International Atomic Energy Agency

INDC(NDS)-66/L

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

REPORT OF THE NUCLEAR DATA SECTION TO THE INTERNATIONAL NUCLEAR DATA COMMITTEE SEPTEMBER 1974 TO AUGUST 1975

August 1975

IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

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INDC(SEC)-044/U	Dec 74	INDC Correspondents for the Exchange of Nuclear Data Information, December 1974 (supersedes INDC(SEC)-39/U of June 74)
INDC(SEC)-045/U	Dec 74	Reprint from Neutron Standard Reference Data Proceedings of a Panel, Vienna, 20-24 Nov. 72
INDC(SEC)-046/U	Jul 75	WRENDA 75 - World Request List for Nuclear Data Measurements. June 1975
INDC(SEC)-047/U	Jun 75	INDC Correspondents for the Exchange of Nuclear Data Information, June 1975 (supersedes INDC(SEC)-39/U)
INDC(SEC)-048/U	Jul 75	List of Documents Received by the INDC Secretariat July 1975 (supersedes INDC(SEC)-41/U and Supplement 1 thereto)
INDC(SEC)-049/L	Jul 75	1975 Compilation of National Nuclear Data Committees, July 1975
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INDC(NDS)-064/S	Aug 75	The Third IAEA Evaluation of the 2200 M/S and 20DEG-C Maxwellian Neutron Data for U-233, U-235, Pu-239, Pu-241. H.D. Lemmel, A.J. Axton, E.J. Deruytter, B.R. Leonard, J.J. Story. August 1975
INDC(NDS)-065LN	Mar 75	Summary - Observations, Conclusions and Recommendations of the Panel on Fission Product Nuclear Data, Bologna, 26-30 November 1973 M. Lammer, March 1975
INDC(NDS)-066/L	Sep 75	Report of the Nuclear Data Section to the International Nuclear Data Committee September 1974 to August 1975
INDC(NDS)-067NF	Aug 75	Atomic and Molecular Data for Fusion - A Survey A. Lorenz, J. Phillips, J.J. Schmidt August 1975

A. INTRODUCTION

Between September 1974 and August 1975 NDS had only a small turn-over of staff and was for the first time since several years fully staffed again. Koichi Okamoto (Japan) left NEA/NDCC and joined NDS in November 1974; he is initially responsible for compiling neutron data, answering requests from and maintaining contacts with all countries in the Section's service area except Eastern European countries. Traudl Lammer (Austria) has replaced her husband Meinhard Lammer; she is mainly responsible for all CINDA entries from the NDS' service area and for the preparation and edition of the newsletter for fission product nuclear data measurements and evaluations. More detailed information regarding the present composition and responsibilities of NDS staff is presented separately to the INDC.

The fortunate effect of a full complement of the Section's staff during the past year was more than outweighed by the considerable disadvantages and programme delays incurred as a consequence of the Section's move in March 1975 to new premises, about 3 km away from the Agency's Headquarters, in the 9th district of Vienna. Apart from the unavoidable negative effects of the spatial separation from the frequently used central library and from the other Agency programmes with whom NDS cooperates, this move caused unfortunate delays in computer programme testing and development, in the Section's publications and services to its customers and in the preparation of NDS meetings. The most important drawback was that during five months (March - July) there was no computer connection between NDS's new premises and the Agency's Headquarters with the result that all computer jobs had to be transported to and from Headquarters by a shuttle bus service. This resulted in a severe loss in the turn-around time of computer jobs and in other inconveniences. Persistent and time-consuming efforts on the part of NDS staff evoked the support of the Agency's management for the acquisition of a remote job entry (RJE) station with a telephone link to the Agency's central computer at Headquarters. The RJE station, installed at the new premises in July 1975, allows NDS staff to run more than 90 percent of the Section's computer jobs directly from the new premises without recourse to Headquarters. It is therefore hoped that in the next reporting period, part of the delays in the Section's programme will be able to be eliminated, and that the Section will be able to resume normal operation.

In the reporting period NDS experienced a strong increase in magnetic tape exchange of nuclear data. This was due to increases in the transmission of experimental and in the release of evaluated neutron data, to an increasing exchange of non-neutron nuclear data and references, as well as to a growing number of nuclear data requests particularly from the Section's service area. While the compilation of data and references can be satisfactorily performed by the available staff, there is an increasing shortage of staff for the handling of nuclear data and answering requests. It is anticipated that the forthcoming 11th edition of the Section's data catalogue CINDU will lead to an even stronger increase in data requests. It is therefore essential to strengthen the service part of the Section. Until a new general service post can be assigned to NDS, the availability of temporary assistance to hire one computer input clerk is being investigated.

Due to increases in the size of the Soviet SOKRATOR library of evaluated neutron data and to their release to NDS, and because of the recent releases of the ENDF/B-IV dosimetry cross section and fission product decay data library, the exchange and services in evaluated neutron data are currently increasing in both quantity and quality. Measures are therefore taken by NDS to get a current feedback and assessment from NDS customers of the quality and usefulness of the disseminated data.

As a follow-up action from the Bologna Panel on Fission Product Nuclear Data (FPND) NDS is currently developing, together with FPND scientists and with the other data centres, a newsletter for FPND measurements and evaluations. This newsletter is planned to be published semi-annually starting in October 1975. First steps have also been taken to collect the results from various fission product decay afterheat experiments.

In the field of neutron data for reactor dosimetry, the review of the available data on all relevant reactions as well as an evaluation of the (n,p) cross section of Ti isotopes is nearing completion. The availability of the ENDF/B-IV dosimetry data file allows a thorough comparison of the experimental evidence with evaluated data as a first step towards the development of a universally acceptable data file for neutron dosimetry. In cooperation with the Physics Section of the Agency's Seibersdorf Laboratory, the Division for Nuclear Power and Reactors, and the reactor dosimetry community, NDS will next perform a detailed assessment of the spectral specifications of neutron dosimetry benchmark fields, the coordination of benchmark integral cross section measurements, the recommendation of suitable computer programmes for the unfolding of neutron spectra from measured activities, and the final preparation of a universally acceptable file of neutron cross section data for reactor dosimetry. The whole programme is expected to take about 2-3 years. Its routine implementation will eventually lead to the set-up of a service by which the Agency will provide laboratories, particularly in developing countries, with the necessary means for the measurement and evaluation of in-pile neutron spectra (i.e. with foils, computer programmes, and "best" cross section data).

In the field of thermal cross sections for the major fissile nuclides, NDS has reported on a third Agency review at the Washington Conference on Nuclear Cross Sections and Technology in March 1975. Several measurements on key quantities are nearing completion so that an updating of this evaluation to a final stage can probably be prepared before the end of 1975.

The 1975 edition of the World Request List for Nuclear Data Measurements (WRENDA 75) combines for the first time updated requests for fission, fusion and safeguards nuclear data in one document, and contains altogether more than 1600 individual requests from more than 20 Member States. While the fusion and safeguards requests appear to be better substantiated than in the past, the fission list shows a tendency of an increase in requests for actinide nuclear data, while data requests for the key reactor materials and fission products still do not show any sign of decreasing. As a result of encouragement by NDS, a gradual tendency in smaller countries to orient their nuclear data programmes towards WRENDA requests has been observed. As a consequence of successive personal contacts during the latter part of 1974 and in 1975, particularly on the occasion of J.J. Schmidt's visit to several East Asian countries in October and November 74, plans have been

formulated to initiate two programmes within the framework of the Agency's Research Cooperative Agreement (RCA) programme. The first of these is between the Japanese and Korean Atomic Energy Research Institutes in the measurement and evaluation of fission product nuclear data, and the second one is between BARC Trombay and the Atomic Energy Centre Dacca in the measurement of fission nuclear data, related to the Th-232/U-233 fuel cycle.

Requests for targets and samples received during the past year under the Targets and Samples (T + S) Program reflect the work of Agency-sponsored technical experts in developing laboratories and the contacts which have been established during visits by NDS staff members and INDC members to laboratories in many Member States. In connection with the Regional Cooperative Agreement (RCA), which is part of the Agency's general effort to encourage regional cooperation in nuclear science and technology, samples have been requested by Bangladesh (the Atomic Energy Centre) for cooperative work with scientists from India (BARC); also, sample requirements for cooperative work between Korea (KAERI) and Japan (JAERI) are under discussion.

The preparations of the Advisory Group Meeting on Transactinium Isotope Nuclear Data (TND) (Karlsruhe, 3-7 November 1975) and of the Consultants Meeting on the Use of Nuclear Theory in Neutron Nuclear Data Evaluation (Trieste, 8-12 December 1975) are well underway. Both meetings are expected to provide comprehensive field reviews, which are hoped to lead to a concentration of measurement and evaluation activities on important outstanding issues (TND Meeting) and to new workshop activities of the International Centre for Theoretical Physics Trieste in the field of applied nuclear theory (Theory Meeting).

In the field of "non-neutron" nuclear data the following developments are currently taking place: the neutron data centres, together with the charged particle nuclear data (CPND) centres, are developing an extension of the EXFOR system to "non-neutron" nuclear reaction data so as to adapt it to the compilation and exchange of CPND needed for applications such as fusion, activation analysis, radioisotope production, etc. It is hoped that at the forthcoming Consultants Meeting on Charged Particle Nuclear Data Compilation in September 1975 major agreements on the coding and exchange of CPND for applications will be reached. The interest to cooperate in the compilation and exchange of nuclear structure and decay data, particularly between data centres in the US and the USSR, has been strongly increasing during the last year. A first technical review of this development, including the discussion of common procedures and formats, is planned for May 1976 (planned Meeting on Nuclear Structure and Decay Data Compilation for Applications, Vienna, 3-7 May 1976).

In response to a recommendation of the Agency's International Fusion Research Council (IFRC), the Director General has asked NDS to review the needs and perform a world-wide survey of existing compilation activities in the field of atomic and molecular (A+M) data with specific emphasis on plasma research and fusion technology. It is proposed that, subject to the approval by Member States, NDS add to its nuclear data activities new atomic physics and programming staff, and implement a short- and long-term programme in the field of A+M data for fusion with the responsibility to

- coordinate compilation activities and assess data requirements;
- compile and exchange references and data;
- disseminate atomic data to users in fusion research and technology;
- sponsor and support critical data review and evaluation.

On a number of occasions, France, FRG, UK, USA and USSR have expressed strong interest in the establishment of this new programme and consider it essential for the successful development of fusion technology. This interest was demonstrated by these countries by sending specialists to the NDS Consultants Meeting on A+M data for Fusion held in Vienna on 21 and 22 July 1975, at their own cost. A report on "Atomic and Molecular Data for Fusion, Proposal and Survey", prepared by NDS in cooperation with the Agency's Physics Section, was critically reviewed by the consultants. This survey report and the recommendations of the consultants regarding the proposed A+M programme were to be submitted to the next meeting of IFRC in Lausanne, 30 and 31 August 1975, and to the INDC Meeting in October 1975 for consideration and approval, before being submitted to the Agency's Scientific Advisory Committee and governing organs for the final decision.

It has been made clear within and outside the Agency, that, in view of the still growing activities in the field of nuclear data, the new programme component and its successful realization depend critically on the approval to add adequate atomic physics and programming staff to NDS as recommended by the A+M Data Consultants Meeting.

B. INDC SECRETARIAT

B.1. Liaison Officers

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

Belgium:	Dr. F. Poortmans	
	has replaced	Dr. M. Nêve de Mevergnies;
Bolivia:	Mr. Francisco Mariaca	
	has replaced	Mr. F. Paz Lora;
German Democratic Republic:		Dr. Klaus Seidel has been appointed Liaison Officer;
Iran:	Mr. M.A. Etemad	
	has replaced	Mr. H. Rouhaninejad;
Israel:	Dr. S. Amiel	
	has replaced	Dr. G. Ben David;
Korea:	Dr. M. Cho	
	has replaced	Mr. J.D. Kim;
Turkey:	Mr. C. Ertek	
	has replaced	Mr. T. Enginol.

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

As in previous years, progress reports submitted by countries not directly represented on the INDC, have been compiled into two consolidated reports: one for those countries which are in the NDS service area, published as INDC(SEC)-50/L, the other for those outside the NDS service area, published as INDC(SEC)-51/L.

B.2. List of Correspondents

The current list of INDC Correspondents for the Exchange of Nuclear Data Information has been distributed June 1975 as INDC(SEC)-47/U. The next issue of this list will be published in November 1975.

At its last meeting in October 1974, the INDC approved the extension of the existing INDC documents distribution, currently consisting of the G, L, and U categories, by creating two new distribution categories, N and W, to facilitate the distribution of documents and reports generated by/for the INDC in the field of "non-neutron"* nuclear data.

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*) "Non-neutron" nuclear data is used here to mean nuclear structure, decay and charged particle and photonuclear reaction data.

This "non-neutron" distribution would consist of the following three categories:

G - Distribution (same as for the neutron nuclear document distribution)

N - Distribution (equivalent to the neutron data L distribution) consisting of the G distribution, INDC Liaison Officers, heads of nuclear data centres, members of national nuclear data committees and other recipients concerned with the development of programmes and international cooperation in the measurement, compilation, evaluation, dissemination and application of "non-neutron" nuclear data, and the INDC Secretariat.

W - Distribution (equivalent to the neutron data U distribution) consisting of the N distribution and of additional selected measurers, evaluators and users of "non-neutron" nuclear data.

At this stage of "non-neutron" nuclear data consideration by the INDC, the N distribution is deemed to be the most important inasmuch as documents requiring such distribution have already been generated by IAEA/NDS last year (e.g. the reports on the "non-neutron" nuclear data meetings held by NDS in April-May 1974). The W distribution is one primarily oriented toward the users of "non-neutron" nuclear data.

In response to a request to INDC, names of Correspondents for the N and W distribution have been received from a few Member States in the course of this reporting period. Although the N and W distribution lists have not yet been incorporated in the published "List of INDC Correspondents", pending the receipt of lists from other Member States, the names and addresses included in all submitted lists have been entered on the internal file and are available for the distribution of N or W documents.

B.3. List of Documents

The current list of INDC documents received and distributed by NDS/INDC Secretariat has been published as INDC(SEC)-48/U in August 1975. A Supplement to this list will be distributed in November 1975.

With the expansion in the scope of nuclear data considered by INDC and NDS, to include "non-neutron" nuclear data, the number of documents received by the INDC Secretariat is expected to increase.

Inasmuch as the existing system for INDC documents distribution by the INDC Secretariat (see INDC(SEC)-48/U) does not depend on subject matter classification, all "non-neutron" nuclear data documents generated by or for the INDC could be incorporated into the existing procedures of document distribution in accordance with the N and W distribution categories described under B.2. above.

In order to implement the document distribution system for "non-neutron" nuclear data documents and reports, all producers of "non-neutron" nuclear data documents in every participating Member State are asked to comply with

the INDC document distribution instructions (i.e. as to the method of nomenclature to be used and the number of copies to be sent to the INDC Secretariat) given in the "List of Documents Received by the INDC Secretariat" (INDC(SEC)-48/U) and the "List of INDC Correspondents" (INDC(SEC)-47/U).

"Non-neutron" nuclear data reports received as single (or few) copies by NDS or the INDC Secretariat, for which no INDC distribution is provided for, will be listed in the annually published "List of Documents Received by the INDC Secretariat", together with the neutron data documents received as single copies.

The INDC Secretariat is 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 responsible for the dissemination of nuclear data information to distribute more documents through the established INDC channels (L, U, N and W distributions).

