

Summary Record of the Nineteenth Meeting of the Committee

(Technical Sessions)

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Compiled by

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Nuclear Energy Agency Nuclear Data Committee



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## Highlights

Over the last two meetings of the NEANDC there has been an increase in the work done in sub-committees. On this occasion 6 sub-committees met covering the following topics:

- (1) Standards and Discrepancies
- (2) Isotopes
- (3) The NEANDC Monographs on Neutron Physics for Science and Technology
- (4) Co-ordination of Measurements and Evaluations
- (5) Further technical activities
- (6) The abolition of the "barn" as the unit of cross-section

The discussions of the Standards and Discrepancies Sub-committee (which are published separately) now cover a wide range of topics. New discrepancies considered at this meeting were the sub-threshold fission of Th-232, the resonance parameters of Ni-59 and the fission cross-section of Am-241.

The Isotopes Sub-committee discussed a number of points regarding sample preparation and availability. Some of the problems would be cleared up if the U.S. could make available a catalogue of heavy element samples.

The proposal to have an NEANDC Monograph series on Neutron Physics was approved by the Committee. It was decided that the monographs should be published commercially and arrangements were made to find a publisher. The first four topics selected for publication are (i) Radiative Neutron Capture, (ii) Fission Cross-sections, (iii) Neutron Detectors and (iv) Neutron Sources.

The co-ordination of measurements and evaluations is difficult to achieve because of national priorities and as a first step lists of work being done or proposed are required. These are available for evaluations in the Neutron Nuclear Data Evaluation Newsletter (NNDEN). For measurements it was agreed that all progress reports should have a CINDA type index and that these should also be published in NNDEN.

The Sub-committee on Further Technical Activities agreed that a specialist meeting on the cross-sections of structural materials should be held at Geel in the Autumn of 1977. It was also suggested that the support for a specialist meeting on "Cross-sections of Relevance to Actinide Build-up" in 1978 should be investigated.

In recent years a number of decisions have been made which will shortly prohibit the use of the barn as the unit of cross-section. These decisions, which are due to the adoption of SI units, have been taken with almost no discussion within the nuclear data community. The NEANDC agreed unanimously that the barn should be retained and a number of actions were placed to attempt to ensure this.

The Committee reviewed the arrangements for the first NEA sponsored Western European Nuclear Data Conference which is to be held at A.E.R.E. Harwell starting on the 25th September, 1978. A committee consisting of the European and Japanese members of NEANDC, some NEACRP representatives and members of the local organising committee was set up to arrange the Conference programme and to oversee the detailed Conference arrangements. The non-European members of NEANDC plus 3 representatives from outside the OECD area will act as international advisors.

As far as the organisation of the NEANDC is concerned it was agreed not to expand the Regional Sub-committee to include all European countries as proposed at the previous NEANDC meeting. The revised NEANDC membership for the countries of the European Communities and European Commission acting together is now agreed to be:

- 2 members each for France, Germany, U.K.
- 1 member for Italy
- 1 member European Commission taking special concern for the interests of the remaining countries

The Committee agreed with the proposal of the NEACRP to hold a joint meeting to discuss data priorities within the European Community and draw up a European request list.

The results of specialist meetings on fission cross-sections and inelastic scattering and fission neutron spectra were reviewed. Good progress in meeting the data needs in these areas was reported but the Committee noted that there was likely to be a continuing need for work on inelastic scattering and fission neutron spectra - an area where effort is tending to fall.

Sessions were held on needs for fission product nuclear data, decay heat information, shielding data, data required for fast reactor safety calculations and data required for burn-up calculations.

In line with NEACRP practice a number of agenda items were selected for discussion at the next meeting.

On Wednesday, 22nd September the Committee visited Studsvik. In the morning a Topical Conference on Integral and Differential After-heat Measurements was held. In the afternoon the Committee visited the Neutron Physics Laboratory and the Swedish Research Council's Laboratory.

