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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Report of the Nuclear Data Section to the International Nuclear Data Committee September 1981 - February 1983

A. Lorenz, Editor

February 1983

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 September 1981 to February 1983. It describes past, current and planned activities of the Section and presents the status of its nuclear data centre services.

A. Lorenz, Editor

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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
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
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
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

INDC(NDS) Documents Published since the last INDC Meeting

INDC DOCUMENT DESIGNATOR	DATE OF DISTRIB.	DOCUMENT TITLE, AUTHOR, OTHER IDENTIFICATION NUMBERS, ETC...	ACC.NO
INDC(NDS)-125/G+SP	Sep 81	REPORT ON THE FIFTH IAEA CONSULTANTS' MEETING OF NUCLEAR REACTION DATA CENTERS, BROOKHAVEN NATIONAL LABORATORY, UPTON, N.Y. 29 SEPTEMBER - 2 OCTOBER 1980 INCLUDING THE 16TH FOUR-CENTERS MEETING OF THE NEUTRON DATA CENTERS AND THE 6TH MEETING ON CHARGED PARTICLE NUCLEAR DATA COMPILATION G.J. WYANT, A.M. DALY, JUNE 1981	1131
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INDC(NDS)-138/GE	Dec 82	FIFTH RESEARCH COORDINATION MEETING ON THE MEASUREMENT AND EVALUATION OF TRANSACTINIUM ISOTOPE NUCLEAR DATA GEEL, BELGIUM, 1-3 SEPTEMBER 1982 A. LORENZ, DECEMBER 1982 (50 PAGES)	1234
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INDC(NDS)-141/G	Dec 82	REPORT ON THE SIXTH IAEA CONSULTANTS' MEETING OF NUCLEAR REACTION DATA CENTERS, VIENNA, 3-7 MAY 1982 INCLUDING THE 17TH FOUR-CENTERS MEETING OF THE NEUTRON DATA CENTERS AND THE 7TH MEETING ON CHARGED PARTICLE NUCLEAR DATA COMPILATION BY M. LAMMER AND O. SCHWERER (153 PAGES)	1228
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INDC(SEC)-082/UN	82	INDC CORRESPONDENTS FOR THE EXCHANGE OF NUCLEAR DATA INFORMATION, JUNE 1982 (SUPERSEDES INDC(SEC)-79/UN)	1173
INDC(SEC)-083/UN	82	LIST OF DOCUMENTS RECEIVED BY THE INDC SECRETARIAT JUNE 1982 (SUPERSEDES INDC(SEC)-80/UN)	1174
INDC(SEC)-084/GA	Jan 83	SECOND MEETING OF THE IFRC SUBCOMMITTEE ON ATOMIC AND MOLECULAR (A+M) DATA FOR FUSION, IAEA, VIENNA, 4-5 NOVEMBER 1982, SUMMARY REPORT A. LORENZ, JANUARY 1983	1243

Programme Summary

J.J. Schmidt
Head, Nuclear Data Section

This progress report on the activities and services of the IAEA Nuclear Data Section covers the eighteen months period from September 1981 to February 1983.

In the light of programmatic needs, brought about by the growth of the Section's technical co-operation projects with developing countries, and budgetary "zero growth" stringencies, some programmatic responsibilities were shifted within the Section. After Robert A. Langley, head of the A+M Data Unit, returned to Oak Ridge National Laboratory in November 1981, A. Lorenz was given the responsibilities of head of the A+M Data Unit, while keeping his functions as deputy head of the Section and giving up some other technical duties. This freed the post previously occupied by Robert Langley for major responsibilities in the framework of the Interregional Project TC/INT/1/018 and other developing country projects. These were taken over by Madhu K. Mehta, Head of the Physics Group at the Bhabha Atomic Research Centre, Bombay, who joined the Section end of January 1983. Nikolai Kocherov returned to the Khlopin Radium Institute, Leningrad, in February 1983 and was replaced by Vladimir Piksaikin from the Institute for Physics and Energetics, Obninsk. Necmi Dayday left NDS in February 1982 to assume a position in the IAEA Safeguards Department and was replaced in October 1982 by Dario Gandarias Cruz from the Institute of Nuclear Investigations of the Academy of Sciences of Cuba. Mrs. Henrietta Hendrickson, who returned in December 1981 to Oak Ridge National Laboratory, was replaced by Miss Martha Okumu from Kenya.

These manpower changes have significantly strengthened the Section's experimental and research coordination capabilities, thus implementing one of the main recommendations of the INDC during its last meeting in October 1981. At the same time, it was possible to increase the number of professional staff from developing countries, in accordance with the recommendation made by the Agency's General Conference in September 1981.

The major development during the reporting period was the growth of NDS activities in the Interregional Technical Co-operation Project for Nuclear Data Techniques and Instrumentation (TC/INT/1/018) and related training and research co-ordination activities. Also in pace with the continuously growing requirements of developing countries, a significant strengthening in the Section's data verification and service capabilities was implemented. The number of requests received by NDS grew from 405 in 1980 to over 700 (from 64 Member States) in 1982: 250 for numerical nuclear data, 60 for data processing codes, and more than 400 for reports. The PROFILE system of the Section's correspondents grew in 1982 alone by 600 names and addresses to a total of 5300 entries.

During the reporting period, the interest of developing (DC) as well as advanced countries (AC) in participating in the Interregional Project has grown significantly, including not only assistance and technology transfer from ACs to DCs, but also some technical co-operation between several DCs. The project activities are closely co-ordinated with other relevant Agency programmes in the field of Physical Sciences, in particular the Physics

Section. They are expected to contribute to the full utilization of neutron generators and other accelerators partly provided by the Agency to DCs and thus to the development of self-supporting nuclear scientific infrastructures, and to strengthen the capabilities of institutes in DCs for performing reliable nuclear measurements on their own. During 1981 and 1982, the initial phase of this project, eight partly exploratory, partly advisory, expert missions were carried out to 37 institutes in 12 DCs, eleven scientists from eight DCs received fellowship awards or undertook scientific visits to laboratories in ACs or other DCs, and auxiliary equipment and special materials (tritium targets and material samples) were supplied to 15 laboratories in 13 DCs to assist them in the startup phase of their measurement programmes. The number of countries and laboratories actively participating in the project is presently 30 (23 DCs and 7 ACs) and 36 (27 in DCs and 9 in ACs) respectively. All these activities were entirely funded from the Regular Budget of the Agency's Technical Co-operation Programme.

In view of the interest expressed by the developing countries, the extension of the project through 1985 is at present foreseen and has been approved by the Agency's policy organs. During this second phase, special emphasis will be placed on strengthening and consolidating the capabilities of the participating DC laboratories and on promoting co-operation in the field of neutron data measurement technology among laboratories in DCs working at different levels.

Complementary to the Interregional Project, a co-ordinated research programme (CRP) on the measurement and analysis of 14 MeV neutron nuclear data needed for fission and fusion reactor technology has been initiated. This CRP has the dual objective to train nuclear scientists from developing countries in nuclear data techniques and to improve the accuracy of 14 MeV neutron nuclear data. As in the case of the Interregional Project, the data scope will be based on the requests contained in the Agency's current WRENDA list. This CRP will link ten more advanced DC laboratories, participating in the Interregional Project, which have established neutron generator facilities, with six advanced neutron generator laboratories in ACs and other DCs. This will allow the Nuclear Data Section to convene annual research coordination meetings to review research progress and to evaluate the advancement of the participating DC laboratories.

An activity related to the transfer of nuclear techniques and nuclear data technology was the Interregional Technical Co-operation Training Course on the Utilization of Neutron Generators, held at the Institute of Experimental Physics of the Kossuth University in Debrecen, Hungary, 7 June - 9 July 1982. Through lectures supplemented by laboratory exercises, this course provided 24 young scientists from 23 developing countries an intensive training in selected 14 MeV neutron nuclear data measurements as well as in a variety of scientific and technological neutron generator applications of immediate benefit to their countries.

As a follow-up of similar courses given in 1978 and 1980, a four week course, organized jointly by the Nuclear Data Section and ICTP was held at the ICTP in Trieste in 1982. This course reviewed recent progress in applied low-energy neutron nuclear reaction theory and nuclear model computer codes as well as the nuclear data bases needed for thermal reactor physics design and safety analysis; it was attended by 70 scientists from 23 developing countries.

In the reporting period, NDS convened two specialist meetings. A Consultants Meeting, held in Vienna from 28 September to 2 October 1981, reviewed the status of resonance parameters for uranium and plutonium isotopes. This meeting revealed that many of the more important experimental results obtained in the past are still not included in current evaluations, and drew up a substantial list of needed future measurements and data analysis. An Advisory Group Meeting, held in Vienna from 12 to 16 October 1981, reviewed the status of nuclear data required for the estimation of radiation damage to reactor structural materials and recommended that NDS develop a new nuclear data file for the estimation of reactor radiation damage of international reference status. In the context of this development, NDS finished and distributed the International Reactor Dosimetry File (IRDF) during 1982. The REAL-80 intercomparison exercise, a first step towards standardisation of the methods and nuclear data used for the determination of reactor radiation damage, was also terminated at the end of 1982. It revealed large discrepancies in unfolded neutron spectra and displacements per atom as computed by the 25 participating laboratories. A second round of comparisons with the preliminary title REAL-84, is planned to focus both on improving the unfolding codes and investigating the sensitivity of the results to the use of several different damage cross section files.

