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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Report of the Nuclear Data Section to the International Nuclear Data Committee September 1978 - February 1980

A. Lorenz, Editor

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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 1978 to February 1980. It describes past, current and planned activities of the Section and presents the status of its nuclear data centre services.

March 1980

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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 operated 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's 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 Cases
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(NDS)-098/LN	Sep 78	Compilations and Evaluations of Nuclear Structure and Decay Data, Issue no. 4 Compiled by A. Lorenz, October 1978
INDC(NDS)-099/G+Sp	Mar 79	Summary Record of the Third Meeting of Nuclear Reaction Data Centres, Paris, France, 19-23 June 1978 Compiled by P. Johnston
INDC(NDS)-100/M	Mar 79	IAEA Advisory Group Meeting on Nuclear Data for Reactor Dosimetry - Summary Report, Vienna, 13-17 November 1978 A. Lorenz, January 1979
INDC(NDS)-101/LF	May 79	IAEA Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology - Summary Report, Vienna, 11-15 December 1978 A. Lorenz, D.W. Muir, May 1979
INDC(NDS)-102/G+P	Jun 79	Progress in Fission Product Nuclear Data (No. 5) Information about Activities in the Field of Measurements and Compilations/ Evaluations of Fission Product Nuclear Data (FPND) G. Lammer, June 1979
INDC(NDS)-103/M	May 79	Proceedings of the Advisory Group Meeting on Nuclear Data for Reactor Dosimetry Vienna, 13-17 November 1978 May 1979
INDC(NDS)-104/G+Sp	Aug 79	Second Meeting of the Coordinated Research Project on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data - Summary Report Compiled by H.D. Lemmel, July 1979
INDC(NDS)-105/N	Jan 80	Second Coordinated Research Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Data, Aix-en-Provence, 30 April - 1 May 1979 (Summary Report) Compiled by A. Lorenz, November 1979
INDC(NDS)-106/LN	Dec 79	Second IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, CEN Cadarache, France, 2-5 May 1979 (Summary Report) Compiled by A. Lorenz, September 1979

INDC(NDS)-107/G+S	Nov 79	Proceedings of the Consultants' Meeting on Delayed Neutron Properties, Vienna, 26-30 March 1979
INDC(NDS)-108/N	Dec 79	Proposed Recommended List of Transactinium Isotope Decay Data Part I. Half-Lives September 1979 Edition Compiled by A. Lorenz September 1979
INDC(NDS)-109/N		Proposed Recommended List of Transactinium Isotope Decay Data Part II. Alpha and Gamma-Ray Emmission Spectra
INDC(NDS)-110/G+Sp		Report on the 4th Consultants' Meeting of Nuclear Reaction Data Centres, Karlsruhe 1979
INDC(NDS)-111/LNA	Mar 80	Report of the Nuclear Data Section to the International Nuclear Data Committee September 1978 - February 1980
INDC(NDS)-112/LN	Apr 80	Compilations and Evaluations of Nuclear Structure and Decay Data, Issue No. 5 Compiled by A. Lorenz April 1980

INDC(SEC) Documents Published since the last INDC Meeting

INDC(SEC)-070/GA	Oct 78	Minutes of the Fourth Meeting of the Joint IFRC/INDC Subcommittee on Atomic and Molecular Data for Fusion, Vienna, 30 September 1978 Compiled by A. Lorenz and R. Seamon, October 1978
INDC(SEC)-071/UN	Jun 79	INDC Correspondents for the Exchange of Nuclear Data Information, May 1979 (Supersedes INDC(SEC)-65/UN)
INDC(SEC)-072/UN	Jun 79	List of Documents received by the INDC Secretariat, May 1979 (Supersedes INDC(SEC)-66/UN)
INDC(SEC)-073/URSF	Dec 79	WRENDA 79/80 - World Request List of Nuclear Data Compiled by D.W. Muir, October 1979
INDC(SEC)-074/LNQ	Apr 80	1980 Compilation of National Nuclear Data Committees, April 1980 (Supersedes INDC(SEC)-69/LNQ)
INDC(SEC)-075/UN	May 80	INDC Correspondents for the Exchange of Nuclear Data Information, May 1980 (Supersedes INDC(SEC)-071/UN)
INDC(SEC)-076/UN	May 80	List of Documents received by the INDC Secretariat, May 1980 (Supersedes INDC(SEC)-072/UN)

IAEA Technical Reports on Nuclear Data Published During the Period 1970 - 1979

IAEA-153	The Evaluation of Neutron Nuclear Data. Proceedings of a Panel held in Vienna, 30 August - 3 September 1971
IAEA-169	Fission Product Nuclear Data (FPND), Vols. 1, 2 and 3. Proceedings of a Panel held in Bologna, 26-30 November 1973
IAEA-186	Transactinium Isotope Nuclear Data (TND), Vols. 1, 2 and 3. Proceedings of an Advisory Group Meeting held at the Kernforschungszentrum Karlsruhe, 3-7 November 1975
IAEA-190	Nuclear Theory in Neutron Nuclear Data Evaluation, Vols. 1 and 2. Proceedings of a Consultants' Meeting held at ICTP, Trieste, 8-11 December 1975
IAEA-208	Neutron Cross-Sections for Reactor Dosimetry, Vols. 1 and 2. Proceedings of a Consultants' Meeting held at IAEA, Vienna, 15-19 November 1976
IAEA-213	Fission Product Nuclear Data (FPND) - 1977. Vols. 1 and 2. Proceedings of an Advisory Group Meeting held at ECN Petten, 5-9 September 1977
IAEA-SMR/43	Nuclear Theory for Applications. Proceedings of a Joint IAEA/NDS-ICTP Trieste Course, held at ICTP Trieste, 17 January - 10 February 1980
IAEA-TECDOC-223	Nuclear Data for Fusion Reactor Technology. Proceedings of an Advisory Group Meeting held at IAEA, Vienna, 11-15 December 1978
IAEA-TECDOC-232	Transactinium Isotope Nuclear Data (TND). Proceedings of an Advisory Group Meeting held at CEN-Cadarache, 2-5 May 1979

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 September 1978 to February 1980.

This period saw a complete turnover of professional staff in the Section's Programming and Data Processing Unit. Mrs. P.M. Attree, head of this Unit, and P.M. Smith left the Section in September 1979 to assume positions in the Agency's Division of Safeguards Information Treatment. H. Marin-Guzman left NDS in February 1979 to join the Computer Section of UNIDO. Mrs. Attree's responsibilities were assumed by D.E. Cullen from the Lawrence Livermore Laboratory who joined the Agency in December 1979, and Mr. Marin-Guzman's post was filled by Mrs. M.M. Seits, formerly employed by the IAEA Computer Section. Mrs. Attree has rendered invaluable services to the Nuclear Data Section particularly by guiding the Section's computer systems development from the very beginning of the Section's existence. The transition to the new staff was considerably facilitated by the outgoing programmer analyst staff through outstanding systems documentation as well as by the excellent qualification of the new incoming staff. Mr. Smith's post was transferred to the Section's Nuclear Reaction Data Unit and temporarily converted to a physicist post in order to help that unit to cope with the strongly increased services required from the Section.

M.F. Vlasov who has led the Section's programme on nuclear data for reactor dosimetry for a number of years, has left the Section in October 1978 to return to the Institute of Nuclear Research in Kiev, USSR; he was replaced in December 1978 by N.P. Kotcherov from the V.G. Khlopin Radium Institute in Leningrad.

After the leave of Mrs. F. Hirschbichler in July 1978, the duties of the NDS data service coordinator were temporarily taken over by N. DayDay and then assumed by Mrs. H. Hendrickson who came to the Section from the Oak Ridge National Laboratory in the USA in July 1979. Mrs. G. Lammer left NDS and was replaced by her husband M. Lammer in January 1980. As successor to E. Beaty, Professor F.J. Smith from the Queen's University in Belfast, Northern Ireland, headed the Section's Atomic and Molecular (A+M) Data Unit from August 1978 to September 1979. For reasons of budget saving, the post had to be kept open until the end of 1979 and a successor is currently being searched for. R.E. Seamon left the A+M Data Unit in December 1978 and was replaced by J. Rumble Jr. from the Joint Institute for Laboratory Astrophysics, Boulder, Colorado, USA, in January 1979.

At the end of 1979 the international experimental neutron data exchange system EXFOR had been 10 years in operation. During this time the EXFOR data library has grown to 44,000 data sets (EXFOR sub-entries) with 2.5 million numerical data records. At the present stage of development experimental nuclear reaction data including reactions induced by neutrons, charged particles and photons are being exchanged under this system between seven co-operating nuclear reaction data centres. In addition to EXFOR data about 40 data files or libraries of various evaluated nuclear data including nuclear reaction and nuclear structure and decay data are now available from

the Nuclear Data Section. The main recent addition is the entire ENDF/B-4 library from the USA.

The year 1979 also marked the 15th anniversary of CINDA as a common international project of the four world neutron data centres. During this time the content of the CINDA master file has grown to 165,000 entries. In April 1979 an archival issue of CINDA, "CINDA-A", has been published which covers the literature on microscopic neutron data from 1935 to 1976. As a result of a coordinated clean-up effort by the four neutron data centres before April 1979, the archival issue is of high quality with respect to completeness and reliability. The regular CINDA publication continued with CINDA-79 published also in the spring of 1979 covering the literature appearing after 1976, and a supplement published in the fall of 1979.

The year 1979 also marks the 15th anniversary of the Nuclear Data Section (called Nuclear Data Unit before 1970). The summary of the nuclear data request and dissemination statistics for the past 15 years presented in this report illustrates the enormous increase in nuclear data services requested from the Nuclear Data Section by the developing countries in the Section's service area, concurrent with the increasing interest of developing countries in the introduction of nuclear energy and nuclear scientific methods. The dissemination statistics as displayed in Figure 2 of this report shows in fact an exponential increase in the numerical data sets disseminated per year from 73 sets in 1965 to close to 37,000 sets in 1979. Appendix D to this report presents a sample of nuclear data requests received from developing countries during 1978/79 to illustrate the wide variety of data types and purposes of the requests.

In order to improve contacts and services to customers in its service area, the Nuclear Data Section has started in 1979 the issue of a "Nuclear Data Newsletter" and of a new documentation report series entitled "IAEA Nuclear Data Services" (report code "IAEA-NDS-..."). The newsletter is planned to be issued two or three times a year and is designed to advertise the services offered by the centre, including improved and new data files, and to inform about activities and meetings sponsored by the Nuclear Data Section. The report series allows for content and format documentation of each individual system and data file maintained by the centre. The combination of the widely distributed newsletter and the documentation reports replaces the previously issued CINDU catalogues.

In January and February 1979 the Nuclear Data Section hosted two fellow scientists from Brazil, Mrs. R. Paviotti-Corcuera (physicist) and Mr. C.S. da Silva (programmer), at the cost of the Brazilian Government. The purposes of these fellowships were training in the compilation and computer handling of nuclear data and particularly thorough discussions and advice on guidelines, work priorities and technical problems connected with the creation of a new local Brazilian nuclear data centre designed to provide nuclear data services in Brazil.

Regarding programming and systems development during the past period, the EXFOR system of programmes was improved and may now be considered up-to-date, including its documentation. In order to enhance the usefulness of EXFOR to the centre's customers the design of a computation format for experimental data has been started.

Major changes are currently being planned regarding the Nuclear Data Section's remote computer resources, so that eventually the present card-based operation will be phased out and keypunches and verifiers replaced by visual display units.

Following the three-year trial period 1977 - 79, the IAEA has regularized the programme on atomic and molecular data for fusion as part of the overall programme of the Nuclear Data Section, effective 1 January 1980. During this period, eleven quarterly issues of the International Bulletin on Atomic and Molecular Data for Fusion have been published and distributed world-wide to approximately 750 recipients. CIAMDA - a comprehensive Computerized Index to Atomic and Molecular Collision Data relevant to fusion research has been completed and is to be published in April 1980. It covers published literature from about 1950 to 1979 and contains about 13,000 references and over 40,000 indexation lines. Apart from continuing the bibliographic data efforts, the future activity of the Unit will be mainly directed towards the establishment of an international file of evaluated atomic collision data tailored to the needs of the fusion community. A new permanent Subcommittee of the Agency's International Fusion Research Council including also the Chairman of the International Nuclear Data Committee or his nominee is currently being set up to review the planning and execution of the Agency's programme on atomic and molecular data for fusion.