B.4. Translation of Documents

During the past year, the following nuclear data reports of Soviet origin have been translated by the IAEA into English, and distributed as INDC documents, with the following numbers:

INDC(CCP)-046/L	Planning of Neutron Data Experiments and Evaluations for Reactors Yu.G. Bobkov, L.T. Pyatnitskaya, L.N. Usachev	Translated by the IAEA, December 1974
INDC(CCP)-047LN	Bulletin of the Data Centre of the Leningrad Institute of Nuclear Physics	Translated by the IAEA, January 1975
INDC(CCP)-048/L	Nuclear Physics Research in the USSR, Collected abstracts, Issue 17	Translated by the IAEA
INDC(CCP)-049/L	Nuclear Physics Research in the USSR, Collected abstracts, Issue 18	Translated by the IAEA, February 1975
INDC(CCP)-050/U	Table of Content Translations of Soviet Reports Received by the INDC Secretariat	Translated by the IAEA, May 1975
INDC(CCP)-051/L	Competition between Beta Decay and Neutron Emission in 237 Np Fission B.P. Maksyutenko, Yu.F. Balakshev, G.I. Volkova	Translated by the IAEA, July 1975
INDC(CCP)-052LN	Nuclear Constants Issue No. 12 (Part II). Results Obtained in Studies on Photoneutron Reactions Near the Threshold. A.I. Abramov	Translated by the IAEA, June 1975

INDC(CCP)-61/L	Evaluation of Nuclear Reaction Cross Sections for 239 Pu in the Resonance Energy Region with a View to Compiling a Complete File of Constants V.A. Konshin, G.B. Morogovskij, E.Sh. Sukhovitskij	February 1975 English translation
INDC(CCP)-62/L	Nuclear Data for 239 Pu in the Unresolved Resonance Region of Neutron Energies G.V. Antsipov, A.R. Benderskij, V.A. Konshin, E.Sh. Sukhovitskij	February 1975 English translation
INDC(CCP)-63/L	Evaluating the Cross Sections of the (n,2n) and (n,3n) Reactions for 239 Pu E.Sh. Sukhovitskij, V.A. Konshin	February 1975 English translation
INDC(CCP)-065/U	English translation of "Nuclear Physics Research in the USSR, Collected Abstracts". Issue 19.	

B.5. Compilation of National Nuclear Data Committees

The revised 1975 Compilation of National Nuclear Data Committees has been published in August 1975 as INDC(SEC)-49/L. It supersedes the 1974 Compilation, INDC(SEC)-40/L.

The INDC Members and Liaison Officers are urged to send corrections and additions to this Compilation to the INDC Secretariat, and to ascertain that all pertinent members of these committees be included in the list of INDC Correspondents (see B.2. above).

C. MEETINGS

C.1. Past Meetings

C.1.1. Second International Conference on Neutron Capture Gamma Ray Spectroscopy, RCN, Petten, The Netherlands, 2-4 September 1974

The Second International Symposium on Neutron Capture Gamma Ray (NCG) Spectroscopy and Related Topics was held at the Reactor Centrum Nederland (RCN) near Petten, the Netherlands, from 2-6 September 1974. The Agency was not a sponsor of this meeting although it had contributed to the support and published the proceedings of the First Symposium held in Studsvik, Sweden, 11-15 August 1969. At the end of the Symposium it was proposed that a third meeting be considered for approximately October 1977 at Brookhaven National Laboratory with Grenoble the suggested alternative site.

The Symposium was attended by approximately 150 participants representing nearly all countries with capture gamma-ray programmes. Of unanticipated benefit was attendance by many scientists from the NDS service area (eastern Europe, Africa, Asia, Australia and Latin America) so that nuclear data programmes of their laboratories could be discussed in relation to the services of the Nuclear Data Section and the Agency.

The scientific programme covered the following topics:

1. The mechanism of slow neutron capture;
2. Gamma rays from discrete resonance capture;
3. Gamma rays from average resonance capture and from inelastic neutron scattering;
4. Fast neutron capture and related topics;
5. Nuclear photo-excitation;
6. Spin assignments with thermal neutrons;
7. Applications and experimental developments;
8. Decay scheme studies with thermal neutrons;
9. Properties of heavy nuclei.

The majority of papers dealt with contributions of NCG spectroscopy (and related subjects) to basic nuclear science. NCG spectroscopy continues to be a productive technique for study of nuclear structure. New studies of decay schemes, spin and parity assignments and nuclear life-times were reported.

In addition to its responsibilities for compilation and dissemination of neutron nuclear data, NDS is currently investigating requirements for nuclear structure and reaction data and is beginning to serve as an information centre for non-neutron data as well as neutron data. Use of photonuclear and charged-particle reaction data in interpretation of NCG data is an excellent example of the complementary aspects of many types of nuclear data in a single application. The scientific programme, therefore, was of direct importance to the NDS's established responsibilities for neutron data and also to its developing responsibilities in the field of nuclear structure and reaction data.

C.1.2. International Symposium on Neutron Induced Reactions, Smolenice, Czechoslovakia, 2-6 September 1974

The Symposium was held near Smolenice in Czechoslovakia, about 60 kilometers northeast of Bratislava. About 50 scientists attended the Symposium.

The Symposium dwelt primarily on the present state of the theory and experiment of nuclear reactions induced by neutrons and the possible mechanisms of nuclear processes at medium excitation energies. Particular emphasis was placed on the pre-equilibrium models which bridge the gap between direct reactions and compound nucleus processes and which have been developed during the last 8 years. The programme, including the list of papers presented, is given in Appendix B.

The main objective of A. Calamand's participation was to promote the services of the Nuclear Data Section. The fact that his contribution on the "Services of the IAEA Nuclear Data Section to neutron physicists and neutron data users" was accepted by the programme committee, although being of no direct relevance to the topics discussed, is believed to be an indication that advertising campaigns by such direct contacts are still much needed.

This Symposium offered unmatched opportunity to strengthen or establish contacts particularly with East European scientists whose laboratories belong to the NDS Service area.

Other information gained at the meeting and which is worth mentioning are the project of regional cooperation between the nuclear physics laboratories of Debrecen, Zagreb and Bratislava* and the future formation of a Polish nuclear data group. This is precisely in line with the efforts of NDS to promote national and regional nuclear data programmes and foster regional cooperation.

C.1.3. Third Meeting of the International Working Group on Reactor Radiation Measurements (IWGRRM), Vienna, 18-20 November 1974

This meeting of the IWGRRM was attended by Vlasov of NDS.

In accordance with the recommendations of the last INDC meeting, the IWGRRM accepted the Agency's role to advise on nuclear data requirements for reactor dosimetry. Ways of improving reactor dosimetry data, and the application of

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* Institute for Experimental Physics, Kossuth Univ. (Debrecen)
Institute Rudjer Boskovic (Zagreb)
Dept. of Nuclear Physics, Institute of Physics SAV (Bratislava).

standard neutron fields for testing differential data on integral measurements were considered during the meeting.

The following actions were recommended:

a) that the Agency should organize the compilation and critical analysis of neutron energy spectra in available standard neutron fields;

b) the presently available data from microscopic measurements and from experiments in standard neutron fields, for all reactions important for reactor dosimetry, should be consistently re-evaluated with the final goal of deriving an internally consistent and internationally recommended set of data;

c) data of a few important reactions should be measured in several standard neutron fields and intercompared. Both reactions and neutron fields should be selected so as to cover the entire neutron energy range of importance to reactor dosimetry;

d) cross sections for a few important reactions should be measured in a single neutron field by several selected groups of experimentalists using their own equipment and techniques.

The IWGRRM supported NDS's proposal to convene a meeting in 1976 on Integral Cross Section Measurements in Standard Neutron Fields for Reactor Dosimetry.

A second international intercomparison of computer codes for unfolding reactor neutron spectra from the activation of foil detectors was also recommended. For this effort, NDS will have the responsibility to prepare an internally consistent set of neutron cross sections, and send it together with a set of accepted saturation activities to all participants.

C.1.4. Euratom Working Group on Reactor Dosimetry (EWGRD), Brussels, March 1975

The meeting of the EWGRD, which was attended by M. Vlasov, of NDS, was devoted primarily to the forthcoming ASTM-Euratom Symposium on Neutron Irradiation Dosimetry for International Standardization, to be held at Petten, Netherlands, in September 1975.

During the meeting, the present status of standard neutron fields available for the international programme recommended by the September 1973 IAEA Consultants' Meeting on Nuclear Data for Reactor Dosimetry was reviewed by Prof. U. Farinelli, the Chairman of the EWGRD. This programme was strongly supported by the EWGRD, and it was decided to discuss it in detail at a special working group during the Petten Symposium.

New information on two measurements was presented at the meeting, one of the Californium-252 standard neutron field made at Braunschweig (FRG), and the other of the fast reactor field made at the "Tapiro" fast reactor at Casaccia (Italy).

C.1.5. Conference on Nuclear Cross Sections and Technology, Washington, D.C., 10-14 March 1975

Two NDS staff members attended this Conference, J.J. Schmidt as member of the Programme Committee and as one of the four conference reviewers in the summary session, and H.D. Lemmel as an invited speaker on "The third IAEA evaluation of the 2200 m/sec and 20° Maxwellian neutron data for U-233, U-235, Pu-239 and Pu-241" presented in the session on cross-sections and flux standards. In the following several observations on the major technical topics of the conference are summarized in relationship to components of the current and planned NDS programme (given in brackets after each heading). The Conference provided an excellent measure of the up-to-dateness of the NDS programme.

a. Fission product and actinide nuclear data
(Panel on Fission Product Nuclear Data, Bologna, November 1973; second panel planned for 1977. Advisory Group Meeting on Transactinium Isotope Nuclear Data, Karlsruhe, November 1975)

As a consequence of the growth of national nuclear industries, of the energy crisis, and of the growing public concern about nuclear safety and environmental protection, the nuclear build-up, burn-out and decay data of fission product and actinide nuclides of importance throughout the nuclear fuel cycle received major attention at the conference. Of major interest were contributions on the new comprehensive US fission product nuclear data library and its application to detailed fission product radioactive decay heat calculations. A number of papers dealt with recent measurements, evaluations and calculations of actinide nuclear data.

b. Nuclear data for fusion
(Part of the Agency's nuclear data compilation and exchange programme; annual edition of an international list of nuclear data requests for fusion)

For the first time at a nuclear data conference, a whole session was devoted to nuclear data for fusion. The nuclear data requirements for fusion reactor design are increasingly being derived from sensitivity studies and are thus becoming more realistic and detailed. The largest gaps appear to be in the MeV neutron energy range, and concern partial reaction cross sections, and energy and angular distributions of secondary particles in structural materials. More cross sections of charged particle reactions with light nuclei are needed for more sophisticated "futuristic" fusion reactor design. Measurement and theoretical prediction of the needed data is increasing.

c. Biomedical nuclear data
(Specialists' Meeting planned for the late seventies)

Three invited papers dealt with recent trends in medical radionuclide applications, neutron therapy and radiography in humans and, biomedical radiation transport calculations as an application of nuclear data. The speakers outlined the need for the measurement of many useful, but unknown neutron and charged particle nuclear reaction cross sections in the 10-100 MeV range.

d. Neutron data for reactor neutron dosimetry
(Consultants' Meeting on Nuclear Data for Reactor Neutron Dosimetry, Vienna, September 1973; Consultants' Meeting on Integral Cross Section Measurements in Standard Neutron Fields for Reactor Dosimetry, planned to be held in Vienna in 1976, as part of a programme for the development of a universal cross section set for reactor dosimetry; coordination of nuclear data measurement programmes)

Many measurements of the average neutron cross sections important for reactor dosimetry in thermal neutron induced and spontaneous fission spectra were reported, which did, however, not resolve the long standing discrepancies between microscopic and integral reactor dosimetry cross sections. More microscopic measurements, more accurate knowledge of the fission neutron spectra and a more accurate definition and comparison of benchmark spectra are needed in order to arrive at an internally consistent nuclear data set for reactor neutron dosimetry.

e. Nuclear data for shielding
(Study Group on Benchmark Calculation and Sensitivity Studies, Paris, October 1975; potential Specialists' Meeting on Nuclear Data Requirements for Shielding, 1976)

Safety and environmental protection considerations have prompted a strong increase and refinement in experimental and theoretical shielding research including extensive sensitivity studies and the measurement and theoretical prediction of associated nuclear data. Large cooperative programmes are currently being pursued between various laboratories both in the US and in Western Europe. Large computer libraries of nuclear data such as optical model and statistical theory parameters, nuclear masses, level densities, γ-ray decay data and level schemes constitute nowadays the input to the large transport theory computer codes used for the treatment of shielding problems.

f. Oak Ridge nuclear structure data file
(Specialists' Meeting on Nuclear Data for Applications, Vienna, May 1974; Specialists' Meeting on Nuclear Structure and Decay Data for Applications, May 1976)

The Oak Ridge Nuclear Data Project which covers the whole field of basic nuclear structure and decay as well as associated atomic data reported on the development of a computerized data file from which "repackaging" (i.e. integrating, averaging, selection, etc.) can be performed for many different purposes. This file could form the basis of an international nuclear data file whose development was recommended at the May 1974 Specialists' Meeting. It is to be hoped that the completion and current future up-dating of this file can eventually be shared on an international level thus saving much unnecessary duplication of compilation work.

g. Nuclear theory for nuclear data prediction
(Consultants' Meeting on the Use of Nuclear Theory for Neutron Nuclear Data Evaluation, Trieste, December 1975, and potential future workshops at Trieste on this subject)

The numerous papers dealing with this subject gave the strong impression that recently, through more detailed descriptions of the nuclear reaction and decay processes, nuclear theory and models as applied to the prediction and interpretation of nuclear data particularly in the MeV range of particle energies, have considerably gained in reliability. With appropriate parameterization one can nowadays expect from a theoretical calculation a reasonable accuracy compared to experimental capability and compared to the actual requirements. This has made nuclear theory a powerful tool, particularly for the prediction of nuclear data whose measurement would be very difficult, and for survey or exploratory studies over large ranges of reactions and nuclides, for example for fusion and medical purposes and for cross sections of fission product and actinide nuclei. The major conclusion to be drawn from this part of the conference is the need for a systematic survey of the achievements and required improvements of nuclear theories and models with regard to their validity and reliability in the prediction of nuclear data. This is the objective of the meeting in Trieste which will bring together nuclear theorists and data evaluators for this purpose.

h. Nuclear data for fission reactors
(Major part of the Agency's neutron data compilation and exchange programme, annual Consultants' Meetings between the four neutron data centres; Panels on Nuclear Standard Reference Data in November 1972 and in 1976; annual WRENDA request lists)

The bulk of the papers was devoted to the measurement, evaluation and calculation of nuclear data of importance to major reactor constituents such as fissile and fertile isotopes, structural and coolant materials, with a strong emphasis on fission products, actinides and shielding materials. Various improvements in experimental techniques and results were reported, particularly also for standard cross sections used for neutron flux measurement and normalization. These, however, still do not adequately satisfy the requirements of reactor physicists and designers.

C.1.6. 18th Meeting of NEANDC, Harwell, 7-11 April 1975

As IAEA observer, J.J. Schmidt attended the 18th Meeting of NEANDC which took place at Harwell, UK, from 7 to 11 April 1975. At this meeting NEANDC

- re-defined its future role as a more technical committee with a scope restricted essentially to nuclear data for fission and fusion reactors, as opposed to the more policy-oriented and broader scope of INDC which is concerned with all nuclear data for all applications relevant to IAEA programmes;

- decided, on a tentative basis, to follow the proposal of INDC to extend the interval between its meetings to 18 months, similarly to INDC; and

- agreed with the proposed two years cycle for the publication of the CINDA neutron data reference handbook from 1976 onwards.

Also a close cooperation of its Subcommittee on Standards and Discrepancies with the corresponding technical subcommittees of INDC was agreed upon, with the establishment of a common data basis. The meeting agenda and the list of participants are given in Appendices C and D.

C.1.7. Meeting of the Agency's International Working Group on Fast Reactors (IWGFR), Vienna, 15-18 April 1975

J.J. Schmidt attended the meeting as observer and gave a short progress report on the activities of the Nuclear Data Section.

C.1.8. Consultants' Meeting on Atomic and Molecular Data for Fusion, Vienna, 21-22 July 1975

The International Fusion Research Council (IFRC) (at its 5th Meeting, 16 November 1974 in Tokyo) recommended that the Agency consider adding atomic and molecular (A+M) data of importance to plasma research and fusion technology to the scope of its existing nuclear data programme. In response to this recommendation, the Director General proposed that NDS perform a survey of the needs and availability of A+M data in fusion research and technology, and that a meeting of experts be called to review this survey and to recommend to him the extent and scope of an IAEA programme in this field. (See Section E.3. of this report for a more detailed description of this proposed programme component.)