As part of its data centre co-ordination activity, NDS convened three separate meetings of representatives of the nuclear reaction data (NRDC), nuclear structure and decay data (NSDD), and atomic and molecular data (A+MD) centre networks. Of the more important conclusions, the NRDC centre network will include more detailed information on experimental errors in future EXFOR data compilations, the NSDD centre network adopted priority criteria in the choice of mass chains to be evaluated in order to keep with the requirement of a four-year update cycle, and the A+MD centre network discussed the adoption of an EXFOR-type format for the exchange of A+M data.

In addition to the "14 MeV Co-ordinated Research Programme (CRP)" referred to above, NDS currently maintains three other CRPs. The CRP on the Intercomparison of Actinide Neutron Nuclear Data Evaluations, which was terminated at the end of 1982, has resulted in a collection of presently existing evaluations of secondary actinide isotopes and several publications documenting these evaluations and results of their intercomparison. The CRP on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data continued with the review of the accuracies of actinide gamma-ray and alpha emission spectra as well as with the annual publication of the updated list of actinide half-lives. This CRP has been extended until the end of 1984, when it is planned to issue a comprehensive summary of the then current status of heavy element radionuclide decay data. Another CRP on Atomic Collision Data for Diagnostics of Magnetic Fusion Plasmas was started in 1982 with a review of the availability and accuracy of high priority electron impact ionization, excitation and capture data. The CRP on the Evaluation of Atomic Data pertinent to Plasma-Wall Interactions has been completed at the end of 1981; its results are being published in the Agency's Nuclear Fusion Journal.

Since the practical adoption of ENDF/B as the international format for the exchange of evaluated neutron data, NDS has initiated the IAEA Evaluated Nuclear Data Library INDL, a collection of various evaluated data files of different origins and applications. The 1982 version of INDL contains approximately 200 evaluations for 150 nuclides contributed from 13 institutes

in 11 countries. However, so far only about 30 of these evaluations are "complete evaluations" covering all neutron reactions in the full energy range from 0 to 15 or 20 MeV.

In the reporting period NDS has started a project for the verification of nuclear data processing codes, using a very simple accurately established group cross section benchmark for a first inter-laboratory round of code comparisons. Differences between different codes were found particularly in the resonance and threshold regions of neutron cross sections. Some of the problem areas could be eliminated and a number of processing codes could be improved so as to accurately reproduce the benchmark. Encouraged by the positive results of this first exercise, a second round of intercomparison has just been started for a more complex benchmark including resonance Doppler broadening.

In the area of programming and systems development, the data checking programs for evaluated data (in ENDF/B format), EXFOR, CINDA and WRENDA have been significantly improved in automatic error detection. In addition graphic output has been extensively used to detect errors in evaluated data. In order to cope efficiently with the steadily growing number of requests, the index files to the experimental and evaluated data files maintained by NDS have been improved.

Regarding publications, NDS has submitted the 1982 INDC/NEANDC Nuclear Standards File to be published as an IAEA Technical Report with the title "Nuclear Data Standards for Nuclear Measurements". NDS plans to publish a new edition of the largely outdated 1974 IAEA Handbook on Nuclear Activation Cross Sections which should incorporate the most recent evaluated data and also contain a section on standard reference data pertinent to activation analysis. The annual Progress Report on Fission Product Nuclear Data has continued to be published. The continually growing interest in this report series is reflected by an increase of eleven countries with 31 institutes since the last NDS report to INDC who have contributed to this series.

NDS continued the publication of CINDA, the basic international index to neutron reaction data, and of the quarterly International Bulletin on Atomic and Molecular Data for Fusion. This Bulletin is currently being distributed to approximately 1100 scientists and institutes in 26 Member States. The A+M bibliographic data base system has been completed; it allows the generation of the Bulletin and future publications of the CIAMDA index on atomic collision data, as well as to perform selective retrievals upon request. The services of NDS have continued to be advertised to its customers by the "IAEA Nuclear Data Newsletter" of which about 2000 copies are distributed about twice a year. Documentation reports, issued in the IAEA Nuclear Data Services report series, are now available for all data files maintained by NDS.

First direct contacts with several nuclear institutes performing nuclear data research in the People's Republic of China were made in the course of a duty travel, which NDS staff member K. Okamoto performed in July 1982, following an invitation by the Chinese atomic energy authorities. While not a Member State of the IAEA, the People's Republic of China is a major producer and user of nuclear data, and a fairly large number of measured and evaluated data of excellent quality has been supplied to NDS on an exchange basis.

A. INDC Secretariat

A.1. Liaison Officers of the INDC

The following changes in the membership of INDC Liaison Officers have occurred in the course of this reporting period:

Iran	Dr. M.A. Etemad Membership discontinued
Israel	Dr. S. Yiftah reinstated as Liaison Officer after termination of INDC membership

The current list of INDC Liaison Officers, comprising scientists from 38 Member States, is given in Appendix A.

A.2. List of Correspondents

The current list of INDC correspondents for the exchange of nuclear data information is planned to be issued in May 1983.

A.3. List of Documents

The current list of INDC documents received and distributed by the INDC Secretariat is to be published as INDC(SEC)-85/UN in April 1983.

The INDC Secretariat is continuously concerned that many nuclear physics reports related to the measurement or evaluation of nuclear data, such as laboratory reports generated in participating Member States, do not get the adequate dissemination they should have. It therefore urges all those responsible for the dissemination of nuclear data information to distribute more documents through the established INDC channels (L, U and N distribution).

A.4. Translation of Documents

Subject to available funds, the IAEA translates a limited number of INDC reports submitted by the Soviet Union in Russian. During the reporting period 12 nuclear data reports of Soviet Union origin have been translated by the IAEA into English and distributed as INDC documents. Their full titles are given in the latest List of INDC Documents, INDC(SEC)-85/UN, to be published in April 1983.

A.5. Compilation of National Nuclear Data Committees

The 1983 issue of the Compilation of National Nuclear Data Committees will be published as INDC(SEC)-86/LNQ and will be distributed in April 1983. It supersedes the 1981 compilation, INDC(SEC)-81/LNQ.

In view of the turn-over of national nuclear data committee memberships, INDC Members and Liaison Officers are urged to ascertain that all members of those committees are included in the list of INDC Correspondents (see A.2. above).

B. Meetings Sponsored by NDS (September 1981 - February 1983)

B.1. IAEA Consultants' Meeting on Uranium and Plutonium Isotope Resonance Parameter Data for Nuclear Reactor Safety, Vienna, 28 September - 2 October 1981

This meeting had the objectives of reviewing accuracy requirements and current status of evaluated data, and assessing the needs for future work. The scope of the meeting included resolved and unresolved resonance parameters for ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu. The proceedings of this meeting were published as INDC(NDS)-129.

Concerning accuracy requirements, various approaches for the specification of accuracies were discussed. It was considered impractical to use full covariance parameters for this purpose; instead it was felt that for thermal reactor applications the uncertainty in the parameters of the lowest lying levels that dominate the thermal region, and resonance integrals could be used to specify accuracy. Similarly, for fast reactor applications it was felt that accuracy could be specified in terms of the uncertainty in infinitely dilute cross sections in conjunction with self-shielding factors and their derivatives with respect to temperature. INDC(NDS)-129 contains detailed requirements for each isotope.

Concerning the current status of evaluations, it was found that many of the more important experimental results are still not included in current evaluations, e.g., only one evaluation considered Moore's polarization measurement. In addition, experimental data in many cases have not been analyzed using a multilevel formalism; the use of the single level formalism plus non-smooth background correction necessitates the use of kernel Doppler broadening and thus eliminates most of the advantage of a resonance parameter representation.

Concerning needed future work, it was felt that much remains do be done in order to achieve the accuracies required; INDC(NDS)-129 contains a detailed list of future experimental measurements and data analysis that should be performed. It was felt to be particularly important that future evaluations include uncertainty information.

B.2. Fourth Research Coordination Meeting on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data, Vienna, 12-13 October 1981

See Section C.4.1.

B.3. Fourth Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data, Vienna, 12-13 October 1981

See Section C.4.2.

B.4. Advisory Group Meeting on Nuclear Data for Radiation Damage Assessment and Related Safety Aspects, Vienna, 12-16 October 1981

The main objective of this meeting was to review the requirements for and the status of nuclear data needed for the determination of

radiation damage in reactor structural materials, and to develop recommendations to the Nuclear Data Section of the IAEA for its future activities in this field. The meeting was attended by 34 participants from 15 Member States and two international organizations.

The participants identified a number of data needs in this field which were formulated in the conclusions and recommendations published in INDC(NDS)-128/GR. The major recommendation to NDS was to develop within the next three years a new Reactor Radiation Damage Nuclear Data File having an international reference status. The participants also outlined the contents of this future file. Full texts of the papers presented at the meeting were published in the IAEA technical document series as TECDOC-263.

B.5. Course on Advances in Nuclear Theory and Nuclear Data for Reactor Applications, ICTP Trieste, 25 January - 19 February 1982

This course, a follow-up of two similar courses held in 1978 and 1980, was jointly organized by the IAEA Nuclear Data Section and the International Centre for Theoretical Physics (ICTP). It constituted Part I of the 1982 ICTP Winter College on Nuclear Physics and Reactors, was funded within the programme of the ICTP and held at the ICTP in Trieste from 25 January to 19 February 1982. It was directed by J.J. Schmidt, assisted by V.G. Pronyaev and D.E. Cullen, from the IAEA Nuclear Data Section, and Dr. M.K. Mehta from the Bhabha Atomic Research Centre, Bombay, India, with local assistance by Profs. H. Dalafi and L. Fonda from the ICTP Trieste.

The main purposes of this Course were to review recent progress in the theory of low-energy neutron nuclear reactions, to introduce new advanced nuclear model computer codes, and to review the nuclear physics and data bases needed for thermal reactor physics design and safety analysis; the latter being topics treated in the second course of this college. The Course was held at an advanced level and was addressed to nuclear scientists from "nuclear-going" developing countries as a contribution to the formation of scientific infrastructure in nuclear science and technology.