The Advisory Group Meeting on Nuclear Data for Reactor Dosimetry held in Vienna in November 1978 finalized the details for the creation and testing of a new international file of evaluated neutron cross-section data (IRDF) for reactor neutron dosimetry applications. IRDF will contain both energy-dependent cross-section data and data on selected benchmark fields including spectrum-averaged cross-sections measured in these fields, and covariance matrices for both types of data. The purpose of IRDF is to provide the international reactor dosimetry community with a comprehensive set of data which can be used for the spectral characterization of neutron fields. The first version of IRDF is planned to be completed and released in the summer of 1980. Its first use will be in a project planned by the IAEA Seibersdorf Laboratory for an international inter-laboratory comparison of estimates of radiation damage (displacements per atom) in fission and fusion reactors.

The Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology held in Vienna in December 1978 assessed, for the first time on an international scale, the status and needs of nuclear data used in studies of neutron transport, gamma-ray production and radiation effects in fusion reactors. In view of the large data needs above about 5 MeV neutron energy, and particularly also still around 14 MeV, the meeting's major recommendation was that the IAEA establish a coordinated research programme to encourage such measurements on a wide range of materials, with the participation of developing countries for whom such measurements would have a significant educational and training value (see last paragraph).

The Consultants' Meeting on Delayed Neutron Properties held in Vienna in March 1979 reviewed the requirements for delayed neutron data for reactor design, power reactor operation, performance and interpretation of critical experiments, and reactor dynamics and safety, and the status of data for delayed neutron yields, branching ratios and energy spectra. The meeting resulted in very detailed technical recommendations for new measurements, compilations and evaluations. No further activities in the general field

of fission product nuclear data are being pursued or planned at present except for the well acknowledged annual publication of the "Progress in Fission Product Nuclear Data" report series, the regular compilation of FPND as part of the four neutron data centre co-operation, and a co-operation with NEA-DB in soliciting Non-OECD participation in the determination and comparison of average resonance properties.

The two coordinated research programmes (CRP), currently pursued by the Nuclear Data Section, on the Intercomparison of Evaluations of Actinide Neutron Cross-Sections and on the Measurement and Evaluation of Actinide Isotope Nuclear Decay Data are beginning to show initial results. In the framework of the first CRP 15 different evaluations are now available, whose comparison and assessment has been started in 1979. Full or partial evaluations are currently in progress or planned for 15 further nuclides. The participants in the second CRP produced in 1979 a first list of proposed recommended half lives of the more important actinide isotopes. An extension of this list, including data for the minor actinides and heavy element isotopes produced by the decay of the major actinides is in preparation. Also a review was started of alpha- and gamma-ray emission spectra of the major actinide isotopes. The Second Advisory Group Meeting on Transactinium Isotope Nuclear Data, held at Cadarache, France in May 1979 after the research coordination meetings of the two CRPs, was devoted to the review of the changes in the requirements and status of actinide nuclear data, and included a presentation and review of the current results and plans of the two CRPs. The increasing fruitfulness of both programmes strongly warrants their extension for another three years until 1983 which is currently planned.

The sixth edition of the world request list for nuclear data, WRENDA 79/80, which was published in October 1979, reflects numerous changes in the WRENDA masterfile since the issue of WRENDA 76/77. 465 requests listed in WRENDA 76/77 were withdrawn, 487 were modified, and 573 new requests were added, bringing the total number of current requests to 1780, a net increase of 108 requests. This increase reflects particularly the strong increase in the number of fusion requests from 328 to 449, whereas the number of fission and safeguards requests remained essentially constant. Noteworthy is particularly an increase in the number of requests for fast neutron energies at or including 14 MeV, in some cases extending up to 50 MeV. As recommended by the INDC, requests for all applications were combined into a single, unified list in the WRENDA 79/80 report.

The second four weeks Course on Nuclear Theory for Applications, jointly organized by the Nuclear Data Section and the International Centre for Theoretical Physics (ICTP) and held at the ICTP in Trieste in January/February 1980, was predominantly funded by the IAEA Technical Assistance Department as an interregional training course for developing countries. The programme of lectures and workshops included a detailed review of recent advances in the theoretical understanding of fast neutron nuclear reaction mechanisms and of neutron-induced nuclear fission, a broad introduction into the generation and processing of evaluated neutron cross-sections, in particular ENDF/B-data, and a detailed review of experimental and theoretical methods used in the generation of 14 MeV neutron data. The course was attended by 67 scientists from 25 developing and 7 scientists from 7 developed countries. Compared to the first course in 1978, this course achieved a better balance between lectures and workshops, with a stronger emphasis on the co-operation of the participants in the workshops.

The qualification of the course participants was better than in 1978 and enabled strong and useful interaction with the throughout excellent lecturers and workshop leaders.

The workshop held in the fourth week with the active participation of the majority of the course attendees drafted a detailed proposal for a co-operative project between research groups in developing and developed countries in the measurement, computation and evaluation of fast neutron nuclear data (with an emphasis on 14 MeV neutrons). Such a project would be of the greatest importance for the future activities of the Nuclear Data Section and strengthen its relationship particularly to the developing countries, and would represent a systematic and controlled contribution to the build-up of nuclear scientific and technological infrastructure in those countries. Numerous recommendations from previous meetings, the large number of requests (e.g. in WRENDA 79/80) for the new or improved determination of neutron data at and around 14 MeV for a variety of purposes, and the concurrent availability of 14 MeV neutron generators in a number of laboratories in developing countries in all world regions, often acquired with previous technical assistance support by the IAEA, suggests the development of such a co-operative interregional project for a period of at least five years with the participation of many laboratories from developing and developed countries, under the scientific co-ordination by the Nuclear Data Section. The purpose of the project would be to create an integrated network of research groups in developing and developed countries which would be engaged in common scientific research. IAEA assistanceto the participating groups from developing countries would be focussed on the supply of high purity elements and isotopes and parts of auxiliary equipment required for the project measurements. Within the network, expertise would be made available to laboratories in developing countries, whereas staff particularly from the less advanced or beginning research groups would receive fellowship training in the more advanced laboratories particularly in Western and Eastern countries. Apart from closing gaps in the knowledge of required nuclear data, the basic incentive for this project and its unique potential lie in the training of nuclear scientific personnel in developing countries in a large variety of nuclear scientific methods and associated techniques needed for neutron data determinations, which could later be used by the trainees in many other scientific and technological domains of immediate relevance to their countries' economic and social development.

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:

Brazil	Prof. Jader Benuzzi Martins has replaced Dr. S.B. Herdade
Israel	Dr. S. Yiftah (presently Member of INDC) has replaced Dr. K. Amiel
Pakistan	Dr. K. Gul has replaced Dr. A.M. Khan
Switzerland	Dr. F. Widder has replaced Dr. Th. Huerlimann
Zaire	has ended its participation in the INDC

The current list of INDC Liaison Officers comprises scientists from 40 IAEA Member States; the list is given in Appendix A.

As in previous years, INDC Liaison Officers have been requested to submit progress reports in time for distribution at the Eleventh INDC Meeting (June 1980).

A.2. List of Correspondents

The list of INDC Correspondents for the exchange of nuclear data information is produced from the files of the PROFILE system developed by the Nuclear Data Section (see section D5.3.). The current list of Correspondents is to be distributed in May 1980 as INDC(SEC)-75/UN.

In addition to the formal INDC distribution codes G, L, U and N (defined in the List of INDC Correspondents), the Nuclear Data Section has assigned additional distribution codes for the distribution of reports of special interest to a limited number of people, interested in specific aspects of nuclear data or in atomic and molecular data.

The "special interest" distribution codes currently used for the dissemination of some INDC documents, in addition to the G, L, U, and N distribution codes, are:

A - Atomic and molecular data (A+M) documents concerning the international effort in the field of A+M data for fusion.

B - Technical reports on the measurement or calculation of A+M data, data evaluations, surveys and compilations, and progress reports.

D - Recipients of the IAEA Nuclear Data Section "Nuclear Data Newsletter"

E - Nuclear Structure and Decay Data

F - Nuclear Data for Fusion

H - Transactinium Isotope Nuclear Data

K - International Bulletin on A+M Data for Fusion

M - Reactor Dosimetry Nuclear Data

P - Fission Product Nuclear Data

Q - Members of National Nuclear Data Committees

R - Recipients of "WRENDA" World Request List for Nuclear Data

S - Nuclear Material Safeguards

V - Multigroup Cross Sections

X - Charged Particle Nuclear Data

Y - Nuclear Theory and Computer Codes for Nuclear Data Calculations

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)-76/UN in May 1980.

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 distributions).

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 11 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)-76/UN.

A.5. Compilation of National Nuclear Data Committees

The 1980 issue of the Compilation of National Nuclear Data Committees has been published as INDC(SEC)-74/LNQ and will be distributed in May 1980. It supersedes the 1978 compilation, INDC(SEC)-69/LN.

In view of the growth and personnel turn-over of national nuclear data committees, INDC Members and Liaison Officers are urged to ascertain that all members of those committees be included in the list of INDC Correspondents (see A.3. above).

B. Meetings

B.1. Past Meetings (September 1978 - February 1980)

B.1.1. Fourth Meeting of the Joint IFRC/INDC Subcommittee on A+M Data for Fusion, Vienna, 30 September 1978

The Joint IFRC/INDC Subcommittee on A+M Data for Fusion met for the fourth and last time on 30 September 1978. The Subcommittee reviewed the Agency's A+M programme, discussed the future development of the programme, and recommended its regularization in 1980. The minutes of this meeting were published as INDC(SEC)-70/GA in October 1978.

B.1.2. IAEA Advisory Group Meeting on Nuclear Data for Reactor Dosimetry, Vienna, 13-17 November 1978

The Advisory Group Meeting on Nuclear Data for Reactor Dosimetry was convened by the IAEA Nuclear Data Section at IAEA Headquarters in Vienna, Austria, from 13-17 November 1978. The meeting was attended by 20 representatives from 10 Member States and 1 international organization.

The conclusions and recommendations of this meeting are contained in three separate reports produced at the meeting:

1. The General Guidelines for the Creation of the International Reactor Dosimetry File, consisting of a general set of recommendations on the creation, maintenance and up-keep of the basic reactor dosimetry data file, which contains the evaluated energy-dependent cross-section data and their uncertainties,

2. The Report of the Working Group on Benchmark Fields and Integral Data, recommending the creation of a complementary benchmark data file containing data on reference benchmark fields and recommended evaluated integral cross-sections measured in these fields, and

3. The Report of the Working Group on Data Testing, Spectrum Unfolding and Data Adjustment, which recommends the methodology to be used in testing the data contained in the reactor dosimetry (differential) data file, in unfolding neutron flux density spectra, and in performing data adjustments on the basis of information from integral experiments.

The three Working Group Reports are included in the meetings' "Summary Report", INDC(NDS)-103/M. The status of the International Reactor Dosimetry File and of the benchmark file are given in Section C.4. of this report.

B.1.3. Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology, IAEA Headquarters, Vienna, 11-15 December 1978

The Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology was convened by the IAEA Nuclear Data Section at IAEA Headquarters in Vienna, Austria, from 11-15 December 1978. The meeting was attended by 32 scientists from 16 Member States and 2 international organizations.

The main objectives of this meeting were to identify specific nuclear data requirements for fusion reactor technology, to determine the adequacy of available data in relation to these requirements, and to formulate recommendations for future activities needed to remedy the data deficiencies. In order to achieve these objectives, two Working Groups were formed during the meeting to assess the nuclear data used in studies of (1) neutron transport and gamma-ray production phenomena and (2) radiation damage and other nuclear effects.

The meeting recognized the value of 14-MeV cross-section measurements and recommended that the IAEA establish a coordinated research programme to encourage such measurements on a wide range of materials, with the participation also of developing countries. There was a general consensus that another meeting should be convened by the IAEA in three years to review the status of nuclear data for fusion reactor technology. The Working Group on Neutron Transport and Gamma-Ray production recommended the convening of a specialists meeting on the application of sensitivity and uncertainty analysis to the assessment of data needs.

In addition to these general recommendations, considerable attention was devoted to the question of what specific materials, data types, and energy ranges should be emphasized in nuclear data measurements and calculations undertaken in support of fusion reactor technology.

