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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

REPORT OF THE NUCLEAR DATA SECTION TO THE INTERNATIONAL NUCLEAR DATA COMMITTEE MARCH 1986 TO AUGUST 1987

A. Lorenz, Editor

September 1987

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

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Abstract

This progress report of the IAEA Nuclear Data Section covers the 18-months period March 1986 to August 1987. It describes past, current and planned activities of the Section and presents the status of its nuclear data centre services and technology transfer.

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List of Abbreviations

A+M	Atomic and molecular
ADABAS	Data base management system in use at IAEA
CAJaD	Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions of the USSR State Committee on the Utilization of Atomic Energy, located at the Kurchatov Institute
CBNM	Central Bureau for Nuclear Measurements, located at Geel, Belgium
CCDN	Centre de Compilation de Donnees Neutroniques, same as NDCC Neutron Data Compilation Centre of the OECD Nuclear Energy Agency at Saclay near Paris; now part of NEA Data Bank
CDFE	Centre for Photonuclear Experiments Data, Institute of Nuclear Physics of the Moscow State University
CIAMDA	Computerized Index to Literature on Atomic and Molecular Collision Data Relevant to Fusion Research
CINDA	Computerized Index of Neutron Data, a specialized bibliography and data index on neutron nuclear data compiled jointly by NNCSC, NDCC, NDS and CJD
CINDU	A Catalogue of Numerical Nuclear Data Libraries available from NDS
CJD	Centr po Jadernym Dannym, the USSR Nuclear Data Centre at F.E.I. Obninsk
CODATA	Committee on Data for Science and Technology
CODEN	International code for the abbreviation of periodical titles used by ASTM, INIS and Chemical Abstracts
CPL	Computer Programme Library operated by NEA, and located at Ispra, Italy; now part of NEA Data Bank
CPND	Charged Particle Nuclear Reaction Data
CRP	Coordinated Research Programme
CSISRS	NNCSC' internal system for handling experimental data; the previous system was known as SCISRS
DASTAR	Data Storage and Retrieval System used originally at IAEA/NDS
DBMS	Data Base Management System
EBCDIC	Extended Binary-Coded Decimal Interchange Code
EGAS	European Group for Atomic Spectroscopy

ENDF/B	Evaluated Nuclear Data File of the United States
ENSDF	Computer-based Evaluated Nuclear Structure Data File developed by US/NDP
EWGRD	European Working Group on Reactor Dosimetry
ESCAMPIG	Europhysics Study Conference on Atomic and Molecular Physics in Ionized Gases
EXFOR	Exchange Format, initially developed for the international exchange of neutron nuclear data, now being extended to charged particle nuclear data
FIZ	Fachinformationszentrum Energie, Physik, Mathematik GesmbH located at the Kernforschungszentrum Karlsruhe in the Federal Republic of Germany
FPND	Fission Product Nuclear Data
IAEA/NDS	Nuclear Data Section of the International Atomic Energy Agency, also NDS
ICPEAC	International Conference on the Physics of Electronic and Atomic Collisions
ICTP	International Centre for Theoretical Physics
IFRC	International Fusion Research Council
INDC	International Nuclear Data Committee
INDL/A	IAEA Nuclear Data Library for Evaluated Neutron Reaction Data of Actinides
INIS	International Nuclear Information System, a bibliographic system operated by the IAEA
IRDF	International Reactor Dosimetry File
IWGRRM	International Working Group on Reactor Radiation Measurements
JILA	Joint Institute for Laboratory Astrophysics
JINR	Joint Institute for Nuclear Research in Dubna, USSR
KACHAPAG	Karlsruhe Charged Particle Group
KEDAK	Karlsruhe Evaluated Neutron Data File
LIYaF	Leningrad Institut Yadernoy Fiziki: Leningrad Nuclear Physics Institute of the USSR Academy of Sciences
NDCC	Neutron Data Compilation Centre (Centre de Compilation de Donnees Neutroniques - CCDN) of the OECD Nuclear Energy Agency at Saclay near Paris; now part of NEA Data Bank

NDP	Nuclear Data Project located at the Oak Ridge National Laboratory (also referred to as US/NDP)
NDS	IAEA Nuclear Data Section, Vienna
NEA	Nuclear Energy Agency of the OECD
NEA/DB	Nuclear Energy Agency of the OECD Data Bank (previously NDCC)
NEACRP	Committee on Reactor Physics of the Nuclear Energy Agency of the OECD
NEANDC	Nuclear Data Committee of the Nuclear Energy Agency of the OECD
NNCSC	US National Neutron Cross Section Centre at the Brookhaven National Laboratory, Upton, N.Y. (now NNDC)
NND	Neutron Nuclear Reaction Data
NNDC	National Nuclear Data Centre of the United States
NRDC	Nuclear Reaction Data Centres
NSDD	NSD data = Nuclear Structure and Decay Data
OECD	Organization for Economic Cooperation and Development
RCN	Now ECN = Energy Research Foundation at Petten in the Netherlands
RIKEN	Institute of Physical and Chemical Research, Saitama, near Tokyo, Japan
SCISRS	Sigma Centre Information Storage and Retrieval System
SOKRATOR	Soviet Evaluated Neutron Data File Format
TND	Transactinium Isotope Nuclear Data
UKNDL	UK Nuclear Data Library
WRENDA	World Request List for Nuclear Data published by the IAEA
ZAED	Zentralstelle fuer Atomkernenergie-Dokumentation: Nuclear documentation and information centre for the Federal Republic of Germany; now FIZ

Programme Summary

J.J. Schmidt
Head, IAEA Nuclear Data Section (NDS)

This progress report on the activities and services of the IAEA Nuclear Data Section covers the eighteen months period from March 1986 to August 1987.

During this reporting period, Vladimir Piksaikin returned to his home institute FEI Obninsk in January 1987. In order to comply with an urgent requirement to strengthen the Section's current activities in numerical atomic and molecular (A+M) data for plasma and fusion research, the job description of Mr. Piksaikin's post was changed to that of a P-4 grade atomic physicist, and subsequently filled by Professor R. Janev from the Institute of Physics in Belgrade, an internationally renouned expert in A+M physics and data and their applications in plasma and fusion research. He will start his assignment with the Agency in September 1987. End of July 1987, Red Cullen, head of the Section's Data Processing and Programming Unit, left the Agency. Since during his stay with NDS the development of major programming systems needed by NDS could be finalized, it was possible to redefine the responsibilities of this post in terms of a P-4 physicist with main responsibilities in the areas of nuclear data applications and technology transfer. The post is currently advertised. In August 1987 Mr. Madhu K. Mehta rejoined the Agency for a one-year appointment in the capacity of resident expert; he will assist NDS in the implementation of its technical co-operation (TC) projects.

Highlights of the Section's accomplishments during the reporting period were extensive developments of program systems for numerical data processing, continuation of work on handbooks and specialized data files, the initial development of an international file of recommended numerical atomic and molecular (A+M) data for fusion, the successful conduct of two Interregional Nuclear Data Training Courses in India and in the USSR, the start of several new coordinated research programmes related to nuclear data requirements for measurement standardisation, fusion and radiotherapy, the beginning of a new multiyear Technical Co-operation (TC) Interregional Project (TC/INT/1/039) in Training in Nuclear Measurement Techniques, and increased co-operation with the Physics and other Sections of the Agency in the coordination and implementation of TC projects.

Production and publication of data handbooks and of specialized data files continued to receive major emphasis. The handbook on "Nuclear Activation Data" has been published in the IAEA Technical Report Series No. 273 in April 1987; it contains comprehensive recommended sets of nuclear data needed in neutron, charged particle and photonuclear activation analysis and includes an extensive chapter on relevant standard reference data. The second issue of the Computerized Index of Atomic and Molecular Collision Data Relevant to Fusion Research, CIAMDA 87, was published in the beginning of 1987; CIAMDA 87 covers all literature on A+M collision data relevant to fusion research published between the middle of 1979, the cut-off date of CIAMDA 80, and August 1986.

A draft version of the handbook on "Nuclear Data for Safeguards" is currently being prepared and will be ready for distribution in October 1987. As a result of the IAEA/NDS Consultants' Meeting on Data Requirements for Medical Radioisotope Production held in Tokyo in April 1987, a handbook on "Nuclear Data for Medical Radioisotope Production" is planned with an emphasis on evaluated cross section data for the production of some of the most important medical radioisotopes and for monitoring accelerator beam energy and intensity measurements. Following an IAEA/NDS Specialists' Meeting on Nuclear Data for Geophysics in April 1986, the data scope of a handbook on microscopic nuclear data for specific use in nuclear geology and an associated computerized data base has been defined and the compilation of existing data started.

Increasing emphasis is being placed on the development of international nuclear and atomic data files for fusion prompted in particular by the income of the new quadripartite International Thermonuclear Experimental Reactor (ITER) project between the US, USSR, Japan and the Commission of the European Communities. The IAEA/NDS Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology, held in Gaussig, GDR, in December 1986, developed the scope and organizational procedures for the updating of the International Nuclear Data Library for Fusion, INDL/F-83. Until the release of some of the main national and regional data files currently under development and the potential start of true international co-operation in evaluation, the updating will essentially consist in collecting and selecting up-to-date data files for individual materials and their validation by comparison with benchmark measurements. First efforts in this direction have been started. In the field of A+M data for fusion, highest priority is being put on the build-up of an international data base of recommended numerical A+M collision data, and on the development of computer programs necessary for the direct production of publishable data tables, graphs, analytical fits and annotations as needed by plasma and fusion physicists. Meetings on Atomic Data for Fusion Plasma Modelling in September 1985 and on A+M Data for Plasma Edge Studies in July 1987 were convened with the aim to define recommended data for crucial aspects of plasma research and modelling for input into the international file.

