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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

THE IAEA NUCLEAR DATA CENTER
ITS ROLE IN THE INTERNATIONAL SCIENTIFIC COMMUNITY

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ABSTRACT

The role of the IAEA Nuclear Data Section as an international data information and analysis center for the coordination of the world-wide collection, exchange and dissemination of nuclear data is described. Emphasis is put on the recent activities of the center in the assessment of nuclear data needs in various branches of science and technology, and on its projected development as a global referral center for nuclear data.

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INTRODUCTION

The establishment of an international neutron data exchange activity ten years ago by the IAEA, formed the basis for the international centre for nuclear data operated today by the IAEA Nuclear Data Section (IAEA/NDS).

Situated at the cross-roads of international atomic energy activities, IAEA/NDS has always been in a unique position, being exposed to all aspects of nuclear technology. Although initiated primarily to satisfy neutron cross section data requirements for the development of thermal and fast fission reactors, the IAEA nuclear data programme, reflecting the growth and emphasis of national and international nuclear programmes during the last decade, has expanded its original scope in the last few years to include all nuclear data. Today, in addition to neutron nuclear data required mainly by nuclear energy oriented programmes, the IAEA/NDS programme scope includes nuclear structure and reaction data to support the continuous development of improved and sophisticated nuclear methods and techniques, and atomic and molecular data required in the field of plasma physics and fusion technology.

In its approach to the overall problem of data center operation, the IAEA/NDS programme has been centered around three major functions: assessment, identifying what has to be done, coordination, how it is to be done, and finally service, which comprises the actual data centre service functions. Recognizing the differences in the character and needs of the three, more or less, independent data fields of nuclear reaction data, nuclear structure and decay data, and atomic and molecular data, IAEA/NDS has tailored its programme so as to emphasize the assessment, coordination and service functions of the data center in those data fields where they are most needed. Currently, neutron and charged particle reaction data are incorporated in all three of the centre's functions, and nuclear structure and decay data are limited primarily to the centre's coordination and referral functions. Atomic and molecular data, the center's newest data domain which will not assume its full scope until the end of the seventies, is to encompass all three of the centre's functions with primary emphasis on assessment and coordination.

To-day IAEA/NDS provides cost-free data centre services to scientists in approximately fifty IAEA Member States, with an emphasis on the developing countries, and in coordination with other regional and national centres it co-operates in the systematic world-wide collection, compilation, and dissemination of all nuclear data. As such, this centre has been developing an awareness of the needs for all nuclear data in all pertinent aspects of science and technology in all parts of the world, and forms a focal point for the activities of all nuclear data centres.

ASSESSMENT OF DATA STATUS AND NEEDS

In addition to the day-to-day growth of the awareness of data needs and their adequacy, IAEA/NDS has pursued a number of well-defined activities whose primary objective has been the assessment of data status and needs. These consist of conducting surveys of specific nuclear data requirements and identifying their priorities in context of a given field of application, and reviewing the adequacy of existing data and assessing their availability. Four independent means are used by IAEA/NDS to achieve this: scientific meetings, data surveys and reviews, evaluations, and the maintenance of a world-wide request list for nuclear data.

Scientific Meetings

An effective means to ascertain the current needs of nuclear data in a specific field of application, and the extent to which these needs are satisfied, is through scientific meetings. IAEA/NDS has developed a specific type of meeting by which data users in a given field of application are confronted with data producers, that is, data measurers and evaluators. The object of such meetings is to obtain a comparison between the users' detailed nuclear data requirements with the status of available data, and projected data measurements, calculations, and evaluations. The product of such meetings consists not only of timely reviews on the state-of-the-art of specific fields of data application and data determination, but also of detailed assessments of the extent to which the demands for data are being satisfied. The main result consists of recommendations to the scientific community to perform measurements calculations or evaluations of the required nuclear data.

Among the recent meetings which have been convened by IAEA/NDS, characteristic of the type described above: the first [1], held in November 1973, produced the first review of requirements, status and availability of fission product nuclear data, and the other [2], convened in November 1975, resulted in the first survey of the needs and review of the status of transactinium isotope nuclear data. Two other meetings of the same type are planned for the near future, a meeting on Atomic and Molecular Data for Fusion to be held in November 1976, and a second meeting on Fission Product Nuclear Data, scheduled for September 1977.