## List of Participants

### 1. NEANDC Members

Mr. K. Bockhoff, BCMN, Geel, Belgium  
Dr. R. E. Chrien, BNL, Brookhaven, U.S.A.  
Dr. S. Cierjacks, KFK, Karlsruhe, Germany (Chairman)  
Dr. C. Coceva, CNEN, Bologna, Italy  
Dr. H. Condé, FOA, Stockholm, Sweden  
Dr. W. G. Cross, AECL, Chalk River, Canada (Vice-Chairman)  
Dr. E. Fort, CEA, Cadarache, France  
Dr. H. E. Jackson, ANL, Argonne, U.S.A.  
Dr. A. Michaudon, CEA, Bruyeres le Chatel, France  
Dr. H. T. Motz, LASL, Los Alamos, U.S.A.  
Mr. J. A. G. Rosen, NEA, Paris, France  
Dr. S. Qaim, Julich, Germany  
Dr. M. G. Sowerby, AERE, Harwell, U.K. (Scientific Secretary)  
Mr. J. S. Story, AEE, Winfrith, U.K.  
Dr. K. Tsukada, JAERI, Tokai Mura, Japan  
Dr. N. Tubbs, NEA, Paris, France (Secretary)

### 2. Observers

Dr. E. Hellstrand, AB Atomenergi, Studsvik, Sweden (NEACRP Observer)  
Dr. L. G. Stromberg, FOA, Stockholm, Sweden (Local Secretary)  
Mr. G. Appelqvist      Nuclear Power Administration, Stockholm, Sweden  
Prof. I. Bergqvist      Lund University, Sweden  
Dr. H. Haggblom      AB Atomenergi, Studsvik, Sweden  
Dr. L. Lesca      CCDN, Saclay, France  
Mr. J. de Meulder      BCMN, Geel, Belgium  
Dr. L. Nilsson      Uppsala, Sweden  
Prof. G. Rudstal      National Research Council Laboratory, Studsvik, Sweden  
Dr. J. J. Schmidt      Nuclear Data Section, IAEA  
Dr. T. Wiedling      AB Atomenergi, Studsvik, Sweden



## I Opening of the Meeting

Cierjacks welcomed the participants to the 19th Meeting of the NEANDC and asked Dr. T. Magnusson to open the Meeting.

Dr. Magnusson, a former director of FOA, said it was a great personal honour for him to open the Meeting. The Swedish Authorities appreciated the holding of another Meeting in Stockholm at this time when the future of nuclear energy was so much under discussion (the previous meeting was held in 1960). He then proceeded to review the past and future activities on nuclear energy in Sweden. The new government which had been elected the previous day opposed the development of nuclear power and so there were serious doubts about the future. However, in Dr. Magnusson's opinion no other area had been so extensively investigated for safety. On behalf of FOA he therefore welcomed the participants and hoped that the Meeting would be successful.

Dr. Condé then greeted the participants on behalf of the Swedish Nuclear Data Committee. The committee looked forward to this Meeting as international contacts are very important for small countries. He then reviewed the committee's activities and finished by hoping that the NEANDC will continue to function in the future as it had in the past as Sweden had found this to be very satisfactory.

Cierjacks thanked both speakers on behalf of the NEANDC and said that the Committee shared their worries about the future of nuclear energy in Sweden.

## II Relations with Other International Committees (recent meetings and activities connected with NEANDC)

### (1) IAEA International Nuclear Data Committee

Schmidt made the following points:

- (a) It was now agreed that the NEANDC and INDC meetings should alternate at nine month intervals. The next INDC meeting would be in May 1977. The co-operation of the Sub-committees on Standards and Discrepancies appears to be working well.
- (b) CINDA 76 is to last for 2 years with half-yearly supplements. In 1978 there will be an archival volume of older references with regular supplements including the new references.
- (c) WRENDA publication is to be maintained as it is useful to the USSR and the smaller countries. However, the publication will now appear every 2 years and so be more in line with the duration of experiments.

