

SIXTH BIENNIAL REPORT ON THE

ACTIVITIES OF THE EANDC

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EUROPEAN-AMERICAN NUCLEAR DATA COMMITTEE

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by W.W. Havens, Jr. and W.G. Cross

INTRODUCTION

The European American Nuclear Data Committee had its tenth anniversary in March of 1970. It is time now to review its accomplishments and assess its function in view of the circumstances which have changed since its founding, and its potential for significant contributions in the future. The nuclear industry has changed appreciably since the initial talks on founding the EANDC took place in September of 1959. The 1950's have been characterized as the nuclear industry's years of research and the 1960's as the years of development. The 1970's will show an unprecedented growth in the nuclear industry. The EANDC has, during most of its life, been concerned primarily with nuclear cross sections and other fundamental nuclear data for fission reactors. It is appropriate at this time to determine whether there is still a real need for international cooperation in measurements, compilation and assessment of such data and to examine critically the future course for the EANDC.

The administrative structure governing the EANDC has also changed. When the initial talks about the formation of the EANDC began the ENEA (now NEA) was only two years old. The U.S. and Canada were Associate Members of the OEEC and Japan had not yet joined the organization. The OEEC has been changed to the OECD. The U.S., Canada and Japan are now full Members of the OECD, although the U.S. and Canada are still Associate Members of NEA, and many more European countries are now in the process of joining the Common Market. The "Terms of Reference" of the EANDC were recently changed to recognize the addition of Japan to NEA membership. Further changes will be made to reflect the reorganization of the European nations which is now taking place.

Another factor which enters into the future potential of the EANDC is the establishment of the International Nuclear Data Committee (INDC) by the International Atomic Energy Agency in Vienna. The two Committees have some overlapping functions, but basically they complement each other. This complementarity, as well as problems of interface between the EANDC and the INDC, will need further clarification as time goes on.

A BRIEF HISTORY OF THE EANDC AND ITS ACCOMPLISHMENTS THROUGH 1970

The first formal meetings on the formation of the EANDC took place in Saclay in September, 1959. At this meeting, a "Terms of Reference"

for the EANDC was drawn up, establishing the EANDC as a quasi-independent body. This "Terms of Reference" was approved by the ENEA Steering Committee; the EURATOM Commission; the appropriate authorities in Canada and the United States, and later, Japan. The functions of the Committee were defined in its "Terms of Reference" to "assure maximum advancement of the peaceful uses of nuclear energy by means of full and effective collaboration in the measurement of nuclear properties of general importance."

The first meeting of the Committee took place in Stockholm, 4-8 March, 1960. At this meeting, the Committee defined its scope more clearly. The Committee decided to deal specifically with nuclear cross sections relevant to the nuclear energy programs of the constituent organizations. Thus the whole area of measurements, the equipment and technology used to obtain such measurements, the supply of the isotopes required for these measurements, the distribution of the workload and personnel, and finally, the compilation and assessment of the adequacy of the data were the principal concerns of the Committee. In attempting to define and limit the scope of the Committee, it was found necessary to exclude from consideration those measurements of reactor physics applicable primarily to specific systems. The boundary between such "integral" measurements and the more clearly defined microscopic measurements was not well established. The EANDC recommended to the ENEA that it form a reactor physics committee which would be a counterpart to the EANDC to deal with integral measurements. As a result of this recommendation, the European American Committee on Reactor Physics (EACRP) was formed in 1962. A list of the times and places of the Meetings of the EANDC is given in Appendix I.

The EANDC now includes representatives from the following nations and international organizations: Austria, Belgium, Canada, Denmark, France, West Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States, NEA and EURATOM. The membership is made up as follows: 4 from the EURATOM countries and the EURATOM Commission acting together, 4 from the United States, 3 from the United Kingdom, 2 from the other OECD countries acting together, 1 from Canada, 1 from Japan, and 1 from the NEA.

RESPONSIBILITIES OF THE EANDC

The EANDC acts in the following 7 areas of responsibility:

Measurements

It reviews existing knowledge of nuclear cross sections and constants, identifies measurements most needed for advancement of nuclear programs of countries involved and recommends the best methods for obtaining these measurements. Discrepant measurements and the possible reasons for them are identified, and corrective steps are recommended.

Equipment and Techniques

It considers present and future needs for equipment, techniques,

facilities and manpower and recommends appropriate action.

Research Materials

It keeps apprised of special materials available for research and facilitates the pooling, fabrication and exchange of research samples. Programs for production of foil and target materials have been recommended.

Equipment and Personnel Exchange

It recommends pooling and exchange of equipment and personnel wherever appropriate.

Nomenclature

It reviews the nomenclature used in the nuclear field and recommends methods for the presentation of nuclear cross sections and constants.

Data Compilation

It receives reports from groups collecting and compiling nuclear data directly applicable to member-nation needs. It also studies and comments on the general national and international compilation activities.

Technical Meetings

It recommends and sponsors conferences and technical symposia to further its objectives.

Cooperation, rapport, and close community of interests made the EANDC formative period pass quickly and successfully. Committee members developed a basic enthusiasm for the accomplishments of this group of disparate individuals brought together by the common bond of science and technology. No serious problems arose from differences in nuclear programs. Rapid progress came because the Committee soon developed an understanding regarding overall capability of participating laboratories to carry out nuclear measurements.

Since participants have much to gain from collaboration, they have willingly and enthusiastically approached problems concerning equipment use and loan, and personnel exchange. They have been quite willing to review their programs in the light of EANDC discussions and common need. The Committee has been fortunate for the rapidity with which the member nations and organizations have responded to their suggestions.

During EANDC formation, the U.S. continued to contribute most technological information. As the European effort grew in scope and quality, however, U.S. dominance began to diminish. The situation is now in a much better balance; production and exchange of information by the U.S. and the other members are more nearly equal.