The proceedings of the IAEA/NDS Advisory Group Meeting on Neutron Source Properties held in Leningrad in June 1986, published as IAEA-TECDOC-410 in March 1987, and the supplement of the Debrecen Meeting on the same topic in 1980 (INDC(NDS)-114) represent currently the most comprehensive sources of data information on neutron source properties (except for reactor neutron sources). At a Specialists' Meeting on the Analysis of the REAL-84 Intercomparison Exercise, held in Jackson Hole, USA, in May 1987, the results of the previous REAL-84 project were reviewed and the foundations laid for the improvement of input neutron spectra, cross section data and their covariances in the frame of a follow-up intercomparison project called REAL-88. Specialists convened at a Meeting on Covariance Methods and Practices in the Field of Nuclear Data held in Rome in November 1986, in co-operation with NEA/OECD, worked out a list of covariance information needs for fusion-related neutron dosimetry, fission reactor core physics applications as well as for power reactor surveillance programmes and determined the error input from experimentalists into the international EXFOR file needed for the computation of meaningful covariance data in evaluated data files.

During the reporting period the following five new Coordinated Research Programmes (CRP) were started. The CRP on the "Measurement and Analysis of (p,n) and (α,n) Reaction Cross Sections and Neutron Emission Spectra" is designed to extend the knowledge of the energy dependence of nuclear level densities for

use in basic and applied nuclear physics related problems. Another complementary CRP on the "Methods for the Calculation of Fast Neutron Nuclear Data of Structural Materials" is devoted to the development and intercomparison of theoretical methods for the prediction of fast neutron nuclear data for the most common structural materials of fusion and fission reactors and their testing on accurate experimental data. The first research coordination meetings (RCM) held in 1986 defined the detailed scope of work to be performed by the participants in these CRPs. The previous "14 MeV CRP" which has been terminated in 1986 is being followed up by a more specialized CRP on the "Measurement and Analysis of Fast Neutron-induced Double-differential Neutron Emission Cross Sections (DDCS) and (n,n'x) Cross Sections". The first part of this CRP, which will be mainly directed towards improving the data base for fusion reactor neutronics calculations, devoted to DDCS data has already been started; implementation of the second part, to be devoted to specific activation cross sections, will depend on the outcome of a review of status and requirements of the several 1000 activation reactions of potential importance in fusion reactors to be performed before and at the 16th INDC Meeting in October 1987. Another CRP on "Gamma-ray Standards for Detector Efficiency Calibration" which was started with a first RCM held in Rome in June 1987 has the objective to produce a universally accepted set of decay data for the efficiency calibration of gamma-ray detectors. On the basis of the findings of the IAEA/NDS Advisory Group Meeting on Nuclear and Atomic Data for Medical Radiotherapy and Related Radiobiology, held at TNO Rijswijk, the Netherlands, in September 1985, another CRP on "Nuclear Data Needed for Nuclear Particle Therapy" is currently being started with the aim to remove major gaps and inconsistencies in neutron cross section data mainly for tissue materials for neutron energies between 20 and 100 MeV needed for neutron radiotherapy and for Kerma and neutron transport calculations in phantom and real tissues. All of these new CRPs were thoroughly discussed and endorsed by the INDC at its 15th Meeting in June 1986.

The data centre coordination has been continued on a regular basis with data centre meetings convened in June 1986 (NSDD), September 1986 (A+MD) and October 1986 (NRD). The new decentralized system for input to the Agency's CINDA publication has turned out to work satisfactorily. For 1988 it is proposed to publish a new archival issue of CINDA covering the entire period 1935-1986. The neutron data EXFOR generation is now routine; completeness of compilation, however, in certain important data categories such as neutron-induced gamma spectra and higher energy neutron data is hampered by staff shortage. For nuclear structure and decay data, a considerable increase in the number of mass chains submitted for publication has been realized bringing the production close to the desired six-year update cycle.

In the area of system programming, the most important and significant developments are the completion and documentation of ENDF/B processing codes for versions up to ENDF-6, and of codes for the conversion of EXFOR data to computation format and for plotting ENDF and/or EXFOR data in this computation format; these codes written for the Agency's main frame computer have also been adapted to run on personal computers IBM PC-AT. These codes can handle a large variety of nuclear and atomic data types and have thus found immediate extensive utilization both within NDS and among its outside customers.

In the frame of the Section's transfer activities, two successful Interregional Training Courses, funded by the Agency's Technical Co-operation (TC) programme, were held in the reporting period, one on the "Preparation of Nuclear Data for Use in Reactor Calculations" at the Bhabha Atomic Research Centre, Bombay, India, in April 1986, and another one on "Neutron Physics and Nuclear Data Measurements with Accelerators and Research Reactors" in Riga, Leningrad and other places in the USSR.

In worksharing with the Physics Section, NDS is currently responsible for the implementation of eight national multiyear TC projects dealing with the introduction of nuclear science and nuclear analytical techniques in seven countries (Cameroon, Côte d'Ivoire, Ghana, Kenya, Nigeria, Sudan and Zambia). Two other TC projects concern the establishment of computer-based nuclear data libraries and associated computer codes at the major atomic energy institutions in China and Indonesia.

As a follow-up of the TC Interregional Project INT/1/018 on "Nuclear Data Techniques and Instrumentation" which was terminated at the end of 1986, a new TC Interregional Project INT/1/039 on "Training in Nuclear Measurement Techniques" has been started in 1987. The new project emphasizes training in applied nuclear physics on a broader and simultaneously more elementary level, covering the most commonly used nuclear physical measurement techniques for applications in nuclear science and technology. It addresses itself to a larger range of nuclear laboratories in developing countries with no nuclear power programme, including especially less developed and beginning laboratories, most of them established with the assistance of national IAEA TC projects. On a short term, this project is designed to promote training of nuclear scientists in the basic physics techniques of quantitative nuclear measurements. On a long term it should strengthen the scientific manpower pools from which personnel for employment in national nuclear science and technology programmes can be drawn.

A. INDC SECRETARIAT

A.1. Liaison Officers of the INDC

No changes in the membership of INDC Liaison Officers were recorded during this reporting period.

The current list of INDC Liaison Officers, comprising scientists from 46 Member States, is given in Appendix A.

A.2. List of INDC Correspondents and National Nuclear Data Committees

The current list of INDC correspondents for the exchange of nuclear data information is planned to be issued in July 1987. The report also contains the information on National Nuclear Data Committees which had been published separately in the past. This combined report will be published as INDC(SEC)-093/UN.

A.3. List of INDC Documents

The current list of INDC Documents received and distributed by the INDC Secretariat is to be published in July 1987 as report INDC(SEC)-094/UN. In an effort to help reduce the publication load of the Nuclear Data Section, the content of the List of INDC Documents has been reduced to include reports which have been published in the course of the preceeding two years, instead of the preceeding five years which were included in previous issues of this report.

A.4. Translation of Documents

Subject to available funds, the IAEA translates a limited number of INDC reports submitted. During 1985 and 1986, 28 nuclear data reports have been translated from Russian, Portuguese and Chinese, and distributed as INDC reports. Their full titles are given in the List of INDC Documents, INDC(SEC)-094/UN.

B. DATA ASSESSMENT AND RESEARCH COORDINATION

B.1. Data Status and Requirements

B.1.1. Status and Requirements for Neutron Source Data

Six years after the IAEA Consultants' Meeting on Neutron Source Properties, held in Debrecen, Hungary, 17-21 March 1980, the IAEA Nuclear Data Section, with endorsement by the International Nuclear Data Committee (INDC), held an Advisory Group Meeting on the same topic during the week 9-13 June 1986 in Leningrad, in co-operation with the Radium Khlopin Institute, Leningrad, USSR, which hosted the meeting.

The meeting was attended by 31 non-Soviet scientists and 35 Soviet scientists. Fourteen Agency Member States and three international organizations were represented. Twenty-four invited and twenty-eight contributed papers were presented. The meeting was chaired by A.B. Smith.

During the last two days of the meeting the participants split into the following Workshops:

- Cf-252 Fission-neutron Spectrum (chaired by J.W. Boldeman)
- Monoenergetic Neutron Sources (chaired by M. Drosg)
- White Neutron Sources and Fields (chaired by C.D. Bowman)
- 14-MeV Neutron Sources and Associated Equipment (chaired by H.K. Vonach).

The proceedings were issued as IAEA-TECDOC-410 (March 1987) which include the Chairman's introduction and summarizing remarks, all invited papers prepared specifically for this meeting, contributed papers, as well as the conclusions and recommendations of the Workshops.

This IAEA meeting is expected to be the last to deal with this broad topic and there is no doubt that the proceedings together with the issue of the Supplement of the Debrecen Meeting in 1980 [INDC(NDS)-114] will be the best available sources of information covering neutron source properties (except for reactor neutron sources).

B.1.2. Nuclear Data Correlations and Covariances

A Specialists' meeting on Covariance Methods and Practices in the Field of Nuclear Data was held in Rome, on 17-19 November 1986, in cooperation with NEA/OECD. The meeting was attended by fifteen specialists from seven countries and three international organizations.

The objectives of the meeting were to review the status of contemporary covariance information for standard reference neutron fields and evaluated nuclear data files, as well as to discuss the methodologies used for generating covariance data from experimental information, and to review existing and planned computer codes for processing covariance data into multigroup structure form.

The main topics of the meeting were:

- covariance data related to evaluated nuclear files and standard neutron fields,

- methodologies used for generating covariance data on the basis of experimental information,

- methodologies and computer codes involved in processing ENDF format uncertainty data into multigroup covariance matrices.

The current status of the covariance information was presented in 15 papers and discussed in workshop sessions. As outcome of the discussions during the workshop the participants of the meeting worked out the list of covariance information needs in the field of fusion dosimetry, core physics applications for fast, thermal and intermediate spectrum reactors, as well as for power reactor surveillance programmes. Special attention was drawn to the information needed from experimentalists in order to be able to generate the covariances needed for evaluations. It was pointed out

that the EXFOR system and EXFOR nuclear data library (maintained by the IAEA Nuclear Data Section) could play an important role in accumulating such information.

The final report of this meeting will be published as INDC(NDS)-192.