The Consultants' Meeting on A+M data for fusion, originally planned to take place on 30 June - 1 July 1975, was held on 21-22 July 1975. Because of previous commitments, Dr. C.F. Barnett, of the Controlled Fusion Center at Oak Ridge, was unable to attend the meeting at the rescheduled time; however, he did come to Vienna on the originally planned dates to discuss the proposed IAEA programme on A+M data for fusion, and comment on the draft recommendations. His comments, conclusion, and suggested set of recommendations were distributed to the other experts prior to the meeting.

The participating experts at the 21-22 July 1975 meeting were Dr. Yu. Martynenko (Kurchatov Inst., Moscow, USSR), Dr. H.W. Drawin (CEN, Fontenay-aux-Roses, France) and Dr. M.F.A. Harrison (Culham Laboratory, UK); IAEA representation included J. Lemley, A. Lorenz (Scientific Secretary) and J.J. Schmidt from NDS, and J. Phillips and A. Belozerov from the Physics Section.

The Conclusions and Recommendations of the meeting were submitted to the Director General in August 1975, and presented to the International Fusion Research Council (IFRC) at its meeting on the 30-31 August 1975 in Lausanne, Switzerland. The survey report on "Atomic and Molecular Data for Fusion", by A. Lorenz, J. Phillips and J.J. Schmidt, was distributed in report form as INDC(NDS)-67/NF.

C.1.9. Third All-Union Conference on Neutron Physics, Kiev, 9-13 June 1975

J.J.Schmidt from NDS participated in the Conference upon invitation by the organizing committee. The Conference was sponsored by the Ukrainian Academy of Sciences and the USSR State Committee on the Utilization of Atomic Energy. As in the second Conference on Neutron Physics held in Kiev in June 1973 there was invited participation by scientists outside the USSR. Of the 350 participants - about twice as many as in 1973 - 50 were from the following countries and organizations: Australia, Bulgaria, Czechoslovakia, Egypt, France, FRG, GDR, Hungary, Netherlands, Poland, Sweden, UK, the Joint Institute for Nuclear Research Dubna, and the IAEA. Simultaneous inter pretation into English was provided.

Similarly to the Nuclear Cross Sections and Technology Conference held in Washington, D.C., USA, in March 1975, the participation from developing countries outside Europe was extremely small, again probably due to lack of financial support.

In altogether 84 papers the Conference gave a broad survey of fundamental and applied aspects of neutron physics work in the USSR with a strong emphasis on neutron data needed for fast reactor development. The Conference programme is reproduced in Appendix E.

Regrets were expressed that Soviet scientists could not participate in the March 1975 Washington Conference on Nuclear Cross Sections and Technology, and that US scientists could not attend the present Kiev Conference. At both Conferences IAEA/NDS was asked to arrange for an exchange of the proceedings of the Conferences between both countries.

A small booklet containing annotations in keywords of the INIS system of all contributions reviewed at the Conference was made available to the participants; unfortunately the annotations were without abstracts.

In format, the Conference consisted entirely of presentations of invited papers and review summaries of individual contributions. Of the total of 84 papers, 60 were delivered by Soviet scientists and 24 by scientists from outside the USSR.

The Conference was heavily oriented towards neutron data needs, measurements and evaluations for fast fission reactors and heavy nuclei, with the exception of very few papers that were devoted to neutron data for thermonuclear fusion, soil investigation, and astrophysics. The fact that fundamental as well as applied scientists appear to be working closely together on neutron physics and data problems for nuclear technology deserves particular mention.

A strong activity in the evaluation of neutron data for fission reactors was noted; the main groups at Minsk and Obninsk work in close collaboration with the Nuclear Data Centre Obninsk. Results were reported on new neutron data evaluations for U-235, Pu-240, C-12, Fe, Cr, Ni and Au over a neutron energy range from 10^{-4} eV to 15 MeV. These will form part of the comprehensive SOKRATOR evaluated neutron data library which is now designed to become the basic nuclear data reference source for nuclear energy applications in the

USSR and Eastern Europe. The data contained in this library will be made available to IAEA/NDS for international distribution and comparison with similar libraries in other countries.

Several reports dealt in detail with nuclear data requirements for nuclear fission and also fusion (one report) reactor technology, including needs for fission product and actinide nuclear data, in close similarity to the needs expressed at the Washington nuclear data conference. In deriving accuracy requirements for nuclear data from mathematical sensitivity studies the possibility to improve nuclear data not only by microscopic but also by integral experiments in critical facilities was explicitly taken into account. The neutron data requirements for fusion are based on given accuracy requirements for the prediction of the tritium breeding ratio in normal (D-T) fusion reactors and of both the tritium and plutonium breeding ratios in hybrid fusion reactors. The Soviet requests for fission and fusion reactor nuclear data belong to the best founded requests submitted for inclusion in the IAEA/NDS WRENDA request list.

The scientifically most interesting part of the Conference consisted of three sessions devoted to fission research on heavy nuclei. It was also in this area where the most vivid interaction between Soviet and other scientists took place. New empirical and theoretical material was presented on the double-humped fission barrier problem, and on the properties of the nuclear states in the so-called second well, which are responsible for the shape of actinide neutron fission cross sections needed in nuclear technology.

C.2. Future Meetings

C.2.1. Consultants' Meeting on Charged Particle Nuclear Data (CPND) Compilation, Vienna, 8-12 September 1975

In April 1974, the Nuclear Data Section convened a Consultants' Meeting on Charged Particle and Photonuclear Reaction Data. This meeting reviewed existing and planned activities, and outlined the general features of an international cooperation.

In order to implement this international cooperation along the lines of the recommendations of that meeting, NDS has organized a second meeting in this field. It will be devoted specifically to the discussion of technical problems related to the establishment of an international collaborative effort in the compilation, exchange and dissemination of CPND, similar to the international cooperation in the field of neutron data. Further details on the meeting are given in the tentative agenda (Appendix F). This agenda was established on the basis of answers received in response to a questionnaire (see Appendix G) which NDS sent to Centres and Groups involved in CPND compilation activities.

C.2.2. ASTM-EURATOM Symposium for Neutron Irradiation Dosimetry for International Standardization, Petten, 22-26 September 1975

The purpose of this Symposium is to provide a forum for the presentation and exchange of new and critical information concerning the application of neutron dosimetry in materials damage studies, and the influence of the neutron energy spectrum on materials damage response.

This meeting should bring together specialists working in applied radiation damage studies, physicists working on the basic models for damages, and specialists in reactor materials dosimetry. NDS will present a status report on some neutron cross sections important to reactor radiation dosimetry.

As indicated in the proposed agenda for this Meeting (see Appendix H), nuclear data for radiation dosimetry will be extensively discussed. A special working group will discuss in detail the international programme on integral cross section measurements in standard neutron fields. Discussion topics for the 1976 Consultants' Meeting on the same subject will also be discussed at that time.

C.2.3. IAEA/NEA Specialists' Meeting on Sensitivity Studies and Benchmarks, Paris, 7-10 October 1975

NEA will co-sponsor the IAEA Specialists' Meeting on Sensitivity Studies and Benchmarks, which the Agency's Division of Nuclear Power and Reactors is going to hold at Paris from 7-10 October 1975 (tentative date). At the time of this writing an agenda of the meeting was not yet available. As outlined in the last progress report of NDS to INDC (INDC(NDS)-63/L, paragraph C.2.3.) the meeting will not include nuclear data in its topics and will therefore not be co-sponsored by NDS. However, depending on the outcome and recommendations of this meeting NDS would consider holding a meeting on the status and requirements of nuclear data for shielding in 1976.

C.2.4. IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, Karlsruhe, FRG, 3-7 November 1975

IAEA/NDS, in cooperation with the OECD Nuclear Energy Agency, will convene an advisory group meeting on "Transactinium Isotope Nuclear Data", at the Kernforschungszentrum Karlsruhe, Federal Republic of Germany, from 3 to 7 November 1975. Details concerning the objectives and organization of this meeting are described in Appendix I. The scientific secretaries for this meeting are A. Lorenz and J.J. Schmidt.

To ensure that the goals of the meeting be successfully met, this meeting will be organized in the same way as the Panel on Fission Product Nuclear Data, held in Bologna, November 1973. The meeting is organized around seventeen review papers which will be distributed to the participants prior to the meeting and will provide the basis for the discussions. In addition to the reviewers' own contribution, over 100 experts have been asked to contribute to the review reports.

C.2.5. IAEA Consultants' Meeting on the Use of Nuclear Theory in Neutron Nuclear Data Evaluation, International Centre for Theoretical Physics (ICTP), Trieste, 8-12 December 1975

During a visit of J.J. Schmidt on 17 and 18 February 1975 to the ICTP Trieste agreement was reached with the Centre's staff concerned (Profs. Salam, Budini, Fonda and Dr. Rimini) on the objectives, programme, and organization of this Consultants' Meeting.

The scientific preparation of the meeting is the responsibility of NDS. ICTP will provide two nuclear physicists (Drs. Rimini and Weber) as local secretaries to the Meeting, meeting rooms adequate to host a maximum anticipated number of 20-30 participants, and all secretarial help needed for the preparation and the conduct of the Meeting.

The Meeting will have the objective to gather application-oriented nuclear theorists and neutron nuclear data evaluation scientists in an attempt to review comprehensively the status and possible improvements of nuclear theory, models and computer codes which are used in the evaluation of neutron nuclear data needed for fission and fusion reactor design and other nuclear applications. Specific consideration should be given to the needs and usefulness of further developments of nuclear theory and computer codes for applied nuclear programmes of developing countries. The Meeting's participants should develop concrete ideas and recommendations to the IAEA as to how, by whom and where the needed developments and improvements can best be implemented. One example would be the organization of workshops held at the ICTP Trieste. Further details regarding the objectives, subject scope, organization and tentative programme of the Meeting are given in Appendix J and attachments 1 and 2 to this appendix.

In order to achieve maximum efficiency and optimum results, the Meeting is organized around several review papers (outlined in attachment 1 to Appendix J) followed by contributed papers and discussions on needed improvements. The review papers are to be presented by the designated reviewers and serve as the major basis for the discussions and for the formulation of conclusions and recommendations.

The review papers should give a comprehensive account of the status, applicability, limitations and expected accuracy of the nuclear theory subject concerned and of existing widely used computer codes and outline possible needed improvements and developments. In addition to its theoretical content the paper should give consideration to practical applications of the theory and to their usefulness to nuclear scientists in developing countries.

The contributed papers should follow those review papers to which they are most closely related. They should address specific developments and applications, particularly problems encountered in the accurate interpretation of existing experiments, and in the adequate prediction of unknown data. They should also describe and compare widely used computer codes, and suggest improvements.

It is anticipated that the results of this meeting as well as of potential future workshops at the ICTP Trieste will be of great benefit to nuclear scientists and engineers, particularly in developing countries, who can usually not afford to undertake themselves major efforts in nuclear data evaluation and computer code development.

C.2.6. Specialists' Meeting on Nuclear Structure and Decay Data, Vienna, 3-7 May, 1976

The two "non-neutron" nuclear data meetings held in the spring of 1974 (see INDC(NDS)-59 and 60) recommended that IAEA/NDS convene future meetings for the implementation of the proposed international collaboration in the compilation, evaluation and dissemination of "non-neutron" nuclear data. In the charged

particle nuclear data (CPND) field, the original meeting of April 1974 has been followed-up by a second CPND meeting in September 1975 (see Section C.2.1.). In the nuclear structure and decay nuclear data (NSDND) field, however, there has been no meeting sponsored by IAEA/NDS in 1975. There are two reasons for this: first, it was deemed desirable to wait until the reorganization of the US NSDND programme had been completed before formulating any agreement on internationally acceptable formats or methods of data exchange and dissemination; second, with the IFRC recommendation to the IAEA to appraise the needs and availability of atomic and molecular data for fusion (see Sections C.1.9. and E.3.), NDS had no manpower to maintain an active programme in NSDND during 1975.

In 1976, NDS is planning to convene a specialists' meeting on NSDND, with the dual objective of agreeing on an acceptable keyword and referencing system for nuclear structure and decay data, and considering aspects of an international file of evaluated NSDND.

C.2.7. Specialists' Meeting on Atomic and Molecular Data for Fusion, Vienna, 1976

A Specialists' Meeting on Atomic and Molecular (A+M) Data for Fusion Applications is planned to be convened by NDS in 1976. This Meeting is intended to bring together atomic data compilers and fusion scientists, who would perform a more detailed study of an international cooperative programme in the A+M field and organize the framework for the compilation, exchange and dissemination of A+M data for fusion.

This Meeting is to be the second (see Section C.1.9. of this report descrining the first meeting) of a series of meetings in support of the A+M programme component which is to be incorporated into the NDS programme in 1976. A more detailed description of this programme is given in Section E.3. of this report.

C.2.8. Third IAEA Advisory Group Meeting on Nuclear Standard Reference Data

The Third IAEA Advisory Group Meeting (previously called Panel) on Nuclear Standard Reference Data is scheduled as an advisory group meeting for late 1976, the exact date has not been fixed. At present the agenda is expected to include the recognized neutron standards, for which a large amount of work has been in progress since the 2nd Panel convened in November 1972, as well as the high-energy γ-ray efficiency and neutron energy standards, both of which have been accepted as areas of responsibility by the INDC Subcommittee on Standard Reference Data.

Participants will be selected so as to guarantee the attendance of at least one expert in each of the major subject areas, and try as far as possible for the participation of all active research groups. INDC Members and Liaison Officers are asked to recommend participants so that invitations can be sent to the governments concerned before the end of 1975. More detailed considerations are given in Section C.2.7. of last year's NDS Report to the INDC, INDC(NDS)-63/L.

C.2.9. Consultants' Meeting on Integral Cross Section Measurements in Standard Neutron Fields for Reactor Dosimetry, November 1976

In accordance with the recommendations of the September 1973 IAEA Consultants' Meeting on Nuclear Data for Reactor Dosimetry (CMNDRD), the results of which were reported at the previous INDC meeting (see INDC(NDS)-63/L, Section C.1.1., p. 8), NDS has initiated a coordination programme involving the Integral Cross Section Measurements in Standard Neutron Fields for Reactor Dosimetry.

The goal of this programme is to eliminate existing discrepancies between differential and integral data by testing differential data in integral measurements using carefully selected standard neutron fields over all energy ranges important to reactor dosimetry, and to arrive at an internationally recommended set of neutron cross sections for reactor dosimetry. The standard neutron fields which could be used for this programme were identified at the September 1973 CMNDRD.

Instructions to participate in this programme, which are now being prepared by Dr. A. Fabry at CEN, Mol, will be distributed to all laboratories which have a standard neutron field. The more detailed aspects of this programme are to be discussed at the September 1975 Petten Symposium.

The Agency's Consultants' Meeting planned for the latter part of 1976 will review the status and evaluate the results of the programme.

C.2.10. Second Advisory Group Meeting on Fission Product Nuclear Data (FPND), 1977

A follow-up FPND meeting, recommended to be held three years after the Bologna FPND meeting in November 1973, had to be deferred from Fall 1976 to the first half of 1977 for financial reasons.

The proceedings of the Bologna FPND Panel were published at the end of 1974 in three volumes (IAEA Technical Report 169, Vol. I - III) containing all review papers, the summary of the Panel's conclusions and recommendations (Vol. I and II), and selected contributed papers (Vol. III).

A newsletter on FPND measurements and evaluations, recommended at the Bologna FPND Meeting, has been initiated by NDS (see Section D.4.).

D. COORDINATING ACTIVITIES

D.1. WRENDA: 1975 Publication

WRENDA 75 was published as document INDC(SEC)-46 and was expected to be ready for distribution during July 1975. In accordance with Recommendations of the 7th INDC Meeting, the data request lists for the three fields of application, i.e. fission reactor development, fusion research and reactor development, and nuclear safeguards development, appear for the first time as a single publication.