ACCOMPLISHMENTS

Soon after its formation, EANDC was asked to review and comment on EURATOM plans to establish a Central Bureau for Nuclear Measurements at

Geel, Belgium. EURATOM had budgeted funds for provision of several facilities including electromagnetic separators for fissile and stable isotopes. Extensive facilities of this type did not then exist in Europe. European laboratories had been getting separated isotopes from Oak Ridge National Laboratory in the U.S. and the Atomic Energy Research Establishment of the U.K. at Harwell and wished to establish their own independent source. U.S. delegates informed EANDC that efforts were underway to expand the electromagnetic isotope separation at Oak Ridge and that these facilities would meet the separated-isotope needs of the entire Atlantic community. The EANDC view was that the facilities planned at Geel would not increase the overall isotope-separation capacity of EANDC nations by a significant amount and would be very costly. The Committee, therefore, recommended that EURATOM not build the isotope-separation facilities. It pointed out, however, that no laboratory in Europe could supply targets and foils of separated isotopes to European laboratories. Taking the advice of the Committee, EURATOM dropped its plans for an electromagnetic separation facility and instead established a central laboratory for the fabrication and assay of targets and samples as part of BCMN, and was supported by U.S. assurances to provide the necessary separated isotopes.

The Geel center is primarily concerned with standardization problems of nuclear physics, chemistry and technology. Before its establishment, the National Physical Laboratory of the U.K. and the U.S. National Bureau of Standards performed nuclear standardization services for EANDC nations. Since standardization services were only a small portion of the total activities of these laboratories and since standard needs in nuclear data were growing rapidly, EANDC thought that these two laboratories would not meet the needs. Therefore the Committee encouraged development of the Geel center and advised on appropriate areas for emphasis such as absolute neutron-source calibrations, standard flux determinations, absolute counting techniques, establishment of such primary cross sections as those for U^{235} fission and B^{10} (n, α), and procurement and establishment of standard isotopic plutonium samples.

It is generally agreed that experimental results must be in a form easily used by designers and compilation centers for storage and retrieval purposes. In November 1963 the EANDC recommended the establishment of the ENEA Neutron Data Compilation Center at Saclay, France. This Center has subsequently become another major accomplishment for the EANDC. Only ten months after its establishment, the Center was producing results. It uses computers for indexing, sorting and compiling nuclear data and ties in with similar centers at Brookhaven in the U.S. and at the International Atomic Energy Agency in Vienna.

International symposia sponsored by EANDC have been among its major accomplishments. For instance, the Committee sponsored a Symposium on Neutron Time-of-Flight Methods in Paris in July 1961 that was primarily concerned with the transition region from 100 to 10,000 eV.

In November 1962 the U.S. Atomic Energy Commission and its Nuclear Cross Section and Computer Advisory Groups cooperated to sponsor a conference at Grossinger, New York, that brought together computer experts and physicists who measure nuclear cross sections. The Grossinger conference showed that the multidimensional analyzers were essentially small computers and that both computer types were in the same price range although technical differences between the capabilities of the two approaches were the source of a good deal of debate.

When the EANDC met at Chalk River, Canada, in February 1962, the on-line PDP-1 computer of the Atomic Energy of Canada Limited Nuclear Physics Division was demonstrated for the Committee, and several talks were given on small computers and the acquisition of nuclear data. At that meeting, EANDC agreed to sponsor a conference concerning on-line computers that would be a sequel to the Grossinger conference but international in character. This recommendation resulted in the July 1964 Karlsruhe Conference on Automatic Acquisition and Reduction of Nuclear Data. Developments discussed at this conference predicted that in the future not only nuclear data but most experimental data would probably be taken with small on-line computers. The main purpose of the conference was to determine new methods for obtaining nuclear data and handling them in large amounts. The present role of on-line computers throughout experimental science bears witness to the validity of this conclusion.

In September 1966, ENEA and the USAEC sponsored a Seminar on Intense Neutron Sources (SINS) at Santa Fe, New Mexico. It was organized under the auspices of EANDC and the EACRP. SINS was the first international conference dealing with the design, performance and research capabilities of very-high-flux reactors and other very-high-neutron-flux producers. Approximately 170 participants discussed existing steady-state high-flux reactors in the United States, western Europe, and the USSR, as well as proposed designs for higher-flux devices. The conference also concerned itself with existing and planned pulsed neutron sources with and without reactor assemblies, such as IBR at Dubna, SORA proposed by EURATOM at Ispra, the Harwell Superbooster proposed in the U.K. and the General Atomic Booster proposed in the U.S. Linear accelerators, cyclotrons and synchrotrons were discussed as they are related to this field. Four international panels compared the relative advantages of all these devices in various research fields in solid-state and nuclear physics. The conference conclusions were submitted to atomic energy authorities of the participating countries as a joint EANDC-EACRP report. A list of International Conferences sponsored by the EANDC is given in Appendix II. With the establishment of the International Nuclear Data Committee (INDC) and its growing effectiveness in the nuclear data field, EANDC has transferred the bulk of its responsibility for sponsoring international meetings in the nuclear data field to the INDC.

Perhaps the most noteworthy accomplishment of EANDC is the body of

nuclear measurements that has accumulated and is still growing from the Committee's efforts. Many of the best cross sections of the fissile isotopes now available were obtained from measurements promoted by EANDC in the U.K. and France. Very difficult and important measurements of $\bar{\nu}$ (average number of neutrons released per neutron captured in the isotope) for a number of fissionable isotopes have been completed in Sweden and in the U.K.

HIGHLIGHTS OF THE EANDC ACCOMPLISHMENTS IN 1970 AND 1971

By far the most important accomplishment of the EANDC in the biennial period 1970-71 was its Conference on Neutron Standards and Flux Normalization, held at the Argonne National Laboratory, October 21-23, 1970. The Proceedings of this Conference were published by the United States Atomic Energy Commission in a book entitled "Neutron Standards and Flux Normalization," and constitutes one of the definitive volumes in the area of neutron standardization.

Since its inception, the EANDC has witnessed a fundamental change in the character of nuclear data. The field has shifted from a qualitative to a highly quantitative basis, with emphasis on the provision of precise nuclear quantities of critical importance to nuclear energy programs, primarily reactor development. The required measurements are difficult, complex and particularly demanding of precise, well-verified, and readily usable neutron standards. The EANDC recognized the increased importance of neutron standards and sponsored the Argonne Symposium with the objectives of: 1) quantitatively assessing the status of the field; 2) defining available precisions; 3) identifying outstanding problems; 4) formulating recommendations; and 5) providing guidance for future work.

