International Atomic Energy Agency

INDC(NDS)-53/L

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

REPORT OF THE NUCLEAR DATA SECTION TO THE INTERNATIONAL NUCLEAR DATA COMMITTEE JUNE 1972 TO AUGUST 1973

August 1973

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

INDC(NDS)-53/L

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INDC(SEC) Documents Published Since Last INDC Meeting

(SEC)-28/L Consolidated Progress Report for 1972 on Nuclear Data Activities in the NDS Service Area, September 1972

(SEC)-29/G International Working Group on Nuclear Structure and Reaction Data, Minutes of First Meeting, Vienna, 13-17 March 1972.

(SEC)-30/U INDC Correspondents for the Exchange of Nuclear Data Information, November 1972 (supersedes INDC(SEC)-23/U)

(SEC)-31/U Fifth Meeting of the International Nuclear Data Committee, Topical Discussion on Inelastic Scattering of Fast Neutrons, January 1973

(SEC)-32/U WRENDA - World Request List for Neutron Data Measurements for Nuclear Reactors, March 1973

(SEC)-33/U INDC Correspondents for the Exchange of Nuclear Data Information, May 1973 (supersedes INDC(SEC)-30/U of November 1972)

(SEC)-34/U List of Documents Received by the INDC Secretariat May 1973 (supersedes INDC(SEC)-22/U and Supplement 1 thereto)

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(NDS)-34/G Status of the Energy Dependent Nubar-Values for the Heavy Isotopes (Z 90) from Thermal to 15 MeV and of Nubar-Values for Spontaneous Fission, F. Manero and V.A. Konshin, July 1972

(NDS)-46/U Conclusions and Recommendations of the First Meeting of the International Working Group on Nuclear Structure and Reaction Data, Vienna, 13-17 March 1972

(NDS)-47/L Status of Neutron Cross Section Data for Reactor Radiation Measurements, Part I. Reactions of High Priority, M.F. Vlasov et al., October 1972

(NDS)-48/G A Status Report on Nuclear Data for Shielding Calculations, C. Dunford et al. (presented at the 4th Intern. Conference on Reactor Shielding, Paris, October 9-13, 1972)

(NDS)-49/L Requirements Versus Present Status of Evaluated Neutron Nuclear Data for Fast Reactor Design, J.J. Schmidt (Lecture Presented at the International Summer School on Nuclear Data for Reactors and Reactor Physics, Predeal/Romania, 30 April - 9 September 1972)

(NDS)-50/U Request List of Nuclear Data for Safeguards Development Purposes as Submitted to the International Atomic Energy Agency by Member States, Compiled and Edited by Trevor A. Byer, March 1973

(NDS)-51/G Report on the Eighth Four-Center Meeting, Vienna, 16-20 October 1972

(NDS)-52/L Summary of the Symposium on Applications of Nuclear Data in Science and Technology, Paris, 12-16 March 1973, L. Hjärne and J.J. Schmidt

(NDS)-53/L Report of the Nuclear Data Section to the International Nuclear Data Committee, June 1972 to August 1973

A. INTRODUCTION

Due to the change of schedule for meetings of the International Nuclear Data Committee (INDC), the annual progress report of the Nuclear Data Section (NDS) to the INDC will cover a period of fourteen months from June 1972 to August 1973. During this period Trevor Byer (Jamaica) left the Section on 1 January 1973 and will be replaced on 1 September 1973 by Peter Smith from Canada. A consultant, Peter Winiwarter (Austria) was hired for the period 1 November 1972 to 1 July 1973 to assist with EXFOR and CINDA compilation. Leif Hjärne (Sweden) left the Section on 1 July and Francisco Manero (Spain) will leave on 1 September 1973. For budgetary reasons each post will remain vacant for four months.

In order to assist in determining the Section's activity for the next several years, a Symposium on "Applications of Nuclear Data in Science and Technology" was held in Paris, 12-16 March 1973. The symposium was successful in bringing out the data needs in several non-reactor areas. As a result of the information presented at the Symposium and the discussions at an informal meeting of some INDC members and some members of the International Working Group on Nuclear Structure and Reaction Data (IWGNSRD), the NDS will begin a small international coordination programme in the compilation of nuclear structure data.

Considerable effort was required on the part of NDS during this period to prepare the new computer programmes necessary for printing the CINDA 1973 book from the new format CINDA files at CCDN (Saclay). In spite of very tight deadlines, the book has been published on schedule. Some errors in content were introduced during the conversion at CCDN and some improvements are still needed in the book format. All these matters will be resolved before the publication of CINDA 1974.

The final version of the Nuclear Data Request List for Safeguards Development was published in March 1973. The last publication of WRENDA - World Request List for Neutron Data Measurements for Nuclear Reactors based on the CCDN RENDA file was published in March 1973. The main improvement of the 1972 edition was a major revision of the United States entries. The next edition of WRENDA is planned for the spring of 1974 using a new file format maintained at NDS. The conversion of the old CCDN RENDA file has been completed, but the computer system programming has been delayed by staff recruitment problems. A Request List for Nuclear Data for Fusion will be published in the fall.

The amount of experimental neutron data contained in the EXFOR system continues to grow. NDS has completed the conversion of all the DASTAR entries from our service area to EXFOR. In addition to compiling all new data from our area, NDS will begin to convert data from our area

contained in the data files from NNCSC and CCDN. The recent Four Center Meeting in Moscow discussed the remaining two major EXFOR format problems, namely the coding of multidimensional tables and non-neutron reactions. The latter is important for the storage of inverse reaction data widely used in neutron data evaluations. Final decisions on these format modifications should be taken within one year.

Following the decision of the INDC at its last meeting, the Agency contracted for the preparation and supply of samples for neutron experiments for laboratories in six countries, Greece, Hungary, Pakistan, Romania, Turkey and Yugoslavia. Sample material has been loaned to the Agency by Sweden; further offers have been made by the USSR; and requests for purchase of special materials have been made to the USA and the UK. As of this date delivery has been made only to Greece.

Three data reviews on Pu-239 α, Pu-239 fission, and $\bar{\nu}$ for all heavy isotopes were published in the December 1972 issue of Atomic Energy Review. A review of fission spectrum averaged (n,2n), (n,p) and (n,α) cross sections has been completed. This work will form one chapter of a data handbook for neutron activation analysis.

A consultants' meeting was held in November 1972 to discuss problems related to the Section's review of the 2200 meter/sec fissile isotope cross sections. A sophisticated least square fitting programme has been used to permit a more realistic description of the input variables and other functional relationships. The discrepancy between the measured and deduced Cf-252 $\bar{\nu}$ still exists when all available experimental data are used in the fit. Crucial new half life measurements from Geel are still awaited.

The NDS review of neutron dosimetry cross sections is continuing. A report analyzing the status for the most important reactions was issued in October 1972. The analysis of additional reaction cross sections is now being prepared for release in advance of the planned Consultants' Meeting on Nuclear Data for Reactor Neutron Dosimetry in September 1973.

A Panel on Neutron Standard Cross Sections was held in Vienna in November 1972. A publication containing the papers and discussions of the meeting is being prepared. A Consultants' Meeting was held in December 1972 to assist in planning the Fission Product Nuclear Data Panel to be held in Bologna in November 1973. The Consultants' Meeting recommended that the Panel consist of sixteen review papers and discussions. The reviewers were selected with the help of the INDC and are now preparing their reviews.

B. INDC SECRETARIAT

B.1. Liaison Officers

The current list of Liaison Officers to the INDC comprizes scientists from 37 countries and is given in Appendix A. The new state Bangla-Desh has been added since the last report period.

As in 1972, the individual progress reports submitted by those countries within the service area of NDS which are not directly represented on INDC, will be combined into one single document and will be issued as such before the Sixth INDC Meeting.

B.2. List of Correspondents

The current list of "INDC Correspondents for the Exchange of Nuclear Data Information" has been distributed as INDC(SEC)-33/U in June 1973. The next issue will be distributed in November 1973.

B.3. List of Documents

The current list of INDC documents received and distributed by NDS/INDC Secretariat has been distributed as INDC(SEC)-34/U in May 1973. A supplement will be distributed in November 1973.

B.4. Translation of Documents

During the past year the following documents of Soviet origin were translated by the IAEA into English and distributed as INDC documents with the following numbers:

(CCP)-25/U Proposals on RENDA - A World-Wide Compilation of Requests for Neutron Data Measurements for Reactors, L.N. Usachev and Yu.G. Bobkov

(CCP)-26/U Nuclear Constants - Issue 9: Evaluation of the U-235 Fission Cross-Section, V.A. Konshin and M.N. Nikolaev

(CCP)-27/L Nuclear Constants No. 7 (Appendix 2): Systematics of Mean Radiation Widths of Neutron Resonances, S.M. Zakharova et al.

(CCP)-28/U	Nuclear Data Requirements for Reactor Shielding Calculations, A.A. Abagyan et al.
(CCP)-29/L	Principles of Constructing Systematized, Bibliographic Nuclear Data Files, A.I. Abramov
(CCP)-30/U	Nuclear Physics Research in the USSR (Collected Abstracts) No. 12
(CCP)-31/U	Nuclear Physics Research in the USSR (Collected Abstracts) No. 11
(CCP)-32/U	Nuclear Physics Research in the USSR (Collected Abstracts) No. 13
(CCP)-33/L	Determination of Required Accuracy of Nuclear Data, L.N. Usachev and Yu.G. Bobkov

C. MEETINGS

C.1. Past Meetings

C.1.1. IAEA Consultants' Meeting on the Thermal Neutron Data for the Fissile Isotopes

Date and place: Vienna, 15-17 November 1972

Participants:
E.J. Axton (Teddington, U.K.)
A.J. Deruytter (Geel, CEC)
C.L. Dunford (NDS)
H.D. Lemmel (NDS)
B.R. Leonard, Jr. (Richland, USA)
J.S. Story (Winfrith, U.K.)

This meeting was convened to consider the experimental data to be used in the Third IAEA evaluation of the 2200 m/s cross sections and related parameters for the main fissile isotopes, U-233, U-235, Pu-239, Pu-241, and $\bar{\nu}$ Californium. For further details see below under E.4.1.

C.1.2. IAEA Panel on Neutron Standard Reference Data

Following the recommendation of INDC, the Agency convened a Second Panel on Neutron Standard Reference Data from 20-24 November 1972 in Vienna. It was attended by 22 participants for 11 of whom the total costs of attendance were borne by the Agency.

The agenda, which was reviewed by the INDC at its Fifth Meeting, included the following major topics:

1) methods and techniques of neutron flux measurements;
2) light-element standards;
3) fission and capture standards;
4) criteria for standards for neutron data measurements.