The programme of the Course was conducted in the form of invited lectures and extended topical discussion sessions, part of which were introduced by special seminars which selected participants were asked to present. In the framework of ICTP's very useful new lecture series on "Physics and Development", Dr. Mehta and several participants gave very informative lectures on nuclear physics research in their respective countries and its impact on their national industry and economy. Using the presence of 21 scientists from 14 developing countries who are engaged in the Agency's Interregional Project TC/INT/1/018 on Nuclear Data Techniques and Instrumentation, three lively discussion sessions were devoted to technical questions connected with work for this project. These discussions resulted in several useful suggestions to enhance cross-fertilization between the institutions participating in this project.

The course was attended by a total of 73 scientists from 23 developing (70), two developed (2) countries and one international organization (1). Almost all participants who hold advanced university degrees, are engaged in teaching and/or research at universities or scientific institutes; they were able to use the information conveyed by the course lectures directly in their research and/or teaching curricula.

While this course was particularly successful in achieving intensive interaction between lecturers and participants, it was regretted by many participants that workshops with computer code exercises could not be held due to the presently limited computer facilities of the ICTP.

ICTP is interested, in co-operation with the Nuclear Data Section, to continue its activities in applied nuclear theory and nuclear data, and agreed to hold an intensive computer-oriented workshop on Nuclear Model Computer codes in the beginning of 1984, with a limited number of well-tutored participants (25-30) from developing countries. This workshop will concentrate on the evaluation of the results and problems connected with the large transfer of nuclear model codes to nuclear science institutions in developing countries achieved as a result of the 1978, 1980 and 1982 courses. The Nuclear Data Section will co-operate with the ICTP in organizing and running this workshop.

A detailed report on the 1982 Course has been distributed to INDC participants as document INDC/P(82)-3.

B.6. Sixth Meeting of the Nuclear Reaction Data Centres, Vienna, 3-7 May 1982

The purpose of the meetings of the Nuclear Reaction Data Centres (NRDC) network is to coordinate the data compilation and exchange between the four neutron data centres as well as several centres specialized in charged-particle data or photonuclear data. In particular, it is the forum to discuss the maintenance and further development of the commonly operated systems and exchange procedures of CINDA, EXFOR, WRENDA, ENDF/B and others. Meetings are no longer held annually, but at approximately 18 months' intervals.

The Sixth NRDC Meeting (combining the 17th meeting of the neutron data centres and the 7th meeting of the charged-particle data centres) was held in Vienna, 3-7 May 1982. A detailed report describing the results of the meeting is available as INDC(NDS)-141.

Some of the more important topics discussed at this meeting are:

1. Error analysis in data compilations

Data compilers are advised to compile in EXFOR (but also in the text part of ENDF/B formatted evaluated data) detailed information on error analysis, experimental corrections, standards, etc., and to inquire with the authors when such information is not available. EXFOR has the required features to include such information. Some format improvements agreed earlier, by which different error values (statistical error, several systematic errors) were made computer-intelligible, were found to function well.

2. Developments in charged particle nuclear data compilation

The Karlsruhe charged-particle data centre KACHAPAG, which has been the most active of the five charged-particle compilation centres/ groups, has ceased its operation. At the same time the US NNDC discontinued the production of the "charged particle data bibliography" which has served as the charged-particle CINDA. Both of these activities were discontinued due to the lack of financial support. There is, however, sufficient interest in charged-particle data, and there is hope that other centres will take up the work discontinued by KACHAPAG and NNDC. However, nothing definitive can be said at this time.

3. Evaluated data

In view of the fact that ENDF/B had been established as international exchange format and NDS had started to compile the IAEA Evaluated Nuclear Data Library INDL in ENDF/B format, a special session of the NRDC meeting was devoted to matters, definitions and computer codes related to ENDF/B. It was resolved that a mechanism must be found to guarantee the coordinated development of ENDF/B codes and rules in order to avoid the development of different ENDF/B versions.

B.7. Advisory Group Meeting on Nuclear Structure and Decay Data, Zeist, Netherlands, 11-14 May 1982

The international NSDD Network, consisting presently of 16 evaluation groups in 11 Member States and 2 international data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric mass-chains on a four year cycle, the continuous publication of these evaluated data, and their dissemination to the scientific community. This international cooperative effort is coordinated jointly by NDS and NNDC Brookhaven.

The periodic meetings of the international NSDD network have the objective of maintaining the coordination of all centres and groups participating in the compilation and evaluation 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. The fifth meeting of this network was attended by 24 scientists from eleven Member States and two international organizations. The meeting proceedings have been published in INDC(NDS)-133/NE.

The meeting

- reviewed the status of the international NSDD Network, the progress of mass-chain evaluations, and the current mass-chain evaluation assignments. It concluded that even though a mass-chain evaluation cycle of four years had not yet been achieved, the overall progress was satisfactory.

- adopted priority criteria in the choice of mass-chains to be evaluated.

- reviewed and adopted revised procedures for mass-chain evaluation and procedures for the review of mass-chain evaluations prior to their publication.

- reviewed the status of the Nuclear Structure Reference File and of the Evaluated Nuclear Structure Data File (ENSDF), and discussed procedures for updating these files.

- reviewed and adopted formal procedures for the approval and adoption of format change proposals and/or procedural changes for ENSDF and the Nuclear Data Sheets publication.

- agreed on a geographical distribution of the responsibility to provide NSDD user services.

- discussed the physics of NSDD evaluation including ENSDF physics data processing codes, came to a number of agreements with regard to terminology, and made substantial physics recommendations aimed at the improvement of the standards and rules governing NSDD evaluation.

B.8. Technical Co-operation Training Course on the Utilization of Neutron Generators, Debrecen, Hungary, 7 June - 9 July 1982

The IAEA TC Interregional Training Course on the Utilization of Neutron Generators, organized jointly by the IAEA Technical Co-operation, the Nuclear Data Section and the Institute of Experimental Physics of the Kossuth University and assisted by the Agency's Physics Section, took place at the Institute of Experimental Physics in Debrecen, Hungary.

This course was to enable the participants to achieve the required expertise in fast neutron data measurements, using neutron generators which have been supplied by the IAEA to a number of Member States, in the study of neutron interactions with reactor materials and in technological applications of immediate benefit to their countries. The course lectures were supplemented by laboratory exercises on a variety of practical applications of neutron generators.

The course was attended by 24 participants from 23 developing countries. A comprehensive summary of this course has been written up in INDC/P(82)-5 (11 August 1982).

B.9. First Research Coordination Meeting on A+M Collision Data for Plasma Diagnostics, Vienna, 21-25 June 1982

See Section C.4.4.

B.10. Fifth Research Coordination Meeting on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data, Geel, Belgium, 2-3 September 1982

See Section C.4.1.

B.11. Fifth Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data, CBNM, Geel, 1-3 September 1982

See Section C.4.2.

B.12. Third Meeting of the A+M Data Centre Network, Vienna, 1-3 November 1982

The meeting was attended by five representatives of centres from four Member States concerned with the coordinated international management of atomic and molecular data pertinent to controlled fusion research and technology. The summary report of the meeting is published in INDC(NDS)-140/GA.

The following conclusions were reached:

- Having completed the internal computer system for the IAEA A+M bibliographic data base, IAEA formally offered to provide other centres with selective bibliographic retrieval services, and to make available the entire A+M bibliographic data base system to other centres upon request.

- Recognizing the need for improved literature coverage in the field of plasma-wall and other surface interaction data for the A+M Data Bulletin, the data centres encouraged the support that could be provided by the Fachinformationszentrum in Karlsruhe, Federal Republic of Germany, in this respect.

- Discussed the publication of the next CIAMDA atomic collision data index, and agreed to have its publication deferred until 1985. Provisionally, IAEA agreed to provide the other data centres with a current compendium of A+M collision data references which would complement the CIAMDA-80 publication.

- IAEA agreed to provide other data centres with an index to numerical and bibliographic A+M data available at each of the data centres in the network, and to publicize this information in the A+M Data Bulletin.

- The participating centres, present at the meeting, discussed the adoption of an EXFOR-type format for the exchange of data between A+M data centres, agreed to participate in the conceptional development of an EXFOR-type format for A+M data, and investigated the adaptability of such an EXFOR transmission format within their own data centre environments.

B.13. Second Meeting of the IFRC Subcommittee on Atomic and Molecular Data for Fusion, Vienna, 4-5 November 1982

The second meeting of the IFRC Subcommittee on A+M Data for Fusion was attended by five of the eight members of the Subcommittee and one member substitute, and staff of the IAEA Nuclear Data Section.

While a more detailed account of the meeting proceedings is given in the Summary Report of the meeting INDC(SEC)-84/GA, the main conclusions and recommendations made by the Subcommittee are summarized in Appendix B.

B.14. Technical Committee Meeting on Research Reactor Production of Radioisotopes, Vienna, 15-18 November 1982

This Technical Committee Meeting was convened by the Chemistry and Industrial Applications Section of the IAEA. K. Okamoto of the Nuclear Data Section participated in the meeting and chaired the Working Group on Nuclear Data.

The meeting

- reviewed and assessed the current status of the relevant nuclear data as well as reactor neutron spectra in order to identify possible gaps in nuclear data for reactor production of medically important radioisotopes.

- analyzed and discussed optimal reactor core management practices and irradiation schedules for an optimization of the production yields with research reactors having relatively low neutron flux.

- discussed the most suitable target compositions and post-irradiation target chemistry.

- discussed economical aspects associated with radioisotope production programmes at nuclear research centres.

