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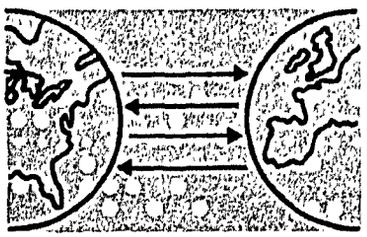
The European-American Nuclear-Data Committee



Numbers needed for fission power development can not be measured by any one country as fast as they are wanted. But the cooperation arranged by this 16-man group has enabled 21 nations to improve measurement, collection, storage and dissemination of information. Under their cognizance come measurement, facility sharing, personnel exchange and arrangement of symposia.

by William W. Havens Jr, George A. Kolstad, Alan B. Smith and Richard F. Taschek

NUCLEAR DATA REQUIRED for today's atomic-power programs are largely gathered, stored and disseminated under the supervision of the European-American Nuclear-Data Committee, a group of 16 individual scientists who represent 21 nations and two international organizations. Formed in 1959 under the auspices of the European Nuclear Energy Agency of the Organization for Economic Coöperation and Development, the committee has distinguished itself by leadership in program planning and by effective coordination of several national nuclear-data activities.

EANDC is primarily concerned with nuclear cross sections and other fundamental nuclear data that are relevant to nuclear-energy development. Its functions encompass measurement, equipment and technology underlying measurement, provision of separated isotopes to experimentalists who can best make measurements, distribution of effort, and compilation and assessment of resulting data. The committee actively engages in sponsoring international meetings. It recommends development of special nuclear-data research facilities. Due in part to EANDC efforts, contributions of European laboratories now form a substantial and growing part of the nuclear-data activity of the entire western world. This development has directly benefitted the applied nuclear programs of the United States and other OECD nations and has freed US personnel and equipment for other work.

Membership and organization

EANDC now includes representatives of the following nations and international organizations: Austria, Belgium, Canada, Denmark, ENEA, Euratom, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States. Of these Canada, Japan and the United States are called "associates." This membership is made up as follows: four from the Euratom countries and the Euratom Commission acting together, four from the US, three from the UK, two from other OECD countries acting together, one from Canada, one from Japan, and one from ENEA. (A guide to the international nuclear-data alphabet appears in the box on page 42.) The figure on page 36 shows present EANDC members.

Originally the membership was 13. Then shortly after the first meeting, US and UK representations were each increased by one. Since June 1965, a representative from Japan has been present. So the present membership is 16.

The organization functions continuously—between as well as during meetings. The chairman is appointed by the responsible authority or organization whose term has come up in the order listed in the "terms of reference"—the document under which EANDC was founded. Thus the committee has no politicking on who will become chairman. Serving with the chairman are an executive secretary from the same part of the world (Europe or North America) and a corresponding secretary from the other part of the world. Both are chosen by the groups from which they come, the executive secretary in consultation with the chairman. The three officers serve two-year terms and are normally committee members.

Meetings are held at intervals of nine months to a year. They alternate between the two sides of the Atlantic on a schedule that calls for two meetings in Europe and then one in North America. After the committee agrees on approximate time and place of the

next meeting, the chairman calls the meeting, arranges for a local secretary, develops a tentative agenda and invites observers. Meetings so far have been as follows: Stockholm, Oak Ridge (1960), Harwell (1961), Rome (1962), Chalk River, Athens (1963), Karlsruhe (1964), Los Alamos (1965), Ascot (1966), Istanbul (1967). The next meeting will be in Montreal in March 1968.

Need for nuclear data

Before formation of EANDC, most nuclear-data measurements were made by the United Kingdom, Canada and the United States. In 1956, after the first Geneva Atoms-for-Peace conference, these three nations formed the Tripartite Nuclear Cross Sections Committee under the then classified bilateral agreements for coöperation in nuclear energy. Much of the programmatic nuclear-energy data was still classified at that time. The coöperation that developed was close; participating groups often measured nuclear cross sections or carried out related tasks in response to specific requests of mutual interest to TNCC.

The US took the initiative in establishing this trilateral collaboration as a part of its increasing nuclear-data effort. It was clear that the US needed data for its nuclear-energy program far faster than it could hope to make the measurements; so did the UK and Canada. The collaboration offered a mechanism to bring more talent to bear on these problems than would have been possible by any one of the participating states. It also eased difficulties from fiscal and manpower limitations and competition for federal funds necessary for advancement of other scientific areas.

The downgrading of security classification that took place at the time of the first Geneva conference eased international communication in this field and thus enabled extension of this collaboration to include the whole of western Europe. Europe had a tradition of scientific leadership. There was already a broad foundation for European coöperation, and rapid growth of European science during the 1950's made such a step obvious. Within this context, the US approached the ENEA and suggested formation of an EANDC through which European and American scientists could collaborate in measurement of nuclear quantities and in furthering their mutual nuclear-data objectives.