- (d) The terms of reference of the INDC policy sub-committees had been clarified, covering respectively Energy and Non-energy applications of nuclear data. Nuclear structure and decay data would be handled as 'non-energy'; however neutron data, considered as lying in the energy applications field, was of great importance in bio-medical applications.
- (e) The Fusion Research Council had urged IAEA to extend their work in the field of data for fusion applications: A unit consisting of two physicists and a programmer would be set up for a trial period, and its activities reviewed in 1979. An advisory group meeting in November 1976 in Culham, U.K., would mark the start of this activity, and determine its working priorities.

(2) NEA Committee on Reactor Physics

(a) Bologna Meeting, 9-13 June, 1975

Coceva presented the report. He noted that the NEACRP had rejected the idea of a common meeting with NEANDC because (i) there would not be enough time for their interests and (ii) they are not interested in techniques but only in results. Their interests in nuclear data can best be dealt with by having specialist meetings. The NEACRP considered 3 possible specialist meetings proposed by NEANDC on fission cross-sections, capture cross-section of U-238 and capture cross-section of structural materials. They supported the first of these and said that the other two should not take place until 1977.

Coceva said that the items of data of greatest interest to NEACRP are (not in order of importance):

- (i) Resonance parameters of U-238
- (ii) Inelastic scattering of U-238
- (iii) Structural material capture cross-sections
- (iv) Cross-sections of Am-241
- (v) Half lives of U-234 and Pu-241

The NEACRP had asked Coceva to inform the NEANDC that more effort is required on the measurement of the fission neutron spectrum of Pu-240 and Pu-241.

(b) Chalk River Meeting, 21-25 June, 1976

Cross presented the report of the meeting. He noted that the NEACRP consider that the second half of 1977 would be suitable for the specialist meeting on the capture cross-sections of structural materials. However, they would also like to include inelastic and reaction cross-sections in the discussions.

The NEACRP felt that the ever longer request lists were of reduced usefulness in providing priorities to measurers and evaluators. It had therefore been proposed that a joint meeting of 3 representatives each from NEACRP and NEANDC be held to discuss priorities within the European Community. If the NEANDC agreed this would be held early in 1977 and the NEACRP representatives would be Barre, Campbell and Kusters.

Cross said that he was impressed with the NEACRP operations and their technical content. At the end of the meeting the technical items for the next meeting are agreed and each country provides a review paper on these. Because there is a year to prepare these they are well done.

Cross finished by noting the types of data accorded greatest discussion by NEACRP:

Yields and cross-sections (particularly (n,n') of fission products)

Fission product decay data for after-heat calculation

Gamma-ray production data for fusion reactors

Actinide cross-sections (for build up and destruction)

Data on U-238 giving information on Doppler effect in reactors

The NEANDC considered that it was a good idea to have a meeting to draw up a European request list. It was agreed that the NEANDC representatives at this meeting should be Michaudon, Cierjacks and one person from the U.K. Sowerby and

Story were asked to inform the Secretariat, Michaudon and the Chairman who would be the U.K. representative. The Chairman was asked to inform the Committee on the results of the meeting. All members of the Committee were asked to inform the Chairman before 15th January, 1977 on any points they would like raised at the meeting on request lists.

- (3) Committee of the NEA Neutron Data Compilation Centre
- (4) Committee of the NEA Computer Programme Library
- (5) Proposed NEA Data Bank

Rosen reviewed a proposal to amalgamate the CPL and CCDN into the NEA Data Bank which had arisen because the NEA Steering Committee had requested the Secretariat to investigate methods of reducing running costs of the Centres. Considerable effort had been put into these studies, but when the Centres were considered separately the results were rather disappointing; user charges for CPL were felt to be impractical and possibly damaging in their effects, while a worthwhile saving in CCDN operations could only be made by mutilating one or more of the essential functions of the Centre. The Data Bank proposal should make it possible to save money by cutting administrative and logistic overheads rather than scientific output, and in addition had considerable technical advantages over two separate centres, due to the complementary nature of their activities and of the experience and skills of their staff. It was hoped that these synergistic effects would in time allow an extension of the Data Bank's activities in response to changes in the emphasis of the NEA programme of work. The French authorities would be prepared to accept location of the Data Bank in Saclay, and this location had been endorsed by the management committees of both CPL and CCDN.