The proceedings of the meeting will be published by the Chemistry and Industrial Applications Section. The Meeting Summary is being issued as an INDC/P(83) report.

C. Nuclear Data Assessment and Co-ordination

C.1. Interregional Project on Nuclear Data Techniques and Instrumentation (TC/INT/1/018)

NDS has continued to conduct the Technical Cooperation Interregional Project (IP) TC/INT/1/018 "Nuclear Data Techniques and Instrumentation". The main objective of the IP is the transfer of the technology and know-how required for nuclear data measurements and development of nuclear instrumentation and techniques to less advanced laboratories and also the promotion of collaboration between institutes. The number of developing countries and laboratories currently involved in the project is now 23 and 27 respectively. Nine institutes in seven developed countries are actively participating by hosting fellows and sending experts; two others are providing targets and samples. A list of presently actively participating countries and institutes is given in Appendix C. Since the beginning of the IP in 1981 eight expert missions to 37 institutes in 12 developing countries have been performed. For training purposes eleven scientists from Algeria, Bangladesh, Brazil, Chile, Hungary, Pakistan, Poland and Turkey received fellowship awards (seven) or undertook scientific visits (four) involving 13 host laboratories in six developed

and two developing countries. Auxiliary equipment and special materials (targets and samples) were supplied to 15 institutes in 13 developing countries to assist them in the start-up phase of their measurement programmes.

For 1983, assistance will continue to be provided to less-advanced laboratories through short-term expert missions, training fellowships and scientific visits, and the supply of special project-related materials and equipment. In view of the interest expressed by developing Member States, the project will be extended through 1985. Special emphasis will be placed on promoting co-operation in the field of neutron data measurement technology among laboratories in developing countries working at various levels.

C.2. Technical Co-operation Mission to Greece

In the framework of the Interregional Project described under C.1. N.P. Kocherov visited the "Demokritos" Centre in Athens, Greece, during a Technical Co-operation expert mission. The Tandem Accelerator Laboratory of this Centre which has initiated work on neutron physics measurements has expressed its willingness to participate in the IP. As part of future research to be undertaken in context of the IP, the group is ready to receive fellows and co-operate with other groups working on the measurement of (n, charged particle) reactions. The situation looks very promising since a number of laboratories (e.g., in Poland, Yugoslavia and Austria) have shown interest to participate in such measurements. The group will start work after the receipt of auxiliary equipment, partly to be supplied by the IAEA.

C.3. Targets and Samples

NDS continued to provide some limited assistance in the supply of targets and samples required by laboratories in developing countries for nuclear data measurements requested in WRENDA.

The following table summarizes the target and sample contracts concluded and/or paid for in 1981 and 1982.

Contract	Country	Samples	Price US-$	Comments
RC/NDS/558	Pakistan	^{237}Np ^{241}Am	8 440.-	Delivered and paid
RC/NDS/557	Bolivia	$^{235,238}U$ ^{232}Th	3 312.-	Delivered and paid
RC/NDS/577	Bolivia	Pb natural	492.-	Delivered and paid
RC/NDS/560	Egypt	$^{239,240}Pu$	3 420.-	Obligated
		Total:	$ 15 664.-	

C.4. Co-ordinated Research Programmes (CRP)

C.4.1. CRP on the Intercomparison of Actinide Neutron Nuclear Data Evaluations

The fourth and fifth meetings of this CRP were convened at the IAEA in Vienna, 12-13 October 1981, and at Geel, Belgium, 2-3 September 1982.

This CRP which has been terminated at the end of 1982, was composed of 13 participants from 10 countries: France (2 labs), German Democratic Republic, Germany Federal Republic (2 labs), India, Israel, Italy, Japan, Romania, UK, USSR (2 labs). Most of the participants produced evaluations for one or more nuclides, and intercompared it with available evaluations. The results are available in published laboratory reports. Other participants concentrated on intercomparison by graphical or computational means, on nuclear theory, or on precise determination of fission cross sections. During the CRP meetings, evaluation methods and theoretical models were discussed.

The evaluations are stored in the computer file INDL/A (IAEA Nuclear Data Library for Actinides), which is not a library of recommended evaluations. It is rather

- a working file which has been frequently revised in the course of the CRP, as well as
- a collection of existing evaluations with several evaluations per nuclide in many cases.

The library is described in the documentation report IAEA-NDS-12 (Rev. 7) to be issued in the spring of 1983.

C.4.2. CRP on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data

This CRP aims specifically at improving the quality and accuracy of nuclear decay data required to calculate the effects of transactinium isotopes on the fuel cycle of both thermal and fast reactors, to assess their impact on nuclear waste management, to improve the accuracy of safeguard techniques, and to improve the knowledge of their nuclear characteristics required in many applications in science and industry.

The participants in this CRP meet annually to review the status of measurements performed by the participants in this programme, to review the current status and accuracy of gamma-ray and alpha emission spectra for the heavy element radionuclides and to update the list of heavy element radionuclide half-lives, which is published regularly by the IAEA. The Meeting Summary of the last meeting of this CRP is described in the report INDC(NDS)-138/GE, and the latest list has been published in INDC(NDS)-139/NE.

The final report of this CRP, which will consist of a comprehensive summary of the current status of heavy element

radionuclide decay data, will be published by the IAEA in the Technical Report Series after the termination of this programme at the end of 1984.

C.4.3. CRP on the Evaluation of Atomic Data Pertinent to Plasma-Wall Interaction Processes

This CRP, conducted by R.A. Langley, was a one-year project which was completed during calendar year 1981. The compendium of data for plasma-surface interaction which resulted from this CRP is to be published in the Agency's Nuclear Fusion Journal.

C.4.4. CRP on Atomic Collision Data for Diagnostics of Magnetic Fusion Plasmas

The objectives of this CRP concentrate on the calculation and evaluation of collision processes which have been identified to have the highest priority (INDC(SEC)-77/GA), namely

- electron impact ionization,
- electron excitation, and
- electron capture.

At the first meeting of this CRP, the participants reviewed the overall status of electron collision data of importance to the diagnostics of magnetic fusion plasmas. From the point of view of reliability and presently accepted accuracies, the CRP could identify only certain electron impact ionization data which could be recommended to be used by the fusion community at this time. The accuracy of these data could be taken to be $\pm$ 10 %.

The summary report of this meeting has been released as INDC(NDS)-136/GA.

C.4.5. CRP on the Measurement and Analysis of 14 MeV Neutron Nuclear Data needed for Fission and Fusion Reactor Technology

The objectives of this CRP are to train nuclear scientists from developing countries in nuclear data techniques as well as to improve the status and accuracy of 14 MeV neutron nuclear data, by specific measurements at established facilities, including careful validation and error analysis and, where possible, a comparison with other experimental or theoretical evidence.

Following the endorsement of NDS's proposal of this CRP at the 12th INDC Meeting in October 1981, and internal IAEA approval, research contracts and research agreements were concluded or are under preparation with neutron generator groups from 12 developing and four developed countries.

The scientific scope of the CRP comprises the measurement and analysis of 14 MeV neutron scattering and reaction cross sections and secondary particle energy and angular distributions.

The work envisaged under the research contracts and agreements covers a large range of WRENDA 81/82 requests for a variety of structural and other nuclear technology materials mainly for the following reaction types:

(n,p), (n,np), (n,α), $(n,2n)$, (n,t), $(n,^3He)$,
(n,p), $(n,p)(E_p,\theta_p)$, (n,nem) $(E;\theta)$, $(n,totaly\gamma)$ $(E\gamma)$.

An additional proposal by R.C. Haight from Lawrence Livermore National Laboratory, USA, which was found to be of interest to a number of CRP participants particularly from developing countries, is intended to be pursued as part of the CRP. It consists of irradiating specific isotopic samples in LLNL's intense neutron source RTNS-II, producing long-lived activities, and circulating the irradiated samples to interested laboratories participating in the CRP for counting and analysis. This procedure would allow a check of the measuring systems used in different laboratories.

The presence of ten principal investigators of the CRP at the Antwerp Conference in September 1982 was used to convene two special meetings to discuss details of the programme of the CRP and to fix the date and place of the first Research Coordination Meeting for Gaussig near Dresden, German Democratic Republic, for November 1983. Prof. J. Csikai led the discussions of these two special meetings and summarized the conclusions in document INDC/P(83)-2.

C.5. Research Contracts

The following new research contracts not associated with any of the aforementioned CRPs have been let:

Contract # 3004: Dr. M. Adib Shihata (Egypt)

Study of the transmission of poly- and mono-germanium crystals for thermal neutrons at different temperatures.

Contract # 3015: Dr. L. Vasvary (Hungary)

Development of a time-of-flight spectrometer for the measurement of secondary neutrons and gamma-rays.

Contract # 3114: Dr. Z. Boedy (Hungary)

Quality assessment and consistency check of measured (n, charged particle) nuclear data up to 20 MeV, including the range of resonances.

C.6. Nuclear Data for Radiation Damage Estimation

C.6.1. REAL-80

The aim of the REAL-80 project is to determine the impact of the uncertainties in input data on the radiation damage estimates of reactor components; it is a first step in the standardization of the methods and nuclear data used for the determination of radiation damage.

At the beginning of 1981, data for the first round of the REAL-80 project, which involved the analysis of the ORR and YAYOI reactors, were distributed to 25 participants. Emphasis of this first round focussed on the calculation of a limited number of integral quantities, e.g. nickel activation and iron displacement rates. Subsequent rounds will concentrate on more complex quantities used in unfolding codes, e.g., spatially dependent self-shielding factors. Results of the first round of REAL-80 will be published in an INDC report in the spring of 1983.

