotopes for medical applications;

- Support of the nuclear data centers for the IAEA Co-ordinated Research Programme on the evaluation of fission-product yield data;

- The provision of data files and computer codes for use on Personal Computers;

- On-line computer links among data-centers and between data-centers and users, and resulting changes in data-center services including changes in the publication schedule of CINDA;

- Adaption of the EXFOR system to new data types occuring in medium energy nuclear data of which the importance is increasing.

GLOSSARY OF ABBREVIATIONS

BNL	Brookhaven National Laboratory, Upton, N.Y., USA
CAJaD	Center for Nuclear Structure and Reaction Data, Kurchatov Institute, Moscow, USSR
CDFE	Centr Dannykh Fotojad. Eksp., Moscow State University, USSR
CINDA	A specialized bibliography and data index on neutron nuclear data operated jointly by NNDC, NEA-DB, NDS and CJD
CJD	USSR Nuclear Data Center at F.E.I., Obninsk, USSR
CNDC	Chinese Nuclear Data Center, Beijing, P.R. China
CPL	Computer Program Library of NEA-DB
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
DOE	US Department of Energy
DOE-NDC	Nuclear Data Committee of DOE
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, USSR
FIZ	Information Center of the Fed. Rep. of Germany for energy, physics, mathematics, Karlsruhe, Fed. Rep. of Germany
GKAE	UUSR State Committee on the Utilization of Atomic Energy, Moscow, USSR
IAEA	International Atomic Energy Agency
INDC	International Nuclear Data Committee
INDL	The IAEA Nuclear Data Library for evaluated neutron reaction data
INIS	International Nuclear Information System
IRDF	The International Reactor Dosimetry File, maintained by the IAEA/NDS
ITER	International Thermonuclear Experimental Reactor
JEF	The Joint Evaluated File of neutron data, a collaboration of European NEA member countries and Japan
KACHAPAG	Charged Particle Nuclear Data Group, Karlsruhe, Fed. Rep. of Germany
LANL	Los Alamos National Laboratory, Los Alamos, N.M., USA

LEXFOR	Part of the EXFOR manual containing physics information for compilers
LIJaF	Leningrad Nuclear Physics Inst., Gatchina
NDS	IAEA Nuclear Data Section, Vienna, Austria
NEA	Nuclear Energy Agency of the OECD, Paris, France
NEACRP	Nuclear Energy Agency Committee on Reactor Physics
NEA-DB	NEA Data Bank, Saclay, France
NEANDC	Nuclear Data Committee of the OECD Nuclear Energy Agency
NEUDADA	Neutron Data Direct Access. Earlier data file of NEA, now included in EXFOR
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
NSDD	Nuclear structure and decay data
NSR	Nuclear structure references, a bibliographic system
OECD	Organization for Economic Cooperation and Development, Paris, France
PC	Personal Computer
ORNL	Oak Ridge National Laboratory, Oak Ridge, Tenn., USA
PhDC	Photonuclear Data Center, Washington, USA
PhND	Photonuclear data
RIKEN	Nuclear Data Group, RIKEN Inst. of Phys. and Chem. Res., Wako-Shi, Saitama, Japan
SGIP	Study Group for Information Processing, Sapporo, Japan
SOKRATOR	USSR evaluated neutron data library (and format), now included in INDL
TRANS	Name of transmission tapes for data exchange in the EXFOR system
TUD	Technical University, Dresden, German Democratic Republic
WRENDA	World Request List for Nuclear Data

The network of Nuclear Reaction Data Centers

National and regional nuclear reaction data centers, co-ordinated by the International Atomic Energy Agency, co-operate in the compilation, exchange and dissemination of nuclear reaction data, in order to meet the requirements of nuclear data users in all countries. A brief summary of the data centers network is given below.

The nuclear reaction data centers:

NNDC	- US National Nuclear Data Center, Brookhaven, USA
NEA-DB	- OECD/NEA Nuclear Data Bank, Saclay, France
NDS	- IAEA Nuclear Data Section
CJD	- USSR Centr po Jadernym Dannym (= Nuclear Data Centre), Obninsk, USSR
CAJaD	- USSR Centr po Dannym o Stroenii Atomnogo Jadra i Jadernykh Reakcikh (= Nuclear Structure and Nuclear Reaction Data Centre), Moscow, USSR
CDFE	- Centr Dannykh Fotojad. Eksp. (= Centre for Experimental Photonuclear Data), Moscow, USSR
RIKEN	- Nuclear Data Group, RIKEN Inst. of Phys. and Chem. Res., Wako-Shi, Japan
CNDC	- Chinese Nuclear Data Centre, Beijing, P.R. of China
KACHAPAG	- Karlsruhe Charged Particle Group, Karlsruhe, FRG*)
FIZ	- Fachinformationszentrum Karlsruhe, FRG
PhDC	- Photonuclear Data Center, Washington, USA

These data centres cooperate on the following projects:

1. Neutron Nuclear Data

1.a Bibliography and Data Index "CINDA":
Input prepared by NEA-DB, NNDC, NDS, CJD
Handbooks published by IAEA

1.b Experimental data exchanged in EXFOR format:
Input prepared by NNDC, NEA-DB, NDS, CJD

1.c Data Handbooks based on EXFOR published by NNDC

1.d Evaluated data exchanged in ENDF format:
NNDC, NEA-DB, NDS, CJD and others

1.e Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CJD

1.f WRENDA: compilation of requested data that are known with insufficient accuracy. Compiled by NNDC, NEA-DB, NDS, CJD, published by IAEA

2. Charged Particle Nuclear Data (including heavy-ion reaction data)

2.a Bibliography published by NNDC

2.b Numerical data exchanged in EXFOR format:
Input prepared by CAJaD, RIKEN, CNDC, NDS, NNDC, KACHAPAG*)

2.c Data Handbooks based on EXFOR published by FIZ/KACHAPAG*)

2.d Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CAJaD

3. Photonuclear Data

3.a Numerical data exchanged in EXFOR format:
Input prepared by CDFE, occasional contributions from NNDC(PhDC), NDS

3.b. Bibliography published by CDFE

3.c Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CAJaD

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*) Discontinued in 1982. Since then CAJaD has increased its compilation activities.

9th IAEA Consultants' Meeting
of the
NUCLEAR REACTION DATA CENTERS MEETING

October 27 - 29, 1987

National Nuclear Data Center
Brookhaven National Laboratory

LIST OF PARTICIPANTS

Cai Dunjiu	Chinese Nuclear Data Center Institute of Atomic Energy, Beijing, China
Chukreev, F.E.	Center for Nuclear Structure and Reaction Data I.V. Kurchatov Institute, Moscow, U.S.S.R.
Dunford, C.L.	N.N.D.C.
Hashizume, Akire	Nuclear Data Group RIKEN Inst. of Physical & Chemical Research, Sitama, Japan
Holden, N.R.	N.N.D.C.
Hubbell, John	Photon & Charged Particle Data Center National Bureau of Standards, Gaithersburg, MD
Lemmel, H.D.	I.A.E.A. Nuclear Data Section Vienna, Austria
Manokhin, V.N.	Center for Nuclear Data Fiziko-Energeticheskij Institut, Obninsk, U.S.S.R.
McLane, V.	N.N.D.C.
Nordborg, C.	Nuclear Energy Agency Data Bank Gif-sur-Yvette, France
Pearlstein, S.	N.N.D.C.
Schmidt, J.J.	I.A.E.A. Nuclear Data Section Vienna, Austria
Siciliano, E.R.	Los Alamos National Laboratory, NM
Tubbs, N.	Nuclear Energy Agency Data Bank Gif-sur-Yvette, France
Warshaw, S.	Lawrence Livermore National Laboratory, CA
Whetstone, S.	D.O.E. Division of Nuclear Physics, Washingston, D.C.
Zhuang Youxiang	Chinese Nuclear Data Center (currently at the N.N.D.C.) Institute of Atomic Energy, Beijing, China

9th IAEA Consultants' Meeting
of the
NUCLEAR REACTION DATA CENTERS MEETING

October 27 - 29, 1987

National Nuclear Data Center
Brookhaven National Laboratory

AGENDA

Tues. General session

1. Opening, election of chairman, adoption of agenda.

2. Status reports by participants.

3. Brief report on 1987 INDC Meeting in Beijing and actions from the 1986 INDC Meeting. (See extracts from INDC/P(87)-6)

4. Commitments and cooperation of centers, assessment of present work, scope, priorities, EXFOR/CINDA completeness.
(See Memo 4C-3/315: CINDA and EXFOR statistics,
CP-D/159, p.9: Compilation scope)

Wed. Technical Session: General

5. Review of actions from previous meeting.
(See CP-D/159, P.10-13: EXFOR general, actions)

6. The EXFOR System: rules, manual, dictionaries, proposals, etc. Part. 1. (See WP1:EXFOR; WP3: Summary of TRANS tape errors)

7. Discussions with U.S. observers.

Wed. Technical session: CPND and Photonuclear data

8. Compilation and exchange of CPND, experiences with TRANS tapes. Review of conclusions and actions from previous meeting.

9. Evaluated CPND in ENDF-6 format.

10. Photonuclear data.

11. Publications, CPND bibliography.

12. Stopping power.

13. Coordination of compilation and evaluation of CPND for medical and radioisotopes production. (See CP-D/164).

14. Photonuclear data evaluation for ENDF/B-6.

15. Nuclear model codes, availability, documentation and customer services.

Thurs. General session: Planning and coordination

16. Customer services, handbooks planned.

17. Planning and coordination of future specialists' meetings on nuclear data. (See Memo CP-D/158 and INDC/P(87)-13)

18. Center-to-center on-line data transmission.

19. CINDA publication, new 'archival' issue.
(See Memos 4C-3/314 and 4C-1/193)

20. Important neutron data not covered in EXFOR.

21. Medium-energy nuclear data. (See BNL-NCS-40070)

22. Coordination of fission-product yield compilation and evaluation, computation format. (See Memo 4C-3/317)

23. Coordination of neutron data evaluation.

24. Mito Meeting, presentation on EXFOR.

25. Dates of the 1988 Technical NRDC Meeting in Vienna and the 10th NRDC Meeting in 1989 in Vienna.

26. Miscellaneous, conclusions.

Fri. Technical session: Neutron nuclear data

27. CINDA: coverage, decentralized network, etc.
(See WP2: pending CINDA matters)

28. WRENDA.

29. EXFOR (remaining items from 6.)
Isomeric states, transliteration of Cyrillic characters.

30. Exchange of EXFOR, experiences with TRANS tapes.

31. Evaluated data files. (See IAEA-NDS-90 for BROND file)

32. ENDF/B processing computer codes.

33. Miscellaneous, conclusions, etc.

List of Working Papers

For the status reports by the centers see the appendices to this document.

The discussions were based

- on the conclusions and actions of the 8th NRDC Meeting 1985, see report INDC(NDS)-178,
- on the conclusions and actions of the 1986 Technical NRDC Meeting, see Memo CP-D/159,
- on the actions arising from the 15th INDC Meeting, see report INDC/P(87)-6,
- and on the 4C-Memos and CP-Memos exchanged among the centers during the past year.

The results of discussions are included in the Conclusions and Actions of the present meeting.

Additional working papers:

WP1 Pending EXFOR matters. Not appended to this document. See the EXFOR conclusions.

WP2 Pending CINDA matters. (See also Memo 4C-3/318.) Not appended to this document. See the CINDA conclusions.

WP3 Summary of important errors found by NDS in EXFOR TRANS tapes. See page 139.

Introductory pages to: Neutron Cross-Sections, Vol. 2: Curves (NNDC). Not appended to this document.

Summary of the meeting of the medium energy nuclear data working group, NASA Langley Research Center, Hampton, Virginia, 27-29 May 1987. See BNL-NCS-40070.

Summary of charged particle data collections (NNDC). See page 141 of this document.

Computer program abstracts: Nuclear model and related computer codes (NEA-DB). Not appended to this document. An updated version will be distributed soon.

Nuclear and atomic data meetings for 1988-1990 (NDS). See INDC/P(87)-13.

Index of data libraries available on magnetic tape from IAEA/NDS. See IAEA-NDS-7 Rev. 87/10.

Index to the IAEA-NDS-Documentation Series. See IAEA-NDS-0 Rev. 87/10.

BROND - USSR evaluated neutron data library (CJD). See IAEA-NDS-90.

Some measurements of charged-particle nuclear reaction data (CNDC). Not appended to this document.

Overview of the facilities and measurements in China (CNDC). Not appended to this document. Compare the report "Nuclear data research in the P.R. of China", INDC(CPR)-11.

and others.

M I N U T E S

Ninth NRDC Meeting

Brookhaven National Laboratory, USA, 27-30 October 1987

The Ninth NRDC Meeting was hosted by the National Nuclear Data Center, BNL, USA. Charles Dunford from the NNDC chaired the meeting, Norman Holden and Vicky McLane acted as local secretaries, H.D. Lemmel as scientific secretary of the meeting. The list of participants is given on page 9. During lunch times guided visits of selected BNL facilities were offered to meeting participants, on Wednesday to the National Synchrotron Light Source, and on Thursday to the High Flux Reactor.

1. Opening

The meeting was opened by Dr. Blume, one of the Deputy Directors of BNL, a solid state physicist.

Agenda: The IAEA Specialists Meeting on Nuclear Data Correlations and Covariance Data, Rome, November 1986 was added to Agenda Item 17. The finally adopted agenda is reproduced on page 10. The list of conclusions and actions resulting from the meeting is given on page 38.

2. Status reports by participants

Lemmel/NDS: Status report see Appendix 3.
McLane/NNDC: Status report see Appendix 1.
Hashizume/RIKEN: Status report see Appendix 6.
Manokhin/CJD: Status report see Appendix 4.

Some details:

Experimental Data. CJD developed his own computation format similar to that by Red Cullen; format allows conversion from EXFOR and ENDF-B.

CINDA. In the first half of 1988, a master file for area 4 will be sent to NDS. For the second half of 1988, they hope for a fully decentralized input into CINDA. Hundred EXFOR entries are not yet in CINDA, they hope to enter them before the end of 1987. They will try to send very often linked CINDA and EXFOR entries to NDS. They detected a lot of errors and discrepancies; 9000 corrected records were sent to NDS last year. CJD intends to send Blokhin in September 1988 to NDS for corrections, errors, erroneous codes, etc. in CINDA, in time close to the next NRDC meeting 1988 in Vienna.

BROND. They used FISCON and CHEQUER programmes for the checking of the BROND data. Additional errors were detected with the GRUKON and NJOY codes. BROND is now processed by GRUKON and NJOY into 26 and 300 MGCS, For checking they used version V of FISCON and CHEQUER. Dunford mentioned that version VI of these codes contains many improvements in checking procedures. CJD should get the latest versions, perform new checks and report the experiences to NNDC.

BOSPOR. An improved library for threshold reactions, BOSPOR '86, has been developed.

Nuclear theory developments concern mostly nuclear level densities, multistep reactions and precompound decay.

Publications. A special issue of "Nuclear Constants" was issued covering evaluation activities in Socialist countries.

WRENDA. 14 Soviet requests are considered fulfilled and were removed, the others are not yet fulfilled and will continue to figure in WRENDA 87/88.

Future. CJD will move to another building. At the end of 1988 they intend to replace the current computer with a new computer, EC 1066, with more powerful magnetic tape and magnetic disk units. This computer will be compatible with IBM and will be fully at CJD disposal. Presently they use an EC 1045 computer in another department for CINDA, this computer is not powerful enough to have a full CINDA system operating.

Chukreev/CAJaD: Status report see Appendix 5. Some details:

After the last NRDC meeting most activities concerned medical nuclear data. A transtape with radioisotope production data will be distributed next week. Chukreev expressed some concern with measurement units, particularly regarding stopping powers and thick target yields. The nuclear activation data handbook contains unusual thick target yields, and Chukreev was concerned that the users will not be pleased with these data.

A paper on neutron yields from (α,n) reactions on Li, Be and O for α-energies up to 10 MeV has recently been published; the data are evaluated but coded in EXFOR-format. Dunford suggested that it would be a very interesting international contribution if they would put these data also into the charged particle format of ENDF/B-VI.

Chukreev mentioned the book by Anderson from IBM on stopping power data, recently published by Academic Press. Dunford mentioned a review of stopping power data at the last CSEWG meeting by Perkins from Livermore. Pearlstein enquired about the range of input of CAJaD stopping power data. Chukreev replied that the heavy ion data are very bad, and that the p and α particle beam data were more reliable. Upon enquiry by Pearlstein into the reference on this work by CAJaD, Chukreev replied that there was no publication on stopping power data by his center. The data differed from those in the handbook by Ziegler, because they used different input data. They do not intend to publish these stopping power data. Lemmel mentioned the CPND data base for light ions for fusion applications recently developed by TU Graz and published as report INDC(AUS)-12/G.

Tubbs/NEA Data Bank: Status report see Appendix 2. Some details:

In the last year, NEA member states came strongly out in support of nuclear data activities of NEADB assigning highest priority to JEF.

JEF release would probably be in 1990. One full manyear was put on U-238 evaluation; this presents a particular evaluation bottleneck. Benchmarking of JEF required quite a lot of work.

The new NEADB activity in thermochemical data has strong support from member states and gains in momentum. They co-operate with CODATA and have currently three evaluation teams working on U(long effort), Am and Tc.

15 % of computer code distribution goes to non-OECD countries. The return of those countries in terms of new computer codes is not that large. Some programs were obtained from China, furthermore the FEDGROUP versions of Vertes and Trkov, respectively.

At the end of 1988, NEADB is supposed to get a new 8700 computer. Manokhin enquired into the comparison of evaluated data under the JEF project. Tubbs responded that they adopted the philosophy that an optimum benchmark is better than optimum evaluated data files, a philosophy which was doubted by Manokhin. Lemmel mentioned that intercomparison of data files by people not directly associated with their evaluation are not of a great impact and interest.

Cai Dunjiu/CNDC: Status report see Appendix 7. The second version of CENDL, CENDL-2, is planned to be completed in 1990.

CDFE: The status report by CDFE was available in writing, see Appendix 8.

3. Report on the 16th INDC Meeting, Beijing, and actions resulting from this and the last INDC meetings

Schmidt reported briefly on the major data-center-related discussions and recommendations of the 16th INDC meeting held in Beijing, 19-23 October 87. He mentioned in particular that the proposed publication (proposed by NNDC) of a final CINDA archival handbook covering the years 1935-1986 was approved by the Committee.

4. Commitments and co-operation of data centers etc. - selected notes

Pearlstein started the discussion by mentioning that the nuclear power programme in the US is slowing down. Nevertheless, NNDC is able to keep up with the traditional CINDA and EXFOR activities. Less funding was received for evaluation, but the well co-ordinated CSEWG represented still a viable effort. The compilation of CPND is increasing in importance, both at low energy (neutron and other beam sources), in medical radioisotope production, and at high energy for defence and space applications. After the space shuttle disaster, the space organisations would like to make sure for larger space flights, say, of 1-2 year duration e.g. to the Mars, that astronauts be well protected against space radiation; analysis of space radiation would need additional CPND. In conclusion, NNDC feels that CPND data compilation must be taken up, without impairing the neutron data compilation. Even if Kachapag had deceased, there are still efforts available such as RIKEN, CNDC and in particular CAJaD, and a

new effort in Los Alamos. NNDC would be prepared to help to co-ordinate CPND compilation as much as possible. Pearlstein reminded that ENDF-formats will also accommodate evaluated CPND. Co-ordination should not necessarily be limited to experimental CPND only. Schmidt emphasized that it would be realistic, in view of the limited manpower available, to restrict compilation and evaluation activities to well-defined CPND for well-defined and limited applications. Also, the help of outside experts in evaluation should be ensured. Hashizume and Chukreev both underlined the importance of CP monitor reactions for medical radioisotope production.

In conclusion it was felt, that data bases in CPND are presently rather poor, but that CPND compilation and evaluation should be an area of increasing cooperation between the data centers, without imposing on any cooperating data center the obligation to participate in the CPND compilation activities.

Two points which Pearlstein mentioned seem worthwhile to retain. Medical people did not put much emphasis on medical data so far, because they are afraid of the size of support needed for medical data which would compete heavily with the size of their own funds. The many manyears the data centers devoted to neutron data for reactors they consider a deterring example. The second remark: Whetstone (USDOE) wished to maintain the special ability of the data centers in the compilation and handling of data. This is one of the reasons why USDOE maintains its support for NNDC. Schmidt mentioned the usefulness of the data center experience in nuclear data for other data fields. The atomic data centers for example have partially adopted an EXFOR-like format for the compilation of experimental atomic data. A similar example was mentioned by Manokhin. The thermo-dynamical data center at Obninsk uses the EXFOR format.

Finally Pearlstein underlined the vested interest of NNDC in the NSDD data compilations. He appreciated the help from IAEA for participation in meetings, and mentioned his travels to China and India designed to encourage participation of these countries in the NSDD effort.

5. Review of actions from previous meeting

As next point on the agenda, the actions from the last NRDC meeting were reviewed (ref.: CP-D/159, p. 12 f.)

A number of actions was done since the last NRDC meeting, a number was continued as standing actions, a number was referred to further discussion in the technical sessions.

Highlights from the discussion during the review of actions

During the preparation of the new BNL-325 handbook, NNDC compiled also entries from the other areas into the EXFOR series 6, 7 and 8. An action was put on NNDC to send these entries to the other data centers for update. The new "barnbook" is ready and could go very shortly to the printer provided that contract difficulties with Academic Press are being solved.

The Dimitriev handbook is not available in computerized form, however, the majority of the data was put into EXFOR, some data were not put into EXFOR because they are considered not to be exact. Usually such a book, before publication, would have to be submitted for review and approval to the USSR Standards Committee. This was not done in this case. Lemmel enquired whether there were any copy-right problems regarding the translation of this book into English. Manokhin was not informed about any copy-right problems concerning Dimitriev's book.

Participating data centers

Pages 9.5 and 9.6 in the NNDC EXFOR Manual, version 87-1, were reviewed concerning the data centers participating in the NRDC network. An action was put on NDS to enquire with Tanaka, whether he would intend to stay in the NRDC network or not, since that group has not provided any contributions in the past years. The intention would be to exclude this group from the network rather than keep it unless there are real contributions into the EXFOR system made or to be expected. NNDC would have to correct Ishkanov to Varlamov as the head of the Moscow Photonuclear Data Center. Once they will make regular contributions to the systems, Reid-Glasgow, Warshaw-LLNL and Siciliano-Los Alamos should appear on page 9.6. Behrens from FIZ Karlsruhe, FRG, wants to be kept informed of NRDC discussions, but does no more want to participate in NRDC meetings. The address of the NBS Photonuclear Data Center should be changed to Gaithersburg. Dearnaley and Marchinkowski should be removed from the list. Dragovitsch/Desy, Hamburg, contacted Chukreev for CPND data, and is interested in co-operation with CAJaD. Chukreev has recommended him to contact Behrens/Karlsruhe and NDS Vienna, but neither he himself nor Karlsruhe nor Vienna have obtained any additional information in this case. Dunford felt that the main contact for CPND participants should be NDS.

Finally, an action was put on all data centers, to provide electronic or other mail addresses to NNDC to be added to the addresses of the co-operating centers.

6. The EXFOR System

The discussions on the EXFOR System were based on Working Papers 1 and 3. Numerous conclusions and actions were agreed upon which are summarized further below under Conclusions and Actions.

Pearlstein mentioned that some of the errors in transmission tapes escape the checking codes. He wondered whether all centers check in the same way the same errors by their checking codes. After some discussion it was concluded that, when an error is found in the transmission, which is not simply cosmetic, it should be included as an item to be checked by the checking codes and used for updating the existing checking codes of the data centers. Also, compilers should be educated so as to avoid such errors in future compilation.

7. Discussions with US observers

E. Siciliano from the T2 Division (Nuclear Data Group) of Los Alamos National Laboratory, reported on phase I of a three-phase project for the build-up of a medium-energy nuclear data library (MENDLIB). Work on phase I is documented in the report LA-11085-MS by E.R. Siciliano and E.D. Arthur, issued October 1987. This library would contain published medium-energy experimental data from measured charged-particle and meson-induced nuclear scattering and reactions, and is intended to serve the basic and applied needs of the medium-energy nuclear physics community. Phase I of this project involves compilation of nucleon and pion induced reaction data from the Los Alamos Meson Physics Facility (LAMPF), Phase II would include nucleon and pion data from other medium-energy facilities, and Phase III electron, light ion, and possibly kaon and anti-nucleon data.

Concerning input into MENDLIB, Siciliano mentioned 300-800 MeV proton data, 400 MeV pion data coming from LAMPF. Also, neutron source data from the Los Alamos Weapons Neutron Research Facility (WNRF) will come on-line. The Meson Facility at Vancouver produced protons up to 400 MeV and pions. The Bates Facility at MIT produces medium energy electron data. Siciliano emphasized that the medium energy community is a community in itself between low and high energy communities and deserves its own services. It covers essentially the energy range between about 100 MeV and 1 GeV.

Phase I of this project is proposed to demonstrate the feasibility of MENDLIB with the existing software and computer resources. The main emphasis is at present to make the first data available to LAMPF users and to develop on-line retrieval capabilities and user-friendly data base management. They co-operate with many experimental physicists in this project. As to the time table of Phase I: in summer 1988, a meeting with the LAMPF Director is planned on the continuation and future directions of the project. The feasibiliby of MENDLIB will have to be demonstrated up to that time. The support of Phase I comes from LAMPF in terms of computer help (VAX), T2 helps in the development of user interface. The total manpower involved in the first year of Phase I is about 1 MY/Y plus 20 % of Siciliano's time. Most of this is programming manpower, a bit of it physics manpower.

In the discussion, Siciliano pointed out that the size of the user community is between 400-800 people world-wide. The third phase of the project would also include facilities outside the USA. The interest would be in all masses of outgoing particles and in energy losses up to 30 MeV. The lower energy limit is 100 MeV for protons, for pions about 20 MeV. There is only a small overlap with medical data, e.g. for protons up to 250 MeV. They are now in the middle of Phase I. This is the only ongoing nuclear data effort for medium energies all over the world, with the exception of the medium-energy nuclear data meetings convened by NNDC. Schmidt offered help in accessing non-OECD laboratories, e.g. in the USSR, China, and India, at the time when the project will have reached Phase III. As to the size of the MENDLIB, it appears that each experiment has a large number of data points comparable to that produced in one typical set of Linac measurements. There will be only a very limited overlap

with the elementary particle compilations of CERN/Geneva. Their lower energy limit is 1 GeV, whereas for MENDLIB 1 GeV will be the upper limit.

Chukreev mentioned that the Institute of High Energy Physics of the USSR Academy of Sciences in Protvino near Serpuchov has compiled many proton and pion-production data. It would have many interesting data for the Los Alamos MENDLIB Project. The Head of the compilation group, "KOMPASS", is Dr. V.V. Ezhela. An action was put on Chukreev to inform Dr. Ezhela of the planned Los Alamos effort and its interest in an exchange of data. Dunford emphasized that compilation formats should be developed in close contact with the EXFOR effort of the NRDC. One should keep each other informed.

Hashizume promised to inform Dr. Siciliano of the Japanese effort and facilities which could be approached for contributions to MENDLIB in Phase III of the project. Zhuang Youxiang and Cai Dunjiu mentioned that perhaps data may come from the Lanzhou Heavy Ion Accelerator currently under construction. They promised to inform Siciliano of any Chinese activities in the medium energy data field.

The next presentation was given by Steve Warshaw from Lawrence Livermore National Laboratory on a new project in photonuclear data compilation, which had started about 1.5 y ago with the compilation of 150 experimental data sets for Fe isotopes. The compilation is meant to provide the data bases for evaluation. They are particularly interested in looking into the consistency of the available experimental data. All atomic masses will be covered and energies from keV-140 MeV (meson threshold). The data are sparce and scattered, particularly above the giant dipole resonance. This effort would have its Soviet counterparts in Drs. A.I. Abramov from FEI Obninsk and Varlamov from the Photonuclear Data Center at the Moscow State University. The user community this project aims at, is concerned with shielding studies, medical accelerator problems, radiation protection of space shuttle personnel, fusion reactor blankets and other applications.

John Hubble from the National Bureau of Standards reported on the activities of the Photon and Charged- Particle Data Center at Gaithersburg, NBS. This data center was created as a merger of the previous photonuclear data center under Ed Fuller and the NBS Charged Particle Data Center. It is directed by Dr. Martin Berger. Hubble mentioned the set of 15 volumes on photonuclear data published successively by Henry Gerstenberg. G. is retired and would be the contact for these handbooks. The new data center works in contact with the Livermore photonuclear data effort. Hubble himself has a library of photon attenuation coefficients for energies between 1 keV - 100 GeV. These data are stored on disks. NDS and the Photonuclear Data Center in Moscow would be interested in these data. NBS would be interested in a feed-back from these two data centers.