Briefly, the hydrogen cross section was judged to be adequately known and that of carbon to be satisfactory between 0.5 and 1.5 MeV. Knowledge of the Li^6 and B^{10} cross sections has improved considerably in recent years, but further work on their total cross sections is desirable. The status of the U^{235} fission cross section, the cross section on which the whole nuclear energy program of all countries is based, remains unsatisfactory. New measurements indicate that the best available data agree to about 3% below 1 keV. Above this energy the situation deteriorates until at 15 MeV the cross section is not known to better than 15%. Recent measurements on $\bar{\nu}$ of Cf^{252} showed a distinct discrepancy between the high measurements of the liquid scintillator results and the low measurements of manganese bath and boron pile results.

Reference cross sections for capture were briefly reviewed. Gold may still be the best reference material, though better data are needed above 350 keV. However, other nuclides should be studied as possible

capture reference standards. The present status and recommendations for future work in the area of standards were clearly stated at the end of the Conference by the Chairmen of the working groups which reported on their specific assignments. These recommendations are published in the Proceedings of the Conference.

The Argonne Symposium stimulated more work in the area of standards and it appears now that several measurements are underway which will resolve the discrepancies which were pointed out at the Symposium. The success of this Conference and its significant impact on the area of neutron standards are largely due to the brilliant direction given to it by Dr. A.B. Smith of Argonne National Laboratory.

MEETINGS OF THE EANDC

During 1970 and 1971 the EANDC held two meetings, one at Argonne National Laboratory, 26-29 October 1970; and the other in the Hotel Tivoli in Lisbon, Portugal, 11-15 October 1971. The membership of the EANDC for the biennial period is given in Appendix III. There were many changes in the membership of the EANDC during this period. For the 14th Meeting Professor Aten and Dr. Fröhner replaced Drs. Spaepen and Beckurts for the EURATOM delegation, Dr. Tsukada of Japan replaced Dr. Momota and Dr. Hürlimann of Switzerland replaced Dr. Weinzierl of Austria. Mr. Rosén, the ENEA representative, could not be present at the 14th Meeting and the ENEA was represented by Mr. Potter. Dr. Hürlimann of Switzerland was also unable to attend. At the 15th Meeting, Dr. W.G. Cross of Canada, replaced G.C. Hanna as Executive Secretary. J.L. Rowlands and M. Sowerby, of the U.K., replaced E.R. Rae and R. Batchelor. P. Ribon, of France, attended in the place of R. Joly. R.E. Chrien, of the U.S., replaced M.S. Moore. However, M.S. Moore attended the meeting instead of A.B. Smith. G.A. Kolstad was, unfortunately, unable to attend.

Although it is desirable to have some rotation of membership in the EANDC, the Committee was seriously impeded in its progress by the large turnover of membership in the last two years. In order for the Committee to function effectively, continuity of membership is of vital importance. A large change in membership required, for example, that such important subjects as standards and discrepancies be treated at the 15th Meeting by the Committee as a whole rather than by subcommittee action. A great deal of time was also required at the Committee meeting to explain what had happened at the previous Committee meetings, resulting in slower progress than usual. Even so, the free exchange of information characteristic of past EANDC meetings prevailed throughout.

MODIFICATION OF THE EANDC TERMS OF REFERENCE

Mr. I.G.K. Williams, Deputy Director-General of ENEA (now NEA), in a letter of 29 September 1970, requested the Chairman of the EANDC

to consider modifying the "Terms of Reference" of the EANDC which was approved by the Steering Committee in September of 1959. The reason for requesting the Committee to reconsider its framework was to enable the Committee to carry out its tasks in as expeditious and efficient a manner as possible, while adapting the framework to conform with OECD rules of procedure and other current circumstances. Unfortunately, the procedures evolved by the Committee during its period of operation were significantly different from the rules of procedure of the OECD for other types of committees on a number of points, and recently more rigorous enforcement of the OECD rules of procedure have been exerted by the ENEA Secretariat. Mr. Williams proposed a revised Terms of Reference for the EANDC to consider and requested that it be approved at the 14th Meeting, so it could be brought to the attention of the Steering Committee of the ENEA at its meeting in April 1972. The EANDC considered the proposed revisions at its 14th Meeting in October 1970, but most members had received them too late to permit adequate consultations with the appropriate authorities in their countries prior to the meeting of the EANDC. The Committee was of the opinion that close consultation with the appropriate authorities was essential to the revision of its Terms of Reference and thought it more appropriate for the Committee to consider the revised Terms of Reference at its 15th Meeting in Lisbon, in October 1971. The revised Terms of Reference given in Appendix IV was adopted by the Committee at its 15th Meeting.

NUCLEAR DATA

From the scientific standpoint, the 1970-71 Meetings of the EANDC showed that significant progress is being made in a number of areas. New facilities are being constructed in a number of countries and modifications to existing facilities continue in spite of reduced funds. The extensive progress reports which are listed in Appendix V show that there have been considerable improvements in the knowledge of standard cross sections and that several outstanding discrepancies have been resolved.

The differences in the spectrum of prompt fission neutrons determined by integral measurements and by microscopic measurements remain unresolved. A complete review of the microscopic measurements, as well as new measurements by A.B. Smith of Argonne, have shown the nature and extent of the differences. Previous experiments were criticized and new measurements recommended. It is now accepted that the Maxwellian shape is inadequate to explain the spectrum, particularly at and below the peak of the spectrum. Considerable further work must be done in this area to resolve these fundamental discrepancies.

International cooperation in measurement, sample exchange, data compilation and evaluation continues to be of mutual benefit.

REQUEST LIST

At the 14th Meeting of the EANDC the members of the Committee presented detailed and careful reviews of the current Request List for neutron data measurements. Their individual reports were given an "L" distribution and brought to the attention of local Data Committees.

The EANDC agreed that their requests should be merged with those from non-OECD countries and the world-wide Request List produced under the responsibility of the IAEA. The letter transferring the EANDC Request List for Neutron Data Measurements (RENDA) to the Nuclear Data Section of the International Atomic Energy Agency is given in Appendix VI. The Chairman of the International Nuclear Data Committee, Dr. George A. Kolstad, requested the EANDC to review the first World Request List prior to its publication. The EANDC agreed that its members would review the first World Request List and send comments to the Nuclear Data Section of the IAEA prior to June 1, 1972. Brief reviews of requests were given at the 15th EANDC Meeting as follows: Condé ($\bar{\nu}$ requests); Story (moderator requests); Cross (thermal cross sections); Chrien (resonance parameters, non-fissile nuclei); Ribon (resonance parameters, fissile nuclei); Moore (fast fission); and Fröhner (fast capture). Moore and Nève also spoke on requests for data for design of fusion reactors.

