

15 April 1988

To: Distribution

From: H.D. Lemmel  
*Lemmel*

Subject: 9th NRDC Meeting  
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Please find attached the Minutes of the 9th NRDC-Meeting, Brookhaven, 27-30 October 1987.

If you wish to submit changes, additions, corrections, etc., kindly inform me by telex by 2 May. Thereafter, the minutes will be issued as an INDC report together with the progress reports of the centers as appendices.

I wish to apologize that the Minutes got so much delayed. The write-up was interrupted a few times by other duties.

I would like to thank again our hosts of the NNDC for having organized the meeting so excellently. And I would also like to thank all participants for making the meeting successful.

*J.J. Schmidt*  
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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 - 30 October 1987

Including the 20th FOUR-CENTRES MEETING of the NEUTRON DATA CENTRES  
and the 10th MEETING ON CHARGED PARTICLE NUCLEAR DATA COMPILATION

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.

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Appendices

Status reports

NNDC  
NEA-DB  
NDS  
CJD  
CAJaD  
CDFE  
RIKEN  
CNDC

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

WP3 Summary of important errors found by NDS in  
EXFOR TRANS tapes

C.L. Dunford: Summary of charged particle data collections

### 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 occurring 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	USSR 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 Reakcih (= Nuclear Structure and Nuclear Reaction Data Centre), Moscow, USSR
CDFE	- Centr Dannyx 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, Washington, 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 ...

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 .. 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...

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 ( $\alpha, n$ ) reactions on Li, Be and O for  $\alpha$ -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  $\alpha$  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 many years 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 (WNRFF) 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 feasibility 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 sparse 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  ${}^7\text{Li}$ . Dunford proposed an informal exchange between NNDC and CAJaD and suggested that Chukreev put his ( $\alpha, n$ ) 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 ( $\alpha, n$ ) 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  ${}^6, {}^7\text{Li}$  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  $\alpha$ -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 radio-nuclides; and
- organisation of an intercomparison of nuclear model code calculations for the  $^{127}\text{I}(p,xn)$  and  $^{75}\text{As}(p,xn)$  radioisotope 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  $^{27}\text{Al}$  leading to  $^{24}\text{Na}$  and  $^{22}\text{Na}$  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:

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

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 (CND) 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  $^{127}\text{I}(p,xn)$  and  $^{75}\text{As}(p,xn)$  reactions in co-operation with Marshall Blann.

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

Warsaw enquired whether PhND exist in ENDF/B-6 format. Dunford confirmed their existence. Warsaw 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 library 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  $\gamma$ -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 NNDC 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 ( $\alpha$ ,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, publication 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 between 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 <sup>view</sup>received 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 based 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

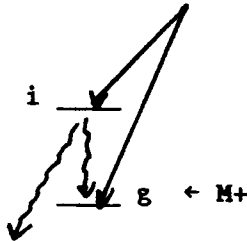
for updating the dictionary. These flags may be suitable for the low-energy data, but in the medium energy region in which more and more data are compiled now, there are many more isomers.

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 distribution 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 foreseeable 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 recommended 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, $\alpha$ ) 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<sup>235</sup> and U<sup>236</sup> 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 ( $\alpha$ ,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,  $\alpha$  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 ( $\gamma$ ,n) on D, Be, Zr, Na and, recently, ( $\gamma$ ,f). Related reports should be sent to NDS. See action 54.
- 7.2 S. Warsaw 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 up-to-date.
- 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        ALL        Prepare and circulate a list of scientific meetings in their respective areas during 1988 and 1989.  
(61)
- 1.3        NDS        Co-ordinate the lists of scientific meetings and circulate revised copy to all centers.  
(62)

### 2. CINDA book

- 2.1        NNDC        Reminder: to contribute to CINDA text pages, in particular:  
(20)       NEA-DB       a) to send coverage cutoff dates for literature listed under  
             CJD        "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        NDS        Provide a revised publication schedule for the "archival issue" with revised cost estimates.  
(63)
- 2.3        NDS        Decide whether to include covariance information in the introduction, when preparing CINDA-88 book.  
(79)

3. CINDA file

- 3.1 ALL To check target nuclei entered in CINDA against EXFOR Dict. (17) 27, and to submit new nuclides for inclusion before transmission of the corresponding entries to other centers.
- 3.2 CJD To make sure that mail delays are minimized. Full-scale (18) 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 ALL To ensure that the coding of index lines to non-EXFOR data (19) libraries is complete and up-to-date until CINDA-88.
- 3.4 NDS To continue work towards full responsibility of CJD for the (21) area 4 CINDA subfile.
- 3.5 CJD To plan another visit of staff to Vienna for cleanup of the (22) area 4 subfile and work on action 21.
- 3.6 NDS To continue to send to CJD: (23) - fast feedback on their CINDA entries  
- CINDA checking codes and updates  
- CINDA file (in agreed schedule)
- 3.7 NNDC To send to CJD from now on also all area 4 entries in reader (24) NEA-DB format prepared by NDS, NNDC or NEA-DB, and update the area 4 NDS subfile only with entries received from CJD.
- 3.8 ALL Provide comments on new version of the CINDA manual to NEA-DB (78) by January 2, 1988.
- 3.9 NEA-DB Update the CINDA manual using the conclusions of this (80) meeting.
- 3.10 ALL Send CINDA transmissions at least four times per year. (81)

4. Joint CINDA/EXFOR matters

- 4.1 ALL To contribute to the cleanup of Dictionary 3 (institutes) (2) 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 NDS To write a Lexfor entry on the special treatment in EXFOR of (5) Chinese and other South-East Asian names.
- 4.3 ALL To bring EXFOR index lines in CINDA up-to-date with high (25) priority, because CINDA is used in NNDC and elsewhere as an EXFOR index.