In addition to these meetings which are specifically designed for the simultaneous assessment of data status and needs, IAEA/NDS also convenes conventional scientific meetings with the object of reviewing a given nuclear data topic or field of applications so as to provide current up-to-date reviews. These meetings have ranged from large conferences, such as the one on Neutron Data for Reactors held in 1966 in Paris [3], on Nuclear Data for Reactors in 1970 in Helsinki [4], and on Nuclear Data for Science and Technology in 1973 in Paris [5], to medium-sized specialists' meetings on nuclear data standards [6,7] and on data compilation and evaluation [8,9], to smaller consultants' meetings convened to inquire into the status of particular nuclear data parameters, such as $\bar{\upsilon}$ or the prompt fission neutron spectrum [10,11], or a particular field of nuclear data application [12,13,14,15]. To summarize, in the course of the last ten years, NDS has been holding approximately three such scientific meetings every two years.

Data Surveys, Reviews and Evaluations

As a result of the continuous assessment of nuclear data by the nuclear scientific community, specific needs for nuclear data, and inadequacies in the existing body of nuclear data are continuously identified. At the same time, results of continuing nuclear data measurements constantly improve the status of nuclear data and their acceptance. Another approach to nuclear data assessment is the critical review of existing data in order to ascertain their accuracies, and to compare them with new measurements. The results of such critical reviews have in general pointed to the needs for more extensive evaluations of the data in question with the ultimate aim to supplement or revise the body of evaluated nuclear data.

In the past IAEA/NDS has contributed to this form of nuclear data assessment and has performed a number of critical reviews directed primarily at the development of fast nuclear reactors. These reviews have resulted in comprehensive surveys of the available experimental data, and on the basis of systematic errors of individual measurements, have provided weighted average curves of the analyzed parameters as a function of energy with point-wise confidence levels. Gaps, inconsistencies and gross uncertainties in these final curves have provided a clear indication for the need of additional measurements or re-evaluation of these data. The nuclear data which were thus investigated are the fast fission cross sections of U-238, Np-237 and Th-232 [16], the capture-to-fission ratio α for Pu-239 [17], the Pu-239 fission cross section [18], the status of $\bar{\nu}$, the average number of neutrons released in fission, for all fissile nuclides [19], and the status of the U-238 capture cross section [20].

A continuous IAEA/NDS assessment activity, which was initiated at the very beginning of the IAEA nuclear data programme has been the evaluation of the 2200 m/s neutron cross sections and related fission parameters for the major fissile nuclides U-233, U-235, Pu-239 and Pu-241, which constitute a basic set of quantities required for the performance of many reactor calculations [21,22,23]. Performed under the auspices of IAEA/NDS, these evaluations are recognized by the international scientific community as the standard reference data for these fissile nuclides. Another ongoing assessment effort by IAEA/NDS, is the review of neutron reaction cross section used in reactor neutron dosimetry [24].

Request List for Nuclear Data Measurements

As a consequence of the increasing demand for better and more accurate neutron nuclear data by the scientific and technical community, a world-wide cooperative effort of the national and regional nuclear data centres * and laboratories has emerged in the last five to ten years. One aspect of this cooperative effort has been the establishment of a world request list for nuclear data measurements, called WRENDA, in the form of a computerized file. This constitutes the third method for the assessment of data status and needs.

In its position as the focal point for the international coordination of nuclear data matters, IAEA/NDS has been maintaining the master file of the WRENDA compilation, updating it with the input supplied by more than twenty IAEA Member

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* Particularly the National Neutron Cross Section Center at the Brookhaven National Laboratory in the USA, the Neutron Data Compilation Centre at Saclay, France, and the Nuclear Data Centre at Obninsk, USSR, which, together with IAEA/NDS, form the "Four-Centre" network for the world-wide compilation, exchange and dissemination of neutron nuclear data.

States, and publishing it on behalf of the cooperating data centres. The current WRENDA publication [25] contains some 1200 requests for measurements of (primarily neutron) nuclear data, which were originated by members of the fission reactor, fusion reactor, and safeguards development communities.

In this list each individual request provides information on the requested parameter of a specific nuclide (e.g. fission cross section of uranium-235), the neutron energy range of interest, the required accuracy and priority, the origin and justification of the request, and the status of the requested data. The WRENDA request list, aside from identifying specific gaps in the required knowledge of nuclear data, has proven to be very useful in the stimulation and coordination of required nuclear data measurements, and has also been used as justification for the performance of certain measurements, particularly in smaller and developing countries.