B.1.3. Nuclear Data for Fusion Reactor Technology

Following recommendations by the International Nuclear Data Committee (INDC) and the International Fusion Research Council, the Nuclear Data Section convened an Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology in co-operation with the Technical University Dresden, German Democratic Republic, 1-5 December 1986. The general aim of this meeting was to review changes in the requirements and status of nuclear data for fusion reactor technology since the first meeting on the same topic which the Agency held in 1978.

The meeting's Working Groups discussed the following subjects:

- Nuclear data requirements and status of available nuclear data for integral calculations for blanket, shielding and activation problems,

- status of differential data, theory and possibilities to meeting data needs,

- organizational principles for updating of the International Nuclear Data Library for Fusion, and the

- beginning of the international comparison of benchmark measurements and calculations.

Conclusions and recommendations of the working groups are summarized in paper INDC/P(87)-3. The proceedings of the meeting will be published in 1987 in the form of a TECDOC report.

B.1.4. Data Requirements for Medical Radioisotope Production

In view of the significant developments in the production of medical radioisotopes and their wide usage in the world, the IAEA Nuclear Data Section, with endorsement by the International Nuclear Data Committee (INDC), and in co-operation with the Institute of Physical and Chemical Research (RIKEN), as host, held a Consultants' Meeting on Data Requirements for Medical Radioisotope Production during the week 20-24 April 1987 in Tokyo, Japan.

The objectives of the meeting were as follows:

- to produce a survey of the medical radioisotopes (RI) in use and their production methods,

- to optimize the production methods by recommending suitable nuclear reactions(s) and optimum energy range(s) of production, methods of calculation of the expected production yields, and the estimation of level of radioactive impurities,

- to identify experimental gaps which can only be closed by theoretical calculations, and list reliable and generally available computer codes suitable for the calculation of excitation functions of radioisotopes, and describe their present status and limitations,

- to consider the standard monitor reactions for the production of radioisotopes for medical use,

- to enquire into the availability of the appropriate target material (most time should be devoted to accelerator produced RI and only a short time for reactor produced RI),

- to develop guidelines and priorities for the compilation of available excitation functions including a list of scientists to be contacted, and

- to prepare an outline of the planned IAEA Handbook/Computer File for "Data for Medical Radioisotope Production" (list of content, authors, etc.).

The most important recommendation from this Meeting was to compile and evaluate charged particle reactions for monitoring of beam energy and intensity measurements (see C.2.2.c). While the summary report is included in INDC/P(87)-4, the proceedings are to be issued as INDC report INDC(NDS)-194.

B.1.5. Analysis of the REAL-84 Intercomparison Exercise

The Nuclear Data Section convened a Specialists' Meeting on the "Analysis of the REAL-84 Intercomparison Exercise", from 27-29 May 1987 in connection with the 6th ASTM-EURATOM Symposium on Reactor Dosimetry, Jackson Hole, Wyoming, USA (31 May to 5 June 1987).

The objective of that meeting was to review the results of the interlaboratory REAL-84 exercise (see INDC(NDS)-190/GFR (1987)) compiled by the IAEA Consultants' meeting held in Budapest, Hungary (September 1986). The final report of this meeting will include a description of the problems encountered in the course of the exercise connected with input neutron spectra, cross section data, their covariances, etc., as well as the situation with respect to recommendations and actions agreed upon in Budapest, and a discussion of the follow-up REAL-88 programme.

B.1.6. Atomic Data Needed in Radiation Research and Biomedical Applications

An IAEA Specialists' meeting on Atomic and Molecular Data Needed in Radiation Research and Application is planned to be held during the 8th International Congress of Radiation Research (ICRR), Edinburgh, UK, 19-24 July 1987. This meeting is concerned specifically with interactions of nuclear particles with atoms and molecules, production of secondary electrons, energy spectra and spatial distributions of electrons, as well as basic radiation - physics quantitites, such as stopping powers and ionization fields.

The objectives of the meeting are:

- to define the processes taking place in the interaction of electrons with molecules over the range of kinetic energies from tens of keV down to a few eV,

- to investigate the importance and the necessity of basic quantities such as stopping powers of materials for various particles, yield of ions and excited states, as well as electron slowing-down spectra,

- to propose the development of theories to assess the correctness of cross section data and foster the theoretical work useful for data validation, extrapolation, and interpolation, and

- to develop the scope of a new CRP on atomic and molecular data needed in radiation research and applications.

B.1.7. Evaluation of Fission Yield Data

An IAEA Specialists' Meeting on Fission Yield Evaluation is planned to be held on 11-15 September at Studsvik, Sweden, following the NEA/OECD Specialists' Meeting on Data for Decay Heat Calculation held at the same location on 7-10 September.

The meeting will discuss the present situation in fission yield compilation and evaluation work and possibilities for an international cooperation in the future (including common data base, format for experimental data, partial evaluations). Deficiencies in presently available data will be assessed, and the value and scope of an IAEA Coordinated Research Project will be discussed.

B.1.8. Influence of Target and Sample Properties on Nuclear Data Measurements

A Specialists' Meeting on the Influence of Target and Sample Properties on Nuclear Data Measurements is planned to be held at CBNM, Geel, in Belgium on 21-24 September 1987, in co-operation with the Central Bureau of Nuclear Measurements (CBNM) and the International Nuclear Target Development Society (INTDS).

The primary objective of this meeting is to discuss the organization of the planned joint INTDS/IAEA Advisory Group Meeting to be held concurrently with the 1988 INTDS Conference at Darmstadt, Federal Republic of Germany, 5-9 September 1988. That meeting will address a number of issues regarding the purity, self-support, uniformity and durability of targets and samples used in nuclear measurements.

B.1.9. Nuclear Theory for Fast Neutron Nuclear Data Evaluation

Fusion reactor research and nuclear fission technology application programmes are being actively pursued in a number of IAEA Member States. For design, operation and safety calculations performed in the framework of these programmes complete sets of evaluated fast neutron nuclear data are required. Applied nuclear reaction theory and nuclear model calculations are needed to complement the available experimental data and to check their mutual consistency.

Recognizing these requirements, the International Nuclear Data Committee recommended that the IAEA Nuclear Data Section convene an Advisory Group Meeting on Nuclear Theory for Fast Neutron Nuclear Data Evaluation in 1987. This meeting has been planned to be convened in co-operation with the Institute of Atomic Energy, Beijing, in Beijing, People's Republic of China, from 12 to 16 October 1987.

Compared with other more fundamental research oriented nuclear theory meetings, the special emphasis of this meeting will be placed on applied nuclear theory and nuclear models used for fast neutron nuclear data computations.

B.1.10. Nuclear Data for Calculations of Reactivity Coefficients

An Advisory Group Meeting is scheduled to take place in Vienna, 7-11 December 1987. The objectives of this meeting will be:

- to review the accuracy requirements for, and current status of, predictions of reactivity coefficiencts for the different types of thermal reactors, including those types under development,

- to report measurements made on reactors and experimental facilities which can be used to validate the methods and data used to predict reactivity coefficients and to refine the nuclear data in the thermal energy region,

- to describe the nuclear data adjustments which can be deduced from these measurements and the uniqueness and accuracy of the adjustments (relative, for example, to ENDF/B-V),

- to review the status of nuclear data for the thermal and low energy resonance regions, for the primary actinides, taking into account the results of recent measurements and evaluations,

- to review the sensitivity of calculated reactivity coefficients to the choice of thermal scattering data and to assess the uncertainties arising from uncertainties in thermal scattering data, and

- to draw conclusions about the current accuracy of reactivity coefficient predictions and itemise further work needed.

The proceedings of this meeting are planned to be published in an IAEA-TECDOC in 1988.

B.2. Coordinated Research Programmes (CRP)

B.2.1. Measurement and Analysis of (p,n) and (α,n) Reaction Cross Sections and Neutron Emission Spectra

The first Research Co-ordination Meeting of the participants in the CRP on the Measurement and Analysis of Double-Differential Neutron Emission Spectra in (p,n) and (α,n) Reactions was convened by the IAEA Nuclear Data Section at IAEA Headquarters in Vienna during 23-27 June 1986.

The main objectives of this Co-ordinated Research Programme are:

- to extract systematic information about nuclear level densities as function of excitation energy by analysing the neutron emission spectra from (p,n) and (α,n) reactions on properly selected targets and bombarding energy range, and

- to parameterise this information into appropriate phenomenological models to enable reliable extrapolation for general use of level density information in basic and applied nuclear physics related problems.

The principal objectives of this first RCM were to report and discuss the work done at the participant laboratories related to the above objectives and to specify the detailed scope and programme of measurement and analysis to be carried out under this co-ordinated research programme. The summary report of this meeting was published in INDC(NDS)-185.

The next RCM in the frame of this CRP is planned to be convened in Vienna from 15-17 February 1988 in conjunction with the RCM of the CRP "Methods for the Calculation of Fast Neutron Nuclear Data of Structural Materials".

B.2.2. Methods for the Calculation of Fast Neutron Nuclear Data of Structural Materials

The IAEA Coordinated Research Programme on the "Methods for the Calculation of Fast Neutron Nuclear Data of Structural Materials" includes at the moment the participation of sixteen laboratories. The first RCM of this CRP was convened in Bologna, Italy, in co-operation with the Centro di Calcolo del ENEA, 7-10 October 1986. The summary report of this meeting is given in INDC(NDS)-193 (November 1987).

The main objectives of the meeting were the following:

- to review the status of the activities related to the CRP;
- to discuss and intercompare the various calculation methods used; and
- to summarize the results of these intercomparisons, to assess the reliability of the calculational methods and to select those best suited for use in calculations of neutron cross sections of structural materials of fission and fusion reactors.

The next RCM in the frame of the CRP is planned to be convened in Vienna from 15-17 February 1988 in conjunction with the RCM of the CRP "Measurements and Analysis of (p,n) and (α,n) Reaction Cross Sections and Neutron Emission Spectra".