J.J. Schmidt, of the Nuclear Data Section of the IAEA, reported that the first World Request List would include only data for nuclear reactors and would not include any requests for fusion or safeguards. The EACRP recommended that the EANDC include requests for evaluations in RENDA. The EANDC finally decided that evaluation requests should not be included, except in the sense that any request is a request for evaluated data. Requests for evaluated data will not be included in the World Request List.

SAMPLES

The role of the EANDC in the field of samples is to examine requests for loans of samples and special materials (usually enriched isotopes) for nuclear data measurements. The Committee considers the proposed measurements and their relation to the "RENDA" list, checks that no duplication occurs, and forwards its recommendations to the Director of Physical Research of the USAEC. The availability of samples through this channel has been the only way that some of the important measurements have been made in the past and probably will be made in the future.

The important matter of the possible activation of loan samples in the course of a measurement was discussed at both the 14th and 15th

EANDC Meetings. The present rules applied by the USAEC specify a maximum activity level per sample. The U.S. Nuclear Data Committee has made recommendations about the maximum activity level, but unfortunately, the recommendations of the USNDC have not been acted upon by the USAEC. Therefore, the activity limitations established by Oak Ridge National Laboratory still apply to the loan, both foreign and domestic, of separated stable isotopes by the USAEC. However, if there are high priority cross section requests which European laboratories would like to measure, but are not willing to undertake because of expected activation of an expensive sample, the EANDC could make a special recommendation for an exception to these rules.

RELATIONS OF THE EANDC WITH OTHER ORGANIZATIONS

The exchange of observers attending the full meeting between the EANDC and the EACRP was continued during this period. Fred Maienschein of ORNL attended the 14th Meeting of the EANDC as the EACRP representative and H.W. Küsters of KFK Karlsruhe attended the 15th Meeting of the EANDC. The Head of the Nuclear Data Section of the IAEA, Dr. J.J. Schmidt, attended as an observer for most of the Agenda Items of both the 14th and 15th Meetings of the EANDC.

The relations between the INDC and the EANDC were discussed at some length during both meetings. An adequate mutual information exchange between the two Committees is insured by the fact that several persons are members of both the INDC and the EANDC. It was agreed that the effectiveness of handling technical matters by the International Nuclear Data Committee would be carefully observed and that full support would be given to the INDC by the EANDC. The Nuclear Data Section of the IAEA now appears to be capable of handling the World Request List and therefore this activity has been transferred from the EANDC to the INDC.

THE FUTURE OF THE EANDC

The accomplishments of the EANDC over the past 10 years demonstrate that it has provided leadership and coordination in nuclear data activities throughout Europe and North America, with primary concern for those processes fundamental to nuclear energy development and, more especially, fission reactors. The primary interest of the Committee has been nuclear data for fission reactors since the need for these data has long been recognized and highly refined. However, because the field has shifted from a qualitative to a highly quantitative basis, with emphasis on the provision of high precision nuclear data, and because many measurements have been made in the last 10 years, the emphasis of the Committee has gradually shifted away from measurements toward evaluations. The change in membership of the Committee has also reflected this shift. The original members of the Committee were primarily concerned with measure-

ments and secondarily concerned with evaluation, whereas the present Committee has as many members who are primarily concerned with evaluation as those who are concerned with measurements. It is obvious that evaluation has played an increasingly important role in the EANDC. It would be a mistake, however, for the EANDC to assume that the role of evaluation now exceeds that of measurement. Such a position would imply that the nuclear design of reactors is now fully understood and ignores the challenge posed by the necessity of breeder reactors for meeting our future power requirements with a clean, cheap source of energy.

In the reactor field itself, the EANDC can continue to provide the leadership and coordination of nuclear data activities for both the United States and Europe. The nuclear reactor designer often sees the nuclear data used in his reactor calculations as a set of mathematical parameters unrelated to a physical system. The EANDC can supply the much needed ingredient of physical understanding to the nuclear data needs for reactor design. Although the needs and emphasis for nuclear data for reactor design are primarily experimental, there are still many regions where important information will remain experimentally inaccessible and major reliance must continue to be placed upon theoretical estimates. In these cases physical understanding of the processes taking place is essential. However, if the EANDC confines its activities to fission reactors alone, it will gradually become less effective because the need for new and interesting nuclear data for reactor design will become less important in the near future.

The establishment of the INDC on a continuing basis by the IAEA in 1968 has certainly affected the activities of the EANDC. The broadened collaboration envisaged by the INDC carries with it several advantages and some drawbacks. It brings to bear on a common applied research problem a wider range of talents, techniques and experimental facilities. It helps to avoid undesirable duplication of effort and increases specific productivity in this subject throughout the world. On the other hand, it increases by one the number of committees on which nuclear data specialists must serve and introduces the problem of reconciling the interests of a much larger group of nations.

The EANDC has transferred its data compilation activities in the form of "RENDA" to the INDC. The INDC and the IAEA are well set up to organize and run international conferences. However, in the area of measurements, equipment and techniques, research materials, and equipment personnel exchange, the relationships which have been developed between the European and American laboratories through the EANDC are much closer than those which have been developed between these laboratories and those in the remainder of the world. The INDC is an excellent mechanism for information exchange, but it has not led to the cooperative projects which have been so successful within the EANDC. Even in the area of information exchange, the EANDC has run two outstanding conferences which required close liaison between the individuals involved and probably could not have been as successful had they been run by the INDC. The two

conferences are: 1) the EANDC Symposium on Absolute Determination of Neutron Flux in the Energy Range of 1 to 100 keV, held at Oxford in 1963; and 2) the Symposium on Neutron Standards and Flux Normalization, held at Argonne National Laboratory, October 21-23, 1970.