COORDINATION AND ORGANIZATION

A data centre, having the scientific scope, technical versatility and geographic coverage as IAEA/NDS, cannot perform its tasks satisfactorily on its own, without the support and guidance of an advisory or steering committee, and the cooperation of other regional and national nuclear data centres and committees. At the same time, IAEA/NDS being an integral part of the IAEA, is in an advantageous position to organize and coordinate research coordination programmes and grant research assistance in the form of contracts, and to supply target and sample materials in support of regional or national nuclear data programmes.

National and International Nuclear Data Committees

The similarity of nuclear data requirements in many countries, the impossibility to measure all the required data in one or a few countries only, the need to avoid unnecessary duplication of effort, and the large amounts of data involved, made it imperative to share the work among all countries involved. On the national scene, a number of countries have established internal nuclear data committees [26] with the objective to coordinate and evaluate nuclear data research activities of concern to energy and non-energy programmes with national priorities. On an international basis, two nuclear data committees have been instrumental in coordinating the development of nuclear data activities, the regional Nuclear Energy Agency Nuclear Data Committee (NEANDC) [27], and the International Nuclear Data Committee (INDC).

The INDC was formed by the IAEA in 1967 as a continuing committee of the IAEA with the stated purpose of "serving as a means of promoting international cooperation in all phases of nuclear data activities of general usefulness to nuclear energy programmes and other peaceful applications of nuclear science and technology, and of advising the Director General of the IAEA in the field of nuclear data" [28]. Membership of this committee, currently limited to thirteen, is composed of leading nuclear scientists from IAEA Member States which have nuclear data activities. For those countries not represented on the INDC, forty-two appointed liaison officers provide direct communication links between scientists in their country and the INDC through IAEA/NDS. The INDC secretariat functions are fulfilled by IAEA/NDS under the guidance of its head who serves at the same time as scientific secretary of the INDC. The committee meets at intervals of approximately eighteen months; the last INDC meeting was held at IAEA Headquarters in Vienna, in October 1975 [29].

Aside from its advisory functions which it has with regard to the IAEA nuclear data programme, the INDC, in promoting international cooperation of nuclear data activities, works closely with IAEA/NDS in the coordination of a number of nuclear data activities of international impact. The committee's responsibilities for nuclear data availability and requirements, for their collection, exchange and dissemination, and for the coordination of their measurements are reflected in most of IAEA/NDS's coordinating functions.

In support of INDC's responsibility for the exchange and dissemination of information, and in its capacity of INDC secretariat, IAEA/NDS maintains a compilation of INDC correspondents [30], and compilation of INDC documents [31] which are continuously updated and published twice a year; these serve as a basis for the exchange and dissemination of nuclear data information. As secretariat to the INDC, IAEA/NDS serves as the coordinating agency for the recording and distribution of INDC documents, and keeps copies of all INDC documents in an archival file. At the same time, the INDC document series is used by IAEA/NDS as a publication medium for all of its reports. In addition to its function as INDC documents distribution centre, IAEA/NDS sponsors the translation of selected USSR nuclear data articles and reports into English, publishes them as INDC documents, and distributes them world-wide.

Inter-Centre Coordination and Cooperation

Shortly after neutron data compilation was initiated in the late 1950's in the U.S.A., it became evident that one centre, namely the Sigma Center at the Brookhaven National Laboratory, could not keep pace with the increasing volume of neutron nuclear data. Recognizing this fact, the European American Nuclear Data Committee (EANDC) recommended in 1963 the creation of a centre for the compilation and dissemination of neutron data in Western Europe and Japan. Shortly thereafter, the IAEA established the Nuclear Data Section, and with the support and encouragement of the INDC, a world-wide cooperative effort aimed at the systematic compilation, exchange and dissemination of experimental neutron data on the basis of clearly defined geographical areas of responsibility by four regional data centers was started. The four regional data centers, which then formalized their agreement in 1970 to exchange experimental neutron data in a common computer-compatible format, are:

- The NEA Neutron Data Compilation Centre, located at Saclay (France), servicing Western Europe and Japan,

- The National Neutron Cross Section Center, located at the Brookhaven National Laboratory (USA), servicing the USA and Canada,

- The USSR Nuclear Data Centre, at Obninsk (USSR), servicing the USSR, and

- The IAEA Nuclear Data Section, located in Vienna (Austria), servicing Eastern Europe, Africa, Asia (except Japan), and South America, Australia and New Zealand.