B.2.3. Measurement and Analysis of 14 MeV Neutron-induced Double-differential Neutron Emission Cross Sections and (n,n'x) Cross Sections

The scope of this CRP will be limited to the measurement of double-differential neutron emission spectra, (n,n'p) and (n,n'α) reaction cross sections, and cross sections for the production of nuclear isomers under fast neutron bombardment of elements of special importance in fusion reactor technology. These measurements should be carried out at 14 MeV neutron energy but those laboratories which have appropriate facilities should do measurements at lower neutron energies, especially in the energy region of 8-12 MeV. The scope should also include theoretical analysis of the measured double-differential data.

The output from the CRP would be:

a) Double-differential neutron emission spectra data needed for blanket calculations in fusion reactor technology and for the development and verification of theoretical models to predict required neutron cross sections.

b) Cross sections for (n,n'p) and (n,n'α) reactions and for isomer production for fast neutron energies for materials of importance in nuclear technology as well as for the development of appropriate theoretical models for the prediction of fast neutron cross sections.

The scope and implementation of part (b) should be decided only after a thorough review of the present status of the cross sections before and at the 16th INDC meeting in October 1987.

The first meeting of this CRP is planned to be held in Vienna, 28-30 March 1988.

B.2.4. Gamma-ray Standards for Detector Efficiency Calibration

The first meeting of this CRP took place at the E.N.E.A. Headquarters in Rome, Italy, on 11-13 June 1987. This programme is composed of nine scientists from the major nuclear standards laboratories.

In preparation for this first meeting the CRP participants have performed the following tasks:

- Made a preliminary review of the half-life status of 30 radionuclides identified as being of particular importance in the calibration of gamma-ray detectors.

- Evaluated the gamma-ray emission probabilities of the following radionuclides: Cr51, Co57, Co58, Zn65, Se75, Y88, I125, Sb125, Ba133, Cs137, Eu152, Eu155, Au198.

- Reviewed the current status of the x-ray emission probabilities of the radionuclides used for detector calibration.

The meeting made an assessment of the existing data, and set priorities for the measurement and/or evaluation of the required decay data to produce a universally accepted set of decay data for the efficiency calibration of gamma-ray detectors.

B.2.5. Nuclear Data Needed for Nuclear Particle Therapy

An Advisory Group Meeting on Nuclear and Atomic Data for Medical Radiotherapy and Related Radiobiology, held by the Agency at TNO, Rijswijk, The Netherlands, from 16-20 September 1985, identified major gaps and inconsistencies in neutron cross section data mainly for tissue materials for neutron energies between 20 and 100 MeV needed for neutron radiotherapy and for Kerma and neutron transport calculations in phantom and real tissues. The meeting participants recommended that the Agency initiate a coordinated research programme to improve the nuclear data base for neutron radiotherapy. This recommendation was thoroughly discussed and strongly supported by the International Nuclear Data Committee (INDC).

This programme aims specifically at improving the present state of nuclear data for nuclear particle therapy. The programme's scientific scope includes the following aspects:

a) Measurement and analysis of neutron data for transport calculations in phantoms including the effect of inhomogeneities.

b) Measurement and analysis of primary and secondary charged particle spectra required to determine variations of absorbed dose at interfaces.

As a result of this programme, it is expected that improved nuclear data will be produced and used in the dosimetry protocols for radiotherapy applications of nuclear particle beams as formulated by ECNEU (European Clinical Neutron Dosimetry Group) and AAPM (American Association of Physicists in Medicine).

It is planned to convene the first Research Co-ordination Meeting of this CRP in Vienna in November 1987.

C. DATA PROCESSING AND EXCHANGE

C.1. Data Centre Network Coordination

C.1.1. Nuclear Reaction Data (NRD)

C.1.1.a) Nuclear Reaction Data Centre Network

The co-ordination meetings of the network of data centers for nuclear reaction data ("NRDC Meetings") take place annually, in two cycles. Each "odd" year (1985, 1987 ...) there is a "full" NRDC Meeting hosted in turn by one of the centers, attended by technical staff and the center heads. Each "even" year (1984, 1986 ...) there is a "technical" NRDC Meeting hosted by the Agency and convened at no cost to the Agency, which is attended by technical staff only.

The "Second Technical NRDC Meeting" took place in Vienna, 7-9 October 1986. The summary record is included in INDC/P(87)-5 [same as "Memo CP-D/159"]. Eight centers were represented:

- CAJaD, Center for Nuclear Structure and Reaction Data, Moscow: charged-particle data
- CDFE, Photonuclear Data Center, Moscow (represented through CAJaD): photonuclear data
- CJD, Nuclear Data Center, Obninsk: neutron data
- CNDC, Chinese Nuclear Data Center, Beijing: charged-particle data
- NEA Data Bank: neutron data
- NNDC, National Nuclear Data Center, Brookhaven: all nuclear reaction data
- RIKEN Nuclear Data Group, Japan: charged-particle data
- NDS: all nuclear reaction data

The discussions concentrated on technical details of the EXFOR and CINDA systems, as well on compilation rules which must be updated continuously with respect to new data types to be compiled (e.g. Kerma factors), data types that may occur in various representations (e.g. gamma-production cross-sections), or with respect to increased sophistication of data processing. A number of conclusions and actions were agreed upon.

Following a recommendation by the INDC, a comparison of EXFOR output formats as provided by the different centers has been performed. User-friendly output formats (where EXFOR data are converted to uniform units) are now available at NNDC, NEA-DB and NDS.

An essential conclusion was that there continue to be important data types that have been requested for applications, that are not compiled by any of the centers due to lack of compilation manpower. This includes, among others, higher-energy neutron data and certain types of charged-particle induced neutron production data required for radiotherapy.

The next "full" meeting will take place in Brookhaven, 26-30 October 1987.

C.1.1.b) The CINDA Network

CINDA 86 and CINDA 87 have been produced according to the new decentralized scheme for CINDA compilation and file maintenance (for details see the report to the previous INDC meeting, INDC(NDS)-180/LNA). The transition did not create any major problem.

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

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

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

C.1.1.c) Neutron Data

The neutron data EXFOR operation is now routine, requiring a constant level of manpower for compilation, exchange, file maintenance, and correctness and completeness checking. Due to the limited number of staff, certain data categories, such as neutron-induced gamma spectra, higher-energy neutron data, though considered to be important, are not compiled systematically.

Evaluated neutron data are now mostly available in ENDF format, however, versions ENDF-4, ENDF-5 and, since recently, ENDF-6 are all in use. The new version of the ENDF processing codes are supposed to handle all versions of the ENDF format.

C.1.1.d) Charged-particle Nuclear Data

For charged-particle nuclear data, the main EXFOR compilation work continues to be done by CAJaD, which also co-ordinates the compilation efforts of the charged-particle data compiling centers RIKEN, CNDC, NNDC and NDS, in order to avoid inadvertent duplication of efforts.

C.1.1.e) Photonuclear Data

CDFE (Moscow) is the only active centre which compiles photonuclear data in EXFOR format, and which publishes CINDA type bibliographies. Additional EXFOR compilation of photonuclear data is expected to start in the UK.

C.1.2. Nuclear Structure and Decay Data

The seventh meeting of the International Network on Nuclear Structure and Decay Data (NSDD) Evaluators was convened by the IAEA Nuclear Data Section at the CEN Grenoble in France, from 2-5 June 1986. The meeting was attended by twenty scientists from ten Member States and one international organization, representing centres and groups concerned with the compilation, evaluation and dissemination of nuclear structure and decay (NSD) data.

The international NSDD Network, consisting presently of eighteen evaluation groups in thirteen Member States, and two international data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric mass chains on a six-year cycle, the continuous publication of these evaluated data in the Nuclear Data Sheets and Nuclear Physics A journals, and their dissemination to the scientific community. This international cooperative effort is coordinated by the Nuclear Data Section of the IAEA and the Brookhaven National Nuclear Data Centre in the U.S.

The periodic meetings of the international NSDD network have the objectives to maintain the coordination of all centres and groups participating in the compilation, evaluation and dissemination of NSDD, to maintain and improve the standards and rules governing NSDD evaluation, and to review the development and common use of the computerized systems and data bases maintained specifically for this activity.

This meeting concentrated on the following objectives:

- Consideration of network membership and mass-chain assignments; two new groups were admitted to the network: the Chinese Nuclear Data Center (PRC) and the Banaras Hindu University Group (India).

- Review of NSDD evaluation status. There has been a considerable increase in the number of mass-chains submitted for publication per year (since 1984); it is expected that 30 mass-chains will be finished during 1986. For a (desirable) six-year cycle, one needs a production of 36 mass-chains per year.

- Consideration of changes in the Nuclear Data Sheets journal publication format. The network considered proposals (submitted by BNL) to revise the published output format of mass-chain evaluations in order to reduce the number of pages per published mass-chain (i.e. more efficient use of available page space) so as to avoid increase in journal subscription price, and to improve readability of the printed output.

- Review of evaluation rules, a continuous process to improve the methodology used by mass-chain evaluators.

The final report of this meeting was published in INDC(NDS)-182/GE. The next meeting of the NSDD network is scheduled to be convened in the spring of 1988.

C.1.3. Atomic and Molecular Data for Fusion

C.1.3.a) Sixth Meeting of the A+M Data Centre Network

The sixth A+M Data Centre Network (DCN) meeting was convened by the IAEA Nuclear Data Section at IAEA Headquarters in Vienna, from 10-12 September 1986. The meeting was attended by ten representatives of data centres from four Member States concerned with the coordinated international management of atomic and molecular data pertinent to controlled fusion research and technology.

The meeting achieved the following:

- recommended that the final report of the September 1985 IAEA Advisory Group Meeting on iron data be published as a special supplement to the Nuclear Fusion journal, and that the iron data recommended by that meeting be incorporated in the internationally recommended A+M collision data file;

- decided to initiate a co-operative inter-centre project on atomic data characterizing the collisions of H, D, He atoms, molecules and their ions and electrons of importance to plasma edge effects, and to have IAEA convene a meeting on this topic in 1987;

- reviewed the final version of the CIAMDA-87 index on atomic collision data, and made a number of suggestions with regard to its publication;

- decided to change the publication frequency of the International Bulletin on A+M Data for Fusion from quarterly to semi-annually;

- agreed that the A+M Data Centre Network be the body responsible to recommend A+M data for inclusion in the international A+M Collision Data File, and made specific recommendation on the initial content of this file.