Chukreev took the occasion to thank Hubble for the previous data exchange, under which NBS had sent many data to the Photonuclear Data Center in Moscow. The Soviet scientists actually used these data and appreciated their high quality. Hubble mentioned that for Si there are large errors in scattering cross sections between 30 - 50 keV;

also no attenuation coefficient data are available between 0.5 and 6 keV through the K-edge.

Hubble went on to mention two future conferences which would be of interest to the NRDC network. The first is a Session on Atomic and Radiation Data and Applications (session organiser John Hubble), to be organised on Tuesday, 17th November 1987, at the forthcoming ANS-meeting in Los Angeles. The second is the 4th International Symposium on Radiation Physics, planned to take place in Sao Paulo, Brazil, 3-7 October 1988.

Pearlstein reminded the meeting that yesterday's discussion revealed a shift in the interest of nuclear data compilation from neutron nuclear data to CPND. Medium energy data are of particular interest for intense neutron sources, space protection, shielding, radiation damage research, and other applications. He mentioned the measurements of medium energy proton data up to 200 MeV currently underway at two facilities at Brookhaven. Both facilities are interested in compiling CPND. Part of these data are being compiled in EXFOR and will be exchanged with the other data centers. Pearlstein tried to stimulate the CPND compilation, and hopes for other countries to join this effort. As a result of travels to other countries such as India and China, Pearlstein found that people are unaware of what is actually being done. NNDC interest in medium energy data compilation is going up to 1 GeV, and that of Berkeley is in energies higher than 1 GeV. NNDC hopes for co-operation in this effort. Siciliano mentioned that the efforts of LA and BNL seem to be complementary. The bulk of the data in which the LA project is interested are inelastic and elastic scattering data. So far there is no co-ordination between LA and NNDC.

8. Compilation and exchange of CPND

It was agreed that the co-ordination of CPND compilation in EXFOR remains as before. This means that CAJaD is the main co-ordinator. To avoid duplications, CPND compiling centers should inform CAJaD of their compilation intentions in time before starting the compilation. (Exempt are Chinese data compiled by CNDC and Japanese data compiled by RIKEN.) During the past year this co-ordination suffered from the fact that the one or other letter did not arrive. Therefore, telexes should be used.

The magnetic tape exchange is reorganized such that the CPND compiling centers, i.e. CAJaD, RIKEN, NNDC, NDS and CNDC, send copies of their tapes to each of the other centers. In addition, a tape copy is sent to NEA-DB.

9. Evaluated CPND in ENDF-6 format

Chukreev explained that CAJaD has so far no experience to put evaluated CPND in ENDF-VI format; he hopes that CJD will help CAJaD to get experience. Manokhin confirmed that nobody in the USSR at present has experience to put CPND into ENDF-6 format. Chukreev mentioned that he has data for so-called exotic fusion reactions such

as p and t reactions on ^{7}Li. Dunford proposed an informal exchange between NNDC and CAJaD and suggested that Chukreev put his (α,n) data in ENDF-6 format, and sends them to NNDC. NNDC would be prepared to run the checking codes on the CAJaD entries and inform CAJaD back of the findings. Chukreev welcomed this proposal, but first would like to look into which data to compile, and secondly whether they are perhaps already in a position to run ENDF-VI checking codes themselves. Thereafter he would be prepared to respond to Dunford's proposal. An action was put on Chukreev to investigate (i) what data he could compile and send in ENDF-VI format, and (ii) which problems CAJaD had with implementing and running the checking codes for ENDF-6 formatted CPND.

An action was placed on NNDC to send to the other data centers the evaluated proton data for Fe with relevant documentation.

Zhuang Youxiang mentioned that as part of his fellowship work at NNDC he has compiled 150 CPND entries into EXFOR. Over the next few years CNDC would be interested in the compilation and evaluation of (α,n) and (p,n) reactions, including all Chinese and non-Chinese data. About 10 Chinese scientists would be part-time involved in this effort, making up about 4-5 MY/Y including experimental measurements: two from the IAE Beijing, four from the Sichuan University, four from the Shanghai Institute of Nuclear Research, and two from the Applied Physics and Computational Mathematics Institute in Beijing. An action was put on Zhuang Youxiang, before compiling non-Chinese data, to check with CAJaD as the coordinating center, to avoid duplication of compilation.

10. Photonuclear data

Chukreev said that the Photonuclear Data Center of the Moscow State University has plans to continue the compilation and evaluation of experimental photonuclear data; he had no information on the detailed plans. Manokhin and Chukreev took it to inform Varlamov and ask him to inform the other data centers about their compilation and evaluation plans by the usual NRDC memo. Chukreev mentioned plans of the Photonuclear Data Center to compile photodisintegration data of $^{6,7}Li$ into EXFOR. They have the same problem as CAJaD, in having no experience in compilation in ENDF-VI format. An action was put on all three USSR data centers to investigate the feasibility of evaluation of CPND and PhND in ENDF-VI format and to report the findings to the NRDC network. Informal steps will be taken regarding the initiation of co-operation between the Moscow Photonuclear Data Center and the new Livermore effort in PhND compilation.

11. Publications, CPND Bibliography

The CPND bibliography compiled by NNDC covers energy dependent cross sections and thick target yields up to 100 MeV incident energy. This is a by-product of the nuclear structure references (NSR) compilation effort. Dunford emphasized that only integral CPND are compiled, not differential CPND such as for example secondary neutron spectra from CP reactions. In terms of primary journals the CPND library is

complete. The publication is not cumulative. So far there were four editions over the past five years. If looking for a given reaction one would have to scan all these four editions; however, a retrieval from the computerized database ICPND is possible for all references per reaction. To satisfy NDS needs, NNDC will look into the possibility to make 130 copies, which have been requested from NDS, available to NDS.

Dunford mentioned that Ed Arthur from LA compiled a reference file for medium energy nuclear data. For non-integral data one of the major sources would be INIS; however this source is neither accurate nor complete enough.

12. Stopping power

Chukreev mentioned that they have developed a special rule for including stopping power data in a separate column of data sections of CPND entries in EXFOR. He would be prepared to write the usual memo to the other data centers about this problem, to give examples and references and to ask the other data centers for comments. Chukreev has a special problem in converting cross section data coded in mb/MeV into cross section data coded in mb. These are thick target transmission data which contain stopping power data as free parameters. For this conversion they need a unique definition of the stopping power data.

Lemmel wants to enter stopping power data as additional parameters to explain the experimental CPND and also because of the use in calculation of cross sections. According to the present rules, stopping power data cannot be retrieved and are all entered as free text information. An action was put on Chukreev to describe the rule for including stopping power data as retrievable items in CPND EXFOR and send a memorandum to the other data centers.

Cai Dunjiu informed that they compile p, d, and α-stopping power data, for Be, Al and Ni in free format in order to calculate the energy loss of charged particles. This is so far only an internal report and written in Chinese. They have also some photonuclear data for D, Be, Na and Zr and some photofission data, again as internal documents. An action was put on Cai Dunjiu to send the reports to Vienna, and another action on NDS to provide translations into English.

A further action was put on Cai Dunjiu, to comment on the problems in compiling stopping power data into EXFOR.

13. Coordination of compilation and evaluation of CPND for medical radioisotope production

Hashizume reported on the major recommendations of the IAEA Consultants' Meeting on Nuclear Data Requirements for Medical Radioisotope Production, held at RIKEN, Tokyo, April 1987. The major recommendations of this meeting and the conclusions of the present meeting can be summarized as follows:

- compilation and evaluation of 19 monitor reactions between threshold and 200 MeV and publication in an own report (priority I);

- compilation and evaluation of all production cross sections for eight most commonly used radioisotopes and publications of reports for each radioisotope (priority I);

- compilation of all EXFOR index lines and references for 23 less common medical radioisotopes and their addition to the Okamoto/ Gandarias Cruz report presented at the Tokyo meeting, and compilation of the experimental production data for these radioisotopes into EXFOR (priority II);

- checking, and if needed, correction of decay data for 12 radionuclides; and

- organisation of an intercomparison of nuclear model code calculations for the $^{127}I(p,xn)$ and $^{75}As(p,xn)$ radioisope production reactions.

Work on the implementation of these recommendations would essentially only involve RIKEN, IAE-CP (CNDC), CAJaD and NDS. NNDC might help in format questions, as regards the compilation of evaluated CPND in ENDF-VI format, NEADB could help in providing nuclear model codes for the intercomparison exercise. It was decided to discuss the actions following from the recommendations of the Tokyo meeting in a smaller sub-group, consisting of Hashizume, Cai Dunjiu, Zhuang Youxiang, Manokhin, Chukreev, Pearlstein (part-time), Lemmel (part-time) and Schmidt (chairman).

Monitor reactions (Priority I)

The Subgroup started with an information exchange on available data and publications. Chukreev mentioned that data from threshold up to 200 MeV would be important, and mentioned in this context in particular the ratio of proton reactions with ^{27}Al leading to ^{24}Na and ^{22}Na residual nuclei respectively. He also mentioned a German thesis by Michel from the FRG and, that Czechoslovakia has evaluated data for Cu plus proton monitoring reactions. Hashizume mentioned that he has already computerized
some monitor reaction data which he intends to recompile in EXFOR format.

Following a suggestion by Chukreev, it was concluded that RIKEN should compile in EXFOR format and evaluate the available data for the CP monitor reactions identified by Working Group I of the Tokyo meeting (Memo CP-D/164, p. 3-4) and send the report to NDS before October 1988 for publication. Chukreev agreed to send the available CPND for Al, Cu and Zn to RIKEN as soon as possible after this NRDC meeting. In the discussion it was emphasized that not a full-fledged evaluation would be needed, but an educated eye-guide curve through the experimental data, supplemented in the case of lacking data by nuclear model code calculations.

NDS was asked to start a new INDC-report series with distribution to the medical radioisotope community and to publish the report on monitor reactions as the first report in this new series before the end of 1988, on behalf of RIKEN and CAJaD. This report plus the reports for other radioisotope production data to be discussed below, could form the basis of a comprehensive handbook on radioisotope production data, which could be published at a later date and contain more comprehensive and more detailed evaluations. In the production of this handbook, comments by the users on the first reports could be taken into account.

Finally,an action was placed on NNDC to transmit recent CPND compilations in EXFOR to the other data centers.

Eight most commonly used radioisotopes (Priority I)

The following agreement was reached. All CP production reactions for the eight most common radioisotopes should be compiled in EXFOR format and evaluated by the following data centers:

^{11}C	RIKEN + CAJaD
^{13}N	RIKEN
^{15}O	RIKEN + CAJaD (?)
^{18}F	RIKEN + CAJaD (?)
^{67}Ga	RIKEN
^{111}In	RIKEN
^{123}I	RIKEN and
^{201}Tl	CAJaD

For each of these radioisotopes a separate report should be compiled and sent to NDS for publication, preferably before October 1988. An action was placed on CAJaD, to inform RIKEN and the other data centers whether it would co-operate with RIKEN on work for ^{15}O and ^{18}F.

23 less commonly used radioisotopes (Priority II)

In order to implement these compilations, the following actions were placed on data centers as follows:

- on NDS: to prepare a list of monitor reactions and all CP reactions for the production of all medical radioisotopes identified by the Tokyo meeting and send this list to the other data centers;

- on RIKEN, CAJaD, and NNDC: to transmit new CPND compiled in EXFOR format to the other data centers;

- on IAE-CP (CNDC) and RIKEN: to inform CAJaD as the coordination center for CPND compilation which of the 23 reactions quoted on page 5 of memo CP-D/164, and which of the medical radioisotopes listed on page 6 of the same memo they wish to compile; to inform also NDS and the other data centers;

- on NNDC: to send a complete index for all CPND contained in EXFOR to the other data centers; and

- on NDS: to update the report by Okamoto and Gandarias Cruz on Nuclear Data for Radioisotopes in accordance with the recommendations of the Tokyo meeting (CP-D/164, p. 6) and to publish this updated report in the new INDC-report series for medical radioisotopes.

Cai Dunjiu indicated that the Chinese would be prepared to measure some of these reactions.

Decay Data

Chukreev mentioned that these data are actually rather well known and should only be checked and verified.

Code Intercomparison

Schmidt offered that NDS could organise the code intercomparison for the $^{127}I(p,xn)$ and $^{75}As(p,xn)$ reactions in co-operation with Marshall Blann.

14. Photonuclear data evaluation for ENDF/B-6

Warshaw enquired whether PhND exist in ENDF/B-6 format. Dunford confirmed their existence. Warshaw noticed that in data reduction one can divide the data sources into two groups, Bremsstrahlung-type sources and electro-nuclear data such as electron-proton, electron-neutron interaction data, etc. which might have quite a practical importance in the future.

15. Nuclear model codes, availability, documentation, and customer services

Nordborg distributed a report, which contains a survey of most of the nuclear model codes available from NEADB. Schmidt raised the general problem connected with the non-availability of nuclear model codes of US origin to non-OECD countries. For several NDS projects, including e.g. the ICTP Trieste Workshop in February/March 1988, the intercomparison of theoretically evaluated nuclear data e.g. for the ITER-related evaluated nuclear data library, the code intercomparison of medical radioisotope production cross sections and other projects, a limited and well-defined package of US nuclear model codes would be needed. In the discussions, Tubbs confirmed the non-availability of US codes to non-OECD countries, without explicit permission by the US originator and/or the National Energy Software Center at Argonne National Laboratory. He thought, however, that nuclear model codes

would not be of such a sensitive nature as the reactor physics or other nuclear technology related codes and would thus probably be more easily released. In view of the fact that the field of applied nuclear theory and nuclear model codes was presently quite active, with contributions from both OECD and non-OECD countries, it should not present a very difficult problem to get a limited package of codes released. In fact the code blocking was damaging to the progress of the field. Tubbs underlined the good contacts of NEA to both Joe Coyne, head of the TIC office at ORNL, and Margaret Butler, head of the ANL National Energy Software Center. NEADB would volunteer to ask the Argonne Center for en-bloc release of nuclear model codes, related to a well-defined benchmark exercise or other well-defined applications. Pearlstein provided Schmidt with some background information on the DOE legislation related to the release of computer codes to non-US users. Tubbs informed, that NEADB has an account with the Argonne Center and pays up to 1 000 US$ for a big code. From the discussions it appears to be best, if NDS approaches first Margaret Butler for a release of a well-defined class of nuclear model codes.

16. Customer services, handbooks planned

Lemmel started this item by mentioning the safeguards, radioisotope production, and geophysics handbooks planned by NDS. Pearlstein underlined the usefulness of data "wish lists" as a basis for the scope of compilations. Schmidt agreed with this and mentioned that such concrete "wish lists" had been established before starting the handbooks mentioned by Lemmel. Chukreev informed about an index to CPND and PhND data in EXFOR format which comprises 200 pages, is currently in press, and will be published in spring of 1988. CAJaD will send 30 copies to NNDC, and 50 copies to NDS. Lemmel said that NDS would need 130 copies. Chukreev will ask his authorities to get permission to increase the number of copies to be sent to Vienna. Pearlstein enquired whether Chukreev planned to make this a regular publication; he mentioned data which had only recently been published, not yet been transmitted to the other data centers and will thus not appear in Chukreev's handbook. Manokhin replied that in principle they plan to have regular publications with supplements, depending on the response to the first publication.

Lemmel mentioned that more recently NDS has started to distribute smaller nuclear data files on diskettes, and to transfer nuclear model codes to PC. An action was placed on NDS to send copies of these codes converted to PC to the NEADB, in order to be incorporated in the computer programme liberary of NEADB. Lemmel mentioned that it would be tedious to send PC codes through the NEADB liaison officers in non-OECD member states. Nordborg explained that NEADB sends also codes directly to scientists in non-OECD member states with letter copy to the liaison officers. A similar action was placed on NNDC to send the ENSDF handling codes on PC to NEADB and NDS.

Schmidt raised again the problem of the universal availability of codes to non-OECD countries. Pearlstein underlined the need for some control of the distribution of codes, since particularly in the case

of nuclear model codes, different versions were floating around. He recommended again that NDS should first approach Margaret Butler from the Argonne National Energy Software Center. RSIC and NNDC had exceptional permission to deal directly with the code customers who would not have to go through the Argonne center. Cai Dunjiu mentioned, that they have requested codes from the NEADB, and are in return prepared to contribute an automatic optical potential parameter adjustment code and a code for the calculation of γ-production data including pre-equilibrium decay to the NEADB. Schmidt recommended strongly that also the HFTT code be included by the Chinese in their contributions to the NEADB computer code collection. At the recent Nuclear Theory Meeting in Beijing, this code was shown to achieve results in very good agreement with experimental data. Cai Dunjiu mentioned that another pre-equilibrium code, written by Zhang Jin Shang (?) which takes the Pauli exclusion principle into account and was successfully reported at the Nuclear Theory Meeting in Beijing, will also be sent to NEADB. A publication on fission product yield data has been prepared by Wang Dao on 10 fission product yield data sets which have been recently compiled and which will be issued in about one year's time. Regarding radioisotope production data, Cai Dunjiu mentioned that measurements of nuclear data are going on at the Nuclear Research Institute at Shanghai (decay data), Sichuan University (activation cross sections), and at the Institute of Atomic Energy in Beijing (beam-spectroscopy measurements).

Manokhin mentioned a compilation of theoretically calculated fission product yield data which has been carried out at the Institute of Physics and Engineering in Moscow. This library has been created on the basis of thermo-dynamic considerations. The publication was advertised in Nuclear Constants No. 2, 1987; the data are available on magnetic tape. An action was placed on CJD to inform the data center network about the availability of these data. Hashizume mentioned that 90 reactions for the production of medical radioisotopes have not yet been measured; he inquired whether the Chinese could perform some of these measurements.

Nordborg mentioned that NEADB offers on-line access to most of its databases, there is no special publication planned. Tubbs noted that NEADB will continue to publish reports on nuclear model code inter-comparisons, the index of the computer programmes available in its computer programme library, and the NNDEN newsletter.

McLane informed about the status of the new "barn-book". The book includes for the first time isomers with half-lives > 1 sec. The low-energy cut-off is 0.01 eV, and the higher energy limit about 200 MeV. The book will contain about 900 pages and probably be published in January/February 1988. A lot of work has also been done on activation cross sections for this edition of the "barn-book".

Lemmel enquired whether it would be possible to obtain the "eye-guide" curves appearing in the book on magnetic tape. Dunford replied that this would not be possible for all curves but for specific curves the release would be possible. He warned that the summing-up of all partial cross sections to the total cross sections is not guaranteed. An action was placed on NDS to define a request

for experimental data and eye-guide curves for activation reactions as defined at the 16th INDC Meeting to be included in the CRP on long-lived activation cross sections and isomeric cross section ratios.

Dunford mentioned that five major databases are now on-line; CSIRS would be the next on-line database. On-line excess is via MFENET, CYNET, TYNET and HEPNET. Lemmel enquired how the on-line service is being advertised by NNDC. Dunford replied, as "NNDC on-line systems". Lemmel suggested that all centers should have the same collective names for their nuclear data systems, e.g. international nuclear data base or similar.

Pearlstein will investigate the possible use of the neutron cross section tools employed in the preparation of the new "barn-book" for future publications of CPND. Such publications are not yet decided. The emphasis would be on high energy data between 20 MeV and 1 GeV. NNDC will investigate over the next years the feasibility of such a publication. In any case such a CPND handbook would not be as complete as the "barn-book", but will only contain a selection of CPND. The feasibility of the handbook depends mainly on manpower. NNDC has the tools but no manpower for the production of this handbook; it would need additional manpower for well-defined jobs, such as the development of a computation format for CPND.

17. Future meetings

Lemmel and Schmidt introduced document INDC/P(87)-13 which lists the future NDS meetings. Nordborg mentioned the NEANDC pre-equilibrium meeting planned for February 1988 on the Semmering in Austria. Late spring 1989 or early fall 1989, a meeting on nuclear level densities is planned in Bologna. If there is a (p,n) and (α,n) emission spectra RCM planned in 1989, this should be held adjacent to this meeting in Bologna.

Another meeting on activation cross sections for fission and fusion reactors has been suggested by A.B. Smith for spring 1989; this meeting should be small and confined to a maximum of 20 participants. Manokhin mentioned that the next USSR Conference on Nuclear Spectroscopy and Nuclear Structure would probably take place in Baku in 1988. In 1989, a national neutron physics conference is planned in Kiev. He also mentioned that in 1988 a fission meeting is planned in Smolenice. An action was placed on CJD to report the date of the Baku conference to Vienna. Another action was placed on NDS to produce an update of the meeting list and send it to the data center network.

18. Center-to-center on-line data transmission

On-line computer connections between the centers work routinely between NNDC and NEA-DB.

NDS had made some on-line data transmissions as a trial only. For details see the NDS status report given as Appendix 3. It was

recommended that IAEA should link to EARN in Europe which corresponds to BITNET in the US.

Lemmel noted that on-line transmission between Obninsk and NDS for CINDA entries would be very desirable.

NNDC has five of its major data bases opened for on-line transmission in the US, and it appears that this facility is frequently being used by US users. As a next step, NNDC intends to open CSISRS data on-line transmission to US users.

19. CINDA publication, new 'archival' issue

The publication of CINDA was reviewed. In areas 1 and 2 more and more CINDA users have on-line access to the CINDA file so that the need for the publication of CINDA in book form is decreasing. Sooner or later the publication of CINDA will no longer be economic. Therefore, a final cumulative issue will be desirable.

The situation is certainly different in areas 3 and 4, where on-line access to the CINDA file is a quite rare exception, and where CINDA books remain desirable. However, pubication of CINDA in the conventional way for areas 3 and 4 only, is unlikely to be economic. Annual supplement books, not cumulative, may be a solution.

The date for the final issue cannot be earlier than 1990 because a thorough cleanup of the file (mainly area 4) still requires some time. The financing of the final issue may be a problem. NDS will provide cost estimates. Payment in two installments should be possible.

20. Important neutron data not covered in EXFOR

Due to manpower restrictions at the centers, there are several types of important neutron data that are presently not compiled in EXFOR, although requests for the compilation of such data have been expressed on several occasions. The situation was reviewed and summarized as given in Conclusion 8.1. It can be seen that certain data types are compiled by three of the four centers but not by the fourth. In such cases the fourth center (i.e., NEA-DB in the case of data above 100 MeV, or NNDC in the case of kinetic energy of fission fragments) should possibly aim at joining the other three centers with the compilation effort.

21. Medium-energy nuclear data

Pearlstein introduced the document on the recent BNL meeting on this subject. He emphasized in particular his interest in benchmark calculations.

Chukreev mentioned again the proton data up to 800 MeV by Dragovitsch from DESY. He has the data on paper but not yet compiled in EXFOR. Some other data will be transmitted with the EXFOR tape TRANS A019.

22. Co-ordination of fission product yield compilation and evaluation, computation format (see Memo 4C-3/317)

McLane reported on the outcome of the recent Studsvik Meeting on Fission Product Yields. The main recommendations from this meeting were, that

- from now on fission product yield data be compiled by the data centers in EXFOR format,
- compiled fission product yield data be sent to evaluators for review, and
- a computation format common to all data centers be developed

The centers will have help e.g. by Wang Dao and Zhang Dongming in data compilation. Dickens from ORNL has promised to help NNDC by providing a summer student. NNDC plans to convert the latest 1985 Meek-Rider file into EXFOR. Manokhin promised to investigate into the possibility of fission product yield compilation and evaluation in area 4. McLane and Nordborg have already a fission product yield computation format, which was in principle approved by Rider and Mike James. An action was placed on NNDC to transmit by October 1987 to all centers the proposed computation format for fission product yields, as agreed between NEADB and NNDC. NDS and CJD are asked to report comments to NNDC by 1st March 1988. An action was placed on all data centers to transmit fission product yield data in EXFOR series 5-8 to the other data centers in official EXFOR format, as soon as manpower allows. The start of the CRP for fission product yield compilation and evaluation planned for 1989 fits well into the current plans for the experimental fission product yield compilation by the data centers. Incidentally fission product yield compilations are also needed and currently being performed by JEF and ENDF/B-VI.

In further discussion an action was placed on Schmidt to speed up the publication of the proceedings of the structural material RCM in Bologna and their distribution well in time before the February 1988 structural materials RCM. An action was placed on Goulo, to send more local information to the US meeting participants in the forthcoming FENDL Meeting in November 1987 in Vienna.

23. Co-ordination of neutron data evaluation

Dunford informed about the current status of ENDF/B-6. There is not a single funding source but a general pool of support for ENDF/B-6, co-ordinated by the nuclear physics part of the USDOE. As a consequence, this library will be fully released, and Dunford does not foresee any problem for its release. Since there is not enough manpower available in the US for its creation, formal and informal co-operations have been established with scientists in various countries to produce the input. He mentioned the co-operation with the CNDC on evaluations for O and F. It is also intended to take the Am-241, Bk and Cf isotope evaluations from CNDL and, to submit them for review by the CSEWG. Several co-operations between JEF and ENDF/B-6 evaluators are taking place. A new major updating of the

resonance data for U-235, Pu-239 and Pu-241 has been carried out in co-operation between Cadarache (Derrien) and ORNL. Li-7 data were evaluated in co-operation between Geel, Karlsruhe and Los Alamos. On fission product nuclear data, a co-operation beween Gruppelaar and Schenter has taken place, however, with major concentration on Gruppelaar. NNDC discussed with Manokhin which of the Soviet evaluations would be reviewed for incorporation into ENDF/B-6. Dunford distributed a list of all evaluations contained in ENDF/B-6. This list indicates that a number of ENDF/B-5 data were taken over in the -6 version after scanning for their correctness. In addition, the ENDF/B-V library has been fully translated into the ENDF-6 format.

The ENDF/B-6 standards are now available for review. A large effort has gone into their evaluation, including the use of covariance techniques, simultaneous evaluation techniques (R-matrix fitting versus evaluation of experimental data) etc. He hopes for comments by the users on the quality of these evaluations. The JEF standards group gave a preliminary positive feed-back, and will continue to provide feed-back. Short documentation will go with the file, a larger documentation is in preparation. Covariance matrices are not yet available. An action was placed on all data centers except NNDC to advertise the availability of the ENDF/B-6 standards file and to invite comments to be sent to NNDC.

Nordborg reported on the current work on the JEF-2 library. The goal is to have the fission product and minor actinide data ready by the end of 1988. Concerning structural materials and main actinides, the Scientific Co-ordination Committee of JEF suggested to do a major benchmarking; this may take the completion of these evaluations well to the end of 1989. So far JEF data have been compiled in ENDF/B-V format; eventually probably the ENDF-6 format will be adopted; NEADB has not yet received any data in ENDF/B-6 format. Tubbs mentioned an initiative coming from the NEANDC that its current chairman, A.B. Smith, should write to Japan, JEF and the US to investigate the possibilities for future co-operation in nuclear data evaluation.

Lemmel noted that NDS does not do evaluations itself, but assists other centers and groups in evaluation work such as CNDC, Minsk, and TU Dresden. Checking of the BROND and CENDL libraries is planned. In area 2 NDS supports dosimetry cross section evaluations by Vonach, and assists Mannhart in his Cf-252 prompt fission neutron spectrum evaluation. The "Mannhart evaluation" contains two files, one point-wise evaluation and one histogram evaluation with covariance matrices. Schmidt explained briefly the strategy for the creation of the Fusion Evaluated Nuclear Data Library (FENDL) related to the International Thermonuclear Experimental Reactor (ITER) project. This file will be coded in ENDF/B-6 format.

Manokhin started his presentation by strongly advocating the need for co-operation in evaluations in order to save manpower and time. Even to take over files from other evaluators was not easy and involves a number of checks, group cross section calculations etc. CJD supports the NDS activities in the Coordinated Research Programme (CRP) on Methods of Calculation of Fast Neutron Cross Sections for Structural Materials, but feels that it does not enough cover evaluation and experimental aspects. Manokhin therefore suggested that the next

Research Coordination Meeting (RCM) under this CRP should be extended in scope and in particular discuss the neutron capture and inelastic scattering data contained in the Fe, Cr and Ni data files of the BROND library and compare them with other evaluated data files.

Pearlstein noted that, what Manokhin had said, confirmed the consistent continuing interest of CJD mostly in documentation and curves, not so much in other evaluated data files. Tubbs said that he would raise the question of comparison with the BROND files for Cr, Fe and Ni at the November 87 JEF meeting. Schmidt suggested, that a first intercomparison of these files could take place at the forthcoming FENDL meeting in Vienna in November 87. Manokhin was more interested to have this intercomparison take place at the RCM in February 1988, because Ignatyuk will participate in the meeting, who was heavily involved in the structural material evaluations. At the FENDL meeting only the Kurchatov Institute will be represented. Both Dunford and Manokhin expressed a common interest in independent peer review of the other's data files. Manokhin mentioned, that the BROND evaluations for Li and Cr have been completed, and that ENDF/B-6 plans to do the same evaluations; he asked whether the BROND evaluations could not be taken from the beginning. Dunford said he would be delighted, but unfortunately the documentation is only in Russian and therefore difficult to understand. Also, there was quite some experience in co-operation between US and West European evaluators; the interaction with Soviet evaluators would, at least in the beginning, be more difficult and would have to be exercised. Manokhin mentioned that the Cr evaluation, while completed, is not yet available in BROND, but will soon be ready; he asked Dunford whether they would be interested in a review of these data. He himself would be very interested in the resonance data of ORNL for the Ni-isotopes. McLane prepared copies of the Fe, Cr and Ni pages of the new "barn-book" and gave them both to Manokhin and Schmidt for the planned intercomparison at the aforementioned meetings in November 87 and February 88.