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

5. EXFOR

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

- 5.13 NNDC Remove Dearnaley and Marcinkowski from list of participating  
(30) centers.
- 5.14 NNDC Correct Prof. Seeliger's name.  
(31)
- 5.15 NNDC Change name of head of CDFE to Vladimir Varlamov.  
(32)
- 5.16 NNDC Propose the LEXFOR entry for the approved spin-spin cross  
(35) section.
- 5.17 CAJaD Inquire whether CDFE really needs partial cross section entry  
(38) in EXFOR. If item is required, more information is  
necessary.
- 5.18 ALL Make concentrated effort to correct and retransmit those  
(39) EXFOR entries for which retransmission had been requested.
- 5.19 ALL Whenever possible, update checking codes.  
(40)
- 5.20 ALL If an error occurs on retransmission, which should have been  
(41) caught by the checking program, inform the transmitting  
center.
- 5.21 NDS Benchmark the checking programs using PL1 and Fortran  
(42) compilers and report on the intercomparisons.
- 5.22 NDS Remove A flags for short-lived isomers from dictionary 27.  
(85)
- 5.23 ALL Update check programs according to action 85.  
(86)
- 5.24 NNDC To send to CAJaD prior to January 31, 1988 examples of  
(87) and difficult coding cases dealing with short-lived isomers.  
other  
interested  
centers
- 5.25 CAJaD To draft memo with a proposal for coding of short-lived  
(88) 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 NNDC To retransmit that entry from TRANS-C004 where Na-22 and C-12  
(13) were inverted.
- 6.2 NDS Investigate whether the Study Group in Japan wishes to  
(27) continue as an active cooperating center.
- 6.3 CAJaD Send to other centers proton beam monitor reaction data on  
(33) copper and carbon.
- 6.4 CAJaD Inform V.V. Ezhela about the efforts of Siciliano of LASL on  
(43) medium energy CPND compilation.
- 6.5 ALL In the interests of coordination and to avoid overlap in CPND  
(44) compilation, notify CAJaD by telex of any data sets being compiled.
- 6.6 CAJaD Investigate the possibility of compiling their evaluated CPND  
(45) in ENDF-6 format.
- 6.7 CAJaD Investigate the potential problems in getting checking codes  
(46) for data written in ENDF-6 format operational on their computer.
- 6.8 NNDC Send to all centers an example of CPND coded in ENDF-6  
(47) format (proton reactions on iron) along with documentation.
- 6.9 CNDC Check with CAJaD about their (p,n) and ( $\alpha$ ,n) data sets to  
(48) avoid overlap in the CPND compilation effort.
- 6.10 NNDC Increase the distribution to NDS of the next ICPND  
(51) bibliography (April 1988) to 130 copies.
- 6.11 CAJaD Prepare a memo on their proposal to code stopping power  
(52) information within CPND entries.
- 6.12 CNDC Provide comments on any potential problems in the compilation  
(53) of stopping power data in EXFOR format.
- 6.13 CNDC Provide NDS with a copy of their internal report on the  
(54) photonuclear and photofission data that they have compiled.
- 6.14 CNDC Consider the possibility of converting their photonuclear and  
(55) photofission data into the EXFOR format.
- 6.15 CAJaD Send available CPND for Al, Cu and Zn to RIKEN as soon as  
(64) possible after this NRDC meeting.
- 6.16 RIKEN Compile in EXFOR format and evaluate, in cooperation with  
(65) 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 Transmit new CPND compiled in EXFOR format to other data centers.  
CAJaD  
NNDC
- 6.19 (68) RIKEN Compile in EXFOR format and evaluate excitation functions for all CP production reactions for the following of the most common radioisotopes:  
CAJaD  
 $^{11}\text{C}$ (RIKEN + CAJaD),  $^{13}\text{N}$ (RIKEN),  $^{15}\text{O}$ (RIKEN + CAJaD(?)),  $^{18}\text{F}$ (RIKEN + CAJaD(?)),  $^{67}\text{Ga}$ (RIKEN),  $^{111}\text{In}$ (RIKEN),  $^{123}\text{I}$ (RIKEN), and  $^{201}\text{Tl}$ (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  $^{15}\text{O}$  and  $^{18}\text{F}$ .
- 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 Inform CAJaD as coordination center for CPND compilation (CNDC) 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.  
RIKEN
- 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  $^{127}\text{I}(p,xn)$  and  $^{75}\text{As}(p,xn)$  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 CAJaD To retransmit entry A0177 avoiding three-digit multiplicity  
(1) factors in REACTION subfield 3, by using the formalism of variable number of product nucleos.

### 7. Photonuclear data

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

### 8. Neutron nuclear data

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

9. Evaluated neutron nuclear data

- 9.1 NDS To distribute, at regular intervals, tape copies of IAEA-NDS-  
(14) 70, the Z-S-A index to evaluated data libraries.
- 9.2 NEA-DB To distribute the new JENDL-2 FP library.  
(15)
- 9.3 NEA-DB If existing, to provide (or quote the reference of) the  
(16) documentation for JENDL-2 evaluations, including the FP  
library.
- 9.4 ALL Inform customers about the availability of the ENDF/B-6  
(59) standards file and request that any comments on the file be  
transmitted back to NNDC.
- 9.5 NNDC On a selected basis, use the computer programs developed for  
(60) 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 NNDC 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 NNDC 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 distribution would be given.

10. Computer codes

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