The final report of this meeting was published in INDC(NDS)-186/GA.

C.1.3.b) Specialists' Meeting on Atomic and Molecular Data for Plasma Edge Studies

Participants in the September 1986 meeting of the Atomic and Molecular Data Centre Network recommended that the next atomic data topic to be considered by the Data Centre Network in a joint effort be: "Collisions of H, D, He atoms, and their molecules and ions, and electrons, at low energies". This data topic was considered to be timely in view of its importance in the modelling of plasma edge effects, divertors and ion sources in Tokamak experiments.

The objective of this meeting is to identify the fundamental processes in the plasma edge region of fusion devices, with special emphasis on the interaction of electrons, and H, D, He atoms and their molecules and ions in the energy region of a few hundred eV and below, and will address primarily the atomic and molecular data needs for the modelling of the plasma edge, and to produce recommended values of these data which are to be incorporated into the international file of recommended atomic collision data for fusion.

The meeting was held at IAEA Headquarters in Vienna, 8-10 July 1987. The proceedings of the meeting have been recommended to be published in the Agency's Nuclear Fusion journal.

C.1.3.c) CIAMDA 87 - An Index to the Literature on Atomic and Molecular Collision Data Relevant to Fusion Research

This is the second issue of the Computerized Index to Atomic and Molecular Data Relevant to Controlled Fusion Research. The CIAMDA series provides a worldwide bibliographical index of the research publications on collisions between electrons, photons, hydrogen isotopes and helium, as well as collisions between these species and other ions, atoms and (a few) molecules of importance in magnetic-confinement fusion research. The first issue, CIAMDA 80, covered the period from the early 1950s to the middle of 1979. CIAMDA 87 extends the index from the cut-off date of CIAMDA 80 to August 1986.

This index is composed of the following sections:

- A major data reference section which provides references to the most important data compilations; covers the fields of atomic structure and spectra, atomic and molecular collisions and plasma-surface interaction.

- A data index for collisions between two partners, in which each citation has been indexed with respect to the collision partners, the physical process, the energy range and the method. There are 11 200 data indexing entries.

- A bibliography for the data index comprising 2484 bibliographic references, and an author index.

This sales publication is available from the IAEA Division of Publication for Austrian Shillings 360.-.

C.2. Data Processing

C.2.1. Data Compilation and Exchange

C.2.1.a) CINDA

CINDA data compilation (i.e. scanning of literature and preparing CINDA entries) for all countries outside OECD and USSR, is part of a continuing routine. After the recent revision of the structure of the CINDA network, the computer programs (input checking, file maintenance, exchange with other centers) have been revised, so that input can be prepared in batch mode (mainly new entries) or online (mainly revisions and updates). The work for CINDA input is intimately linked with EXFOR compilation.

C.2.1.b) EXFOR

- Experimental neutron reaction data

  During the last few years compilation of experimental neutron reaction data produced in the NDS service area was complete and up-to-date. In addition, many of the data compiled earlier were

updated in close co-operation with the authors who receive proof copies of their data as compiled in EXFOR. Special attention is given to error analysis and standard reference data. Data completeness checks were co-ordinated with the NNDC schedule for the production of cross-section handbooks.

- Charged particle and photonuclear data

  The EXFOR compilation of charged-particle reaction data and photonuclear data by NDS continues at a low rate with emphasis on neutron production reactions.

  Guidance to compilation and data checking was given to the Nuclear Data Group at RIKEN (Japan) and the Chinese Nuclear Data Center both of which have joined the EXFOR network for charged-particle nuclear data. EXFOR background material (coding manual, dictionaries, etc.) have been provided to Prof. J.M. Reid at the University of Glasgow (UK) who intends to join the EXFOR network for photonuclear data.

C.2.1.c) Evaluated Data

During the reporting period the following evaluated data files were received and documented for distribution.

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

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

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

The new handbook on activation data contains several specialized data files that are being brought into computerized form for easier updating and distribution on diskettes for personal computers.

C.2.2. Generation of Special Data Bases and Handbooks

C.2.2.a) Handbook on Nuclear Activation Data

The "Handbook on Nuclear Activation Data", was published in the IAEA Technical Report Series No. 273 in April 1987. This Handbook was produced in response to the many requests received from scientists using nuclear activation methods for a more up-to-date version of IAEA Technical Report Series 156 (published in 1974). The contents of the Handbook are as follows:

Part 1. Standard reference data: 1-1. Nuclear properties; 1-2. Standard monitor reactions for neutrons; 1-3. Production of monoenergetic neutrons between 0.1 and 23 MeV: Neutron energies and cross-sections; 1-4. The neutron spectrum of spontaneous fission of californium-252; 1-5. Decay data for radionuclides used as calibration standards.

Part 2. Neutron activation: 2-1. Thermal neutron cross-sections and infinite dilution resonance integrals; 2-2. Data for 14 MeV neutron activation analysis; 2-3. Activation cross-sections induced by fast neutrons; 2-4. Californium-252 spectrum averaged neutron cross-sections.

Part 3. Charged particle activation: 3-1. Calculation of excitation functions for charged particle induced reactions; 3-2. Activation cross-sections for elements from lithium to sulphur; 3-3. Thick target yields for the production of radioisotopes.

Part 4. Photonuclear activation: 4-1. Photonuclear cross-sections.

C.2.2.b) Nuclear Data for Safeguards

Data files for the first version of the handbook "Nuclear Data for Safeguards" have been collected and computer programs for producing edited user-friendly output have been written and tested. A good part of the tables have been produced in a format ready for printing by the end of this year. A draft version of the handbook will be ready for distribution before the INDC meeting, October 1987.

C.2.2.c) Medical Radioisotope Production

The IAEA Consultants, meeting on Data Requirements for Medical Radioisotope Production, Tokyo, 20-24 April 1987, (see Section B.1.9.) recommended that the IAEA/NDS produce a "Handbook of Nuclear Data for Medical Radioisotope Production" with the following content:

- A short introduction describing the most important nuclear concepts of radioisotope production by accelerators.

- A section containing evaluated cross section data for the production of some of the most important medical radioisotopes (e.g., the lightest positron emitters for PET studies, namely C11, N13, O15, F18 and In14, Ga67, Ir23 and T1201).

- A section containing evaluated nuclear reaction data for monitoring beam energy and intensity measurements for the following reactions:

$^{12}C(p,pn)^{11}C$
$^{27}Al(p,3pn)^{24}Na$
$^{27}Al(p,3p3n)^{22}Na$
$^{59}Co(p,pn)^{58}Co$
$^{63}Cu(p,2n)^{62}Zn$
$^{63}Cu(p,n)^{63}Zn$
$^{65}Cu(p,n)^{65}Zn$
$^{nat}Cu(p,x)^{58}Co$
$^{27}Al(d,3p2n)^{24}Na$
$^{56}Fe(d,n)^{57}Co$
$^{nat}Ti(^{3}He,x)^{48}V$
$^{63}Cu(^{3}He,p3n)^{62}Zn$
$^{65}Cu(^{3}He,2n)^{66}Ga$
$^{65}Cu(^{3}He,p2n)^{65}Zn$
$^{63}Cu(^{4}He,n)^{66}Ga$
$^{65}Cu(^{4}He,2n)^{67}Ga$
$^{63}Cu(^{4}He,pn)^{65}Zn$

C.2.2.d) Neutron Data for Fusion

The current major national and regional evaluations of nuclear data for fusion reactors are mostly related to fission-reactor programmes. The latest versions of these evaluations will be completed in the period 1987 to 1989. At present some of these evaluations are still restricted with respect to their distribution,

but it is expected that these restrictions will disappear in the near future, particularly for those materials important in fusion-reactor design. Although further evaluation work could perhaps be organised with world-wide participation in two-years time, there is already now a need for one international file, specifically for the design of the planned International Thermonuclear Experimental Reactor (ITER). The presently available INTOR file (INDL-F) is not adequate for this purpose and therefore this file should be updated to form an international ITER file consisting of the best evaluations that could be obtained within one or at most two years.

The following specifications were suggested at the 1986 Meeting on Nuclear Data for Fusion (see Section B.1.3.):

- The detailed requirements for the ITER file should be specified by the ITER team;
- The format of the file should be ENDF/B-VI;
- The file should be made to facilitate neutron and photon transport calculations, (e.g. so as to obtain tritium breading ratios and magnet shielding requirements);
- The file should be fusion application specific, excluding all information on fissile materials;
- A separate file would be required for activation and dosimetry calculations.

The following materials are suggested to be included in the ITER file

H, D, T, ^{6}Li, ^{7}Li, Be, ^{10}B, ^{11}B, C, O, N
Al, Si, Ti, V, Cr, Mn, Fe, Ni, Co, Cu, Zr
Nb, Mo, Ba, W, Pb, Bi

By mid-1988, each material should have been examined and the preferred evaluation should be selected. This starter file will require testing and checking prior to distribution; this is expected to take about one year to be completed. By mid-1989, a useful version of the file is tentatively planned to be distributed.

C.2.2.e) Nuclear Data for Geophysics

A meeting of thirteen specialists, including nuclear geochemists, nuclear geophysicists, and nuclear data experts from seven countries was held in April 1986. (See INDC(NDS)-184/GM).

Implicit in the conclusions of this meeting, the following data scope was recommended to be compiled in the form of a handbook of microscopic nuclear data for specific use in nuclear geology and stored in an associated computerized data base:

- Data on the following elements are of primary importance for geological consideration: Ca, C, O, Fe, S, Al, Si, Na, Mg, Ti, and V as well as the geologically important elements Zr, Hf, and the rare earth elements.