The specific recommendations are contained in two working group reports: the Report of the Working Group on Neutron Transport and Gamma-Ray Production, and the Report of the Working Group on Radiation Effects. Both of these reports are incorporated in the meetings' "Summary Report", INDC(NDS)-101. The proceedings of this meeting, including all invited papers presented at the meeting are published in the IAEA-TECDOC-223 report.

B.1.4. IAEA Specialists' Meeting on Delayed Neutron Properties, Vienna, 26-30 March 1979

A Consultants' Meeting on Delayed Neutron Properties was convened by the IAEA Nuclear Data Section in Vienna from 26-30 March 1979. It was attended by 13 scientists from 7 member states.

The main objectives of the meeting were to review the current requirements for delayed neutron data with special emphasis on energy applications, to review the status of delayed neutron data and try to resolve the existing discrepancies in experimental data, and to formulate specific recommendations for necessary future work and its coordination.

In order to achieve these objectives, four review papers and several contributed papers were presented in the first part of the meeting, followed by extensive plenary discussions on the delayed neutron data requirements and status in the second part of the meeting. All papers are published in the proceedings (report INDC(NDS)-107/G+Special).

Corresponding to the scope of the four review papers, specific conclusions and recommendations were formulated referring to the following subjects:

- Requirements for delayed neutron data (for reactor design, power reactor operation, critical experiment operation and interpretation, reactor dynamics and safety);
- Delayed neutron yields;
- Delayed neutron branching ratios;
- Delayed neutron energy spectra (including equilibrium and near-equilibrium spectra, decay-group spectra, separated precursor spectra and theoretical spectra).

A number of new measurements, compilations and evaluations were recommended in areas where no or only few data exist or where existing data are discrepant and were assigned different priorities.

B.1.5. Second IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, Cadarache, France, 2-5 May 1979

The Second Advisory Group Meeting on Transactinium Isotope Nuclear Data (TND) was convened as a sequel to the first TND meeting held at the Kernforschungszentrum Karlsruhe in November 1975. This meeting was held at the CEA Centre d'Etudes Nucleaires at Cadarache, France, from 2-5 May 1979. The meeting was attended by 37 scientists from 10 Member States and 2 international organizations.

The three years since the 1975 TND Meeting have seen a growing emphasis on alternate fuel cycles aiming at improved safety of nuclear fuel cycles and at increased viability of nuclear materials safeguards. This meeting was convened in order to review these developments, to appraise the progress made by the Agency's coordinated research programmes since the last meeting, and to review the status of the international efforts in the field of transactinium isotope nuclear data.

In summary, the meeting:

- summarized the TND requirements for nuclear reactors and fuel cycles including new trends in nuclear technology;
- reviewed the status of the required TND in the light of new measurements, calculations and evaluations, including reports on coordinated research programmes and recent meetings;
- formulated specific technical recommendations for future activities and their coordination.

The "Summary Report" of the meeting was published as INDC(NDS)-106 in September 1979, and the review papers, prepared specifically for the meeting have been published as IAEA-TECDOC-232 Report.

B.1.6. Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Data, 30 April - 1 May 1979, Aix-en-Provence, France

The second meeting of the participants in the IAEA Coordinated Research Programme on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data, was convened by the IAEA Nuclear Data Section on 30 April and 1 May 1979, in Aix-en-Provence, France.

The meeting reviewed the existing and planned programme for the measurement and evaluation of transactinium isotope nuclear decay data of each participating research group. In particular, the meeting

- decided to release as a separate report the list of proposed half-live values compiled by this group for consideration by the scientific community,

- started a detailed review of the status and accuracies of the α and γ radiation spectra emitted by transactinium isotopes,

- discussed the INDC proposal to coordinate the data considered by this group with data in the Evaluated Nuclear Structure and Decay Data File (ENSDF) and other computerized libraries of nuclear decay data.

The "Summary Report" of this meeting has been published as INDC(NDS)-105.

B.1.7. Second Research Coordination Meeting on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data, Aix-en-Provence, France, 30 April to 1 May 1979

See item C.6.1. describing the scope of this Coordinated Research Programme (CRP).

CRP participants exchanged and discussed their status reports, reviewed the applications and limitations of nuclear models for data evaluation, and coordinated their work for the next years. In addition to the CRP participants, the meeting was attended by 7 other scientists on their own initiative. A summary of the meeting and its conclusions and recommendations was issued as report INDC(NDS)-104.

See Table I for a list of evaluations which were available or in progress for consideration and intercomparison at the time of the meeting.

B.1.8. Fourth Annual Meeting of the Nuclear Reaction Data Centres, Karlsruhe, Federal Republic of Germany, 8-13 October 1979

The Meeting was hosted by the Karlsruhe Charged Particle Group (KACHAPAG) and co-sponsored by the German Fachinformationszentrum for Energy, Physics, Mathematics. The meeting included the 15th "Four-Centre Meeting" of the four neutron data centres and the 5th "CPND Meeting" or Charged Particle Nuclear Data Compilation.

Fifteen representatives (Centre Head plus a staff member) of all data centres that participate in the international data exchange by means of the EXFOR System attended this meeting:

Table I

List of Nuclides Covered by the CRP on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data

	Completed Evaluations		In Progress 1979/80
	1977	1978/79	
France Bruyère-le-Châtel J.Salvy Cadarache (Observer)		(Pu-242) Am-241	Th-232, U-237, 239 Np-237
Germany, Fed. Rep. H. Kuesters			Pu-242, Am-241, 242, 243 Cm-244
India M.K. Mehta			Th-232
Israel S. Yiftah	Np-237, Pu-238	Cm-244	Cm-246
Italy E. Menapace		(Pu-241, 242) (Am-241, Cm-242)	Pu-241, 242 Am-241, 243 Cm-242, 245
Japan S. Tanaka	Th-232, Pa-233 U -234, Np-239 Pu-240, 241 Am-241	Am-243, Cm-244 (Cm-245)	Cm-242, 245
Romania G. Vasiliu		Th-233	U -233
U.K. J.E. Lynn		Am-241	Am-243
U.S.S.R. L.N. Usachev (Obninsk) V. Konshin (Minsk)		Pu-241, 242	Am-241

( ) = partial or preliminary

- IAEA Nuclear Data Section (2 participants)
- US National Nuclear Data Centre, Brookhaven (2 participants)
- NEA Data Bank, Saclay (2 participants)
- USSR Centr po Jadernym Dannym, Obninsk (2 participants)
- USSR Centre for Nuclear Structure and Reaction Data, Moscow (1 participant)
- Japanese Study Group for Nuclear Data Processing (1 participant)
- Karlsruhe Charged Particle Group (3 participants)
- Karlsruhe Fachinformationszentrum (2 participants)

The USSR Photonuclear Data Centre, Moscow, which is expected to join the EXFOR data exchange network soon, did not have representation at the meeting.

The Meeting commemorated the tenth anniversary of the creation of the EXFOR system, which is now a well established truly international exchange system for all types of nuclear reaction data and is unique in the world. The two Karlsruhe centres had jointly produced a voluminous handbook on charged particle reaction data for scientific and technical applications, produced fully automatically from the EXFOR data base which now contains 44 000 data sets with 2.5 million numerical data records.

The discussions at the meeting concentrated on:

- further improvements of EXFOR with particular emphasis on data uncertainties as required by many data users;
- the exchange of evaluated nuclear data libraries, in particular the release of essential parts of ENDF/B-5 and all of ENDF/B-4;
- the continuing compilation and publication of CINDA, the data index and bibliography for neutron reaction data; and of a similar document for charged-particle data;
- the present and future compilation and publication of WRENDA, the world request list for nuclear data.

The Meeting included excursions to the Karlsruhe Charged Particle Group and other institutes at the Kernforschungszentrum Karlsruhe, and to the Fachinformationszentrum Karlsruhe.

A summary of the meeting and its conclusions and recommendations is being issued as INDC(NDS)-110.

B.1.9. Second Course on Nuclear Theory for Applications, ICTP Trieste, 28 January - 22 February 1980

This course was jointly organized by the IAEA Nuclear Data Section and the International Centre for Theoretical Physics (ICTP) within the framework of the 1980 nuclear physics activities of the ICTP and predominantly funded by the Technical Assistance Department of the IAEA. It was directed by J.J. Schmidt from the IAEA Nuclear Data Section and Dr. M.K. Mehta from the Bhabha Atomic Research Centre, Bombay, India, with the assistance of a local Organizing Committee headed by Prof. L. Fonda from the ICTP Trieste.

The main purpose of this Course was, pursuant to a similar course held in 1978, to review advances in contemporary neutron nuclear reaction theory and to train scientists from developing countries on an advanced level in the application of this theory to the computation of neutron nuclear data needed for nuclear reactor calculations and in the generation and processing of evaluated neutron data.

The programme of lectures and workshops included the following major topics:

1. Reaction mechanisms for fast neutron-nuclear interactions
2. Nuclear fission
3. Generation and processing of evaluated neutron nuclear data
4. 14 MeV neutron cross-sections in experiment and theory

The detailed lecture programme is contained in Appendix B. The mornings were devoted to lectures and the afternoons to workshop sessions. This course exhibited a better balance between lectures and workshops, with a larger emphasis on the latter. In the first three weeks the workshop sessions were essentially devoted to discussions on problems arising from the morning lectures, to reports and special seminars complementing the content of the morning lectures, and to detailed introductions into selected nuclear models and nuclear data processing computer codes. The fourth week brought the majority of the participants together in a workshop for the detailed discussion and development of the technical programme for the planned Interregional Project for the measurement, computation and evaluation of fast neutron cross-sections (with an emphasis on 14 MeV neutrons) (see section C.7 of this report) including the drafting of an extensive report.

The course was attended by 67 participants from 25 developing and 7 participants from 7 developed countries. Mostly due to limited funds the attendance at this course was not quite as large as in the first course in 1978. The participants interacted substantially with the excellent lecturers and workshop leaders. Three course participants gave tutorial lectures to the less qualified attendees.

The lectures presented at the Course are planned to be published by the IAEA.

B.2. NDS Meetings Planned for 1980 - 1981

1. Consultants' Meeting on Neutron Source Properties, Debrecen, Hungary, 17-21 March 1980
2. Advisory Group Meeting on Nuclear Structure and Decay Data (NSDD network), Vienna, 21-25 April 1980
3. Technical Committee Meeting on Atomic and Molecular Data for Fusion, Paris, 19-22 May 1980
4. Meeting of the A+M Data Centre Network, Paris, 23-24 May 1980
5. Third Research Coordination Meeting on the Intercomparison of Actinide Neutron Nuclear Data Evaluations, Vienna, 12-13 June 1980
6. Third Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data, Vienna, 12-13 June 1980
7. Eleventh meeting of the INDC, 16-20 June 1980
8. Fifth Annual Nuclear Reaction Data Centre Meeting, Brookhaven, 29 September - 3 October 1980
9. Consultants' Meeting on Biomedical Nuclear Data, Vienna, December 1980
10. Advisory Group Meeting on Nuclear Data for Radiation Damage, May 1981
11. Consultants' Meeting on Uranium and Plutonium Resonance Parameters (1981)
12. Sixth Annual Meeting of the Nuclear Reaction Data Centres, Vienna, Fall 1981
13. Meeting of the Atomic and Molecular (A+M) Data Centre Network (1981)
14. Fourth Research Coordination Meeting on Intercomparison of Actinide Neutron Nuclear Data Evaluations (1981)
15. Fourth Research Coordination Meeting on Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data (1981)
16. Research Coordination Meeting on A+M Data Evaluation (1981)
17. First Meeting of IFRC Subcommittee on A+M Data for Fusion (1981)
18. Twelfth Meeting of the INDC, Fall 1981

B.3. Meetings attended by NDS Staff (September 1978 - February 1980)

1. International Conference on Neutron Physics and Nuclear Data for Reactors and other Applied Purposes, Harwell, UK, 25-29 September 1978

2. Fourth Europhysics Study Conference on Atomic and Molecular Physics in Ionized Gases (ESCAMPIG), Essen, Federal Republic of Germany, 18-20 September 1978

3. Atomic Collision Processes: A Conference in honour of Sir Harry Massey, London, UK, 20-22 September 1978

4. 11th International Conference on Physics of Electronic and Atomic Collisions (ICPEAC), Kyoto, Japan, 24 August - 4 September 1979

5. Nagoya Seminar on Atomic Processes in Fusion Plasmas, Nagoya, Japan, 5-7 September 1979

6. 21st Meeting of the NEA Nuclear Data Committee (NEANDC) CBNM/Geel, Belgium, 24-28 September 1979

7. IAEA Technical Committee Meeting on Accuracies in Correlation between Property Change and Exposure Data from Reactor Pressure Vessel Irradiation. KFA/Juelich, Federal Republic of Germany, 24 - 27 September 1979

8. Third ASTM-Euratom Symposium on Reactor Dosimetry, Ispra/Varese, Italy, 1-5 October 1979

9. Workshop on "Decoupling Methods for Low Energy Molecular Collisions", Kaiserslautern, Federal Republic of Germany, 1-2 October 1979

10. 5th US Conference on Nuclear Cross Sections and Technology, Knoxville, USA, 22-26 October 1979

11. IXth International Symposium on the Interaction of Fast Neutrons with Nuclei, Gaussig/Dresden, GDR, 26-30 November 1979

12. NEANDC Specialist's Meeting on Neutron Cross Sections of Fission Product Nuclei, CNEN Bologna, Italy, 12-14 December 1979

13. Seminar on "Interaction of Ionizing Nuclear Radiations with Solids", Institute of Applied Physics, Johann Goethe University in Frankfurt/Main, 31 January - 2 February 1980

C. Nuclear Data Assessment and Research Coordination

C.1. WRENDA

NDS coordinates the compilation and publishes, on behalf of the four neutron data centres, WRENDA, the world request list for nuclear data needed for the development of fission and fusion reactors and of nuclear materials safeguard techniques.

