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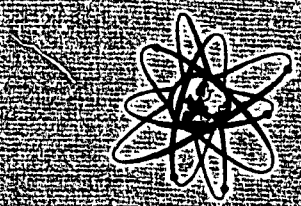
THIRD BIENNIAL REPORT OF THE ACTIVITIES OF EANDC

E. BRETSCHER and R. BATCHELOR



NUCLEAR DATA UNIT
INDC-138
MAY 1966

EUROPEAN-AMERICAN NUCLEAR DATA COMMITTEE

THIRD BIENNIAL REPORT OF THE ACTIVITIES OF THE EUROPEAN AMERICAN NUCLEAR DATA COMMITTEE

by
E. Bretcher and R. Batchelor

May 1966

European Nuclear Energy Agency, O.E.C.D.
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1. INTRODUCTION

This report describes the activities of the EUROPEAN AMERICAN NUCLEAR DATA COMMITTEE over the period January 1964 to January 1966.

During the period the members of the Committee were:

E. Bretscher, AERE, Harwell, UK (Chairman)
R. Batchelor, AWRE, Aldermaston, UK (Executive Secretary)
K.H. Beckurts, KFR, Karlsruhe
H. Goldstein, Columbia University, New York, USA (Corresponding Secretary)
G.C. Hanna, AECL, Chalk River, Canada
W.W. Havens, Columbia University, New York, USA
R. Joly, CEA, Saclay, France
G.A. Kolstad, USAEC, Washington, USA
M. Nève de Mévergnies, CEN, Mol, Belgium
H.B. Smets, ENEA, Paris, France
J. Spaepen, Euratom, Geel, Belgium
N. Starfelt, AB Atomenergi, Sweden
J.S. Story, AEE, Winfrith, UK
R.F. Taschek, LASAL, Los Alamos, USA
P. Weinzierl, SGAE, Seibersdorf, Austria
T. Momota, JAERI, Tokai-mura, Japan (since June 1965)

Two meetings were held, the first at Karlsruhe, F.R. of Germany from 20th-24th July 1964 and the second at Los Alamos, U.S.A. from 17th-21st May 1965. Following a suggestion by Professor Havens, the Chairman set up a Standing Sub-Committee on Standards consisting of J. Spaepen (Chairman), W.W. Havens, G.C. Hanna, R. Taschek, R. Batchelor, H.W. Koch (NBS, Washington) and E.R. Rae (AERE, Harwell), which met at NBS, Washington on 13th and 14th May.

2. NUCLEAR DATA

The question of meeting the nuclear data request lists by microscopic measurements and the methods to do this continued to be the most important item discussed by the Committee. The ENEA secretariat kept up to date a Combined Request List for nuclear data based on information received from the various regions

and these lists, together with regional progress reports, were used as a basis for discussion on the status of work completed and in progress. It is convenient to consider these requests in the three energy regions, thermal, resonance and fast.

In the thermal region an aggravating discrepancy of about 2% in $\bar{\nu}$ values was brought to light during the period. Although the Committee was instrumental in bringing together a group of experts to discuss it, as far as is known no further work has yet been started on a new measurement. Another outstanding and important measurement required in this region is the fission cross-section of Pu^{239}.

The resonance region attracts considerable activity, and of great interest is the recent theoretical work of E. Lynn which throws doubt on the interpretations previously made on the measured data. The Committee took note of a powerful new technique applicable to the resonance region, developed by a team at Los Alamos Scientific Laboratories. In this technique an underground nuclear explosion is used as the neutron source and because of the high intensity, an energy resolution can be obtained comparable with laboratory instruments, but in addition measurements can be made on very active samples.

In the fast region a vast amount of data on neutron scattering is now accumulating through the use of the pulsed and bunched Van de Graaff accelerators. The accuracies requested for the more important fission and capture data in the region below about 500 keV appear to be beyond the capabilities of present techniques. Since this problem is intimately concerned with standards, the Standards Sub-Committee has given it considerable attention, but no solution has yet appeared.