- Subsurface Ca, C, O, Fe, S, Si, and Ti can currently be detected and determined by neutron-induced prompt gamma-ray spectroscopic techniques, whereas detection of Al, Na, Mg, and V require delayed-activation techniques. Knowledge of the (n,p), (n,α) and (n,n'γ) reactions for the naturally occurring isotopes of Al, Na, Mg and V are therefore required from threshold to 15 MeV. Uncertainty information is required for the specific microscopic radiative capture data.

- In addition to the elements/isotopes listed above, there are other elements of importance to mineral exploration and industrial development. The following elements are amenable to neutron-induced gamma-ray spectroscopic techniques: Cr, Mn, Ni, W, Hg, Cu, Ag, and Au. Other elements which are also of importance but are more difficult to detect, include Co, Mo, Pt, Zn, Rh, Pd, Sn, and Pb.

The data part of the handbook should be preceded by a concise description of the nuclear analytical techniques currently employed in nuclear geology. The data part of the handbook should be organized in ascending order of atomic weight and the data base should be formatted so as to be immediately usable in analysis calculations by nuclear geologists.

For each of the required isotopes the handbook should contain

- prompt and delayed gamma-ray emission data,

- branching ratios for gamma-ray lines,

- activation cross sections ((n,p), (n,α), (n,2n) etc.), and

- data for interfering reactions and relative cross sections if needed.

A graphical network-like representation of the activation and interfering reactions should be added. As far as possible, uncertainties should be included with the data. For calculating the neutron flux distributions total cross-sections as well as gamma-ray production cross-sections are needed.

Compilation of the existing data required for this handbook has started; a meeting to discuss the status of the data, as well as the content, format and layout of the handbook is planned for February 1988.

C.2.3. Data Base Management

C.2.3.a) EXFOR Data Base Development

A system of procedures was developed to allow direct ONLINE entry of new EXFOR entries ("new" entry being defined as an entry not yet in the MASTER file). The system provides options to 1) automatically allocate new entries, creating a skeleton entry; 2) edit any new entry, providing full editing functions; 3) automatically submit a batch job to execute the check programme for a new entry, and 4) sets up a series of "help" screens providing information pertinent to the functions.

D. DATA SERVICES AND TECHNOLOGY TRANSFER

D.1. Data Centre Services

D.1.1. Documentation and User Services

The services of NDS are advertised to its customers by the "IAEA Nuclear Data Newsletter" to which most of the incoming requests refer.

Each data library sent out and each selective retrieval from a data library prepared on request is accompanied by "documentation" describing contents and format of the file and related data procesing computer codes. Such documentation is included in the IAEA Nuclear Data Services report series (IAEA-NDS-...). Among others, the following reports were issued recently:

IAEA-NDS-7 : Index of data libraries available
IAEA-NDS-70: Element and isotope index to the major neutron data libraries
INDC(NDS)-189: Index of neutron-induced gamma production data included in ENDF formatted libraries. (In view of many requests for such data this was published as INDC document)
IAEA-NDS-39 (Rev. 3): ENDF/B pre-processing codes (for versions up to ENDF-6)
IAEA-NDS-69: ENDF/B pre-processing codes for a Personal Computer AT
IAEA-NDS-79: Program PLOTC4. (Plots data from ENDF format and/or EXFOR data in Computation format C4)
IAEA-NDS-80: Program X4TOC4. (Converts EXFOR data to Computation Format C4)
IAEA-NDS-81: Programs PLOTC4 and X4TOC4 for a Personal Computer AT

Many earlier IAEA-NDS- reports have been updated.

D.1.2. Data Requests

As part of its function as a data centre, NDS disseminates on request nuclear data, data processing computer programs and reports to users in Member States within its service area[1], as well as to other requestors in other countries. The average number of requests received annually by NDS is about 700.

In these statistics, a "request" is defined as any query received by NDS for any one of the following specific categories: experimental data, evaluated data, bibliographic retrievals (e.g. from the CINDA master file), documents and computer programs. For example: one letter asking for experimental and evaluated data would count as two requests, or one letter asking for 10 EXFOR data sets would count as one request.

Request statistics for each of the considered categories, and statistics showing the total number of requests handled by NDS for each of the last 21 years are given in Table I. Figure 1 shows the request statistics since 1965 in terms of number of requests per year averaged over 3-year periods (i.e., the value for 1986 is the average over the years 1984, 1985 and 1986).

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1 The IAEA/NDS service area comprises Eastern Europe (except the USSR), Africa, Asia (except Japan), Latin America, Australia and New Zealand.

D.1.3. Data Dissemination

Data dissemination statistics are designed to show what data and associated data information have been sent out as a result of requests received by NDS. Numerical data are normally quantified in terms of "data sets". A "data set" is defined as a set of numerical data of a given type for a given energy range which resulted from a specific data measurement or evaluation. For evaluated data, a data set comprises all data given under one "MAT" number in a given evaluated data library; for EXFOR, a data set comprises all data combined in an EXFOR sub-entry (excluding the first BIB subentry).

In the past, statistics on the number of data sets, Mbytes of data, computer codes disseminated, the number of tapes dispatched, etc. has been calculated by hand. Last year, an automatic system to collect these data was implemented which resulted in a more comprehensive and accurate dissemination statistics. For example, past manual collection of dissemination data included only information on standard requests for complete data libraries and EXFOR retrievals.

The automatic system includes also dissemination information for individual retrievals from evaluated data libraries, any non-standard requests for data or codes (typically performed by non-clerical staff) as well as regular dissemination of CINDA EXCHANGE data, EXFOR TRANS, EXFOR UPDAT, and EXFOR Dictionary transmissions. As of this publication, the dissemination statistics produced by the new automatic system will be used.

The information given below includes not only dissemination statistics for 1986, but for comparison purposes, also statistics for 1985 collected by the automatic method. Moreover, information on dissemination of CINDA EXCHANGE data, EXFOR TRANS and UPDAT and EXFOR Dictionary data has been given separately. Dissemination of these data is not the result of individual requests, but the result of standing data exchange agreement among the 4 centres, and represents a significant portion of data sent out.

The drop in the number of evaluated data libraries sent out can partly be explained by the fact that NDS did not receive many new versions of libraries in 1986, so that previous recipients of these libraries were not sent new versions.

In the spirit of economy, an effort has been made to reduce as much as possible duplication of documents sent out. Therefore, the actual number of requests for documents did not drop as sharply as the relative drop in the number of documents sent out.

Please note also that the dissemination statistics given below reflect the year when the requested information was sent out. If information, for which a request was received and recorded during a given year (y) is sent out in the course of a subsequent year (y+1), it will be recorded under the dissemination statistics for the year (y+1).

Dissemination Statistics for the years 1985 and 1986:

Sets of experimental nuclear reaction data (EXFOR subentries)

1985 - 51,777 (including 44,938 data sets for EXFOR TRANS & UPDAT)
1986 - 80,473 (including 39,439 data sets for EXFOR TRANS & UPDAT)

Fig. 1 Nuclear Data Requests

(Number of requests per year averaged over 3-year periods)