In recent years, it has become increasingly clear that nuclear data are needed for such applications as controlled thermonuclear fusion, the safeguards of nuclear material, medical applications, and industrial and environmental analysis. The EANDC may wish to consider a gradual change in the composition of its membership to reflect these new needs and thus supply the kind of leadership in the procurement, compilation and dissemination of nuclear data for these new programs as it has in the past for fission reactors.

If the EANDC is to be a leader in the field of nuclear data in the future, it should, in our judgment, expand its scope to include nuclear data activities in the OECD countries, not only in the fission reactor area, but in the controlled fusion reactor program, medical applications, safeguards of nuclear material, and nuclear data for industrial and environmental analysis.

EANDC MEETINGS

Formation Meeting		
	Saclay, France	28-29 Sept. 1959
1.	Stockholm, Sweden	4-8 March 1960
2.	Oak Ridge, Tenn., U.S.A.	15-18 Nov. 1960
3.	Harwell, England	18-21 July 1961
4.	Casaccia & Ispra, Italy	8-10 April 1962
5.	Chalk River, Canada	4-8 February 1963
6.	Athens, Greece	11-15 Nov. 1963
7.	Karlsruhe, West Germany	20-24 July 1964
8.	Los Alamos, New Mexico, U.S.A.	17-21 May 1965
9.	Ascot, England	18-20 April 1966
10.	Istanbul, Turkey	20-24 February 1967
11.	Montreal, Canada	11-14 March 1968
12.	Brussels, Belgium	20-24 January 1969
13.	Bournemouth, England	6-10 October 1969
14.	Argonne, Illinois, U.S.A.	26-29 October 1970
15.	Lisbon, Portugal	11-15 October 1971

International Conferences Sponsored by EANDC

<u>Conference</u>	<u>Location</u>	<u>Date</u>
Symposium on Neutron Time of Flight Methods	Saclay	24-27 July 1961
Isotope Supply and Sample Preparation	Geel	6-8 Aug. 1963
Symposium on Absolute Determination of Neutron Flux in the Energy Range 1 to 100 keV	Oxford	10-13 Sept. 1963
Automatic Acquisition and Reduction of Nuclear Data	Karlsruhe	20-24 July 1964
Round Table Conference on High Precision Chemical Analysis of Substances of Interest to Nuclear Energy	Brussels	18-22 Jan. 1965
International Conference on Study of Nuclear Structure with Neutrons	Antwerp	19-23 July 1965
Seminar on Preparation and Standardization of Isotopic Targets and Foils	Harwell	20-21 Oct. 1965
2nd Round Table Conference on High Precision Chemical Analysis of Substances of Interest to Nuclear Energy	Brussels	November 1965
Seminar on Intense Neutron Sources	Santa Fe	19-23 Sept. 1966
Symposium on Neutron Standards and Flux Normalization	Argonne	21-23 Oct. 1970

Members of the EANDC for the Biennial Period 1970-72

A.H.W. Aten, Jr., Euratom, Geel, Belgium
R. Batchelor, AWRE, Aldermaston, U.K.
R.E. Chrien, BNL, Brookhaven, USA
H. Condé, RIND, Stockholm, Sweden
W.G. Cross, AECL, Chalk River, Canada
F.H. Fröhner, KFK, Karlsruhe, Germany
G.C. Hanna, Chalk River, Canada
W.W. Havens, Jr., Columbia University, New York, USA
T. Hürlimann, EIR, Würenlingen, Switzerland
R. Joly, CEA Saclay, France
G.A. Kolstad, USAEC, Washington, USA
M. Nève de Mévergnies, Mol, Belgium
M.S. Moore, LASL, Los Alamos, USA
W.T. Potter, ENEA, Paris, France
E.R. Rae, Harwell, U.K.
P. Ribon, CEA, Saclay, France
J.A.G. Rosén, ENEA, Paris, France
J.L. Rowlands, AERE, Winfrith, U.K.
A.B. Smith, Argonne, USA
M.G. Sowerby, AERE, Harwell, U.K.
J. Story, AEE, Winfrith, U.K.
K. Tsukada, JAERI, Japan

EANDC TERMS OF REFERENCE

as adopted at the Fifteenth Meeting

INTRODUCTION

Pursuant to the agreement reached between the OEEC Member and Associate Member countries and the Euratom Commission at the meeting on 18th June 1959 of the Steering Committee of the OEEC European Nuclear Energy Agency (ENEA), and subject to ratification by the appropriate authorities in the United States and Canada, the OEEC Member and Associate Member countries agreed to cooperate through the establishment of a "European-American Nuclear Data Committee" (hereinafter called "the Committee") in order to assure the maximum advancement of the peaceful uses of nuclear properties of general importance. In the light of the changed circumstances since then, and after consultations involving the Committee, ENEA and the appropriate authorities in interested countries, the following revised Terms of Reference have been adopted at a meeting on of the Steering Committee for Nuclear Energy of OECD.

I - SCOPE

The Committee shall be concerned primarily with the measurements of nuclear cross-sections and other basic nuclear data of general relevance to nuclear energy programmes, other peaceful uses of nuclear science, and the pre-commercial development of laboratory instruments and techniques related thereto. The responsibility of the Committee shall include the following:

1. Measurements

It shall critically review the existing state of knowledge of nuclear cross-sections and constants, identify those gaps in the knowledge which are of special significance to the nuclear energy programmes of the countries concerned and recommend the most expeditious methods for obtaining the required measurements.

2. Equipment and Techniques

It shall review the facilities, techniques and manpower available for the determination of nuclear cross-sections and constants, consider present and future needs for techniques, equipment and facilities and recommend appropriate action.

3. Research Materials

It shall keep informed of special materials available for research and facilitate the pooling and exchange of such samples as required.

4. Equipment and Personnel Exchange

It shall consider and recommend pooling and exchange of equipment and personnel where appropriate.

5. Nomenclature

It shall make continuing studies of the nomenclature used in this field and recommend methods for the presentation of nuclear cross-sections and constants.

6. Compilation of Data

It shall receive reports from and comment on the activities of relevant compilation groups.

7. Technical meetings

It shall recommend the holding of and shall assist in the sponsorship of technical symposia to further the objectives of the Committee.

II - MEMBERSHIP

The Committee shall consist of sixteen members: four from the Euratom countries and the Euratom Commission acting together, four from the United States, three from the United Kingdom, one from Canada, one from Japan, two from the other OECD countries acting together, and one from ENEA.