3. STANDARDS

The Standards Sub-Committee has undertaken to discuss standards for cross-section and flux measurements in the three energy regions, isotopic standards for stable and fissile elements, standard samples (especially fission foils), compilation and evaluation of data related to standards and standardisation of the

way in which results should be quoted. As noted in section 2, considerable attention has so far been given to cross-section standards in the 1 keV to 100 keV region. Regarding compilation and evaluation of data related to standards, it was recommended that BCMN, Geel, undertake this work.

4. NUCLEAR DATA COMPILATION AND EVALUATION

It was noted in the previous biennial report that as a result of an EANDC recommendation, the ENEA Neutron Data Compilation Centre was established at C.E.N., Saclay, in late 1963. The Committee has followed closely the activities of this Centre and its relationship with the corresponding centre in the U.S.A. From the measurers' point of view the efforts of the Centre, in collaboration with Columbia University, with regard to indexing, appear to have proved rewarding. These are early days to judge the usefulness of the work on compilation but the Committee believes that the Centre is working along the right lines. The EANDC has discussed the attitude it should take towards international activity in the evaluation field and at its last meeting it suggested that a Sub-committee on nuclear data evaluation be set up jointly with the EACRP for a two-year period with the following defined objectives:

(1) To encourage and stimulate the flow of information among evaluators;
(2) To assist in informal co-ordination of activities to cut down wasteful duplication of effort;
(3) To assist in establishing guidelines for evaluation procedures in the hope of raising standards for evaluated data.

The EACRP has agreed to participate in this sub-committee.

5. SAMPLES USED FOR NUCLEAR DATA RESEARCH

The EANDC has continued to assess the value of measurements proposed, needing special materials not readily available to the experimenters in their own countries. The Committee's recommendations are then used by the countries owning the samples to determine whether they will release the samples and if so whether

by loan or sale. Most samples are owned by the U.S.A. which, as noted in the last Biennial Report, has also made arrangements for producing sufficient quantities of very pure Pu isotopes. During the period under review some of this material became available and Pu^{240} has now been fabricated by the U.S.A. into samples suitable for linear accelerator experiments. Some of these samples have been loaned to AERE, Harwell and BCMN, Geel.

6. CONFERENCES

As a result of EANDC recommendations two major conferences were organised during the period under review. These were:

(a) "Conference on the Automatic Acquisition and Reduction of Nuclear data" held at Karlsruhe, 13th-16th July, 1964, and organised by K.F.K.

(b) "International Conference on the Study of Nuclear Structure with Neutrons" held at Antwerp, 19th-23rd July 1965, and organised by C.E.N.

In addition the EANDC supported:

(a) A "Seminar on the Evaluation of Neutron Cross-Section Data" held at Brookhaven National Laboratory (U.S.), 3rd-8th May 1965.

(b) A "Round Table Conference on High Precision Chemical Analysis of Substances of interest to Nuclear Energy" held at Euratom, Brussels, 18th-22nd June 1965.

(c) "EANDC Colloquium on Mass Spectrometry and Counting Techniques" held at Euratom, Brussels, 29th November - 2nd December 1965.

(d) "Seminar on the Preparation and Standardisation of Isotopic Targets and Foils", AERE, Harwell, 20th-21st October 1965.

At the present time a "Seminar on Intense Neutron Sources" is being planned as a joint EANDC-EACRP venture to be held at Santa Fé, U.S.A. in September 1966.

7. JAPANESE PARTICIPATION IN EANDC

Following the entry of Japan into the O.E.C.D. and its subsequent participation in ENEA, the EANDC extended an invitation

to Japan to send a representative as an observer to the Los Alamos meeting. After hearing details of the activities of Japan in the nuclear data field, the Committee suggested that Japan should be invited to participate as a full member at its future meetings. This recommendation was endorsed by the ENEA Steering Committee, and a Japanese scientist has been taking part in the work of the EANDC since June 1965.