24. Mito Conference, presentation on EXFOR

Since EXFOR is still not enough known by experimental nuclear physicists, a presentation on the EXFOR system at the Mito Conference was recommended with McLane as main author and Nordborg/NEADB, Manokhin/CJD and Lemmel/NDS as co-authors in order to give EXFOR a wider publicity. Schmidt was asked, as member of the International Advisory Committee of the Conference, to enquire with the Conference organisers whether in view of the late date such a paper could still be accepted and presented as a plenary talk or at least as a poster. He promised to try his best to get the paper still approved.

25. NRDC meetings in 1988 and 1989

The next technical meeting of the NRDC network was fixed for 4-6 October 1988 in Vienna. The 10th full NRDC meeting in 1989 could be in Vienna or possibly in China. The latter possibility would depend on whether the next NSDD meeting is already planned for China or not. If not, then the 10th NRDC meeting could be held in China in

1989. An action was placed on NDS to fix the meeting date and place of the 1989 meeting in consultation with the network members. Tentatively the date 10-13 October 1989 was fixed.

26. Miscellaneous, conclusions

The resulting actions were written up by N. Holden and reviewed by the participants already during the meeting.

For the conclusions see page 39.
For the resulting actions see page 46.

27. CINDA

The discussions on the CINDA system and co-operation were baed on Working Paper 2 which summarized the pending CINDA matters. The results of the discussions are summarized in the Conclusions and Actions under items 3 and 4.

28. WRENDA

Schmidt informed that some West European contributions to the new WRENDA 87/88 list were still lacking and that WRENDA 87/88 would be published in the first half of 1988. Manokhin advised that accuracies quoted in requests by Usachev should be rounded off to the next integer % figure (e.g. 2.1 % to 2 % etc.). Schmidt mentioned that this time, as an exception, mainly because of staff change at NEADB, NDS has taken on the coding of WRENDA input from area 2 and expressed the hope that for the next edition NEADB would return to the previous practice of coding area 2 input.

29. EXFOR (remaining items from 6)

The remaining discussions concentrated mainly on two topics.

The transliteration of cyrillic characters in author names should be standardized, as far as possible. Contrary to the Chinese who issued an official regulation for Chinese transliteration, there is no such regulation in the USSR. Chukreev explained that in the USSR two transliterations are used: the "international" transliteration with Ju and Ja is used in Yadernye Konstanty (Nuclear Constants), the "English" transliteration with Yu and Ya is used in the journal Yadernaya Fizika. As CINDA and EXFOR are in English language, the English transliteration should be preferred, unless an official transliteration scheme is issued by USSR authorities. Where feasible, a different author's transliteration could be given in EXFOR in the "free text" following the machine-retrievable author names.

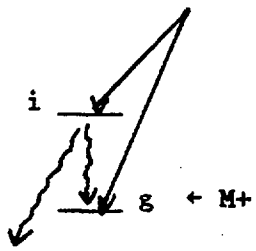
The EXFOR coding of short-living isomers was reviewed. Chukreev criticized that the flags in Dict. 27 indicate only those isomers that existed already in the file. This requires bureaucratic work

for updating the dictionary. These flags may be suitable for the low-energy data, but in the medium energy region in which more and more data are compiled now, there are many more isomers.

Consequently the use of isomer labels in Dict. 27 will be inadequate.

The codes CUM and M+ within the REACTION coding are defined as follows:

- CUM includes radioactive decay from other nuclides, not from isomers
- M+:



However, complication arises by the possibility of beta-decay which is not forbidden.

CAJaD will write a new proposal. Other centers are invited to send examples of difficult cases to CAJaD.

30. Exchange of EXFOR, experience with TRANS tapes

Lemmel presented Working Paper WP3 giving a summary of important errors found by NDS in EXFOR TRANS tapes. See Appendix 9. It was found that several items to be checked seem to be missing in the EXFOR check programs of the one or other centers. Efforts should be made to improve these check programs and to compare the check programs by the different centers. The results of the discussions can be found under item 5 of the Conclusions and Actions.

31. Evaluated data files

NNDC is going to release the ENDF/B-6 standards file, however still without covariances. The availability of the file should be advertised to customers.

ENDF/B-6 will be fully released whenever it is ready. The documentation of the evaluations can be found in CINDA. A summary documentation will be issued later. All materials are to be included though some of them will be taken over from ENDF/B-5 with only small improvements.

NEA-DB works on JEF-2 till the end of 1988. Benchmark testing will continue until end of 1989. The format is still ENDF-5, but ENDF-6 is likely to be adopted. There is no news about the release of JEF.

NDS has issued a Supplement tape to INDL, the new Cf-252 spectrum by Mannhart, and has distributed the new evaluated Fission-Product Yield

Library from China. NDS works on a file for Fusion Data in the framework of ITER. NDS had issued a new Z-S-A index to evaluated data libraries, IAEA-NDS-70.

CJD has issued the BROND file. The tape was handed over during the INDC Meeting in Beijing, but tape copies were not yet received from there. CJD will send another tape to NDS for distribtuion to the other centers.

Co-operation in NND evaluation was recommended. Forthcoming events will be the fusion meeting in Vienna in November 1987 and the structural materials meeting in Vienna in February 1988, for which data files together with documentation should be exchanged for graphical intercomparison.

Meeting of evaluators at the IAEA at no cost to the Agency were proposed. NNDC offers their plotting facilities to support any co-operation projects.

CNDC co-operation with Los Alamos in the evaluation of some actinides (Cf, Bk), which will be submitted for inclusion in ENDF/B-6.

CNDC proposed to define in ENDF-6 a new file for the total gamma-ray production, for which cross-section (or total multiplicity), energy spectrum and angular distribution would be given. Similarly, files for the total production of charged particles and light nuclei should be defined. This proposal should be considered by NNDC.

32. ENDF/B processing codes

Dunford informed that no updating of ENDF/B-6 processing codes is foreseen in the next 6-12 months. Lemmel mentioned Red Cullen's work on ENDF/B pre-processing codes. The next step would be a check of these codes from experiences of users in area 3. Manokhin mentioned that the GRUKON code is universally available, but unfortunately documented only in Russian language. An action was placed on CJD to send the GRUKON code with a short documentation to the NEADB.

Conclusions and actions

The conclusions and actions are summarized in the following sequence:

A. Conclusions

1. Publications and meetings
2. CINDA book
3. CINDA file
4. Joint CINDA/EXFOR matters
5. EXFOR
6. Charged-particle nuclear data
7. Photonuclear data
8. Neutron nuclear data
9. Evaluated neutron nuclear data
10. Computer codes and computer links

B. Actions

given under the same subject headings as the Conclusions above

A. Conclusions

1. Publications

1.1 NDS plans handbooks on nuclear data for safeguards, for geophysics, and for medical radioisotope production.

1.2 CAJaD works on a handbook for fission-product beta-spectra, and on an index to non-neutron EXFOR data. Of the latter 50 copies will be made available to NDS.

1.3 CJD published a summary documentation on the BROND evaluations and considers to publish a handbook on threshold reactions. A data base of fission-product yield data is being published in YK.

1.4 CNDC is issuing a handbook on fission-product yields.

1.5 NNDC has a new barn book in print as described in a separate document. It now includes also cross-sections leading to metastable states. The experimental data are fitted partly to ENDF/B-5 data, partly to eyeguide curves. NNDC continues to publish the CPND bibliography.

1.6 NEA-DB continues to publish NNDEN.

1.7 The work for WRENDA88 is on the way. There are delays for the contributions from UK, Belgium, FR Germany. NDS will finalize the file and publish it in the usual way as INDC report.

2. CINDA book

2.1 As users get on-line access to the CINDA file, it is forseeable that the publication of CINDA in the conventional way will no longer be economic.

2.2 A final archival issue of CINDA should be published in 1990.

2.3 Thereafter, a less ambitious publication mode may be practical such as annual supplement books which are not cumulative.

2.4 The financing of the final archival issue must be investigated.

2.5 The text about the importance of covariances could be included in the CINDA book, as reacommended by the meeting on Covariance methods and practices in the field of nuclear data, Rome, Italy, 17-19 November 1986. (See INDC(NDS)-192).

2.6 The production of the CINDA87 Supplement book is in progress. A tape from CJD was dispatched on 28 October 1987 (RL-432) which was too late for inclusion in the supplement.

2.7 Data tags do no longer exist in the CINDA file but are created at NDS in the book production program to the first line of a block which contains a data-index line with ref-type 3 or 4.

3. CINDA file

3.1 CJD requests to receive any updates of the programs for the CINDA file management.

3.2 The CINDA file acts as an EXFOR index. For this purpose, EXFOR entries in process should be indexed in CINDA with hierarchy 6 and the comment "In process", as proposed in 4C-1/191 solution 1. When such index lines are changed from preliminary to final, this should be treated as a "cosmetic" change. Such preliminary index lines would appear also in the book, and would be flagged by NDS with the "Data tag" as usual.

3.3 For hydrogen, the quantity code DNG was so far forbidden in CINDA. For Bremsstrahlung DNG with H should now be permitted, but a warning message should appear in the check program. The comment "Bremsstrahlung production" should be given in the comment field.

3.4 NEA-DB is issuing a new CINDA Manual, to which comments are requested as soon as possible. Update pages should be distributed without delay whenever proposals have been agreed.

3.5 The work-type codes "e" and "d" are NEA-DB internal and should be marked as such in the Manual p.II.8.1. The codes "X" and "B" are obsolete and should be removed from the Manual pages I.1.3 and II.8.2.

3.6 Resonance integrals for (n,p) and (n,α) should be coded under NP and NA with appropriate comment. The CINDA Manual should be updated accordingly.

3.7 Transmission of CINDA tapes should be continuous but at least four times per year. Frequent CINDA transmissions are now even more essential as more and more customers have on-line access to the CINDA file.

3.8 NDS had encountered a number of mistakes in CINDA entries, mainly by external CINDA co-workers of area 2, indicating that these co-workers need improved supervision. For details see Memo 4C-3/318.

4. Joint CINDA/EXFOR matters

4.1 The transliteration of cyrillic characters in author names should be standardized in the English scheme (i.e., Yu and Ya, not Ju and Ja).

4.2 The journal Fusion Technology is coded with the code FTC. (Cf Memos CP-C/167 and CP-D/160).

4.3 The journal codes for Nuclear Instr. and Methods as proposed in CP-D/163 is accepted.

4.4 For the conference 83MOSKVA more detailed information is requested from CJD. (Cf CP-D/160).

4.5 To the lab-code 4CCPMBP as proposed in CP-A/53 the place "Moscow" is added in the Dictionary.

4.6 The reference codes for the series "Fotojadernye Dannye" as proposed in CP-D/164 are adopted. CDFE is requested to print report codes on the cover of this series.

4.7 Special characters permitted in EXFOR and CINDA are restricted to

+ - , ( ) * / = ' . as originally agreed, and

% > < : ; ! ? & as adopted in 1986.

Additional signs were not accepted. In particular, square brackets, Greek characters, or small numbers were found not possible due to inconsistencies in different systems. Also lower case characters remain forbidden in the exchange systems. The signs that are forbidden in the exchange systems, can be created for output products, where feasible. However, the use of upper case or lower case numbers is not recommended in output products because they come out illegibly small so that, e.g., U^{236} and U^{236} can easily be confused.

5. EXFOR

5.1 The treatment of isomeric data in EXFOR was designed for low-energy data. Medium energy data being compiled now, have many more short-living isomers for which the EXFOR formalisms create difficulties. CAJaD will submit a new proposal. The other centers are invited to send examples of difficult cases to CAJaD.

5.2 In contrast to the code M+, the code CUM includes radioactive decay from other nuclides.

5.3 In inelastic scattering it is not distinguished whether the inelastic gammas come from an isomer or another excited state.

5.4 The column heading keyword FLAG remains forbidden in subentry 001. (Cf Memo 4C-3/313 and entry 22036). This should be added to check programs.

5.5 The quantity modifier MSC is added to the list of "General purpose modifiers" to be used for extreme rare representations of data. The nearest quantity code from Dict. 36 should be used to which the MSC modifier is added. (Cf Memo CP-D/157).

5.6 The multiplicity factors in REACTION-subfield 3 (example: D,XN+YP) are limited to 99, i.e., two digits. In the rare cases that they are larger than 99, the formalism for the variable number of product nucleons should be used. (Cf entry A0177 subentries 5, 9, 13, which should be retransmitted).

5.7 For "Spin-spin" cross-sections the formalism proposed in Memo CP-C/168 is approved, pending a Lexfor entry to be proposed by NNDC.

5.8 The Manual entries on MOM-SEC, EMS-SEC, etc. are adopted as proposed in Memo CP-M/9.

5.9 The dictionary additions as proposed in CP-M/8 are adopted with the following exceptions:

- the code TABLE in Dict. 16 was considered as not necessary and was therefore rejected,
- the PAR cross-sections proposed for Dict. 36 were not sufficiently understood, and more information on their meaning was requested from CDFE.

5.10 In EXFOR check programs consistency checks should be introduced where possible. For example:

- ANG or its derivatives in DATA must always coincide with DA or COR in REACTION.
- Column headings for errors must be the same under ERR-ANALYS and in the DATA table.
- EN must not be given when REACTION SF2=0.

In Memos cases should be pointed out where check-programs should be improved.

5.11 E-format numerical data must continue to be right-adjusted within the DATA fields. This should be checked in the check programs.

5.12 Alter flags in col. 80 should be given correctly. (They were found incorrect or missing mainly in area 2 entries.)

5.13 It was stressed again that quantities given under MONITOR must be proportional to the DATA. Otherwise use "ASSUMED" instead.

6. Charged-particle nuclear data

6.1 The co-ordination of CPND compilation activities remains unchanged.

6.2 The 5 CPND compiling centers (CAJaD, RIKEN, NNDC, NDS, CNDC) should exchange TRANS tape from each to each. In addition, a tape copy should be sent to NEA-DB.

6.3 Evaluated CPND should be compiled in ENDF-6 format. NNDC will do the checking for USSR ENDF-6 data as long as the FORTRAN-77 CHECKER codes cannot be implemented in the USSR.

6.4 CNDC intends to compile (p,n) and (α,n) data in EXFOR, in a cooperative effort of twelve universities. This plan is highly appreciated. If the compilation includes also data of non-Chinese origin, the compilation must be co-ordinated with CAJaD in order to avoid duplications in EXFOR.

6.5 NNDC will continue the publication of the Bibliography of integral CPND covering the energy range up to 100 MeV. If possible, NDS will receive 130 copies. Medium energy CPND are now being tagged in the NSR system but not included in above bibliography.

6.6 CAJaD suggested to include stopping power data in EXFOR and intends to write a memo on this topic. CNDC compiles such data presently in free format. (So far p, d, α on Al, Be, Ni etc.)

6.7 It was agreed to compile CPND data for radioisotope production in a co-ordinated effort with the goal of producing a handbook. As an interim step a special INDC report series will be created for publishing one report per reaction, whenever work for a reaction is finished. For details of this co-ordinated effort see the Minutes for agenda item 13.

7. Photonuclear data

7.1 Photonuclear data work in China covers (γ,n) on D, Be, Zr, Na and, recently, (γ,f). Related reports should be sent to NDS. See action 54.

7.2 S. Warshaw reports on their activities to provide photonuclear data for ENDF/B-6, including monoenergetic data and bremsstrahlung data. Electronuclear data, which may be important for the future, were not considered in the ENDF format.

7.3 A photonuclear data file on PC-diskette was distributed to participants.

8. Neutron nuclear data

8.1 Certain types of neutron data are not or insufficiently compiled in EXFOR. The following data types were identified.

data type	area 1	2	3	4
1. thermal scattering data	-	-	+	-
2. gamma spectra	-	-	-	(+)
3. spin assignment of fission resonances	-	-	-	-
4. charged-particle induced fission, e.g. (d,pf)	-	-	-	-
5. fission product yields	+	+	(+)	+
6. kinetic energy of fission fragments	-	+	(+)	+
7. data above 100 MeV	+	-	0	(+)
8. polarization	+	+	0	(+)
9. reaction with polarized neutrons	+	+	0	+

+ the center compiles such data
- the center does not compile such data
0 such data did not occur in area 3
(+) area 3: such data are compiled, but there is a serious backlog
(+) area 4: such data are presently not compiled, but they could be compiled

8.2 A joint computation format for fission-product yields will be essential. NDS will adopt the computation format developed jointly by NNDC and NEA-DB. NDS should contact the other centers as soon as possible.

8.3 The co-ordinated research program on FPY evaluation will start by the end of 1988. Until then the EXFOR data base for FPY should be uptodate.

8.4 NNDC has converted the Rider file to EXFOR format and will send this to Drs. Wang Dao and Zhang Dongming at Birmingham. They will review them and code additional entries in the preliminary EXFOR series 5-8.

9. Evaluated neutron nuclear data

9.1 The ENDF/B-6 Standards file, the JENDL-2 FP file and the BROND file were announced to be released. Centers should advertise their existence.

9.2 The use of the ENDF/B-6 standards should be promoted, supplemented by the new Cf-252 fission-neutron spectrum by Mannhart, Braunschweig, that had been distributed by NDS.

9.3 Centers should encourage co-operation between evaluators. In addition to the forthcoming IAEA meetings, IAEA should consider meetings of evaluators at no cost to the Agency.

9.4 Cullen's ENDF/B pre-processing codes will be updated, when need arises, by Cullen at Livermore. Relevant proposals and notification of defaults should be sent to Cullen with copy to Dunford.

10. Computer Codes and Computer Links

10.1 Nuclear model codes are included in the scope of NEA-DB. An updated inventory will be distributed to the other centers early 1988.

NEA cannot distribute US codes to non-OECD countries. To obtain codes from the US an account of ca US$ 1000 is required. Contact persons are Margaret Butler at the Argonne Code Center, and J. Coyne at TIC Oak Ridge.

10.2 NDS is presently converting some nuclear model codes for use on a PC.

10.3 NEA-DB will also deal with codes on PC diskettes but has presently no such activities because the post of the IAEA representative at NEA-DB is presently vacant. (It is to be filled by the IAEA INIS Section).

10.4 When converting codes for use on a PC, centers should be aware that many codes (e.g., GNASH) are in permanent update and that various versions exist.

10.5 CJD offers the GRUKON code which should be sent to the IAEA man at NEA-DB, together with documentation as soon as this is ready.

10.6 Possibilities of On-line connection of centers were discussed. See also NDS progress report and the brochure by NEA-DB. So far only NNDC and NEA-DB are connected, apart from a trial connection between NDS and NEA-DB. It was recommended that the IAEA should link to EARN in Europe which is linked to BITNET in the US, which can be reached by NNDC. There are no such possibilities in the USSR or China yet.

B. Actions

The actions are mostly as written up by N. Holden during the meeting, but were sorted under subject headings. The original numbering of actions is given in brackets, e.g.

5.10 ← new numbering under subject headings
(26) ← number of the action in the list by N. Holden. If this is missing, the action was added by H.D. Lemmel after the meeting.

1. Publications and meetings

1.1	NDS	In WRENDA, to change entries in entries by Usachev accuracies such as 2.1% or 4.9% to 2% or 5%.
1.2 (61)	ALL	Prepare and circulate a list of scientific meetings in their respective areas during 1988 and 1989.
1.3 (62)	NDS	Co-ordinate the lists of scientific meetings and circulate revised copy to all centers.

2. CINDA book

2.1 (20)	NNDC NEA-DB CJD	Reminder: to contribute to CINDA text pages, in particular: a) to send coverage cutoff dates for literature listed under "selected" literature scanned for the present edition (new for CJD). b) to explicitly state any codes to be added to or omitted from this list. c) to send information on conferences indexed since the last edition. d) to check other sections of the text pages and submit revisions and additions, in particular the sections: - Neutron Data Handbooks - Acknowledgements - Annex, section 8 (numerical data libraries)
2.2 (63)	NDS	Provide a revised publication schedule for the "archival issue" with revised cost estimates.
2.3 (79)	NDS	Decide whether to include covariance information in the introduction, when preparing CINDA-88 book.

3. CINDA file

3.1 (17)	ALL	To check target nuclei entered in CINDA against EXFOR Dict. 27, and to submit new nuclides for inclusion before transmission of the corresponding entries to other centers.
3.2 (18)	CJD	To make sure that mail delays are minimized. Full-scale CINDA co-operation cannot function without prompt transmission of correspondence and magnetic tapes. For information of the receiving centers CJD should send telexes announcing the dispatches.
3.3 (19)	ALL	To ensure that the coding of index lines to non-EXFOR data libraries is complete and up-to-date until CINDA-88.
3.4 (21)	NDS	To continue work towards full responsibility of CJD for the area 4 CINDA subfile.
3.5 (22)	CJD	To plan another visit of staff to Vienna for cleanup of the area 4 subfile and work on action 21.
3.6 (23)	NDS	To continue to send to CJD: - fast feedback on their CINDA entries - CINDA checking codes and updates - CINDA file (in agreed schedule)
3.7 (24)	NNDC NEA-DB NDS	To send to CJD from now on also all area 4 entries in reader format prepared by NDS, NNDC or NEA-DB, and update the area 4 subfile only with entries received from CJD.
3.8 (78)	ALL	Provide comments on new version of the CINDA manual to NEA-DB by January 2, 1988.
3.9 (80)	NEA-DB	Update the CINDA manual using the conclusions of this meeting.
3.10 (81)	ALL	Send CINDA transmissions at least four times per year.

4. Joint CINDA/EXFOR matters

4.1 (2)	ALL	To contribute to the cleanup of Dictionary 3 (institutes) and of the reference dictionaries 5, 6, 7 and to keep them up-to-date. Specifically: New conference proceedings and any changes in institute names or journal names should be reported to NDS. Comments for improvements in the new "short expansions" for conference proceedings are welcome.
4.2 (5)	NDS	To write a Lexfor entry on the special treatment in EXFOR of Chinese and other South-East Asian names.
4.3 (25)	ALL	To bring EXFOR index lines in CINDA up-to-date with high priority, because CINDA is used in NNDC and elsewhere as an EXFOR index.

4.4 (36)	CJD	Send to NDS a copy of the proceedings of the 83MOSKVA Conference.
4.5 (77)	NNDC	Provide CJD with a copy of the CINDA/EXFOR control list for inclusion of EXFOR line in CINDA blocks prior to transmission.

5. EXFOR

5.1 (1)	NDS	To send the EXFOR check program, whenever the new version is ready, also to NEA-DB in addition to the established distributions which includes CJD, CAJaD, RIKEN, IAE-CP, TUD.
5.2 (3)	ALL	With high priority to review memos containing requests for retransmissions of erroneous EXFOR entries and to correct and retransmit them speedily; specifically to review the list of requested retransmissions by O. Schwerer (will be sent out as a Memo).
5.3 (4)	ALL	To update their EXFOR checking programs to include the items included in the list of disturbing errors found in TRANS tapes (see Appendix ...).
5.4 (6)	NNDC	To distribute for review the Manual updates resulting from the 1985 NRDC Meeting.
5.5 (7)	NNDC	To update the Manual according to the conclusions of the present meeting.
5.6 (8)	NDS	To update the Dictionaries according to the conclusions of the present meeting.
5.7 (9)	ALL	to update their computer codes according to the conclusions of the present meeting.
5.8 (11)	NEA-DB NDS CJD	To review the EXFOR files 6, 7, 8 recently compiled by NNDC for missing data from areas 2, 3, 4, as soon as this has been transmitted. However, the compilation of new data should have higher priority than the conversion of the EXFOR 6, 7, 8 files into the regular 2, 3, 4 files.
5.9 (12)	NNDC	Send EXFOR files 6, 7, 8 to other centers for adding details and updating.
5.10 (26)	ALL	Supply NNDC with any electronic or other mail addresses for the LEXFOR manual.
5.11 (28)	NNDC	Investigate whether Lawrence Livermore National Laboratory intends to become a participating center.
5.12 (29)	NNDC	Change address for M. Berger to Gaithersburg, Maryland 20899.

5.13 (30)	NNDC	Remove Dearnaley and Marcinkowski from list of participating centers.
5.14 (31)	NNDC	Correct Prof. Seeliger's name.
5.15 (32)	NNDC	Change name of head of CDFE to Vladimir Varlamov.
5.16 (35)	NNDC	Propose the LEXFOR entry for the approved spin-spin cross section.
5.17 (38)	CAJaD	Inquire whether CDFE really needs partial cross section entry in EXFOR. If item is required, more information is necessary.
5.18 (39)	ALL	Make concentrated effort to correct and retransmit those EXFOR entires for which retransmission had been requested.
5.19 (40)	ALL	Whenever possible, update checking codes.
5.20 (41)	ALL	If an error occurs on retransmission, which should have been caught by the checking program, inform the transmitting center.
5.21 (42)	NDS	Benchmark the checking programs using PL1 and Fortran compilers and report on the intercomparisons.
5.22 (85)	NDS	Remove A flags for short-lived isomers from dictionary 27.
5.23 (86)	ALL	Update check programs according to action 85.
5.24 (87)	NNDC and other interested centers	To send to CAJaD prior to January 31, 1988 examples of difficult coding cases dealing with short-lived isomers.
5.25 (88)	CAJaD	To draft memo with a proposal for coding od short-lived isomers.
5.26	CAJaD	To submit a memo containing the physics of data involving short-lived isomers, and to propose an improved coding scheme for such data.
5.27	NEA-DB	To improve the EXFOR check program with respect to - consistency between REACTION (DA,COR) and column headings (ANG), and between ERR-ANALYS and error column headings - right adjusted E-format data - alter flags and others.

6. Charged-particle nuclear data

6.1 (13)	NNDC	To retransmit that entry from TRANS-C004 where Na-22 and C-12 were inverted.
6.2 (27)	NDS	Investigate whether the Study Group in Japan wishes to continue as an active cooperating center.
6.3 (33)	CAJaD	Send to other centers proton beam monitor reaction data on copper and carbon.
6.4 (43)	CAJaD	Inform V.V. Ezhela about the efforts of Siciliano of LASL on medium energy CPND compilation.
6.5 (44)	ALL	In the ineresets of coordination and to avoid overlap in CPND compilation, notify CAJaD by telex of any data sets being compiled.
6.6 (45)	CAJaD	Investigate the possibility of compiling their evaluated CPND in ENDF-6 format.
6.7 (46)	CAJaD	Investigate the potential problems in getting checking codes for data written in ENDF-6 format operational on their computer.
6.8 (47)	NNDC	Send to all centers an example of CPND coded in ENDF-6 format (proton reactions on iron) along with documentation.
6.9 (48)	CNDC	Check with CAJaD about their (p,n) and (α,n) data sets to avoid overlap in the CPND compilation effort.
6.10 (51)	NNDC	Increase the distribution to NDS of the next ICPND bibliography (April 1988) to 130 copies.
6.11 (52)	CAJaD	Prepare a memo on their proposal to code stopping power information within CPND entries.
6.12 (53)	CNDC	Provide comments on any potential problems in the compilation of stopping power data in EXFOR format.
6.13 (54)	CNDC	Provide NDS with a copy of their internal report on the photonuclear and photofission data that they have compiled.
6.14 (55)	CNDC	Consider the possibility of converting their photonuclear and photofission data into the EXFOR format.
6.15 (64)	CAJaD	Send available CPND for Al, Cu and Zn to RIKEN as soon as possible after this NRDC meeting.
6.16 (65)	RIKEN	Compile in EXFOR format and evaluate, in cooperation with CAJaD (see preceding Action), available data for CP monitor reactions identified by Working Group I of IAEA Consultants' Meeting on Data Requirements for Medical Radioisotope Production, Tokyo, April 1987 (Memo CP-D/164, p.3-4), and send report to NDS before October 1988 for publication (see following Action).