The fission request list contains over 1200 requests from 21 Member States and one International Organization; the fusion list, 329 requests from 5 Member States; and the safeguards list, 130 requests from 4 Member States.

A separate report describing details of the WRENDA system and future objectives of WRENDA is being prepared. Points to be decided upon include the following:

1) Coordinated publication schedule (Spring or Summer);

2) Frequency of "book" publication since master file can be updated continually and retrievals made at any time;

3) Problem of history of request numbers when similar requests from requestors in the same country are combined and subsequently modified;

4) Content and purpose of the Status Comments;

5) Derivation of uncertainty information for Status Comments from information of this type now being incorporated in evaluated data files;

6) More rigid format for Status Comments, i.e. fields for source of information, energy range and reference as in CINDA, for example;

7) Since WRENDA 75 contains requests for evaluation, especially in the fusion and safeguards lists, the word "measurements" might be dropped from the expansions of WRENDA (presently World Request List for Nuclear Data Measurements);

8) Separate request lists for evaluation;

9) Should requests still be separated according to application (fission, fusion, safeguards)?

10) Country retrievals, which are used by national data committees to review their requests, are currently provided through the regional neutron data centres in 3 separate files according to application (fission, fusion or safeguards). If merged country retrievals in Z-A-Q sort are preferred, preference should be communicated to the responsible data centre.

11) Separate request lists for other applications (e.g. biomedical research);

12) Feedback from users of WRENDA concerning usefulness of the system;

13) Feedback from contributors to WRENDA (requestors, national data committees, data centres) concerning usefulness of the system.

During the past year continuing programming work has improved the operating efficiency and service capability of the system. Two small new WRENDA programmes have been written:

1) to list the requests (by number) that belong to a given requestor;

2) to separate the status file records into separate files ordered by:

   a) Lab code

   b) Reference Name

   c) Reference Code (Journal, Report, etc.).

D.2. Targets and Samples: Programme Status

Two formal proposals have been received during the first half of 1975. In addition to new requests which NDS may receive during the second part of 1975, it is possible that unsupported proposals submitted during previous years can be updated and reconsidered. Work performed under the 1972 and 1974 programmes is being reviewed. In two cases it now appears unlikely that the proposed measurements can be completed.

In general the most productive work in terms of nuclear-data measurements of high quality has been performed in laboratories with thoroughly demonstrated capabilities, but having limited resources for procurement of materials and equipment. If measurement of useful nuclear data continues to be the primary objective of the Targets and Samples (T+S) programme, then proposals should be solicited from this type of laboratory without regard to classification of the country as less-developed or developing. Support of proposals from less-well established institutions would be more accurately justified as support for the scientific and technological development of the institution and country rather than on the basis of obtaining high-quality nuclear data. Specifically it is proposed to expand the programme to include proposals from laboratories which receive relatively limited support for nuclear data measurements.

Regarding final disposition of materials procured by the Agency under the T+S Programme, the cost of thorough analysis, chemical reprocessing and refabrication of materials for use in a completely unrelated type of measurement would approach or exceed the cost of using new raw material. Therefore it seems expedient to donate T+S materials to the institute upon completion of the contracted measurements perhaps with the understanding that they would be made available for related measurements which would not require refabrication.

In the case of more expensive materials such as enriched isotopes, it would be useful for the Agency to retain possession, if the material could be chemically reprocessed and refabricated for use in other experiments for a fraction of the acquisition price.

D.3. Fission Product Nuclear Data (FPND) Newsletter

Following a recommendation of the FPND Panel, held in Bologna in November 1973, NDS has initiated an FPND Newsletter which is to comprise information on any activities, planned, on-going or recently completed, in the field of measurement, compilation and evaluation of FPND.

So far, the format of the newsletter has been drafted and sent to the other four neutron data centres for comments and suggestions. At the same time, INDC members and Liaison Officers have been requested to name possible contributors and users of FPND in their respective countries in order to enable NDS to set up an FPND newsletter distribution list.

The first issue of the FPND Newsletter is scheduled to be published in October 1975.

D.4. Nuclear Data Measurements in Developing Countries

This is a short summary of the relevant discussions and results of the duty travel of J.J. Schmidt to several East Asian countries after the Lucas Heights INDC Meeting. A more detailed travel report has been sent to all INDC Members (in fulfillment of action 33 of the Lucas Heights INDC Meeting) and submitted to the October 1975 INDC Meeting for consideration.

D.4.1. Cooperation between KAERI (South Korea) and JAERI (Japan)

In discussions with scientists at JAERI, Tokai-Mura, Japan, and KAERI, Seoul, South Korea, first plans were established regarding bilateral cooperation, in the framework of the Agency's Regional Cooperative Agreement (RCA) programme for East Asian countries, between JAERI and KAERI in the measurement and evaluation of fission product nuclear data needed for nuclear safety, fuel management and environmental protection.

As a result of further discussions between KAERI and JAERI during the past months, collaboration between both laboratories will start before the end of 1975 on a trial basis in the following way.

KAERI will send a few research fellows to JAERI to participate with JAERI physicists in those linac and Van de Graaff measurements of fission product neutron cross sections which have already been scheduled as part of the current Japanese nuclear data programme. The samples for these measurements have already been ordered, by direct contact, from the Oak Ridge pool, and the KAERI fellowships will probably be paid from Colombo Plan money. Thus for 1975 no financial support of this cooperation will be solicited from the IAEA, neither for fellowships nor for samples.

Depending upon the success of this trial collaboration, a more formal scheme of cooperation between KAERI and JAERI in the measurement and evaluation of nuclear data will be set up. For this stage of collaboration, the Agency's support will be solicited (in the form of samples and fellowships) in the framework of its Regional Cooperative Agreement. This subject will form part of the deliberations between the Japanese and Korean Ministries for Science and Technology which are to take place during the summer this year.

Plans for Korean nuclear data measurements, using the reactor and Cockroft-Walton generator available at KAERI, are supposed to evolve separately. As a first step, 14 MeV neutron cross section measurements are foreseen with an improved detector system supported by IAEA, and requests for sample materials for these measurements are expected to reach the Agency still this year.

The Department of Nuclear Engineering of the Seoul National University, which has very poor laboratory equipment, aims at improved cooperation with KAERI with the aim of using KAERI's facilities. Subject to Japanese funds, it plans to set up a small nuclear spectroscopy group in cooperation with KAERI.

D.4.2. Cooperation between BARC Trombay, India, and the Atomic Energy Centre Dacca, Bangladesh

BARC plans to develop a long-term measurement and evaluation programme for nuclear data needed for the future Indian Th-232/U-233 fission reactor and fuel cycle development programme, with the use of the available Van de Graff accelerator at Trombay and, later, the Variable Energy Cyclotron in Calcutta. The Van de Graff group of the Atomic Energy Centre in Dacca intends to co-operate in the fission physics and cross sections part of this programme. Contacts have been taken up between both centres, and Dr. S.S. Kapoor from BARC Trombay is presently at the Dacca Centre as an IAEA fellow. The cooperation will be part of the existing bilateral agreement between the Bangladesh Atomic Energy Commission and BARC Trombay.

D.4.3. Cooperation between the Saha Institute, Calcutta, and Universities in Bangladesh

Possibilities were suggested and discussed for an informal technical cooperation between the Cockroft-Walton groups of the Saha Institute and the Chittagong and Rajshahi Universities in Bangladesh in 14 MeV neutron research partly based on the WRENDA request list.

D.4.4. PINSTECH, Rawalpindi

This is the only place where there was a strong interest in the INDC proposal to use prompt decay γ-rays from thermal neutron capture for material composition analysis. In discussions during the trip and in correspondence and visits afterwards, particularly with the Nuclear Chemistry Division of PINSTECH (Head I.H. Qureshi) and with R.L. Heath from the Idaho Nuclear Engineering Laboratory (INEL), it was concluded that the existing recent γ-ray data measurements and compilations should first be carefully assessed, particularly for their accuracy, before any further action is being taken.

D.4.5. Tehran University Nuclear Centre

The nuclear data activity in Iran is so far very small, but is expected to grow in the future with the development of a nuclear power programme. The greatest task which the Iran is presently facing in the nuclear domain is the build-up of an adequate infrastructure and a well-planned use of the large financial resources now available. Only very minimal use has been made so far of the Centre's research reactor and Van de Graff accelerator.

D.4.6. Miscellaneous

Numerous actions for improving the information transfer between NDS and the laboratories concerned for sending nuclear data and documents to a variety of customers, and for assisting laboratories by technical advice and financial aid in their nuclear data programme have resulted from this trip. Lectures on the NDS programme were given at JAERI, Kumatori/Osaka Laboratory, Dacca, Calcutta, BARC and PINSTECH.

D.5. Nuclear Data for Reactor Neutron Dosimetry

D.5.1. Measurement of the $^{103}Rh(n,n')\ ^{103}Rh^{m}$ Cross Section

In connection with its continuing programme for the development of reliable nuclear data files for use in reactor neutron dosimetry, NDS has promoted and coordinated work on the cross section for the reaction $^{103}Rh(n,n')\ ^{103}Rh^{m}$ as described in its previous report to the INDC (INDC(NDS)-63/L). Because of the significant results which became available earlier this year, NDS distributed a brief status report in April 1975 on this work. This summary is shown in Appendix K.

Since April 1975, Dr. K.H. Czock (IAEA/Seibersdorf) has announced plans to collaborate with Prof. Csikai in furthering the work on this cross section in Debrecen, Hungary, using D-D, D-T, and ^{252}Cf-fission neutron sources.

D.5.2. NDS participation in the IAEA programme on neutron fluence and spectra determination by the foil activation technique

The Agency has started a new programme the primary objective of which is to make possible reliable and consistent neutron spectra determination using the foil activation method. This programme is a joint programme of the Division of Nuclear Power and Reactors, the Seibersdorf Laboratory and the Nuclear Data Section.

To unfold a neutron spectrum from measured activities, the following information is required:

a) the saturation activities of the irradiated detector foils;

b) energy-dependent internally consistent neutron cross sections for each of the involved reactions; and

c) a computer programme for unfolding neutron spectra using input data noted in a) and b).

As one first step, an international intercomparison of available computer programmes (indicated under c) above) is planned.

A set of saturation activities and energy-dependent cross sections for ~12 reactions prepared by NDS will be distributed by the IAEA to those participants who will be asked to unfold a neutron spectrum (not known to them) using the computer programmes available in their laboratories.

All participants will be asked to use the same set of multi-group cross sections which will be prepared and provided by the NDS.

A questionnaire, a draft of which appears in Appendix L, will be distributed to all reactor centres to obtain information on the status of neutron fluence and spectra determination by the activation technique.

E. NON-NEUTRON NUCLEAR DATA

E.1. Charged Particle Nuclear Data (CPND)

NDS activities in the field of CPND have been concentrated primarily on the international coordination of existing CPND centres, and in the preparation of the Second CPND Consultants' Meeting (Vienna, 8-12 September 1975) concerned with the organization of CPND compilation on an international basis. The tentative agenda of this Meeting is given in Appendix F.

The prime consideration in this international effort has been the choice of an internationally accepted data compilation and exchange format, similar to the EXFOR format used for neutron data. As a consequence of last year's CPND Consultants' Meeting (April 1975), Prof. Münzel's CPND group at Karlsruhe has initiated the adaptation of the EXFOR format in consultation with NDS. A member of Prof. Münzel's group, Mr. Kronenberger, spent one week at NDS to study the EXFOR system. The modifications of EXFOR for its adaptation to CPND as proposed by the Karlsruhe group, and their critical review at the 1975 Four Centre Meeting at Brookhaven, will provide the basis for discussion at the 1975 CPND Meeting.

As part of this cooperative effort, a trial magnetic tape containing 23 subentries of experimental CPND in EXFOR-like format have been received by NDS from Karlsruhe. A copy of a sample subentry from this tape is attached as Appendix M. Also, evaluated CPND from systematics based on the work of Prof. Münzel were received from NNCSC in ENDF format. This "starter" library contains data for 305 nuclides in the energy range between 0-20 MeV for the following reactions: (p,n), (p,2n), (p,3n), (d,n), (d,2n), (d,3n), (d,p), (α,n), α,2n), (α,3n), (α,p) and (α,np).

E.2. Nuclear Structure and Decay Data

Because of the unanticipated emphasis which has been given to the need for atomic and molecular data for fusion (see Section E.3.), and the time taken for the transfer of the Nuclear Data Section from IAEA Headquarters to its new annex, the implementation and continuation of most nuclear structure and decay data projects at NDS (i.e. the Nuclear Data Reference File, and the questionnaire for the assessment of data needs) had to be deferred.

Within the activities of the "non-neutron" nuclear data Information Office, described in last year's report to the INDC (INDC(NDS)-63), NDS has expanded its contacts with existing non-neutron nuclear data centres and pursued the acquisition of nuclear structure and decay data references, tabulation and compilations.

NDS has received two data compilations on magnetic tape:

a) the Decay-Data Compilation from the Nuclear Data Project which consists of data adopted from the Nuclear Data Sheets for over 300 radioactive decay schemes contained on February 20, 1975, in the Evaluated Nuclear Structure Data File (ENSDF) of the Nuclear

Data Project. The data file is organized into data sets. A β-decay data set includes information about all daughter levels observed in the decay, the energies and intensities of β- and γ-radiation, log ft for each β-branch, and multipolarity and internal conversion coefficients for each γ-ray. The decay data set also includes information about the parent nucleus (half-life and decay energy) when it is available. Each data set includes reference codes to identify sources of data and as many comments as may be needed to explain the particular data choices;

b) the compilation by G. Erdtmann and W. Soyka (KFA-Jülich) of the gamma-ray lines of the radionuclides. This compilation is also available in tabular form published in three volumes as reports Jül-1003-AC (September 1973). The compilation contains a complete set of all γ-emitting radionuclides and of all of their γ-lines. In addition to their energies, intensities of the lines are given as far as data have been found in the published literature. The radionuclide data are supplemented by data concerning their half-life, parent and daughter nuclides and generating reactions.

E.3. Atomic and Molecular Data for Fusion

The International Fusion Research Council (IFRC) at its fifth meeting, held on 16 November 1974 in Tokyo, recognized the vital importance and need for a coordinated world-wide atomic and molecular (A+M) data service to ensure the successful development of fusion technology. On this premise, it recommended that the International Atomic Energy Agency (IAEA) perform a survey of existing data banks, and consider adding atomic and molecular data for fusion to the scope of its existing nuclear data programme.

In response to the IFRC recommendation, the Director General of the IAEA asked the Nuclear Data Section (NDS) to review the needs and to perform a world-wide survey of existing compilation activities concerned with atomic and molecular data for fusion. To assist in this task, members of the International Nuclear Data Committee (INDC) and of the IFRC were invited to convey to NDS any information on existing and planned compilations, evaluations and publications of A+M data in their own country. The report was written by NDS in cooperation with the IAEA Physics Section and submitted to the Consultants' Meeting in July 1975. It has been published as INDC(NDS)-67/NF. At the same time the Director General instructed NDS to convene a small consultants' meeting to assess the needs and availability of A+M data for plasma research and fusion technology, and advise him on the size and scope of an IAEA programme in this field. This meeting took place on 21-22 July 1975 in Vienna (see Section C.1.8. above).

Conditional upon positive recommendations of the IFRC and INDC, and the approval by the IAEA Scientific Advisory Committee (SAC), the Director General has indicated that he will support an extension of the Agency's nuclear data programme to include compilation, analysis and dissemination of atomic and molecular data for fusion.

Implementation of an IAEA programme could be realized in 1977 with the formation of an atomic and molecular data unit within the IAEA Nuclear Data Section (NDS). In the first half of 1976 an Advisory Group Meeting of Fusion and Atomic Data Specialists is planned to be convened by the IAEA to initiate concrete plans for the international cooperation in this field.

From discussions with various experts and their suggestions concerning a future A+M data programme of the IAEA it appears that the fusion community has a primary need for a world-wide computerized A+M references and data service. Listed in the logical order of their development, such a service would comprise the following components:

1. collection and dissemination of information on existing data compilation activities and publications;

2. continuous appraisal of the current A+M data needs and priorities;

3. development of existing bibliographic reference indexes to one comprehensive international index, with regular cumulative publications;

4. international coordination of systematic compilation of atomic and molecular data for fusion, and

5. development of an international A+M data bank information from which would be accessible to all interested scientists and engineers.