8. RELATIONS WITH OTHER ORGANISATIONS

At each of the two meetings observers representing the EACRP and the I.A.E.A. respectively, were invited and attended, the latter for a limited section of the meetings only. An EANDC observer has also been present at the meetings of the EACRP. This permitted the members of the EANDC to be aware of the activities of the EACRP and the International Nuclear Data Scientific Working Group (INDSWG). Many EANDC members participate in the INDSWG meetings and the EANDC has provided the INDSWG with scientific documents.

9. GENERAL COMMENTS

The general purpose of the committee, its exact terms of reference, fields of interest and of mutual assistance can best be seen from the First Biennial Report (EANDC-23), supplemented by the Second, covering 1962 and 1963 (EANDC-39).

The present report is perhaps unorthodox in so far as it presents not only attainments through the meetings but also offers some thoughts relevant to the future activities of the committee.

The most important document presented to the committee is the "request list", the tables of the nuclear quantities to be measured. This list is compounded from the national (e.g. U.K.) and regional (e.g. Euratom) lists. Each item of this document does, or should represent a careful examination of the need by the requesting nations leading to an assessment of the error acceptable, the energy range needed and the priority of the request on the basis of the national nuclear power programme. For example, the statement on the error of a certain datum

requested is determined by the penalty one has to pay through uncertainties in the design and performance, resulting from the errors of the data used for the reactor calculations. The forecast of the contribution to the future reactivity of the fuel depends strongly on the nuclear data of the nuclides formed by multiple neutron capture and the spectrum characteristics; thus the uncertainty of the fuel cycle length and therefore the associated fuel cost are, inter alia, related to nuclear data errors. Some reactor parameters are quite sensitive to the uncertainties of nuclear data used; the breeding ratio is one, the temperature coefficient of reactivity of dilute fast reactors associated with the reactor safety is another. Requests for measurements should therefore be well documented and the need to devote effort should be justified clearly to the nuclear physicist who will have to do the measurements.

Looking through the contents of the request list and the records of the discussions between the committee members several points emerge:

(a) It is clear that a large body of nuclear information is by now available and many requests, including high priority ones, have been satisfied through the efforts of the various national laboratories and universities. The information obtained experimentally is often not as complete as it might be ; for example, it may only cover part of the energy range stated and for this reason the request remains on the request list.

(b) There exist measurements which seem of high accuracy (say 3% statistical error) but the results differ among the various laboratories by much larger amounts (say 15-20%). We would like to suggest that these obnoxious and persistent cases of discrepancies be attacked with more vigour by the EANDC in future, and with a larger participation internationally. Repetition in the same laboratory often does not resolve the problem, as a new and fresh outlook may be needed because unknown systematic errors can be inherent in a particular method

or experimental set-up, without the experimenter noticing it.

(c) There are a few special cases of requests for unusually high precision; for example, the fission cross-section of Pu^{239}, and its energy dependence, to ½% accuracy. When such demands are made, the character of the problem can change completely. A point will be reached where the error due to the purely nuclear physical measurement is no longer the only determining factor in the final precision of the result. Owing to the continuously progressive refinement of nuclear methods, chemical errors and those due to isotopic constitution, non-uniformity of samples and other factors, are contributing perceptibly to the uncertainties of the final result. This circumstance necessitates the participation of many other disciplines in extensive studies, involving ad hoc research, for example, in chemical and spectroscopic analysis and the properties of thin material foils. If the results are to have sufficient credibility, measurements must be made in several independent laboratories in parallel but not in collusion. Here international planning and collaboration will become more necessary than ever to attack the formidable task before them. One can anticipate that some of these extensive tasks (especially the assaying) may, with economic advantage, be taken over by the respective National Standard Physical and Chemical Laboratories.

As time goes on, the problem of keeping all the information stored at suitable centres in a way that permits easy retrieval is likely to increase in importance. The effectiveness of these centres will depend to a considerable extent on the promptness or completeness with which the laboratories transmit their experimental results to the centres. Here again the EANDC can lend a hand to stimulate and perhaps even supervise the flow of information to the centres. Let us not forget that

nuclear data presents a large capital investment which ought to be put to good use. To some extent the Neutron Data Compilation Centres can help to achieve this.