6.17 (66)	NDS	Start new INDC-report series and distribution for medical radioisotope production data and publish joint RIKEN-CAJaD report on monitor reactions as first report in the new series before the end of 1988, on behalf of RIKEN and CAJaD.
6.18 (67)	RIKEN CAJaD NNDC	Transmit new CPND compiled in EXFOR format to other data centers.
6.19 (68)	RIKEN CAJaD	Compile in EXFOR format and evaluate excitation functions for all CP production reactions for the following of the most common radioisotopes: ^{11}C(RIKEN + CAJaD), ^{13}N(RIKEN), ^{15}O(RIKEN) + CAJaD(?)), ^{18}F(RIKEN + CAJaD(?)), ^{67}Ga(RIKEN), ^{111}In(RIKEN), ^{123}I(RIKEN), and ^{201}Tl(CAJaD), compile report for each radioisotope and send to NDS for publication, preferably before October 1988.
6.20 (69)	CAJaD	Inform RIKEN and the other data centers whether it will co-operate with RIKEN on work for ^{15}O and ^{18}F.
6.21 (70)	NDS	Publish separate reports, for each radioisotope, resulting from the preceding two Actions in the new INDC report series for radioisotope production.
6.22 (71)	NDS	Prepare list of monitor reactions and all CP reactions for medical radioisotope production identified by Tokyo Meeting on Radioisotope Production Data and send to other data centers.
6.23 (72)	NNDC	Send to CAJaD, IAE-CP (CNDC), NDS and RIKEN monthly excerpts from NSR file for all CP reactions listed by NDS (see preceding Action).
6.24 (73)	IAE-CP (CNDC) RIKEN	Inform CAJaD as coordination center for CPND compilation which of the 23 reactions quoted on page 5 of Memo CP-D/164, and medical radioisotopes listed on page 6 of same memo they wish to compile. Inform also NDS and other data centers.
6.25 (74)	NNDC	Send complete index for all CPND contained in EXFOR to the other data centers.
6.26 (75)	NDS	Update the report by Okamoto and Gandarias-Cruz on nuclear data for medical radioisotopes in accordance with the recommendations of the Tokyo Meeting (CP-D/164, p.6) and publish in the new INDC report series for medical radioisotopes.
6.27 (76)	NDS	Organize intercomparison of nuclear model calculations for the reactions ^{127}I(p,xn) and ^{75}As(p,xn) and inform the other data centers about the results.

6.28	NNDC	To send out the new EXFOR compilation of medium-energy CPND.
6.29	ALL	Check Dunford's survey of CPND compilations and communicate to him any omissions.
6.30 (1)	CAJaD	To retransmit entry A0177 avoiding three-digit multiplicity factors in REACTION subfield 3, by using the formalism of variable number of product nucleuos.

7. Photonuclear data

7.1 (37)	CAJaD	Contact CDFE and suggest that a report code be added to their photonuclear publication series.
7.2 (49)	CAJaD CJD	Inform CDFE and investigate the possibility of their evaluation of CPND and photonuclear data in ENDF-6 format and report CDFE plans to the network.
7.3 (50)	CAJaD CJD	Query CDFE about the status of the photonuclear data tapes described in their progress report. Have these tapes been prepared and sent? Telex reply to network.

8. Neutron nuclear data

8.1 (10)	NDS	To contact Dr. Cai Dunjiu and clarify the EXFOR coding of fission-products as mentioned in his letter of 86/9/23.
8.2 (34)	NEA-DB	Retransmit entry 22036 (Trans 2117) with corrected FLAGS.
8.3 (58)	CJD	Will inform network on the availability of the fission product yield calculated data from thermodynamic principles on magnetic tapes from the Moscow Institute of Physics and Engineering.
8.4 (82)	NNDC	Send the proposed computation format description of the fission product yields to all centers prior to December 1, 1987.
8.5 (83)	ALL	Report back to NNDC any problems with the product yields computation format by March 1, 1988.
8.6 (84)	ALL	On a time available basis, convert the 5000, 6000, 7000, and 8000 entries of fission product yields into legal EXFOR format and retransmit as soon as possible.
8.7	ALL	To contribute implementing the covariance recommendations from the Rome Meeting [see report INDC(NDS)-192].
8.8	Neutron Centers	To compile in EXFOR fission product yield data for review and evaluation by the specialized centers in US, UK, China.

9. Evaluated neutron nuclear data

9.1 (14)	NDS	To distribute, at regular intervals, tape copies of IAEA-NDS-70, the Z-S-A index to evaluated data libraries.
9.2 (15)	NEA-DB	To distribute the new JENDL-2 FP library.
9.3 (16)	NEA-DB	If existing, to provide (or quote the reference of) the documentation for JENDL-2 evaluations, including the FP library.
9.4 (59)	ALL	Inform customers about the availability of the ENDF/B-6 standards file and request that any comments on the file be transmitted back to NNDC.
9.5 (60)	NNDC	On a selected basis, use the computer programs developed for the new BNL book of curves to assist specialists' meetings by plotting overlays of evaluated and experimental nuclear data.
9.6	NDS	To update the area 3 distribution list for NNDEN and to include Wang Gongqing, Nuclear Data Group, Shanghai Inst. of Nucl. Res., Academia Sinica, P.O. Box 8204, Shanghai, China.
9.7	NDS	After receipt of the BROND tape, send copies to the other centers.
9.8	NNDC	To examine the CNDC proposal to create in the ENDF-6 format new files for - total gamma-ray production - total production of light nuclei for which cross-sections (or multiplicity), energy spectrum and angular distribtuion would be given.

10. Computer codes

10.1 (56)	NDS	Send copies of the nuclear model codes on personnel computer diskettes to NEA-DB.
10.2 (57)	NNDC	Send copies of P.C. diskettes of nuclear structure codes to NEA-DB and NDS.
10.3 (89)	CAJaD	To send to NEA-DB a tape copy of the GRUKON code with documentation.
10.4	NEA-DB	To distribute the updated version of the Computer Program Abstracts on nuclear model and related computer codes.

National Nuclear Data Center

Status Report

to the

Ninth Nuclear Reaction Data Centers Meeting

October 27 - 29, 1987

I. General

Since the last meeting of the Nuclear Reaction Data Centers in October 1985, our staff has remained the same (13 scientific/professional and 9¼ support positions). In addition, we have a visiting scientist from the People's Republic of China doing NSR reference coding and experimental high energy proton-induced reaction data compilation.

II. Computer Facilities

The VAX 11/780 has hardware additions in the following areas:

1. Three RA81 disk units 456 MB each
2. DMR-11 communications link to the BNL Central Scientific Computing Facility which has access to networks. The link speed is 56 kilobaud.
3. Three LN03 plus laser printers
4. One DEC server-100, 8 asynchronous ports.
5. One DEC server-200, 8 asynchronous ports.
6. Ethernet local access network.
7. IBM PC/FIT with software and hardware to link to Ethernet.
8. Line printer 1200 LPM.
9. Several modems for remote telephone access.
10. 12 megabytes of memory

A diagram of the system as of September, 1987, is attached.

We anticipate replacing the DEC system-10 computer in the first quarter of 1988 with a Vax processor 8,000 series with a CPU rating of from 6 to 12 million instructions per second (MIPS).

II. Bibliographies

The normal CINDA and NRS activity has continued. Four supplements and two cumulative issues of Recent References have been published since October, 1985. Two editions of *Charged Particle Nuclear Data Bibliography* were published covering the literature from April 1, 1985 through April 10, 1987.

CINDA indices were prepared for the 1986 and 1987 DOE-NDC Progress Reports.

III. Data Libraries

In the period from October 1985 through September 1987, 29 neutron data transmission tapes (TRANS 1199-1227) were sent containing new and corrected entries.

In conjunctions with the Book of Curves, major corrections to the data files were undertaken.

The compilation of charged-particle data for incident protons was begun. A transmission tape will be sent shortly.

The NNDC chairs the Medium-Energy Nuclear Data Working Group (MENDWG) which held its first meeting May 21-22, 1986. Seventeen organizations from the U.S., Canada, the Federal Republic of Germany, and the U.K. provided input.

IV. Evaluated Nuclear Reaction Data

ENDF/B-VI is now scheduled for completion in the first half of 1989. The entire ENDF/B-V library has been converted to ENDF-6 format. The ENDF utility codes have been converted to ANSI-77 FORTRAN and upgraded to handle all but the generalized R-matrix and new covariance formats. The checking codes have been extensively tested on the converted ENDF/B-V library and on JEF.

The evaluation of standards for ENDF/B-6 has been completed and is available at the NNDC.

High energy Neutron and proton libraries for ^{56}Fe have been prepared in the ENDF-6 formats.

V. Nuclear Strucure Data

NNDC continues to publish the Nuclear Data Sheets. As of September, 1987, issues through Volume 52, issue#3 have been sent to Academic Press. Publication is on schedule.

VI. Customer Services

During the past two years, the NNDC has instituted on-line services for the following types of data bases:

Nuclear Structure References (NSR)
CINDA
ENDF/B-V
ENSDF
NUDAT - a collection of evaluated nuclear data , including nuclear levels and their properties, nuclear masses, nuclear ground and metastable state properties, and radioactive decay radiations.

Since October 1, 1985, 5141 retrievals have been made by on-line customers. Approximately 50% of the retrievals have been from the NRS data base. There are 45 active customer accounts; many of these serving more than one user.

The request statistics for July 1, 1985 through June 30, 1986 are attached.

VII. Publications

The fourth edition of *Neutron Cross Sections*, Vol. 2, Book of Curves, is in press.

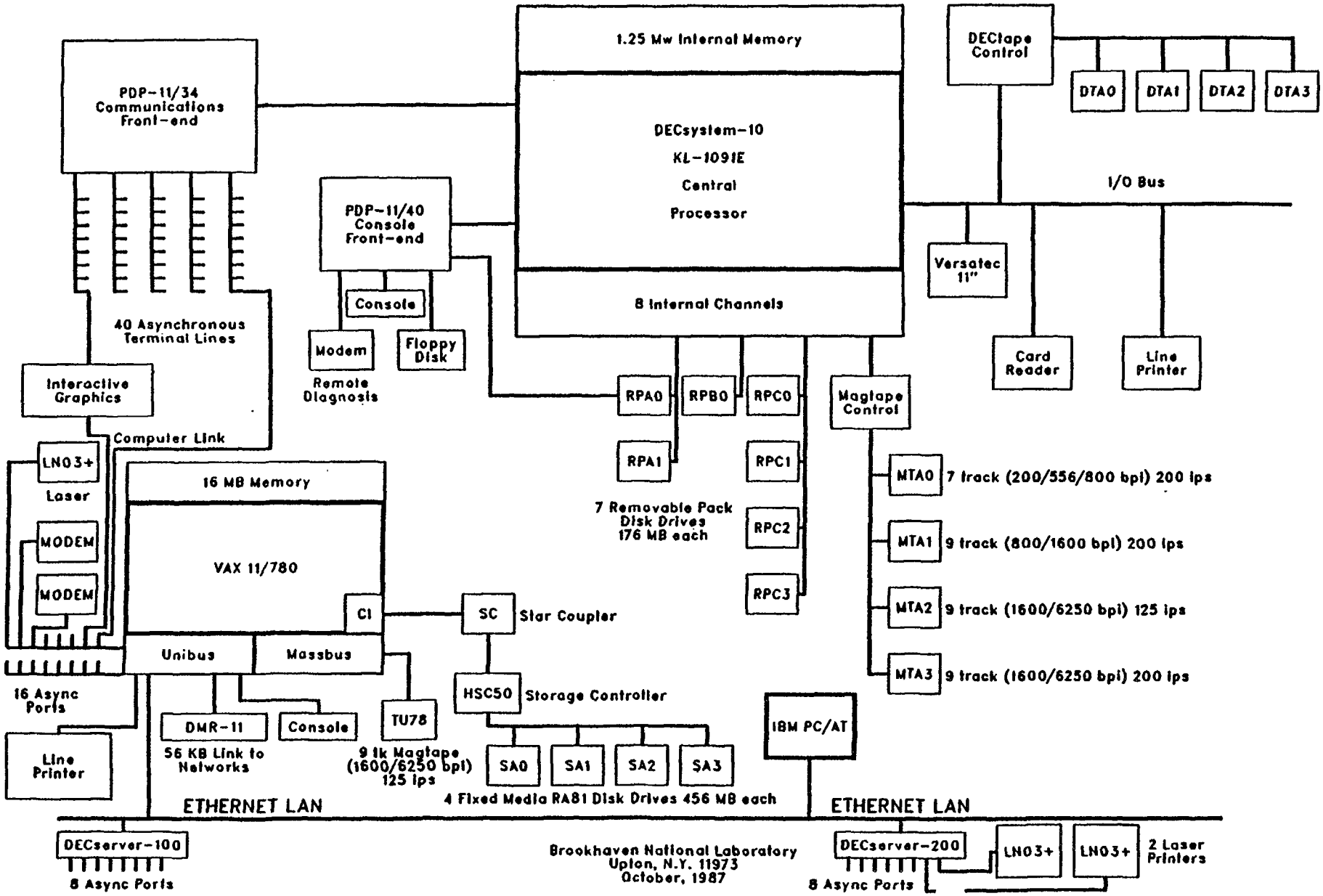
A new edition of the *Nuclear Wallet Cards* is planned for January 1989.

J. K. Tuli contributed the section on Nuclear Properties to the IAEA *Handbook on Nuclear Activation Data, 1987*.

The latest DOE-NDC Compilation of Requests for Nuclear Data was published in January 1987

The Fast Neutron Newsletter, Issue #7 is in preperation.

National Nuclear Data Center
Computer System



Request Statistics

TABLE II

1 July 1985 to 1 July 1987

Area 1

REGULAR DISTRIBUTION OF DATA AND INFORMATION

A. Experimental Neutron Data: 31 Tapes (TRANS 1196 to 1226)

B. Experimental Charged Particle Data: 1 Tape (C005)

C. Experimental Photonuclear Data: 1 Tape (L002, Update To L001)

D. Evaluated Neutron Information: 6 Tapes
ENDF Utility Programs (ENDF/B-VI Version 6.0, Version 6.1, Version 6.2)

ENDF/B-V Data (Tape 520; Photon Interation Data, Tape 567,568: General Purpose Data-Mods. for Version 1 and 2)

E. Bibliographic Neutron Information: 27 Tapes CINDA COVERAGE (C068 TO C094)

Request Statistics

TABLE I

1 July 1985 to July 1987

Area 1

NUMBER OF REQUESTS FOR NEUTRON AND CHARGE PARTICLE INFORMATION*

Requestor	Experimental Data	Evaluated Data	Bibliographic Information	Programs	Documents	Total
USA-Goverment Agencies	86	73	5	22	147	333
USA-Education Institutions	31	22	2	12	89	156
USA-Industry	24	26	0	8	156	214
Canada	0	4	0	3	13	20
Foreign (except Canada)	-	-	-	21	194	215
TOTAL	141	125	7	66	599	938

*This table does not include regular distributions, see Table II.

Request Statistics

TABLE III

1 January 1985 to 31 December 1985

Area 1

EXPERIMENTAL NEUTRON DATA

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. C/S	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
0-NN	1	2	0	0	0	0	0	0	0	3
1-H	6	7	1	0	0	5	0	0	2	21
2-He	3	7	0	0	4	1	2	0	1	18
3-Li	3	1	2	0	0	0	8	0	0	14
4-Be	1	1	0	0	0	0	2	0	1	5
5-B	3	5	5	3	0	0	1	0	8	25
6-C	7	8	4	6	37	12	43	0	1	118
7-N	2	1	0	0	0	0	4	0	0	7
8-O	2	3	2	0	0	0	2	0	1	10
9-F	1	0	1	0	2	3	13	0	0	20
10-Ne	0	0	0	0	0	1	3	0	0	4
11-Na	1	0	0	0	0	4	6	0	1	12
12-Mg	1	1	1	0	0	1	17	0	1	22
13-Al	4	3	1	0	0	1	16	0	3	28
14-Si	4	6	1	0	0	0	6	0	0	17
15-P	1	0	0	0	0	1	6	0	0	8
16-S	1	2	1	0	0	0	4	0	0	8
17-Cl	1	0	0	0	0	3	6	0	0	10

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. C/S	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
18-Ar	1	0	0	0	0	1	4	0	0	6
19-K	1	0	0	0	0	2	2	0	0	5
20-Ca	1	2	0	0	0	3	7	0	1	14
21-Sc	1	2	1	1	8	5	11	0	1	30
22-Ti	1	1	0	0	0	1	5	0	1	9
23-V	3	0	0	0	0	1	7	0	0	11
24-Cr	2	0	0	0	0	1	7	0	0	10
25-Mn	1	1	1	1	10	6	18	0	3	41
26-Fe	4	20	15	6	31	23	49	0	5	153
27-Co	2	2	1	0	1	4	7	0	1	18
28-Ni	5	4	4	0	0	4	7	0	0	24
29-Cu	2	1	0	0	0	3	9	0	1	16
30-Zn	2	0	0	0	0	1	9	0	0	12
31-Ga	1	0	0	0	0	1	2	0	0	4
32-Ge	0	0	0	0	0	1	2	0	0	3
33-As	0	0	0	0	0	0	5	0	0	5
34-Se	0	0	0	0	0	2	6	0	0	8
35-Br	1	0	0	0	0	0	0	0	0	1
36-Kr	0	0	0	0	0	7	0	0	1	8
37-Rb	0	0	0	0	0	0	0	0	0	0
38-Sr	6	5	3	5	20	13	3	0	2	57
39-Y	2	1	1	0	0	3	2	0	0	9
40-Zr	7	2	1	0	0	11	16	0	1	38
41-Nb	2	2	3	0	0	1	7	0	0	15
42-Mo	7	5	0	1	0	11	5	0	1	30
43-Tc	0	0	0	0	0	0	0	0	0	0

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. C/S	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
44-Ru	0	0	0	0	0	0	0	0	0	0
45-Rh	1	0	0	0	0	2	0	0	0	3
46-PD	3	0	0	0	0	3	3	0	0	9
47-Ag	2	0	0	0	0	2	5	0	0	9
48-Cd	2	1	0	0	0	0	9	0	1	13
49-In	2	0	0	0	0	0	0	0	0	2
50-Sn	7	3	1	0	0	9	1	0	1	22
51-Sb	1	0	0	0	0	1	4	0	0	6
52-Te	0	0	0	0	0	0	0	0	0	0
53-I	1	0	0	0	0	1	11	0	0	13
54-Xe	0	0	0	0	0	0	0	0	0	0
55-Cs	5	2	1	4	11	6	17	0	0	46
56-Ba	2	0	0	1	0	7	3	0	0	13
57-La	1	0	0	0	0	1	5	0	0	7
58-Ce	3	0	0	0	0	0	1	0	0	4
59-Pr	1	0	0	0	0	1	3	0	0	5
60-Nd	15	9	7	12	60	26	20	0	2	151
61-Pm	0	0	0	0	0	0	0	0	0	0
62-Sm	12	7	5	3	43	24	13	0	5	112
63-Eu	10	10	3	3	54	23	2	0	12	117
64-Gd	0	0	0	0	0	1	0	0	0	1
65-Tb	0	0	0	0	0	0	2	0	0	2
66-Dy	0	0	0	0	0	1	2	0	0	3
67-Ho	2	1	1	3	6	4	8	0	1	26
68-Er	7	7	2	14	38	13	12	0	2	95
69-Tm	0	0	0	0	0	3	1	0	0	4

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. C/S	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUEST
70-Yb	1	0	0	0	0	2	2	0	0	
71-Lu	3	3	1	3	15	9	8	0	3	4
72-Hf	0	0	0	0	0	0	0	0	0	
73-Ta	2	0	0	0	0	2	5	0	0	
74-W	1	0	0	0	0	1	6	0	0	
75-Re	0	0	0	0	0	0	3	0	0	
76-Os	0	0	0	0	2	1	0	0	0	
77-Ir	0	0	0	0	0	4	0	0	0	
78-Pt	1	0	0	0	0	0	0	0	0	
79-Au	1	0	0	0	0	10	6	0	0	1
80-Hg	1	0	0	0	0	0	1	0	0	
81-Tl	0	0	0	0	0	4	2	0	0	
82-Pb	5	5	4	0	0	2	4	0	1	21
83-Bi	1	1	0	0	0	4	3	0	1	10
88-Ra	0	0	0	0	0	0	0	1	0	1
89-Ac	0	0	0	0	0	0	0	0	0	0
90-Th	1	0	0	0	0	1	1	0	0	3
91-Pa	1	1	0	0	0	0	0	0	0	2
92-U-000	0	0	0	0	1	0	0	0	0	1
92-U-230	0	0	0	0	0	0	0	0	0	0
92-U-231	0	0	0	0	0	0	0	0	0	0
92-U-232	0	0	0	0	0	0	0	0	0	0
92-U-233	0	0	0	0	0	1	0	2	1	4
92-U-234	1	0	0	0	0	0	0	1	0	2

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. C/S	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
92-U-235	2	0	0	0	0	4	0	11	1	18
92-U-236	1	0	0	0	0	0	0	1	0	2
92-U-237	0	0	0	0	0	0	0	0	0	0
92-U-238	2	1	0	0	0	3	0	10	0	16
92-U-239	0	0	0	0	0	0	0	0	0	0
92-U-oxi	0	0	0	0	0	0	0	0	0	0
93-Np	0	0	0	0	0	0	0	1	0	1
94-Pu-000	0	0	0	0	0	0	0	0	0	0
94-Pu-238	0	0	0	0	0	0	0	1	0	1
94-Pu-239	1	0	0	0	0	0	0	3	1	5
94-Pu-240	1	1	1	1	5	1	0	2	1	13
94-Pu-241	1	1	0	0	7	1	0	2	1	13
94-Pu-242	1	0	0	0	1	1	0	1	0	4
94-Pu-243	0	0	0	0	0	0	0	0	0	0
94-Pu-244	0	0	0	0	0	0	0	1	0	1
94-Pu-245	0	0	0	0	0	0	0	0	0	0
95-Am	1	0	0	0	0	0	0	3	0	4
96-Cm	0	0	0	0	0	0	0	0	0	0
97-Bk	0	0	0	0	0	0	0	0	0	0
98-Cf	0	0	0	0	0	1	0	1	0	2
99-Es	0	0	0	0	0	0	0	0	0	0
100-Fm	0	0	0	0	0	0	0	0	0	0
TOTAL	180	148	75	67	356	317	492	41	71	1,747

Request Statistics

TABLE IIIA

1 January 1985 to 31 December 1985

Area 1

EXPERIMENTAL CHARGED PARTICLE AND PHOTONUCLEAR DATA

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	OTHERS	TOTAL REQUESTS
0-NN	0	0	0	0	0	0	0
1-H	0	0	0	0	0	0	0
2-He	0	0	0	0	0	0	0
3-Li	0	0	0	0	0	0	0
4-Be	0	0	0	0	0	0	0
5-B	0	0	0	0	0	0	0
6-C	0	0	0	0	0	0	0
7-N	0	0	0	0	0	0	0
8-O	0	0	0	0	0	0	0
9-F	0	0	0	0	0	0	0
10-Ne	0	0	0	0	0	0	0
11-Na	0	0	0	0	0	0	0
12-Mg	0	0	0	0	0	0	0
13-Al	0	0	0	0	0	0	0
14-Si	0	0	0	0	0	0	0
15-P	0	0	0	0	0	0	0
16-S	0	0	0	0	0	0	0
17-Cl	0	0	0	0	0	0	0

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	OTHERS	TOTAL REQUESTS
18-Ar	0	0	0	0	0	0	0
19-K	0	0	0	0	0	0	0
20-Ca	0	0	0	0	0	0	0
21-Sc	0	0	0	0	0	0	0
22-Ti	0	0	0	0	0	0	0
23-V	0	0	0	0	0	0	0
24-Cr	0	0	0	0	0	0	0
25-Mn	0	0	6	2	0	0	8
26-Fe	0	0	0	0	0	0	0
27-Co	0	0	0	0	0	0	0
28-Ni	0	0	0	0	0	0	0
29-Cu	0	0	0	0	0	0	0
30-Zn	0	0	0	0	0	0	0
31-Ga	0	0	0	0	0	0	0
32-Ge	0	0	0	0	0	0	0
33-As	0	0	0	0	0	0	0
34-Se	0	0	0	0	0	0	0
35-Br	0	0	0	0	0	0	0
36-Kr	0	0	0	0	0	0	0
37-Rb	0	0	0	0	0	0	0
38-Sr	0	0	0	0	0	0	0
39-Y	0	0	0	0	0	0	0
40-Zr	0	0	0	0	0	0	0
41-Nb	0	0	0	0	0	0	0
42-Mo	0	0	0	0	0	0	0
43-Tc	0	0	0	0	0	0	0

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	OTHERS	TOTAL REQUESTS
44-Ru	0	0	0	0	0	0	0
45-Rh	0	0	0	0	0	0	0
46-Pd	0	0	0	0	0	0	0
47-Ag	0	0	0	0	0	0	0
48-Cd	0	0	0	0	0	0	0
49-In	0	0	0	0	0	0	0
50-Sn	0	0	0	0	0	0	0
51-Sb	0	0	0	0	0	0	0
52-Te	0	0	0	0	0	0	0
53-I	0	0	0	0	0	0	0
54-Xe	0	0	0	0	0	0	0
55-Cs	0	0	0	0	0	0	0
56-Ba	0	0	0	0	0	0	0
57-La	0	0	0	0	0	0	0
58-Ce	0	0	0	0	0	0	0
59-Pr	0	0	0	0	0	0	0
60-Nd	1	1	24	2	0	0	28
61-Pm	0	0	0	0	0	0	0
62-Sm	0	0	21	3	0	0	24
63-Eu	0	0	0	0	0	0	0
64-Gd	0	0	0	0	0	0	0
65-Tb	0	0	0	0	0	0	0
66-Dy	0	0	0	0	0	0	0
67-Ho	0	0	0	0	0	0	0
68-Er	0	1	4	1	0	0	6
69-Tm	0	0	0	0	0	0	0

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	OTHERS	TOTAL REQUESTS
70-Yb	0	0	0	0	0	0	0
71-Lu	0	0	4	0	0	0	4
72-Hf	0	0	0	0	0	0	0
73-Ta	0	0	0	0	0	0	0
74-W	0	0	0	0	0	0	0
75-Re	0	0	0	0	0	0	0
76-Os	0	0	0	0	0	0	0
77-Ir	0	0	0	0	0	0	0
78-Pt	0	0	0	0	0	0	0
79-Au	0	0	0	0	0	0	0
80-Hg	0	0	0	0	0	0	0
81-Tl	0	0	0	0	0	0	0
82-Pb	0	0	0	0	0	0	0
83-Bi	0	0	0	0	0	0	0
88-Ra	0	0	0	0	0	0	0
89-Ac	0	0	0	0	0	0	0
90-Th	0	0	0	0	0	0	0
91-Pa	0	0	0	0	0	0	0
92-U-000	0	0	0	0	0	0	0
92-U-230	0	0	0	0	0	0	0
92-U-231	0	0	0	0	0	0	0
92-U-232	0	0	0	0	0	0	0
92-U-233	0	0	0	0	0	0	0
92-U-234	0	0	0	0	0	0	0

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	OTHERS	TOTAL REQUESTS
92-U-235	0	0	0	0	0	0	0
92-U-236	0	0	0	0	0	0	0
92-U-237	0	0	0	0	0	0	0
92-U-238	0	0	0	0	0	0	0
92-U-239	0	0	0	0	0	0	0
92-U-oxi	0	0	0	0	0	0	0
93-Np	0	0	0	0	0	0	0
94-Pu-000	0	0	0	0	0	0	0
94-Pu-238	0	0	0	0	0	0	0
94-Pu-239	0	0	0	0	0	0	0
94-Pu-240	0	0	0	0	0	0	0
94-Pu-241	0	0	0	0	0	0	0
94-Pu-242	0	0	0	0	0	0	0
94-Pu-243	0	0	0	0	0	0	0
94-Pu-244	0	0	0	0	0	0	0
94-Pu-245	0	0	0	0	0	0	0
95-Am	0	0	0	0	0	0	0
96-Cm	0	0	0	0	0	0	0
97-Bk	0	0	0	0	0	0	0
98-Cf	0	0	0	0	0	0	0
99-Es	0	0	0	0	0	0	0
100-Fm	0	0	0	0	0	0	0
TOTAL	1	2	59	8	0	0	70

Appendix 1
NNDC

Request Statistics

TABLE III

1 January 1986 to 31 December 1986

Area 1

EXPERIMENTAL NEUTRON DATA

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. (C/S)	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
0-N	2	1	0	0	0	0	0	0	0	3
1-H	13	7	2	0	0	7	0	0	2	31
2-He	6	4	0	0	4	0	8	0	1	23
3-Li	6	1	2	0	0	6	13	0	0	28
4-Be	4	2	1	0	0	1	2	0	2	12
5-B	5	2	1	2	14	7	11	0	4	46
6-C	26	29	21	7	11	18	28	0	8	148
7-N	4	1	2	0	0	3	3	0	0	13
8-O	9	4	5	0	6	3	3	0	1	31
9-F	1	0	0	0	0	1	0	0	0	2
10-Ne	1	0	0	0	0	2	0	0	0	3
11-Na	1	0	0	0	0	2	0	0	0	3
12-Mg	1	1	0	0	0	0	5	0	0	7
13-Al	3	0	0	0	6	2	6	0	0	17
14-Si	2	3	0	0	0	0	0	0	0	5
15-P	1	0	0	0	0	2	2	0	0	5
16-S	1	3	0	0	0	0	0	0	0	4
17-Cl	1	0	0	0	0	1	0	0	0	2