   In addition to these basic data centre functions, it has also been urged that this programme include:

6. critical review and evaluation of A+M data, and

7. assistance in the international coordination of A+M data measurements.

The conclusions and recommendations of the consultants, with regard to the extent, scope and functions of an IAEA programme in the A+M data field will be published as a separate report as soon as they will be finalized.

During the preliminary meeting with the US consultant Dr. C.F. Barnett, three significant preliminary agreements were reached between him and NDS:

- that the Nuclear Data Section (NDS) should investigate the possibilityto publish Dr. Barnett's compiled Bibliography of Atomic and Molecular Processes by the IAEA. This index would cover the years 1950 to 1975, and be produced in two volumes comprising an estimated total of 2000 pages. It is anticipated that the production of this publication would be done directly from the existing information on magnetic tape either from an off-set reproduction of computer print-out or using photo-typesetting procedures. This bibliographic handbook would be sold by the IAEA on the same basis as the CINDA index to neutron data. In

order to justify publication by the IAEA it would be useful to have also direct input from other countries to the book, if obtaining of this input does not unduly delay the publication date, NDS will follow this up;

- cooperate in the publication of a compendium of numerical data on surface effects (e.g. sputtering) which Dr. Barnett has compiled over the past years. This compilation would be published in the form of a report and receive a selected international free distribution. Publication and distribution will be done by IAEA/NDS.

- investigate the possibility of extending the US Newsletter on Atomic Data for Fusion to an international one with the additional input from other interested countries. This international newsletter would be collated and world-wide distributed by IAEA/NDS on a quarterly basis.

F. NEUTRON DATA CENTRE ACTIVITIES

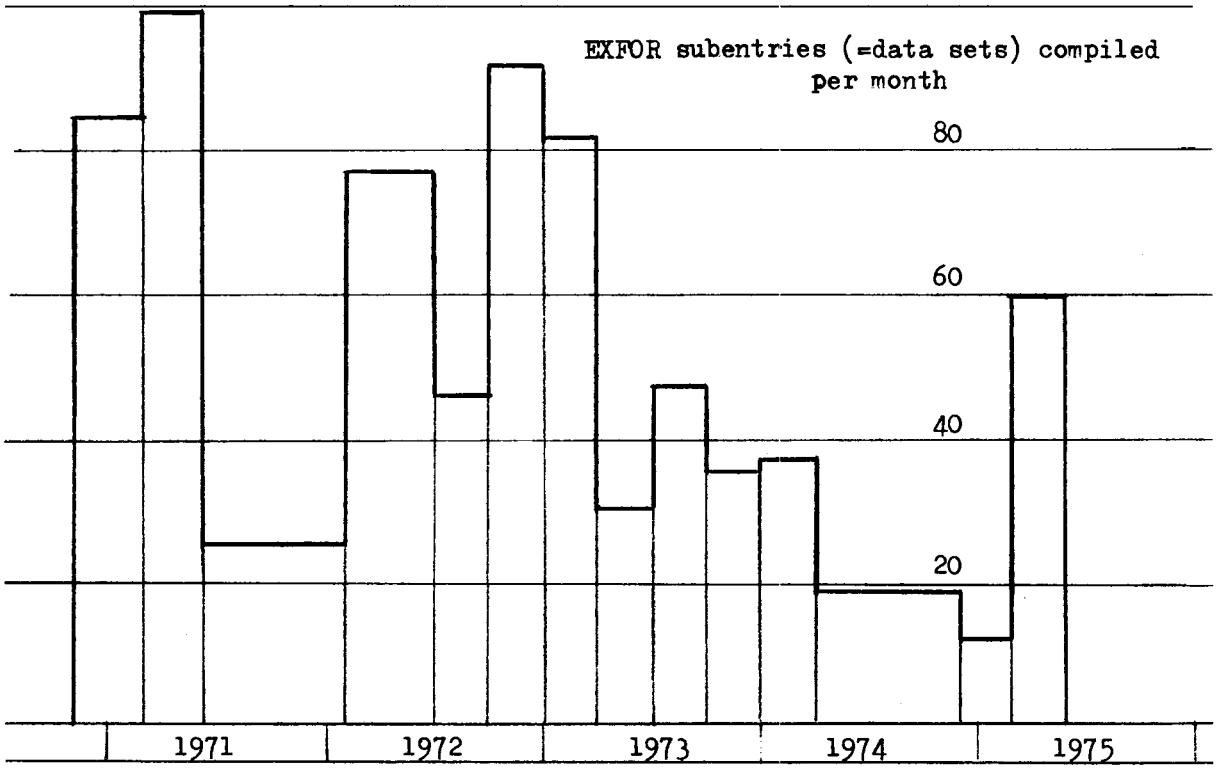
F.1. NDS Area Service

F.1.1. Experimental Data Compilation

At the beginning of 1975 the compilation staff was complete for the first time since several years. Consequently, speed and completeness of compilation of new data has much improved, and the backlog in the compilation of older data was reduced.

Of particular importance was the compilation of an East German data set consisting of about 20 000 data points of double differential neutron emission cross sections for 34 nuclides. This data file was received in printed form only; however, since then the Dresden Laboratory is now studying the EXFOR format in order to be able to produce their data in a similar format.

An overall record of the number of EXFOR subentries (i.e. data sets) and EXFOR records (individual data lines) compiled per month between mid-1970 and mid-1975 is shown in Figure 1.


EXFOR subentries (=data sets) compiled per month
80
60
40
20
1971
1972
1973
1974
1975

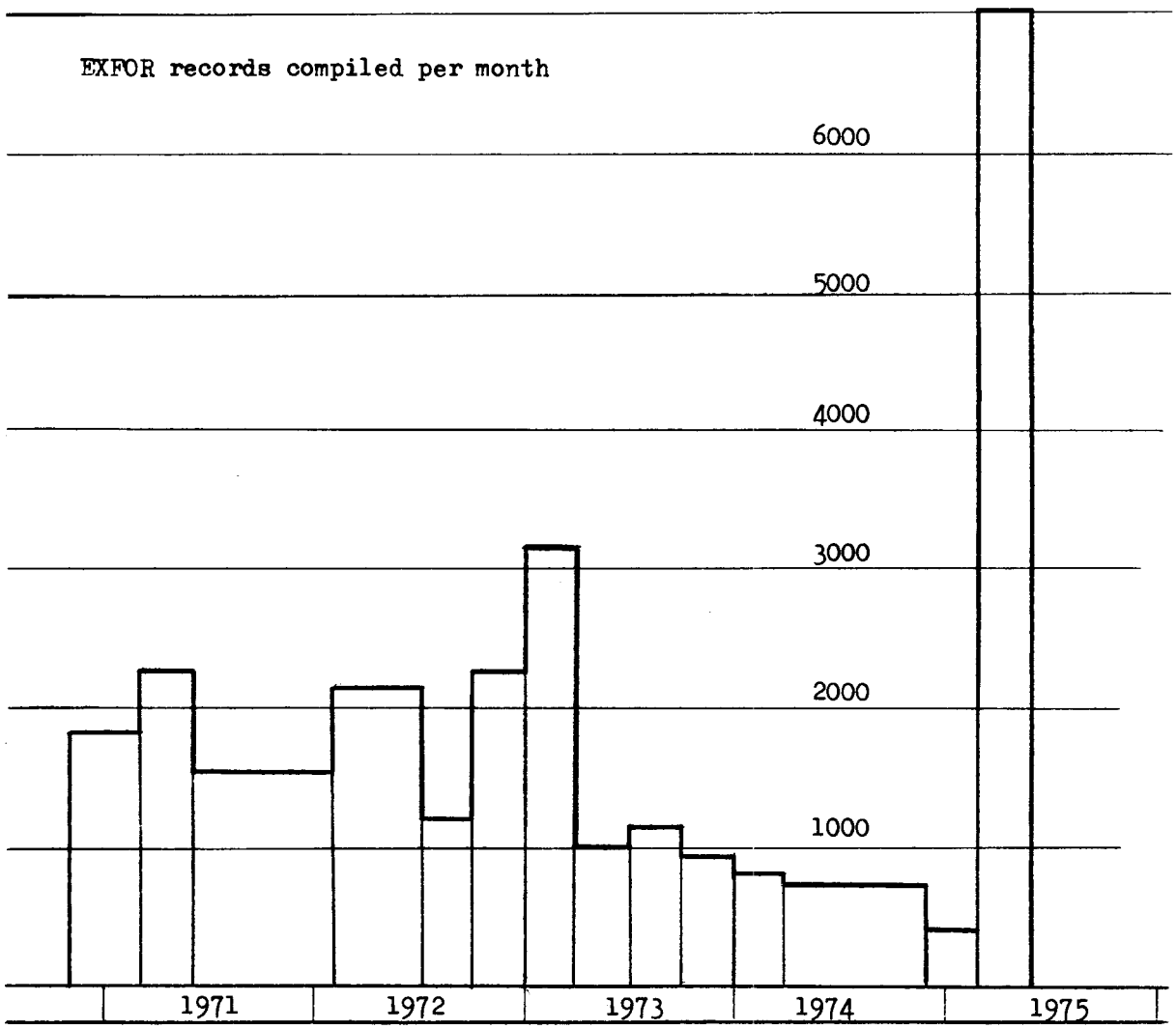

EXFOR records compiled per month
6000
5000
4000
3000
2000
1000
1971
1972
1973
1974
1975

Figure 1

F.1.2. Status of Evaluated Data Files

The status and contents of old, updated and new evaluated data libraries which are available at NDS will be published in CINDU-11, which will be issued soon. This publication describes the following evaluated neutron data files which are available on request from NDS:

1. United Kingdom Library (UKNDL), a number of new files were received and many files have been updated.

2. ENDF/B-IV, containing the 7 standard isotopes.

3. ENDF/B-IV Dosimetry Library, received recently.

4. ENDF/B-IV Fission Products Decay Data Library, received recently.

5. Lawrence Livermore Laboratory Evaluated Nuclear Data Library (ENDL 2), supersedes the ENDL 1 library.

6. Karlsruhe Evaluated Nuclear Data Library (KEDAK), updated on the basis of recently received new evaluations.

7. Italian (Bologna) Fission Product Library, as of 1973 in UK format (the 1971 issue is also available in ENDF/B format).

8. Australian Fission Product Library as of November 1971, data available as point cross sections, in UK format, and as group cross sections.

9. USSR Library, consisting now of the new complete evaluation of ^{239}Pu, the earlier evaluation of ^{238}U, and Nikolaev's file of integral and differential elastic cross sections.

10. French Evaluated Data Library, part was received earlier in UK format, and part received recently in ENDF/B format.

11. SAND-II Reactor Dosimetry Library.

12. DETAN-74, modified part of SAND-11 including the re-evaluation of 7 standard reactions.

Generally, non-negligible manpower has to be wasted because many evaluated data files received contain mistakes. These concern, for example, errors in the record sequence, varying use of leading zeros or blanks in the record-identification fields, errors in the numerical data formats, etc.

F.1.3. Data Request and Dissemination Statistics

The exchange of experimental neutron data between the four neutron data centres is achieved primarily by means of the EXFOR system (see Section F.3.2. Status of EXFOR data exchange). The dissemination of experimental neutron data by NDS is therefore limited primarily to its own service area (i.e. area 3).

The statistics of data requests received and originated by NDS, and of data disseminated during the current reporting period (1974 - 1975) are given in Tables I, II A and II B, organized in the same way as in last year's report.

Table I gives the request statistics, which is organized in three groups: (1) "Incoming" requests received at NDS, (2) "Follow-up" requests, which are initiated when data needed for an "incoming" request are not yet available at the centre, (3) "NDS origin" requests which were sent as part of the NDS nuclear data centre activities. Each request group is sub-divided by service area, where area 1 is the NNCSC area (North America), 2 is the NDCC area (West Europe and Japan), 3 is the NDS area and 4 is the CJD area (USSR).

Tables II A and II B give the statistics of data disseminated on request. This excludes the routine exchange of EXFOR data between the centres.

Data requests include requests for experimental data, evaluated data, documents or CINDA retrievals. Most frequent request-types are: "send all existing data on specified reactions", or "send best existing data on specified reactions". All data are requested for data reviews and comparison with own experiment or theory. Best data are requested for applied purposes. Both request-types include experimental and evaluated data, for example: latest evaluated data plus more recent experimental data.

In general, there was a considerable increase of data disseminated to area 3. Compared to the statistics given a year ago, the increase in the dissemination of experimental data was about 50 % when counting data sets, and 80 % when counting data records. The dissemination of evaluated data was slightly reduced compared to the figures reported a year ago, which however had been unusually large compared to previous years.

Note that only little advertising for available data was done during the past year. A new index to available evaluated data, CINDU-11, which is being prepared, was much delayed due to the move of the NDS to the IAEA Headquarters annex at Wasagasse. The new index which will soon receive a wide distribution, is expected to stimulate a large number of requests for evaluated data.

TABLE 1

SUMMARY OF NDS REQUEST STATISTICS

Note: The COBOL compiler at the IAEA computer has recently been changed, so that the programme producing the request statistics is presently not in operation. This is not within the control of NDS.

As of 1 July 1975, a relatively large number of requests was pending because the updating of libraries and processing of requests has been taking considerably more time at NDS's new premises than previously at IAEA Headquarters.

TABLE II A

Experimental Data Dissemination

(Excluding EXFOR data exchange)

7 July 1975

	Number of data sets		Number of data lines	
	Cumulative total (since Oct. 1966)	From 1 Sep. 1974 to 7 July 1975	Cumulative total (since Oct. 1966)	From 1 Sep. 1974 to 7 July 1975
To Area 1	2.532	5	70.155	2.016
" " 2	3.623	21	69.463	96
" " 3	6.777	1.927	608.684	188.515
" " 4	623	0	160.999	0
Total:	13.555	1.953	909.301	190.627

TABLE II B

Evaluated Data Dissemination

7 July 1975

	Number of data sets		Number of data lines	
	Cumulative total (since May 1967)	From 1 Sep. 1974 to 7 July 1975	Cumulative total (since May 1967)	From 1 Sep. 1974 to 7 July 1975
To Area 1	1.172	0	228.099	0
" " 2	1.358	15	258.232	5.234
" " 3	6.633	862	3,415.267	895.257
" " 4	1.891	52	826.920	13.836*
Total:	11.054	929	4,728.518	914.327

* The distribution of evaluated data to area 4 (USSR) decreased significantly during the past year because distribution of these data within the USSR is now done primarily by CJD.

F.1.4. Programming Activities

a. General

System specifications for an improved data index system, which is to replace the present CINDU system, are being drawn up. It is hoped that this new index system will be operational by the end of the year.

b. EXFOR

A new version of the EXFOR user List programme is now in production use. The following features were included:

- Reference codes are fully expanded;
- Complex Iso-quants are expanded in a more readable form;
- Data tables of more than 10 columns are printed in a readable fashion;

Pointers are highlighted.

More of the day-to-day EXFOR production work is now being handled by clerical staff. Standard operating procedures have been written for such jobs as altering EXFOR subentries and keeping the master files up-to-date.

We are now keeping and updating our own sub-accession number versus trans-tape number cross reference file. Previously this file was obtained from CCDN every 6 months or so, and so was usually out of date. We have added data for all of the series 5000 and 6000 Transmission tapes which was not in the file.

An EXFOR computer System manual has been written and is gradually being expanded. The manual includes:

- Run Flow Charts
- File Formats
- Input Formats
- JCL listings for runs
- Catalogued Procedures of runs
- Programme abstracts
- Production run procedures

c. WRENDA

WRENDA computer system documentation which is currently being written up includes:

- system specification
- programme manuals·
- run manuals.

d. Evaluated Data Libraries

The growing number of evaluated data libraries and formats requires an increasing number of file handling programmes for updating, retrievals (indexing still done manually), corrections, editing of "pretty listings", etc. Only some of these programmes are available from the Ispra programme library or from elsewhere.