WRENDA 79/80, issued in October 1979, reflects numerous recent changes to the WRENDA master-file of requests, the first major file update since the production of WRENDA 76/77. To summarize the changes: 465 requests listed in WRENDA 76/77 were withdrawn, 487 were modified and 573 new requests were added, bringing the total number of current requests to 1780, a net increase of 108.

The number of fission reactor related requests remained about the same as before, but the number of fusion requests increased from 328 to 449. As recommended at the 9th INDC meeting in May 1977, requests for all applications were combined into a single, unified list in the WRENDA report. Because of this reorganisation of the list, most of the descriptive material in the report has been rewritten.

Other changes to the list include a reduction in the amount of space devoted to status comments. The only status comments listed in WRENDA 79/80 are short comments, provided by the NDS, to indicate which data are under review by technical subcommittees of the INDC and NEANDC.

A third aspect worth noting is an increase in the number of requests for high-energy neutron data, in some cases extending up to 50 MeV. Some of these new high-energy requests specify reactions previously not allowed by the WRENDA system, a fact which accounts for most of the 12 new reaction types added to the WRENDA "quantities" table.

The issue of WRENDA 81/82 is planned for the summer of 1981. Thus, the data centres should be receiving "country retrievals" to begin the next WRENDA update cycle in August 1980. NDS plans to issue an updated set of WRENDA input instructions at about the same time.

C.2. Research Contracts

The following nuclear data research contracts have been let in conjunction with programmes of the Nuclear Data Section:

2047 Prof. H. Vonach (Austria)

Development of improved procedures for evaluation of neutron cross-sections for reactor neutron dosimetry.

The evaluations of the cross-sections for the reactions $^{24}Mg\ (n,p)^{24}Na$, $^{64}Zn(n,p)^{64}Cu$, $Cu^{63}(n,2n)^{62}Cu$ and $^{90}Zr(n,2n)^{89}Zr$ were completed. The data were supplied to NDS on magnetic tape. Research contract has expired.

2048 Dr. M.V. Blinov (USSR)

Determination of the spectral shape of Cf-252 spontaneous fission neutrons in the energy range 10-2000 keV using a 6LiI(Eu) crystal.

The neutron energy spectrum is measured with the time-of-flight technique using both a 6LiI crystal and a U-235 chamber in similar experimental conditions. The preliminary results were to be discussed during the IAEA Consultants' Meeting on Neutron Source Properties in Debrecen, March 1980.

2060 Prof. S. Yiftah (Israel)

Cm-244 neutron data evaluation (in conjunction with the Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data).

The work on Cm-244 data evaluation was finished, the data in KEDAK format were supplied to NDS on magnetic tape. The Cm-246 evaluation is in progress now.

2061 Dr. G. Vasiliu (Romania)

Evaluation of some neutron nuclear data for Th-232, U-233 and Pa-231, 232, 233, (in conjunction with the Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data).

The work on Th-232 data evaluation was finished and the final report was received in 1979. Renewal of the contract is under consideration.

2076 Dr. M.K. Mehta (India)

Evaluation of neutron cross-sections for Th-232, (in conjunction with the Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data).

The evaluations of the Th-232 capture cross-sections and the (n,2n) and (n,3n) cross-sections for Th-233 and Pa-233 have been performed. The evaluations of other neutron induced reactions for Th-232 are now in progress.

2496 Dr. N. Cindro (Yugoslavia)

Systematic investigation of trends in the (n,2n) reaction cross-sections from the (n,2n) threshold to 24 MeV; the role of pre-equilibrium mechanisms.

The estimation of the pre-equilibrium process contribution to (n,2n) reactions over a range of nuclei A=45-209 is now in progress.

2498 Dr. N. Islam Molla (Bangladesh)

Measurement of cross-sections for neutron-induced reactions at 14 MeV via activation technique.

The experiment is now being prepared for the measurement of the (n,d), (n,n'p), (n,n'α), (n,^{3}He) and (n,t) reaction cross-sections.

2499 Dr. S.S.J. Nassiff (Argentina)

Charged particle cross-section data and their evaluation systematization.

The data for (d,t) and (d,^{3}He) reactions leading to formation of isomeric pairs are being compiled at present. Adaptations of computer programmes for processing experimental data are also under way.

C.3. Targets and Samples

NDS solicits requests and provides assistance in the supply of accelerator targets and isotope samples required by developing countries for nuclear data measurements related to WRENDA.

During 1979, targets and samples were delivered for projects in the following countries involving the indicated costs: Romania (₰ 9,800), Bangladesh (₰ 3,753), Romania (₰ 1,300), and Hungary (₰ 1,437). The projects deal with fission cross-section measurements and high-resolution measurement of gamma-ray spectra accompanying fission for reactor design and safeguards. The first three projects listed were carried over from 1977 and 1978 due to difficulties in obtaining fissile materials.

In addition, two new contracts were initiated in 1979: with Egypt for the "Measurements of the total neutron cross-sections on natural Eu, Eu-151 and Eu-153 in the energy range from 1.8 meV to 5 eV", and with Pakistan for the measurement of the "Total and differential cross-sections for (n,α) on V, Cr and Mo-94 at 15 MeV". The samples for these contracts have been purchased and delivered in the course of 1979 (Egypt ₰ 900.- and Pakistan ₰ 1,650).

The samples of Pu-241 which were ordered by Romania for the measurement of the Pu-241 fission cross-section were destroyed in the 1975 earthquake in Bucharest. The samples for this experiment have been reordered, but were not delivered in 1979; the amount obligated (US ₰ 3,579.-) will be carried over to the next year. Of the US ₰ 24,000.- available for this programme in 1979, approximately ₰ 20,000.- were spent.

C.4. Nuclear Data For Radiation Damage and Reactor Dosimetry

C.4.1. Radiation Damage

Several IAEA technical committee meetings and INDC have recently stressed the necessity to create a comprehensive international data base for the international standardization of radiation damage assessment. In 1976, at a meeting in Harwell, UK, members of the IAEA Technical Committee on Radiation Damage Units discussed the problem of calculating radiation damage induced in reactor structural materials and came to the conclusion that a library of cross-sections on neutron induced reactions for fission reactor structural materials should be kept by NDS and disseminated to laboratories engaged in radiation damage calculations.

The problem of uncertainties involved in the assessment of radiation damage in fission reactor pressure vessels was considered in detail at the IAEA Technical Committee Meeting in Juelich, 24-27 September 1979. It became clear to the participants that at present, the radiation damage induced material property changes as well as the end of life of pressure vessels could not be estimated to an accuracy of better than 50 % ($\pm$ 1σ). This problem was considered by the participants of this meeting and a programme of actions was recommended to the Agency. One of the recommendations was for the Agency to set up an internationally accepted neutron cross-section set to be used in radiation damage calculations in all institutes and laboratories and to coordinate the standardization of the procedures used in these calculations (e.g. unfolding codes, damage cross-sections, formats etc.). Such a standardization would allow a straightforward comparison of radiation damage data obtained in laboratories in different countries, and would lead to the development of a radiation damage data base needed for the prediction of the service life of reactor components including pressure vessels of commercial reactors which are now in operation.

In response to these needs, IAEA has initiated a programme to implement these recommendations. The first step in this programme is the participation of NDS in the REAL-80 International Exercise (Reaction Rate Estimates, Evaluated by Adjustment and Analysis in Leading Laboratories) which has the objective to estimate the contribution of uncertainties of nuclear cross-sections and damage cross-sections to the total error in damage calculations. The results of this exercise are planned to be discussed and compared with the available data at the IAEA Radiation Damage Advisory Group planned for 1981.

C.4.2. Reactor Dosimetry

The Advisory Group Meeting on Nuclear Data for Reactor Dosimetry, convened by the Nuclear Data Section in Vienna, November 1978, finalized the details of the creation of a new international file of evaluated neutron cross-section data for reactor dosimetry applications and has established a procedure for the testing and adjustment of these data. The purpose of this file is to provide to the international reactor dosimetry community a comprehensive set of dosimetry reaction cross-sections (and their uncertainties)

which can be used for the spectral characterization of neutron fields, including, for example, the unfolding of neutron spectra from in-pile multiple foil reaction rate measurements and the estimation of radiation damage in fission and fusion reactors.

The differential-data part of IRDF will contain point-wise energy dependent cross-section data derived only from differential measurements and/or theory. Both the reaction cross-sections and the cross-section uncertainties will be in ENDF/B-V format. Initially, the IRDF will contain differential data for the 33 reactions included in the ENDF/B-V Dosimetry File and also of a set of 10 - 15 reactions evaluated by groups outside the USA, partially coordinated by NDS.

The non-ENDF data now on hand at NDS include the reactions $^{23}Na(n,2n)$, $^{24}Mg(n, p)$, $^{45}Sc(n,2n)$, $^{63}Cu(n,2n)$, $^{64}Zn(n,p)$, and $^{90}Zr(n,2n)$.

An additional six evaluations are expected to be received in the next few months.

The IRDF will also contain data on a set of benchmark fields which can be used for testing and/or adjusting the differential cross-section data as well as spectrum-averaged cross-sections measured in these fields and covariance matrices for both types of data. Evaluations of the neutron spectra in five reference fields (namely, U-235 thermal fission, ISNF, CFRMF, Big-10 and $\Sigma\Sigma$) have recently been received from C. Eisenhauer from the US National Bureau of Standards.

The IRDF will be maintained by IAEA/NDS and will be freely available upon request from IAEA/NDS. Updating of the file will be performed by the IAEA/NDS with corrections and additions to be released in a timely manner. The first version of the IRDF is planned to be released in the summer of 1980.

C.5. Fission Product Nuclear Data (FPND): Report Series

News on activities in the field of FPND are continued to be published annually as INDC(NDS)-Reports "Progress in Fission Product Nuclear Data". In order to avoid unnecessary printing and mailing cost, in August 1978 a circular enquiring about the interest in this report series was sent to all recipients. According to the replies we received, the number of copies to be distributed was reduced from 360 to 280. The 6th issue of this report series is envisaged to be published in May 1980.

C.6. Transactinium Nuclear Data

C.6.1. Coordinated Research Programme (CRP) on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data

This CRP comprises actinide neutron data evaluation activities outside CSEWG-ENDF/B, with the following objectives:

- to bring new evaluators from developing countries in contact with experienced evaluators in institutes with long evaluation tradition;
- to intercompare existing evaluations with each other and eventually with integral experiments;
- to study and intercompare nuclear models and codes for producing evaluations;

The coordination activity of the NDS consists of

- sending circulars to the participants with new evaluation information (references and/or the reports themselves);
- providing experimental and evaluated data requested by the participants;
- convening annual meetings of the participants;
- collecting and distributing reports and evaluated data produced by the participants.

Evaluations produced by the participants are compiled in the

- IAEA Nuclear Data Library for Actinides (INDL/A).

The current status of this library is described in the document IAEA-NDS-12, Rev. 1 (1980). At present INDL/A contains about 15 evaluations, so far in a heterogeneous form: most are in ENDF/B format, but some in KEDAK or UK format; some cover resonance-parameters only, others are full evaluations. Some results from intercomparisons are included in the reports by the participants, which are listed in IAEA-NDS-12.