The results of the REAL-80 exercise have clearly illustrated that the present state of the art in spectrum unfolding is such that there are large differences in the unfolded spectra calculated by different codes, and there are even larger differences in the results (displacements per atom) calculated by the same code using different input options. These results suggest that it is worth continuing this project in an attempt to improve the consistency of the results obtained from unfolding codes. Therefore, a second round of comparisons, with the preliminary title REAL-84, is planned to be initiated in the course of this year. REAL-84 will focus both on improving the unfolding codes and investigating the sensitivity of results to the use of several different nuclear data evaluations.

C.6.2. The International Reactor Dosimetry File (IRDF)

The first version of the IRDF-82 library was distributed in January 1982 in a 620 group format (described in documentation report IAEA-NDS-41) and in June 1982 in continuous energy form (described in documentation report IAEA-NDS-48). This library consists of two separate parts, dosimetry cross sections and benchmark spectra. The dosimetry cross sections contained in IRDF-82 include the entire ENDF/B-V dosimetry library with additional dosimetry reaction evaluations contributed by H. Vonach, B. Patrick, A. Marcinkowski and W. Zijp. The benchmark spectra contained in IRDF-82 consist of ten spectra submitted by C. Eisenhower, L. Greenwood and B. Goel.

C.7. Nuclear Data for the INTOR Fusion Reactor Project

In response to a request from the International Fusion Research Council (IFRC), NDS has compiled a preliminary data file of neutron reaction data for fusion reactor calculations. This initial file is composed of the best available evaluated data from various sources; at a later stage, it will be expanded as needed, incorporating newly measured and evaluated data. The current content of the file, stored in ENDF/B format, consists of data for those elements and isotopes which have been identified by the INTOR workshop to be of current importance; a list of the required data is given in INDC/P(81)-26 (September 1981).

In addition to the data compilation activity, NDS has compiled all available bibliographic information on references describing benchmark and integral experiments for fusion reactor applications. The compilation of the numerical data for these experiments in a computerized format will require a considerably larger effort.

C.8. Nuclear Data for Safeguards

A comprehensive survey of analytical methods applied in nuclear material safeguards as well as of the nuclear data in the application of these methods was presented at the 12th INDC meeting in INDC/P(81)-24.

Discussions are under way with staff of the Agency's Safeguards Department to determine the scope and content of a compendium of consistent nuclear data for universal use in the application of safeguards methods which is planned to be published in the form of an IAEA report. A consultants' meeting on nuclear data for safeguards is planned to be held in 1984.

C.9. Fission Product Nuclear Data (FPND)

Annual Progress Report Series

News on activities in the field of FPND are continued to be published as INDC(NDS)-Reports "Progress in Fission Product Nuclear Data". The 7th issue was published as INDC(NDS)-116 in June 1981, the 8th issue as INDC(NDS)-130 in July 1982. The continually growing interest in this report series is reflected by the increase in the number of contributions, contributing countries and institutes and by the requests received for these reports. Since the last NDS report to the INDC eleven additional countries with altogether 31 additional institutes have contributed to this series.

C.10. Nuclear Data Standards for Nuclear Measurements

The NDS, in cooperation with H. Condé and A.B. Smith of the INDC, has compiled the 1982 INDC/NEANDC Nuclear Standards File, and submitted it to be published as an IAEA Technical Report with the title "Nuclear Data Standards for Nuclear Measurements". The report is expected to be published mid-year 1983.

The 1982 INDC/NEANDC Nuclear Standards File, which is the product of the INDC Standards Subcommittee and the counterpart subcommittee of the NEANDC, consists of recommended reference values and status summaries for fifteen nuclear data standards. The narrative summaries which describe the current status of each of the standards, including references to recent relevant work and areas of continuing uncertainties, were prepared under the auspices of the INDC by outstanding specialists in the respective fields. The Table of Content of this report is given in Appendix D.

The large majority of the recommended numerical data for the *standard cross sections included in the report is taken from ENDF/B-V*, produced by the U.S. Cross Section Evaluation Working Group. The remainder of the numerical data are evaluations undertaken by individuals or groups closely connected with nuclear data activities promoted by the INDC and NEANDC. Generally, the numerical data tables include quantitative definitions of the data uncertainties and some guidelines for their appropriate usage.

C.11. WRENDA

NDS co-ordinates the compilation of the requests to be included in WRENDA and publishes the WRENDA document on behalf of the four neutron data centres every second year. WRENDA 81/82 was published in July 1981, WRENDA 83/84 is planned to be published in summer 1983. The WRENDA list is being heavily used for planning of work under the Interregional Project INT/1/018 and under the "14 MeV CRP".

C.12. Nuclear Activation Data Handbook

In view of the successful sales of the IAEA "Handbook on Nuclear Activation Cross-Sections", published in 1974, and in response to recent requests, as well as to comments that the information contained in the 1974 Handbook is outdated, the IAEA/NDS plans to publish a new edition of this handbook.

In addition to the main topics of the 1974 handbook (neutron, charged particle and photonuclear activation cross sections), the new handbook shall have a section on standard reference data pertinent to activation analysis and shall as much as possible contain the most recent evaluated data or recommended best values and their uncertainties. The data shall be presented in tabular form, supplemented by graphs where deemed necessary. It is planned to have the handbook organized and indexed for optimum user convenience.

The draft outline of this Handbook is given in Appendix E.

C.13. Invited trip to the People's Republic of China

On the invitation of the People's Republic of China, K. Okamoto (NDS staff member) visited the Beijing Research Institute of Atomic Energy, the Institute of High Energy Physics (Beijing), Beijing University, the Lanzhou Research Institute of Modern Physics, Lanzhou University, the Shanghai Institute of Nuclear Research and the Accelerator Research Institute in the Vanguard Factory (Shanghai), from 4-18 July 1982.

While not a Member State of the Agency, the People's Republic of China is a major producer and user of nuclear data, and a fairly large number of the results of their measurements and evaluations has been supplied to IAEA/NDS on an exchange basis. These data are of excellent quality and have raised significant interest among many scientists in Member States. The duty travel of K. Okamoto to the major nuclear physics institutes in China, performed at their invitation, was therefore of timely interest and benefit to the Agency and its Member States. The quality of the Chinese nuclear data technology has now reached a very high standard, and the improvement in their facilities and development of new equipment indicate a rapid advancement of their nuclear research activities. However, their work in the nuclear data field is still considerably hampered by the lack of adequate computing facilities. Throughout the discussions held with senior scientists on future co-operation in the field of nuclear data, it was apparent that Chinese scientists have a great interest in the NDS programme, and expressed their desire to participate in NDS activities.

In addition to the numerous technical reports given to K. Okamoto during his visits, the most successful result of his trip was to obtain the release of part of the Chinese Evaluated Nuclear Data Library, CENDL-1, which was given to him in Beijing in the form of a listing, and later supplied through the Embassy of the People's Republic of China in Vienna on magnetic tape.

A comprehensive account of K. Okamoto's trip to the People's Republic of China has been given in INDC/P(82)-6 (October 1982).

D. Data Centre Activities

D.1. Nuclear Reaction Data

D.1.1. Experimental Data

EXFOR continues to function as a comprehensive system for the international exchange of experimental nuclear reaction data, primarily data for neutron reactions, but also for reactions induced by charged particles, heavy ions, photons and selected related nuclear data such as decay constants, nuclear temperatures and spontaneous fission yields. Compilation of neutron reaction data is comprehensive, the compilation of the other data is selective.

Data compilation continues in close co-operation with the authors who acknowledge the critical review of their data by NDS during compilation. Authors receive proof-copies of their data as retrieved from EXFOR and, since recently, graphical plots of their data plotted with other experimental or evaluated data wherever possible.

During a large part of 1982 almost no EXFOR data could be compiled due to the vacancy of a post. The workload due to the continuous increase in data requests and other top-priority work is such that NDS staff can no longer absorb the vacancy of a post, so that EXFOR compilation had to be interrupted.

D.1.2. Evaluated Data

Since the adoption of ENDF/B as the international format for the exchange of evaluated data, NDS has initiated the IAEA Evaluated Nuclear Data Library INDL to serve the following purposes:

a) to collect evaluations that are not part of one of the large recognized libraries; these evaluations would not be generally accessible if they were not made available through INDL,

b) to store the SOKRATOR and BOSPOR libraries, and a collection of evaluations compiled earlier in EXFOR format (Subfile INDL/V documented in IAEA-NDS-31 Rev. 2), which have been converted to the ENDF/B format,

c) to store the secondary actinide evaluations (Subfile INDL/A documented in IAEA-NDS-12 Rev. 6) resulting from the co-ordinated research programme on the intercomparison of secondary actinide neutron nuclear data evaluations (see C.4.1.),

d) to store the International Reactor Dosimetry File "IRDF" consisting of recommended data for 38 neutron reactions used for reactor neutron dosimetry by multiple foil activation (see C.6.2.).

It should be noted that INDL (with the exception of the IRDF Subfile) does not have the status of a comprehensive and internally consistent library of recommended evaluations. It is a collection of existing evaluations of varying quality. Updates and corrections are issued approximately once a year. Although the overall quality of the INDL library has been improved with the use of ENDF/B checking codes, some difficulties remain because the evaluations produced by evaluators do not always comply with the definitions acceptable in ENDF/B. Consequently some of the evaluations converted to ENDF/B format are not quite identical to the evaluations provided by the authors.

The 1982 version of INDL contains approximately 200 evaluations for 150 nuclides contributed from 13 institutes in 11 countries. However, so far only about 30 of the evaluations are "complete evaluations" covering all reactions in the full energy range from 0 up to 15 or 20 MeV.