Three facts required particular programming efforts which could partly be provided by the originators of evaluated data:

- There are frequent small changes in the formats, for example: Livermore data in ENDF/B format versus ENDF/B from NNCSC, Bologna data in UK format versus original UK-NDL data, the updated version of any given library versus its earlier version. Such changes normally require a number of more or less trivial but time-consuming changes in the existing programmes.

- There are many evaluated data files received with errors of a type disturbing the file-handling programmes (see also F.1.2. above), so that correction programmes need to be written.

- Small corrections needed for certain UK files were communicated from the originator in form of written information on the records to be corrected. It would save parallel efforts at different centres if such files were simply re-transmitted in the corrected version.

F.2. CINDA

F.2.1. CINDA Coverage

As a result of a survey on the completeness of CINDA, performed by NDS during the latter part of 1974 (see Memos 4C-3/116 and 4C-3/118), it became evident that the current CINDA compilation had significant gaps in the systematic coverage of important journals and latest progress reports.

These coverage gaps, due to different and independent causes at the individual CINDA centres, were discussed at the last Four Centre Meeting. An action was agreed that each Centre tidy up its portion of the CINDA file for post-1970 references in time to meet the deadline for CINDA 76. This should include completeness, blocking of references pertaining to the same experiment and removal from the publication of less important and superseded references.

As part of its CINDA coverage, NDS makes regular cross checks against the coverage of INIS (International Nuclear Information System), which now provides improved indexes and keyword retrieval possibilities, and informs the other three CINDA centres when INIS uncovers CINDA relevant information published in some not-regularly scanned journal or report series from any one of the other three service areas.

F.2.2. CINDA Publications

CINDA 75 has been published and distributed on schedule. It has about 108 000 entries in two volumes with about 1000 pages each. A supplement with about 250 pages will be issued toward the end of 1975. The sales price of the set

(main volumes plus supplement) is US$ 58,- compared to US$ 36,- for CINDA 74. Of this 61% price increase, 9 % is due to the increased volume size, 24 % is due to the exchange rate between US dollars and Austrian schillings, and the rest is due to increased paper price and salaries. The number of sold copies is approximately 1000.

All CINDA Centres undertake systematic efforts to reduce the volume increase of CINDA by omitting from the book (though not from the file) less important entries (e.g. superseded progress reports). This operation, which is done manually, is progressing gradually.

In order to reduce the CINDA production costs, NDS has proposed to publish CINDA in a two-year publication cycle as follows:

Spring 1976: main issue, called CINDA 76/77, with about 2300 pages in 3 volumes;

Fall 1976: Supplement 1, about 200-250 pages;

Spring 1977: Supplement 2, including Supplement 1, about 400-500 pages;

Fall 1977: Supplement 3, including Supplement 2, about 600-700 pages;

Spring 1978: new main issue, CINDA 78/79.

This scheme will preserve the principle that not more than two volumes must be consulted for obtaining full information on a given reaction. Compared to the conventional annual publication cycle, at least 25 % of the production costs will be saved. The supplement books will include new entries plus revisions to earlier entries. Some more saving could be obtained by excluding the less important revisions to earlier entries from the supplement books. (The revisions to earlier entries include blocking of entries that refer to the same experiment, improvements in the comments field, correction of mistakes, etc. Such revisions are made as feedback from data compilation or evaluation, or as a result of systematic tidying up of parts of the CINDA file.)

The March 1975 Four Centre Meeting agreed to this proposal, starting with CINDA 76/77.

The NDCC Committee suggested to consider a different publication schedule by which the CINDA book would be split into an "early" and a "late" volume, containing the references published before or after 1 January 1970, respectively. This "early" volume would be left unchanged for 3 to 5 years, and the "late" volume would appear annually as a cumulative issue in spring plus a supplement issue in the fall. Detailed examinations of this proposal show, however, that it entails no real advantages when compared with the two-year publication scheme described above (see Memo 4C-3/124).

NDS prefers the two-year publication scheme and asks INDC for its approval

NEANDC, at its last meeting, agreed to the two-year publication schedule for CINDA from 1976 onwards.

F.3. Inter-Centre Activities

F.3.1. Eleventh Four Centre Meeting

The annual consultants' meeting between the Four Neutron Data Centres took place at NNCSC, Brookhaven, in the week 10-14 March 1975. The summary of the agenda and the list of participants is given in Appendix N.

A large part of the meeting was, as usual, routine work on the coordination of the activities of the Four Centres, on the future development of the data exchange and on the common computerized systems CINDA, EXFOR and WRENDA.

Items of special interest were:

(a) The US CINDA activities had been transferred from the Technical Information Centre at Oak Ridge to the NNCSC, so that the combined compilation of numerical neutron data and related bibliographical references is now finally implemented at each of the Four Centres. Consequently, the discussion of CINDA matters, being now a legitimate agenda item at the Four Centre Meetings, occupied a substantial fraction of the meeting period.

(b) The increased size and production costs demand that CINDA will have to be published in a two-year cycle from 1976 on, with 3 cumulative supplements in half-year intervals, subject to the approval of the pertinent nuclear data and steering committees (see Section F.2.2.).

(c) Following the decision taken at Karlsruhe to use the EXFOR system for charged particle induced nuclear data (see Section E.1.), and realizing that similar considerations are made at other centres, the generalization of EXFOR was discussed. Since EXFOR was developed for neutron data only, some modifications will be required, in particular in the quantity scheme describing reactions and parameters measured. It was, however, decided to leave the "neutron EXFOR" presently unchanged, to develop in parallel a "generalized EXFOR" as close as possible to the "neutron EXFOR", and to adapt the "neutron EXFOR" later on such that all relevant computer programmes can be used for both EXFOR systems.

(d) The "neutron EXFOR" system seems now to be in its final stage of development, after some features on multi-dimensional tables have been implemented. Discussions continue on matters of compilation quality and on widening the data scope, for example in the field of fission products or delayed neutron data.

The minutes, conclusions and recommendations, list of actions, etc., will be published as an INDC(NDS) document.

F.3.2. Status of EXFOR Data Exchange

The transmission of neutron data by means of the EXFOR system has continued satisfactorily. The following table shows the EXFOR transmission tapes, number of entries and subentries transmitted by each centre for the period June 1974 to May 1975.

Centre	Tapes transmitted	Entries new	Entries revised	Subentries new	Subentries revised
NNCSC	16	134	29	975	235
NDCC	5	149	0	1125	0
NDS	3	28	27	235	116
CJD	5	56	34	563	109
Total:	29	367	90	2898	460

A subentry corresponds roughly to a data set; as an example, a certain cross section for a certain isotope in a certain energy range. An entry consists of all data sets (subentries) produced in the same experiment or recorded in the same published article or report. There is, however, certain freedom for the compiler to arrange a given array of data in one or more subentries or entries.

A revision of an entry is done when missing information, for example a) error analysis is obtained from the author on request by the compiler, b) a publication on the data comes out after the data had been compiled from a private communication, c) when the author revises his data or submits comments on the proof-copy received, etc.

At the March 1975 Four Centre Meeting, the four centres made an estimate of the completeness of the present EXFOR library for data produced during the 1970 - 1974 time period. The following completeness estimates (experimental data compiled/experimental data measured) were made:

NNCS (Area 1) - about 75 %
NDCC (Area 2) - about 50 %
NDS (Area 3) - better than 80 %
CJD (Area 4) - about 60 %

At the time of the Meeting, a considerable fraction of the uncompiled data was in process of compilation.

It should be noted that the percentage figures quoted are to some extent guesses only, and that some important data types such as gamma spectra, fission product yields, delayed neutron data, were not considered, because none of the centres have presently sufficient staff to deal with such data systematically.

F.4. Data Reviews

F.4.1. Third IAEA evaluation of thermal fission data

The results of the third IAEA evaluation of the 2200 m/s and 20°C Maxwellian neutron data for ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu have been reported at the March 1975 Washington Conference on Nuclear Cross Sections and Technology. The complete report to be issued as an INDC(NDS) document has been delayed mostly due to the time lost by the move of NDS to the IAEA annex, and by the decrease in working efficiency resulting from the separation of NDS from IAEA Headquarters.

Some conclusions are:

1. $\bar{\nu}$ data are based on a value of $\bar{\nu}_t(^{252}Cf) = 3.746 \pm 0.009$.
2. η data remained essentially as high as before.
3. The reduced $\bar{\nu}$ data and the high η data are compatible when they are compared with the 2200 m/s fission and absorption cross sections

$$\bar{\nu}_t/\eta^o = \sigma_a^o/\sigma_f^o$$

but they are inconsistent if they are compared with the integral $\hat{\alpha}$ data of the uranium isotopes

$$\bar{\nu}_t/\eta_o = (1 + \hat{\alpha})\ g_f/g_a$$

4. For the uranium isotopes 2200 m/s data and thermal Maxwellian data, in particular fission data, are not consistent. This inconsistency represents a serious problem which requires further research.

For example:

	$\sigma_f^o(^{235}U)$	$\alpha_o(^{235}U)$
deduced from 2200 m/s experiments	587.7 ± 1.9 b	0.157 ± 0.006
deduced from thermal Maxwellian experiments and g-factors	578.7 ± 4.0 b	0.172 ± 0.001

F.4.2. Reactor Dosimetry Cross Sections Review

Review of some neutron cross sections for reactor dosimetry has been completed and will be published as a report, INDC(NDS)-47/L, part 2.

The following reactions are included in this review:

$^{27}Al(n,\alpha)^{24}Na$, $^{31}P(n,p)^{31}Si$, $^{32}S(n,p)^{32}P$, $^{46,47,48}Ti(n,p)^{46,47,48}Sc$, $^{55}Mn(n,2n)^{54}Mn$, $^{56}Fe(n,p)^{56}Mn$, $^{59}Co(n,\alpha)^{56}Mn$, $^{93}Nb(n,2n)^{92}Nb^m$, $^{93}Nb(n,\gamma)^{94}Nb$.

The recent release of the ENDF/B-IV dosimetry file gave good opportunity to compare these evaluated data for above mentioned reactions with experimental data and other evaluations which are included in the review.

Current List of Liaison Officers to the INDC

July 1975

Argentina	Ricabarra, G.
Austria	Eder, O.J.
Bangla Desh	Islam, M.
Belgium	Poortmans, F.
Bolivia	Mariaca, F.
Brazil	Herdade, S.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	Seidel, K.
Greece	Dritsa, S.
Hungary	Kluge, G.
Iran	Etemad, M.A.
Iraq	Said, K.I.
Israel	Amiel, S.
Jamaica	Chen, A.A.
Kenya	Gacii, P.
Korea	Cho, M.
Mexico	Graef Fernandez, C.
Netherlands	Bustraan, M.
Norway	Andersen, E.
Pakistan	Khan, A.M.
Philippines	Navarro, Q.O.
Poland	Sujkowski, Z.
Portugal	Carvalho, F.G.
Romania	Rapeanu, S.N.
South Africa	Reitmann, D.
Spain	Velarde Pinacho, G.
Switzerland	Huerlimann, Th.
Thailand	Nimwanadon, Th.
Turkey	Ertek, C.
Uruguay	Lalanne, A.
Viet Nam	Ngo-Dinh-Long
Yugoslavia	Slaus, I.
Zaire	Pollak, H.

APPENDIX B

International Symposium on Neutron Induced Reactions

Smolenice, Czechoslovakia, 2-6 September 1974

Programme

MONDAY, September 2, 1974 15.00 - 18.00 h

G.J. Csikai: Fast neutron induced reactions (45 min., invited talk)

S. Mukherjee: Investigation of (N-Z) dependence of (n,n') and (n,2n) cross section on the basis of experimental neutron spectra (15 min.)

E. Holub: Systematics of (n,2n) reactions at 14 MeV (15 min.)

TUESDAY, September, 1974 8.30 - 11.30 h

A. Marcinkowski: Theoretical and experimental level densities (2x45 min., invited talk)

G. Pető: Radiative capture cross section for 14.7 MeV neutrons (15 min.)

I. Turkiewiicz: $^{9}Be + n \rightarrow {}^{4}He + {}^{6}He$ reaction induced by fast neutrons (15 min.)

15.00 - 18.00 h

D. Didier: Neutron physics studies at Bruyéres-le-Chatel (40 min.)

P. Galan: The structure of excited states in ^{84}Rb (15 min.)

G. Kyrchev: The model for the description of highly excited states in doubly even deformed nuclei (15 min.)

S. Hlaváč: (n,2n) cross section measurements at 14 MeV (15 min.)

R. Bayer: Polar α-particle emission from ^{235}U thermal neutron induced fission (15 min.)

J. Trochon: The (n,γf) reaction induced by slow neutrons (15 min.)

WEDNESDAY, September 4, 1974 m 8.30 - 11.30 h

K. Nedzwiedziuk: Nekotoryje rezultaty izučenija spectorov α-častic v reakcijach (n,α) (15 min.)
Some results of the investigation of α-particle spectra from (n,α) reactions

M. Jaskola: Investigation of the (n,α) reactions induced by fast neutrons in the rare-earth nuclei (15 min.)

R. Čaplar: (n,α) reactions on $^{178,180}Hf$ induced by 14.8 MeV neutrons (15 min.)

C. Kalbach: Pre-equilibrium models in general and the Griffin model in particular (45 min., invited talk)

15.00 - 18.00 h

C. Kalbach: Pre-equilibrium models in general and the Griffin model in particular (45 min., invited talk)

T. Meister: The inclusion of pre-compound processes into 14 MeV neutron reactions with multiple nucleon emission (20 min.)

P. Obložinský: Complex particle emission in the hybrid model (15 min.)

E. Gadioli: Pre-equilibrium model analysis of nucleon induced reactions (45 min., invited talk)

THURSDAY, September 5, 1974 9.30 - 11.30 h

R. Reif: Investigation of pre-compound reactions (45 min.)

A. Calamand: Services of the IAEA nuclear data section to neutron physicists and neutron data users (15 min.)

15.00 - 18.00 h

K. Seidel: Fast neutron spectroscopy to investigate pre-compound processes (45 min., invited talk)

Š. Bederka: Neutron generators in nuclear physics (45 min., invited talk)

J. Vincour: *Precizionnoje izmerenie potoka bystrych nejtronov* (15 min.)
Precise measurement of fast neutron flux

FRIDAY, September 6, 1974 8.30 - 11.30 h

N. Cindro: Perspectives of fast neutron studies (invited talk)

APPENDIX C

18th Meeting of NEANDC

Harwell, 7-11 April 1975

Technical Agenda

1. Review of recent meetings of other international committees
2. National progress reports on nuclear data measurements and facilities
3. Achievements on measurements and evaluations
4. New needs for nuclear data
5. International co-operation in nuclear data measurements and analysis
6. Data indexing, compilation and evaluation
7. Meetings and conferences on nuclear data
8. Discussion of the report of the sub-committee on standards and discrepancies
9. Co-operation in the field of nuclear data between Europe, Japan and North America
10. Topical discussion on neutron capture cross section measurements

APPENDIX D

18th Meeting of NEANDC

LIST OF PARTICIPANTS

Committee members

R. Batchelor, CBNM Geel, Belgium
R.E. Chrien, Brookhaven, USA
C. Coceva, Centro di Calcolo, Bologna, Italy
W.G. Cross, Chalk River, Canada (acting chairman)
H. Condé, Research Institute of National Defense, Stockholm, Sweden
U. Farinelli, Casaccia, Italy
F.H. Froehner, Karlsruhe, FRG (for S.W. Cierjacks, chairman)
H.E. Jackson, Argonne, USA
G.D. James, Harwell, UK (local secretary)
H.T. Motz, Los Alamos, USA
A. Michaudon, Bruyeres-le-Chatel, France
J.L. Rowlands, Winfrith, UK
A.P. Schmitt, Cadarache, France
A.B. Smith, Argonne, USA
M.G. Sowerby, Harwell, UK (executive secretary)
J.S. Story, Winfrith, UK
J. Rosen, OECD/NEA, Paris, France
J. Royen, OECD/NEA, Paris, France
K. Tsukada, JAERI, Japan

Observers

J. de Meulder, CBNM Geel, Belgium
O.J. Eder, Seibersdorf, Austria
A.L. Nichols, Harwell, UK
S.M. Qaim, Juelich, FRG
J.J. Schmidt, IAEA, Austria

APPENDIX E

Third All-Union Conference on Neutron Physics

Kiev, 9 - 13 June 1975

Programme

1. Nuclear data needs for fission and fusion reactors and astrophysics
2. Experimental methods of neutron physics
3. Nuclear data needs and their evaluation
4. Fundamental properties of the neutron
5. General problems of the interaction between neutrons and nuclei.
6. Experimental study of the interactions of thermal and resonance neutrons with nuclei (two sessions)
7. Experimental study of the interaction of fast neutrons with nuclei
8. Cross sections and other characteristics of neutron fission of heavy nuclei (three sessions)
9. Summary of the Conference.