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. (C/S)	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
18-Ar	1	0	0	0	0	0	0	0	0	1
19-K	1	0	0	0	0	3	0	0	0	4
20-Ca	11	4	4	0	14	5	1	0	0	39
21-Sc	1	0	0	0	0	0	0	0	0	1
22-Ti	1	0	0	0	0	0	1	0	0	2
23-V	1	2	0	0	0	3	0	0	0	6
24-Cr	1	0	0	0	0	0	4	0	0	5
25-Mn	1	0	0	0	0	3	0	0	0	4
26-Fe	11	3	2	0	23	8	5	0	0	52
27-Co	1	0	1	0	1	4	2	0	0	9
28-Ni	3	3	2	0	0	1	5	0	0	14
29-Cu	1	0	0	0	0	12	5	0	0	18
30-Zn	6	5	5	8	10	15	40	0	3	92
31-Ga	4	3	4	5	20	6	7	0	1	49
32-Ge	1	4	0	0	0	0	0	0	0	5
33-As	1	3	0	0	0	0	0	0	0	4
34-Se	1	0	0	0	0	0	0	0	0	1
35-Br	1	0	0	0	0	0	0	0	0	1
36-Kr	1	0	0	0	0	0	0	0	0	1
37-Rb	1	0	0	0	0	0	0	0	1	1
38-Sr	1	0	0	0	0	0	0	0	0	1
39-Y	1	0	0	0	0	0	0	0	0	1
40-Zr	7	7	10	0	0	1	0	0	1	26
41-Nb	1	0	0	0	0	0	0	0	0	1
42-Mo	18	8	3	0	24	2	0	0	0	55
43-Tc	0	0	0	0	0	0	0	0	0	0

Appendix 1
NNDC

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. (C/S)	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
44-Ru	0	0	0	0	0	0	0	0	0	0
45-Rh	1	0	0	0	0	0	0	0	0	1
46-PD	1	0	0	0	0	0	0	0	0	1
47-Ag	1	0	0	0	0	0	0	0	0	1
48-Cd	1	16	1	0	104	20	1	0	0	143
49-In	5	1	4	0	22	9	2	0	0	43
50-Sn	1	0	0	0	0	4	0	0	0	5
51-Sb	1	0	0	0	0	0	0	0	0	1
52-Te	2	0	0	0	42	18	0	0	0	62
53-I	1	0	0	0	0	0	0	0	0	1
54-Xe	2	1	2	0	2	1	10	0	0	18
55-Cs	0	0	0	0	0	0	0	0	0	0
56-Ba	1	0	0	0	0	0	0	0	0	1
57-La	1	0	0	0	0	0	0	0	0	1
58-Ce	2	0	0	0	0	0	0	0	0	2
59-Pr	1	0	0	0	0	0	0	0	0	1
60-Nd	1	0	0	0	2	0	0	0	0	3
61-Pm	0	1	0	0	6	4	0	0	0	11
62-Sm	1	0	0	0	0	0	0	0	0	1
63-Eu	0	0	0	0	0	0	0	0	0	0
64-Gd	1	0	0	0	0	0	0	0	0	1
65-Tb	0	0	0	0	0	0	0	0	0	0
66-Dy	1	0	0	0	0	0	0	0	0	1
67-Ho	1	0	0	0	0	0	0	0	0	1
68-Er	0	0	0	0	0	0	0	0	0	0
69-Tm	0	0	0	0	0	1	0	0	0	1

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. (C/S)	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
70-Yb	0	0	0	0	0	0	0	0	0	0
71-Lu	0	0	0	0	0	0	0	0	0	0
72-Hf	1	0	0	0	0	0	0	0	0	1
73-Ta	2	0	0	0	0	0	0	0	0	2
74-W	4	0	0	0	0	0	0	0	0	4
75-Re	6	6	2	0	31	12	4	2	1	
76-Os	7	1	0	0	16	0	0	0	0	24
77-Ir	0	0	0	0	0	0	0	0	0	0
78-Pt	8	1	0	0	29	1	0	0	0	39
79-Au	1	0	0	0	0	6	0	0	0	7
80-Hg	1	0	0	0	0	0	0	0	0	1
81-Tl	1	0	0	0	0	0	0	0	0	1
82-Pb	13	2	3	0	3	4	1	3	1	30
83-Bi	3	3	2	0	0	0	0	0	0	8
88-Ra	0	0	0	0	0	0	0	0	0	0
89-Ac	0	1	1	0	0	0	0	0	0	2
90-Th	6	1	0	0	1	2	1	5	0	16
91-Pa	0	0	0	0	0	0	0	0	0	0
92-U-000	1	1	1	0	0	0	0	0	0	3
92-U-230	0	0	0	0	0	0	0	0	0	0
92-U-231	0	0	0	0	0	0	0	0	0	0
92-U-232	0	0	0	0	0	0	0	2	0	2
92-U-233	1	0	0	0	0	1	0	9	0	10
92-U-234	0	0	0	0	0	0	0	2	0	2

Appendix 1
NNDC

ELEMENT	TOTAL (TOT)	ELAS. SCAT. (EL)	INEL. SCAT. (INL)	OTHER SCAT. (C/S)	RES. PAR. (RES)	GAMMA & NEUTRON EMISSION (NG)	CHARGED PARTICLE EMISSION (NX)	FISSION (NF)	OTHERS	TOTAL REQUESTS
92-U-235	3	2	1	0	11	3	0	28	0	48
92-U-236	1	0	0	0	0	0	0	2	0	3
92-U-237	0	0	0	0	0	0	0	0	0	0
92-U-238	7	3	4	0	0	7	0	16	0	37
92-U-239	0	0	0	0	0	0	0	0	0	0
92-U-oxi	0	0	0	0	0	0	0	0	0	0
93-Np	1	0	0	0	0	0	0	4	0	5
94-Pu-000	0	0	0	0	0	0	0	0	0	0
94-Pu-238	0	0	0	0	0	0	0	4	0	4
94-Pu-239	2	1	2	0	0	0	0	10	0	15
94-Pu-240	0	0	0	0	0	1	0	4	0	5
94-Pu-241	0	0	0	0	0	2	0	3	0	5
94-Pu-242	1	0	0	0	0	1	0	1	0	3
94-Pu-243	0	0	0	0	0	0	0	0	0	0
94-Pu-244	0	0	0	0	0	0	0	0	0	0
94-Pu-245	0	0	0	0	0	0	0	0	0	0
95-Am	1	0	0	0	0	5	0	2	0	8
96-Cm	0	0	0	0	0	3	0	2	0	5
97-Bk	0	0	0	0	0	0	0	0	0	0
98-Cf	0	0	0	0	0	0	0	6	0	6
99-Es	0	0	0	0	0	0	0	0	0	0
100-Fm	0	0	0	0	0	0	0	1	0	1
TOTAL	262	141	87	22	402	222	170	55	25	1,437

Appendix 1
NNDC

Request Statistics

TABLE IIIA

1 January 1986 to 31 December 1986

Area 1

EXPERIMENTAL CHARGED PARTICLE AND PHOTONUCLEAR DATA

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	HE3 (H)	2HE-3 (2H)	OTHERS	TOTAL REQUESTS
0-N	0	0	0	2	0	0	0	0	2
1-H	0	11	0	6	2	1	0	0	20
2-He	0	8	0	0	4	1	0	0	13
3-Li	1	20	7	11	13	3	0	0	55
4-Be	5	8	0	5	0	3	0	0	21
5-B	7	4		11	4	3	0	0	29
6-C	6	7	8	13	0	5	2	0	41
7-N	0	4	2	22	0	0	0	0	28
8-O	4	6	0	24	0	1	0	0	35
9-F	2	3	0	12	0	1	0	0	18
10-Ne	0	3	0	2	0	3	0	0	8
11-Na	11	7	9	4	0	0	0	0	31
12-Mg	12	2	11	17	0	10	0	0	52
13-Al	17	8	6	13	0	9	2	0	55
14-Si	7	1	0	6	0	5	0	0	19
15-P	1	0	0	5	0	0	0	0	6
16-S	1	1	0	11	0	4	0	0	17
17-Cl	1	1	0	3	0	0	0	0	5

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	HE3 (H)	2HE-3 (2H)	OTHERS	TOTAL REQUESTS
18-Ar	2	2	0	3	0	0	0	0	7
19-K	1	0	0	2	0	3	0	0	6
20-Ca	0	3	0	18	0	1	0	0	22
21-Sc	1	5	0	7	0	1	0	0	14
22-Ti	1	3	0	6	0	1	0	0	11
23-V	9	6	4	6	0	1	0	0	26
24-Cr	2	5	0	12	0	1	0	0	20
25-Mn	5	3	5	7	0	7	0	0	.
26-Fe	21	1	1	20	0	0	0	0	43
27-Co	23	4	7	52	0	0	0	0	86
28-Ni	30	11	12	36	0	0	1	0	90
29-Cu	11	8	12	26	0	27	0	0	84
30-Zn	15	6	3	19	0	0	0	0	43
31-Ga	3	4	0	33	0	1	0	0	41
32-Ge	5	6	1	8	0	2	0	0	22
33-As	5	2	4	7	0	5	0	0	23
34-Se	1	5	2	14	0	14	0	0	36
35-Br	2	1	0	19	0	0	0	0	22
36-Kr	1	2	0	4	0	0	0	0	7
37-Rb	3	3	2	11	0	0	0	0	19
38-Sr	2	1	1	11	0	0	0	0	15
39-Y	1	3	4	10	0	0	0	0	18
40-Zr	18	5	17	41	0	0	0	0	81
41-Nb	4	3	0	4	0	0	1	0	12
42-Mo	0	0	28	0	0	0	0	0	28
43-Tc	0	0	0	0	0	0	0	0	0

Appendix 1

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	HE3 (H)	2HE-3 (2H)	NNDC OTHERS	TOTAL REQUESTS
44-Ru	0	0	0	0	0	0	0	0	0
45-Rh	6	3	2	5	0	0	0	0	16
46-Pd	2	8	2	10	0	0	0	0	22
47-Ag	9	5	5	9	0	0	0	0	28
48-Cd	4	2	2	21	0	0	0	0	29
49-In	12	3	7	7	0	0	0	0	29
50-Sn	10	3	39	26	0	0	2	0	80
51-Sb	4	5	3	3	0	6	0	0	21
52-Te	2	10	2	16	0	1	0	0	31
53-I	25	0	5	8	0	0	0	0	38
54-Xe	1	0	0	0	0	0	0	0	1
55-Cs	0	0	5	3	0	0	0	0	8
56-Ba	0	1	4	1	0	0	0	0	6
57-La	5	1	3	2	0	0	0	0	11
58-Ce	2	0	3	2	0	0	0	0	7
59-Pr	0	0	5	4	0	0	0	0	9
60-Nd	2	1	16	3	0	0	0	0	22
61-Pm	0	0	0	0	0	0	0	0	0
62-Sm	0	0	13	8	0	0	0	0	21
63-Eu	0	0	5	0	0	0	0	0	5
64-Gd	0	0	5	1	0	0	0	0	6
65-Tb	0	3	5	0	0	0	0	0	8
66-Dy	0	0	0	0	0	0	0	0	0
67-Ho	0	0	5	0	0	0	0	0	5
68-Er	0	0	3	0	0	0	0	0	3
69-Tm	0	0	0	3	0	0	0	0	3

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	HE3 (H)	2HE-3 (2H)	OTHERS	TOTAL REQUESTS
70-Yb	0	0	0	3	0	0	0	0	3
71-Lu	0	0	3	1	0	0	0	0	4
72-Hf	0	0	4	0	0	0	0	0	4
73-Ta	1	0	7	7	0	0	0	0	15
74-W	0	6	11	5	0	0	0	0	22
75-Re	0	0	0	0	0	0	0	0	0
76-Os	0	0	0	0	0	0	0	0	0
77-Ir	0	0	4	0	0	0	0	0	4
78-Pt	0	0	8	1	0	0	0	0	9
79-Au	0	3	9	22	0	0	6	0	40
80-Hg	0	0	0	10	0	0	0	0	10
81-Tl	0	0	0	9	0	0	0	0	9
82-Pb	0	2	13	11	0	0	0	0	26
83-Bi	0	1	0	7	0	0	0	0	8
88-Ra	0	1	0	1	0	0	0	0	2
89-Ac	0	0	0	0	0	0	0	0	0
90-Th	0	4	0	0	0	0	0	0	4
91-Pa	0	0	0	0	0	0	0	0	
92-U-000	0	0	0	2	0	1	0	0	3
92-U-230	0	0	0	0	0	0	0	0	0
92-U-231	0	0	0	0	0	0	0	0	0
92-U-232	2	0	0	10	0	0	0	0	12
92-U-233	4	1	0	0	0	0	0	0	5
92-U-234	5	3	0	0	0	0	0	0	8

ELEMENT	ALPHA (A)	DEUTERON (D)	GAMMA (G)	PROTON (P)	TRITON (T)	HE3 (H)	Appendix 1/NNDC 2HE-3 (2H)	OTHERS	TOTAL REQUESTS
92-U-235	6	4	1	0	0	0	0	0	11
92-U-236	0	2	0	0	0	0	0	0	2
92-U-237	0	0	0	0	0	0	0	0	0
92-U-238	2	5	0	4	0	1	0	0	12
92-U-239	0	0	0	0	0	0	0	0	0
92-U-oxi	2	0	0	0	0	0	0	0	2
92-U-CMP	2	0	0	0	0	0	0	0	2
93-Np	6	0	0	0	0	0	0	0	6
94-Pu-000	0	0	0	0	0	0	0	0	0
94-Pu-238	3	0	0	0	0	0	0	0	3
94-Pu-239	0	3	0	0	0	0	0	0	3
94-Pu-240	0	0	0	0	0	0	0	0	0
94-Pu-241	0	0	0	2	0	0	0	0	2
94-Pu-242	0	0	0	0	0	0	0	0	0
94-Pu-243	0	0	0	0	0	0	0	0	0
94-Pu-244	0	0	0	0	0	0	0	0	0
94-Pu-245	0	0	0	0	0	0	0	0	0
95-Am	0	0	0	0	0	0	0	0	0
96-Cm	0	0	0	0	0	0	0	0	0
97-Bk	0	0	0	0	0	0	0	0	0
98-Cf	0	0	0	0	0	0	0	0	0
99-Es	0	0	0	0	0	0	0	0	0
99-Es	0	0	0	0	0	0	0	0	0
100-Fm	0	0	0	0	0	0	0	0	0
TOTAL	358	266	345	770	23	128	8	0	1898

Appendix 2

NEA Data Bank NEA-DB

Progress report to the Nuclear Reaction Data Centres

October 1987

Introduction

The two main topics of interest concerning the Data Bank over the past year have been the Joint Evaluated File (JEF), and the proposal for partial redirection of the Data Bank's work programme. After discussion at successive meetings of the Steering Committee for Nuclear Energy, and consideration by a 'Wise Men' group set up by the Steering Committee, the proposals are converging towards a limited redistribution of Data Bank resources, with a division of scientific manpower about two-thirds/one-third between neutron data plus computer program srvices, and new data and program projects in nuclear waste management and safety. A total of eight scientific staff would be working on the 'traditional' projects, including JEF.

I. Neutron Data Compilation and CINDA

During 1986, a total of 136 EXFOR entries, of which 45 were new compilations, were transmitted to the other data centres. Nineteen of the new compilations referred to data that had been published during 1986. Shifting the window to the 12-month period September 1986 to August 1987, we find 31 new works from area 2, with 22757 data points.

Following the transfer of the responsibility for the production of the CINDA book to the IAEA and the standardisation of the exchange format, the transmission of CINDA entries between the data centres is working very satisfactorily. During 1986, the Data Bank updated the CINDA coding manual, and distributed the new version to the other centres and to CINDA readers in area 2. More of the CINDA scanning work is now done in the Data Bank.

Customer service

A small increase, about 7 percent, in the number of requests for nuclear data was encountered in 1986. 194 requests were answered and the distribution of requests for the different data categories are shown in the following table:

JEF data	36%
EXFOR data	24%
Evaluated data (except JEF)	18%
Documents	16%
Miscellaneous	6%

The number of data records sent out was about the same as in 1985, i.e. 36 million. In the first eight months of 1987, eighty-six requests were answered, with an average of about 140,000 data records per request (as against 180,000 for 1986). The large number of records reflects the dispatch of evaluated data, and of large volumes of experimental data to evaluators.

II. The Joint Evaluated File (JEF)

Semi-annual meetings of the JEF working groups, on Benchmark Testing and Evaluation, are held in November and May, with a meeting of the Scientific Coordination Group in May, most recently in May 1987. A new version of the file, JEF 1.1, was announced by the Data Bank in the fourth issue of the newsletter JEF-1 News, in October 1986.

In addition to regular maintenance work on the JEF data and the associated checking and verifying programs, the Data Bank has cooperated with Petten to update the resonance parameter information of almost all the fission products. Further, two new elemental evaluations were created at the Data Bank and a large effort was put into plotting the most important JEF-1 cross section data and comparing them with experimental data from EXFOR, in order to assist the evaluators working on new evaluations for JEF-2. A computer code was developed to translate automatically an evaluated file in ENDF-5 format to ENDF-6 format, which is expected to be the format for the JEF-2 file, although a decision cannot be taken until the corresponding version of NJOY has been received and tested at the Data Bank.

In order to ensure that the new evaluation for U-238 is ready in time for the JEF-2 file, where it will be of crucial importance, the Data Bank has worked very closely with AERE Harwell. A senior Data Bank physicist has shared in the new analysis of experimental resonance data, and a consultancy contract was placed for additional computing work on these data. Progress has been good. Versions of the REFIT resonance fitting program have been run on VAX, CRAY and IBM computers.

The 175-group cross section set for shielding calculations, VITAMIN-J, was updated to include covariance information and true absorption cross sections. Shielding benchmark calculations were also performed in cooperation with Winfrith, and the results were presented at the NEACRP Specialists' Meeting, Paris, in October 1986. The Data Bank has cooperated with the EFF (European Fusion File) project in the creation of a fusion data group cross section set, called GEFF-1.

Results of burn-up and fuel cycle calculations of different benchmark specifications, using the JEF-1 library, have been reported from Karlsruhe and Cadarache, as well as analysis of LWHCR experiments from Würenlingen. The possible inconsistency between the evaluated thermal values by Axton and the results from the benchmark testing of the JEF-1 library has been discussed and a small subgroup formed to investigate this problem and to report back to the JEF and CSEWG communities.

III. Computer program services

During 1986, 1319 program packages were distributed to requesters; 13% of these, or 177 programs, were sent to users in non-OECD countries. This total figure has increased only slowly since the establishment of the Data Bank; on the other hand, the areas of user interest, and the ratios between different categories of users, have shifted more markedly. For the first nine months of 1987, 1080 packages were sent out. About 15 percent of these program packages were sent to IAEA member countries who are not members of OECD.

It is interesting to compare the "Bestseller lists" of programs sent out in these two years:

1986	1987
INTERTRAN	SLATEC-3
SCALE-3	MINEQL-EIR
NJE-4.00	EISPACK-3
DYNA3D	NJE-4.00
LINPAC	SCALE-3

The programs in the two lists illustrate the importance of making special efforts in preparing, testing and presentation of codes /INTERTRAN-I is packaged in a transportable version suitable for IBM, CDC and VAX computers, while SCALE, MINEQL and NJE were presented in specialised Data Bank workshops/, and also the need of users for access to high-quality packages of mathematical subroutines /SLATEC, EISPACK, LINPAC/.

Program Acquisition and Testing

In order to keep the computer code collection up to date, and in order to include more codes from new priority areas, special efforts were devoted to computer code acquisition during 1986. 148 new program packages were acquired in 1986, and 99 new codes included in the master files. For the first nine months of 1987, 58 new programs have been master filed.

Particular care has been taken in testing program packages released within the Probabilistic System Analysis Codes project (PSAC) for predicting the long-term effects of radioactive waste burial. In addition, the Data Bank has provided support to the PSAC users group in its recent 'level 0' code comparison exercise, and further more complex exercises are planned for these codes.

IV. Validation of Nuclear Model codes

The series of benchmark comparisons of nuclear model codes has continued with a "blind benchmark" where cross-sections, including pre-equilibrium effects, were calculated for W182. Eight answers had been received by the end of 1986, and analysis of the results has now started. Specifications for two new international statistical model code comparisons were prepared and sent out, for Weisskopf-Ewing and Hauser-Feshbach calculations. About twenty contributions were received and a draft report will be prepared by the end of 1987.

First steps have been taken in the development of a Reactor Physics Data Base and Validation System, starting within the reactor shielding area. Other areas planned for inclusion are reactor criticality and core lattice experiments.

V. Activities in the areas of Nuclear Waste Management and Reactor Safety

The Data Bank's work can be seen either as a set of long-term projects in support of national programmes in reactor physics, for which validated computer programs and nuclear data are needed, or as the application of knowledge in nuclear and reactor physics, with skills in computing and data base construction, to a variable group of problems in the field of nuclear energy. The latter view emphasizes the Data Bank's inherent flexibility, and the encouragement it has received from its Management Committee in carrying out preliminary work in support of the NEA main Secretariat's efforts in nuclear safety and waste management.

Discussion over the past year in the Steering Committee for Nuclear Energy, and the report by a "Wise Men" group of experts convened to examine the question in detail, have led to proposals for inclusion of work in these areas, at an increased level, in the Data Bank's programme of work. It is expected that four scientific staff members will be engaged in these new activities in 1988.

At these different meetings, delegates stressed the importance to Member countries of maintaining a high level of service on nuclear data and computer programs for nuclear energy. Particular emphasis was placed on the need to complete the Joint Evaluated File project to a high standard; it was recommended that manpower for these activities should not be reduced below the 1987 level of eight professional staff unless experience at that manning level had shown clearly that this could be done without affecting the quality of service.

Thermochemical Data Base (TDB) and ISIRS

The development of the NEA Thermochemical Data Base (TDB) has gained further momentum in 1986-7. The international critical review on Uranium data made considerable progress, and reviews on two new elements, Americium and Technetium, have been started. The Uranium expert team met in December 1986, to discuss the state of the review and to reach a consensus on the current draft of the report, which then already covered about 250 type-written pages. A similar meeting was held in September 1987 to coordinate work on the Americium evaluation. Twenty-seven requests for unevaluated data compilations were serviced between May and December 1986.

A data input program for IBM computers for the ISIRS (International Sorption Information Retrieval System) data base has been developed by CISI. The program has been announced to users and if requests arise for other versions of this program, e.g. versions for PCs, the Data Bank would be responsible for making the necessary modifications to the program.

The Probabilistic System Assessment Codes (PSAC) User Group

Effort has been concentrated on the acquisition of fully developed and documented codes (SYVAC codes from AECL and UK DOE, LISA from JRC Ispra). These codes have been made available to the Data Bank and have been fully tested, documented and packaged.

The development of a standard interfacing system is under way, so as to allow easy interchange of modules within the code. This is particularly important in avoiding duplication of effort, reducing development time and reducing costs. In order to simplify the analysis of results obtained with PSA codes and allow homogeneous comparisons of results from code intercomparison exercises, standardized interface and output files are required. A proposal for a standard interface file, based on different suggestions of the PSAC user group members, was adopted by the November 1986 PSAC users group meeting. Utility routines were developed by the Data Bank for handling this format.

A first international code comparison was conducted on a hypothetical safety assessment case study for radioactive waste disposal systems. The final report, showing the good agreement achieved amongst the different codes, will be published in the course of 1987.

Work related to Nuclear Safety

The structure of the IRS (Incident Reporting System) data base was redefined and coding sheets were sent to the coordinators in order to facilitate compilation of the reports. The Data Bank had to restructure and reload the data base to conform to the new system. A small program was written to input new data and to correct old entries in the data base, and existing entries are being revised to bring them up to a common standard of information content.

A special Task Group within CSNI (Committee on the Safety of Nuclear Installations) has developed a code validation matrix for LWR safety codes and designed an assessment procedure, as well as defining specifications for the documentation of experiments. The Data Bank has been included in discussions on the further development of this project within NEA, the procedures for obtaining experimental data and potential problems in standardising these data.

VI. Computing at NEA Data Bank

The in-house computing facilities comprise a VAX-11/780 linked to a MicroVax II, with a total of 2.6 Gigabytes of magnetic disk memory. An optical disk unit will be installed in order to bring most of the master files of tested computer programs on line, in order to simplify customer service procedures.

The Data Bank's use of networks increased considerably during 1986-7. The Data Bank is connected to the French TRANSPAC network and is also a node in EARN (European Academic and Research Network). Data Bank staff continue to access local French CISINET via the HASP link to the main-frame computers. So far, owing to difficulties in file transmission between different computers, most use of the networks has been to send electronic mail messages to other establishments, but an increasing number of computer codes and nuclear data sets are now distributed this way. A network service, allowing authorised users to consult the computer program abstracts and data files, is under development.

Appendix 3
NDS

NDS Status Report to the 1987 NRDC Meeting

H.D. Lemmel, Oct. 1987

1. Staff

The main change was that D.E. Cullen left, who was the head of the Computer Unit of the Nuclear Data Section. His position is temporarily filled by changes of responsibility within NDS. Also V. Piksaikin ended his contract and went back to his home country. Marisa de Moraes Cunha is now in charge of monitoring requests, replacing Martha Oshomuvwe who, however, came back to the Section for a temporary appointment. Prof. R. Janev joined the Section as the head of the unit for atomic and molecular data. M.K. Mehta re-joined the Section for a one-year appointment for technical co-operation projects. Wang Dahai joined the Section preparing, among other work, Chinese EXFOR entries.

2. CINDA

The CINDA compilation from area 3 is uptodate. It serves as the basis for EXFOR compilation. CINDA86 and CINDA87 have been produced according to the new decentralized scheme for CINDA compilation and file maintenance. The transition did not create any major problem, except for time delays. We ask the other centers for their co-operation by sending CINDA entries continuously. We cannot process everything in the last minute before book production, or we have to fix the deadline several weeks earlier. A special problem is the slow speed of magnetic tapes coming from CJD which are in the mail up to 10 weeks. The CINDA co-operation with CJD as one of the Four CINDA Centers cannot function unless CJD finds a way to speed up the data transmission considerably.

After the recent revision of the structure of the CINDA network, the computer programs (input checking, file maintenance, exchange with other centers) have been revised, so that input can be prepared in batch mode (mainly new entries) or online (mainly revisions and updates).

The design of the CINDA cover which still showed an antiquated punched card, was modernized to illustrate the function of the data centers between data producers and data users, and to advertise EXFOR.

The future publication of CINDA is to be reviewed now. "Archival issues" of CINDA have been published in 1979 ("CINDA-A" covering the period 1935-1976) and 1984 ("CINDA-B" covering the period 1977-1981).

Meanwhile, many additions and revisions have been made to the contents of CINDA-A and CINDA-B, including the insertion of EXFOR-index lines; consequently, it is proposed to publish in 1989 a new archival issue covering the entire period 1935-1986. The then current issue CINDA-89 would cover the years 1987-1989.

3. The EXFOR System

The EXFOR System and its rules were the main topic of the Technical NRDC Meeting in Vienna in October 1986. Since then, some more new proposals have been submitted by means of CP-Memos. See a separate working paper. However, it is noticeable that the EXFOR System has stabilized and seems to have reached a final state. The number of new proposals and technical problems encountered has decreased significantly.

The main problem remaining is the fact that the formal correctness of the EXFOR exchange tapes (TRANS tapes) is still insufficient. Centers continue to create each other extra workload because TRANS tapes received from other centers must be reviewed and corrected before they can be processed. See a separate working paper for the most disturbing mistakes encountered.

Another problem is the frequent lack of response when correction and retransmission of specific EXFOR entries is requested. It should be realized that EXFOR files remain incomplete without speedy response to these retransmission requests.

4. EXFOR Compilation

During the past 2 years 7 TRANS tapes with 69 new EXFOR entries and 57 revisions were transmitted originating from the following countries:

	new	revised
Argentina	2	
Australia	2	1
Bulgaria	1	
China, P.R.	20	7
Czechoslovakia	3	8
Egypt	2	3
German Dem. Rep.	4	7
Hungary	12	9
India	4	1
Korea, Rep.	1	
Morocco	2	8
Pakistan	2	1
Poland	2	4
Romania	4	3
South Africa	2	1
Taiwan	2	2
Thailand	1	
Vietnam	1	2
Yugoslavia	1	
	69	57

This includes neutron data only. Due to lack of staff there was no time for the compilation of CPND or Photonuclear Data. Even in the field of neutron data we have, unfortunately, a considerable backlog including primarily fission-product yield data (about 40 entries) and some other data considered of secondary importance.

Several charged-particle data entries received from China in the S-series were reviewed and finalized.

5. Evaluated Data

The following evaluated data files were received and documented for distribution.

- A new ENDF/B formatted library for fisson-product yield data by the Chinese Nuclear Data Center (Wang Dao).

- A new version of the Minsk evaluations (V.A. Konshin) of U-235, Pu-239, 240, 241, 242 which was distributed as a supplement to the IAEA actinides file INDL/A.