There are other important evaluations, such as the neutron reaction data for carbon above 20 MeV, for which the ENDF/B format is not suitable. Evaluations such as these will continue to be stored in EXFOR format only, in the so-called "EXFOR-V" subseries documented in IAEA-NDS-34 Rev. 1.

D.1.3. CINDA

The compilation and publication of CINDA continues as a routine operation. It forms also the basis for the EXFOR compilation and completeness checks of the data files. Two issues of CINDA are published every year: the spring issue is cumulative for the period 1977 up to the present, the fall issue is a supplement covering the half year since the spring issue. The two-volume archival issue CINDA-A covering the time period before 1976 has not been reprinted since 1979.

D.1.4. Project for the verification of neutron cross section processing codes

In estimating the quality of evaluations and determining how to improve such evaluations, two common procedures used are (1) simply to look at the evaluated data in graphic and/or tabular form, or (2) to perform benchmark calculations. The ability to usefully employ these procedures, however, depends to a large extent on the ability of cross section processing codes to accurately reproduce energy dependent data (for example, from resonance parameters plus background cross section),

in order to accurately define group constants for use in benchmark calculations. Our ability to estimate the quality of evaluated data, therefore, is intimately connected with the accuracy of cross section processing codes. In the sequence of procedures that extend from the evaluated data files, through cross section processing, to application codes (such as SN or Monte Carlo transport), it is normally assumed that the cross section processing code is a fairly simple link in the sequence and introduces a negligible error. With this assumption, if we use a sufficiently accurate transport method, any difference that we see between calculated and experimental benchmark results can be attributed to uncertainty in the experimental benchmark results and errors in the evaluated data.

However, by comparing fine group cross section output generated by a variety of cross section processing codes it has been found that all of the codes tested introduced significant errors which were particularly large compared to the quoted uncertainties in the evaluated cross sections. In an initial comparison exercise, results were obtained from twenty-eight participants using the following ten different cross section processing codes:

ENTOSAN - Petten, Netherlands

RESEND/INTEND - Brookhaven National Laboratory, U.S.A.

LINEAR/RECENT/GROUPIE - Nuclear Data Section, IAEA, Austria

FOURACES - Bologna, Italy

Greenwood - Argonne National Laboratory, U.S.A.

RESENDD - JAERI, Japan

FEDGROUP-3 - Central Research Institute for Physics, Budapest, Hungary

FEDGROUP-C - Institut Jozef Stefan, Ljubljana, Yugoslavia

NJOY - Los Alamos National Laboratory, U.S.A.

AMPX - Oak Ridge National Laboratory, U.S.A.

Each participant was asked to use the ENDF/B-V, mod. 1 dosimetry library to create 620 group, cold (0^{o} Kelvin) unshielded cross sections, possibly one of the simplest quantities which can be derived from evaluated data. Results demonstrated that not one single participant was able to obtain agreement with our benchmark results in every group, for every reaction on their first try. The largest differences were found in the resolved and unresolved resonance regions. However, surprisingly large differences were found even for simple tabulated cross sections, particularly those which use non-linear ENDF/B interpolation laws.

The results of these comparisons demonstrate that it is not valid to assume that the existing cross section processing codes introduce a negligible error into the processed data. Therefore, unless these processing codes are improved, they will introduce additional errors in the interpretation of the results of benchmark calculations for data

testing, primarily in the resonance range. Also the validity of sensitivity calculations, which use the quoted evaluated data errors, could be questionable.

The NDS Cross Section Processing Code Verification Project is yielding positive results in the sense that once our comparisons indicate where the output from a given processing code differs from our benchmark results it has been relatively simple to locate and eliminate problem areas from the code. By working with the authors of processing codes and following the aforementioned approach we have been able to improve a number of processing codes to the point where they can accurately reproduce our benchmark results. At the end of March 1983 we will publish a status report on this project, including a list of codes which have, or have not, passed our benchmark tests.

D.2. Nuclear Structure and Decay Data

This programme component of NDS consists of two activities: the coordination of the international nuclear structure and decay data (NSDD) network, in co-operation with the National Nuclear Data Center (Brookhaven, USA), for the systematic evaluation of nuclear structure data, and the maintenance of a co-ordinated research programme (CRP) on the measurement and evaluation of transactinium isotope nuclear decay data.

The international nuclear structure and decay data (NSDD) network, consisting of numerous evaluation groups and data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric mass-chains on a four-year cycle, the continuous publication of these evaluations and their dissemination to the scientific community. The evaluated mass-chain data resulting from this concerted international effort are published in Nuclear Physics A and the Nuclear Data Sheets, and comprise the currently recommended "best values" of all nuclear structure and decay data. The international NSDD network has evolved from the long-standing cooperation between the US effort, initiated by the Oak Ridge Nuclear Data Group and presently coordinated by the National Nuclear Data Centre at the Brookhaven National Laboratory, and the effort at the Rijksuniversiteit at Utrecht in the Netherlands. The last meeting of this network was held in May 1982 (see Section B.7)

The activities of the CRP on transactinium isotope nuclear decay data are described in Section C.4.2.

D.3. Atomic and Molecular Data

The IAEA A+M bibliographic data base system, that is used to generate the IAEA A+M Data Bulletin and the CIAMDA data index, has been completed. Selective retrievals from the complete bibliographic data base can be performed on request from individual users. This data base continues to be updated by the systematic scanning of 137 journals. The IAEA A+M Data Bulletin has continued to be published on a quarterly basis, and is now distributed to approximately 1100 scientists and institutions in 26 Member States. Until now, more than 500 copies of the CIAMDA-80 data index have been sold. The next publication of CIAMDA is tentatively foreseen for 1985.

An EXFOR-like format for the inter-centre exchange of numerical A+M data has been developed by the A+M Data Unit and proposed to the A+M Data Centre Network for implementation. At the same time the A+M Data Unit has started to stimulate the exchange of atomic collision data which are being compiled by some of the co-operating data centres.

D.4. Data Centre Services

D.4.1. Documentation and User Services

The services of NDS are advertised to its customers by the "IAEA Nuclear Data Newsletter" of which about 2000 copies are distributed about twice a year in intervals that depend on the rate at which important new material is received at NDS. Attached to the Newsletter is a return postcard by which data, reports or other information can be requested.

In order to improve the data services offered to NDS customers, the receipt of new data files or updates to older files, initiates a search of the standing requests filed in the computerized Request Log, resulting in the despatch of the new data to the requestor.

Documentation reports, issued in the IAEA Nuclear Data Services report series (with report code IAEA-NDS-...), which describe the format and content of data files, are now available for all data files kept at NDS. These reports, kept up-to-date and continuously improved, are sent together with the date files requested from NDS.

Data retrievals in the EXFOR, ENDF/B and some other formats are available in "standard format" for computer processing, or in "edited format" for easy reading, either on tape or in the form of listings. Graphical computer plots can also be provided. These services are provided primarily to the NDS service area. The exchange of EXFOR, involving maintenance of EXFOR Dictionaries, checking of EXFOR transmission tapes and performing completeness checks, is a continuing inter-centre co-ordination activity of NDS.

D.4.2. Data Request and Dissemination Statistics

D.4.2.1. Data Request Statistics

As part of its function as a data centre, NDS disseminates on request nuclear data in computerized form, data processing computer programs and reports to Member States within its service area[1], as well as to other requestors in other countries. During 1982, NDS has received 713 requests, which amounts to approximately three requests per working day. For the definition of a "request" the reader is referred to report INDC(NDS)-124, p. 18.

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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.

Averaged over the years 1980, 1981 and 1982, NDS received an annual average of 588 requests. Of these:

9.9 % were for experimental data
25.2 % were for evaluated data
7.6 % were for data processing programs, and
57.3 % were for reports.

With regard to request origin,

7.0 % originated in area 1 (USA and Canada)
20.6 % originated in area 2 (Western Europe and Japan)
67.3 % originated in area 3 (NDS service area)
5.1 % originated in area 4 (USSR).

Request statistics for each of the considered categories, and statistics showing the total number of requests handled by NDS for each of the last 18 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 number for 1982 is the annual average over the years 1980, 1981 and 1982).

D.4.2.2. Data Dissemination Statistics

Data dissemination statistics show what NDS has sent out as a result of requests received; 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 nuclide in 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). Averaged over the years until 1979, and considering both experimental and evaluated data, a data set comprises an average of 184 data points or data records which would represent a typical data set. As shown on Figure 2, the number of nuclear data sets distributed per year (including experimental and evaluated data) has increased exponentially during the last 18 years.

The dissemination statistics for data, data processing codes and reports sent out during 1981 and 1982 are given in Table II.

Table I

Data Request and Distribution Statistics 1965 - 1982

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

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

Table II

Dissemination of numerical data, data processing programs, reports and tapes: Statistics for 1982

Sets of experimental nuclear reaction data (EXFOR subentries)	59 052
Sets of evaluated nuclear data	25 200
Total number of data sets (Experimental + Evaluated)	84 252
Dispatch of complete (non-EXFOR) data libraries	25
Dispatch of data processing computer programs	340
Total number of tapes dispatched to send (above) data and programs	230
Number of individual reports sent on request	734
Number of reports sent on distributions* (bulk shipment)	13 970

* Reports sent on distribution consist of INDC reports which are issued in the course of the year by NDS or Member States; during 1982, 64 individual INDC reports were distributed by IAEA/NDS.