Organization and development

EANDC was formed ". . . to assure the 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." Organizing-committee members were not motivated by their interest in long-range plans for international amity so much as by their interest in providing more and better nuclear data for satisfactory development of nuclear-energy programs that they represented. Each nation agreed to participate in EANDC with its own national objective as a major concern. It was also agreed that nuclear-cross-section information that was primarily of military significance or otherwise subject to legal prohibitions against dissemination would not be exchanged. EANDC operates under a clearly defined "Frame of Reference" approved by the ENEA steering committee and is constituted as a quasi-independent body.

This broadened collaboration envisaged by EANDC establishment carried with it several advantages and some drawbacks. It brought to bear on a common applied-research problem a wider range of talents, techniques and experimental facilities. It helped to avoid undesirable duplication of effort and increased scientific productivity in this subject throughout the Atlantic community. On the other hand, it increased by one the number of committees on which US personnel in this field must serve and introduced the problem of reconciling the interests of a much larger group of nations.

The ground rules prescribe that only technically trained individuals in their respective countries or organizations be appointed to EANDC.

Subject matter

EANDC acts in the following seven 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 pool-

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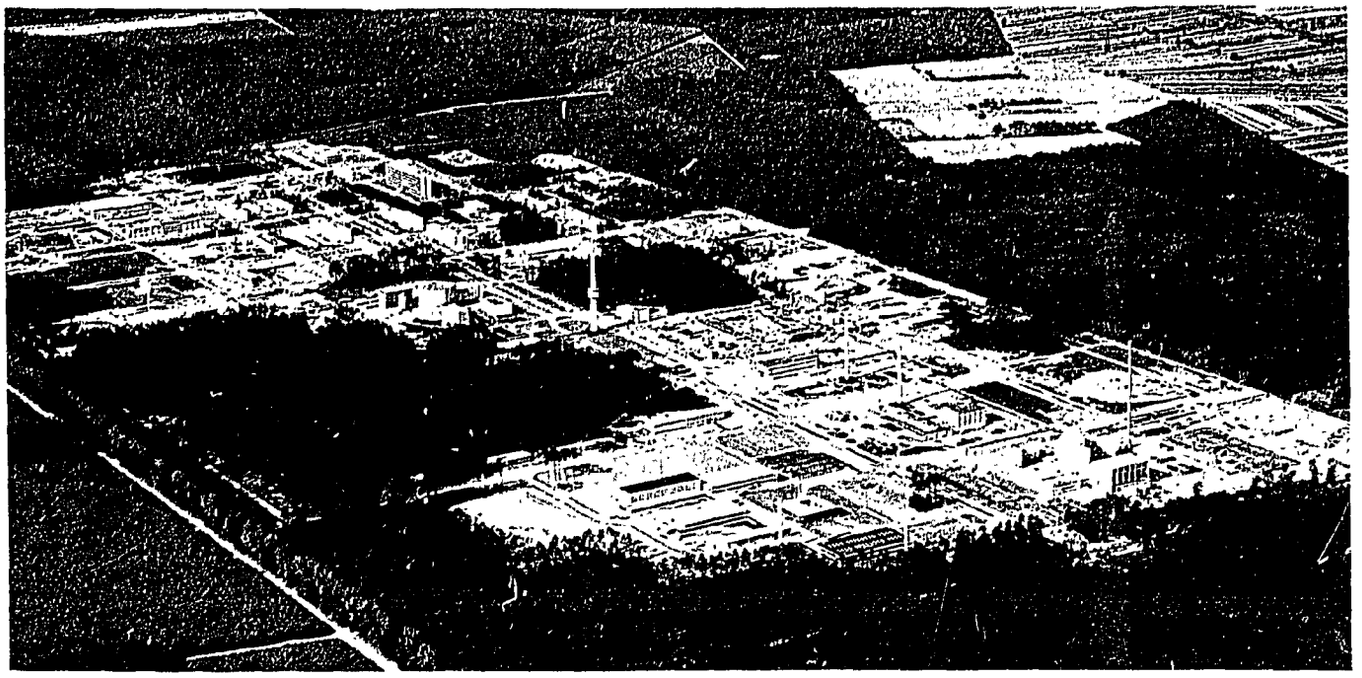


KARLSRUHE Nuclear Research Center where EANDC sponsored a conference on automatic data handling.

ing, 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 conferences and technical symposia to further its objectives.