Only technically-trained individuals with broad responsibilities for the direction of the relevant programmes in their respective countries or organizations shall be appointed. Appointments should be made in such a way that they provide continuity of membership, while allowing for such rotation as may be desired.

III - ORGANIZATION

A Chairman and a Vice-Chairman shall be appointed for a two-year term. The order of rotation of the Chair shall be (1) the United States, (2) the Euratom countries and Commission acting together, (3) the United Kingdom, (4) Canada, (5) Japan and (6) other OECD countries acting together. The order of rotation of the Vice-Chairman shall be the same as that for the Chairman with the Vice-Chairman coming from the country or countries next in order in the list given above.

Two Secretaries shall be appointed. One, designated the Scientific Secretary, shall be a member of the Committee and shall be drawn from the United States or Canada when the Chairman is from North America, or from Europe when the Chairman is from elsewhere. The Scientific Secretary shall be chosen by the Chairman in consultation with the other members of the Committee. The other, designated the Secretary, shall be provided by the ENEA.

The Secretariat of the Committee shall be provided by ENEA. The Secretariat shall be responsible for assisting the Committee where necessary in implementing actions or recommendations of the Committee and in liaison with other international organizations and non-OECD countries.

IV - MEETINGS

Intervals between meetings shall normally be about one year. In fixing the place of meetings, which shall normally be held in accordance with the conventions established by the Committee, consideration shall be given to the interest of the Committee in meeting where relevant scientific personnel and facilities are available. As necessary the Secretariat shall assist any organization which is host to the meeting. The host country or group shall appoint a "Local Secretary" to assure appropriate arrangements for meetings.

A notice of the meeting and draft agenda shall be sent by the Chairman so as to be received by the members of the Committee and the Secretary at least thirty days in advance of the meeting.

Observers from OECD Member countries may be invited by the Chairman to attend meetings or portions of meetings of the Committee. When the Committee wishes to invite observers from non-OECD countries or other international organizations, such arrangements shall be made by or with the approval of the Director General of ENEA.

V - RECORDS, REPORTS AND COMMITTEE FILES

Documents for meetings shall normally be distributed by the originators to members of the Committee and the Secretary so as to be received at least two weeks in advance of meetings.

A summary record of each meeting shall be prepared by the Scientific Secretary and shall be sent by him to the Secretary and each of the members not later than thirty days after the close of the meeting. Amendments to the summary record may be submitted to the Scientific Secretary within sixty days after the close of each meeting. The amended summary record shall then be distributed.

The Committee shall issue such reports and recommendations as it may consider appropriate and shall establish rules regarding their distribution.

A continuing official file (archive) shall be kept by the Secretariat to which copies of Committee correspondence shall be provided. The Secretariat shall be responsible for arranging the issue and distribution of reports and other documents arising out of the Committee's work.

VI - AMENDMENTS

Proposals for amendments of the above terms of reference may be made by the Committee, the appropriate authorities in interested countries or by ENEA. After all necessary consultations with the others concerned, amendments shall be adopted formally at a meeting of the Steering Committee for Nuclear Energy of OECD.

LIST OF EANDC DOCUMENTS ISSUED SINCE THE
13TH EANDC MEETING (October 1969)Committee Papers

- 82U Distribution List of EANDC documents
- 83A Complete Minutes of the Thirteenth Meeting of the Committee
- 83U Technical Minutes of the Thirteenth Meeting of the Committee
- 84U Isotope Separation Facilities
- 85U RENDA Compilation of EANDC Requests for Neutron Data Measurements
- 86L Fifth Biennial Report of the Activities of EANDC (P. Weinzierl
and M. Nève de Mévergnies)
- 87A Complete Minutes of the Fourteenth Meeting of the Committee
(G.C. Hanna)
- 87U Technical Minutes of the Fourteenth Meeting of the Committee
(G.C. Hanna)

Canadian Documents

- (Can)42L Progress Report, September 1969-September 1970, comp. by G.C. Hanna
- (Can)43L Review of the 1970 EANDC Request List - Thermal Neutron Capture
Cross Sections and Capture Resonance Integrals, by G.C. Hanna
- (Can)44L Canadian Progress Report, September 1970 to September 1971
(W.G. Cross)
- (Can)45L Canadian List of Requests for Measurement, October 1971
(W.G. Cross)

Euratom Documents

- (E)124U Neutron Nuclear Data Compilation and Evaluation - Past,
Present and Future, by J.J. Schmidt
- (E)125U Evaluated Microscopic Neutron Cross Sections and 26 Group
Constants for Cd, by H. Bachmann et al

- (E)126AL Examen critique des sections efficaces neutroniques du ^{240}Pu , by J.P. L'Hériteau and P. Ribon
- (E)127U Progress Report on Nuclear Data Research in the Euratom Community, January 1 to December 31 1969
*
- (E)128U Microscopic Neutron Nuclear Data and 5-group Cross Sections for the Actinides ^{231}Pa , ^{232}U , ^{234}U , ^{236}U , ^{237}U , ^{237}Np , ^{238}Np , ^{236}Pu , ^{238}Pu , ^{241}Am and ^{242}Cm (B. Hinkelmann)
- (E)129AL Measurement of the ^{235}U Fission Cross Section in the Resonance Region and Discussion of the Normalization Differences, by A.J. Deruytter and C. Wagemans
- (E)130L Scattering Cross Section of ^{235}U below 100 eV, Determination of Γ_n and J of Resonances, by F. Poortmans, H. Ceulemans, E. Migneco and J. Theobald
- (E)131AL Measurement and Normalization of the ^{239}Pu Fission Cross Section in the Low Resonance Region, by A.J. Deruytter, C. Wagemans and G. Penning
**
- (E)133AL The Half Life of ^{234}U , by P. DeBièvre et al
- (E)134L Some Comments on Requests in RENDA-70 for Heavy Element Resonance Parameters, by R. Joly
- (E)135L Review of RENDA Requests for Fast Neutron Capture Measurements, by F.H. Fröhner
- (E)136L Remarks on RENDA Requests for Threshold Cross Sections, by A.H.W. Aten
- (E)137L Remarks on Renda Requests for Threshold Cross Sections (A.H.W. Aten Jr.)
- (E)138AL Evaluation des Données Neutroniques de ^{239}Pu (P. Ribon and G. Le Coq)
- (E)139AL Some Comments on Requests in RENDA-70 for Heavy Element Resonance Parameters (R. Joly and P. Ribon)
- (E)140U Progress Report on Nuclear Data Research in the Euratom Community, Jan-Dec. 1970
- (E)141A A List of Nuclear Data Requests for Fusion Reactor Technology (M. Nève de Mévergnies and A. Paulsen)
- (E)142L Propriétés des Niveaux Induits par les Neutrons de Résonance dans les Isotopes Stables de Néodyme (H. Tellier)