Each of the four neutron data centres compiles all neutron data from its service area, distributes these data to the other centres in the agreed format, and answers requests for neutron data from users in its service area. All operations are fully computerized. The data exchange which was formally established in 1970 assures that every user in the world has access to the complete body of experimental neutron data. The four neutron data centres meet every year to coordinate the international collection, compilation and dissemination of neutron nuclear data [32]. A similar objective to allow free exchange and distribution

of evaluated neutron data through the four-centre network has been slower to materialize. Today, however, most of the existing evaluated neutron data files are available without restrictions.

If neutron nuclear data were the first to be coordinated on a world-wide basis, it was because of their vital need in the development of nuclear energy, particularly thermal and fast fission reactors. Other nuclear data, such as charged particle induced nuclear reaction data and nuclear structure and decay data, did not gain in importance from the point of view of systematic data compilation and dissemination, until nuclear techniques and isotope applications became more prevalent and the new fusion reactor technology began to develop.

Although a number of very knowledgeable and experienced nuclear structure data groups have existed in several countries for a number of years, and successful bilateral cooperative efforts had been initiated and pursued with reasonably good results, it became evident, as in the case of neutron data, that a few independent centers could not cope with the growing demand for a growing volume of data. The situation had become particularly accute with the compilation and evaluation of nuclear structure and decay data.

In view of this situation, characterized by a shortage in manpower and funding, a lack of coordination, and increasing backlog in data compilation the IAEA on the recommendations of an ad hoc group of consultants [33] formed the International Working Group on Nuclear Structure and Reaction Data (IWGNSRD). The objectives of this interim group were to formulate guidelines for the compilation, evaluation and dissemination of nuclear structure and reaction data, and to perform a first review of the status and needs for nuclear structure and decay data. The efforts of this group and of INDC, as well as the papers presented at the Symposium on the Application of Nuclear Data in Science and Technology [5], convened by IAEA/NDS in 1973, established a first broad overview of nuclear data user requirements in a variety of applied fields, and of current national compilation and evaluation activities.

Two subsequent meetings, convened by IAEA/NDS in April 1974 [34] and in May 1976 [35], devised the necessary measures for an extended international cooperation in the compilation, evaluation, exchange and dissemination of nuclear structure and decay data. These meetings resulted in an agreement to establish a network of centres which would contribute to the evaluation of nuclear structure data (particularly mass-chain evaluation), and to exchange bibliographic data and numerical data in agreed computer compatible formats. Also, in addition to its function of coordinating this field of data, IAEA/NDS was entrusted to serve as a referral centre for non-neutron nuclear data information and to establish a compilation of nuclear data compilations which would be kept up-to-date and published twice a year.

Three meetings on charged particle and photonuclear reaction data, held in 1974 [36], 1975 [37] and in 1976 [38], established a coherent international cooperation between existing centres and groups and agreed to use an extended version of the neutron data exchange format, EXFOR, for the exchange of charged particle nuclear reaction data. The centers and groups cooperating with IAEA/NDS in this field of data, in addition to the neutron data centers mentioned above, are:

- The Charged Particle Nuclear Data Group, at the Institut fuer Radiochemie, Kernforschungszentrum Karlsruhe in the Federal Republic of Germany,

- The Center for Nuclear Structure and Reaction Data of the USSR State Committee on the Utilization of Atomic Energy, at the Kurchatov Institute of Atomic Energy in Moscow, USSR,

- The Study Group for Information Processing in Nuclear Physics, Department of Physics, Hokkaido University, Sapporo, Hokkaido, Japan,

- The Zentralstelle fuer Atomkernenergie-Dokumentation, located at the Kernforschungszentrum Karlsruhe in the Federal Republic of Germany,

- The Nuclear Physics Division of the Atomic Energy Establishment at Harwell, UK, and

- The Nuclear Data Group of the Institute Badran Jadrowych in Warsaw, Poland.

Research Coordination and Support

In context of the statutory responsibility of the IAEA to assist Member States in conducting research toward the development of the practical uses of atomic energy, IAEA/NDS has supported programmes by which it can allocate funds for the measurement and evaluation of nuclear data, and has actively participated in regional research coordination projects to encourage the measurement of required nuclear data.