- Several files for structural materials to be included in the INDL library and in the international fusion data file IRDF. Some evaluations are in the ENDF-6 format.

- The new evaluation of the Cf-252 fission neutron spectrum by W. Mannhart was received and documented for distribution. It is in an ENDF similar format. The inclusion of its covariance matrix in proper ENDF-6 format may still present some problems.

- A new evaluation of charged-particle induced neutron source reactions by M. Drosg, Vienna, was received and documented for distribution. It includes Legendre fits to angular dependences of neutron energies and cross-sections.

6. WRENDA

The publication of WRENDA 87/88 is in preparation. It is behind schedule because we are still waiting for contributions from several countries of area 2.

7. Publications

The routine publications continued including

- INDC reports
- Nuclear Data Newsletter
- CINDA
- Atomic and Molecular Data Bulletin
- IAEA-NDS-documents

and some more. Of special importance were some handbooks and proceedings of meetings.

* Handbook on Nuclear Activation Data, IAEA Technical Report Series No. 273 (1987). Contributions by leading experts (compiled and reviewed by K. Okamoto) contain data surveys and up-to-date compilations for various data required for applied nuclear activation techniques. Brief summary of contents:
- Isotopic abundances, half-lives, decay modes.
- Neutron-reaction standard reference data.
- Neutron-source reactions: energies and cross-sections.
- The neutron spectrum of a Cf-252 fission-neutron source.

- Decay data for radionuclides used as calibration standards.
- Neutron activation cross-sections for thermal neutrons, for 14 MeV neutrons, for 1 to 20 MeV neutrons, for Cf-252 fission neutrons.
- Activation cross-sections and thick-target yields for charged-particle induced reactions.
- Photonuclear cross-sections.

This handbook (820 pages) is available for 1640.- Austrian Schillings from the IAEA Division of Publications, Box 100, A-1400 Vienna, Austria.

* Nuclear and Atomic Data for Radiotherapy and Related Radiobiology. Proceedings of an IAEA meeting, Rijswijk, Netherlands, 16-20 Sept. 1985. IAEA, 1987. K. Okamoto (ed.). Contains 27 papers and 3 working group reports covering topics such as physical basis of biological radiation effects, beam production, dosimetry, interactions of neutrons, pions, charged particles, and others. - Available for 950.- Austrian Schillings from the IAEA Division of Publications, Box 100, A-1400 Vienna, Austria. (Compare the note in Nucl. Data Newsletter No. 10 how to buy priced IAEA publications.)

* Properties of Neutron Sources, IAEA-TECDOC-410. Proceedings of an IAEA meeting on Properties of Neutron Sources, Leningrad, USSR, 9-13 June 1986. Includes chapters on pulsed white neutron sources, fast neutron fields, Cf-252, monoenergetic sources, filtered beams, 14 MeV neutron sources, medical applications, and others. Available costfree upon request.

* Applications in Nuclear Data and Reactor Physics. D.E. Cullen, R. Muranaka, J.J. Schmidt (ed.). Proceedings of a workshop held at the International Centre for Theoretical Physics, Trieste, Italy, 17.2.-21.3. 1986, in co-operation with the IAEA Nuclear Data Section. Contains 26 lectures on reactor physics and related computer codes. Published by World Scientific Publishing Co., P.O. Box 128, Farrer Road, Singapore, 994 pages, 1986. Not available from IAEA.

* INDC(NDS)-195. Proceedings of the IAEA meeting on Data Requirements for Medical Radioisotope Production, Tokyo, 20-24 April 1987. K. Okamoto (ed.). Contains all papers, a summary and recommendations of three working groups on experimental data, data calculation and computer files, data compilation.

* INDC(NDS)-192. Covariance methods and practices in the field of nuclear data. Proceedings of a meeting under this topic, Rome, Italy, 17-19 Nov. 1986. V. Piksaikin, editor. Contains review papers and recommendations about treatment of covariances in evaluated nuclear data files, with emphasis on dosimetry, neutron spectra, actinide cross-sections, fission-product yield data, and others.

* INDC(NDS)-198. L. Greenwood et al., Summary of the IAEA meeting on Analysis of the REAL-84 Intercomparison Exercise on spectrum unfolding in dosimetry by foil activation, 27-29 May 1987, Jackson Hole, USA.

* CIAMDA, a CINDA type index to atomic and molecular collision data relevant to fusion research.

8. Customer services

The number of requests received has stabilized. There are about 700 requests per year received from over 60 countries. This includes approximately

30	requests for experimental data
140	requests for evaluated data
480	requests for documents
50	requests for data processing computer codes
700	

In response, about 270 magnetic tapes are dispatched per year and 1800 documents. For the first time, close to 200 floppy diskettes were sent out in 1987.

The distribution of the "IAEA Nuclear Data Newsletter" is now over 3000, most of them to area 3, 300 to areas 1, 2, 4 upon individual requests.

Data retrievals sent out to customers are accompanied by "IAEA-NDS-documents" summarizing contents and/or format of the data files.

Various format conversions ("standard", "edited", "RECENT-output", graphical plotting) are provided upon request.

9. Programming and Systems Development

The EXFOR programming has been improved by

- developing procedures for on-line compilation or correction of EXFOR entries,
- updating the EXFOR check program,
- finalizing the computation format ("C4") of EXFOR.

Before Red Cullen left the Section, he finalized a set of codes such as

- the 1987 version of the ENDF pre-processing codes
- a set of codes for graphical plotting of EXFOR data and ENDF-formatted data
- and a code package for model parameters and cross-section data.

All of them operate on a mainframe computer and on a personal computer (PC/AT). Consequently, codes and data are available not only on magnetic tape but also on floppy diskettes with appropriate documentation.

10. On-line center-to-center data transmission

The IAEA host computer can be accessed via two packet-switching networks, DATEX-P and TYMNET via Radio Austria (of the Austrian PTT). There are also direct dial-up ports at 300 Baud available.

The ID of the Austrian DATEX-P is 2322, and our host-ID is 6221047. The ID of the Austrian TYMNET Node is 2329 and our Host-ID is 11507701. The telephone number for direct calling is Vienna (222) 23-55-75.

A TSO Logon ID has been established for users wishing to access the IAEA mainframe: RN2. The password is "IAEANDS". The TSO SEND command can be used to send a message (send the message to user RNS, Monica Seits).

In case you have an IBM 3274 (or equivalent) connected to your Public Packet Switching Network, please tell us your IDBLK and IDNUM in advance, so we can define your cluster to VTAM. In this case you can use SPF (full screen support)- a Mailbox system is available (send the message to user MONICA).

At present, NDS has access (via Radio-Austria) to the TRANSPAC network in France and the ITT-UDTS, MCII/WUI, TIMNET, TRT, IPST, ACCUNET, CONNECT and various other networks on a test basis in the USA, as well as various other networks in other countries. We are in the process of establishing access to the EARN and BITNET networks via IEZ (Austrian Interuniversity EDP Center).

TELEPHONE LIST FOR NDS

	Nuclear Data Section	Ext.	Room
1.	(ARCILLA's ex office)	6382	A23-37
2.	AUNG Sofie	1716	A23-22
3.	BAUMGARTNER Liesl	1711	A23-14
4.	BUSH Georgina	1720	A23-24
5.	DE MORAES Marisa	1726	A23-35
6.	GANDARIAS CRUZ Dario	1714	A23-18
7.	GOULO Valery	1708	A23-11
8.	JANEV Ratko	1731	A23-43
9.	LAMMER Meinhart	1727	A23-36
10.	LEMMEL Hans	1717	A23-20
11.	LORENZ Alex	1712	A23-16
12.	MARTINEZ RICO José	1718	A23-23
13.	MCLAUGHLIN Kevin	1723	A23-32
14.	MEHTA Madhu	1706	A23-10
15.	MUNDY Gordon	1720	A23-24
16.	NEUMANN Maureen	1710	A23-14
17.	OKAMOTO Koichi	1713	A23-17
18.	OSHOMUVWE Martha	1725	A23-34
19.	SCHMIDT Joe	1709	A23-12
20.	SCHMIED Sabine	1719	A23-22
21.	SCHWERER Otto	1715	A23-19
22.	SEITS Monica	1724	A23-33
23.	SHEIKH Khalid	1730	A23-42
24.	SMITH Jim	1729	A23-41
25.	WANG Dahai	1707	A23-09

Appendix 4
CJD

The main results of the USSR neutron data activities in 1986 - 1987

V.N. Manokhin

Introduction.

This report gives a review of the main results of neutron data activities in the USSR and CJD's activity in 1986 - 1987.

A leading objective of neutron data activity in the USSR is as before the supplying of nuclear power engeneering by neutron data. This activity remains actual and is conducted in the following directions:

- precise measurements of the most important cross sections;
- experimental and theoretical investigation of nuclear structure and nuclear reaction mechanism and development of model representations, which can meet practical demands from point of view of reliability;
- development of evaluation methods, evaluation of nuclear data and further development national evaluated data library.

Experimental neutron data.

1. Nowdays the experimental neutron data library of the USSR area contains 900 works. During two years the TRANS 4060 - 4066 are transmitted which contains 64 new works and 137 corrected works.

2. The measurements of the most important nuclear data are continued in Institute of Physics and Power Engeneering, Institute of Nuclear Investigations of AN USSR, Radium Institute, Institute of Atomic Energy and so on. The results are published in the journals "Atomnaya Energia", "Yadernaya Fizika" and "Voprosy Atomnoi Nauki i Techniki", Series "Yadernye Constanty". The titles of some important works are given in the referencies / 1 - 13 / of Appendix.

3. Recently the essential work has been carried out in the CJD on data processing procedure. The computational format has been developped for presentation of experimental and evaluated cross section data. The programmes are written and put into operation for data transmission from the EXFOR and ENDF formats into computational format and for data input to plotter.

We think to form in the computational format temporary data bases for practical tasks (evaluations, theoretical calculations and so on).

In this connections the possibility of adaption of the format to new data types is envisaged.

Bibliographic data.

1. The technology of checking the CINDA data input in Reader Format is realized.

The work on development of the technology of data input into Master File is progres. The first half of next year it is suppo - sed to prepare and send to NDS the magnetic tape with CINDA data file for direct inclusion into MASTER FILE. So as the results ha- ving been approved by NDS, the CJD could begin symmetrical 4- lat- teral CINDA data exchange.

2. In 1986 - 1987 the CJD transmitted into NDS the 9270 CINDA records. The most part of these records contains the replacement of CCP - codes by LAB - codes and other kinds of corrections. New information is put into 370 records. The CJD carried out the check and correction of four CINDA data sets transmitted from NNDC. The work on link of CINDA - entries with EXFOR - entries are under way.

Evaluated neutron data.

1. In FEI the library of the recommended evaluated neutron data files (BROND) is formed. The library contains full neutron data files in the neutron energy range of 10^{-5} ev - 20 Mev for main technologi- cal, structural and fuel reactor materials, for radiation shielding materials, for materials of air, soil, biological tissue. The fissi- on products, neutron data of which are given in the library, provide more 80% of radiative capture of fission product mixture in any re - actor. The neutron data files of the main fuel, structural and tech- nological reactor materials, and also of the most important fission products are formed on the base of the recent evaluations, made in FEI, IJE AN BSSR and TU of Dresden. The data recommended by IAEA are adopted for the isotopes used as neutron standards. For other materials those available foreign files has been adopted which data were more reliable in soviet specialists opinion. The resolved and unresolved resonance regions have been replaced in the most of files the results of recent soviet evaluations.

All the evaluated neutron data library files were checked on the format and physical consistency of included data and transmitted in- to group representation by means of GRUCON and NJOY programmes.

The Nuclear Data Comission of GKAE recommended the Library as a base of development of the advanced neutron constant systems for neutron calculations in various scientific and engeneering regions. The calculational accuracy given by the use of the library requires the check by means of comparison of calculational results with experimental data obtained in reference experiments on critical assemblies, reactors and facilities for shielding study and so on.

As new neutron information and the results of library test are appeared it is supposed to reexamine the data for the main reactor and shield materials, to wide the list of nuclei, which data must be presented in the library, and the list of data (for example, to include gamma - production data in neutron reactions and so on).

2. At the time being the work on evaluation of curium isotopes, nitrogen, niobium, zirconium is under way. A number of articles on nuclear data evaluation is publiched in "Yadernye Konstanty" and in "Atomnaya Energia".

3. The testing of the data files for iron, cromium and nickel has been carried out on the base of the results of integral measurements on critical assemblies. Preliminary results displayed a good quality of CJD' full files of the materials mentioned.

4. A new version of threshold reaction cross sections library (BOSPOR-86) is prepared. The number of isotopes has been increased, some data reexamined, uncertainty values added. Some threshold reaction cross sections from BOSPOR have been included as curves with related tables into Handbook on Nuclear Activation Data.

Theoretical work in CJD.

Along with nuclear data evaluation CJD pays a considerable attention to improvement of theoretical models, used for nuclear reaction cross section analysis. One can point out three main directions of these works. Above all this is developments of consistent description of nuclear level density in wide energy excitation range. Main problems of such description are connected with taking into account shell, superfluid and collective effects, and were analysed in /19/ for structural material nuclei. At the present time the development of this direction is aimed to combine statistical description, working well at excitation energy above several Mev,

with combinatorial calculational methods, describing properly observable spectra of nuclear low lying levels. The second direction of theoretical works is connected with development of unified optical model. The key issues here are the taking into account of strong couple of many channels and correct partition of compound and direct process contributions, including direct multistep transitions. The taking into account of many channels is important also for analysis of intermediate structure of neutron cross sections and consistent description of neutron strength functions. The third direction is aimed to improvement of preequilibrium nuclear decay model. The works are concentrated, firstly, on separation of direct process contribution in inelastic scattering reactions, in the charge exchange and charged particle knock - out reactions;secondly, on obtaining correct microscopic description of n - quaziparticle excitations and formfactors for particles emitted in decay. For verification of theoretical models a variety of experimental data on neutron threshold reaction excitation functions and particle spectra are used.

A number of results is given in the reports submitted to Kiev conference this year.

W R E N D A.

The analysis of the USSR requests in the list WRENDA - 83/84 has been made for the next issue of the list. The 14 request were removed as fulfilld or duplicated. In soviet specialists opinion the required accuracies are not achieved in other cases.

C J D's organization work.

1. Early 1986 the meeting on nuclear data of representatives of the Council of Mutual Economic Assistance countries was conved. The reports submitted has been published in Yadernye Konstanty.
2. CJD took active part in formation of program and conducting the IAEA Interregional Training Courses in Riga. The 5 lectures were delivered by CJD's coworkers.
3. The CJD's coworkers participated in organization of the Ull-Union Symposium on Nuclear Fission (Obninsk, June 1987).

P U B L I C A T I O N S.

1. The following works has been published in VANT (Yadernye Konstanty Series).
   1.1. The collection of works containing the results of ^{238}U data analysis, fulfilled by soviet specialists (Jssue 4, 1985).
   1.2. A number of works on the neutron data evaluation (see references / 14 - 18 / in Appendix).
   1.3. The proposals on ENDF format modification for presentation of data in the unresolved resonance region (Issue 1, 1986).
2. CJD submitted 9 reports to International Conference on Neutron Physics.

Appendix

The works on measurements and evaluation of neutron data in 1986 - 1987

1. Bokhovko M.V., Kazakov L.E., Kononov V.N. et al. Measurement of neutron radiative capture cross sections for W isotopes in the energy range 5 - 400 kev. - In: VANT, Ser. Yadernye Konstanty, 1986, issue 1, p. 39.

2. Kazakov L.E., Bokhovko M.V., Timokhov V.M., Voevodskij A.A. Measurements of neutron radiative capture cross sections for ^{238}U in the energy range 4 - 460 kev. - In: VANT, Ser. Yadernye Konstanty, 1986, issue 3, p. 37.

3. Goverdovskij A.A., Gordjushin A.K., Kuz'minov B.D. et al. Measurement of fission cross sections of heavy nuclei induced by 16 Mev neutrons. - Atomnaya Energia, 1986, v. 60, p. 416.

4. Fursov B.I., Baranov E.Yu., Klemyshev M.P. et al. Measurement of ^{232}U fission cross section in the neutron energy range 0.06 - 7.4 Mev. - Atomnaya Energia, 1986, v. 61, p.383.

5. Kozharin B.B., Kovalenko S.S., Selitskij Yu.A. et al. Thermal neutron fission cross section and fission resonance integral of ^{237}Np. - Atomnaya Energia, 1986, v. 60, p. 419.

6. Goverdovskiy A.A., Gordjushin A.K., Kuzminov B.D. et al. Measurement of fission cross section ratio of ^{232}Th and ^{235}U in the neutron energy range 5 - 10 Mev. - Atomnaya Energia, 1986, v. 61, p. 380.

7. Fomushkin E.F., Novoselov G.F., Vinogradov Yu.I. et al. The fast neutron fission cross section of ^{243}Cm. - Atomnaya Energia, 1987, v. 62, p. 278.

8. Fomushkin E.F., Novoselov G.F., Vinogradov Yu.I. et al. Measurement of fission cross section energy dependence of ^{247}Cm in the neutron energy range 0.02 - 3.0 Mev. - Atomnaya Energia, 1987, v. 62, p. 279.

9. Vorotnikov P.E., Dmitriev S.V. et al. Intermediate structure in ^{241}Am fission cross section induced by 0.08 MeV - 1.3 MeV neutrons. - Yadernaya Fizika, 1986, v.44, p. 1403.

10. Goverdovskij A.A., Gordjushin A.K., Kuz'minov B.D. et al. Measurement of fission cross section ratio of ^{236}U and ^{235}U in the neutron energy range 4 - 11 MeV. - Atomnaya Energia, 1985, v. 59, p. 429.

11. Fursov B.I., Klemyshev M.P., Samylin B.F. et al. Measurement of fission cross section ratio of ^{236}U and ^{235}U in the neutron energy range 0.34 - 7.4 MeV. - Atomnaya Energia, 1985, v. 59, p. 284.

12. Adamchuk Yu. V., Voskanjan M.A., Muradjan G.V.,Shchepkin Yu.G. Measurement of alpha valus on ^{239}Pu resonances. - Atomnaja Energia, 1986, v.61, p.199.

13. Korzh I.A., Measurement and analysis of neutron scattering cross section on structural materials in the neutron energy range 0.5 - 9.0 MeV - In: VANT, Ser. Yadernye Konstanty, 1987, issue 1, p. 18.

14. Ignatjuk A.V., Maslov V.M. Consistent neutron cross section evaluation of $^{242-244}Cm$. - In: VANT, Ser. Yadernye Konstanty, 1986, issue 4, p. 43.

15. Fursov B.I., Kudjaev G.A., Smirenkin G.N. Fast neutron fission cross section of curium isotopes. In: VANT, Ser. Yadernye Konstanty, 1986, issue 4, p. 37.

16. Pronjaev V .G., Ignatjuk A.V. Reevaluation of iron neutron cross sections. - In: VANT, Ser. Yadernye Konstanty, 1986, issue 4, p. 51.

17. Ignatjuk A.V., Kravchenko I.V., Manturov G.N. The library of recommended evaluated neutron cross sections for the most important fission products. In: VANT, Ser. Yadernye Konstanty, 1987, issue 1, p. 3.

18. Kon'shin V.A., Salakhov N.K. Evaluation of averaged resonance parameters of ^{235}U, Pu isotopes and ^{241}Am on the base of data in resolved resonance region. In: VANT, Ser. Yadernye Konstanty, 1986, issue 3, p. 46.

19. Blokhin A.I., Ignatjuk A.V. Consistent description of the neut - ron spectra and excitation functions of threshold reactions on structural materials. Report, presented to CRP Meeting on Methods of Nuclear data calculation for structural materials (Bologna,1986)

87-12971 (0678E/312e)
Translated from Russian

Appendix 5
CAJaD

DATA ON CHARGED-PARTICLE-INDUCED REACTIONS: SOME PROBLEMS

(Information for the Ninth Consultants' Meeting of the Nuclear Reaction Data Centres)

by F.E. Chukreev
I.V. Kurchatov Institute of Atomic Energy

Moscow - 1987

Since the Eighth Meeting of the Centres, the Atomic and Nuclear Data Centre of the USSR State Committee on the Utilization of Atomic Energy has concentrated on the formation of radionuclides of medical interest in its nuclear reaction data compilation. The compilations have also encompassed a number of publications on thermonuclear fusion reactions and on neutron spectra.

The main difficulties in the data compilation work arise from the use of non-standard measurement units. By "standard" we mean "barn" and its derivatives for cross-sections and "curie/A.h" for reaction yields. In the original publications, however, we often encounter measurement units including target energy losses of the form " μcurie/μA.h.MeV". In some cases these units can be standardized by calculating the total mass stopping-power, although this naturally leads to uncertainty as various tables of total mass stopping power may be used. When authors' data are converted in this way, we say so in the notes.

A second problem is the use of a single term for different quantities.

Most authors use the term "thick target yield" to mean

$$Y \sim \int_0^E \frac{\sigma(E)}{-dE/dx}\, dE$$

and related quantities. However, in papers by M.S. Lagunas-Solar's group (USA), "thick target yield" appears to be used for the integrand expression from the conventional "yield". This group uses the term "cumulative yield" for Y, which bears no relation to the EXFOR "CUM". We wrote to Lagunas-Solar requesting a definition of the term "thick target yield", but there has been no reply. I am hoping for assistance from our American colleagues, as an explanation would benefit us all: we are not the only ones who have had trouble with this. Data from this group have been included in Ref. [1], for example, and if used by readers could lead to misunderstandings and errors.

A third problem is the presentation of data in graph form. By no means all graphs are presented in such a way that the information in them can be read easily and accurately, and they are often very small. Sometimes even the co-ordinate axes are distorted, making the graphs unsuitable for processing. In such cases we try to contact the authors, and here I should mention the valuable help we have received from the Jülich group (Professor S.M. Stöcklin and his colleagues) and the University of Hamburg (Professor Scobel and his colleagues).

In addition to the compilations we have been performing evaluations. This year we have published our data [2] on neutron yields from light elements bombarded by alpha-particles, and these data have also been applied to the calculation of neutron yields from fuels of various compositions.

At the last meeting we took responsibility for co-ordinating the compilation efforts of our network of Centres devoted to charged-particle-induced nuclear reactions. Since then we have received only two communications (from RIKEN and BNL), to which we replied. In both cases we trust that unnecessary duplication has been avoided.

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[1] ALBERT, P. et al., Technical Report No. 273, IAEA, Vienna (1987) 537.

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CDFE FOR PHOTONUCLEAR RESEARCHES

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Reporting the works carried out the results obtained, and the problems faced with, at CDFE from mid-1985 to early in 1987 is expedient to begin by discussing the problems. The major present-day problem has arisen from actual absence of any international exchange by photonuclear data, first of all the data of machine-sensible form. True, within the said period, the CDFE received an excellent edition of Photonuclear Data-Abstract Sheets from Professor E. Fuller of USA NBS and, besides receives routinely the NSR file photonuclear data output samples from Professor S. Pearlstein and copies of the JAERI editions from Professor A. Hashizume. These materials make it easier, to some extent, for the CDFE and its cooperative institutions (including the specialized nuclear data centers (SCJAD) at several universities) to solve the problems of processing the distributing photonuclear data.

Regretfully, it has to be stated once again that, despite the respective actions of the 7th and 8th IAFA Consultant's Meetings the second version of B.L. Berman's compilation on the photonuclear reaction cross sections obtained using quasimonoenergetic photons. In this connection, CDFE is planning to extend the scope of its activities in compiling photonuclear works and to include the works of physicists from abroad, of course with an appropriate STATUS. In particular, this concern the EXFOR format records of the data published as plots in the Photoneutron Cross Section Atlas and obtained

using quasimonoenergetic photons (PREPRINT UCRL-78482, B.L. Berman, 1976) and also the data published in other similar editions and scientific periodicals.

The following works carried out during the above mentioned period in accordance with the main trends of the CDFE activities should be noted.

1. Computer processing of data in the EXFOR format

The next consecutive exchange magnetic tape CDFE TRANS M005 has been prepared for sending the IAEA NDS. The tape contains numerical data of 45 experimental works of Soviet physicists.

Exchange tape TRANS M006 is being completed.

All the data arrays on the photons and charged-particle induced reactions distributed through the channels of international exchange, namely the files with indices A, B, C, D, S, R, P, etc., have been obtained, adopted, and used actively.

2. Activities with bibliography

The series of the CDFE information bulletins "Photonuclear Data" has been continued with issues 8 and 9 containing systematized information about the experimental works on photonuclear reactions published in 1984 and 1985, respectively, in scientific periodicals both in the USSR and abroad.

The materials of CDFE information bulletins Nos.1-9 have baen used to publish and dissiminate Data Index "Photonuclear Data 1976-1985" where the photonuclear research results obtained during the decade are presented in an ordered form. The Data Index includes a table summarizing all the information about the features of the experiments carried out and about its main results and contains the complete list of references, the author index and the indices of the elements and reactions studied.

3. Preparation of reviews on given subjects

The results of studying the (γ , X γ') reactions on light and mediu nuclei obtained during the last two decades have been systematized and analized. The ENSDF file has been used to specify the spectroscopic information about low-lying levels of atomic nuclei from ^{7}Li to ^{52}Cr and to compile the partial cross sections of the processes of occupation individual states of final nuclei of the reactions with emissinn of neutron, protons, deuterons, tritons, and α -particles. The results of the analysis have been published in the review "Photonuclear Data (γ, X γ') Reactions".

The issue "Photodisintegration of Lithium Evaluated Cross Sections of Channels and Reactions" has been published in addition to the CDFE information Review" "Photodisintegration of Lithium. Atlas of Cross Sections" published and distributed earlier to carry out the program for preparing the evaluated photonuclear data. The issue includes a brief description of the approach used for the evaluation, the detailed information about the experimental works on photodisintegraion of Li isotopes, both included in the Atlas (1984) and published later, and the results of analyzing various partial cross sections of ^{6,7}Li photodisintegration. The evaluated cross sections of channels and photodisintegration reactions for the ^{6,7}Li isotopes are presented as plots and in numerical form. The numerical data are planned to include in a next CDFE exchange magnetic tape.

4. Evaluation of photonuclear data

The photonuclear research show quite a number of characteristic features which compicate the analysis and evaluation of the results obtained. The features include:

(1) the relatively small reaction yields, hence a low systematic

accuracy of measurements. The statistics has to be improved by making long-time experiments, thusby increasing the systematic errors due to drift of meters;
(ii) the continuous γ -quantum spectra used in most cases make it necessary to solve the inverse problem to obtain the cross section by means of unfolding of the reaction yield curve. The methods avoiding such problem (radioactive sources, radiative-capture reactions) deal primarily with low intensities of γ -quantum beams and, therefore, involve a poor statistics again;
(iii) the methods for solving the inverse problem appear to be diverse, thereby giving rise to definite systematic differences in the results.

Considering the circumstances outlined above the CDFE has designed a special approach to evaluate the photonuclear data, first of all the cross sections. The essence of the approach is to find the feasible contributions of disregarded systematic errors from analyzing and evaluating the generalized characteristics of initial cross sections, such as integral cross section and center of gravity. The systematic errors are allowed for using the procedures of an appropriate renormalization (scaling along the cross section axis) and a recalibration (scaling along the energy axis) of individual initial cross sections.

The method designed was used to evaluate a great number of the ^{6,7}Li photodisintegration reaction and channel cross sections. The results of the evaluation were published in the review mentioned above.

Sticking to the photonuclear data evaluation program, the CDFE has evaluated the U isotope photodisintegration cross sections. The results obtained will be published as an appropriate review.

The numerical data on the cross sections estimated will be presented on one of the CDFE exchange magnetic tapes.

5. Activities on the Actions of the IAEA NDS

In conformity with the CDFE proposals (MEMO CP/M-6,7) and with the IAEA NDS Actions , the next LEXFOR entries describing the use of the BIB keywords MOM-SEC and EMS-SEC and of the quantity-parameters ECO, MCO, EMS has been prepared (see Apprendix).

6. Activities in processing requests

Within the reviewed period the CDFE received and processed more than 500 requests concerning bibliography and some 300 requests concerning numerical information about the properties of atomic nuclei and the characteristics of the low- and medium-energy nuclear reactions.

7. Center Personnel

All the papers and materials concerning the international nuclear data exchange are to be forwarded to V.V. Varlamov, Head of the CDFE of the Institute of Nuclear Physics of Moscow State University.

8. Specification of address

CDFE, Institute of Nuclear Physics, Moscow State University, Moscow 119899, USSR.

Appendix 7
RIKEN

Status Report of RIKEN Nuclear Data Group

In these two years efforts were continue to collect the reaction cross sections to produce radioisotopes which are usefull for medical uses. the isotopes are ^{11}C, ^{13}N, ^{15}O, ^{18}F, ^{28}Mg, ^{52}Fe, ^{67}Ge, ^{74}As, ^{77}Br, ^{82}Br, ^{77}Kr, ^{81}Rb, ^{82m}Rb, ^{111}In, ^{123}Xe, ^{127}Xe, ^{123}I, ^{124}I, and ^{125}I. During this period a IAEA consultant's meeting on Data Requirements for Medical Radioisotope Production were held in Tokyo with co-operation with our group and various situations to make radioisotopes for medical use were clarified.