*(E)128 Not assigned

** (E)132 Not assigned

Japanese Documents

- (J)16AL Bibliography for Thermal Neutron Scattering (2nd Edition)
July 1969
- (J)17AL Average Level Spacings and the Nuclear Level Density
Parameter, August 1969
- (J)18AL Evaluation of Thermal Neutron Scattering Cross Sections for
Reactor Moderators (Summary Report) September 1969
- (J)19L Progress Report, August 1969 - June 1970, by T. Momota
- (J)20AL Japanese List of Requests for Measurements September 1970
- (J)21AL Japanese List of Requests for Evaluation, May 1971
- (J)22L Progress Report, July 1970 to June 1971 (T. Momota)
- (J)23AL Japanese List of Requests for Measurement, September 1971

Documents from other OECD countries

- (OR)93L Progress Report from Switzerland, June 1970, edited by T. Hürlimann
- (OR)94L Progress Report to EANDC from Austria, January 1970, edited by
P. Weinzierl
- (OR)95L Progress Report from Denmark, August 1970, edited by H. Bjerrum
Møller and C.J. Christensen
- *(OR)96L Progress Report from Spain, September 1970, edited by F. Verdaguer
- (OR)99L Progress Report on Nuclear Data Research from Sweden, August 1970,
edited by H. Condé
- **
(OR)101L Progress Report from Portugal, August 1970, edited by F. Gama Carvalho
- (OR)102L Review of $\bar{\nu}$ Requests in RENDA, 1970, by H. Condé
- (OR)103AL Neutron Capture Cross Sections in F, Mg, Al, Si, P and S from
20 to 80 keV, by G. Nyström, B. Lundberg and I. Bergqvist
- (OR)104AL Gamma Rays from Inelastic Neutron Scattering in Oxygen
(B. Lundberg, L.G. Strömberg and H. Condé)
- (OR)105L Progress Report to EANDC from Austria, August 1971 (P. Weinzierl)
- (OR)106L Progress Report to EANDC from Denmark, August 1971 (H.B. Møller)
- ***
(OR)108L Prompt $\bar{\nu}$ in Spontaneous and Neutron Induced Fission of ^{236}U and
the Half Life for Spontaneous Fission (H. Condé and M. Holmberg)
- *(OR)97 & 98 Assigned to Progress Reports which have not been produced
- ** (OR)100 " " "
- *** (OR)107L Not issued. (Greece)

- (OR)109L Progress Report to EANDC from Portugal, August 1971
(F. Gama Carvalho)
- *
(OR)111L Progress Report on Neutron Physics Research in Sweden,
August 1971 (H. Condé and T. Wiedling)
- (OR)112L Progress Report to EANDC from Switzerland, June 1971
(T. Hürlimann)
- (OR)113L Nuclear Data Activities at the Cekmece Nuclear Research and
Training Center - Turkey, January-September 1971 (C. Ertek)

U.K. Documents

- (UK)118AL The Half-lives of ^{198}Au and ^{148}Pm , by M.J. Cabell and M. Wilkins
- (UK)119AL Structure in the Fission Cross-section of ^{235}U , by B.H. Patrick,
M.G. Sowerby and M.G. Schomberg
- (UK)120AL U.K. Nuclear Data Progress Report Mid 1968, by E.R. Rae
- (UK)121AL Measurements of $\bar{\nu}_p$ for ^{239}Pu between 40 keV and 1.2 MeV,
by D.S. Mather, P.F. Bampton, G. James and P.J. Nind
- (UK)122AL The Ratio of the $^6\text{Li}(n,\alpha)$ to $^{10}\text{B}(n,\alpha)$ Cross-section from
10 eV to 80 keV and recommended values of the $^{10}\text{B}(n,\alpha)$
Cross-section, by M.G. Sowerby, B.H. Patrick, C.A. Uttley
and K.M. Diment
- (UK)123AL The ENADC-EACRP Joint Sub-Committee for Evaluations - Report
of the 5th Meeting in London, 10-12 June 1970, by B.H. Patrick
- (UK)124AL An Activation Technique for the Absolute Calibration of a Long
Counter, by J.M. Adams, A.T.G. Ferguson and C.D. McKenzie
- (UK)125AL Evaluation of $\bar{\nu}$ for ^{239}Pu , by D.S. Mather and P.F. Bampton
- (UK)126AL Elastic and Inelastic Scattering of Neutrons in the Energy Range
1.0-5.0 MeV by Natural Mo, by R.E. Coles and D. Porter
- (UK)127AL Evaluation of Cross-sections and Angular Distribution for Total
Elastic and Inelastic Neutron Scattering from Carbon in the
Energy Range 1 eV-15 MeV, by D. Porter and K. Wyld
- (UK)128AL A Code of Practice for the Statement of Accuracy, by P.J. Campion,
J.E. Burns and A. Williams
- (UK)129A On the Requests in RENDA for Nuclear Data for Moderators (draft),
by J.S. Story
- * (OR)110L Not issued. (Spain)