Rosen said that the fact that Dr. Lesca would be returning to CNEN in November was a factor in the considerations. It was envisaged that Dr. Derrien would be responsible for the data activities at the Data Bank.

Schmidt said that the IAEA approved of the principle of combining the CPL and the CCDN but were concerned in the shorter term that the services of CCDN might not be maintained to their usual standard. Rosen said that the fact that the Data Bank would be at Saclay should minimize any perturbation. The CCDN Management Committee were also concerned to minimize the short term detrimental effects of the amalgamation and it was foreseen that the old computer system would be kept in operation until the new system had been proved. Lesca said that any change must cost something; in this case the development of the new activities foreseen for CCDN would not take place so soon.

(6) NEANDC Regional Sub-committee

Condé presented a report of the meeting of the NEANDC Regional Sub-committee held on 13th September 1976 (Summary Record SEN/DATA(76)2). An important item at the meeting was the discussion on the role and function of the Sub-committee. At the Eighteenth Meeting of the NEANDC it was proposed that it be expanded to cover all European members and so take over some of the functions of the Joint Euratom Nuclear Data and Reactor Physics Committee (JENDRPC) which no longer exists. This proposal did not find favour with the Regional Sub-committee because it will not meet the specific needs of the 'OR' group of countries and there will be overlapping of functions between the enlarged committee and the NEANDC and the INDC. The Regional Sub-committee favours the proposal of Kusters that there be no regularisation of the JENDRPC follow up group but instead there should be regular specialist meetings on topics agreed between NEANDC and NEACRP. The Regional Sub-committee requested the opportunity to participate in the selection of topics for the specialist meeting.

Following discussion it was agreed that (a) NEANDC Regional Sub-committee should stay as it is and not be expanded, (b) specialist meetings will be held in Europe as agreed between the NEANDC and the NEACRP (if it appears necessary in the future an ad hoc sub-committee of European members of NEANDC and NEACRP could be formed to select topics and organise the specialist meetings) and (c) the 'OR' group will help in the selection of topics by feeding their ideas to the NEANDC.

(7) Euratom Advisory Committee on the Management of Programmes

De Meulder reported on the proposals for the NEANDC membership for the countries of the European Communities and the European Commission acting together. It had now been agreed by the countries concerned that this membership should be as follows:

- 1 Member from the European Commission taking special concern for the interests of the smaller countries (i.e. Belgium, the Netherlands, Luxembourg, Denmark and Eire)
- 2 Members from France
- 2 Members from Germany
- 2 Members from the U.K.
- 1 Member from Italy

This proposal was accepted by the NEANDC.

III Appointment of Ad-hoc Sub-committees on (a) the Development of Further Technical Activities and (b) the Co-ordination of Measurements and Evaluations

The Committee appointed the Sub-committee on the Development of Further Technical Activities to consider future specialist meetings, reviews at conferences and other co-operative activities as follows:

Bockhoff	Michaudon
Cierjacks (Chairman)	Motz
Condé	Sowerby
Cross	Tubbs
Jackson	

The Sub-committee on the Co-ordination of Measurements and Evaluations was appointed with the following members:

Chrien	Qaim
Coceva	Story (Chairman)
Fort	Tsukada
Lesca	Condé

IV National Progress Reports on Nuclear Data Measurements and Activities

- 1) Short additions (no presentations) of printed progress reports
- 2) Short summary on nuclear data activities in the 'OR' countries
- 3) Introduction of new research papers of interest to the NEANDC

Owing to shortage of time discussion on these Agenda Items was not possible.