In response to a growing tendency in smaller countries to orient their nuclear data programmes to satisfy data requests listed in the world request list for nuclear data measurements WRENDA, IAEA/NDS has initiated two coordinated nuclear data measurement programmes in the framework of the IAEA Regional Cooperative Agreement (RCA) * programme. The first of these consists of a cooperative effort between the Japanese and Korean Atomic Energy Research Institutes for the measurement and evaluation of fission product nuclear data, and the second, between the Bhabha Atomic Research Centre in India and the Atomic Energy Centre in Dacca for the measurement of fission nuclear data related to the Th-232/U-233 fuel cycle.

Another area in which IAEA/NDS has started coordinating activities resulted from recommendations put forward at the recent meeting of Transactinium Isotope Nuclear Data [2]. In summary, these recommended to implement and pursue internationally coordinated efforts during the next ten years so as to improve the status of transactinium isotope nuclear data required for nuclear technology. Specifically, these efforts are to be directed towards the evaluation of neutron nuclear data and in the measurement of nuclear decay data of a number of transactinium isotopes of importance in reactor design and in nuclear waste management respectively.

At times, IAEA/NDS coordinates the measurement by a number of laboratories of one specific nuclear data quantity, important in one or another aspect of nuclear technology. One example has been the promotion to have five different laboratories measure the Rh103(n,n') Rh103m reaction cross-section because of its importance in reactor neutron dosimetry.

During the late sixties, the IAEA received several requests for accelerator targets and samples. In order to alleviate the difficulties encountered by physicists in developing countries to procure target and sample materials for accelerator measurements of required neutron nuclear data, IAEA/NDS has initiated and maintained a "Targets and Samples" programme [39] funded at levels varying from $ 15.000 to $ 25.000 per year since 1972. Under this programme, IAEA/NDS purchases and lends under contract the material requested by laboratories in developing countries. Requests have been received from Bangladesh, Brazil, Greece, Hungary, India, Pakistan, Poland, Romania, South Africa, Turkey and Yugoslavia. The cost of materials supplied has varied from a few hundred dollars to a few thousand dollars per request.

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* Regional cooperative agreement for research, development and training related to nuclear science and technology.

DATA COMPILATION AND DISSEMINATION

Data Centre services can vary, according to need and available resources, from a basic referral service to broad scope and in-depth compilation, analysis, evaluation and dissemination centre services. The latter are typical functions of an Information Analysis Center (IAC) using the definition introduced by Weinberg et al [40]. Of the services provided by IAEA/NDS, data center services for neutron nuclear data include practically all IAC functions, while those for nuclear structure and decay data are restricted to more simple referral and dissemination of general information.

Generally speaking, data centre functions can be separated into three general types of activities: gathering of information, processing of information and dissemination of information. Within each of these three categories, specific activities can be classified according to manpower intensiveness. Thus, listing the least manpower intensive in each of the categories first, IAEA/NDS data centre service functions can be summarized as follows:

Compilation of information
- General information collection
- Bibliographic data compilation
- Numerical data compilation

Processing of information
- Format transformation
- Analysis of information
- Evaluation

Dissemination of information
- Referral service
- Data distribution - systematic or "on request"
- Publication

Rather than belaboring each individual activity of this list separately, the "compilation and dissemination" activities will be combined and described in context of the IAEA/NDS programme under one title. The "analysis and evaluation" of information was described above. In general, IAEA/NDS devotes approximately 65 % of it professional manpower to activities related to data centre functions as defined above. Included in this effort is a programming group which developes and maintains the necessary data storage and retrieval programmes.

The IAEA/NDS data centre processes three types of information related to nuclear data: general information, comprising general compilations, handbooks and reports and report series; bibliographic data consisting of structured compilations of bibliographic references to specific nuclear data measurements, evaluations, etc.; and numerical data consisting of tabulations, files and libraries of numerical values, in other words the actual nuclear data. While items which fall under "general information" are normally not computerized, "bibliographic and numerical data", by virtue of their sheer volume, are transformed and handled in computerized media.

General information

One of the IAEA/NDS publications which probably has the closest relationship to its data centre service functions, is CINDU, the catalogue of numerical nuclear data published by IAEA/NDS [41]. This catalogue is addressed primarily to the nuclear science community in the service area of IAEA/NDS (see section B2 above), and describes in considerable detail not only what is available from the IAEA nuclear data centre but also how to obtain this information.