APPENDIX F

21 May 1975

Consultants' Meeting

on

Charged Particle Nuclear Data (CPND) Compilation

Vienna, 8-12 September 1975

Tentative Agenda

I. Brief review of current and planned CPND compilation activities

Bibliography, Compilation and Evaluation of CPND
- Scope, content and format.
- Publications and services.

II. Matters of technical cooperation (on the basis of last year's meeting recommendations *)

A. Bibliography

1. Experience gained from the use of "Recent References", as far as related to CPND; any changes desirable ?
2. Who compiles what where ?
   - Continue centralized input ?
   - Start coordinated input from different Centres and Groups ?
   - Practical details for coordinated input.
3. Publications and services.

B. Compilation and Exchange of CPND

1. Principle decision whether a format close to the "neutron data EXFOR" is acceptable, mutatis mutandis, for CPND.
2. Scope and distribution of work between Centres and Groups involved.
   - Targets, projectiles, reactions, quantities.
   - Experimental, deduced, interpolated, theoretical data, thick target yields.
   - Selective versus comprehensive compilation.
   - Distribution of work defined by physics criteria (excitation function, angular distribution, etc.) and/or geographical origin of data.
   - Possible future extension of the scope (heavy ions ?).
3. Technical details, contents and format.
   - Numeric information.
   - Bibliographic and experimental description.
   - Keywords, codes, retrievability (what is needed ?)
   - What modifications to EXFOR are required ?
   - Codes for reactions and quantities.
   - Associated parameters (standard reference values, half-lives, etc.)
   - Accession-numbers.

4. Organization of cooperation
   - Mechanisms for exchange, compiler's and system manual, dictionaries of codes and keywords, meetings.
   - Implementation schedule.

C. Evaluation of CPND
   1. Scope.
   2. Feasibility of cooperation.

D. Service to users

III. Review of actions, conclusions and recommendations from this meeting

* See INDC(NDS)-59: Summary report on the Consultants' Meeting on Charged Particle and Photonuclear Reaction Data, 24 - 26 April 1974, Vienna.

QUESTIONNAIRE TO GROUPS OR CENTRES COMPILING CHARGED PARTICLE REACTION DATA

Please give any other information you may find useful.

1) References

A complete file of bibliographic references is the basis of any system of data compilation and evaluation. Could you please specify the file on which you are relying (or will rely) for the compilation of references on charged particle induced reaction data ?

a) Oak Ridge NDP's Recent References (as published quarterly in the ND sheets or specific retrievals from the computer file)?

b) MacGowan's Reaction Lists (as published annually in the ND Tables or specific retrievals from the computer file)?

c) Your own file ?
In this case give the main features and provide us with a sample.

d) Another file ?
Same precisions as for c) above.

2) Compilation of Charged-Particle Reaction Data

a) Define precisely the scope of the compilation you are performing or planning (if necessary, briefly state the reasons of your enterprise), in particular specify:
- What are the incident charged particles and targets considered?
- What are the quantities compiled (excitation functions, angular and/or energy distributions, other quantities)?
- Is the scope of your compilation limited (for instance by a cut off value of half-lives of isomeric states) ? Specify.
- What is the "geographical" extent of your compilation (all data produced everywhere or on the contrary in a limited geographical area)?

b) Specify the kind of associated information you are compiling (or will compile). In particular specify whether you include:
- All references pertinent to a given work.
- Experimental information, such as SAMPLE, FACILITY, METHOD, DETECTOR, STANDARD; etc.
- The analysis methods used to extract the compiled data from the experiment results.
- Error analysis and specification.

c) Specify the computer format used or contemplated. Is it an originally devised format or a format widely used elsewhere, such as EXFOR? If possible send an example of your compilation output; Specify the available computer hardware.

d) What is the present or future output of your compilation? In particular, are you considering:
- to publish it ? In this case specify how (report, journal, book) and whether updating is being considered.
- only to answer data users' requests as the four neutron data centres do ?
- to do something else ?

e) What are the type and number of people involved in your compilation group ?

f) Do you perform or plan to perform evaluations, reviews or surveys ?

APPENDIX H

REVISED PROPOSAL FROM ASTM 10/9/74

ASTM-EURATOM SYMPOSIUM ON NEUTRON IRRADIATION DOSIMETRY FOR INTERNATIONAL STANDARDIZATION, RCN Petten, September 1975

1. Needs for radiation damage studies, required accuracies and implications on dosimetry

   McElroy (HEDL), Dudey (ANL), to be identified (GGA)
   Farinelli (CNEN)

   Safety Requirements

   Serpan (USAEC)

2. Dosimetry methods for structural materials
   A) Energy-dependent flux determination spectrometry

   Campan (CEA)
   Gold (ANL), De Leeuw (CEN-Mol)

   Activation Techniques

   Zijp (RCN)
   Fischer, Hasenclever (KFA)
   Kam (ORNL)
   Dudey (ANL)

   Calculations

   Dudziak (LASL)
   Bennet (HEDL)
   Meneghetti (ANL)
   to be identified (UKAEA)

   B) Reaction rates
   Fission rates

   Bouchard (CEA)
   Grundl (NBS)

   Non-fission (including damage detectors and fission products)

   Mas (CEA)
   Martin (GE)
   Heinrich (ANL)
   Kellogg (HEDL)

   C) Nuclear Heating

   Boyd (AECL)

3. Dosimetry for fluence applications

   Schneider (KFA)
   Farrai (AI)
   McElroy (HEDL)

4. Damage analysis

A) Theoretical models

Norgett (UKAEA)
Borinson (ORNL)
Doran (HEDL)
to be identified (KAPL)

B) Damage function development and application

Simons (HEDL), Odette (UCAL)

C) Direct damage dosimetry

Genthon (CEA)

5. Nuclear data for radiation dosimetry

A) Cross section

Liskien (CBNM)
McElroy (HEDL)

B) Other nuclear data

Dudey (ANL)
Helmer (ACC)

APPENDIX I

International Atomic Energy Agency

OECD Nuclear Energy Agency

Advisory Group Meeting on

Transactinium Isotope Nuclear Data

Karlsruhe, FRG, 3-7 November 1975

INFORMATION SHEET

1. Introduction

Transactinium Isotope Nuclear Data (TND) play an important role within the nuclear fuel cycle as well as in other application areas such as life sciences and industrial research. This meeting, which will be convened by the International Atomic Energy Agency (IAEA), in cooperation with the OECD Nuclear Energy Agency (NEA), will be the first international meeting on this topic. Its principal purpose will be to survey the needs and to review the status of transactinium isotope nuclear data in these fields of applications. The advisory group meeting will be asked to report to both IAEA and NEA on the current status of the topics discussed and to recommend guidelines for future work in this field. The expected number of participants is about 30-40.

2. Objectives

The main objectives of the meeting will be as follows:

- The meeting should bring together users and producers of TND.
- Users of TND should specify their nuclear data requirements and their priorities in detail as a prerequisite of the meetings' discussions, conclusions and recommendations.
- The status of knowledge of TND should be reviewed including a critical comparison of existing evaluations and compilations.
- The meeting should identify and discuss measurements, compilations and evaluations required to satisfy the needs of TND users, and sensitivity studies required to better specify user needs. It should aim at specific recommendations and measures for coordination of future work.

3. Organization

In order to meet these objectives, the organization of the meeting is envisaged to be similar to that adopted for the IAEA Panel on Fission Product Nuclear Data held in Bologna in November 1973.

The body of the meeting should be formed by 16 comprehensive review papers covering the full scope of applications and status of TND and forming the basis for the discussions of the meeting. The titles of these papers are listed in Annex I.

The task of each reviewer is to write a comprehensive and coherent review of his subject, incorporating not only a report on his own work and experience but also contributions he will receive from pertinent specialists in other institutions and countries.

Our experience with the organization of the Bologna Panel suggests that

- reviewers of user needs should send lists of TND required to reviewers of the data status during an early stage of the preparation of their review papers;
- reviewers of data status should include in their papers tables with achieved accuracies for data appearing in the lists received from the reviewers of user needs;
- reviewers of user needs (data status) should prepare short lists of required (achieved) accuracies, extracted from their papers for distribution to participants before the meeting;
- user requirements supported by sensitivity studies would be extremely valuable, particularly in complex cases or were high accuracy is required;
- reviewers should include in their papers suggestions for recommendations which should be discussed further at the meeting.

In order to achieve maximum efficiency and optimum results, the meeting, in addition to the presentation of the high lights of the review papers should devote its time to discussions on the suggested recommendations and open questions rather than spend much time on additionally submitted original contributions. These discussions will require the participation of carefully selected users, compilers and evaluators, and measurers of TND.

The meeting should discuss the following categories of TND:

- thermal and resonance neutron cross sections
- fast neutron cross sections
- half life, decay scheme and spontaneous fission data.

Prompt gamma ray production cross sections should not be discussed.

In general, needs for nuclear data for all transactinium isotopes would be a proper subject for discussion in the review papers and at the meeting. However, in the area of reactor core physics, the needs for neutron cross section data for the main fertile and fissile isotopes (Th-232, U-233, U-235, U-238, Pu-239) has been so extensively reviewed in the past that this subject should be excluded from consideration. Likewise the status of the available neutron cross section data for these nuclides is well covered elsewhere and should not be discussed at this meeting.

4. Participation

The nomination of a participant will be accepted only if it is presented by the Government of a Member State of the International Atomic Energy Agency or by an international organization invited to participate.

Participants will receive official invitations from the scientific secretaries of the meeting, A. Lorenz and J.J. Schmidt.

5. Target Dates

15 April 1975	Invitation to Governments to appoint reviewers sent out by IAEA.
15 May 1975	Nomination of reviewers from Governments received by IAEA.* Official invitations including list of suggested contributors and initial instructions sent to reviewers by IAEA/NDS.
20 May 1975	Letters sent to contributors by IAEA/NDS.

* Nomination of observers still acceptable until end of September 1975.

15 September 1975	Latest date for reviewers to send their papers to IAEA.
1 October 1975	IAEA distributes all review papers to all participants.
3-7 November 1975	Meeting.

Summary of Review Papers

A. Survey of TND Applications

1. General Survey of Applications of Actinide Nuclear Data in the Nuclear Fuel Cycle and the Nuclear Industry. (S. Raman)

2. Importance of TND in the Physics Design of Fast and Thermal Reactor Cores. (J.Y. Barré, J. Bouchard)

3. Sensitivity Studies of Build-up of Actinides during Normal Reactor Operations. (H. Kuesters)

4. Importance of TND for Engineering Design and Operations of Reactors. (R.G. Nunn)

5. Importance of TND for Fuel Handling (excluding waste management). (B.L. Richardson)

6. European Programmes in Waste Management (Incineration) of Actinides. (L. Koch)

7. US Programmes in the Waste Management (Incineration) of Actinides. (S. Raman)

8. Importance of TND for Fuel Analysis. (R. Dierckx)

9. Importance of TND in Non-reactor Applications. (A.H.W. Aten, Jr.)

B. Review of TND Status

1. Status of Measured Neutron Cross Sections of Transactinium Isotopes for Thermal Reactors. (R.W. Benjamin)

2. Status of Neutron Cross Sections of Transactinium Isotopes in the Resonance Energy Region - Linear Accelerator Measurements. (G.D. James)

3. Status of Neutron Cross Section of Transactinium Isotopes in the Resonance and Fast Energy Regions - Underground Nuclear Explosion Measurements. (M.S. Moore)

4. Status of Measured Neutron Cross Section of Transactinium Isotopes in the Fast Region. (S. Igarasi)

5a. Status of Transactinium Isotope Evaluated Neutron Data in the Energy Range 10^{-3} eV to 15 MeV. (S. Yiftah)

5b. Evaluation and Theoretical Calculation of TND. (J.E. Lynn)

6. Status of Alpha Decay Data of the Transactinium Isotopes. (A.G. Zelenkov/S.A. Baranov)

7. Status of Beta and Gamma Decay and Spontaneous Fission Data from Transactinium Isotopes. (C.W. Reich)

APPENDIX J

Information sheet

IAEA Consultants Meeting on the Use of Nuclear Theory in Neutron Nuclear Data Evaluation

at the

International Centre for Theoretical Physics, Trieste
8-12 December 1975

Following a recommendation by the International Nuclear Data Committee (INDC), the IAEA Nuclear Data Section (NDS), in cooperation with the International Centre for Theoretical Physics (ICTP) in Trieste, will convene a Consultants Meeting on the Use of Nuclear Theory in Neutron Nuclear Data Evaluation at the ICTP in Trieste from 8-12 December 1975.

Motivation

This meeting is motivated by the fact that a considerable fraction of the many nuclear data needed for fission and fusion reactor design, such as neutron reaction data for many fission product and actinide nuclides, is either very difficult to measure or has to wait for being measured for unpredictable time delays. However, for many of these data, the accuracies needed can or could be met by estimates based on nuclear theories and models. Status and needed improvements of the latter with regard to practical applications have never been reviewed so far in a comprehensive and systematic way.

It is expected that the results of this meeting as well as of potential future workshops will be of great benefit to nuclear scientists and engineers particularly in developing countries, who can usually not afford to undertake themselves major efforts in nuclear data evaluation and computer code development.

Objectives

The objectives of the meeting will therefore be to gather application-oriented nuclear theorists and neutron nuclear data evaluation scientists who should

- review the role and use of nuclear theories, models and computer codes in practical neutron nuclear data evaluation needed for

fission and fusion reactor design and other nuclear applications including the most commonly used computer codes;

- review the status of these theories and models, their applicability, limitations and accuracy;

- delimit those areas where further developments and improvements of existing theories, models and computer codes are needed; and

- develop concrete ideas and recommendations, how, by whom and where the needed developments and improvements can best be implemented, for example by workshops held at the ICTP, Trieste, with particular consideration of the interest and possible cooperation of nuclear scientists from developing countries.

Organization

In order to meet these objectives and to achieve maximum efficiency and optimum results, the meeting will be organized around review and contributed papers in the following way.

The basis for the discussions at the meeting will consist of several comprehensive review papers. These should give as complete an account as possible of the status, applicability, limitations and expected accuracy of the nuclear theory subject concerned and of existing, widely used computer codes and outline possible needed improvements and developments.

The contributed papers should follow those review papers to which they are most closely related, and discuss specific developments and applications, in particular outline problems encountered in the accurate interpretation of existing experiments and in the adequate prediction of unknown data, describe and compare, to the extent needed and possible, widely used computer codes, and suggest improvements, as applicable.

The meeting should devote as much time as possible to the discussion of open questions and of conclusions and recommendations. Therefore, both review and contributed papers should be available to IAEA/NDS by 1 November 1975 so that NDS can distribute them in advance of the meeting to all participants.

Programme

The meeting should start with reviews of the role and use of nuclear theories, models and computer codes in practical evaluation of neutron nuclear data needed for fission and fusion reactor design and other nuclear applications, and of the role and importance this subject is to take in nuclear programmes of developing countries. It should then review the status of the following three major nuclear theory areas (for a more detailed breakdown see attachment 1):

Attachment 1

LIST OF SUBJECT AREAS AND REVIEW PAPERS (RP)

Introductory review papers on

RP 1a The role and use of nuclear theories and models in practical evaluation of neutron nuclear data needed for fission and fusion reactor design and other nuclear applications.