1 Exfor files

We have compiled constantly the cross sectional data of charged particle induced reactions for medical use and data occured in Japan in exfor files but this period we have no transmission to other centers. In this point, reflection should be made.

2 Reference files

The reference files of secondary reports appeared in 1986 were compiled in the form of nuclear structure references coding and submitted to Brookhaven National Laboratory.

3 Coperation of ENSDF

Japanese group(represented by Dr.T.Tamura) coperate for the evaluation of nuclear structure in the mass region from 118 to 129 and 1 cycle of evaluation were completed.

3 Programming

By utilizing a graphic display and its supporting program, a flexible graph describing program has been completed. This program can make graphs utilizing the data. When many experimental results are expressed in a graphic form, it is very convenient to know the present status of the results. We are now editing these graphs of excitation curves.

editing a handbook of the nuclear cross sections to produce radioactive isotopes for medical use has been proposed after the technical meeting at IAEA.

We compared some of the excitation curves to the calculated results by Alice code, but the results are not yet satisfactory. An example are shown in Fig. 1 in Appendix. The effort is now continuing to this direction to obtain good fittness of experimental results.

4 Monitor Reactions

In collecting the excitation functions of reactions which produce the radioisotopes for medical use, we have found that there exist sometimes discrepancies between the experimental results. In view of these discrepancies, we realize the importance of the evaluations of monitor reaction cross sections. The monitor reactions utilized in the measurements of reaction cross sections which are useful for the production of medical isotopes are sumarized Table 1 in appendix. If each reaction cross section were compared with ehse of monitor reactions, a kind of systematic errors would be much reduced.

For the proton induced reactions, the measurements of cross sections of the $^{12}C(p,pn))^{11}C$ reaction have been made most precisely and in wide range of incident energies. The present situations of the results of cross section measurements of Cu(p,n) reactions which are often used are shown Fig.2 and Fig. 3 in Appendix.

Table 1. Monitor reaction List used for the measurement of cross sections of the reactions useful for medical use.

Kind of reactions	Energy region
$^{12}C(p,pn)^{11}C$	21-300 GeV
$Al(p,x)^{7}Be$	118-800 MeV 540,593
$Al(p,x)^{22}Na$	82-800 540,593
$Al(p,x)^{24}Na$	70-190
$^{63}Cu(p,n)^{63}Zn$	3 MeV-11.5 GeV
$^{63}Cu(p,2n)^{62}Zn$	16-33 MeV
$^{65}Cu(p,n)^{65}Zn$	3-100
$^{65}Cu(p,pn)^{64}Cu$	23-102
$^{65}Cu(p,4n)^{62}Zn$	34-100
$^{27}Al(d,p\alpha)^{24}Na$	11-28
$^{51}V(d,2n)^{51}Cr$	5-90
$^{56}Fe(^{3}He,p2n)^{56}Co$	18-29
$^{56}Fe(^{3}He,pn)^{57}Co$	6-29
$^{56}Fe(^{3}He,2n)^{57}Ni$	6-29
$^{nat}Ti(^{3}He,X)^{48}V$	5-130
$^{27}Al(\alpha,2p)^{29}Al$	15-152
$^{27}Al(\alpha,^{7}Be)^{24}Na$	40-103

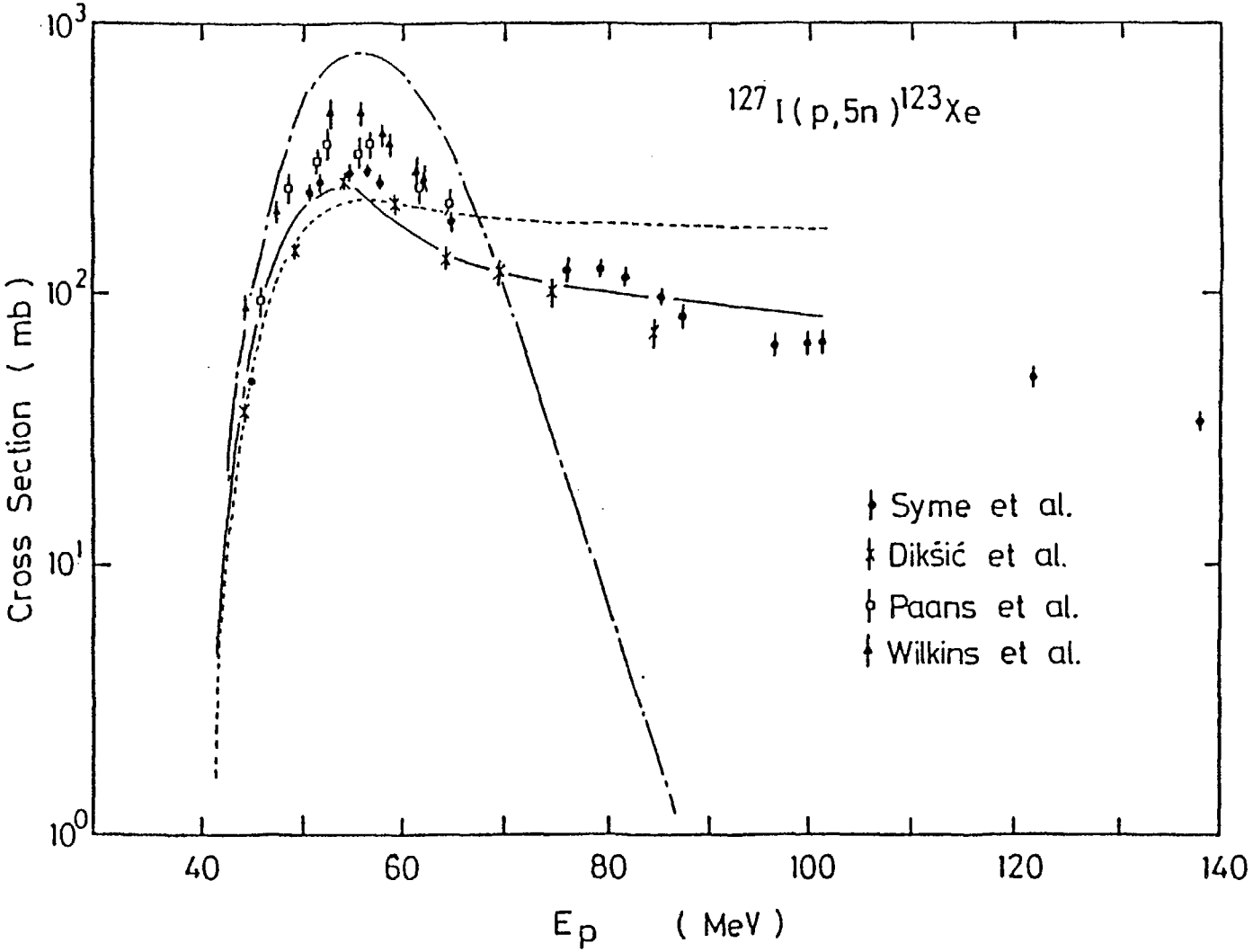

Fig. 1 Calculated (Alice) and experimental excitation functions for proton induced reaction on ^{127}I target. Dot-dashed line is CN-theory, and dashed and solid lines are hybrid model.

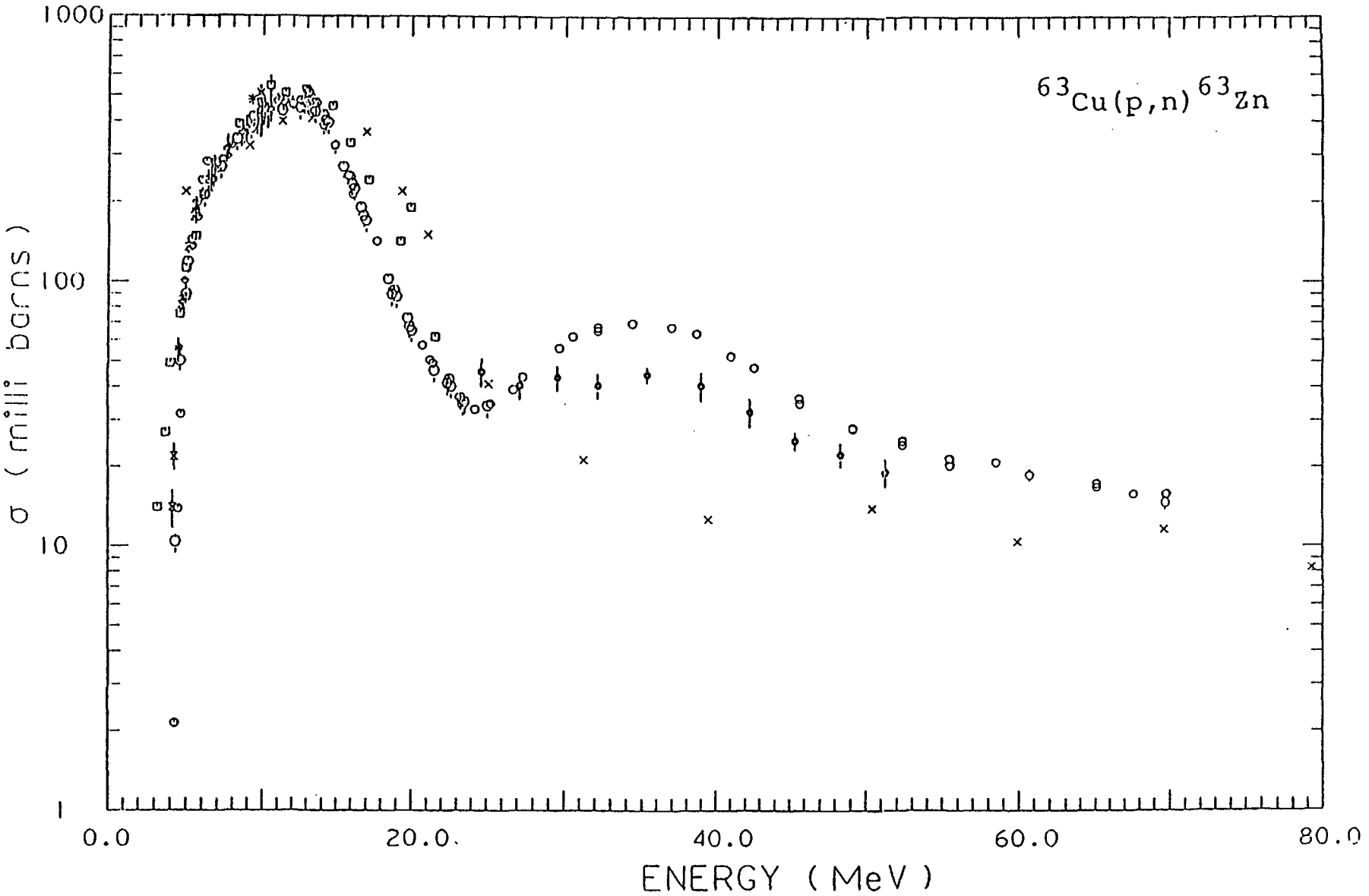

Fig. 2 The reaction cross sections of $^{63}Cu(p,n)^{63}Zn$

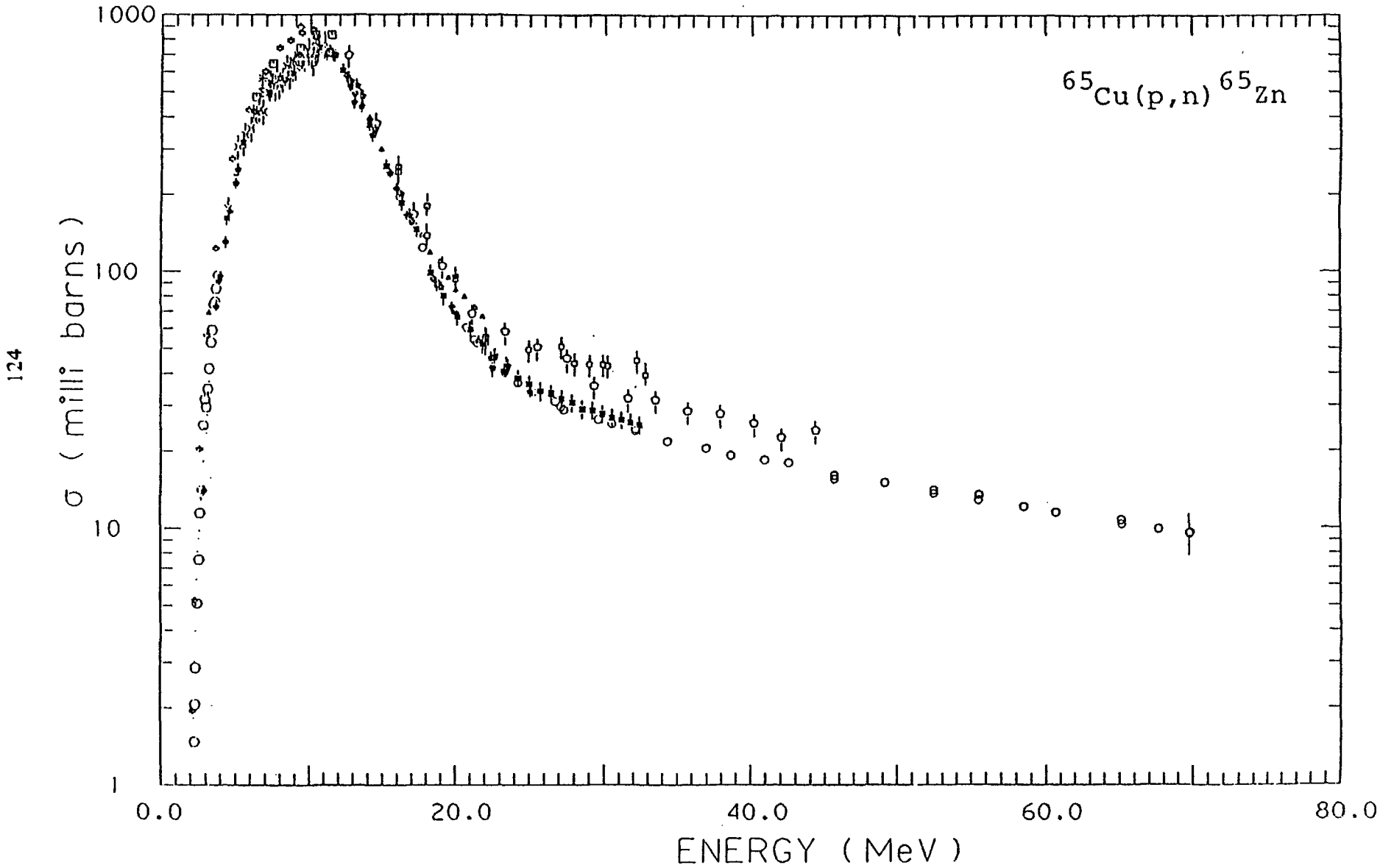

Fig. 3 The reaction cross sections of the ^{65}Cu(p,n)^{65}Zn.

Appendix 8
CNDC

Nuclear Data Activities in China

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Chinese Nuclear Data Center P.O.Box 275 (41), Beijing, China

1. Introduction

In China, the scientific research on nuclear physics started in the late 1950's. At that time a research reactor and some accelerators were built in the Institute of Atomic Energy, Beijing, and some nuclear data measurements were carried out. As to the nuclear data compilation and evaluation, it started systematically just in 1975, when the Chinese Nuclear Data Center (CNDC) and the Chinese Nuclear Data Coordination Network (CNDCN) were set up in order to meet the requirements of development of nuclear energy, nuclear science and engineering technology. Since China was non IAEA member at that time, we could get only very few evaluated data from abroad publications, we had to do evaluation ourselves to serve our users, many experimental and theoretical nuclear scientists were involved in the related work, including developing theoretical models, writing calculation codes and performing nuclear data evaluation, etc.

This situation has been changed since the CNDC started to make contacts with IAEA/NDS, JAERI/NDC and BNL/NNDC in 1980. Especially, since the People's Republic of China became an IAEA member in 1984, the international cooperation and exchange have obviously increased between the CNDC and other nuclear data centres. For example, we have participated in the evaluation and compilation of neutron data, structure and decay data, fission product yields and charged particle data under international cooperation, and some coordinated research programmes under the IAEA contracts. We have got whole sets of evaluated neutron data of ENDF/B-4, ENDL, JENDL-2, INDL/V and quite a lot of EXFOR experimental data as well as some programmes from IAEA/NDS and OECD/NEA.DB.

We have also sent some neutron data evaluated or measured in China to IAEA/NDS and several codes to NEA Data Bank. It is clear that the international cooperation and exchange have promoted the nuclear data activities in China and also become a proper approach for us to make contributions to the international nuclear data activities.

Afterwards, according to the needs of nuclear data for both home and abroad we will do our best in nuclear data activities to make more contributions.

2. Organizations and Objectives

2.1 Chinese Nuclear Data Center (CNDC)

As mentioned above, the Chinese Nuclear Data Center was founded in 1975 by the Ministry of Nuclear Industry. At present, the CNDC has about 30 scientists and a number of support staff, and is equipped with a PDP 11/70 computer.

The principal task of the CNDC is to function as a national center for generating, collecting, processing and disseminating nuclear data, to provide services to all nuclear data users in China, and to coordinate nuclear data activities on a national scale.

So far the CNDC's activities have mainly involved the following respects:

- working out a countrywide, long-term plan on nuclear data measurement and evaluation; arranging and coordinating nuclear data activities of the CNDCN;
- studying and developing nuclear data evaluation methods; coordinating and supervising data evaluators; compiling and evaluating nuclear data;
- collecting and validating data processing programmes, reports and recommended data from the network;
- maintaining and developing the Chinese Evaluated Nuclear Data Library (CENDL);
- performing benchmark testing of CENDL and generating multi-group constants for users;
- maintaining the data base of internationally available nuclear data files; providing selective retrievals and data processing to users;
- providing nuclear data and computer program services; publishing nuclear data reports and other publications;

— convening national nuclear data meetings;

— coordinating cooperation and exchange in the nuclear data field with other national and international nuclear data organizations.

2.2 Chinese Nuclear Data Coordination Network (CNDCN)

The CNDCN is composed of the institutes and universities which are taking up nuclear data measurement and evaluation. It is organized and coordinated by the CNDC. At present, the network has about 20 members. The following list shows the main 12 institutions in the network which have participated in the nuclear data activities for many years.

Institution	City
Beijing University	Beijing
Qinghua University	Beijing
Beijing Normal University	Beijing
Sichuan University	Chengdu
Fudan University	Shanghai
Jilin University	Changchun
Nankai University	Tianjin
Wuhan University	Wuhan
Lanzhou University	Lanzhou
Institute of Nuclear Research	Shanghai
Institute of Applied Physics and Computational Mathematics	Beijing
Institute of Atomic Energy	Beijing

All the network members undertake their projects according to the nuclear data plan and their own capacity and conditions under the guidance of the CNDC. The measured or evaluated data are provided to the CNDC. Of course, all the members of the CNDCN get some financial support from the Ministry of Nuclear Industry.

2.3 Working Groups

In order to assist the CNDC in its primary task on a national scale, some working groups on the following specialities were organized.

- Nuclear Data Measurement
- Theoretical Calculation of Nuclear Data
- Neutron Nuclear Data Evaluation
- γ - Production Data
- Construction of Chinese Nuclear Data Library (CENDL)
- Group Constant Generation and Benchmark Testing
- Nuclear Data processing and computational program
- Nuclear Structure and Decay Data
- Charged particle Nuclear Data
- Fission Product Yield Data
- Neutron Resonance Parameter and level Density
- Atomic and Molecular Data (1986)

The members of these groups come from CNDC and network institutions.

The function of working groups is as follows :

- To search the proper way or method to perform the given task;

— To hold symposiums in order to exchange experiences or discuss common problems appearing in the activities;

— To examine, review and recommend the data from the network.

2.4 China Committee of Nuclear Data (CCND).

In order to strengthen the guidance of nuclear data activities in China, the China Committee of Nuclear Data was established at the end of 1986.

— It is a professional consultative organization under the leadership of the leading body responsible for nuclear data research work in China.

— It attaches importance to the investigation of the urgent demands for nuclear data in atomic energy, nuclear science and nuclear engineering technology development, and to the better understanding of the progress and achievements made in the field of international nuclear data activities.

— It is responsible for the examination of the nuclear data long-term programme and phase plans, and offers key task projects and proposals of different kinds to the leading body for consideration.

— It helps the leading body to examine and approve the important progress and achievements made in nuclear data research.

— It plays its own role in such fields as external relations, nuclear technical and academic exchange at home and abroad, and takes vigorous action to promote the mutual relation, intercourse and cooperation with the organizations of the same occupation, at home and abroad.

3. Progress in nuclear data measurements

(This chapter, p. 7-13 and figures on p. 26-39, is omitted from this report. The same information is contained in the report INDC(CPR)-11, March 88, containing papers and progress reports presented at the 16th INDC Meeting, Beijing, 19-23 October 1987.)

4. Activities on Nuclear Data Evaluation

4.1 Nuclear Data Evaluation

According to the long-term plan on nuclear data evaluation many experimenters from the network institutions, such as Sichuan University, Qinghua University, Beijing University, Beijing Normal University, Lanzhou University and the IAE, have been engaged in the compilations and evaluations of neutron data for general purpose, nuclear data for special purposes and the studies on the evaluation methods.

4.1.1 Neutron Data for general purpose

Up to now, the neutron data including file-1 to file-5 for 36 nuclides (or elements) have been evaluated in the ENDF/B-4 format. All evaluated data make up the first version of the Chinese Evaluated Nuclear Data Library (CENDL-1) and are stored on magnetic tapes. The evaluated nuclides include H, D, T, ^{3,4}He, ^{6,7}Li, ^{9}Be, ^{10,11}B, N, O, ^{19}F, ^{23}Na, Mg, ^{27}Al, Si, V, Cr, Fe, Ni, Cu, Zn, Zr, Nb, Mo, Sn, Hf, Ta, W, Au, Pb, ^{235,238}U and ^{239,240}Pu. The incident neutron energy range of the evaluated data is from 10^{-5} to 2×10^{7}eV.

The evaluations for some other structural material elements, such as P, S, Ca, Ti, Mn, Co, Ag, Cd, In and Sb, have also been finished. The data will be included in the new version of CENDL.

Besides, under the cooperation with a Japanese Scientist a CNDC's staff has evaluated the neutron data of ^{107,109,Nat}Ag (file 1-5, 13-15) for JENDL-3 at the beginning of 1987 at JAERI.

4.1.2 Nuclear Data for Special Purposes

a) Charged Particle Nuclear Data (CPND)

The evaluation of the CPND was started in 1975. In 1983, a CPND group was organized. Its members are from the IAE, the Institute of Applied Physics and Computational Mathematics, Sichuan University and the Institute of Nuclear Research in Shanghai. By July of 1986, this group had collected the measured data for about 16 reactions performed in China and compiled them in the EXFOR format. The group has also developed a simple program for checking the EXFOR entries. In order to develop international cooperation

this group has joined the activities of the IAEA/NDS coordinated network of CPND centres since 1985.

b) Actinide Nuclear Data (AND)

Some transplutonium nuclear data had been evaluated and compiled before 1985 and a report of CNDC-85012 was published. Since 1985, the CNDC has participated the IAEA/NDS coordinated research program on the "Validation and Benchmark Testing of Actinide Nuclear Data". The neutron data evaluation for ^{249}Bk and ^{249}Cf have been finished. The evaluation of the neutron capture cross sections of ^{241}Am is being undertaken.

c) Fission Product Yield Data (FPYD)

A group at IAE is engaged in FPYD measurement and evaluation. Before 1981, three versions of "Evaluated Fission-Product Yield" had been issued.

On the basis of IAEA/NDS' suggestion, this group has continued to develop the Rider and Crouch FPYD libraries, abiding by the IAEA/NDS suggestions to issue a compilation of recommended values similar to the well-known Meek and Rider file at regular intervals.

Since 1985, this group has been devoting itself to the project of setting up a fission product yield library. In the first phase of the project, top priority was given to the following 10 fission systems: U235T, U235F, U235HE, U238F, U238HE, Pu239T, Pu239F, Pu241T, U233T, Th232F.

Up to now, the 10 sets of fission yield data evaluation are completed. The recommended values have been edited in the ENDF/B-5 format and in a "people-readable" format. The first set of recommended FPYD values has been transmitted to the IAEA/NDS.

The recommended values of the thermal fission of ^{235}U and ^{239}Pu have been tested and compared with ENDF/B-VE by Dr. T. R. England (LASL) through calculating the decay powers. The results are satisfactory.

d) Nuclear Structure and Decay Data (NSDD)

Initiated by the visit of Dr. S. Pearlstein, Director of the Brookhaven National Nuclear Data Center, USA, in 1981, the CNDC has participated in the international effort on NSDD evaluation.

Accordingly, ten mass chains were permanently assigned to China (A=51-56, 195-198). The Chinese NSDD evaluation group was formed in 1983 and the members are from IAE, Jilin University, Changchun, and the Institute of Nuclear Research in Shanghai.

Up to now, the evaluation for mass chains of A=51, 54, 55, 56, 170, 172 has been finished and published with the help of the NNDC; work on the evaluation of mass chains of A=52, 195 and 196 is in progress.

4.1.3 Evaluation Methods

To improve evaluation, some evaluation methods have been developed or are being developed, such as

a) Data processing methods

— Curve fitting:a spline fitting program for multi-sets of data has been written, with which the knots can be optimized and spline order number can be chosen;

— "Union adjusting" (to make all cross sections consistence for one nuclide or material):
  * single energy point union adjusting based on Bayes principle;
  * spline fitting for multi-curves;

— Simultaneous evaluation for several nuclides (materials) based on spline fitting for multi-curves.

b) Covariance processing methods

— Calculation of covariance matrix for experimental data using the information about errors in experiments given by authors. The program is codding;

— Covariance propagation in data evaluation processing, including curve fitting, union adjusting. The programs have been finished. Some primary results have been got. Now the programs are being improved and will be used in more realistic case;

— Simplification of the methods to deal with experimental data with covariance. Some primary results have been got;

— Calculation of covariance matrix between different nuclides (which are relative to each other in experimental measurements). The study in physics has been finished. The program is writting.

In fact, our efforts in this field have been made for years. But so far only some primary results have been got, we still have a lot of work to do and a long way to go.

c) Systematics Studies

Systematics studies on the excitation functions of the (n,2n), (n,3n) as well as (n,x) (x=p,d,t and ^{3,4}He) reactions have been performed. The parameterized formulae and all the parameters related have been obtained on the basis of the evaporation model with preequilibrium mechanism and the collected data for A=25-200 in the neutron energy range of from threshold to 25 MeV.

With the formulae and parameters, the excitation function could be predicted more reliably than before for the energy regions or nuclides not measured heretofore.

Recently, the systematics study on the (n,γ) reaction cross sections has also been performed.

4.2 Theory Research and Nuclear Data Calculation

As we know, in nuclear data evaluation the theoretical calculation plays an important role. Since the CNDCN was formed many theorists in the CNDCN have been engaged in the study of applications of various kinds of nuclear reaction theories and models, developing computer codes and performing theoretical calculations of nuclear data.

The main theories and methods applied for calculations of neutron nuclear data are shown in the following list :

Theory	Target	Institution
Phase Shift Analysis	H, D	Fudan Univ.
Faddeev Equation	D	CNDC
Resonance Group Theory	^{3}H, ^{3}He	Inst. of Nucl. Resea.
R-Matrix Theory Optical Model Hauser-Feshbach Theory DWBA	^{6}Li, ^{7}Li	Jilin Univ.
Quasifree Scattering	^{9}Be	Inst. of Appl. Phys. and Compu. Math.
Optical Model Hauser-Feshbach Theory with WFC Evaporation Model Preequilibrium Exciton Model DWBA Couple Channel Calculation	structural and fissionable nuclei	CNDC Nankai Univ. Wuhan Univ. Beijing Univ.

In statistical theory calculations, the calculated results are very sensitive to the level density and its parameters, so that some efforts were made in this field and a new set of level density parameters in the Gilbert-Cameron formula has been gained based on more accurate data which were obtained in recent years.

To improve the agreement between calculated results and experimental data of double differential cross sections the effects of the Fermi Motion and the Pauli Principle were first taken into account in the exciton model by our theorists. This physical

consideration has been accepted by some colleagues in the world.

At present, an unified preequilibrium and equilibrium model with conservation of angular momentum is being developed under an IAEA contract.

Apart from these, some studies on underlying theory have also been carried out in the CNDCN. For instance, some encouraging results have been reached in the study on the microscopic theory of the nuclear optical potential and the study on the fission mechanism. The study on new sets of nucleon-nucleon interaction of rank-1 and rank-2 separable types through fitting 2-body and 3-body data is in progress in order to improve calculations of few-body reaction data.