Another product of the IAEA/NDS, whose publication is scheduled to start in summer 1976, is a "Compilation of Compilations". This compilation, which is planned to be published twice annually, will list all existing and planned compilations of nuclear structure and decay data, pertaining to a particular nuclear property or properties for a range of nuclides. Designed to serve primarily as a referral tool, this publication will be distributed on a world-wide basis to the nuclear science community.

Two information report series have been initiated by IAEA/NDS. The "Progress in Fission Product Nuclear Data" [42] with information on activities in the field of measurements, compilations and evaluations of fission product nuclear data, is to be published every six months. Another report series recommended by the meeting on Transactinium Isotope Nuclear Data [2], which is to contain brief descriptions of measurements, compilation activities and computer calculations pertaining to transactinium isotope nuclear data, is to be published jointly by the Oak Ridge National Laboratory and IAEA/NDS.

Due to the fast progress of activation analysis in the last decade, and its extensive use in applied fields such as medicine, environmental control, industry, and agriculture, the need for a handbook containing various types of cross section data required for activation analysis became evident. A handbook on nuclear activation cross-sections, consisting of contributions from outside scientists and NDS staff on neutron, charged particle and photon induced reaction cross sections was compiled by IAEA/NDS and published by the IAEA in August 1974 [43].

Bibliographic Data

Perhaps the most well-known product of the four neutron data center cooperation is the index to the literature on microscopic neutron data, CINDA, published annually on behalf of the four neutron data centers by the IAEA [44].

CINDA evolved from a card index file which was started by Professor H. Goldstein and associates in the USA. This file gained world-wide recognition and became the primary reference source in the field of neutron nuclear data. The computerized CINDA compilation, fed and kept up-to-date by the four neutron data centers, also serves as the index to the international experimental neutron data file EXFOR.

The input to CINDA is the result of a systematic scanning of neutron physics literature published all over the world. The content and format of CINDA, is exactly tailored to the needs of the nuclear scientific community, and presents up-to-date information on each measurement, evaluation and theoretical determination of all neutron data quantities of importance to all scientists and engineers interested in neutron physics. As of April 1976, the CINDA master file which is maintained by the CCDN centre at Saclay contained approximately 115.000 entries.

In the other nuclear data fields, namely charged particle nuclear reaction data and nuclear structure and decay data, IAEA/NDS is currently pursuing the development of bibliographic reference files together with the other nuclear data centres involved. In both cases these cooperative efforts aim at arriving at bibliographic files produced from input supplied by all centres concerned, and distributed to all interested users.

Numerical Data

The neutron data services which have been performed by IAEA/NDS for the last five years are a prototype of data centre services which should serve as a model for the other data types handled by IAEA/NDS.

In 1970, the four neutron data centres entered into an agreement to share the responsibility to collect, compile and disseminate experimental neutron data and to exchange them in a common computer-compatible format. The data storage and retrieval system, EXFOR, developed for this purpose, has served for the periodic exchange of computerized neutron data information between the four regional data centres since 1971. The centres use the same terminology, keywords, codes and other conventions so that all neutron data information coded and transmitted is unequivocally identifiable.

Since most laboratories and data centres have different computer facilities and user needs, each centre has developed its own in-house storage and retrieval system. In its development, the EXFOR system was therefore designed to be compatible with and easily translatable into any of the other existing systems.

As of April 1976, the EXFOR file contained about 1.7 million experimental data points, distributed among some 1600 entries, where each entry corresponds to a single experiment, or a set of experiments, performed in a laboratory by a research group. IAEA/NDS provides cost-free retrievals from its EXFOR files, and disseminates these data to users in its service area on request in any desired computer output medium. To improve its customer services, IAEA/NDS plans to develop a computational format to allow automatic handling of data stored in the EXFOR format for plotting or direct input into data processing codes.

In addition to the experimental neutron data, IAEA/NDS maintains and disseminates a number of evaluated neutron data libraries, originated separately in the USA (Evaluated Nuclear Data File B, ENDF/B), the UK (the UK Nuclear Data Library, UKNDL), the Fed. Rep. of Germany (the Karlsruhe Evaluated Nuclear Data File, KEDAK) and the USSR (the SOKRATOR library). Although excluded for a number of years from free exchange and distribution, evaluated neutron data, because of their vital importance to the development of the nuclear reactor technology, have been gradually released for free international exchange. With the recent release of the US ENDF/B-IV fission product and dosimetry data files IAEA/NDS now holds twenty different files of evaluated neutron data, available to all Member States.