The panel reviewed experimental results obtained since the 1970 Argonne Symposium and summarized the status of the experimental and evaluated data available for each of the standard cross sections. Based on the presentations and discussions, the panel prepared technical recommendations directed primarily to the scientific community for further work which should result in improved knowledge of

the standards. Brief summaries of the status reviews and technical recommendations appear in Appendix B.

In recommendations of more general interest the panel proposed that a standard fission neutron spectrum be included among the Neutron Standard Reference Data (NSRD). For reactor dosimetry purposes the panel recommended that the value of designating the Np fission cross section as NSRD be explored with those groups which have recommended rapid improvement of data for various capture and threshold reactions. As in other Agency-sponsored meetings the panel noted that reporting of errors and sources of uncertainty is frequently unsatisfactory and recommended that in the case of NSRD detailed accounts be included in final reports of the work.

The panel suggested that important points raised during the discussions should be included in the proceedings. These are now being extracted from tape recordings. The complete proceedings should be available soon.

In consideration of the extensive efforts presently in progress at many laboratories, a third panel on NSRD was recommended for Spring 1975.

C.1.3. IAEA Consultants' Meeting on Fission Product Nuclear Data

Following a recommendation of the INDC, the IAEA will convene a Panel on Fission Product Nuclear Data (FPND) to be held from 26-30 November 1973 at Bologna, Italy.

A preparatory consultants' meeting, which met at IAEA Headquarters in Vienna, 11-13 December 1972, developed a detailed programme for this panel. Prior to the consultants' meeting a circular letter was sent to more than 200 users and producers of FPND in various Member States, asking specific questions on the scope and objectives of the panel and on the nuclear data to be discussed. About 100 replies, some of them representing collective opinions, supplied important background information to the preparatory meeting.

Relying on this information and on its own deliberations it defined the main objectives of the panel, as outlined in Appendix C. The meeting concluded that, in order to best meet these objectives, the panel should be organized around 16 internationally coordinated review papers. These review papers should supply the basic information for the panel discussions, aiming at recommendations for future actions. The consultants' meeting defined the titles and contents of the review papers and worked out a provisional programme, which can be found in Appendix D.

C.1.4. IAEA Symposium on the Applications of Nuclear Data in Science and Technology

The IAEA Symposium on "Applications of Nuclear Data in Science and Technology" was convened by the International Atomic Energy Agency on 12-16 March 1973 in Paris at the invitation of the French Government. The meeting was held upon recommendation of the INDC and the International Working Group on Nuclear Structure and Reaction Data (IWGNSRD). The main purpose of the symposium was to illuminate the needs for nuclear data in the technological and scientific community. Over 200 delegates attended, representing 30 countries and 5 international organizations. 74 papers were presented, including the keynote address and the summary paper. The sessions and chairmen are given in Appendix E.

For many years the mechanisms for satisfying the nuclear data needs related to neutron induced reactions have been fairly well organized by those concerned with neutron reactor technology which is a major field of application of this kind of data. However, for several years it has become increasingly evident that there is a strong need for better, up-to-date compilations of nuclear data for a large number of other applications. The IAEA was therefore requested to convene a symposium in order to review the status of and needs for new nuclear data evaluation activities. During the preparation, it became evident that the symposium should emphasize data needs in the various applications rather than existing data compilation activities.

The programme committee attempted to achieve a balance between reactor and non-reactor applications as well as a balance between the needs for various applications and the needs for compilation work. As a result four of the sixteen regular sessions were devoted to applications related to nuclear energy, seven to other applications and five to topics related to data compilations. In contrast to the International Conferences on Nuclear Data for Reactors (Paris, 17-21 October 1966 and Helsinki, 15-19 June 1970), this symposium was not meant to be a forum for the presentation of experimental data.

The symposium demonstrated that the compilation of structure and decay data needs considerably increased support. These data are basic to most other data application oriented compilations. The long delay in bringing compilations of this type up-to-date causes inacceptable delays in the process of bringing such data from producers to users. Much information was brought out in the papers and during the discussions. Concerning data needs and status of compilations, attempts have been made to summarize the most important conclusions that can be drawn from the meeting. These are the presentation by Dr. W. Lewis in the summary session and the Symposium Summary distributed as INDC(NDS)-52/L.

C.1.5. NDS Participation in Other Meetings

Conference on Nuclear Structure Study with Neutrons, Budapest, 31 July - 5 August 1972

This conference was jointly sponsored by the Hungarian Academy of Sciences, the Hungarian Atomic Energy Commission and IUPAP. Around 200 physicists of 25 countries attended the conference which gave to the NDS representative, A. Calamand, a good opportunity of meeting Eastern European physicists, whose data production yields a large fraction of NDS data compilation activities.

International School on Nuclear Data for Reactors and Reactor Physics, Predeal, Romania, 30 August - 9 September 1972

The school was jointly organized by the Romanian State Committee for Nuclear Energy and by the Institutes for Atomic Physics (IFA) and for Nuclear Technology, Bucharest. The participants (about 100) were mainly reactor and nuclear physicists including advanced students. They came almost exclusively from East European countries. The lecturers, except several Romanians, came from Italy (2), France (3), Hungary (1), Yugoslavia (1), FRG (1) and USA (1).

The purpose of the school was to present and discuss up-to-date reviews of selected, not necessarily coherent, topics in the fields of nuclear data and of thermal and fast reactor physics. Schmidt from NDS participated and gave an invited lecture on "Requirements versus present status of evaluated neutron nuclear data for fast reactor design" (INDC(NDS)-49/L). It is planned to edit proceedings of the school lectures.

During and outside the school specific discussions were held with the Romanians on possibilities of assistance by IAEA and some countries to the build-up of a Romanian library of evaluated neutron nuclear data required in the context of the future Romanian reactor programme.

Topical Meeting on the "Confidence Level of the Prediction of Physics Parameters of Thermal and Fast Power Reactors", Jülich, Fed.Rep. of Germany, 23-25 January 1973

This meeting was organized by the Deutsche Kerntechnische Gesellschaft. It was mainly a German meeting with some participation from other West European countries. Schmidt from NDS gave a review lecture on the "1972 status of most important nuclear data for thermal and fast reactors" (unpublished).

Second All Union Soviet Neutron Physics Conference, Kiev, 28 May - 1 June 1973

The Second All Union Soviet Neutron Physics Conference was held at the October Palace of Culture in Kiev from 28 May to 1 June 1973. For the first time there was invited participation by non-Soviet scientists. Of the approximately 200 participants 26 represented the following countries and organizations: Sweden, France, Australia, United States, Federal Republic of Germany, German Democratic Republic, Euratom (Geel), Poland, Bulgaria, and the IAEA. (Interpretation into English and French was provided.) Schmidt and Dunford attended for NDS.

In format, the conference consisted entirely of review presentations. Individual contributions from Russian scientists were grouped by topic and summarized by a reviewer. Approximately 25 percent of the reviews were contributed by non-Soviet scientists. Several of the foreign participants gave reviews of the last years' neutron physics research in their institutions which led to extended exchanges on methods and results. Schmidt presented a paper by Schmidt and Dunford reviewing the Agency's WRENDA programme. A small meeting of interested persons was held concerning the Agency's evaluation of the 2200 meter/second constants for the fissile isotopes. A conference summary is given in Appendix F.

32nd and 33rd Meetings of Euratom Working Group on Reactor Dosimetry (EWGRD)

The EWGRD considers the problem of detector cross sections to be very important. This question was a central point of the agenda of both meetings. NDS was represented by Vlasov at both meetings.

At the 32nd meeting of the EWGRD, 21 September 1972, Rome, NDS was asked to present a report on the status of some reactions important for study of the reactor radiation measurements. This report which

has been prepared at the request of the IWGRRM (INDC(NDS)-47/L, part 1) was well received by the meeting. The chairman, Professor Farinelli, has summarized the recommendations of the meeting concerning dosimetry cross sections (Appendix G). These recommendations stress the importance of the IAEA role in coordinating the production of an internationally accepted file of evaluated data for reactor neutron dosimetry.

At the 33rd Meeting of the EWGRD, 2 April 1973 in Brussels, attention was again drawn to the problems of unfolding neutron spectra from irradiation of the activation detectors and the need for nuclear data with good accuracy. The participants were informed about the high level of activity in evaluation of a set of neutron cross sections for neutron dosimetry, which is now taking place in USA. It was agreed that it is very important to have a set of such cross sections freely available. The basis of such a set should be a new ENDF-B dosimetry file. It was mentioned that the IAEA should coordinate the activity directed to the establishment of such internationally accepted values for reactions important for neutron dosimetry.

During this meeting, the possibility of an IAEA sponsored meeting on dosimetry cross sections was discussed. The idea of such a meeting was supported by all members of the EWGRD (see C.2.1.).

EACRP/EANDC Meeting on keV Capture in the Structural Materials Fe, Ni and Cr, Karlsruhe, 8-9 May 1973

The Meeting was attended by 25 participants from the following countries and international organizations: Austria, France, Germany, Sweden, UK, NEA/OECD, EURATOM, IAEA.

On the agenda were three principal topics:

1) Experimental Data which included measurement techniques, methods of analysis, recent measurements and discrepancies in the experimental results;

2) Evaluated Data which included comparison of the ENDF/B-3, UKNDL(71) and KEDAK 70 libraries and results of recent evaluations; and

3) Importance and required accuracy of the data for various applications.

Among the experimental problems encountered in measurement and analysis of capture cross sections are 1) influence of scattered neutrons on the capture detector, 2) background determination,

3) multiple scattering and self-screening corrections, and
4) representation of the cross sections in terms of resonance parameters. Since the scattering cross sections are frequently 100 to 1000 times greater than the capture cross sections of the structural materials, considerable effort must be devoted to the first two problems in order to achieve the requested accuracy of ± 10%.

New absolute measurements of the capture cross sections of Cr, Fe, Ni and Au in the energy range 70 to 550 keV were reported by Le Rigoleur. The total-energy-weighting technique was used with a non-hydrogenous liquid scintillator as gamma detector. For Cr, Fe and Ni the new data seem to support the higher values which have been reported for these cross sections over the last few years. For Au the data agree well (1-2%) with previous results obtained by Poenitz.

Fröhner reviewed measurements made with liquid scintillators at Karlsruhe and at RPI. Using resonance parameters derived from these measurements, the capture cross sections can be calculated with an estimated accuracy of 15-25% to above 150 keV depending on the isotope. New data for seven nuclei measured recently at Karlsruhe with a liquid scintillator were described by Spencer.