Figure 1

Nuclear Data Request Statistics

(each step represents a 3-year average)

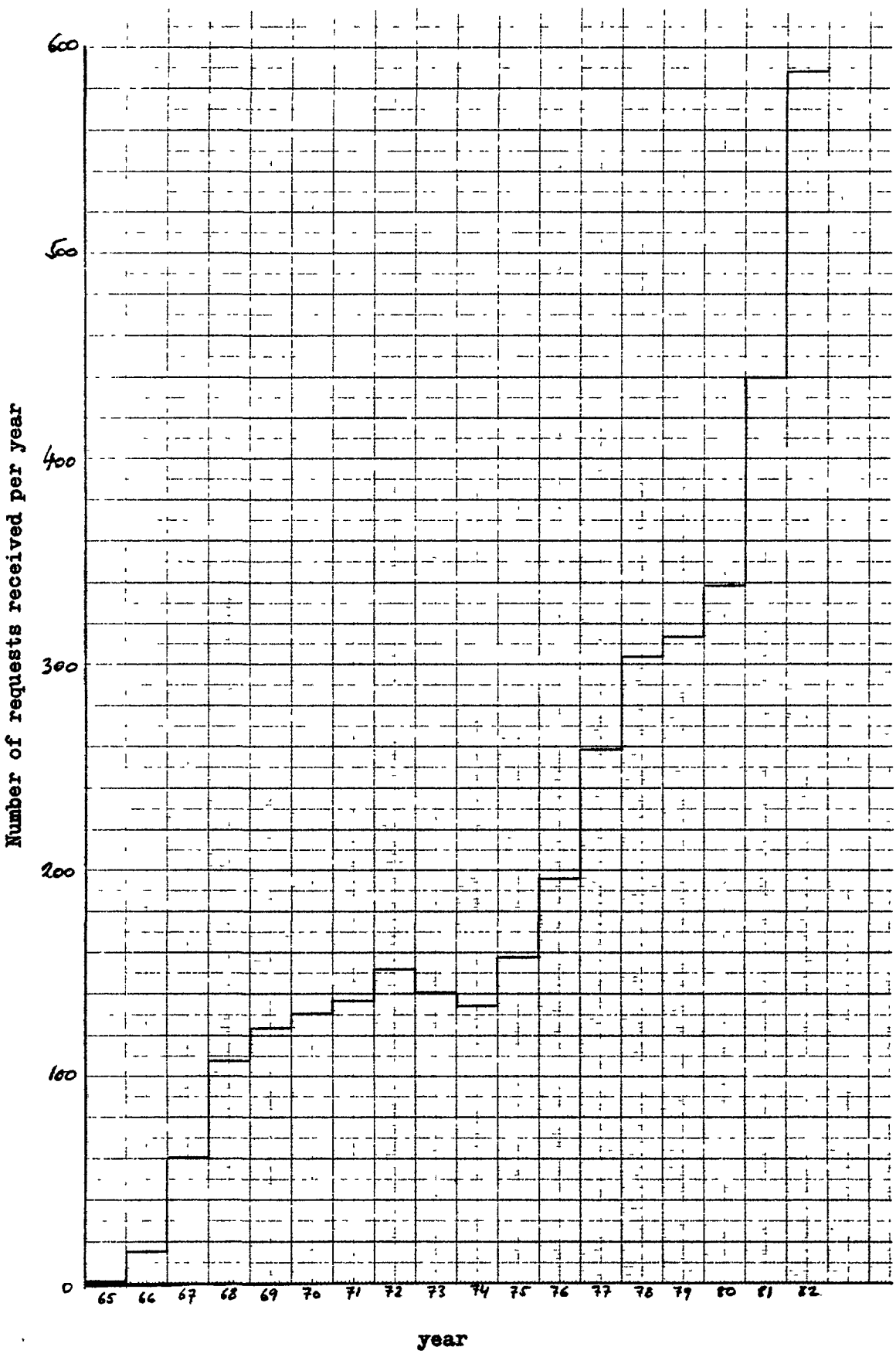
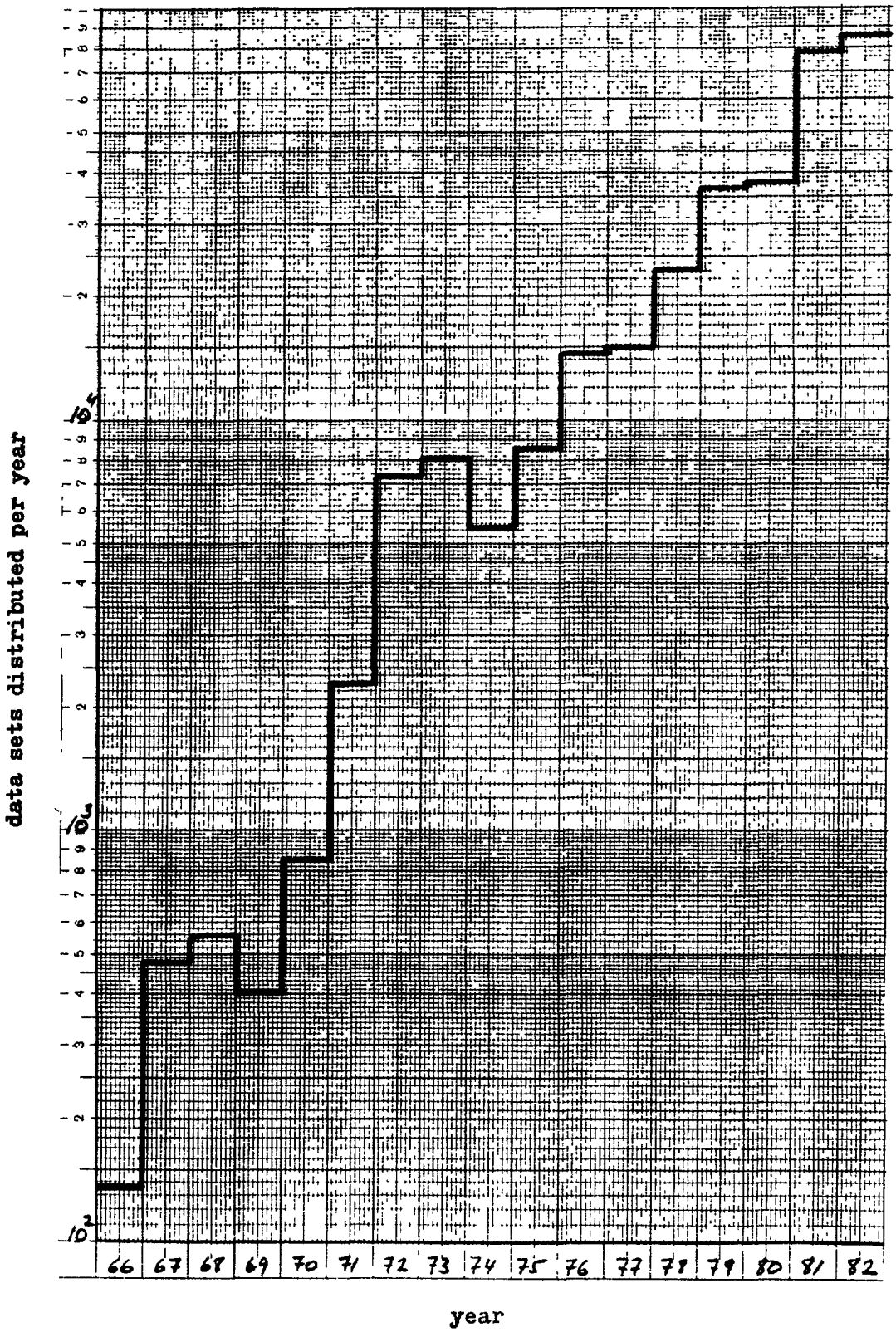


Figure 2

Numerical Data Sets Distributed per Year

(including experimental and evaluated data)



D.5. Programming and Systems Development

D.5.1. General

This period has been a time of consolidation and improvement under the present Agency policy of "zero growth" budget, coupled with the ever increasing size of the nuclear data libraries and number of requests from users for nuclear data. The only way in which it will be possible to maintain the quality of the data libraries and promptly respond to data requests will be by increased efficiency in the utilization of computer equipment.

In line with the above remarks, in an attempt to minimize the amount of manual data checking by NDS physicists, the data checking programs for evaluated data (in the ENDF/B format), EXFOR, CINDA and WRENDA have been significantly updated to improve automatic error detection. In addition, graphic output has been extensively used to detect errors in evaluated data. Work on the computation format for experimental data has continued and graphic output of experimental data will be available in the near future to allow error detection. In order to minimize the amount of effort and response time to answer data requests, the index files to the experimental and evaluated data files have been improved.

D.5.2. EXFOR Programming

The current EXFOR file maintenance programs, used to update the library and retrieve data from the library, may be considered up-to-date and require only a minimum of maintenance. The EXFOR checking program has been significantly improved to automate error detection. Work on the computation format has continued with the aim of developing a program support package to allow tabular and graphical presentation of a variety of experimental data, all in a common, comparable set of units.

D.5.3. Request and Dissemination Log System

The Request Log is designed to monitor the arrival of requests at NDS and the processing of requests through NDS, in order to insure that each request is answered timely. The Dissemination Log is designed to monitor the flow of information out of NDS. Together, the request and dissemination logs allow us to determine what types of information are required by our users, and to quantify the output from our centre (see statistics under Section D.4.).

During this period the request and dissemination log system was improved to simplify use and improve the types of statistics that may be obtained from the system, e.g., request patterns by isotope, type of data, reaction.

D.5.4. WRENDA

The WRENDA file maintenance program system is essentially complete; minor improvements were introduced during this period, in particular concerning retrieval criteria and output sort orders. The WRENDA checking program was updated in order to improve error detection.

D.5.5. The Data Index System

Instead of searching the large numerical data files maintained by NDS, many requests can be more economically satisfied by searching relatively small data index files in order to determine which data satisfy a given request. A Data Index System which indexes all of NDS's data files is being implemented. At present entries into the Data Index System are performed automatically for all EXFOR data when a TRANS tape is merged into our EXFOR master file.