- (UK)129L On the Requests in RENDA for Nuclear Data for Moderators (final version), J.S. Story
- (UK)130AL Concerning the Half-life of ^{144}Ce , by M.J. Cabell and M. Wilkins
- (UK)131A On the Requests in RENDA for Nuclear Data for Resonance Parameters of Non-fissile Materials, by E. Rae
- (UK)132AL Evaluation of $\bar{\nu}$ for ^{235}U (AWRE 0 55/71), D.S. Mather and P.F. Bampton
- (UK)133AL Activation Measurements of the Cross Section of the Reaction $^{147}\text{Pm}(n,\gamma)^{148}\text{Pm}$ for Reactor Neutrons, by M.J. Cabell (published in J. Inorg. Nuc. Chem. 32 3433(1970))
- (UK)134AL UK Nuclear Data Progress Report, Mid 1969-Mid 1970 (E.R. Rae)
- (UK)135AL An Isomeric State of ^{241}Pu (M.J. Cabell and M. Wilkins) published in J. Inorg. Nuc. Chem 33 903 (1971)
- (UK)136AL Evaluation of $\bar{\nu}$ for ^{238}U (AWRE 0 44/71), by D.S. Mather and P.F. Bampton

U.S. Documents

- (US)133A Compilation of Requests for Nuclear Cross Section Measurements (draft version, November 1969), by L. Stewart, H.T. Motz and M.S. Moore
- (US)134A Nuclear Physics Studies with Fast Neutrons: A Survey, by J.C. Hopkins
- (US)135A Comparison of Calculations with Integral Experiments for Plutonium and Uranium Critical Assemblies, by C.C. Cremer, R.E. Hunter, J.J.H. Berlijn and D.R. Worlton
- (US)136A Neutron Fission Cross Sections for ^{231}Th , ^{233}Th , ^{235}U , ^{237}U , ^{239}U , ^{241}Pu , and ^{243}Pu from 0.5 - 2.25 MeV using (t,pf) Reactions, by J.D. Cramer and H.C. Britt
- (US)137A Status of the ^{10}B Absorption Cross Section, by L. Stewart
- (US)138U Angular Distributions in Neutron-induced Reactions, Volume 1, Z=1 to 20 - BNL 400
- (US)139L Remarks on the Neutron-induced Fission Spectrum, by C.R. Lubitz and L. Stewart
- (US)140A Fission Cross Sections of ^{237}Np from Pommard, by W.K. Brown, D.R. Dixon and D.M. Drake

- (US)141A Neutron Flux Determination in Time-of-Flight Cross-Section Measurements using Underground Nuclear Explosions, by W.K. Brown, P.A. Seeger and M.G. Silbert
- (US)142A An Evaluation of ^{235}U Neutron Cross Section Data for Energies above 15 keV, by H. Alter and C. Dunford
- (US)143U Reports to AEC Nuclear Cross Sections Advisory Committee, Argonne National Laboratory, May 20-22, 1970, compiled by R.E. Chrien
- (US)144L Stable Isotope Cross Section and Heavy Element Research Pool Inventory, May 1970
- (US)145A Fast Neutron Total and Scattering Cross Sections of ^{238}U , by P. Lambropoulos
- (US)146A Safeguard Papers from ANS/AIF Winter Meeting - November 1968, February 20, 1970
- (US)147A Some Remarks on Prompt Fission Neutron Spectra, May 1970, by A.B. Smith
- (US)148L Fast Fission Requests in RENDA, October 1970, by M.S. Moore
- (US)149L Review of Requests for Neutron Scattering Cross Sections, October 1970, by A.B. Smith
- (US)150U Reports to NCSAC Livermore Meeting December 1970 (R.E. Chrien)
- (US)151A Evaluated Nuclear Data for Hydrogen in the ENDF/B format (L. Stewart, R.J. LaBauve and P.G. Young)
- (US)152A Nuclear Fusion Resonance Reactions of Possible CTR Interest (J.R. McNally)
- (US)153L Note on the Prompt-Fission Neutron Spectra of ^{235}U and ^{239}Pu (A.B. Smith)
- (US)155AL Survey of Research Reactors 1970 (NBS Comm. on Nuclear Science)
- (US)156U Reports to NCSAC Durham Meeting, May 1971 (R.E. Chrien)
- (US)157A Check List of Neutron Cross Section Discrepancies, May 1971 (H. Goldstein, H. Alter and M.H. Kalos)
- (US)158A Survey of Man power and Facilities to meet the needs of the US Applied Nuclear Energy Program, May 1971
- (US)159A Report of the NCSAC Ad hoc Subcommittee on Safeguards, April 1971.

- (US)160A Recommendation for the Preparation of Modular Size Metallic Isotope Samples for Neutron Cross Section Measurements (R.C. Block and A.B. Smith)
- (US)161AL US Research with Small Reactors, August 1971 (M.S. Moore)
- (US)162A Cross Section Requirements for Fusion Reactors, July 1971
- (US)163A Status of Fast Fission Cross Sections, September 1971 (M.S. Moore)

Columbia University in the City of New York | *New York, N. Y. 10027*

DEPARTMENT OF PHYSICS

Pegram Nuclear Physics Laboratories

538 West 120th Street

November 10, 1970

Dr. George A. Kolstad
Chairman
International Nuclear Data Committee
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear George:

At the meeting of the EANDC at the Argonne National Laboratory, October 26-29, 1970, the Committee voted unanimously to combine the non-EANDC Request List for Neutron Nuclear Data Measurements with RENDA to form one world-wide request compilation. The Committee also considered several questions and problems which may arise as a result of the combination of these two request lists and recommends the following:

1. The combined world request list should be prepared and screened as in the past, by local data committees charged with this responsibility. The world request list should be produced by the IAEA. The Committee suggest that the combined request list be a joint cooperative effort between IAEA and ENEA.
2. Responsibility for the detailed review of the world request list should pass from the EANDC to the INDC. Provision should be retained for computer retrieval of a specialized request list to facilitate reviews by local data committees and task groups as in the past. Some changes in format, permitting requests to be combined, should be considered.
3. The present distribution to EANDC countries should be retained.
4. The extension of the request list to include the data required for nuclear safeguards, fusion reactors, and medical applications appears to be in order. However, extreme caution should be used in introducing these requests, since unrestricted introduction of these requests will expand the request list so much that it will become useless.
5. The Committee has recognized that requests for evaluations are also of interest. The proper way of formalizing requests for evaluations, however, remains to be determined.

The EANDC wishes the INDC the best of luck in the preparation and distribution of a world-wide request list and hopes that the combined list will be a more useful document than the present request list.

Sincerely yours,

A handwritten signature in cursive script that reads "Bill".

W. W. Havens, Jr.
Chairman, EANDC

WVH:ss
cc: G. C. Hanna
R. Joly