The files in the evaluated data libraries - KEDAK (1970), UKNDL (1971) and ENDF/B-3 - differ significantly in the number of resonances included and in the resolution of the data. Some files contain average cross sections which appear to differ from the average of higher resolution data in other files.

In a study of Doppler coefficients derived from the data sets for Fe, Cr and Ni in the ENDF/B-2, ENDF/B-3 and UKNDL libraries, the differences among the coefficients derived from the three libraries were unacceptably large. The discrepancies were mainly due to the uncertainties in the parameters of the 1.15 keV resonance in Fe-56 and in the smooth capture cross section near the resonance.

From comparison of the currently available evaluations with the experimental data, the following observations were made:

1) For Ni the new Moxon evaluation is probably the best available.

2) For Cr a new evaluation is needed.

3) For Fe the UKNDL file is probably the best available.

An accuracy of better than 10% seems to be required for the capture cross sections of Fe, Cr and Ni in order to calculate fast reactor parameters such as the critical enrichment and the breeding gain with

sufficient accuracy for reactor design. Although it is possible to adjust the absorption cross section of Fe to obtain an effective cross section for stainless steel which will reproduce various parameters measured in fast critical assemblies for a given configuration, the adjusted cross sections are not satisfactory to extrapolate design factors to other configurations. For design purposes accurate cross sections for the component Fe, Cr and Ni seem to be required.

Discrepancies in values of central reactivity coefficients measured in critical and core assemblies sometimes are greater than can be explained by uncertainties in the microscopic data. In other cases the influence from uncertainties in the cross sections of the structural materials is overwhelmed by uncertainties in the capture cross section of U-238 and in α(Pu-239).

Symposium on Man-Machine Communications for Scientific Data Handling, Freiburg im Breisgau, Germany, 22-27 July 1973

The Symposium was organized by the CODATA (Committee on Data for Science and Technology) Task Group on Computer Use.

The purpose of the symposium is to bring together specialists concerned with the application of computer technology to the compilation, storage, and utilization of quantitative scientific data in the physical, biological, geological and engineering sciences.

A paper was presented by C. Rickeby of CCDN on the 4-center operation for neutron cross-section data banks, giving broad outlines of CINDA, EXFOR and WRENDA and the internal systems at CCDN.

There were papers and discussion on general data-base systems, computer controlled photo-typesetting and computer graphics all of which are of interest for operation of the Nuclear Data Section.

C.2. Future Meetings

C.2.1. Consultants' Meeting on Nuclear Data for Reactor Neutron Dosimetry, Vienna, 10-12 September 1973

Messrs. McElroy (USA), Zijp (Netherlands), Liskien (CBMN, Geel), Dierckx (Ispra) and Turi (Hungary) were invited to take part in the meeting. Also participating will be Dr. Najzer (Yugoslavia) and Prof. Farinelli (Italy) as well as Dr. Czock (from Seibersdorf Laboratory). The discussions will be restricted to neutron dosimetry by activation techniques. A draft agenda is given in Appendix H.

The meeting will have the following objectives:

1. Determine nuclear reactions important for fission reactor neutron metrology.

2. Determine nuclear quantities which must be known for these reactions and with what accuracies.

3. Determine the present state of knowledge of these nuclear quantities.

4. Determine future activities required on reactor neutron metrology.

This consultants' meeting may be the first step in the direction of establishing an internationally accepted set of neutron cross sections for important neutron dosimetry reactions.

C.2.2. IAEA Panel on Fission Product Nuclear Data, Bologna, 26-30 November 1973

At the invitation of the Italian Government and their CNEN the Panel on Fission Product Nuclear Data will be held in Bologna. Prof. Benzi will be coordinating the meeting for the CNEN.

A preparatory consultants' meeting (see section C.1.3.) recommended the objectives, organization and programme for the IAEA Panel on Fission Product Nuclear Data (FPND) as outlined in Appendix C. The panel is supposed to provide a comprehensive survey of the applications, the status and testing of FPND and to lay the basis for further measurement and evaluation work required. Following the recommendations of the consultants' meeting, the Scientific Secretaries of the panel (Lammer and Schmidt from NDS) informed INDC Members and INDC Liaison Officers in detail about the special

nature of the panel and asked them to name suitable experts for preparing review papers and/or for contributing to those.

Names were received after some delay, the reviewers selected and all named contributors contacted. In order to cope with this delay, reviewers, when confirmed, had to be approached to start their work before official invitation, in agreement with Mission officials.

C.2.3. IAEA Study Group Meeting on Non-Neutron Nuclear Data Compilation, Vienna, Spring 1974

The Symposium on Applications of Nuclear Data in Science and Technology, Paris, March 1973, ended up with the strong recommendation to the Agency to organize, on an international scale, the compilation, exchange and dissemination of nuclear structure and decay data for the benefit of the numerous users of such data. In response to this recommendation the Agency will convene a study group meeting of compilers and evaluators of nuclear data in Spring 1974. The meeting will have the objective to investigate and achieve an appropriate sharing of compilation work between the nuclear data centers concerned and to develop appropriate procedures for data exchange and dissemination to users. From the suggestions received a preliminary agenda will be worked out and submitted to INDC at its October meeting for discussion and approval; official invitations to the meeting will be sent out by the Agency after the INDC Meeting. It is planned to convene the study group meeting in close neighbourhood to the 10th Four Center Meeting so that also heads and other staff members from the neutron data centers may be able to attend.

C.2.4. Other Meetings

The Nuclear Data Conference recommended for the Fall of 1974 by the INDC at its July 1972 meeting was not included in the Agency's programme. This resulted from the failure of the Agency's Scientific Advisory Committee (SAC) to support the meeting. The future of this conference will again be discussed by the INDC at its next meeting.

A Study Group Meeting on Shielding Nuclear Data Requirements was originally planned for the Summer of 1974. It was to be jointly sponsored by NEA and the Agency's Reactor Physics and Nuclear Data Sections. However the members of the shielding community have expressed the desire to concentrate on sensitivity methods in 1974 and postpone a possible meeting on nuclear data requirements for about one year. NDS continues to have interest in the planned meeting and will consider sponsorship at the later date.

D. REQUEST LISTS AND TARGETS AND SAMPLES

D.1. Publication of WRENDA 73

After review by the INDC at its July 1972 meeting, the Agency published a neutron data request list for neutron reactors, RENDA 72 (INDC(SEC)-27/L). It was recognized that there were some errors in the list and that several countries' contributions had not been updated for a few years. However it was felt that there should be no delay in issuing RENDA.

In cooperation with CCDN, NDS undertook to update approximately 300 United States data requests and make other corrections to the RENDA file at Saclay. This work was completed in December 1972 and a new edition WRENDA-73, World Request List for Nuclear Data, was issued as INDC(SEC)-32/U in March 1973.

D.2. Plans for Future WRENDA Publication

All future publications of WRENDA will be based on a data file of requests maintained by the NDS in Vienna. This file will contain data requests for all applications, fission reactors, fusion reactors, safeguards, etc. Nuclear structure and charged particle reactions can be included in the system. Publications can be made by application field or totally merged as required.

The Four Neutron Data Centers have agreed on a format for exchange and storage of data requests. Each data center will be responsible for collecting and encoding data requests from its service area. NDS will maintain the master file in Vienna and be responsible for the annual publication of WRENDA. The present RENDA file from Saclay has been converted by NDS to the new format.

A country review and book format have been devised and are given in Appendix I. The country review format will be used when submitting the contents of the file for annual review by requestors. Each country will receive only its own requests for review. We are going to ask each country to carefully review the first country retrieval for errors which may have been introduced and for current applicability of the request so that a "clean" request list will result.

NDS hopes to be able to publish the first issue of WRENDA from our own files in 1974. A schedule is attached in Appendix J. However due to a five month delay in hiring staff to do this work, some schedule slippages are probable.

D.3. Nuclear Data Request List for Safeguards

The draft safeguards data request list reviewed by the INDC at its July 1972 Meeting was issued in March 1973 as INDC(NDS)-50/U. A few minor corrections to the draft list were made. A brief introduction was prepared by the Department of Safeguards and Inspection as requested by the INDC.

D.4. Nuclear Data Request List for Fusion

During the past year NDS has received official nuclear data request lists for controlled thermonuclear research (CTR) from five Member States. These lists are identified in Appendix K. NDS also has permission to use a semi-official list of charged-particle nuclear data requirements for CTR prepared by J. Rand McNally of Oak Ridge National Laboratory. Several other Member States have sent notification that they have no plans to prepare a data request list for CTR at this time. No lists in addition to those mentioned in Appendix K are therefore expected in the immediate future.

INDC has recommended that the individual lists be combined and sorted by nuclei and published in that form. The combined list will be published as an INDC report at about the time of the INDC meeting in October this year and will be submitted to IFRC (International Fusion Research Council) members for their comments at the same time.

Nearly all of the requests in the official lists are for data associated with neutron-induced reactions. A brief analysis of the lists is being prepared for the INDC Report.

All of the lists except one contain priority assignments which indicate the current relative importance of the requested data. Two of the lists use explicitly the Priority Criteria developed previously by the Agency and the IFRC. The United States Nuclear Data Committee has deleted all priority assignments from its requests because it believes that at present there are insufficient grounds for meaningful assignments.

D.5. 1972 Targets and Samples Programme Summary

At its July 1972 meeting the INDC recommended the acceptance of requests for neutron measurement samples from seven IAEA Member States, Brazil, Greece, Hungary, Pakistan, Romania, Turkey and Yugoslavia. The NDS was to arrange for the procurement of the samples subject to funding, material availability, and to need for the measurement as

expressed in WRENDA. The following is a summary of action taken by country.

Brazil - Requests from Solange de Barros for U-233 and W.

Attempts were made to contact Dr. Solange de Barros both directly and through the Brazilian Mission, but no replies to our communications were received. Therefore no action was taken.

Greece - Requests from Dritsa for Zr, Hf, Nb and Mo-97.

The requested samples with Mo substituted for Mo-97 were ordered from Geel. The samples were prepared and shipped to Dr. Dritsa in June 1973. Harwell has been contacted concerning possible loan of Mo-97 but no procurement action was taken.

Hungary - Requests from Csikai for Pa-231, U-233, U-235, Np-237, and Pu-239.

The five requested samples have been ordered from Geel. A request has been made to the USAEC for release of the required U-233, U-235 and Np-237 but no answer has yet been received. An informal offer of the Np-237 and the Pu-239 has been made by the USSR but no official offer has been received.