RP 1b The role and importance of the use and development of applied nuclear theory and computer codes for neutron nuclear data evaluation in developing countries.

1. Reaction mechanisms and statistical theory

RP 2 a) Statistical theory of neutron nuclear reactions for discrete and "continuous" rest nucleus levels, including statistical properties of the compound nucleus and particle emission mechanisms;

RP 3 b) Neutron radiative capture mechanisms, capture widths and their statistical distributions;

RP 4 c) Theory and systematics of nuclear level densities as functions of A,E,J,π (or 1).

2. Optical, direct reaction and pre-equilibrium models

RP 5 a) Optical model with an emphasis on the coupled-channel optical model, including elastic and inelastic neutron scattering widths (or transmission coefficients);

RP 6 b) Direct reaction and pre-equilibrium processes at high ($\lesssim$ 20 MeV) energies including multiparticle and γ-cascade emission (e.g. (n,np); (n,nα), etc.)

3. Fission theory

RP 7 a) Fission theory, with emphasis on the double-humped fission barrier concept and on applications such as calculation of fission cross-sections, $\bar{\nu}(E)$ and (perhaps) prompt fission neutron spectra;

RP 7 b) Systematics of fission parameters such as fission widths (averages, distributions, and as functions of the quantum properties and fission barrier shapes of the fissioning compound nuclei), barrier level densities etc..

1. Reaction mechanisms and statistical theory;

2. Optical, direct reaction and pre-equilibrium models; and

3. Fission theory.

The meeting should then split into subgroups whose task will be to draft reports for submission to the plenary meeting. These reports should include a concise summary of the meeting's discussions and conclusions, and detailed recommendations for future work on the development of nuclear theory and computer codes for applications. The meeting will be finished with the discussion and approval of the reports and recommendations of the subgroups by the plenary.

Details of the tentative agenda of the meeting are given in attachment 2.

Publication

Subject to the approval of the Agency's publications committee, the proceedings of the meeting, consisting of review and contributed papers and of the meeting's conclusions and recommendations are planned to be published in the IAEA Report Series and distributed free of charge. Since this form of IAEA publication is not edited or retyped, the original manuscripts of the submitted papers will have to be used for the final publication. In order to speed up the publication of the proceedings and end up with a publication of uniform quality, both reviewers and contributors are requested to use a clearly understandable logic and style and to adhere to the specifications given in the instruction for authors.

Attachment 2

TENTATIVE AGENDA

Monday, 8 December

- Opening and announcements
- Introductory review papers on:

  The role and use of nuclear theories and models in practical evaluation of neutron nuclear data needed for fission and fusion reactor design and other nuclear applications (RP 1a); and on

  The role and importance of the use and development of applied nuclear theory and computer codes for neutron nuclear data evaluation in developing countries (RP 1b)

  Election of subgroups participants, chairmen and secretaries (for taking notes during the discussion periods and helping to draft subgroup reports)
- Reviews of subject area 1: neutron nuclear reaction mechanisms and statistical theory (RP 2,3 and 4)
- Contributions under this topic
- Discussion of needed improvements and developments

Tuesday, 9 December

- Subject area 1 continued
- Reviews of subject area 2: optical, direct reaction and pre-equilibrium models (RP 5 and 6)
- Contributions under this topic
- Discussion of needed improvements and developments

Wednesday, 10 December

- Review of subject are 3: neutron fission theory (RP 7)
- Contributions under this topic
- Discussions of needed improvements and developments

Thursday, 11 December

- Splitting into three (or more) subgroups on the topics 1, 2 and 3.

The tasks of the subgroups will be to draft reports for submission to the plenary meeting, which should include for the topics concerned:

a) a short, concise summary of the results of the meeting's discussions and conclusions on the present status and needed possible improvements;

b) concepts and recommendations to the Director General of the IAEA on how, by whom and where the needed improvements could best be implemented.

These reports should be typed and copied so as to be available to all participants at the latest on Friday morning.

Friday, 12 December

Morning

- Meeting of subgroups chairmen and secretaries to coordinate the concepts and recommendations of the three subgroups and draft corresponding changes to the subgroups' reports

Afternoon

- Discussion and approval of the subgroups' draft reports and recommendations by the plenary meeting.

- Meeting closed.

APPENDIX K

Status of Recent Experimental and Theoretical Work on the $^{103}Rh(n,n')^{103}Rh^m$ Cross Section prepared

by M.F. Vlasov and J.R. Lemley

1. Santry and Butler have remeasured the cross section from threshold to 15 MeV using the activation method. Their new measurements [1] essentially confirm their previous results [2]. Their paper acknowledges the extensive work of Ing and Cross [12] concerning absolute determination of $^{103}Rh^m$ disintegration rates.

2. Reitmann et al.[3] presented cross-section data in the range 600 - 1400 KeV and additional level-scheme information at the recent Conference on Nuclear Cross Sections and Technology, Washington, D.C., 3-7 March 1975. The effective cross-section for excitation of the 40-keV isomeric state was derived from neutron time-of-flight measurements and from high-resolution gamma-ray spectroscopy. Agreement with the data of Santry and Butler [1] in this energy range is remarkably good.

3. Miscalculations in the analysis of data measured in Debrecen, Hungary, have been corrected. The corrected values[4] relative to $^{115}In(n,n')^{115}In^m$ follow:

En(MeV)	σ(mb)	Standard σ (mb)
2.7 ± 0.3	999 ± 111	340 ± 30
14.8 ± 0.2	216 ± 26	63 ± 6
^{252}Cf neutron spectrum	757 ± 53	188 ± 8
^{238}Pu-α-Be neutron spectrum	918 ± 64	260 ± 10

The point at 2.7 MeV agrees with Santry and Butler [1], and the point at 15 MeV is lower by more than the quoted errors of the respective measurements.

4. Fabry and Czock[5] have made integral measurements of the cross section in the $\Sigma\Sigma$ Standard Neutron Field and in the ^{235}U fission neutron spectrum at Mol. Their values, 294 ± 7 and 729 ± 20 mb respectively, agree well with values [1,5] obtained by averaging the differential data of Santry and Butler [1,2] over the $\Sigma\Sigma$ spectrum and various representations of the ^{235}U fission neutron spectrum. Czock et al [13,14] have also measured conversion coefficients and done extensive background work related to absolute measurement of $^{103}Rh^m$ disintegration rates.

5. Preliminary calculations of the cross section by P. Ribon [6] in the energy range 100 - 300 keV are slightly higher than the data of Santry and Butler [1]. The calculations involve no adjustments depending on experimental data.

6. During 1975 Liskien [7] et al. plan to begin measurements of the cross section using the van de Graaff at Geel.

7. During 1974 Douglas [8] et al. planned to begin measurements of the cross section above 3 MeV using the Pelletron Accelerator System of the University of Sao Paulo, Brazil. No further information is available.

Summary

Santry and Butler [1] have confirmed their earlier data [2]. In the range 600 - 1500 KeV new measurements by Reitmann et al.[3] appear to support the Santry and Butler data and to disagree with Kimura et al.[9]. New integral measurements by Fabry et al.[5] are also consistent with the Santry and Butler differential data.

With the exception of the single point of Petö, between 1.5 MeV and 14 MeV there exist only two sets of differential measurements - Santry and Butler [1,2] and Kimura et al.[9] - which are in serious disagreement up to 5 MeV where the latter measurements end. Although new measurements at lower energies and integral measurements tend to support the Santry and Butler data, it remains important to verify the magnitude and shape of these data in the range 1.5 - 15 MeV. The information reported in the paper of Kimura et al.[9] is not sufficiently detailed to permit full evaluation of their work.

Between 14 and 15 MeV the existing measurements from three laboratories [1,2;4;10] are in rather poor agreement.

In view of the following considerations:

1. agreement of the two sets of data by Santry and Butler,

2. consistency between the Santry and Butler data and integral measurements, and

3. support of the Santry and Butler data by new measurements of Reitmann et al., which were obtained by a non-activation method (neutron time-of-flight coupled with gamma ray spectroscopy) in the limited energy range 600 - 1500 KeV,

at present we recommend the experimental values of Santry and Butler in preference to the preliminary recommended curve given in the report INDC(NDS)-47[11].

References

1. D.C. Santry and J.P. Butler, Can. J. Phys. 52, 1421 (1974). (Photocopy attached).

2. J.P. Butler and D.C. Santry, Conf. on Neutron Cross Section Technology, Proceedings, Washington (1968) Vol. 2, p. 803.

3. D. Reitmann, private communication. (Preliminary report attached. Numerical data expected to become available soon.)

4. G. Petö, private communication. These data are available from the Four Neutron Data Centers as EXFOR Entry 30266.

5. A. Fabry and K.H. Czock, INDC(IAE)-005 (1974). (Attached).

6. P. Ribon, private communication.

7. H. Liskien, private communication.

8. R.A. Douglas, private communication.

9. I. Kimura et al., Nucl. Sci. Technology 6, 485 (1969).

10. W. Nagel and A.H.W. Aten, Jr., J. Nucl. Energy 10, 475 (1966).

11. M.F. Vlasov et al., INDC(NDS)-47, Part I, p. 41.

12. H. Ing and W.G. Cross, Int. J. Appl. Radiat. Isot. 24, 437 (1973).

13. K.H. Czock et al., IAEA/RL/26 (1974).

14. K.H. Czock et al., IAEA/RL/23 (1974).

APPENDIX L

IAEA
June 1975

QUESTIONNAIRE

on the present status of neutron fluence and spectra determination in nuclear reactors

TO ALL REACTOR CENTERS

(1) Do you perform irradiations in the reactor? YES NO

(2) What special irradiation facilities in the reactor are available?

.....

.....

.....

(3) What kind of irradiations do you perform? (Please check)

(a) structural material testing YES NO

(b) fuel materials testing YES NO

(c) irradiation of biological materials YES NO

(d) neutron activation YES NO

(e) isotope production YES NO

(f) others (please specify)

.....

.....

(4) How do you determine the neutron fluence in the irradiation facilities?

(a) thermal neutrons

.....

.....

(b) fast neutrons

.....

.....

(5) How do you determine the neutron energy distribution?

(a) by calculation YES NO

(b) by direct spectrometry (please specify instruments) YES NO

.....

.....

(c) by threshold detector activation YES NO

(6) Do you think that neutron spectra calculations are sufficiently accurate?

(a) for radiation damage determination YES NO

(b) biological application YES NO

(c) others

.....

.....

(7) What instruments do you use for neutron dose rate [rad.sec.$^{-1}$] determination?

.....

.....

(8) If you do not already use the activation foil technique, would you like to use it for neutron spectra determination? YES NO

IF YOU USE THE ACTIVATION FOIL TECHNIQUE:

(9) Which neutron induced reactions do you use?

.....

.....

.....

(10) By what methods and with which instruments do you measure the activities?

.....

.....

(11) How do you calibrate these instruments?

.....

(12) Do you have an up-to-date cross-section file? YES NO
If yes, which one?

.....

(13) Would you like to receive recommended cross section files for threshold detectors, prepared and maintainedx by the IAEA? YES NO

(14) Do you use a computer code for spectrum unfolding? YES NO
If yes, which one?

.....

.....

(15) Would you like to participate in an intercomparison of such computer codes for spectrum unfolding? YES NO

(16) Would you like the IAEA to assist you in obtaining a computer code which would be recommended on the basis of the proposed international intercomparison? x) YES NO

(17) Would you be interested in obtaining from the IAEA unirradiated standard foil materials for use as threshold detectors? x) YES NO
Please specify.

.....

.....

(18) Would you like to obtain from the IAEA standard radioactive sources for calibrations, related to above-mentioned materials? x) YES NO
If yes, please specify.

.....

.....

(19) Remarks and suggestions.

---

x) For these items, the IAEA would have to charge its direct costs.

Sample of the Karlsruhe CPND tape

```
ENTRY           60001      750204
SUBENT        60001001     750204
BIB                13          20
TITLE       (P,XN) AND (P,PXN) REACTIONS OF YTTRIUM-89 WITH 5 - 85
            MEV PROTONS
AUTHOR      (G.B.SAHA, N.T.PORILE, L.YAFFE)
INSTITUTE   (1CANMCG)
REFERENCE   (J,PR,144,962,66)
MONITOR     (29-CU-63(P,N)30-ZN-63)S.N.GHOSHAL,PHYS.REV.80,939,50
            (29-CU-65(P,PN)29-CU-64)S.MEGHIR,L.YAFFE,UNPUBLISHED
METHOD      (STTA,INTB,CHSEP,MONMIX)
FACILITY    (SYNCYC,1CANMCG)
DETECTOR    (ARCJI,NAICR)
SAMPLE      (39-Y-OXI)
ERR-ANALYS  UNCERTAINTIES INCLUDE RANDOM ERROR OF THE DETERMINATION
            OF PHOTOPEAK-AREA, DECAY CURVE ANALYSIS AND CHEMICAL
            YIELD AS WELL AS SYSTEMATIC ERRORS ASSOCIATED WITH
            COUNTER EFFICIENCIES AND SPREAD IN BEAM ENERGY. ERRORS
            IN MONITOR CROSS SECTIONS AND DECAY SCHEME DATA ARE NOT
            INCLUDED
ANALYSIS    (GAREA)
HISTORY     (7411010)LA
STATUS      (COMP)
ENDBIB             20
NOCOMMON
ENDSUBENT          23
SUBENT        60001002     750204
BIB                 2           4
REACTION    (39-Y-89(P,N)40-ZR-89,CRO)
PART-DET    (40-ZR-89,AR,DG) HALF-LIFE 78.6HR
              ANNIHILATION RADIATION 0.22 BETA+ PER DECAY
              908KEV PHOTONS, 1.0 PER DECAY
ENDBIB              4
NOCOMMON
DATA                3          19
EN          DATA        DATA-ERR
MEV         MB          MB
     5.       50.          5.5
     8.5     352.         39.
    12.      720.         79.
    15.      712.         78.
    18.5     552.         61.
    21.5     395.         43.
    24.8     194.         21.
    27.5     103.         11.
    30.5      61.4         6.8
    33.5      43.          4.7
    36.8      45.          5.
    42.       37.          4.1
    48.       29.4         3.2
    54.       29.7         3.3
    60.       23.3         2.6
    66.       19.7         2.2
    72.       17.          1.9
    78.       14.4         1.6
    85.       12.          1.3
ENDDATA            21
ENDSUBENT          30                          entry continues
SUBENT        60001003     750204                    ↓
```

Eleventh Four-Centres Meeting

National Neutron Cross Section Center (NNCSC), Brookhaven National Laboratory, 10-14 March 1975

List of Participants

Opening: W.E. Winsche, Chairman of BNL Department of Applied Science

NNCSC: S. Pearlstein, head (chairman)
G. Thompson, N. Holden } meeting secretaries
C.L. Dunford
V. May

Part-time: D. Garber, R. Kinsey, J. Stehn, R. Chrien, T. Weneser, M. Blau, T. Burrows, W. Kropp, J. Burt, F. Scheffel.
Interpreter for Russian: S. Amoretty, BNL

OECD NEA Neutron Data Compilation Centre (NDCC):

L. Lesca, head (had to leave before opening of meeting for personal reasons)
A. Schofield

IAEA NDS: J.J. Schmidt, head
H.D. Lemmel

USSR Centr po Jadernym Dannym (CJD):

V. Manokhin, head
V. Pronjaev

Part-time observers:

H. Goldstein, Columbia University, New York
G. Rogosa, ERDA, Washington
E. Ritter, ERDA, Washington

Summary of agenda

1. Welcome address, organization and announcements.

2. Progress reports from the Centres, common data distribution statistics, future meetings and publications, planned improvements to customer services.

3. CINDA, compilation, possible improvements, future publication schedule.

4. EXFOR, compilation and development, manuals and protocol, data exchange, technical details.

5. Non-neutron nuclear data, photoneutron data, charged-particles nuclear data, adaption of EXFOR for charged-particles nuclear data, bibliographies, international cooperation.

6. Summary and conclusions. The next meeting was provisionally scheduled for 26-30 April 1976 in Vienna.