Currently, the programme has participants from nine countries: France, Fed. Rep. of Germany, India, Israel, Italy, Japan, Romania, UK and USSR. They intend to cover about 30 actinides.

Subject to approval, this CRP is planned to be continued until 1983.

C.6.2. Coordinated Research Programme (CRP) on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data

This CRP aims at improving the accuracy of nuclear decay data of the transactinium isotopes, with the objective to arrive at a consistent set of transactinium isotope nuclear decay data and their uncertainties (including half-lives, branching fractions and gamma-ray and alpha emission spectra) which would satisfy the requirements identified by the community of data users. The second meeting of this CRP was held at Aix-en-Provence, France, 30 April to 1 May 1979 (see section B.1.6 of this report).

Measurements performed or planned by members of this CRP are listed in Table II.

In conjunction with their participation in this CRP this group has initiated a review of the existing transactinium isotope decay data. A first list of proposed recommended half-lives of the more important transactinium nuclides has been issued as INDC(NDS)-108/N in September 1979; an extension to this list, including data for the minor actinides and heavy element isotopes produced by the decay of the major actinides is in preparation.

This group has also started a review of alpha and gamma-ray emission spectra for the major transactinium isotopes for their eventual inclusion in the final report of this CRP. The initial proposed list of these values will also be issued as an INDC(NDS) report.

Subject to approval, this CRP is planned to be continued until 1983.

Table II

Completed, On-Going, and Planned Measurements in Conjunction with the Transactinium Isotope Decay Data CRP

Isotope	Quantity Measured	Investigator	Status
Pa-233	$I\gamma$	Reich (INEL, USA)	completed
U -232	$\alpha T_{1/2}$, $I\alpha$, $I\gamma$	Fudge (Harwell, UK)	planned
U -233	$\alpha T_{1/2}$, $I\alpha$, $I\gamma$	Fudge (Harwell, UK)	planned
Np-237	$\alpha T_{1/2}$, $I\alpha$, $I\gamma$	Fudge (Harwell, UK)	in progress
Pu-238	$\alpha T_{1/2}$	Vaninbroukx (CEC/CBMN)	planned
Pu-238	I_{LX} and $I\gamma$ of 43.5 KeV transition	Vaninbroukx (CEC/CBMN)	completed
Pu-238	$I\alpha$ (1st exited state)/ $I\alpha$ (ground state)	Vaninbroukx (CEC/CBMN)	planned
Pu-238	$I\alpha$	Legrand (LMRI, France)	in progress
Pu-239	$\alpha T_{1/2}$ and specific α-emmission	Vaninbroukx (CEC/CBMN)	completed
Pu-239	$I\gamma$	Reich (INEL, USA)	in progress
Pu-239	$I\gamma$	Legrand (LMRI, France)	completed
Pu-240	$\alpha T_{1/2}$	Vaninbroukx (CEC/CBMN)	planned
Pu-240	$I\gamma$	Legrand (LMRI, France)	in progress
Pu-240	$I\gamma$	Reich (INEL, USA)	planned
Pu-241	$\beta^- T_{1/2}$	Fudge (Harwell, UK)	planned
Pu-241	$\beta^- T_{1/2}$	Vaninbroukx (CEC/CBMN)	in progress
Am-241	$I\gamma$	Legrand (LMRI, France)	completed
Am-241	$I\gamma$ of 51.5 KeV transition	Vaninbroukx (CEC/CBMN)	in progress
Cm-242	$T_{1/2}(\alpha)/T_{1/2}(SF)$	Umezawa (JAERI, Japan)	in progress

C.7. Planned Interregional Project on the Measurement, Computation and Evaluation of Fast Neutron Cross-Sections with an Emphasis on 14 MeV Neutrons

In pace with the growing interest of developing countries in the introduction of nuclear energy and nuclear science methods IAEA/NDS in the future will strengthen its efforts in support of the build-up of nuclear scientific know-how and capability in developing countries. Objectives of such an endeavour should be the better and more efficient coordination and focussing of the dispersed and often isolated efforts, the training in experimental procedures applicable widely also outside the nuclear data field and thus of economic and social benefit to the developing countries, and the twinning of institutions performing similar research in developing and developed countries.

The large number of requests for the determination of neutron nuclear data at about 14 MeV neutron energy still needed for specific aspects of the development of fission and fusion reactors such as radiation damage, safety and shielding, for safeguards, biomedical and other nuclear science applications, and the availability of 14 MeV neutron generators in a number of laboratories in developing countries, obtained through previous technical assistance support by the IAEA, suggest the development of a multiyear Interregional Project on the Determination of Fast Neutron Nuclear Data with the participation of many laboratories from developing and developed countries.

First informal explorations indicate an interest of about 20 laboratories from developing countries and several research groups from developed countries. Among the laboratories in the developing countries which expressed their readiness to participate in this project several groups have already some experience in 14 MeV neutron experiments and some of them in neutron data measurements. While this indicates that there would be a real potential for starting this cooperative effort with participation from both developing and developed countries, much more training and support would be needed for the less advanced and beginning laboratories to enhance their scientific level and capabilities.

The purpose of the project would be to create an integrated network of laboratories and research groups in developing and developed countries which would be engaged in common scientific research. IAEA assistance to the participating research groups from developing countries would be focussed on the supply of high purity elements and isotopes (targets and samples) and parts of auxiliary equipment, which are required for the project measurements. Within the network expertise would be made available to laboratories in the developing countries, whereas staff from the less advanced and beginning laboratories would receive training and fellowship in the more advanced laboratories in Western and Eastern countries.

As mentioned above, the developing countries would have an opportunity to participate in an internationally coordinated effort and to do measurements using up-to-date methods. This would offer the possibility of training their scientific personnel in neutron physics measurement. A variety of methods is applied in nuclear data measurement: neutron, beta and gamma counting techniques, activation techniques, radiochemical methods, track detector technique etc. The knowledge of these techniques could be usefully applied for many purposes in developing countries, e.g.

in activation analysis, geological explorations, routine maintenance of atomic power plants, dosimetry, biomedical applications etc. Therefore the personnel which would acquire training through work within the framework of this project could be usefully employed in many other fields in the developing countries.

The project would unite many research groups from developing and developed countries in similar work. It is planned that the participants in the project would meet periodically and discuss their results and techniques at plenary meetings. These meetings would give both developing and developed country groups the opportunity to exchange their experience. This would help to bring many laboratories in the developing countries out of their present isolation.

This project proposal which is now currently under consideration by the IAEA, will be submitted to the INDC for discussion and approval at its 11th meeting in June 1980.

D. Data Centre Activities

D.1. Nuclear Reaction Data

D.1.1. Experimental Data

EXFOR has now reached the stage of a comprehensive system for the international exchange of experimental nuclear reaction data, including reactions induced by neutrons, charged particles and photons. The EXFOR system functions most satisfactorily as an exchange format from which the centres derive various output formats as they require.

Since the beginning of EXFOR ten years ago in 1969, the EXFOR file has grown to about 44 000 data sets (EXFOR subentries) with 2.5 million numerical data records. A more detailed breakdown of the EXFOR File as of February 1980 is shown in Table III. In the field of neutron data the EXFOR compilation has reached a respectable degree of completeness and reliability although a few gaps are still known to exist. For charged-particle and photo-nuclear data, the importance of EXFOR is increasing, and it is hoped that additional data centres will join in this cooperative effort.

The compilation of new as well as older neutron data from the NDS service area is maintained on a continuous basis. Contacts with authors result in a number of corrections and supplements to published data; many authors acknowledge the critical review of their data by NDS during the compilation.

Transmission tapes are sent to the other centres regularly. Until the end of 1979 NDS has compiled and transmitted to the other centres:

	10-year total (1969 - 1979)	in 1979
EXFOR entries	580	66
EXFOR subentries	4,100	443
Numerical data records	56,000	4,323

These figures refer to newly compiled data only. In addition, almost the same number of EXFOR entries or subentries have been updated and retransmitted. This updating process includes, e.g., adding text information, such as new publications or information on standards or error analysis as received from the author; replacing preliminary by final data; and often entering author's corrections to data already published.

In addition to experimental neutron data, the following data types are compiled at NDS in a non-systematic way, and only if the data are considered to be of importance:

- EXFOR V-series: evaluated neutron nuclear data that are not available in ENDF/B, UKNDL or KEDAK format. (According to the request statistics, these data were requested and sent out frequently);

- EXFOR D-series: charged-particle nuclear data, integral and differential, when pertinent to neutron source reactions;

In addition to the EXFOR compilation work, NDS performs a coordinating function among the cooperating data centres by maintaining and distributing the Dictionaries of agreed codes and abbreviations used in EXFOR and by guiding discussions about proposals for coding rules of new data types and maintaining the whole EXFOR exchange system operational.

Table III

Content of EXFOR as of February 1980

	Data sets (EXFOR subentries)	Numerical data records	total records (data + text)
neutron nuclear data, experimental	42 000	2 463 448	3.14 million
neutron nuclear data, evaluated	200	26 000	30 000
charged particle nuclear data	1 600	16 840	51 725
photonuclear data	370	21 000	25 000
nuclear quantities and decay data (nuclear temperature, spontaneous fission spectra, etc)	460	5 300	10 000
	44 000	2.53 million	3.26 million

Notes:

1. A "data set" is usually defined as an "EXFOR subentry" containing for one nucleus a certain cross section type as a function of energy resulting from one experiment. The size of a data set varies between one single and several thousand data records. For certain data types, in particular double differential data, resonance-parameters, etc., the definition of a "data set" varies as different arrangements in EXFOR are possible.
2. The statistics exclude superseded data sets. Data once compiled and transmitted, are often subsequently revised by the author. The data are then retransmitted, whereby the superseded data are erased at all centres automatically.

D.1.2. Evaluated Data

About 40 data files or libraries of evaluated nuclear reaction data are available from NDS. The main recent additions were:

- the entire United States ENDF/B-4 library;
- essential parts of the United States ENDF/B-5 (standards, dosimetry, fission-products, actinides) library;
- the ENDL-78 library from the Lawrence Livermore Laboratory in the US;
- the JENDL-1 library from Japan;
- the Dosimetry and Radiation Damage files from RCN in Holland;
- the Fission Product Data library from CEA, Grenoble

as well as several additions and revisions to existing libraries, e.g. the USSR SOKRATOR (Nb-93 and six Er isotopes), actinide evaluations in the framework of the coordinated research project, and others.

D.1.3. CINDA

This year marks the 15th anniversary of CINDA as an international "Four Centre" project.

Before the publication of the "Archival issue" of CINDA ("CINDA-A") in April 1979, coordinated efforts at all centres were devoted to the cleanup of the file with an emphasis on:

- checking the completeness;
- blocking together all entries that refer to the same experiment (including also reformatting the antiquated form of sublines);
- assigning "no-book flags" to those superseded references (in particular old progress reports, etc.) that should no longer appear in the book (they will, however, remain accessible by retrievals from the CINDA file)
- replacing those old entries that do not comply to up-to-date standards (e.g. entries without author names, with too cryptic abbreviations in the comments, etc.);
- adding EXFOR accession-numbers to the pertinent references;
- correcting errors (e.g. duplications)

All these improvements were agreed among the Four Centres some years ago on the basis of answers to a questionnaire distributed by the National Nuclear Data Centre at Brookhaven.

At NDS, these CINDA improvements were introduced gradually in the course of the last few years. Also, the corrections for Area 4 (= USSR) entries as suggested by CJD were checked and corrected by NDS.

As a result of this concentrated clean-up project, which was completed in April 1979, the archival issue of CINDA, "CINDA-A", is of high quality with respect to completeness and reliability.

After the publication of the fourth and fifth supplement to CINDA 76/77 in spring and autumn 1978, the archival issue CINDA-A, covering the literature from 1935 to 1976, was published in April 1979. At the same time, a current issue, CINDA-79, was published, covering the literature appearing after 1976.

In the future, it is planned to publish one "cumulative current issue" (i.e. an index to all literature that has appeared after 1976) in the spring, and one supplement to it in the fall of each year. The pre-1976 part of CINDA as contained in the "Archival issue" of CINDA-A" will not be reprinted in the foreseeable future. As a result, the annual cost of CINDA publications has been considerably reduced.