Pakistan - Requests from Jafri for Sr-86, Er-170, Yb-172, Yb-176, and Pu-240.

Material for two samples, Er-170 and Yb-176, has been ordered on a trial basis from a USSR Commercial Export Organization. The remaining three samples were not included in the programme for budgetary reasons.

Romania - Requests from Rapeanu for Na, NaK, U-236, Pu-241, Am-241, and Am-243.

All samples have been ordered from Geel. The Na and NaK samples are being prepared. The preparation of the remaining four samples awaits reply to the Geel request for material release by the USAEC.

Turkey - Request from Enginol for U and 10, 40, and 80% enriched U.

All samples have been ordered from Geel.

Yugoslavia - Request from Cvelbar for Sc, Y, Pr, Ho, Lu, and Rh.

The samples of Lu and Rh were not included due to costs. KFK offered 30 gr of Sc but this was insufficient. The cost of the required Sc was too large so this sample was also deleted. Sweden offered 250 grams of Y which is adequate for the sample but this Y needs to be recast. No decision has been made on whether to recast or purchase new material. In addition to the Y sample, the Agency has ordered the Pr and Ho also.

In the cases where the Agency has not been able to get the sample material on loan, it has made the necessary purchases. The materials will then be loaned to the respective Member States by the Agency. All fabrication costs are borne by the Agency. The funds committed were approximately $12,500 of $15,000 allocated.

This programme will be funded again in 1974 by the IAEA. Liaison officers of the INDC and others on our targets and samples programme distribution list have been informed and asked to submit new proposals.

E. DATA CENTER ACTIVITIES

E.1. NDS Area Service

E.1.1. Data Dissemination and Exchange

The statistics of data requests received and data sets distributed are given in the two tables overleaf, which are 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 center, (3) "NDS origin" requests which were sent out for the purpose of NDS data reviews or completion of files. 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).

Table II gives the statistics of data sets disseminated on request. This excludes the routine exchange of EXFOR data between the centers.

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

The large increase of data sets distributed in the 1972/73 period for experimental and evaluated data result from two NDS reviews which were recorded in the experimental and evaluated data logs:

Manero/Konshin = "Status of the energy-dependent $\bar{\nu}$-values for the heavy isotopes (Z 90) from thermal to 15 MeV and of $\bar{\nu}$-values for spontaneous fission"

Byer = "A simultaneous evaluation of the Pu-239 fission cross section and the Pu-239/U-235 fission cross section ratio in the fast neutron energy region".

TABLE I

SUMMARY OF NDS REQUEST STATISTICS AS OF AUGUST 1973

REQUESTS FOR—	EXPERIMENTAL DATA		EVALUATED DATA		DOCUMENTS		CINDA RETRIEVALS		TOTALS	
REQUEST ORIGIN	Cumulative totals	72-73 period	Cumulative totals	72-73 period	Cumulative totals	72-73 period	Cumulative totals	72-73 period	Cumulative totals	72-73 period
Incoming from Area 1	25	2	1	0	33	10	0	0	59	12
" " " 2	36	2	4	2	67	19	1	0	108	23
" " " 3	82	12	54	12	73	19	16	1	225	44
" " " 4	44	4	16	1	12	2	7	0	79	7
Incoming: Subtotal	187	20	75	15	185	50	24	1	471	86
Follow-up to Area 1	66	10	1	0	0	0	0	0	67	10
" " " " 2	64	12	15	1	2	0	17	1	98	14
" " " " 3	48	2	2	1	1	1	0	0	51	4
" " " " 4	31	1	1	0	3	0	0	0	35	1
Follow-up: Subtotal	209	25	19	2	6	1	17	1	251	29
NDS origin: sent to Area 1	26	2	1	0	2	0	0	0	29	2
" " " " " 2	31	1	8	1	4	0	8	4	51	6
" " " " " 3	123	7	0	0	1	0	0	0	124	7
" " " " " 4	12	1	2	1	0	0	0	0	14	2
NDS origin: Subtotal	192	11	11	2	7	0	8	4	218	17
TOTALS:	588	56	105	19	198	51	49	6	940	132

TABLE II

Experimental Data Dissemination

31 July 1973

	Number of data sets		Number of data lines	
	Cumulative total	1Aug.-31July 1972-1973 period	Cumulative total	1Aug.-31July 1972 - 1973 period
To Area 1	2.527	1.996	68.139	33.218
" " 2	3.475	3.221	67.783	52.144
" " 3	3.551	2.339	313.989	108.612
" " 4	623	476	160.999	59.079
Total:	10.176	8.032	610.910	253.053

Evaluated Data Dissemination

31 July 1973

	Number of data sets		Number of data lines	
	Cumulative total	1Aug.-31July 1972 - 1973 period	Cumulative total	1Aug.-31July 1972-1973 period
To Area 1	1.165	563	227.560	15.770
" " 2	897	275	245.957	24.483
" " 3	3.856	1.067	1.750.125	378.348
" " 4	1.489	622	655.607	127.799
Total:	7.407	2.527	2.879.249	546.400

E.1.2. Data Compilation

In general, the report given last year in INDC(NDS)-45, page 17, is still valid.

With the help of a consultant it was possible to convert the entire DASTAR file (as far as it contained data from the NDS service area) to EXFOR format. Thus, all the experimental data from the NDS service area are now in EXFOR format and have been transmitted to the other centers.

E.1.3. Plans for Computer Aided Services

The fast growing data files and the increased volume of data retrievals require now also for the NDS service area more computerized handling of data files and data sets.

An automated indexing of incoming EXFOR exchange tapes has been implemented in a preliminary form. This will be further improved, when the internal data index (CINDU) will be converted to a more compact form. Urgently needed is a so-called "computation format" which is able to present a number of EXFOR entries in a more compact and standardized form, which can be used for more automated data handling such as re-normalization and plotting. This is not only needed for center-internal data reviews but also as a service for external customers. Often comparison between evaluated data and recent experimental data is needed. It is therefore essential that not only EXFOR data are automatically converted to the "computation format" but also evaluated data from the different libraries.

The implementation of these plans will be rather slow due to the extreme shortage of manpower. This means that for the time being data retrievals for customers can only be done in rather bulky and inconvenient form, and that graphical plots for NDS data reviews cannot be done in a very economical way.

E.2. CINDA

E.2.1. CINDA Publication

The cumulative issue CINDA 73 was ready for distribution by end of July 1973. It was published in 2 volumes with 1700 pages. It has about 100,000 entries representing the complete CINDA file as of 10 May 1973.

A major revision of the CINDA system has been performed by the centers involved under the guidance of N. Tubbs, NDCC. The new system allows a better file manipulation and more detailed retrievals. Correspondingly, the NDS programmes for printing the book by phototypesetting on the Linotron had to be re-written. The users of the book will hardly notice a difference. Legibility was further increased by making more use of lower-case characters and introducing the Greek characters α and γ for the reaction types.

The new CINDA system allows also the inclusion of data index lines referring to the corresponding accession-numbers of the EXFOR (and evaluated data) libraries. There is also a new facility of removing much noise from the book by deleting from the book (though not from the file !) unimportant progress reports after the publication of the final articles. These new features will be introduced only gradually in the next issues.

The financing of the CINDA publication is still based on the bulk orders from NEA, USAEC, and USSR. US bulk order was decreased from 400 in 1971 to 275 in 1973. It is hoped that this can be compensated by increased sales on the market, however it remains essential to maintain the bulk orders.

E.2.2. CINDA Coverage

The continuing large increase of the number of CINDA entries shows that the CINDA indexers performed again a large job. However, it appears that the completeness control may have suffered somewhat from the fact that too much manpower was absorbed by the CINDA file conversion. After completion of the file conversion it is hoped that all CINDA centers can direct more efforts to an improved completeness control.

E.3. Intercenter Activity

E.3.1. Eighth Four Center Meeting

The Eighth Four Center Meeting was held in Vienna, 16-20 October 1972. All centers except CJD Obninsk were represented by the Head of Center and a technical advisor. Obninsk was represented by Mr. Kouvshinnikov of the USSR Mission to the IAEA. The agenda is given in Appendix L.

The discussions centered around three major topics which are co-operative efforts of the neutron data centers, namely EXFOR, CINDA and WRENDA. The problems of completeness of the contents of EXFOR is a continuing problem. It was planned to complete the clean-up of any current backlog by June 1973. The conversion of the old NNCSC SCISRS data files would also be completed by that time, thus giving all centers, data files of identical content. Each center also mentioned that there were some data which was impossible to obtain and suggested the INDC consider the matter and possible solutions.

A large number of EXFOR format details were settled primarily by a subcommittee of technical experts. The use of keywords, coded information and dictionaries was reviewed and many simplifications introduced. The formats for coding fission neutron spectra and fission product yields were adopted. There was also discussion of the compilation of capture gamma ray spectra.

The conversion of the CINDA file to a new format at CCDN continues. Schedules for the completion of the conversion and publication of CINDA-73 were agreed. During this changeover period, the contents of the file have suffered due to manpower shortages and loss of coverage control. It is planned to make CINDA an index to the EXFOR system using a blocking system for CINDA entries relating to the same data and adding an entry to the block giving the EXFOR accession number. Some discussion was also devoted to using CINDA as an index to evaluated data.

The cooperative arrangements for the future publication of WRENDA - World Request List for Nuclear Data were agreed. Each center would be responsible for collecting data requests from its service area and transmitting them to Vienna in an agreed format. The first publication under the new agreement is scheduled for 1974.

The next meeting was scheduled for Moscow, 4-8 June 1973, and is to include two days at CJD Obninsk.

E.3.2. Ninth Four Center Meeting

The Ninth Four Center Meeting was held at the Headquarters of the State Committee for the Utilization of Atomic Energy in Moscow, 4, 5 and 8 June 1973 and at the Palace of Culture, Obninsk, 6-7 June 1973. The agenda is given in Appendix M.

During the two days at Obninsk, the meeting's participants had the opportunity to meet and discuss mutual problems with all the staff of the Obninsk Data Center. This opportunity was found to be

extremely useful. Visits were also arranged to various experimental facilities at FEI Obninsk, namely the Van de Graaff, Tandem Van de Graaff, the Cascade Generator, the Microtron Accelerator and the BFS1 and BFS2 critical facilities.

The problem of completeness of the EXFOR files was again discussed extensively. The hoped-for completeness was not achieved. This is in part due to the CINDA effort at CCDN. The converted SCISRS I files are due to be transmitted in the early fall of 1973. The difficulties and long delays in getting data from authors was again discussed. A paper on the matter will be prepared for the INDC. It was further agreed that all intercenter communications including data requests and transmissions will be direct in the future.