For EXFOR data it is possible to retrieve data by reaction, author, institute, energy range, etc. In the case of evaluated data, retrievals are currently performed in two steps: retrieval of whole evaluations using the Data Index System, and selective retrieval by reaction using specially designed retrieval programmes. The index system is currently being extended to automate the handling of evaluated data, particularly those evaluations in the ENDF/B format.

D.5.6. Profile System

NDS maintains a PROFILE system, consisting of a computerized file of the names, addresses and the areas of interest for each of the centre's correspondents. Areas of interest are described by the use of one or more distribution/interest codes. This file is used routinely to produce reports, to selectively retrieve address lists, or print address labels for the mailing of publications and correspondence. During this period the PROFILE system has been extensively modified in order to improve the flexibility of the use of the address field.

There are currently 5 300 names and addresses stored in the PROFILE system master file; last year approximately 600 names were added, and about 200 corrections and/or changes per month were made.

D.5.7. CINDA Programming

The system of CINDA programs that are operational at NDS is used to check new or revised entries, retrieve from the master library and produce the CINDA book. Production of the CINDA book requires two steps: format conversion to a form that is acceptable to the photo-type-setting process, followed by the actual photo-type-setting. This system of computer programs has remained rather stable over the years and only minor improvements were done to improve error detection.

D.5.8. Evaluated Data Processing

The growing number of evaluated data libraries (e.g. UKNDL, KEDAK, ENDF/B etc.) requires that a growing number of programs be maintained and operated at NDS in order to allow for file maintenance, retrieval and correction of evaluated data. In addition, in order to allow the evaluated data to be used by our customers, the data handling programs are distributed with the data.

In order to avoid duplication of effort, programs developed at other data centres are adopted for use at NDS whenever possible. At present NDS maintains and distributes to customers only elementary file handling programs. All requests for more complex programs, such as multigroup processors, are referred to the IAEA Liaison Officer at the NEA Data Bank.

During this period additional computer programs were implemented at NDS in order to allow the introduction of procedures to improve the reliability of the evaluated data which are disseminated by NDS. In particular, format and physics checking codes in conjunction with graphic output have been used to significantly improve the evaluated data files. When minor problems are encountered, the format or data can be corrected on line and the action taken as well as major problems encountered reported to the originating evaluator.

Appendix A

List of Liaison Officers to the INDC as of February 1983

Argentina	Ricabarra, G.
Austria	Vonach, H.K.
Bangladesh	Islam, M.
Belgium	Poortmans, F.
Bolivia	Rondon, A.
Brazil	Auler, L.T.
Bulgaria	Janeva, N.
Chile	Morales, R.
Colombia	Director, Instituto de Asuntos Nucleares
Czechoslovakia	Rocek, J.
Denmark	Christensen, C.J.
Ecuador	Muñoz, R.
Egypt	El-Nady, M.
Finland	Silvennoinen, P.
Greece	Dritsa, S.
Hungary	Kluge, Gy.
Iraq	Said, K.I.
Israel	Yiftah, S.
Jamaica	Chen, A.A.
Kenya	Gacii, P.
Korea, Dem. Peoples Republic	Dzang, S.H.
Korea, Republic of	Cho, M.
Kuwait	Shihab-Eldin, A.
Mexico	Graef Fernandez, C.
Netherlands	Bustraan, M.
Norway	Andersen, E.
Pakistan	Gul, K.
Philippines	Navarro, Q.O.
Poland	Sujkowski, Z.
Portugal	Carvalho, F.G.
Romania	Rapeanu, S.N.
South Africa, Rep. of	Barnard, E.
Spain	Velarde Pinacho, G.
Switzerland	Widder, F.
Thailand	Boonkong, W.
Turkey	Ertek, C.
Uruguay	Lalanne, A.
Yugoslavia	Slaus, I.

Appendix B

Conclusions and Recommendations of the Second Meeting of the IFRC Subcommittee on Atomic and Molecular Data for Fusion

Vienna, 4-5 November 1982

The Subcommittee

- Confirmed its own recommendation on the function of the IAEA A+M Data Unit, made at the January 1981 meeting.

- Stressed the importance to assure the completeness of the Agency's A+M bibliographic data file, and recommended that the newly developed capability to perform selective retrievals from that file for customers, be advertised in the A+M Data Bulletin and the Agency's "Nuclear Fusion" journal.

- Commended the A+M Data Unit on the excellence of the A+M Data Bulletin and decided to maintain the existing subject scope of the Bulletin.

- Decided to postpone the publication of a second edition of the index to A+M collision data, CIAMDA, until 1985.

- Strongly endorsed the plan to have the report which resulted from the CRP on Atomic Data for Plasma-Wall Interaction Processes published in the Agency's Nuclear Fusion Journal.

- Reviewed the work of the CRP on A+M Collision Data for Plasma Diagnostics, commended the over-all quality of their first report, and suggested certain guidelines in the further work.

- Reviewed the procedures to arrive at recommended numerical A+M data, and suggested to have the responsibilities for the data assessment, evaluation and recommendation assigned to specific individual groups.

- Identified specific functions, which the A+M Data Unit should perform, with regard to the stimulation and coordination of A+M data assessment and evaluation, and in the dissemination of these data to the fusion research community.

- Recommended that IAEA publicize the availability of recommended data from the IAEA in the Agency's "Nuclear Fusion" journal and in the A+M Data Bulletin.

- Recommended to have the Agency arrange for a critical assessment of the A+M "recombination" data.

- Recommended that the Agency compile an index of bibliographic and numerical A+M data compilations existing in the A+M data centres, and publicize this information in the A+M Data Bulletin.

- Recommended that the A+M Data Centre Network as well as the IFRC Subcommittee itself meet more frequently.

Appendix C

Interregional Project TC/INT/1/018 on Nuclear Data Techniques and Instrumentation

List of actively participating countries and institutes *

Status 31 January 1983

	Country	Institute
A. Developing countries		
1.	Algeria	Centre des Sciences et de la Technologie Nucléaires, Alger
2.	Bangladesh	Savar Nuclear Research Centre
3.	Brazil	Instituto de Engenharia Nuclear, Rio de Janeiro
		CTA/IEA Nuclear Data Centre, Sao José dos Campos
4.	Bulgaria	Institute of Nuclear Research and Nuclear Energy, Sofia
5.	Chile	University of Chile, Santiago
6.	Czechoslovakia	Institute of Physics, Slovak Academy of Science, Bratislava
7.	Egypt	Atomic Energy Establishment, Cairo
8.	Greece	Nuclear Research Centre "Demokritos", Athens
9.	Hungary	Kossuth University, Debrecen
		Eötvös Lorand University, Budapest
10.	India	Bhabha Atomic Research Centre, Bombay
11.	Indonesia	Pusat Aplikasi Isotop and Radiasi (PAIR), Jakarta

* Several other countries have agreed on participation, but do not actively participate so far.

	Country	Institute
12.	Korea, Rep. of	Seoul National University, Seoul
13.	Malaysia	Atomic Energy Research Centre Puspati
		Universiti Sains Malaysia, Penang
14.	Mexico	Instituto Nacional de Investigaciones Nucleares (ININ), Mexico
15.	Mongolia	State University, Ulan Bator
16.	Morocco	Nuclear Physics Laboratory, Mohamed-V University, Rabat
17.	Pakistan	PINSTECH, Rawalpindi
18.	Poland	Institute of Physics and Nuclear Techniques, Academy of Mining and Metallurgy, Krakow
		Institute of Nuclear Research, Warsaw
19.	Romania	Institute of Nuclear Power Reactors, Bucharest
20.	Thailand	Chiangmai University, Chiangmai
21.	Turkey	Nuclear Research Centre Cekmece, Istanbul
22.	Vietnam	Institute of Physics, National Centre for Scientific Research, Hanoi
23.	Yugoslavia	Ruder Boskovic Institute, Zagreb

	Country	Institute
B. Developed countries		
1.	Australia	AAEC Research Establishment, Lucas Heights
2.	Austria	Institut für Radiumforschung und Kernphysik, Vienna
3.	Germany, Dem. Republic of	Technical University, Dresden
4.	Germany, Fed. Republic of	Kernforschungsanlage Jülich
		Physikalisch-Technische Bundesanstalt, Braunschweig
5.	Italy	ENEA Centro di Calcolo, Bologna
		Legnaro Nuclear Laboratories, Padua
6.	Sweden	International Seminar in Physics, University of Uppsala
7.	USA	Crocker Nuclear Laboratory, University of California, Davis

Appendix D

Content of

IAEA Technical Report

"Nuclear Data Standards for Nuclear Measurements"

1982 INDC/NEANDC Nuclear Standards File

Appendix E

Nuclear Activation Data Handbook Outline

I. Standard Reference Data

A. List of Nuclides with their natural abundances and half-lives.

B. Monitor Reactions: evaluated excitation functions for standard monitor reactions for neutrons and protons.

C. Neutron Source Spectrum Standards: spectra of standard reference neutron sources.

D. Gamma-ray Standards: gamma-ray energies and intensities for isotopes used as detector calibration standards.

II. Neutron Activation

A. Thermal Neutron Activation: The 2200 m/s and infinite dilute resonance integral data.

B. 14 MeV Neutron Activation. Compilation of evaluated threshold reactions

1. 14 MeV Data
2. threshold - 20 MeV energy dependent data

C. Spectrum-averaged cross sections

III. Charged Particle Activation

A. Excitation functions of charged particle activation reactions.

B. Thick target yields for charged particle activation.

IV. Photonuclear Activation

A. Excitation functions of photonuclear reactions