D.2. Nuclear Structure and Decay Data (NSDD)

The general objectives of this component of the Nuclear Data Section programme are to review the requirements for NSDD of importance in applications of radiations and isotopes, to coordinate internationally the compilation, evaluation and dissemination of such data, to promote the measurement and evaluation of needed data, and to provide data centre services to NSDD users.

Since its inception in 1972, the main emphasis of this programme component has been the organization of an internationally coordinated network of data centres, research groups and individual scientists for the systematic compilation, evaluation and dissemination of nuclear structure and decay data. Four advisory group meetings (held in 1974, 1976, 1977 and 1980)have led to the adoption of computer-based systems for the exchange of bibliographic and numerical nuclear structure and decay data between the members of a network of data centres and groups, and to the organization of an international cooperative effort with the aim of achieving a continuous and complete evaluation of NSDD for all isotope mass chains on a four year cycle. The next meeting of the NSDD network is planned for the first quarter of 1982.

In the framework of the same programme component, IAEA/NDS has initiated in 1978 a coordinated research programme for the measurement and evaluation of transactinium isotope nuclear decay data (see Section B.1.6.and C.6.2.). The final objective of this activity is to publish an internationally recommended list of transactinium isotope decay data (e.g. half-lives and α and gamma-ray spectra). A preliminary list of proposed half-lives for selected transactinium isotopes has been published in report INDC(NDS)-108/N.

The fourth issue of the "Compilations and Evaluations of Nuclear Structure and Decay Data" (INDC(NDS)-112/LN) is planned to be published and distributed in the course of 1980.

D.3. Atomic and Molecular Data for Fusion

Following a three-year trial period, the IAEA has regularized the A+M Data Programme as part of the overall programme of the Nuclear Data Section, effective 1 January 1980.

In accordance with recommendations by the temporary Joint IFRC/INDC Subcommittee on A+M Data for Fusion, whose mandate has expired at the end of 1978, the International Nuclear Data Committee (INDC) and the International Fusion Research Council (IFRC), the IAEA has initiated the formation of a new permanent Subcommittee of the IFRC to review periodically the planning and execution of the Agency's A+M Data Programme. It is planned that the Subcommittee will meet every two years.

The long term A+M Data Programme of the IAEA has the following main objectives:

- Continue the periodic publication of the A+M Data Bulletin, (see D.3.1.);
- Maintain the data bank of the A+M Collision Data Index (CIAMDA), and publish subsequent issues of the Index when needed, (see D.3.2.);
- Institute a decentralized coordinated project for the evaluation of A+M data required by the fusion community by established research groups;
- Establish a computerized data bank of evaluated numerical atomic collision data for fusion tailored to the needs of the fusion research community;
- Continue to review A+M data requirements for fusion; and
- Convene regularly the network of A+M data centres and groups participating in this cooperative effort.

A Technical Committee Meeting to assess the current A+M data requirements by fusion research is scheduled to take place at Fontenay-aux-Roses, France, 19-22 May 1980, and a meeting of representatives of A+M Data Centres and groups will be convened immediately following the Technical Committee Meeting on 23-24 May 1980.

D.3.1. International Bulletin on Atomic and Molecular Data for Fusion

The periodical publication of the International Bulletin on Atomic and Molecular Data for Fusion, which was started in July 1977, is continuing. Ten issues of the publication have been produced and distributed world-wide to approximately 750 recipients. In addition to the information collected by the A+M Data Unit Staff, the Bulletin contains material collected at the Kurchatov Institute in Moscow, and at the Nagoya University in Japan. Contributions from a number of other laboratories were also presented in the Bulletin in the form of data tables or "Work in Progress" reports.

The production of the Bulletin is now stabilized; the guidelines issued at the first Atomic and Molecular Data Centre Network Consultants' Meeting have also been implemented. From personal contact and by correspondence it is concluded that people are in general quite satisfied with the present state of the Bulletin. In the near future, it is planned to improve the plasma-surface interactions part. Discussions on related problems are foreseen in the agendas of the forthcoming Technical Committee Meeting on Atomic and Molecular Data for Fusion and the A+M Data Centres' Meeting in May 1980.

D.3.2. CIAMDA - The A+M Collision Data Index

CIAMDA - the Computerized Index to Atomic and Molecular Collision Data relevant to Fusion Research has been completed. This mammoth undertaking has resulted in the first complete index of its type. CIAMDA was formed by combining the five main bibliographic data bases on this subject, IAEA, GAPHYOR (France), Belfast (UK), JILA and ORNL (USA) plus contributions from the USSR and Japan. CIAMDA contains about 13,000 references and over 40,000 indexation lines, reduced from the over 100,000 original references and covers published literature from about 1950 to 1979. The reduction was done by removing duplicate and non-pertinent information. There are three sections to CIAMDA, an Index, a Bibliographic Section and an Author List. Each bibliographic entry can contain the authors, journal citation, and title; however, since some of the information was lacking in the input data bases, all three are not always given. The journal reference is always complete so as to enable easy library usage.

The entire preparation of CIAMDA was computer based, and extensive use was made of the programmes that prepare the International Bulletin on A+M Data for Fusion. The translation from the various input formats (very different in most cases) into one common format required major programming efforts. The entire CIAMDA file now exists in one format and may be used as a real working tool when A+M numerical data bases are developed.

The presentation of CIAMDA, was not, of course, an intellectual exercise, but an attempt to place in the hand of active individual researchers in both fusion and A+M physics a guide to all previous research on A+M collision problems of interest to fusion. Therefore, the real evaluation of its success is the distribution (and use) of

CIAMDA. To maximize the former, contact has been made with several missions to the IAEA to have them participate directly in its distribution within their countries. This in an arrangement similar to that used with CINDA. Not only does this reduce the cost to the individual scientist, since the Mission can purchase it for half price, but it also allows a greater number of people to be reached. It is hoped that over 1000 copies will be distributed in the next 18 months. While future editions of CIAMDA may or may not be published, the computer file, naturally, will be kept current as the material used in preparation of the Bulletin is added.

CIAMDA resulted from the efforts of many people at many places including R.E. Seamon, E.C. Beaty, F.J. Smith, K. Katsonis, H. Marin-Guzman, J. Rumble (IAEA); W.R. McDonough (Belfast); J.L. Delcroix, G. Heft (France); C.F. Barnett (ORNL), P. Ruttenberg (JILA); Yu.V. Martynenko (USSR); and Y. Itikawa (Japan).

D.4. Data Centre Services

D.4.1. Documentation and Customer Service

In September 1979, NDS released the first issue of the "Nuclear Data Newsletter". This newsletter is designed to expand contacts to data users in the NDS service area, to advertise the services offered by NDS, to publicize news about additions and improvements to the data files available from NDS, and to inform the nuclear data community about activities and meetings sponsored by the IAEA/NDS. This Newsletter is aimed specifically at the nuclear data users in the NDS service area, and is planned to be released two or three times a year.

Complementary to the Newsletter, NDS has instituted a new documentation report series, "IAEA Nuclear Data Services" with the report code "IAEA-NDS-...", which allows for the individual documentation (description of content and format) of each data library or data system. These documentation reports are normally included with the requested data library or system, and are also distributed on request. The current Index of the IAEA-NDS Documentation Reports is given in Appendix C.

The combination of the widely distributed "Nuclear Data Newsletter" and the "IAEA Nuclear Data Services" reports replaces the previously issued CINDU catalogue.

D.4.2. Request Statistics and Data Dissemination

On the occasion of the 15th anniversary of the formation of the Nuclear Data Section, it was deemed appropriate this time to summarize the request and dissemination statistics for the last 15 years. The more detailed, regular yearly statistics, by data type and service area, will continue to be presented starting with the next progress report, following the re-organization of our internal Request and Data Dissemination Logs systems.

D.4.2.1. Request Statistics

In its function as a data centre, IAEA/NDS disseminates nuclear data in computerized numerical form, and as reports and documents, to Member States in the IAEA/NDS service area. This geographical area comprises most developing IAEA Member States. Over the last five years IAEA/NDS handled an average of 280 requests per year. This amounts to more than one request per working day.

A "request", as interpreted in the statistics presented below, is defined as any query received by NDS for any one of the following specific categories of experimental data, evaluated data, bibliographic retrievals (e.g. from the CINDA master file), documents, and computer codes. For example: one letter asking for experimental and evaluated data would count as two requests.

Request statistics for each of the considered categories and statistics showing the total number of requests handled by NDS for each of the last 15 years are given in Table IV and Figures 1 and 2. To illustrate the use of the NDS data centre by Member States in the NDS service area, Table V shows the request for numerical nuclear data (experimental and evaluated) received from Member States in the NDS service area during the two-year period 1978-1979. To illustrate the wide variety of data types and purposes of the requests, Appendix D presents selected examples of nuclear data requests received from developing countries during the 1978/79 period.

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 number of data points (interpreted to be equivalent to data lines or data records) and in terms of "data sets" (see definition below); documents, retrievals, computer programmes or codes are counted individually.

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 last 15 years, and considering both experimental and evaluated data, a data set comprises 184 data points. 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 15 years.

Table IV

Data Request and Distribution Statistics 1965 - 1979

Year	Request Statistics						Combined Experimental and Evaluated Data Distribution	
	Experimental Data	Evaluated Data	Documents	Other	Totals per year	Totals Cumulative	Data Sets per Year	Data Sets Cumulative
1965	3	-	-	-	3	3	73	73
1966	40	-	-	5	45	48	138	211
1967	118	-	9	8	135	183	474	685
1968	119	-	16	9	144	327	560	1 245
1969	48	15	25	5	93	420	403	1 648
1970	95	20	34	8	157	577	857	2 505
1971	76	33	43	8	160	737	2 308	4 813
1972	48	23	60	8	139	876	7 274	12 087
1973	43	22	54	6	125	1 001	8 081	20 168
1974	49	24	61	6	140	1 141	5 427	25 595
1975	43	49	114	3	209	1 350	8 472	34 067
1976	34	43	153	9	239	1 589	14 533	48 600
1977	45	49	232	3	329	1 918	15 100	63 700
1978	78	88	177	39	382	2 300	23 691	87 391
1979	63	93	95	18	269	2 569	36 807	124 198

Figure 1: Nuclear Data Request Statistics

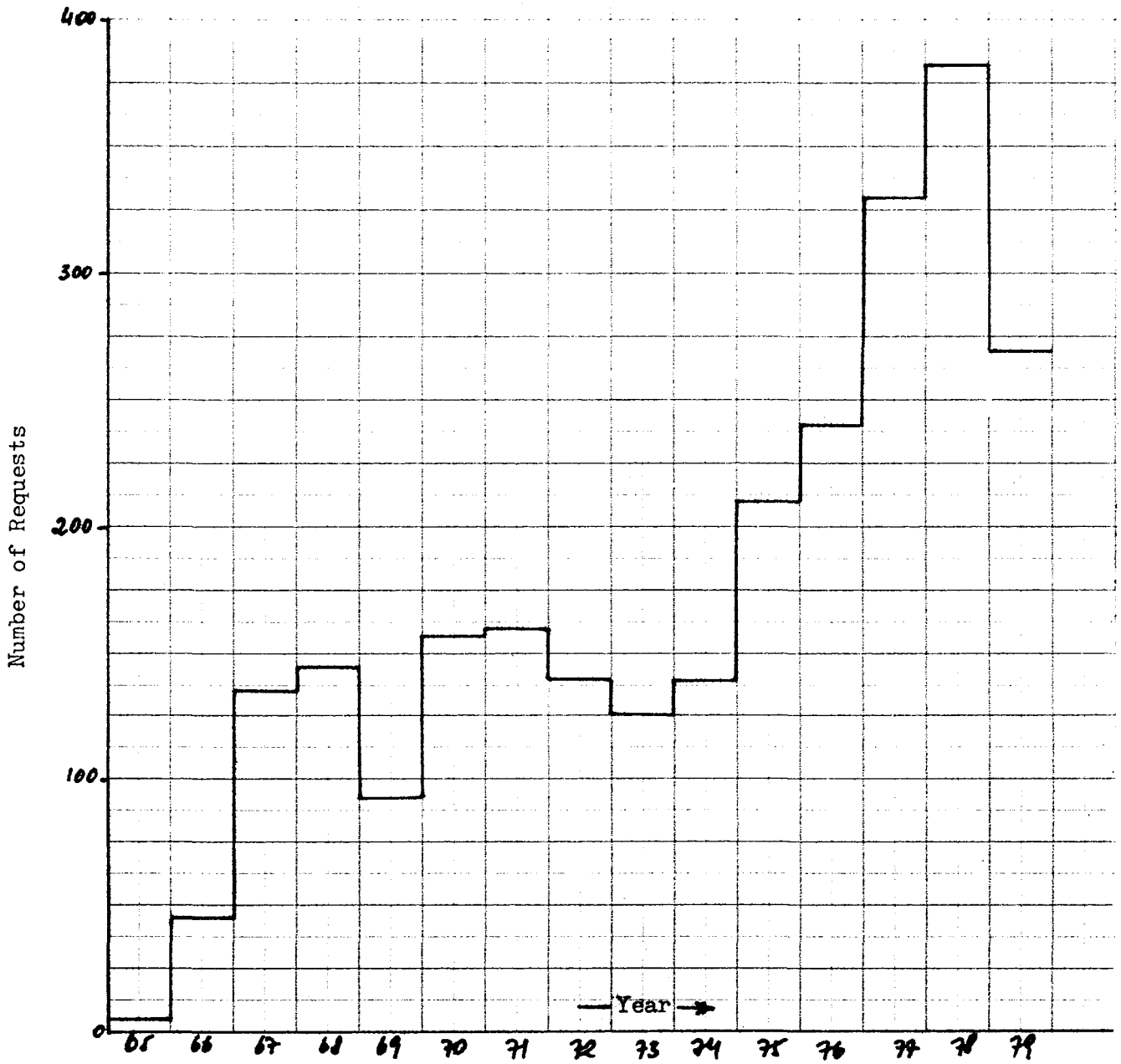

Figure 2

Numerical Nuclear Data Sets Distributed per Year

(including experimental and evaluated data)