The future of EXFOR was considered in the light of compiling multi-dimensional tables (e.g. double differential data) and non-neutron reactions such as inverse reactions (γ,n) used in neutron data evaluation. No final decisions have been made on either subject but a draft proposal on multidimensional tables was completed.

The CINDA conversion was completed and the book tape produced on schedule due to valiant efforts at both CCDN and NDS. Conversion errors and book format problems will be repaired before the 1974 edition of CINDA. No concrete proposals were yet forthcoming for the use of CINDA as a data index.

The relationship of the neutron data centers to the problem of increased demand for non-neutron nuclear data was discussed. It was decided to hold the next Four Center Meeting in Paris 6-10 May 1974 immediately after a planned IAEA Study Group Meeting on Non-Neutron Nuclear Data Compilation. This will enable the neutron data center heads to participate in this study group meeting.

E.3.3. Status of EXFOR Data Exchange

The transmission of neutron data by means of the EXFOR system has been continued successfully on an increased level. The quality of the EXFOR entries has much improved. EXFOR check-programmes are in operation in all four centers, however, some additional sophistication in these check programmes seems desirable. The centers are in continuous contact by "4C-Memos" and the annual "4-C Meetings" to ensure consistency of compilation in all centers. NDS has received very favourable comments on the contents and form of EXFOR.

The table below shows the total number of exchange tapes, entries, subentries and data lines transmitted by 12 July 1973 (statistics provided from NDCC). A data-line is usually a cross-section at one energy, a subentry is roughly one data-set for a given nuclide and quantity, and several such data-sets measured in the same experiment are usually included in one entry. It should be noted that for NNCSC and NDS (not yet for NDCC and CJD) the figures include "retransmissions" of data, where the data were revised, for example, after the author received the proof-copy of the first compilation of his data. Such revisions are as important as the primary compilations !

Originating Center	Transmission tapes	Entries	Subentries	Data-lines in 1000
NNCSC	16 (8)	308(156)	3372(1701)	181 (78)
NDCC	11 (4)	149 (32)	1427 (388)	407 (194)
NDS	8 (4)	298(136)	1947 (745)	20 (9)
CJD	9 (6)	81 (52)	722 (479)	10 (6)
total	44 (22)	836(376)	7468(3313)	618 (287)
total excl.retransmissions		652	6763	601

Data transmitted by 12 July 1973 (in brackets since 12 July 1972).

Most of the data transmitted are fairly recent. For older data NDS is still much relying on retrievals from the NEUDADA (NDCC) and SCISRS (NNCSC) files. Large files of the SCISRS file containing the heavy elements only were however automatically converted to an approximate EXFOR format (with insufficient text information since this did not exist in SCISRS) and transmitted to the other centers outside the normal EXFOR transmission. These data were not included in the above statistics.

The fast and complete transmission of newest data has improved but is still not yet satisfactory.

E.3.4. Modifications to the EXFOR System

As any living system, EXFOR is under continuous development. Current developments with respect to the contents are:

- format for coding data on the fission neutron spectrum and on fission product yields;
- discussions on whether and how gamma spectra data are to be entered;

- revisions made with respect to retrievable codes;

- improved rules on whether and how to enter half-life values that are pertinent to the compiled cross-sections.

Current development plans with respect to the format are:

- to present tables of Legendre-coefficients and double-differential cross-sections in a more compact way;

- to present tabulations of various types of resonance-parameters for a given nuclide in a more compact way.

E.4. Data Reviews

E.4.1. Evaluation of Thermal Neutron Data for Fissile Isotopes

Since the last evaluation (Atomic Energy Review 7(4),3,1969) several new precision data and some revisions of g-factors, half-lives and fission spectra have been published. Thus, a new evaluation of the 2200 m/s and Maxwellian averaged neutron data for U-233, U-235, Pu-239, Pu-241 and nubar (Cf-252) appeared warranted.

In the November 1972 Consultants' Meeting (see above under C.1.1.) the basic principles and problems of this evaluation were discussed. Several items required further work by correspondence during the past year.

Several systematic discrepancies between experimental data were encountered in the least-squares fit of experimental data, for example:

- discrepancies between directly measured 2200 m/s fission cross-sections and those derived from measurements in thermal neutron spectra;

- uncertainties in half-lives basic to fission cross-sections;

- discrepancies between 2200 m/s α data when derived from thermal neutron spectra measurements or when derived from 2200 m/s fission and absorption cross-sections;

- discrepancies between high η data and low $\bar{\nu}$ data;

- discrepancies between g-factor evaluations;
- uncertainties in the fission neutron spectra basic to $\bar{\nu}$ data corrections.

The main experimental data responsible for these discrepancies are:

- the fission cross-sections by Deruytter;
- the mass-spectrometric α data by Lounsbury;
- the η data by J.R. Smith;
- the recent $\bar{\nu}$ data and ratios by Axton, Boldeman and DeVolpi;
- the U-233 g-factor evaluation by Steen.

The half-life problem will be solved by the Geel measurements; but so far for U-233 only a preliminary value and for Pu-239 no result is yet available.

All these main experimental data have been examined very carefully. However, even extreme assumptions on possible experimental error sources of these data do not solve the discrepancies listed above.

At the time of writing this summary (1 August 1973) the only solution which solves all discrepancies (except for the half-life and fission spectra uncertainties) seems to be revision of the g-factors for of U-233, U-235, Pu-241 by about 1%, although these values have claimed accuracies of $\approx$0.1% (Steen), 0.2%, 0.7% (Westcott), respectively.

Various trial fits have been made showing that any other adjustment of input data can always solve only one discrepancy. Similarly, one would expect that a certain adjustment in g_η may solve the α-discrepancy and that another adjustment in g_η is needed to solve the η-$\bar{\nu}$ discrepancy. The fact, that it is the same adjustment in g_η that solves all discrepancies, may be taken as a strong indication that there is a serious error in the previously assumed g_η values.

E.4.2. Review of $\bar{\nu}$

Following the recommendations of the Fifth INDC Meeting, the document INDC(NDS)-34/G by Manero and Konshin was revised to include the $\bar{\nu}$-data made available during that meeting and its final version published in Atomic Energy Review, Vol.10, no.4, pp.637-756 in December 1972. Copies of this review were sent to all the INDC members as well as to the liaison officers and leading scientists working in this field.

The final review includes all available measurements till October 1972, either as published material or from private communications, on the energy dependent $\bar{\nu}$ values for prompt and delayed neutrons from thermal to 15 MeV for the heavy isotopes with $Z \geq 90$, as well as for the $\bar{\nu}$ values for spontaneous fission. A detailed analysis is included also on the status of the $\bar{\nu}_t$ values for thermal fission of the fissile isotopes and for the spontaneous fission of Cf-252, which are normally used as standards.

Attention has been paid also to the problem of a possible correlation of $\bar{\nu}$ with the spin of the resonances and to the existence of structure in $\bar{\nu}$ in the resonance region.

Finally the problem of the isotopic dependence of $\bar{\nu}$ for spontaneous fission has been considered and its correlation with the thermal values analyzed.

A weighted least-squares orthogonal polynomial fitting analysis was applied to the renormalized microscopic data and "best fits" deduced for the energy dependence of the $\bar{\nu}_p$ values. Tables of recommended values of $\bar{\nu}_p$ and $\bar{\nu}_t$ as a function of the incident neutron energy are also included.

As a result of the study made, conclusions are extracted about the actual accuracy of the values of $\bar{\nu}_p$ (E) and $\bar{\nu}_t$ (E) for the fissile and fertile isotopes, and recommendations are made with regard to future measurements.

A short contribution with the main conclusions and recommendations coming out of this review was presented by Dr. J.J. Schmidt to the EANDC Topical Conference on $\bar{\nu}$, held on 29 November 1972, at Saclay (France) on the occasion of the 16th Meeting of the Committee, and published in the document EANDC(E)-154'U' (March 1973), together with all other contributions to this Topical Conference.

Since the publication of the NDS $\bar{\nu}$-review some new works have been published on this subject, in addition to the contributions to the EANDC Topical Meeting on $\bar{\nu}$ mentioned above.

In this context we should mention the paper of Savin et al. on $\bar{\nu}$(E) for U-235 in the energy range from 0.7 to 6 MeV, the paper of Volodin et al. on $\bar{\nu}$(E) for Pu-239 below 1.6 MeV, the work of Sergachev et al., who obtained $\bar{\nu}$ for U-233 below 6 MeV from the energy balance equation, and the contribution of the French group to the problem of the fluctuation of $\bar{\nu}$ in the resolved neutron resonance region of Pu-239 and to the problem of the background corrections in large liquid scintillators.

Finally there should be mentioned a series of papers, published mainly by Russian authors, on spontaneous fission $\bar{\nu}$-values for the Cm, Bk, Cf and Fm isotopes.

E.4.3. Reactor Neutron Dosimetry Cross Sections

A survey of the status of knowledge of the cross sections for eighteen reactions considered as highest priority for neutron dosimetry was completed and distributed as INDC(NDS)-47/L, Part I. NDS is now preparing Part II of INDC(NDS)-47/L: Status of Neutron Cross Section Data for Reactor Radiation Measurements. This report includes a survey of the status of an additional 11 threshold reactions, important for neutron reactor dosimetry. The status of the following reactions will be considered:

$Ti^{46}(n,p)$	$Mn^{55}(n,2n)$	$Nb^{93}(n,2n)$
$Ti^{47}(n,p)$	$Al^{27}(n,\alpha)$	$P^{31}(n,p)$
$Ti^{48}(n,p)$	$Fe^{56}(n,p)$	$S^{32}(n,p)$
$Co^{59}(n,\alpha)$	$Nb^{93}(n,\gamma)$	

This report will compare in graphic form all experimental data and evaluated data. Short comments about requested accuracy from WRENDA and the present status are also included.

E.4.4. Fission Spectrum Averaged Neutron Cross Sections

Due to the fast progress of activation analysis in the last decade and its wide applications in medicine, environmental control, industry, agriculture etc... the need has arisen among workers in the field for a small handbook containing the various types of cross-section values whose knowledge is required for activation analysis. Such a book should also be of special interest for developing countries where well equipped libraries are generally not available.

A compilation of cross-section values for activation analysis has therefore been initiated by Dag Brune (from Studsvik, Sweden) and NDS has agreed to prepare the chapter concerning the cross-sections for fission spectrum neutron induced reactions.