One important feature of the EXFOR system is its versatility and open-endedness. The format can easily be extended and adapted to other reaction data types by the addition of new quantities, expansion of dictionaries, and slight modification of the established conventions. At the last meeting on Charged Particle Nuclear Data Compilation [38], agreement was in fact reached to expand the existing neutron EXFOR system to accommodate charged particle reaction data. Its further extension, to permit other reaction data types, such as photonuclear reaction and ion-induced reaction data, has also been proposed.

With regard to nuclear structure and decay data, the participants of the last meeting on the compilation, evaluation and dissemination of these data [35], agreed to use the format of the Evaluated Nuclear Structure Data File (ENSDF) [45] developed by the Oak Ridge Nuclear Data Project to compile and exchange all data related to nuclear structure and decay data, and to feed all of the compiled and evaluated data into a master file. The IAEA/NDS will maintain a copy of the master file and distribute these data on request to scientists in its service area.

References

1. Fission Product Nuclear Data, (Proc. Panel Mtg., Bologna 1973), Technical Report IAEA-169, IAEA, Vienna (1974).

2. Transactinium Isotope Nuclear Data, (Proc. Panel, Karlsruhe 1975), Technical Report IAEA-186, IAEA, Vienna (June 1976).

3. Neutron Data for Reactors, (Proc. Conf., Paris 1966), STI/PUB/140, IAEA, Vienna (1967).

4. Second Int. Conf. on Nuclear Data for Reactors, (Proc. Conf., Helsinki 1970), STI/PUB/259, IAEA, Vienna (1970).

5. Nuclear Data in Science and Technology, (Proc. Symp., Paris 1973), STI/PUB/343, IAEA, Vienna (1973).

6. Nuclear Standards for Neutron Measurements, (Proc. Panel Mtg., Brussels 1967), Technical Report IAEA-107, IAEA, Vienna (1968).

7. Neutron Standard Reference Data (Proc. Panel Mtg., Vienna 1972), STI/PUB/371, IAEA, Vienna (1974).

8. An International Neutron Data System, (Proc. Panel Mtg., Brookhaven 1969), Technical Report Series No. 100, IAEA, Vienna (1969).

9. Neutron Nuclear Data Evaluation, (Proc. Panel Mtg., Vienna 1971), Technical Report Series No. 146, IAEA, Vienna (1973).

10. Meeting on the status of $\bar{\upsilon}$ data for the main fissile nuclides, IAEA, Vienna, (June 1970). (See Reference 19)

11. Prompt Fission Neutron Spectra, (Proc. Cons. Mtg., Vienna 1972), STI/PUB/329, IAEA, Vienna (1972).

12. Meeting on the thermal neutron data for the fissile isotopes, IAEA, Vienna, (November 1972). (See Reference 23)

13. Nuclear Data for Reactor Dosimetry, (Proc. Cons. Mtg., Vienna 1973), INDC(NDS)-56, IAEA, Vienna (1973).

14. Charged Particle and Photonuclear Reaction Data, (Proc. Cons. Mtg., Vienna 1974), INDC(NDS)-59, IAEA, Vienna (June 1974).

15. Nuclear Theory in Neutron Nuclear Data Evaluation, (Proc. Cons. Mtg., Trieste 1975), Technical Report IAEA-190, IAEA, Vienna (1976).

16. BAK, H.I., LORENZ, A., Review of the current status of the U-238, Np-237 and Th-232 fission cross sections. J. Korean Nucl. Soc. 3, 2 (1971) 77.

17. SOWERBY, M.G., KONSHIN, V.A., Review of the measurements of alpha for Pu-239 in the energy range 100 eV to 1 MeV. At. Energy Rev. 10, 4 (1972) 453.

18. BYER, T.A., A simultaneous evaluation of the Pu-239 fission cross-section and the Pu-239/U-235 cross-section ratio in the fast neutron energy range. At. Energy Rev. 10, 4 (1972) 529.