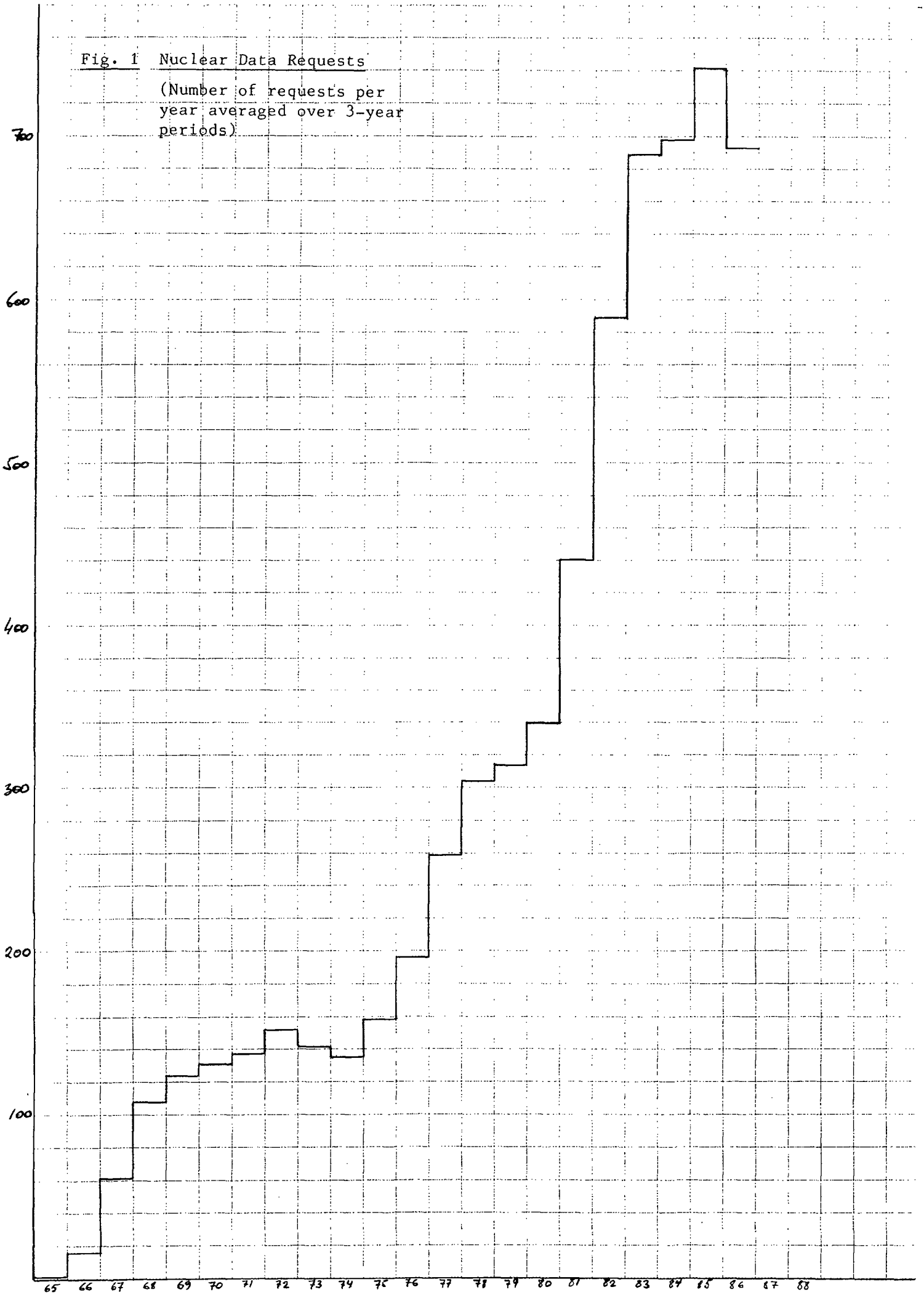

Table I

Data Request and Distribution Statistics 1965 - 1986

Year	Request Statistics (Number of Requests)							
	Experimental Data	Evaluated Data	Experimental and Evaluated Data	Documents	Other*	Totals per year	Totals (Averaged over 3 years)	Totals Cumulative
1965	3	-	3	-	-	3	1	3
1966	40	-	40	-	5	45	16	48
1967	118	-	118	9	8	135	61	183
1968	119	-	119	16	9	144	108	327
1969	48	15	63	25	5	93	124	420
1970	95	20	115	34	8	157	131	577
1971	76	33	109	43	8	160	137	737
1972	48	23	71	60	8	139	152	876
1973	43	22	65	54	6	125	141	1 001
1974	49	24	73	61	6	140	135	1 141
1975	43	49	92	114	3	209	158	1 350
1976	34	43	77	153	9	239	196	1 589
1977	45	49	94	232	3	329	259	1 918
1978	62	71	133	193	17	343	304	2 261
1979	63	93	156	95	18	269	314	2 530
1980	40	86	128	239	42	407	339	2 937
1981	59	185	244	369	31	644	440	3 581
1982	76	174	250	403	60	713	588	4 294
1983	50	113	163	499	44	706	688	5 000
1984	54	113	163	462	38	667	698	5 674
1985	24	221	245	587	12	844	741	6 518
1986	37	93	130	407	32	569	693	7 087

* Since 1978 this category contains exclusively data processing computer programs, all other, including bibliographies, are included under documents.

Sets of evaluated nuclear data

1985 - 24,692
1986 - 10,693

Sets of bibliographic data (CINDA, WRENDA, A+M)

1985 - 3,341 (including 4 data sets for CINDA EXCHANGE)
1986 - 7,926 (including 91 data sets for CINDA EXCHANGE)

Total number of Megabytes (experimental and evaluated data)

1985 - 1,974 (including 298 Megabytes for EXFOR TRANS & UPDAT)
1986 - 2,208 (including 164 Megabytes for EXFOR TRANS & UPDAT)

Dispatch of data processing computer programs

1985 - 21
1986 - 27

Total number of tapes dispatched to send (above) data and programs

1985 - 236 (including 43 tapes for CINDA EXCHANGE and EXFOR TRANS)
1986 - 270 (including 66 tapes for CINDA EXCHANGE and EXFOR TRANS)

Number of individual reports dispatched on request:

1985 - 1,833
1986 - 1,664

For 1985 and 1986 this material was supplied to 41 developing and 17 advanced countries

D.2. Publications

D.2.1. INDC Reports

In the course of the year, NDS distributes approximately 60-70 INDC reports, most of them on behalf of the Member States. Included in the INDC report series are also reports which originate at the NDS and which serve to document meetings and results of projects conducted by NDS. A list of INDC(NDS) and INDC(SEC) reports published by NDS in 1986 and 1987 is given in Appendix B.

D.2.2. The IAEA Nuclear Data Newsletter continues to be published once or twice a year whenever important new data files or documents were received that must be announced to customers. Its distribution exceeds 3000 in the NDS service area. To OECD countries and USSR it is distributed upon request only (ca. 350 copies) in order not to interfere with the services of the other centres. Attached to the Newsletter is a return postcard by which data, reports or other information can be requested.

D.2.3. Fission Products Newsletter

No comments or objections were received from recipients of the series "Progress in Fission Product Nuclear Data" on the change in the publication frequency from annual to biennial.

In order to review the mailing list for this report series, a circular was sent to recipients in March 1986 requesting them to explicitly inform the Section about their continued interest in the series. Roughly half of the addressees replied. To those who have responded, an update of the circular was sent together with the call for contributions to the 12th issue of the series. This call for contributions was distributed in May 1987; the new issue is envisaged to be published in July 1987 as INDC(NDS)-191.

D.2.4. WRENDA-87

The input to the next quadrennial edition of the WRENDA list, WRENDA-87, is currently being compiled by NDS from the co-operating data centres and Member States in area 3. The new list is planned to be published in the fall of 1987.

D.3. Technology Transfer to Developing Countries

D.3.1. IAEA Technical Cooperation Interregional Training Course on Neutron Physics and Nuclear Data Measurements with Accelerators and Research Reactors

This training course was jointly organized by the IAEA and the USSR State Committee on the Utilization of Atomic Energy. It was convened during the period 18 May - 9 June 1987 in Riga, Latvian USSR, at the P. Stucka Latvian University and in Leningrad at the V.G. Khlopin Radium Institute. The course also included visits to the Kurchatov Institute of Atomic Energy in Moscow and the Institute of Nuclear Physics in Tashkent.

The objectives of this training course were to enable the participants to upgrade and update their knowledge of fast neutron physics and to become acquainted with recent developments in the field of fast neutron measurements and their technological applications of immediate benefit to their home countries. To achieve this objective, twenty-two well-known scientists from the main nuclear research institutes of the USSR prepared lectures, on

- nuclear data needs,
- systematics of threshold reaction cross sections,
- use of coupled channel technique for the calculation of neutron cross sections,
- level densities of excited nuclei,
- thermoluminescence neutron dosimetry,
- modifications of the associated particle techniques,
- multiple neutron spectrometer, and
- neutron spectrum unfolding.

Three scientists from Austria, China and Netherlands prepared lectures on concepts of errors, covariances and solid state track detector applications. The lectures were complemented by practical exercises at the Riga host University on neutron spectrum unfolding using the SAIPS system and at the Leningrad host institute on solid state track detectors.

In summary, this training course has achieved the objectives for which it was planned; it provided the 30 participants from 26 developing countries with a good overview of the latest developments in the field of neutron physics and nuclear data measurements. Most participants pointed out that they were very satisfied with the lectures and had found specific aspects which will be very helpful in the implementation or extension of their neutron physics and applied research in their countries. Some participants hoped that the IAEA would convene a training course on neutron spectrum unfolding in the near future.

D.3.2. Interregional Training Course (ITC) on the Preparation of Nuclear Data for Use in Reactor Calculations

In response to numerous requests expressed particularly by "nuclear-going" developing countries, this ITC was convened at the Bhabha Atomic Research Centre, Bombay, India from 31 March to 25 April 1986.

It was designed to provide participants with a working knowledge of the methods currently used to process nuclear data for subsequent use in reactor applications. The course included lectures describing methods, complemented by computer exercises using computer codes, in which the methods described have been incorporated. By the end of the course participants should understand currently used methods and be familiar with computer codes that they can use for actual applications when they return home.

The scope of the course extended from the status of presently available evaluated nuclear data files through the preparation of continuous energy and multigroup libraries for use in applications, to the sensitivity of integral reactor parameters on nuclear data uncertainties. In addition there was a series of lectures on the accuracy of results obtained using currently available multigroup libraries in reactor applications.

Of the 53 applicants for this Training Course, 25 were selected and 19 applicants (from 14 developing countries) actually attended the course. In addition there were a number of Indian participants.

Scope and Programme

The scope of the Training Course included:

1) An introductory to currently available evaluated data libraries with emphasis on the applicability of each library for use in specific reactor applications.

2) Lectures on the methods used in processing nuclear data, including: processing of resonance parameters, Doppler broadening, the multigroup method and self-shielding.

3) Lectures on computer codes in which the above mentioned methods are currently used with emphasis on the applicability and limitations of each code for use in subsequent reactor calculations.

4) Lectures on sensitivity analysis, which can be used to determine the sensitivity of integral reactor parameters to nuclear data uncertainties, e.g. the sensitivity of K-Effective to the fission cross section.

5) Lectures on the accuracy of the results obtained using currently available multigroup libraries in reactor applications.

6) Computer exercises to allow each participant to become familiar with and to actually utilize each computer code on the BARC NORSK ND-100 and 500 computers.

The background and qualifications of the participants were extensive and fairly uniform. This allowed the lectures to be aimed at a high level audience, including advanced computational methods. This in turn allowed the computer exercises to be devoted to modern nuclear data processing computer codes.

During the Course the participants formed an enthusiastic and very active group and at the end, offered a number of very interesting criticisms and suggestions including a set of concrete ideas for the programme of a next course of this type, which the Agency plans to convene at the Brazilian Nuclear Data Centre in Sao José dos Campos in 1988.

D.3.3. National Technical Co-operation (TC) Projects

NDS is currently responsible for the implementation of eight national TC projects dealing with the introduction of nuclear science and nuclear analytical techniques in the following seven African countries: Cameroon, Côte d' Ivoire, Ghana, Kenya, Nigeria, Sudan and Zambia. The main objective of these multiyear projects is to establish, usually at universities, self-supporting centres for training and education of applied nuclear physics and technicians for later use and employment in other research institutes and in the industry of the countries concerned. The main nuclear techniques used in these centres are fast neutron activation analysis with 14 MeV neutron generators and isotopic neutron sources and x-ray fluorescence analysis with tube excited x-ray facilities and isotopic x-ray sources. NDS co-operates closely with the Physics Section in the implementation of these projects. The Agency's assistance to these projects consists in expert missions, purchase and supply of equipment, and training fellowships. All projects are entirely funded from the Agency's Regular Budget for Technical Assistance and Co-operation. Short pre-project and project assessment missions were performed mostly by NDS staff to the National Nuclear Research Institute near Accra, Ghana in February 1987 (G. Paic/Zagreb and J.J. Schmidt) and to the Universities of Zaria and Ife, Nigeria, in June 1987 (Wang Da Hai and J.J. Schmidt).