This chapter includes a review of all integral measurements available in the literature up to April 1973 for (n,p), (n,α), (n,2n) and (n,n') reactions. Whenever possible cross-sections have been renormalized to

a standard value of 1250±70 mb for the U-235 fission cross-section averaged in the thermal fission neutron spectrum of U-235. Recommended values have been determined.

Parallel to this review, an estimation of averaged (n,p), (n,α), (n,2n) cross-sections has been carried out for all stable and a few long-lived isotopes.

This estimation assumes Roy and Hawton's approach (Report CRC-1003 (1960)) whereby the experimental recommended values are used as the basis for the prediction of similar cross-sections in the frame of the effective energy concept. Except for the (n,p) cross-sections on odd-A targets, agreement between the two estimations can be considered as acceptable.

APPENDIX A

Current List of Liaison Officers to the INDC

June 1973

Austria	Weinzierl, P.
Bangla Desh	Ahmed, N.
Belgium	Nève de Mevergnies, M.
Bolivia	Paz Lora, F.
Brazil	Herdade, S.B.
Bulgaria	Nadjakov, E.
Chile	Martens Cook, P.
Colombia	Director, Instituto de Asuntos Nucleares
Czechoslovakia	Rocek, J.
Denmark	Moeller, H.B.
Ecuador	Munoz, R.
Egypt	El-Nady, M.
Finland	Silvennoinen, P.
Greece	Dritsa, S.
Hungary	Kluge, G.
Iran	Rouhaninejad, H.
Iraq	Muhi Eldeen, Z.A.R.
Israel	Ben David, G.
Jamaica	Chen, A.A.
Kenya	Gacii, P.
Korea	Cho, M.
Mexico	Graef Fernandez, C.
Netherlands	Bustraan, M.
Norway	Andersen, E.
Pakistan	Ghani, A.
Philippines	Navarro, Q.O.
Poland	Sujkowski, Z.
Portugal	Carvalho, G.F.
Romania	Rapeanu, S.N.
South Africa	Reitmann, D.
Spain	Velarde Pinacho, G.
Switzerland	Huerlimann, Th.
Thailand	Nimwanadon, Th.
Turkey	Enginol, T.
Uruguay	Buenafama, H.
Viet Nam	Vo Xuan Bang
Zaire	Pollak, H.

Report on the Second IAEA Panel on Neutron Standard Reference Data

Vienna, 20-24 November 1972

by J.R. Lemley

I. Methods and Techniques of Neutron Flux Measurements

Neutron flux measurements fall into two categories: absolute methods and relative methods. Absolute methods are those which do not depend on knowledge of any cross section.

Absolute methods of flux determination may be subdivided into three groups: associated particle, associated activity, and total absorption methods.

In the associated particle method a neutron is produced in conjunction with an associated charged particle of unique type and energy. The neutron flux is determined from a measurement of the charged particle flux. Frequently used reactions are D $(d,n)^3H$, $T(p,n)^3He$ and $T(d,n)^4He$.

In the associated activity method the residual radioactivity left in the neutron-producing target by the source reaction is used to determine the total neutron production in the target. Reactions which have been used successfully with this method are $^7Li(p,n)^7Be$, $^{51}V(p,n)^{51}Cr$, $^{65}Cu(p,n)^{65}Zn$ and $^{57}Fe(p,n)^{57}Co$.

The total absorption method depends upon absorption of essentially all neutrons incident upon a detector and upon detection of those neutrons with an efficiency which is essentially independent of neutron energy. Examples of total absorption detectors are the manganese and vanadium baths and the so-called "black" or "gray" detectors described during the Meeting.

The relative methods of flux determination rely on some well known cross section. Commonly used are the light-element reactions H(n,p), $^6Li(n,\alpha)T$, $^{10}B(n,\alpha)^7Li$ and $^3He(n,p)T$.

New applications of each of the techniques in the field of neutron standards were reported at the Panel. The limitations and accuracies obtainable with each method were discussed and will be reported in the Proceedings.

II. Light-Element Standards

^{6}Li(n,α)T. Four recent measurements of the ^{6}Li(n,α) cross section were reported at the Panel. Between 150 keV and 400 keV across the 250-keV resonance, the results obtained at Harwell, Cadarache and Argonne with ^{6}Li glasses agree to an accuracy of 4% if systematic energy shifts of up to about 5 keV are accepted and if Argonne data, which have only a preliminary normalization, are renormalized down by about 5%. The ^{6}Li sandwich detector results from Harwell are known to be inaccurate in this energy range.

The data described in the previous paragraph are approximately 12% below the peak cross section value derived by Uttley and Diment from measurements of the total cross section. The agreement of the experimental data call into question the validity of deriving the (n,α) cross section from the total cross section through an analysis which treats the 250-keV resonance as the contribution from a single level superimposed on an S-wave background.

Over the resonance the correct energy scale must be established by further experiments, and the total cross section data should be confirmed. The accuracy to which the ^{6}Li content of the glasses is known should be improved. More accurate angular distribution measurements for the (n,α)

reaction are needed above 20 keV for interpretation of the measurements with ^{6}Li sandwich detectors.

Below 50 keV it was considered that the reservations on the reliability of the prediction of the (n,α) cross section from total cross section measurements using simple theory were unlikely to change the values recommended at the 1970 Argonne Symposium. At 100 keV the uncertainty in the P-wave contribution to the (n,α) cross section is not likely to be greater than 2%. Unfortunately the spread of the experimental data is about 8% near this energy.

Above 300 keV it is difficult to estimate the accuracy with which the cross section is known. No reasonable renormalization helps the situation. More accurate measurements are urgently needed.

<u>$^{10}B(n,\alpha)$ and $^{10}B(n,\alpha\gamma)$.</u> The $^{10}B(n,\alpha)$ reaction (ground plus excited state in ^{7}Li) seems potentially useful as a standard to about 1 MeV but is not well established above 80-100 keV. Data which have become available since the 1970 Argonne Symposium do not indicate changes in the recommended values below 40 keV; however new measurements of Friesenhahn et al. are approximately 5% higher at 10 keV and up to 50% higher around 420 keV.

At higher energies (10 keV - 1 MeV) the $(n,\alpha_1\gamma)$ reaction seems potentially more useful provided the 478-keV gamma ray can be resolved. New data of FRIESENHAHN et al. and of COATES et al. agree with each other but show systematic disagreement with current evaluated data files and with earlier measurements. The disagreement is 7% at 100 keV and increases with increasing energy.

$^{3}He(n,p)T$. The cross section is known to 2% below 100 keV, to about 5% below 10 keV and less accurately above 10 keV. Further measurements above 100 eV are recommended to achieve the accuracy requested for this reaction.

Unavailability of sufficiently pure ^{3}He may account for the less frequent use of this reaction as a standard. It was predicted that use reaction would continue to increase.

$^{1}H(n,p)$. The cross section is reasonably well known from 1-14 MeV, but since forward scattered protons only are detected in the upper energy range, the angular distribution of the reaction is needed. Further measurements of the angular distribution at several energies were recommended with the objective of allowing determination of the cross section for forward scattered protons to an accuracy of 0.5 to 1% at 14 MeV.

III. Fission and Capture Standards

Fast fission cross section of ^{235}U. Between absolute values at thermal energies and absolute values above 20 keV, differences in the shape of the cross section among various experiments leave uncertainties of the order of $\pm$ 5%. From 35 keV to 1 MeV where measurements partially overlap, data of Poenitz, Gayther, Szabo and data from ORELA are in reasonable agreement within the errors of approximately 3-4% claimed for the individual experiments. Between 500 keV and 1 MeV the data of Käppeler differ in shape from other measurements and are about 6% higher than the data of Poenitz and of Gayther between 500 and 700 keV. Data of both Käppeler and Poenitz show a "step" in the cross section at approximately 1 MeV where the shape of the cross section remains uncertain. From 1-2 MeV data of Szabo and Poenitz agree while the data of Käppeler and the new data from Los Alamos are somewhat higher. From 2-3.5 MeV the Los Alamos data and those of Poenitz agree.

Below 500 keV the new data agree sufficiently well that an evaluation would be useful. From 0.5 to 2 MeV the shape remains somewhat uncertain, but even now an evaluation might achieve about ± 5% accuracy.

Capture Standards. New absolute measurements by LE RIGOLEUR et al. agree well with the evaluation presented by Poenitz at the 1970 Argonne Symposium. Preliminary activation data by FORT et. al. showed discrepancies of about 15% which should be resolved. Discrepancies also remain in measurements of the Au capture cross section relative to ^{235}U (n,f) and the ^{235}U capture cross section.

Below 500 keV it was estimated that the uncertainty in the Au capture cross section is less than ± 5%. It was recommended that Au be retained as the capture standard.

$\bar{\nu}$ of ^{252}Cf. The $\bar{\nu}$-experts at the Panel recommended a value of 3.733 ± 0.008 based on direct measurements only. In a weighted least-squares fit inclusion of $\bar{\nu}$ values derived from measurements of the parameter η produces a value 0.5% higher. Values derived from η alone are about 1.5% higher.

The panel recommended that corrections and author-estimated errors of the η -measurements should be reassessed or that η should be remeasured. The panel were not convinced that remeasurement of η would yield values of $\bar{\nu}$ with errors as small as the direct measurements; however no η-experts were present.

The 2200 m/sec fission and capture cross sections of the fissile nuclides. A report of the Consultants Meeting in Vienna the previous

week was presented by Panel members who attended both meetings and was discussed briefly.

Fission Neutron Spectra. The panel recommended that a standard fission neutron spectrum be included among the Neutron Standard Reference Data. They proposed that the spectrum of neutrons from spontaneous fission of ^{252}Cf should be a primary standard and that the fission neutron spectrum of ^{235}U induced by neutrons below 150 keV should be regarded as an associated standard.

International Atomic Energy Agency

Panel on Fission Product Nuclear Data

Bologna, Italy, 26 - 30 November 1973

INFORMATION SHEET

1. Introduction

Fission product nuclear data play an important role within the nuclear fuel cycle as well as in some areas of life sciences, agriculture and industry. A Panel on Fission Product Nuclear Data convened by the International Atomic Energy Agency (IAEA) will be the first meeting on this topic, and its principal purpose will be to review the status of fission product nuclear data in these areas. The panel will be asked to report to the Director General of the Agency on the current status of the topics discussed and to recommend guidelines for future work in this field. The panel discussions will be limited to about 40-50 participants. Additional scientists will be admitted as observers.