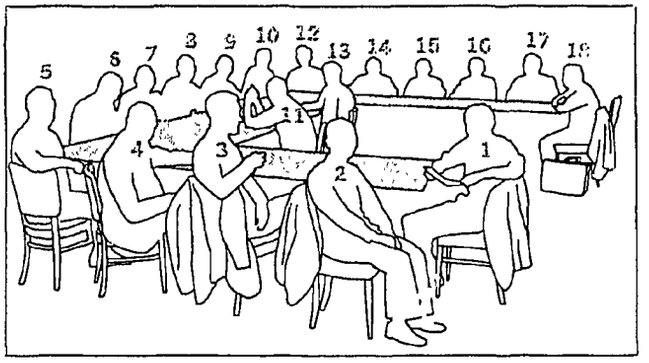
Coöperation, rapport, and close community of interests made the EANDC formative period pass quickly and successfully. Committee members developed a basic enthusiasm for the accomplishments of this group of disparate individuals brought together by the common bond of science and technology. No serious 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 US continued to contribute most technological information. As the European effort grew in scope and quality, however, US dominance began to diminish. The situation is now in a much better balance; production and exchange of information by the US and the other members are more nearly equal. This change is a tribute to the competence and diligence of European scientists working in nuclear data. In certain specialized areas EANDC contributions of some nations have appreciably exceeded those of the US, and the US has directly benefitted. Many measurements made by European scientists have fulfilled needs that would not soon have been met by the internal United States nuclear-data effort. In fact, the objectives that originally motivated US participation in EANDC have been achieved with a success transcending that initially expected by this country and other EANDC participants.

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 US and the Atomic Energy Research Establishment of the UK at Harwell and wished to establish their own independent source. US 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 point-



PRESENT MEMBERS met in Istanbul last February. Shown are Nils Starfelt of Sweden representing OECD (1), Teruo Momota, Japan (2), René Joly, France, Euratom (3), Karl H. Beckurts, West Germany, Euratom (4), Jozef Spaepen, Belgium, Euratom (5), Certin Ertek, Turkey, local secretary (6), William W. Havens Jr, USA, executive secretary (7), Geoffrey C. Hanna, Canada, chairman (8), George A. Kolstad, USA (9), Henri B. Smets, France, ENEA (10), Alan B. Smith, USA (11), John Story, UK (12), Richard F. Taschek, USA (13), Robert Batchelor, UK (14), Ernest R. Rae, UK (15), Marcel Nève de Mévergnies, Belgium, Euratom (16), Peter Weinzierl, Austria, OECD, corresponding secretary (17), Rudolf Meier, Switzerland, observer from EACRP (18).

ed 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 US 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 UK and the US 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.

The entire nuclear-data field has had to agree that experimental results must be in a form easily used by designers and compilation centers for storage and retrieval purposes. In November 1963 EANDC recommended establishment of the ENEA Neutron Data Compilation Center at Saclay, France. This center has subsequently become another major accomplishment for EANDC. Only ten months after this establishment, the center was producing results. It uses large computers for indexing, sorting and compiling nuclear data and ties in with similar centers at Brookhaven in the US and at the International Atomic Energy Agency in Vienna.

International symposia sponsored by EANDC are 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. Data for this region were poorly known because of difficulties in making and interpreting measurements. On the other hand, the region below 100 eV is now an almost classical measurement region in which continuous neutron sources (such as choppers, crystal spectrometers and conventional pulsed electron accelerators) can be used. Moreover, the electrostatic accelerator is used as a monoenergetic neutron source above a few tens of keV. But difficulties occur in the transition region because reactor sources run out of neutrons at the high end of their degraded continuous spectra and electrostatic sources run out of neutron intensity at the low end of their spectral region. Not only are neutron sources working at extreme limits of their capabilities in this region, but detection methods and nuclear cross sections from which they originate are also in a transition stage. The symposium discussed all of these problems and their possible technical solutions.

In November 1962 the US Atomic Energy Commission and its Nuclear Cross Section and Computer Advisory Groups coöperated to sponsor a conference at Grossinger, New York, that brought together computer experts and physicists who measure nuclear cross sections. Until this time nuclear physicists had been developing multidimensional analyzers while computer specialists had been developing small computers. 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 1963, 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 AEC sponsored a Seminar on Intense Neutron Sources (SINS) at Santa Fe, New Mexico (PHYSICS TODAY, December, page 103). It was organized under auspices of EANDC and the European-American Committee on Reactor Physics. 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 UK and the General Atomic Booster proposed in the US. 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 have been submitted to atomic-energy authorities of the participating countries as a joint EANDC-EACRP report.

International Conferences Sponsored by EANDC

Conference	*Location*	*Date*
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
2d 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

Data, present and future

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 UK 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 UK. Such measurements are of direct value to the nuclear program of the US.