On the basis of theory research mentioned above many computer codes for data calculations have been developed. Three of them have been sent to NEA Data Bank. Now some important codes are being revised or standardized.

4.3 Multigroup Constant Generation and Benchmark Testing of Nuclear Data

A group responsible for the generation of multi-group constants and benchmark testing of nuclear data was formed in 1978. Since then, the main efforts of this group have been made in developing computer programmes.

Up to now, the group has developed or implemented the following programs for multigroup cross section generation:

- RQCS, a program to calculate multigroup constants for thermal fission reactors. It generates group constants for MUFT and GAM. (1980)
- KQCS, a fast reactor multigroup constant program based on the Bondarenko method which adjusts group constants to temperature and composition of the reactor. (1982)
- NGCPS, a group constant generation system for fast reactor and shielding calculation;
- LEK, a format transform program to match the ENDF/B-4 data file with the KQCS program;
- AMPX-2, a large medular nuclear data processing program, which was obtained from ORNL/RSIC. It has been implemented on the IBM-3031 computer (1986);
- NJOY, another large modular nuclear data processing program, which was obtained from NESC at ANL(USA). It has been implemented on the CYBER 170/825 at the IAE(1986).

With these programs the CNDC can provide various types of input data for nuclear power reactor design calculations and shielding analysis. The calculations of multigroup cross sections for nuclear power reactor, fast reactor and fusion research already started.

As to the benchmark testing, the following programs have been written or implemented:

— FEONAN, which calculates the uncollided transmitted neutron spectra and checks total cross sections using the Broomstick experiments performed at ORNL/RSIC;

— NDP, one-dimensional diffusion program. It calculates effective multiplication factors, spectrum indexes, and critical dimensions for reactors;

— TDBDC, two-dimensional diffusion and burnup program, which can be used for fast reactor analysis;

— PETRC, a pertubation reactivity coefficient program, which calculates one-dimensional or two-dimentional systems;

— DTF4C, one-dimensional discrete ordinate Sn program, which is a version of the US DTF4 program;

— ONEDANT, one-dimensional discrete ordinate Sn program, which uses the Synthetic Diffusion Method (SDM) allowing for effective accelerated convergence (1986).

Using these programs, the benchmark testing of the CENDL-1 is expected to be finished in the near future.

The checks of total cross sections for Fe, O, Na and N elements of CENDL-1 have been performed.

4.4 Nuclear Data and Program Library

In the CNDC there is a library group, which is responsible for the nuclear data library and the associated computer program library.

At present the group has the following main tasks:

— to prepare and maintain the Chinese Nuclear Data Library (CENDL),

— to collect evaluated nuclear data and computer programs prepared by other centers;

— to improve or develop the library management program system, data computer programs and evaluation system; to make complete

evaluations of specific nuclides;

— to collect, compile and evaluate A+M data and establish an A+M data library under cooperation with the A+M data working group;

— to issue nuclear data publications;

— to provide nuclear data and program services to Chinese users and exchange them with IAEA/NDS and other centers;

— to operate, maintain and manage the computer PDP 11/70.

5. Development for future

As far as the nuclear data activities in China in future is concerned, the first important objective is still to satisfy the requirement of the development of nuclear energy as well as the application of nuclear technology in our country.

As a matter of fact, in the early 1970's our country had a research project on fast breeder reactor and fusion research. However, the project was not made an expected progress for some reasons. Recently the fast reactor and fusion research project has been resumed and reinforced, and a plan for developing hybrid reactor has also been worked out.

In order to meet the needs of nuclear data and A+M data for the plans mentioned above, the nuclear data activities must be further developed in our country. Under the CCND's suggestion, the future project of the CNDC's activities is mainly as follows:

a) to update the evaluated neutron data library for general purpose. CENDL-2 is planed to be finished in 1990 through:

— reevaluating some important nuclides,

— adding some other selected nuclides after analysing and reviewing the existing evaluations made by other centres, etc;

b) to extend the evaluation of nuclear data for special purposes, such as charged particle nuclear data, neutron dosimetry and activation reaction data;

c) to collect and compile A+M data and build up a corresponding A+M data library. The first step is to collect and compile the existing bibliographic and numerical data as well as calculate and measure some of A+M data;

d) to make benchmark testing on some important evaluated nuclear data;

e) to improve and complete theoretical calculation codes,

evaluation and data processing systems to improve the quality of evaluated data.

Apart from these, our center and network would like to develop international cooperation and exchange activities more actively. At present we are participating in some CRP activities as mentioned at the beginning. It is expected that we shall make more contributions to the existing and new CRP activities. On the other hand, we wish to strengthen bilateral cooperations with other centres or foreign institutions. It is planned to evaluate neutron data of O and F elements for ENDF/B-6 under the cooperation between the CNDC and the NNDC (actually, the LASL and ORNL). We are sure that this kind of cooperation activities is profitable for both participating sides.

Finally, on behalf of the CNDC we wish to take this opportunity to express our gratitude to IAEA and other centers as well as all old and new foreign friends for their contributions to promote their cooperations with the CNDC in nuclear data activities.

Table 1.

Unit	Main Facilities	Research Subjects
IAE	600KV Cockcroft-Walton(200-500KV) 2.5 MV Van de Graaff (0.3-2.5MV) AVF Cyclotron(E_p~3-15MeV,E_d~4-14MeV,E_α~8-28MeV) HI-13 Tandem(HVEC,3-13MV,±1KV,provide p,d,α..... heavy ion) Heavy Water Reactor (15MW, 2.8×10^{14}n/sec,cm^2) Swimming Pool Reactor (4000 KW)	Fission Process study Fast neutron spectroscopy Fast neutron reaction Nuclear structure and decay Light and heavy ion nuclear reaction A+M Application of nuclear technique
Institute of Nuclear Science and Technology of Sichuan University	Cockcroft-Walton (400KV; 200KV,~5ns) 2.5MV Van de Graaff (~1ns) Cyclotron (φ1.2M, E_d~12MeV)	Fast neutron scat. angular distr. Neutron capture γ-ray Charged particle reaction, A+M
Peking University	4.5MV VDG (1-2ns,0.3-4.5MV,provide p,d,α,···Ar, will be operated in 1988) Tandem 2×7MV (EN-18, 0.5-6.5MV,will be operated in 1988) 2×7MV (NEC, 5SDH-2)	Nuclear reaction & nuclear structure Nuclear fission Material Science,Atomic collision Heavy ion reaction
Qinghua University	200KV Cockcroft-Walton	Fast neutron scat. & reactions
Beijing Normal University	400KVC-W with post helix acceleration	Fast neutron spectr.&γ production
Institute of Nuclear Research in Shanghai	4MV VDG(NEC, Ep~0.3-4MV,±1KV) Tandem 2×6MV(indigenously designed, under construction) AVF Cyclotron (φ1.2M, E_p~3-30MeV, d,α,···heavy ion)	Application of nuclear technique In-beam γ-spectroscopy Light ion & charged particle nuclear reaction
Fudan University	2.5 MV VDG Tandem 2×3 MV (NEC, is being installed)	Application of Nuclear technique Fast neutron reaction A+M

Working paper WP3

Summary of important errors found by NDS in EXFOR TRANS tapes

O. Schwerer

- use of modifier MSC for neutron data (may be used only for photonuclear data) (Area 1)

- errors given in BIB section under ERR-ANALYS not consistent with those used in DATA section, or errors given under ERR-ANALYS in subentry 1 not used in all subentries (Area 2)

- heading ANG used for other angles than that of the outgoing particle, or for data which, according to the REACTION given, do not depend on angle of outgoing particle. (Implicit rule: ANG and its derivatives may be given only if DA or COR appears in REACTION SF6.) (Areas 2,4) (e.g. 22011, 22028, 40916)

- E-format numerical data not right-adjusted within field in DATA section (Area 2)

- use of obsolete REACTION codes PAR,DE and PAR'SPC (Area 4)

- incorrect or missing alter flags in col. 80 (Area 2)

- giving quantities under MONITOR which are not proportional to the data (ASSUMED should be used instead) (e.g. 40729, 40850, 13104.003,4)

- giving EN if SF2=0, or giving EN twice (Area 2)

SUMMARY OF CHARGED PARTICLE DATA COLLECTIONS

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February 27, 1986

A. Bibliography

The oldest and most comprehensive charged particle bibliography was produced at the Oak Ridge National Laboratory (ORNL) by McGowan and Milner (1). This bibliography covered the literature on charged particle reactions for all projectiles and targets without restriction on incident energy. No reactions involving mesons were included. This project was terminated in 1976.

At the Lawrence Livermore National Laboratory (LLNL), a specialized bibliography devoted to information on interaction of light charged particle reactions of interest to fusion, is currently being maintained (2). This bibliography is limited to targets $Z \leq 8$ and $A \leq 16$, projectiles $Z \leq 2$ and $A \leq 4$ and energies up to 20 MeV. This bibliography is historically complete. Of more recent vintage, is a bibliography for charged particle interactions in which the compound nucleus mass is either 7 or 11 (3). The energy range is limited to below 20 MeV. The bibliography is maintained as part of the Los Alamos National Laboratory (LANL) program to evaluate the ^{6}Li (n,α) and the $^{10}B(n,\alpha)$ neutron standard cross sections. Presently, the two data bases exist in a merged form at LANL.

In 1976, National Nuclear Data Center (NNDC) at Brookhaven undertook the compilation of an integral charged particle bibliography restricted to excitation functions and thick target yields as a part of the newly formed international compilation activity for this kind of data (4). The NNDC compilation was published in a "CINDA-like" format with coverage beginning with the end of the ORNL bibliographic activity. This compilation was terminated in 1982. Specialized bibliographies covering the same information are now extracted from the Nuclear Structure References data base and published annually (5).

A compilation of references to charged particle reaction data covering incident particles with masses between proton and ^{7}Li producing any particle (except meson) or gamma rays is being completed at LANL (6). The compilation will cover both experimental and theoretical papers from 1947 to date covering the incident particle energy range between 50 and 1000 MeV. The information was extracted from the RECON system (INIS equivalent) and is not in computerized form.

Included are some examples of currently available publications. Figure 1 shows a sample page from the Reaction Index in the Recent References publication (7). Figure 2 shows a sample page from the residual nucleus index of the Bibliography of Integral Charged Particle Nuclear Data (5).

B. Experimental Data

The numerical data covered in the LLNL and LANL bibliographies are also available in computerized form (2,3). The ORNL group also compiled experimental data but only for selected nuclides which were included in curve book publications (8). This data base presently is available from NNDC. Charged Particle barn books for elements from Hydrogen to Chromium were published by LANL (12).

The international charged particle effort was started in 1976 to compile excitation function and thick target yield data. The EXFOR format was selected. All data compiled by this network is available in the EXFOR format. The major contribution to this compilation activity was the Karlsruhe Charged Particle Data Group (9). Most of the data of interest in the ORNL compilation has been converted to EXFOR by the group. Unfortunately, this group was disbanded in 1983.

At irregular intervals, compilations of selected charged particle experimental data with eyeguides have been published. These are generally indexed in the introduction to the annual charged particle bibliographies publication by NNDC (5).

The major charged particle data compilation activity is now centered at Kurchatov Institute in Moscow. Originally, this group was established to compile all charged particle data produced in the USSR. Now, the group is compiling some of the data previously compiled at Karlsruhe. A new group at RIKEN Institute of Physics and Chemical Research, Saitama, Japan has joined the compilation activity. They are compiling data for about 20 isotope production reactions in the EXFOR format.

In figure 3, is a sample portion of the index to available experimental charged particle data compiled in the EXFOR format. CSISRS (Cross Section Information Storage and Retrieval System) is the NNDC data base containing data compiled in the EXFOR format. The initial letter of the accession number indicated the data center which compiled the data. Table I explains these codes. At present, the library contains 51,365 data points in 2850 data sets with projectiles from protons to Xe-136, targets from deuterium to Cf-249 and incident energies up to 300 GeV.

TABLE I

Charged Particle Compilation Center Codes

A	CAJAD	Kurchatov Institute, Moscow, USSR
B	KACHAPAG	Kernforschungszentrum, Karlsruhe, FRG
C	NNDC	Brookhaven National Laboratory, USA
D	NDS	Nuclear Data Section, IAEA, Vienna
R	RIKEN	Institute of Physics & Chemical Research, Saitama, Japan
S	CNDC	Chinese Nuclear Data Center, Beijing, PRC

C. Evaluated Data

Charged particle data evaluations are performed at LLNL and LANL for the data contained in their bibliographies (3, 10). The LANL evaluations include covariance matrices. There is also an evaluation of (p,n), (p,2n) and (p,3n) reactions for 306 nuclides from Z=21 to Z=83 by Pearlstein (11) based on systematics. These data are available in ENDF-5 format. Some evaluation work is also done at Kurchatov and RIKEN.

Charged particle reaction data for several materials including C, Al, structural materials, W, Ta and U, are being produced from nuclear model codes for incident protons up to 100 MeV by LANL (6). These data will probably be available in ENDF-6 format. At NNDC, S. Pearlstein is investigating the systematics from high energy proton bombardment.

Extensive effort has gone into modifying the ENDF format to make it useful for storage of evaluated charged particle reaction data. ENDF-6 format is available and documented with all of the utility codes upgraded to handle the format. It is strongly recommended that this format be used for exchange of evaluated data.

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FIGURE 1 - SAMPLE PAGE FROM RECENT REFERENCES (7)

REACTION INDEX

(p,xn) continued

^{63}Cu(p,xn),E=26.7 MeV; measured σ(E(n),θ).	85Ho18	^{98}Mo(p,xn),E=25 MeV; measured inclusive σ(En,θn)	84Sc33
^{79}Br(p,xn),E=threshold-52 MeV; measured residuals	85Sa23	^{100}Mo(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33
^{81}Br(p,xn),E=threshold-52 MeV; measured residuals	85Sa23	^{110}Pd(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33
^{85}Rb(p,xn),E=threshold-52 MeV; measured residuals	85Sa23	^{127}I(p,xn),E=threshold-52 MeV; measured residuals	85Sa23
^{87}Rb(p,xn),E=threshold-52 MeV; measured residuals	85Sa23	^{133}Cs(p,xn),E=threshold-52 MeV; measured residuals	85Sa23
^{89}Y(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33	^{130}Ba(p,xn),E=32-45 MeV; measured Eγ,Iγ,Iγ(E).	85Mo01
^{90}Zr(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33	^{138}Ba(p,xn),E=17-45 MeV; measured Eγ,Iγ,Iγ(E).	85Mo01
^{90}Zr(p,xn),E=18 MeV; measured inclusive σ(En,θn).	84Sc33	^{159}Tb(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33
^{91}Zr(p,xn),E=25 MeV; measured inclusive σ(En,θn).	84Sc33		

(p,xnπ⁻)

^{209}Bi(p,π⁻xn),E=120-800 MeV; measured residuals	85Do11

(p,xnp)

^{79}Br(p,xnp),E=threshold-52 MeV; measured residuals	85Sa23	^{87}Rb(p,xnp),E=threshold-52 MeV; measured residuals	85Sa23
^{81}Br(p,xnp),E=threshold-52 MeV; measured residuals	85Sa23	^{127}I(p,xnp),E=threshold-52 MeV; measured residuals	85Sa23
^{85}Rb(p,xnp),E=threshold-52 MeV; measured residuals	85Sa23	^{133}Cs(p,xnp),E=threshold-52 MeV; measured	85Sa23

(p,xnyp)

V(p,xnyp),E=45-200 MeV; measured σ(E).	85Mi14	^{59}Co(p,xnyp),E=45-200 MeV; measured σ(E).	85Mi14
^{55}Mn(p,xnyp),E=45-200 MeV; measured σ(E).	85Mi14		

(p,F)

^{133}Cs(p,F),E=200 MeV; measured cumulative fission	85Wa15	^{203}Tl(p,F),E=24-41 MeV; measured fission fragment	85It01
^{150}Sm(p,F),E=1 GeV; measured fission fragment	84Ch38	^{204}Pb(p,F),E=24-41 MeV; measured fission fragment	85It01
^{184}W(p,F),E=1 GeV; measured fission fragment mean	85Ch14	^{206}Pb(p,F),E=24-41 MeV; measured fission fragment	85It01
^{185}Re(p,F),E=40-70 MeV; measured fission σ(E).	84Ig01	^{208}Pb(p,F),E=24-41 MeV; measured fission fragment	85It01
^{197}Au(p,F),E=40-70 MeV; measured fission σ(E).	84Ig01	^{209}Bi(p,F),E=40-70 MeV; measured fission σ(E).	84Ig01
^{197}Au(p,F),E=1 GeV; measured fission fragment mean	85Ch14	^{209}Bi(p,F),E=24-41 MeV; measured fission fragment	85It01
^{202}Tl(p,F),E=24-41 MeV; measured fission fragment	85It01	^{232}Th(p,F),E=1 GeV; measured fission fragment mean	85Ch14
^{205}Tl(p,F),E=40-70 MeV; measured fission σ(E)	84Ig01	^{238}U(p,F),E=1 GeV; measured fission fragment mean	85Ch14

(p,nF)

^{233}U(p,nF),E=12.7-25.5 MeV, measured	82Pi08	^{238}U(p,nF),E=12.7-25.5 MeV, measured	82Pi08
^{238}U(p,nF),E=12.7-25.5 MeV, measured	82Pi08		

(p,X)

^{1}H(p,X),E=150 MeV, measured fragment spectra for	84Be58	W(p,X),E=1-3 MeV; measured E(L X-ray),I(l X-ray).	85So09
^{2}H(p,X),E=150 MeV; measured fragment spectra for	84Be58	Au(p,X),E=1-3 MeV; measured L X-rays.	83Co25
^{2}H(p,X),E at 2.06-3.67 GeV/c; measured σ	85Ka11	^{197}Au(p,X),E=0.2-0.9 MeV/nucleon; measured	85Je02
^{9}Be(p,X),E=150 MeV; measured fragment spectra for	84Be58	Pb(p,X),E=1-3 MeV, measured L X-rays.	83Co25
^{12}C(p,X),E=150 MeV; measured fragment spectra for	84Be58	Pb(p,X),E=20 MeV; measured residual isomer	85Ar01
Ne(p,X),E=40 MeV; measured residuals yields.	85Ru03	Pb(p,X),E=0.2-0.9 MeV, nucleon; measured absolute L	85Je02
^{40}Ar(p,X),E=1 GeV; measured fast particle mean	85Er02	Pb(p,X),E=1-3 MeV, measured E(L X-ray),I(l X-ray).	85So09
Cu(p,X),E=4-33 MeV, measured residual production	85Ko26	^{209}Bi(p,X),E=1-3 MeV, measured E(L X-ray).	85So09
Ag(p,X),E=1 GeV; measured inclusive fragment	85Ro10	Th(p,X),E=1-3 MeV, measured L X-rays.	83Co25
Cd(p,X),E=0.3-2 MeV; measured L-subshell X-ray	85Cu02	Th(p,X),E=600 MeV; measured Rn isotope production	84Ca32
Sb(p,X),E=0.3-2 MeV, measured L-subshell X-ray	85Cu02	Th(p,X),E=1-3 MeV; measured E(L X-ray),I(l X-ray)	85So09
Te(p,X),E=0.3-2 MeV; measured L-subshell X-ray	85Cu02	U(p,X),E=1-3 MeV; measured L X-rays.	83Co25
Dy(p,X),E=1-3 MeV; measured L X-rays.	83Co25	U(p,X),E=0.2-0.9 MeV/nucleon; measured absolute L	85Je02
Dy(p,X),E=1-3 MeV; measured E(L X-ray),I(l X-ray).	85So09	U(p,X),E=1-3 MeV, measured E(L X-ray),I(l X-ray).	85So09
Yb(p,X),E=1-3 MeV; measured E(L X-ray),I(l X-ray)	85So09	^{238}U(p,X),E=600 MeV; measured γ-,X-ray spectra.	85Hi02
W(p,X),E=1-3 MeV; measured L X-rays	83Co25		

(p,π⁻X)

^{12}C(p,π⁻X),E=330,400,500 MeV; measured σ(θ) vs	85Di01	^{238}U(p,π⁻X),E=330,... MeV; measured σ(θ) vs pion	85Di01

(p,π⁺X)

^{12}C(p,π⁺X),E=330,400,500 MeV; measured σ(θ) vs	85Di01	^{238}U(p,π⁺X),E=330,... MeV; measured σ(θ) vs pion	85Di01

FIGURE 2 - SAMPLE PAGE FROM CHARGED PARTICLE BIBLIOGRAPHY (5)
RESIDUAL INDEX

RESIDUAL	TARGET-REACTION	INCIDENT ENERGY	REFERENCE	KEY NUMBER
^{94}Nb	^{94}Zr(p,n)	E=22 MeV	JOUR Yad.Fiz. 39, 264	84Zh02
	^{94}Zr(p,n)	E=22 MeV	JOUR Yad.Fiz. 39, 264	84Zh02
^{93}Nb	^{94}Zr(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
^{96}Nb	^{96}Zr(p,n)	E=16 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{96}Zr(p,n)	E=1.3-5.1 MeV	JOUR Nucl.Phys. A430, 301	84Ke12
	^{96}Zr(d,2n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
^{97}Nb	^{96}Zr(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
^{92}Mo	^{92}Mo(^{20}Ne,^{20}Ne)	E=146 MeV	JOUR Z.Phys. A317, 31	84Na12
^{93}Mo	Ni(p,γ)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Ti(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Cr(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Fe(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Ni(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Cu(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Zn(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Ga(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Ge(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	^{75}As(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Se(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Zr(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	^{93}Nb(p,n)	E=16 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{93}Nb(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Mo(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Cd(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Sn(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Sb(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	Te(p,n)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	^{90}Zr(a,n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{91}Zr(a,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
^{98}Mo	^{96}Zr(a,n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
^{100}Mo	^{100}Mo(^{20}Ne,^{20}Ne)	E=146 MeV	JOUR Z.Phys. A317, 31	84Na12
^{93}Tc	^{94}Mo(p,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{92}Mo(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
^{94}Tc	^{94}Mo(p,n)	E=16 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{95}Mo(p,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{94}Mo(d,2n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{92}Mo(a,np)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
^{95}Tc	Ni(p,γ)	E=10.4 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 135	84Is01
	^{95}Mo(p,n)	E=16 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{96}Mo(p,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{94}Mo(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{95}Mo(d,2n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{93}Nb(a,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{93}Nb(a,2n)	E=threshold-140 MeV	JOUR Nuovo Cim. 81, 66	84Ga20
^{96}Tc	^{96}Mo(p,n)	E=16 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{97}Mo(p,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{95}Mo(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{96}Mo(d,2n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{93}Nb(a,n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{93}Nb(a,n)	E=40-140 MeV	JOUR Nuovo Cim. 81, 66	84Ga20
	^{93}Nb(a,n)	E=35 MeV	JOUR J.Radioanal.Nucl.Chem. 82, 61	84Om01
^{99}Tc	^{100}Mo(p,2n)	E=30 MeV	JOUR J.Nucl.Mater. 122/123, 972	84Ab05
	^{98}Mo(d,n)	E=4-12 MeV	JOUR At.Energ. 55, 164	83Va33
	^{96}Zr(^{6}Li,3n)	E=18-25 MeV	JOUR Phys.Rev. C31, 409	85Ka02

Reaction	Energy (eV) min	max	# pts	Institute	Reference		First Author	Accession #
39-Y-89(P,X)37-RB-81-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 19
39-Y-89(P,X)37-RB-82-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 18
39-Y-89(P,X)37-RB-83,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 17
39-Y-89(P,X)37-RB-84-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 16
39-Y-89(P,X)37-RB-86,IND,SIG,,	5.9+08	5.9+08	1	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 15
39-Y-89(P,X)38-SR-81,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 14
39-Y-89(P,X)38-SR-82,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 13
39-Y-89(P,X)38-SR-83,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 12
39-Y-89(P,X)38-SR-85-G,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 11
39-Y-89(P,X)38-SR-85-M+G,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 11
39-Y-89(P,X)38-SR-85-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 11
39-Y-89(P,X)38-SR-87-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 10
39-Y-89(P,X)39-Y-84,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 9
39-Y-89(P,X)39-Y-85-G,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 8
39-Y-89(P,X)39-Y-85-M,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 8
39-Y-89(P,X)39-Y-86-M+G,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 7
39-Y-89(P,X)39-Y-86-M,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 7
39-Y-89(P,X)39-Y-87-G,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 6
39-Y-89(P,X)39-Y-87-M+G,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 6
39-Y-89(P,X)39-Y-87-M,CUM,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 6
39-Y-89(P,X)39-Y-88,IND,SIG,,	5.4+08	5.9+08	2	2SWTWUR	W,GRUETTER	8202	A.GRUETTER	D0029 5
40-ZR-0(A,X)42-MO-90,,SIG,,	4.0+07	5.5+07	18	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 3
40-ZR-0(A,X)39-Y-86,,SIG,,	4.0+07	5.5+07	18	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 3
40-ZR-0(A,X)39-Y-90-M,,SIG,,	1.5+07	5.5+07	45	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 2
40-ZR-0(A,X)39-Y-92,,SIG,,	1.5+07	5.5+07	45	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 2
40-ZR-0(A,X)40-ZR-95,,SIG,,	1.5+07	5.5+07	45	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 2
40-ZR-0(A,X)40-ZR-95,,SIG,,AV	2.5+07	5.4+07	29	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 4
40-ZR-0(A,X)40-ZR-95,,TTY,,A	2.5+07	5.4+07	29	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 4
40-ZR-0(A,X)41-NB-90,,SIG,,	4.0+07	5.5+07	18	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 3
40-ZR-0(A,X)41-NB-97-G,,SIG,,	1.5+07	5.5+07	45	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 2
40-ZR-0(A,X)42-MO-93-M,,SIG,,	1.5+07	5.5+07	45	3ARGCNE	J,JRC,67,165	81	M.DE LA VEGA VEDO	D0043 2
40-ZR-0(P,N)41-NB-90-M,,TTY,,	9.0+06	1.1+07	3	4CCPUZB	J,AE,49,(2),101	8008	A.V.MUMINOV,	A0085 15
40-ZR-90(2-HE-3,A)40-ZR-89,PAR,DA,,	2.1+08	2.1+08	18	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 39
40-ZR-90(2-HE-3,A)40-ZR-89,PAR,DA,,	2.1+08	2.1+08	19	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 41
40-ZR-90(2-HE-3,A)40-ZR-99,PAR,DA,,	2.1+08	2.1+08	19	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 40
40-ZR-90(2-HE-3,A)40-ZR-89,PAR,DA,,	2.1+08	2.1+08	20	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 7
40-ZR-90(A,A)40-ZR-90,PAR,DA,,	2.1+08	2.1+08	15	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 8
40-ZR-90(A,A)40-ZR-90,PAR,DA,,	2.1+08	2.1+08	16	2FR PAR	J,NP/A,297,61	78	J.VAN DE WIELE,	R0015 9
40-ZR-90(A,X)0-NN-1,IND,SIG,,	4.5+07	4.5+07	1	4CCPFEI	C,80KIEV,2,30	80	N.S.BIRJUKOV,	A0101 9
40-ZR-90(P,2N)41-NB-89,M+,SIG,,	4.0+08	4.0+08	1	1USACAR	J,PR,178,1732	69	L.B.CHURCH,	B0024 18
40-ZR-90(P,2N+2P)39-Y-87-M+G,UND,SIG,,	1.2+07	8.6+07	10	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 3
40-ZR-90(P,3N)41-NB-88-G,,SIG,,	4.0+08	4.0+08	1	1USACAR	J,PR,178,1732	69	L.B.CHURCH,	B0024 19
40-ZR-90(P,3N)41-NB-88-M,,SIG,,,SUM	4.0+08	4.0+08	1	1USACAR	J,PR,178,1732	69	L.B.CHURCH,	B0024 19
40-ZR-90(P,3N+2P)39-Y-86-M+G,UND,SIG,,	2.4+07	8.6+07	11	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 4
40-ZR-90(P,3N+3P)38-SR-85,M+/UND,SIG,,	3.8+07	8.6+07	9	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 7
40-ZR-90(P,3N+4P)37-RB-84,IND,SIG,,,RAT	1.0+09	1.0+09	1	4CCPRI	J,YF,24,1177	76	B.N.BELJAEV,	A0043 8
40-ZR-90(P,3N+4P)37-RB-84,IND/M+/UND,SI	5.0+07	8.6+07	7	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 10
40-ZR-90(P,4N+2P)39-Y-85-M+G,UND,SIG,,	3.8+07	8.6+07	9	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 5
40-ZR-90(P,4N+4P)37-RB-83,UND,SIG,,	3.8+07	8.6+07	9	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 11
40-ZR-90(P,5N+2P)39-Y-84-G,(M+,,RAT	5.6+07	8.6+07	6	1CANMCG	J,PR/C,14,64	76	M.V.KANTELO,	B0130 6

FIGURE 3 - PAGE FROM INDEX TO CHARGED PARTICLE EXPERIMENTAL DATA FILE