2. Objectives

A preparatory consultants meeting (Vienna, 11-13 December 1972), supported by numerous replies on a circular letter, defined the following objectives of the Panel:

- to bring together users and producers of fission-product nuclear data
- to define, for the different user groups, data requirements and priorities
- to review the status of knowledge of microscopic fission-product nuclear data, to compare existing compilations and evaluations, and to review the results of testing these data by integral measurements
- to identify and discuss further measurements, compilations and evaluations required to satisfy the needs of FPND users; it should aim at specific recommendations and measures for coordination of future work.

3. Organization

In order to meet the objectives, the following organization of the panel is adopted as recommended by the preparatory meeting:

The body of the panel should be formed by 16 comprehensive review papers covering the full scope of use, status and testing of fission product nuclear data and forming the basis for the discussions of the panel. The titles of these papers are specified in Appendix D.

The task of the author of each review-paper (or briefly reviewer) is to write a comprehensive and coherent review of his subject, incorporating not only his own views but also contributions he will receive from relevant specialists in other institutions and countries.

In order to achieve maximum efficiency and results the panel, subsequent to the presentation of review papers, should devote its time to discussions of open questions rather than spend much time on additionally submitted original contributions which may in part be repetitive. However, participants can present their views during the discussions. The reviews and these discussions require the participation of carefully selected users, compilers, evaluators, and measurers of fission product nuclear data.

Fission product nuclear data to be considered at the panel are:

- yields
- neutron cross sections
- decay data
- delayed neutron data.

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 Panel, M. Lammer and J.J. Schmidt.

Proposed programme for IAEA Panel on

Fission Product Nuclear Data

Bologna, Italy, 26 - 30 November 1973

Monday, 26 November

I. Paper No. 1: Introductory paper

a) summary of the conclusions and recommendations of the preparatory consultants meeting for the Fission Product Nuclear Data Panel (Lammer-IAEA)

b) List of compilations and evaluations of fission product nuclear data (Valente - CCDN)

II. Reviews of user requirements for fission product nuclear data in application fields (brief discussion after each paper)

Paper No. 2: Fission product nuclear data and environmental aspects of the nuclear fuel cycle (Ganguli - India)

Paper No. 3: Importance of fission product nuclear data in the physics design of power reactor cores (Tyror - U.K.)

Paper No. 4: Importance of fission product nuclear data for engineering design and operation of reactors (Devillers-France)

Paper No. 5: Importance of fission product nuclear data for burnup determination (Maeck - USA)

Paper No. 6: Importance of fission product nuclear data for safeguards techniques (Weitkamp - FRG)

Paper No. 7: Importance of fission product nuclear data for fuel handling (Mërz - FRG)

- continued

Tuesday, 27 November

II. continued

Paper No. 8: Importance of fission product nuclear data in life sciences (Comar - USA)

Paper No. 9: Importance of fission product nuclear data in agriculture and industrial technologies (Kühn - FRG)

Nomination of subgroups for items III - VI of subgroup secretaries to take notes of the discussions

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III. Fission product absorption and neutron cross section data

Paper No.10: Status of neutron reaction cross-sections of fission product nuclei (Ribon - France)

Paper No.14: Integral determination of neutron absorption by fission products (Bustraan - Netherlands)

Summary by scientific secretary and discussion: confrontation of user needs and available data.

Suggestions for conclusions and recommendations to be submitted to relevant subgroup.

Wednesday, 28 November

IV. Fission product yields and inventory

Paper No. 11a: Status of fission product yield data for thermal neutrons (Walker - Canada)

Paper No. 11b: Status of fission product yield data for energy dependent and fast neutrons (Cuninghame - U.K.)

Paper No. 16: Prediction of unmeasured fission product yields with the aid of nuclear theory or systematics (Cook-Australia)

Paper No. 15: Integral determination of fission product inventory and decay power. (Lott - France)

Summary by scientific secretary and discussion: confrontation of user needs and available data.

Suggestions for conclusions and recommendations to be submitted to relevant subgroup.

Thursday, 29 November

V. Fission product decay data

Paper No. 12: Status of decay data of fission products (Rudstam-Sweden)

Summary by scientific secretary and discussion: confrontation of user needs and available data.

Suggestions for conclusions and recommendations to be submitted to relevant subgroup.

VI. Delayed neutron data

Paper No. 13: Status of delayed neutron data (Amiel - Israel)

Summary by scientific secretary and discussion: confrontation of user needs and available data.

Suggestions for conclusions and recommendations to be submitted to relevant subgroup.

Friday, 30 November

VII. Morning: Meetings of subgroups to draft detailed conclusions and recommendations.

VIII. Afternoon: Final plenary session: presentation and discussion of conclusions and recommendations drafted by sub-groups.

APPENDIX E

Programme

Symposium on Applications of Nuclear Data in Science and Technology

Paris, 12-16 March 1973

Chairmen:

Opening session:		A. Finkelstein, IAEA
Session I.	Future Technology Requirements	G.A. Kolstad, USA
Session II.	Reactor Technology	W.B. Lewis, Canada
Session III.	Safeguards	O. Eder, Austria
Session IV.	Life Sciences	A.H.W. Aten, CCE
Session V.	Radioisotopes in Chemistry	K.H. Lieser, FRG
Session VI.	Fission Product Nuclear Data	G. Yankov, USSR
Session VII.	Accelerator and Space Shielding	W.W. Havens,Jr.,USA
Session VIII.	Fusion Research	Y.F. Chernilin, IAEA
Session IX.	Evaluated Neutron Data Files	R. Joly, France
Session X.	Activation Analysis: General	B. Grinberg, France
Session XI.	Activation Analysis: Neutrons	Ph. Albert, France
Session XII.	Compilation and Evaluation; Data Centers	G.A.Bartholomew,Canada
Session XIII.	Large Volume Compilations	A.H. Wapstra,Netherlands
Session XIV.	Various Applications	A.T.G. Ferguson, UK
Session XV.	Activation Analysis: Charged Particles and Photons	H. Münzel, FRG
Session XVI.	Application-Oriented Compilation and Evaluations	D.J. Horen, USA
Summary Session:		A. Finkelstein, IAEA

Summary of the Second All Union Neutron Physics Conference

Kiev, 28 May - 1 June 1973

1. Requirements

As in other developed countries nuclear data requirements in the USSR are still mainly connected with the development of fast power breeder reactors and increasingly with thermonuclear fusion. Great importance is being attributed to the development of sophisticated mathematical formalisms to derive required nuclear data accuracies from given tolerances in reactor design parameters. Information from integral experiments is taken into account to weaken accuracy requirements for microscopic data. Soviet nuclear data requirements form part of the international WRENDA request lists published by the Nuclear Data Section. Discussions were held regarding the uniformity of contributions to WRENDA from various sources; it was felt that this matter should be considered by national and international reactor physics committees such as EACRP and IWGFR.

2. Measurements

A large part of the nuclear data measurements programme is determined by practical applications, again mainly by fast reactor development. Priority is given at various places to fission and alpha measurements on the main heavy isotopes. Increasing emphasis is being placed on the investigation of nuclear properties of transuranium isotopes built up in fast reactors. Spontaneous fission of Cf-252 is the subject of precision measurements at a few places partly in line with an old tradition of spontaneous fission research in the USSR, partly following recommendations of specialists meetings the Nuclear Data Section held in the last few years. The systematic research on neutron resonance structure mainly with the fast pulsed reactor (IBR-1) at Dubna deserves particular mention.

3. Evaluation and theory

A current strong increase in neutron data evaluation is apparent. The aim is, similarly to Western countries, to develop a computer library of evaluated neutron data for use mainly in reactor calculations. Current efforts are being devoted to full cross section sets for O, Na, U-235, U-238, Pu-239 and to capture and fission cross sections of transuranium isotopes. For the main fission product isotopes resonance cross sections are being evaluated. Data on angular distributions from neutron elastic scattering have been prepared for more than 40 isotopes. This programme is to be amplified in the next two years to cover also inelastic scattering and threshold

reaction cross sections. The data will gradually be made available in the Soviet evaluated data format to the Agency for free distribution and comparison with other evaluated data files. An updated version of the well-known ABBN set of 26 group cross sections will be sent to theAgency in the near future.

The efforts in nuclear theory on topics such as resonance statistics, intermediate structure and nuclear models are extensive and rather sophisticated. However a need was felt that more emphasis should be placed on the practical application of theory to answer nuclear data needs.

Recommendations of the 32nd EWGRD Meeting

Concerning Dosimetry Cross Sections

1) The problem of cross sections for the detectors used in reactor dosimetry (irradiation experiments, shield assesment, reactor performance studies) is a very critical one that may appreciably influence the development of competitive nuclear power. This fact has recently been recognized by many organizations, and a certain amount of systematic work has been started, notably in the U.S. and by the IAEA.

2) The WGRD considers of primary importance that the improvement in these cross sections should be paralleled by an effort to arrive to normalized values to be recommended for use in the different laboratories, so that reactor experiments, and in particular irradiation experiments, can be directly compared and exchanged, increasing the amount of available information and reducing the duplication of efforts. The acceptance of normalized values on as wide a basis as possible, and the internal consistency of such values, are considered by the WGRD to be potentially more important than the improvement of single cross sections.

3) In this process of normalization, the role of the IAEA (and especially of its Nuclear Data Section) is essential; the WGRS acknowledged the important effort already done by the Agency in this field.

4) One important aspect of the need for standard values is the necessity for the free unrestricted circulation of detector cross sections (evaluated differential files, adjusted fine group or multigroup sets, integral values), much in the same way as has been done for "standard cross sections". A recommendation in this sense is being sent to the INDC and the EANDC, suggesting that all detectors cross sections should be made freely available to the IAEA.

5) In the normalization effort, one should first assume a reference data set and use it in the interpretation of integral results. A part of this reference data set could be the Detector Tape of the ENDF-B now being produced in the U.S.

6) New evaluations of detector cross sections not available in the ENDF-B tape should be encouraged; the results should be compiled also (or exclusively) in ENDF/B or ENDF/B compatible format for ease of exchange.

7) Integral experiments in well know (reference) neutron spectra and in other reactor spectra should be encouraged for the intercomparison of detector cross sections, for the check of internal consistency, for the identification of discrepancies in shape orin normalization factor of the reference data. The reference data mentioned in 5) and 6) should be used, solely or in addition to different evaluations, in the interpretation of the integral experiments.

8) Users of these cross sections should contact at all stages the original evaluators of the cross sections, so that a prompt feedback is provided and improvements are sure to be included in successive evaluations. In the Euratom countries, at least for the moment, the Detector Subgroup of the WGRD (headed by Dr. Zijp) could collect and coordinate the results of these integral evaluations.