It is very difficult to foresee the long-range future of nuclear-data activities in the US, much less the com-

INTERNATIONAL NUCLEAR-DATA ALPHABET

AECL: Atomic Energy of Canada Limited. This crown corporation responsible to, but not part of, the government was founded in 1952 to take over the functions of the National Research Council, considerably changed and enlarged.

CBNM: Central Bureau for Nuclear Measurments. Established in Geel, Belgium, under the treaty that founded Euratom, CBNM is defined as a bureau of standards specializing in nuclear measurements for isotope standardization and absolute measurements of radiation and neutron absorption.

EACRP: European-American Committee on Reactor Physics. Set up in 1962, its function is to promote coöperation between OECD member countries on nuclear-physics questions pertaining to nuclear reactors.

EANDC: European-American Nuclear-Data Committee. The subject of this article, this 16-man committee is made up of technically trained individuals representing 21 nations and two international organizations.

ENEA: European Nuclear Energy Agency. An agency of OECD established in 1957 to develop collaboration among the countries of western Europe in peaceful uses of nuclear energy, it includes the 18 European OECD member countries as well as the US, Canada and Japan (associate members) and Euratom, which also takes part in its activities.

Euratom. A community of six European countries coöperating on nuclear energy development. These countries (France, West Germany, Italy, Belgium, Netherlands, Luxembourg) are the same ones that cooperate in the Common Market and the Coal and Steel Community.

IAEA: International Atomic Energy Agency. A quasi-independent organization affiliated with the United Nations but not one of its specialized agencies. It has 97 member states and was formed to promote peaceful uses of atomic energy and to police activities that might produce material for weapons. Headquarters are in Vienna.

OECD: Organization for Economic Coöperation and Development. It works to promote policies designed to achieve highest sustainable economic growth and employment and a rising standard of living in member countries while maintaining financial stability. Members are 15 non-communist western European nations plus Canada, Greece, Iceland, Japan, Turkey and the US.

TNCC: Tripartite Nuclear-Cross-Sections Committee. An organization formed in 1956 by Canada, UK and US to share then classified information under bilateral agreements. TNCC was terminated in 1963, and all its functions were transferred to EANDC.

munity of nations that form EANDC. US nuclear-data requirements are based on the needs of its broad and dynamic nuclear-energy program. This program is still in an early stage of development and may undergo major modifications to achieve optimal economic use of nuclear energy.

The US nuclear-energy program is somewhat different from the programs motivating the nuclear-data efforts of other EANDC member nations. The US attempts to fulfill a broad spectrum of nuclear-data needs, including needs for reactor and weapon design, radiation effects for the Department of Defense, shielding needs for AEC and the National Aeronautics and Space Agency as well as the interests of basic physics. Many other EANDC nations have committed their resources for an extended period to fixed concepts over a much narrower applied spectrum (including, for example, fixed nuclear power plants), which have largely passed through design stages and are now well into development and production stages. These nations are not extensively pursuing new concepts and, thus, their needs for basic data and for active participation in EANDC can be expected to decrease.

This is certainly not a general characteristic of EANDC member nations. It is very possible, however, that nuclear-data efforts in the European community have passed their principal growth period and that, as a consequence, further increases of the benefits to be derived by the US from coöperative mechanisms such as EANDC will be limited. It is also possible that the needs of the diverse US nuclear-energy programs may increasingly transcend those of smaller EANDC nations. Therefore, if diverse US efforts are to remain strong, the nation must maintain a dominant position in nuclear data and not be overly influenced by the fluctuations in programs of other countries.

Nuclear-data requirements in the US and other EANDC member nations are changing character. Qualitative determinations of nuclear properties are no longer the primary problems. The major data needs now often require precise measurements—even those of "standards" quality—and reflect the increasing accuracy required by the respective nuclear-energy programs. Since such measurements are exceedingly difficult, complex and costly, great benefit can often be derived from a coöperative and coördinated effort at a number of institutions, extending from initial conception of the problem to final evaluation of joint results. Historically, this has been the manner of establishing standard physical quantities.

EANDC offers an opportunity for such a collective attack on many of the outstanding nuclear-data problems. Such an attack will require an increased coördination of efforts through EANDC, which should be fostered and stimulated by the US. Without a joint effort it is still doubtful whether the US alone can carry out the research effort necessary to obtain the precise quantities it needs in its nuclear program as fast as it needs them.

We US members of the EANDC strongly feel that this committee has had a major and beneficial impact on nuclear-data aspects of nuclear-energy programs of this and other nations and should have continuing support. Furthermore EANDC success should encourage similar scientific and technical groups to consider the function and mode of operation of the committee as an example of what can be accomplished in their fields through properly organized international coöperation motivated by enlightened national self-interest. □