19. MANERO, F, KONSHIN, V.A., Status of the energy-dependent $\bar{\upsilon}$ values for the heavy isotopes ($Z \geq 90$) from thermal to 15 MeV, and of the $\bar{\upsilon}$ values for spontaneous fission. At. Energy Rev. 10, 4 (1972) 637.

20. KONSHIN, V.A., Current Status of the U-238 Capture Cross-Section Data in the Neutron Energy Region 2 KeV-10 MeV, INDC(NDS)-18, IAEA, Vienna (March 1970).

21. WESTCOTT, C.H., EKBERG, K., HANNA, G.C., PATTENDEN, N.S., SANATANI, S., ATTREE, P.M., At. Energy Rev. 3, 2 (1965) 3.

22. HANNA, G.C., WESTCOTT, C.H., LEMMEL, H.D., LEONARD Jr. B.R., STORY, J.S., ATTREE, P.M., At. Energy Rev. 7, 4 (1969) 3.

23. LEMMEL, H.D., Nuclear Cross Sections and Technology, (Proc. Conf., Washington D.C. 1975), Natl. Bur. Stands. (U.S.), Spec. Publ. 425, 1 (1975) 286.

24. VLASOV, M.F., et al., Status of Neutron Cross-Section Data for Reactor Radiation Measurements, Part I, INDC(NDS)-47, IAEA, Vienna (October 1972).

25. WRENDA 75, World List for Nuclear Data Measurements, INDC(SEC)-46, IAEA, Vienna (June 1975).

26. The 1975 Compilation of National Nuclear Data Committees, INDC(SEC)-49, IAEA, Vienna (July 1975).

27. STORY, J.S., CONDE, H., Seventh Biennial Report on the Activities of the European-American Nuclear Data Committee, NEANDC-101"U", OECD, Paris (March 1975).

28. Methods of Work of the International Nuclear Data Committee, INDC-20/G, IAEA, Vienna (February 1976).

29. Technical Minutes of the 8th INDC Meeting, Held in Vienna, 5-10 October 1975. (INDC report to be published)

30. INDC Correspondents for the Exchange of Nuclear Data Information, INDC(SEC)-52, IAEA, Vienna (June 1976).

31. List of Documents Received by the INDC Secretariat, INDC(SEC)-53, IAEA, Vienna (June 1976).

32. Report on the Eleventh Four-Centre Meeting, Brookhaven National Laboratory, USA, 10-14 March 1975, INDC(NDS)-68, IAEA, Vienna (August 1975).

33. Report of a Consultants Meeting on Non-Neutron Nuclear Data, Vienna, November 1970, INDC(NDS)-30, IAEA, Vienna (February 1971).

34. Summary Report Specialists' Meeting on Nuclear Data for Applications, Vienna, April 1974, INDC(NDS)-60, IAEA, Vienna (September 1974).

35. Nuclear Structure and Decay Data for Applications (Proc. Adv. Gp. Mtg., Vienna 1976). (INDC report to be published)

36. Charged Particle and Photonuclear Reaction Data, (Proc. Cons. Mtg., Vienna 1974), INDC(NDS)-59, IAEA, Vienna (June 1974).

37. Charged Particle (CPND) Compilation, (Proc. Cons. Mtg., Vienna 1975), INDC(NDS)-69, IAEA, Vienna (December 1975).

38. Charged Particle Nuclear Data (Proc. Cons. Mtg., Vienna 1976), Vienna (April 1976). (INDC report to be published).

39. HJAERNE, L., Requests for Targets and Samples for Nuclear Data Measurements, INDC(NDS)-43, IAEA, Vienna (May 1972).

40. Report of the President's Science Advisory Committee, U.S. Government Printing Office, Washington D.C. (10 January 1963).

41. CINDU-11, Catalogue of Numerical Nuclear Data Available from the IAEA Nuclear Data Section, IAEA, Vienna (March 1976).

42. Progress in Fission Product Nuclear Data, No. 1, INDC(NDS)-70, IAEA, Vienna (November 1975).

43. Handbook on Nuclear Activation Cross-Sections, Technical Report Series No. 156, STI/DOC/10/156, IAEA, Vienna (1974).

44. CINDA-76, An Index to the Literature on Microscopic Neutron Data, IAEA, Vienna (1976).

45. EWBANK, W.B., 5th Int. CODATA Conf., (Proc. Conf., Boulder 1976). (To be published).