Two other new TC projects are in the field of nuclear data and concern the establishment of computer-based nuclear data libraries and associated computer codes at the Chinese Nuclear Data Centre, Institute of Atomic Energy, Beijing, China, and at the National Nuclear Research Centre in Bandung, Indonesia. A pre-project mission was performed by Lemmel and Lorenz to China in April 1987 to determine the need, substance, sequence and coordinated timing of the efforts of the counterpart and of the Agency's assistance to the Chinese project.

D.3.4. New TC Interregional Project INT/1/039 on Training in Nuclear Measurement Techniques

INT/1/039 is a follow-up of the TC Interregional Project INT/1/018 on "Nuclear Data Techniques and Instrumentation", which started in 1981 and was terminated at the end of 1986. The new project emphasizes training in applied nuclear physics on a broader and simultaneously more elementary level, covering the most commonly used nuclear physical measurement techniques for applications in nuclear science and technology. It addresses itself to a larger range of nuclear laboratories in developing countries with no nuclear power programme, including especially less developed and beginning laboratories, most of them established with assistance through national IAEA TC projects since 1980. The project has been given the following short-term objectives:

(1) To provide training to nuclear scientists in the developing countries, except for those who already have an on-going nuclear power programme, in the basic physics techniques of quantitative nuclear measurements utilising already established facilities and equipment supplied by the Agency under separate national TC projects;

(2) To strengthen and promote further the collaboration between nuclear laboratories.

This training should help to develop the capability to perform independent, accurate and reproducible nuclear measurements.

In the long-term, the project aims at contributing to the development of self-supporting nuclear infrastructure in developing countries, by establishing cores of well-trained research workers and technicians in applied nuclear physics thereby strengthening the scientific manpower pools from which personnel for employment in national science and technology programmes can be drawn.

The Agency's main assistance to the implementation of the project will consist in providing short expert services, supporting training through its fellowship programme, and supplying limited auxiliary equipment closely linked to the purposes of the project and to well-established needs of the participating developing laboratories for work under this project. Specifically, no major equipment, such as, for example, a neutron generator, an accelerator, or X-ray fluorescence equipment, will be provided under this project, but minor vital spare parts or limited auxiliary accelerator equipment, special materials such as tritium targets and reference materials, as well as data, documents and data processing and analysis codes directly related to work under this project and required to implement a specific experimental training programme.

It is particularly emphasized that, as a precondition for participation in this project, the counterpart institutions must possess and use adequate radiation protection and radiation monitors for neutrons, γ-rays, X-rays and tritium as applicable to the facilities and techniques involved.

The Agency will closely follow and continuously evaluate the progress of the training programme in the participating laboratories and assist in establishing links and exchange of information, know-how and experiences between more and less advanced laboratories and among the developing laboratories themselves participating in the project.

The following activities have been identified as having maximum training potential for the development of skilled manpower:

(1) Intercomparison of measurements performed by participating laboratories;

(2) Development and application of neutron beam facilities;

(3) Development and utilization of detector systems for nuclear measurements, including associated electronics, computer-based data processing and calculation of detector characteristics;

(4) Utilization of small accelerators and development of associated equipment for applied experimental nuclear research;

(5) Performance of nuclear measurements using radioisotopes and accelerated ion beams for material analysis, environmental science, and as a direct tool in applied research.

In the initial phases of the Interregional Project, activity (1) and the aspects of equipment utilization rather than development under the activities (2) - (5) will be given primary emphasis. For this purpose, an experimental training programme in applied nuclear physics techniques has been drawn up which consists of a series of proposed experimental measurements to be performed with the following nuclear facilities:

- neutron generators and isotopic neutron sources;

- isotopic X-ray sources and X-ray tube excited systems;

- low-energy accelerators such as Van de Graaff accelerators, cyclotrons, or Cockroft-Walton accelerators, and

- low-level counting facilities.

The measurements cover the following areas of nuclear techniques:

- neutron physics measurement techniques (NP);

- fast neutron activation analysis (FNAA);

- X-ray fluorescence (XRF);

- proton-induced X-ray emission (PIXE);

- Rutherford backscattering (RBS);

- charged-particle induced nuclear reaction analysis (CPA); and

- low-level counting (LLC).

Letters have been sent by the Agency in July 1987 to 59 laboratories/ institutes in 46 developing countries, together with a list of proposed measurements, inviting them to participate in the project, to select and carry out, in the initial phase of the project, some of the proposed measurements and report the results back to the Agency. One part of the proposed experiments consists of measurements and analysis of instrumental characteristics, the other part of nuclear application measurements. For the latter experiments the Analytical Quality Control Service of the Agency's Seibersdorf Laboratories will provide reference sample materials of a composition known to the Agency so that the analysis results from these measurements can afterwards be assessed against accurately known reference values. The reports submitted by the participating laboratories to the Agency will be subjected to proper evaluation by NDS technical staff or by relevant outside experts. These evaluations will provide the Agency with a tool to monitor type and level of its assistance under the project, mainly in terms of expert missions and fellowship training.

D.3.5. Trainees, Fellows and Cost-free Experts

During the reporting period, NDS has hosted two fellowships, funded under the Agency' TC fellowship programme, Mr. Ramón Arcilla, a young physicist from the Philippine Atomic Energy Commission, and Mr. José Martinez-Rico from Mexico.

Mr. Ramón Arcilla spent nine months at NDS from April 1986 to January 1987 and received training in designing, implementing and maintaining computer-based evaluated nuclear data files, related to the needs and plans of the Philippine AEC. At the same time he contributed usefully to the Section's activities by writing programs for special retrievals from the EXFOR file.

Mr. Martinez-Rico started his one-year fellowship in May 1987. His training will be devoted partly to compilation and computer processing of data for CINDA and EXFOR under supervision by NDS staff, partly to neutron data evaluation, in fulfilling part of the requirements for an MSc, in the Institut für Radiumforschung und Kernphysik, Vienna, under the supervision of Professor Vonach.

List of Liaison Officers to the INDC as of March 1986

Argentina	Ricabarra, G.
Austria	Vonach, H.K.
Bangladesh	Islam, M.*
Belgium	Poortmans, F.
Bolivia	Rondon, A.*
Bulgaria	Janeva, N.
Chile	Morales-Peña, R.
Colombia	Director, Instituto de Asuntos Nucleares
Costa Rica	Salazar Matarrita, A.
Cuba	Nodarse, F.
Czechoslovakia	Rocek, J.
Denmark	Christensen, C.J.
Ecuador	Muñoz, R.
Egypt	El-Nady, M.*
Finland	Silvennoinen, P.*
Greece	Dritsa, S.
Hong Kong	Wright, J.C.
Hungary	Kluge, G.
Iran	Azimi-Garakani, D.
Iraq	Said, K.I.
Israel	Yiftah, S.
Kenya	Gacii, P.*
Korea, Dem. Peoples Republic	Dzang, S.H.*
Korea, Republic of	Cho, M.
Kuwait	Shihab-Eldin, A.
Libyan Arab Jamahiriya	Aboughalya, E.
Mexico	Graef Fernandez, C.
Morocco	Erradi, L.
Netherlands	Gruppelaar, H.
Nigeria	Director, Centre for Energy*
Norway	Andersen, E.
Pakistan	Gul, K.
Peru	Espinosa Garcia, R.
Philippines	Bartolomé, Z.*
Poland	Sujkowski, Z.
Portugal	Carvalho, F.G.
Romania	Rapeanu, S.N.
Singapore, Republic of	Tang, Seung-Mun
South Africa, Rep. of	Barnard, E.
Spain	Velarde Pinacho, G.
Sudan	Habbani, F.I.
Switzerland	Widder, F.
Thailand	Boonkong, W.
Turkey	Gueltekin, E.
Uruguay	Servian, J.L.
Yugoslavia	Slaus, I.
Viet Nam	Than Quoc Thuong

* to be replaced

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INDC DOCUMENT DESIGNATOR	DATE OF DISTRIB.	ORIGINAL DOCUMENT ID.	DOCUMENT TITLE, AUTHOR, OTHER IDENTIFICATION NUMBERS, ETC.	ACC.NO
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INDC(NDS)-178/G+SP	APR 86		REPORT ON THE 8TH IAEA CONSULTANTS' MEETING OF THE NUCLEAR REACTION DATA CENTRES HOSTED BY THE NEA DATA BANK IN SACLAY, FRANCE, 9-11 OCTOBER 1985 (INCLUDING THE 19TH FOUR-CENTRES MEETING OF THE NEUTRON DATA CENTRES AND THE 9TH MEETING ON CHARGED PARTICLE NUCLEAR DATA COMPILATION) BY H.D. LEMMEL JANUARY 1986 (131 PAGES)	1492
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INDC(SEC)-093/UN	SEP 87		INDC CORRESPONDENTS FOR THE EXCHANGE OF NUCLEAR DATA INFORMATION AND MEMBERS OF NATIONAL NUCLEAR DATA COMMITTEES (SUPERSEDES INDC(SEC)--091/UN) SEPTEMBER 1987	1581
INDC(SEC)-094/UN	SEP 87		LIST OF DOCUMENTS RECEIVED BY THE INDC SECRETARIAT (SUPERSEDES INDC(SEC)-092) SEPTEMBER 1987	1582
INDC(NDS)-197/LNA	SEP 87		REPORT OF THE NUCLEAR DATA SECTION TO THE INTERNATIONAL NUCLEAR DATA COMMITTEE MARCH 1986 - AUGUST 1987 BY A. LORENZ SEPTEMBER 1987 (PAGES)	1585