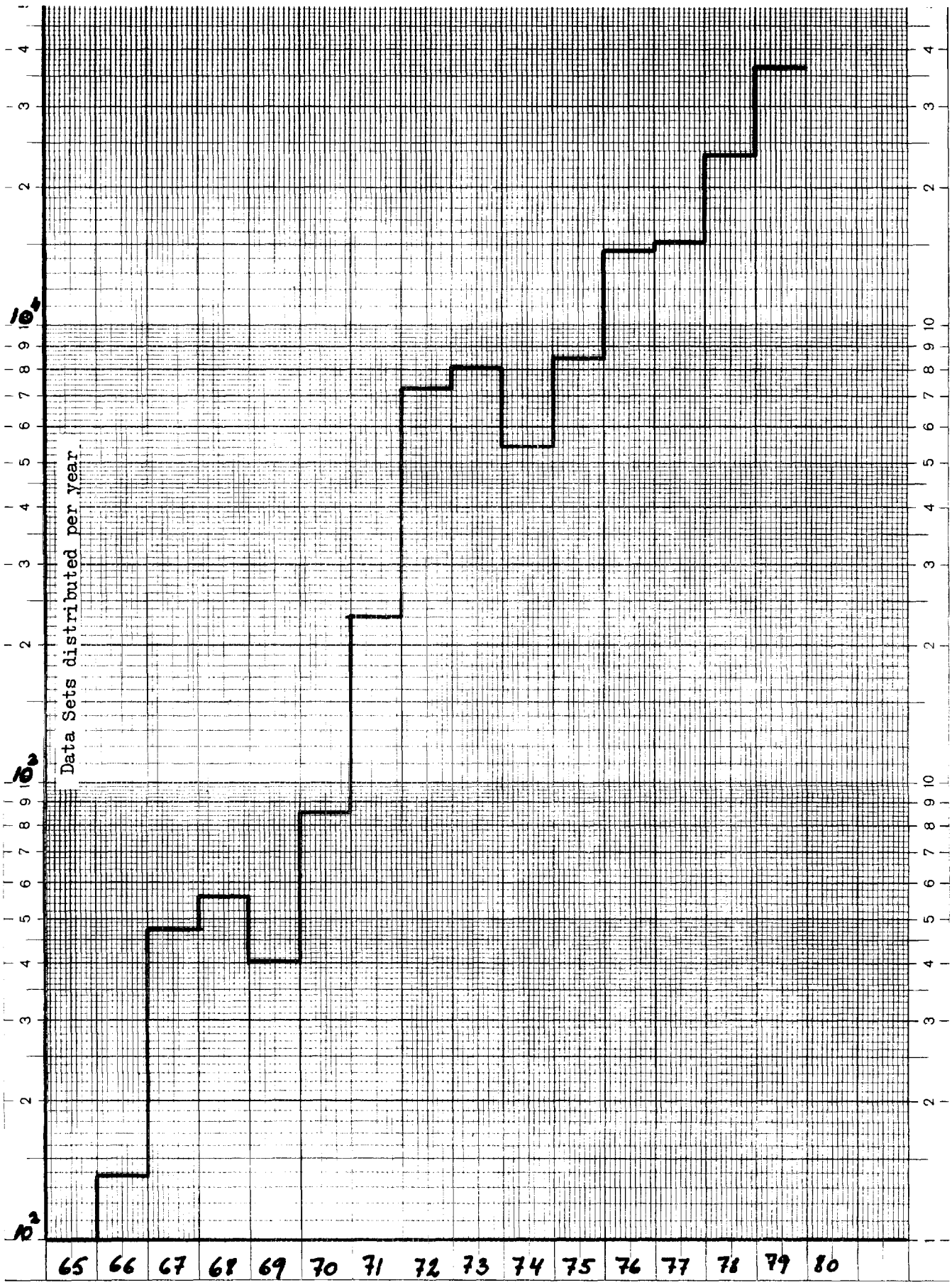

Table V

Nuclear Data Requests Received from IAEA/NDS
Service Area during 1978-1979 Period

Member State	Number of Requests
Argentina	11
Australia	5
Bangladesh	5
Brazil	21
Colombia	1
Cuba	1
Czechoslovakia	16
Egypt	7
German Democratic Republic	24
Ghana	1
Guatemala	2
Hungary	24
India	83
Indonesia	6
Irak	7
Iran	2
Israel	18
Korea, Republic of	8
Kuwait	1
Mexico	2
Pakistan	20
Peru	2
Poland	13
Romania	19
South Africa	8
Sierra Leone	2
Yugoslavia	13
Total:	322

D.4.3. Training of Fellows

In January and February 1979 two fellow scientists from Brazil, Mrs. R. Paviotti (physicist) and Mr. C.S. da Silva (programmer) were hosted by the Nuclear Data Section for training in the compilation and handling of nuclear data, at the cost of the Brazilian Government. Following initial discussions with Brazilian scientists at the 1978 Course on Nuclear Theory for Application held at the International Centre for Theoretical Physics in Trieste, the Division of Advanced Studies of the Institute of Space Activities of the Technical Aerospace Centre in Sao Jose dos Campos, Brazil, to which the two above-mentioned scientists belong, had decided, with the support of the Brazilian Atomic Energy Commission, to set up a local nuclear data centre for providing nuclear data services within Brazil.

The training comprized detailed studies of the formats, input and retrieval procedures and documentations of the experimental and evaluated data libraries maintained by NDS, and a detailed examination of the consistency of available data for the $^{63}Cu(n,\alpha)^{60}Co$ reaction. The two fellows had also thorough technical discussions about guidelines, work priorities and technical problems connected with the creation of the planned nuclear data centre.

D.5. Programming and Systems Development

D.5.1. General

During the past period the EXFOR system of programmes was improved and may now be considered up-to-date, including documentation. The Data Index System, described below, is now operational for all of our data files. The request and dissemination log systems are currently under review and will be re-designed and implemented during the present period. In addition, the utility of the EXFOR will be improved by providing a computation format for experimental data described below.

During the latter portion of 1979 and throughout 1980 there will be major changes in the computer resources available to NDS. The NDS presently has a remote job entry system, which allows jobs to be initiated and computer output listings to be obtained locally. In addition the NDS now has three visual display units which can be used for programme development, maintenance of request and dissemination logs, as well as on-line input and correction of data. During 1980 the present card-based operation will be phased out and keypunches and verifiers replaced by visual display units.

D.5.2. EXFOR Programming

The system of EXFOR programmes for file maintenance may now be considered up-to-date. This includes: a thorough checking code, file management programmes, indexing and retrieval programmes and output editing programmes (the latter to improve readability of EXFOR output). All of these programmes are systematically documented (for internal NDS use) to improve utility and simplify maintenance.

A major new project will be the implementation of a computation format. The computation format will be designed to allow EXFOR data to be put into a form which is easy to read and analyse using a computer. For example, reducing all physically comparable data to the same set of units (e.g. all total cross-sections to barns) and a common format (e.g. energy followed by cross-section), simplifies comparison of two or more measurements. The computation format will facilitate future graphical output.

D.5.3. Request and Dissemination Log System

The request log is designed to monitor the arrival of requests at NDS as well as the processing of requests through NDS, in order to insure that each request is answered on a timely basis. 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.

The entire request and dissemination log system is currently being reviewed with the objective of improving and expanding the information stored in the system in order to improve the types of statistics which may be obtained from the system; in particular usage patterns by isotope, country, type of data (experimental vs. evaluated), etc. Preliminary analysis indicated that the data base management system ADABAS and its associated programming language NATURAL can be used to store and retrieve information. The Statistical Analysis System, SAS, will then be able to be used to prepare meaningful statistics.

D.5.4. WRENDA

The recommendation of the INDC, that all WRENDA request lists be printed as a single combined list with each request identified as associated with a specific application (e.g. fission, fusion etc.), has now been fully implemented (see WRENDA 79/80). Minor improvements continue in the programmes, particularly with respect to sort orders and retrieval criteria.

D.5.5. The Data Index System

Instead of searching the large data files at 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 has been 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 (by each individual subfield), author, institute, energy range, etc. For the evaluated data, at present, retrieval is only possible for whole evaluations; this facility will be extended when data requests indicate a need for further detail.

D.5.6. Profile System

The NDS maintains a computerized file of the names, addresses and a PROFILE describing the areas of interest for each of the centre's correspondents. Areas of interest are described by the use of one or more distribution codes. This file is used to selectively retrieve lists or print address labels for the dissemination of publications or correspondence.

There are currently more than 3800 names and addresses stored in the profile system master file; last year approximately 400 names were added and 150 per month changed. This system is used routinely to produce reports and mailing labels for distribution of INDC documents. Two new listings can now be produced; the committee list, which for each Member State contains the name, address and committee affiliation for each member of the National Nuclear Data Committee, and a participants list, which allows the listing of meeting participants and their addresses intended for use as appendices to meeting reports.

D.5.7. CINDA Programming

The system of CINDA programmes that are operational at NDS are 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 programmes has remained rather stable over the years and only minor improvements were done or are envisaged.

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 programmes 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, these programmes must be distributed with the data.

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

Appendix A

List of Liaison Officers to the INDC as of 1 February 1980

Argentina	Ricabarra, G.
Austria	Vonach, H.K.
Bangladesh	Islam, M.
Belgium	Poortmans, F.
Bolivia	Mariaca, F.
Brazil	Martins, J.B.
Bulgaria	Nadjakov, E.
Chile	Martens Cook, P.
Colombia	Director, Instituto de Asuntos Nucleares
Czechoslovakia	Rocek, J.
Denmark	Christensen, C.J.
Ecuador	Munoz, R.
Egypt	El-Nady, M.
Finland	Silvennoinen, P.
German Democratic Republic	Seeliger, D. (presently member of INDC)
Greece	Dritsa, S.
Hungary	Jeki, L.
Iran	Etemad, M.A.
Iraq	Said, K.I.
Israel	Yiftah, S. (presently Member of INDC)
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	Reitmann, D.
Spain	Velarde Pinacho, G.
Switzerland	Widder, F.
Thailand	Boonkong, W.
Turkey	Ertek, C.
Uruguay	Lalanne, A.
Yugoslavia	Slaus, I.