9) Integral experiments generally require unfolding codes for their interpretation. The introduction of the reference data into the unfolding codes is no trivial endeavour, and prompt solution of this problem should be encouraged.

10) In a second step, a new intercomparison of integral detectors in various reactor spectra (as already accomplished some years ago by the WGRD) could be organized in cooperation with the IAEA.

11) By a coordination of efforts among Euratom countries, the IAEA and the other main contributors (especially the U.S.) one should reach a revised evaluation for detector cross sections which would constitute the first standard to be recommended for general use. It seems reasonable to assume that such a stage could be reached in approximately two years from now. The recommended values could then be updated periodically in a systematic way by coordinated efforts among the various evaluation centres.

12) In addition to the Laboratories in the European communities, the Euratom Joint Research Centre should take a major role in the actions described above and in particular in those mentioned in points 6) to 10).

PROPOSED AGENDA

Consultants' Meeting on
Nuclear Data for
Reactor Neutron Dosimetry

Vienna, 10-12 September 1973

MONDAY, 10 September

I.	Opening of Meeting	Schmidt
	A. Agency welcome	Schmidt
	B. Need for internationally recommended cross sections for neutron dosimetry reactions	Farinelli
II.	Integral Fluence Determination By Activation Methods	Zijp
	A. Critique of method(s) including accuracy, selection of reactions, limitations,etc.	Zijp
	B. Standard methods for detecting radiations for activation techniques	Czock
III.	Differential Flux Determination By Activation Methods	McElroy
	A. Critique of method(s) including accuracy, selection of reactions, limitations, etc.	McElroy
	B. Critical comparison of spectrum unfolding codes	Dierckx
	C. Special problems at low energies $\leq$ 1 MeV	Najzer
IV.	Role of Standard Spectra in Differential Flux Determination	Dierckx

TUESDAY, 11 September

V. Nuclear Data Assessment	Liskien
A. Important nuclear reactions and nuclear quantities required	Zijp
B. Status of knowledge of important nuclear data	Liskien Vlasov

WEDNESDAY, 12 September

VI. Selection of Standards and Reactions for which Internationally Accepted Values Are Desired	Farinelli
A. Thermal and intermediate energies	Zijp
B. Fast energies	McElroy
VII. Recommendations to IAEA for Future Activities	Vlasov
A. Dosimetry standard reaction cross sections	Farinelli
B. Standard cross section values for important reactions	Najzer

Sample WRENDA Output Formats

Sample book page

60 NEODYMIUM 143 NEUTRON CAPTURE

671025 MODIFIED (PARTIALLY FULFILLED)

1.00 MV 1.00 KEV 10% 1
USA BET R.T.BAYARD
USA GEC T.SNYDER
ENERGIES ABOVE 1 EV OF INTEREST.
ACCURACY 10 PERCENT IN RESONANCE INTEGRAL.
NEEDED FOR FISSION PRODUCT POISON CALCULATIONS.

692219 NEW

850. EV 10.0 MEV 10% 2
SWD AE R.HAKANSSON
ENERGY RESOLUTION 10 PERCENT OR BETTER.
NEEDED FOR FAST REACTOR CALCULATIONS.

692220

5.00 KEV 2.00 MEV 10% 2
GER KFK J.J.SCHMIDT
FISSION PRODUCT IMPORTANT IN FAST REACTOR BURN UP CALCULATIONS.

STATUS

CRC WALKER - AECL-3037(9/68) RECOMMENDS 325B FOR THERMAL, RESONANCE INTEGRAL = 60B.
GEL ROHR+ - 71 KNOX 743(3/71) RESOLVED RESONANCE REGION.

60 NEODUMIUM 143 NEUTRON RESONANCE PARAMETERS

etc. etc. etc.

Sample country retrieval

REQUEST NUMBER: 671025 YEAR: 1967

COUNTRY: USA

REQUESTOR(S): R.T.BAYARD BET
T.SNYDER GEC

TARGET: 60 NEODYMIUM 143

QUANTITY: NEUTRON CAPTURE

INCIDENT ENERGY: 1.00 MV TO 100. KEV

APPLICATION: FISSION REACTORS, CORE PHYSICS

ACCURACY: 10 %

PRIORITY: 1

QUANTITY COMMENT(S):

ENERGIES ABOVE 1 EV OF INTEREST.

ACCURACY AND RESOLUTION COMMENT(S):

ACCURACY 10 PERCENT IN RESONANCE INTEGRAL.

OTHER COMMENT(S):

NEEDED FOR FISSION PRODUCT POISON CALCULATIONS.

STATUS:

CRC WALKER - AECL-3037(9/68) RECOMMENDS 325B FOR THERMAL,
RESONANCE INTEGRAL = 60B.

GEL ROHR+ - 71 KNOX 743(3/71) RESOLVED RESONANCE REGION.

WRENDA Production Schedule

1. 1. Feb. Country revisions and additions received by NDS.

2. Feb/March NDS includes these revisions into Request and Status files.

3. 15. March File closed.

4. 15.April Material submitted to publication division.

5. May/June NDS prepares country retrievals.

6. 15 June Country retrievals sent to other centres for distribution.

7. 30 June Printing of WRENDA completed; distributed by IAEA.

The above schedule will start for the publication of WRENDA 75. WRENDA 73 was issued in March 1973 and we envisage the schedule below for the publication of WRENDA 74.

28. Feb 1973	RENDA master file received by NDS from CCDN.
March - May	File conversion.
June	4-Centre Meeting. Final approval of system and schedules.
July	Clean up Status File.
Aug.	Country retrievals made by NDS.
31 Aug.	Country retrievals shipped to other centres.
1 Feb 1974	Country revisions and additions received by NDS.
	Then continue as in normal schedule above.

Official Nuclear Data Request Lists for CTR

Country	Lab.[a]	Requestor	Priority Assignments
USA	AEC	W. GOUGH	Deleted previous assignments
FRG	KFK	S. CIERJACKS R. MEYER	Yes
USSR	KUR	I.N. GOLOVIN	Yes
France	FAR	-	Yes
UK	HAR	S. BLOW	Yes

Special list of data requirements for charged-particle reactions:

USA	ORNL	J.R. McNALLY	Yes

a) AEC = Atomic Energy Commission, Washington D.C.;
KUR = Kurchatov Institute of Atomic Energy, Moscow;
KFK = Kernforschungszentrum, Karlsruhe;
FAR = CEA Fontenay-aux-Roses, Seine.

Eighth Four Center Meeting

Vienna, 16-20 October 1972

Agenda

I. Organization and Announcements

a) Introductory remarks and election of chairman and secretaries.

b) Consideration and adoption of agenda - meeting organization.

c) Review of actions from last 4C meeting.

II. Working Policies and Coordination of Centers

a) Short progress reports from Centers.

b) Recommendations to Centers from Nuclear Data Committees, Steering Committees, scientific meetings or other bodies.

c) Users' data requests and response by the Centers. Data request profile (experimental and evaluated by iso-quant, requestor type (university, industry, etc.) and field of application (reactor, shielding, fusion, etc.). Standing requests.

c') User response to information contained in EXFOR.

d) Completeness of compilation of data from recent experiments.

e) Status of conversion from old experimental data files fo EXFOR.

f) Necessary improvements in the functioning of the Four-Center Network.

g) Problems of obtaining basic measured data from authors (resonance parameters vs. line shape).

III. EXFOR in Detail

a) Review of actions from last meeting and from 4C memos.

b) Experience with exchange-tapes.

c) Checking and correction of entries.

d) Existing programs and plans for automated data processing making use of EXFOR coded information.

e) Critical assessment of keyworded, coded and free text information.

f) Dictionaries: proposals for alterations and additions, pending 4C-Memos and any other new proposals for additions.

g) EXFOR-Manual: proposals for changes and additions, pending 4C-Memos, correspondence and any other new proposals.

h) LEXFOR-Manual: proposals for changes and additions, pending 4C-Memos, correspondence and any other new proposals.

h') Priorities in EXFOR compilation

i) Handling of important data outside the present scope of EXFOR.

1) Fission product yields
2) Capture gamma spectra
3) fission neutron yields

j) Other details pertaining to EXFOR.

IV. CINDA in Detail

a) Completeness and literature coverage of CINDA (particularly report series).

b) Report on the new system at NDCC and DTIE.

c) CINDA as an EXFOR index.

d) Status of publication schedule and distribution.

V. RENDA in Detail

a) Policy for the regular production of a world-wide RENDA within the context of the 4-Center cooperation.

b) Technical details of the RENDA system.

VI. Evaluated Data

a) Published index and documentation.

a') Common evaluation procedures.

b) Technical details concerning the exchange of evaluated data between the 4-Centers.

c) Archive files of evaluated data.

VII. Trends and Developments in the Centers

a) Statement from the Centers.

b) Possible extension of the scope of EXFOR data.

c) Cross links RENDA-CINDA-EXFOR-EVALUATED DATA.

d) Information exchange on evaluation activities.

e) Cooperation between the four neutron centers and the centers for nuclear structure and reaction data.

f) Cooperation in CODATA compendium on Numerical Data Projects update.

g) Compilation of standard cross-section values.

VIII. Conclusions

a) Summary, recommendations, and actions.

b) Next meeting.

Ninth Four Centre Meeting

Moscow, 4-8 June 1973

AGENDA

I. Organization and Announcements

a) Introductory remarks

b) Election of chairman and secretaries

c) Adoption of the agenda

d) Review of actions and recommendations from 8th Four-Centre Meeting

II. Center Activities

a) Progress reports from the four Centres

b) Data request profile report from each Centre

c) EXFOR compilation activities

1) New data

2) Conversion of old data

III. Policies and Coordination of Four-Centre Activities

a) Recommendations to the Centres from external bodies

b) Improvements in operation of the Four-Centre Networks

c) Proposals for common service statistics

d) Exchange of information on services to customers

e) Compilation of fission neutron spectra, fission product yields, and gamma ray spectra

f) Future developments

IV. EXFOR

a) Implementation of decisions of 8th Four-Centre Meeting

b) Contents of data tapes exchanged since last meeting

c) Proposed changes to Dictionaries, EXFOR or LEXFOR

d) Plans for EXFOR transmission of older data

e) Development and implementation of programmes associated with the data files

V. CINDA

a) Coverage of present CINDA

b) Implementation of new CINDA system and its function as EXFOR index

c) Customer services

VI. WRENDA

a) Final WRENDA formats for exchange

b) Coordination and responsibilities for annual WRENDA publication

VII. Evaluated Data

VIII. Other business

IX. Conclusion

a) Summary, recommendations and actions

b) Next meeting