Appendix B

Second Course on Nuclear Theory for Applications
ICTP Trieste, 28 January - 22 February 1980

Lecture Programme

Week 1: 28 January - 1 February 1980

Reaction Mechanisms for Fast Neutron-Nuclear Interactions

- Progress in the theoretical understanding of fast neutron-nuclear interaction mechanisms and associated models (P.A. Moldauer, Argonne, USA - 5 lectures)
- Recent results in the theoretical description of pre-equilibrium processes (E. Gadioli, Milan, Italy - 2 lectures)
- Advances in the application of nuclear reaction theory and models to the computation of neutron nuclear reaction data of the most important constituents of nuclear fission reactors (P. Fu, Oak Ridge, USA - 5 lectures)

Week 2: 4 - 8 February 1980

Nuclear Fission

- A critical review of the theory of fission (H.C. Pauli, Heidelberg, Fed. Rep. of Germany - 5 lectures)
- Theory and phenomenology of neutron induced fission cross-sections (H. Weigmann, BCMN Geel, Belgium - 5 lectures)
- Applications of nuclear theory to the computation of neutron cross-sections for actinide isotopes (V. Konshin, Minsk, USSR - 5 lectures; in the absence of Dr. Konshin partly presented by V.S. Ramamurty, Bhabha Atomic Research Centre, Bombay, India)

Week 3: 11 - 15 February 1980

Evaluation and Processing of Nuclear Data

(S. Pearlstein, Brookhaven, USA - 10 lectures)

- Observables
- Effect of experimental conditions on observables
- Problems in data evaluation
- Evaluation objectives

- Evaluation procedures

- Evaluated data libraries

- Multigroup neutron cross-sections

Week 4: 18 - 22 February 1980

14 MeV Neutron Cross-Sections in Experiment and Theory

- Experimental techniques and theoretical models for the study of integral 14 MeV neutron cross-sections (J. Csikai, Debrecen, Hungary - 3 lectures)

- Experimental techniques and theoretical models for the study of secondary particle energy spectra and angular distributions emanating from 14 MeV neutron induced nuclear reactions (D. Seeliger, Dresden, Democratic Republic of Germany - 3 lectures)

- Advanced techniques for the determination of integral cross-sections for the emission of complex particles in 14 MeV neutron-induced nuclear reactions (S.M. Qaim, Juelich, Fed. Rep. of Germany - 2 lectures)

- Experimental methods for investigation of (n,p) and (n,α) spectra and angular distributions for 14 MeV neutrons (H.K. Vonach, Austria - 2 lectures)

Appendix C

INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

Index to the IAEA-NDS- Documentation Series as of Dec. 1979

The first titles of this series (# 1-9) document the EXFOR system and its computer programmes and operations at NDS. These documents are internal manuals and are distributed to the outside in general only through the INIS microfiche service - with the exception of IAEA-NDS-1, which is a short guide to EXFOR sent out to data centre customers together with each EXFOR data retrieval.

The other documents (# 10 and up) are brief summary descriptions of contents and formats of data libraries distributed by NDS, and will be sent out together with these libraries. These documents will be updated frequently in order to collect all the information received at the data centre about a given library.

The existence of these documents will be advertised in the "Nuclear Data Newsletter".

IAEA-NDS-

#	Title, Author or Editor	Date of Issue
1	Short Guide to EXFOR A. Calamand, H.D. Lemmel	1974 (7 pages)
2	EXFOR Dictionaries, Edition on behalf of the cooperating data centres by O. Schwerer, P.M. Attree, H.D. Lemmel, P.M. Smith (this revision available as INIS microfiche)	79/6 (154 pages)
3	NDS EXFOR manual H.D. Lemmel, editor	79/6 (302 pages)
4	System Specifications for the NDS EXFOR System P.M. Attree, P.M. Smith	79/6
5	System Specifications for the NDS Dictionary System P.M. Attree, P.M. Smith	79/9 (59 pages)
6	System Specifications for the NDS Data Index System P.M. Attree, P.M. Smith	79/9 (68 pages)

10	ENDF/B Format M.A. Khalil	75/1 (13 pages)
11	ENDL-78, LLL Evaluated Nuclear Data Library 1978, Contents and Documentation O. Schwerer	79/7 (7 pages)
12	INDL/A - IAEA Nuclear Data Library for Evaluated Neutron Reaction Data of Actinides. Contents and Documentation H.D. Lemmel	79/4 (5 pages)
13	ENDF/B-V Actinides, Contents and Documentation N. Kocherov	79/7
14	BIBFP and BIBGRFP, the Czechoslovakian Fission-Product Library, Cross-Sections and Group Data N. DayDay	(in preparation)
15	ENDF/B-5 Standards Library, Contents and Documentation N. DayDay	80/3
16	ENDF/C Format	(in preparation)
17	BLA-78, Blachot's Library of Fission-Product Decay Data, Content & Documentation N. DayDay	79/8 (12 pages)
18	JENDL-1, the Japanese Evaluated Nuclear Data Library, Contents and Documentation N. DayDay	(in preparation)
19	JULGAM N. DayDay	(in preparation)
20	UKNDL Format	79/11
21	Quick Guide to KEDAK Library M.A. Khalil	78
22	PNESD - Proton Nucleus Elastic Scattering Data H. Leeb, Vienna, Jan. 78 Edited by N. DayDay	79/12
23	ENDF/B-4 General Purpose File 1974 Summary of Contents and Documentation O. Schwerer	80/3
24	ENDF/B-V Dosimetry File Contents and Documentation N. DayDay	80/3

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AM 4	Compendium of Structure and Collision Data in the First 8 Issues of the International Bulletin on Atomic and Molecular Data for Fusion K. Katsonis, F.J. Smith	1979/9/19 (165 pages)

Appendix D

Selected examples of nuclear data requests received from developing countries in 1978/1979

Request No.	Requestor	Country	Institute	Request Type	Purpose
399	J.E. Volkis	Argentina	Nuclear Data Committee	ENDF/B-IV evaluated nuclear data library	Calculation of reactor systems containing Th and U-233
311	A. Ceballos	Argentina	Fisica Nuclear-CNEA	Evaluated Data: ENDF/B-4 Fission Product Library. Documents: CINDU-11 + Supplement, CINDA 76/77+Supplement, List of INDC documents, WRENDA 76/77, Brookhaven Charged Particle Nuclear Reaction Bibliography	To update and broaden the Atomic Energy Commissions's nuclear data base
99	H.M. Sen Gupta	Bangladesh	University of Dacca	Experimental (p,γ) cross sections including angular distributions, spectroscopic factors, γ-ray decay data and branching ratios. Experimental cross sections for light-ion induced reactions for Fe and Co isotopes and their isobars. Data requestedon computer listings.	To study d, ^{3}He, α and p-induced nuclear reactions
287	P. Molla	Bangladesh	Bangladesh Atomic Energy Commission, Library	Nuclear data reports and meeting proceedings	Development of the Head Office Library of B.A.E.C.
163	J.A.A. Amarante	Brazil	Aerospacial Technology Centre, Division of Advanced Studies, Sao José dos Campos	Evaluated neutron data Libraries (UKNDL, KEDAK, ENDF/B) and associated documentation	Creation of a nuclear data base for a new nuclear data centre
302	K.M. Elawadly	Egypt	University of Alexandria	Information and documents on evaluated nuclear data libraries	Study of the nuclear data libraries available through IAEA/NDS (as a first step for the creation of a nuclear data library in Egypt)

Request No.	Requestor	Country	Institute	Request Type	Purpose
135	G. Tay	Ghana	Ghana Atomic Energy Commission	Experimental neutron cross sections for ^{56}Fe, ^{58}Ni, ^{52}Cr, ^{55}Mn, ^{59}Co, ^{141}Pr, ^{238}U. Nuclear model codes ABACUS-2 and CERBERO-2	Theoretical analysis of neutron scattering and reaction cross section data by nuclear optical model calculations.
397	P. Vértes	Hungary	Hungarian Academy of Sciences, Central Research Institute for Physics	ENDF/B-IV and V evaluated nuclear data libraries	Processing of ENDF/B into multigroup constants using computer code developed by the author
316	M. Mehta	India	Bhabha Atomic Research Centre	Evaluated data for thorium cycle nuclides from the Japanese JENDL-1 data library. CINDA retrievals	Preparation of a review paper on the status of data for thorium fuel cyle elements
92	V.S. Ramamurthy	India	B.A.R.C. Bombay	Evaluated data: ENDF/B-4 complete library. Experimental Data: EXFOR data for all elements for fast neutrons (E>1MeV). Several nuclear model codes.	Evaluation of existing data and development of reliable evaluation procedures for fast neutron cross sections
298	A.K. Chatterjee	India	Nuclear Physics Lab. Bose Institute-Calcutta	Evaluated and experimental elastic, inelastic, reaction and total cross sections up to 20 MeV for selected elements	Preparation of experiments on differential elastic and nonelastic cross sections in the 14 MeV region
404	S.K. Basu	India	B.A.R.C. Calcutta	Evaluated data: KACHAPAG charged particle, JUELGAM 79 gamma-ray and ENSDF79 nuclear structure data libraries	Preparation of research programme at the Variable Energy Cyclotron Laboratory in Calcutta
418	S. Ganesan	India	Reactor Research Centre Kalpakkam	INDC or other report on unresolved resonance data for U-233	Doppler effect calculations
487	T. Alfa	Indonesia	Bandung Reactor Centre	Selected Exfor data, reports and documents	Not specified

Request No.	Requestor	Country	Institute	Request Type	Purpose
109	F. Sefidvash	Iran	Arya-Mehr University of Technology - Tehran	Experimental and evaluated cross sections for benzene, diphenyl, terphenyl for energies between 10^{-5}eV and 5 eV	Study of organic material moderated reactors
14	G.Z. Farouk	Iraq	Iraqi Atomic Energy Commission	ENDL-2 Livermore evaluated nuclear data library on tape and documentation reports UCRL-50400 Vol. 15, 16	Nuclear fuel accounting
398	Y. Atara	Israel	Hebrew University of Jerusalem, Dept. of Theoretical Physics	ENDL-78 Livermore evaluated nuclear data library	Neutron cross sections adjustment studies
126	M. Caner	Israel	Soreq Nuclear Research Centre	Experimental Data: EXFOR entries on Cm-246 and Cm-248	Evaluation of neutron cross sections for Curium isotopes for the IAEA/NDS Coordinated Research Programme on the Intercomparison of Actinide Neutron Data Evaluations
480	M. Cho	Korea	Korea Atomic Energy Research Institute	ENDF/B-IV evaluated nuclear data library	Nuclear reactor design calculations
420	I. Ahmed	Pakistan	PINSTECH	Data and reports on average and total β and γ energies per disintegration for important fission products	Fuel element shielding design work (to determine the residual power due to fission product decay in a spent fuel element)
323	K. Gul	Pakistan	PINSTECH	Data on elastic, non-elastic and inelastic excitation cross-sections to levels at 4.43, 9.63 and 10.1 MeV in ^{12}C for neutron energies of 0.5 - 15 MeV; for the $^{12}C(n,n')3\alpha$ reaction	Computation of the efficiency of a neutron detector using a Monte-Carlo code

Request No.	Requestor	Country	Institute	Request Type	Purpose
112	C.L. Picon	Peru	National University of Engineering, Lima	Evaluated data: σ_f for U-235, U-238 and Th-232 and γ-ray spectrum	Interpretation of activation experiments and determination of uranium, thorium and their contents in rocks
419	K. Morstin	Poland	Institute of Nuclear Physics and Techniques, Krakow	Evaluated data: ENDF/B-4 complete library, ENDF/B-5 Standards, Fission Products, Actinides and Dosimetry Libraries. Nuclear data processing codes: NJOY, VITAMIN-C. Documents: CINDU-11+Supplement	Creation of a data base and multigroup libraries for reactor calculations
439	A. Marcinkowski	Poland	Inst. Badan Jadrowych, Warsaw	Exfor data for $^{107}Ag(n,2n)$, $^{109}Ag(n,2n)$, $^{46}Ti(n,2n)$ and associated documents	Evaluation work on ^{107}Ag and $^{46}Ti(n,2n)$ reactions
17	I. Garlea	Romania	Institute of Nuclear Power Reactors, Bucharest	Evaluated Data: ENDF/B Dosimetry, SAND-II libraries	In-pile neutron dosimetry
73	I.G. Cristian	Romania	Institute of Nuclear Power Reactors, Buchares	Evaluated Data: ENDF/B-4, UKNDL Libraries	Preparation of a multigroup cross section library for reactor calculations (cell and lattice calculations, shielding calculations etc)
115	S.E.B. Nonie	Sierra Leone	Fourah Bay College	Nuclear energy levels of low and intermediate Z nuclei (C^{12}, Mg, Al^{27}, Si, Ca, Ti, Fe^{56} isotopes) together with their γ-ray spectra	Analysis of geological samples by activation