V Advances in Measurements and Evaluations on Neutron Data

(1) Elastic and inelastic scattering

The NEANDC considered the recommendations on inelastic scattering of the Specialist Meeting on Inelastic Scattering and Fission Neutron Spectra held at A.E.R.E., Harwell, April 14 to 16, 1975 (the proceedings were subsequently published as AERE-R 8636, NEANDC(UK)170L, NEACRP/L176). The following activities were reported by members on U-238 inelastic scattering:

Karlsruhe have measured the gamma-ray production and deduced inelastic cross-sections to final states between 680 and 1061 keV below 5.5 MeV. Below 2 MeV the cross-section values are up to 30% lower than the values obtained by neutron counting.

Bruyeres le Châtel have performed angular distribution measurements at 2.5 MeV and are calculating the cross-sections of U-238. Michaudon agreed to send Cierjacks these calculations.

Argonne have made measurements of the excitation of ground state rotational bands for incident neutrons between 0.1 and 3 MeV (see ANL/NDM-16).

University of Lowell have made measurements between 1.1 and 3.1 MeV.

ORNL are trying to make gamma-ray production measurements.

Bergqvist commented that it was important for experimenters to vary the details of their experiments so that systematic errors in techniques could be investigated.

[This topic is further discussed in the report of the Sub-committee on Standards and Discrepancies [NEANDC-105/L]].

## (2) Fission neutron spectra

Sowerby presented the conclusions on fission neutron spectra of the Specialist Meeting at Harwell (see previous page). He also discussed the result of the comparison of spectra undertaken after the meeting by J. M. Adams.

Motz commented that the shape of the fission neutron spectrum does not appear to be well fitted by the Watt distribution though this is a better description than the Maxwellian shape.

The NEANDC noted that the sensitivity studies on U-238 inelastic scattering and fission neutron spectra recommended by the Specialist Meeting had not been performed. Hellstrand was therefore requested to ask the NEACRP to provide the sensitivity studies on U-238 inelastic scattering and fission neutron spectra requested in the conclusions of the Harwell Specialist Meeting and the NEANDC representatives at the Meeting on a European Request List were asked to raise the need for these studies.

The Committee noted that work was still being performed on both the inelastic scattering of U-238 and fission neutron spectra. However, there were indications that the effort may fall and all members were asked to advise their local data committees and sponsoring organisations of the continuing need for inelastic scattering and fission spectrum measurements as specified in the Summary Record of the Bologna Meeting of NEACRP and in the conclusions of the Harwell Specialist Meeting.

## (3) Fast neutron fission cross-sections of U-235, U-238 and Pu-239

Jackson reported on the NEANDC/NEACRP Specialist Meeting on Fast Fission Cross-sections of U-233, U-235, U-238 and Pu-239 held on the 28-30 June 1976 at the Argonne National Laboratory. [The proceedings were subsequently published as ANL-76-90, NEANDC(US)-199/L, ERDA-NDC-5/L]. He said the Meeting was a complete success with high points as follows:

- (a) most fission ratios known to  $\pm 3-5\%$  between 10 keV and 15 MeV

- (b) the cross-section of U-235 known to  $\pm 3\%$  above 10 keV except in the energy range around 300 keV where there is a local  $\pm 5\%$  discrepancy and more measurements are required
- (c) the problem of energy scales has largely been eliminated
- (d) cross-section measurements accurate to  $\sim \pm 2\%$  are now possible if required

Jackson then made two points regarding the organisation of the Meeting:

- (i) The organisers had requested new data to be sent to them 60 days in advance of the Meeting via the data centres. Two weeks before the meeting very little had arrived. The only possible way to ensure that all the available data are collected is to allow authors to present data up to the last possible moment direct to the organisers.
- (ii) A. B. Smith would like to register a complaint about the state of the data files produced by the various centres. Since the formats and units are different it took man-months of effort to get it all into a form that could be used at the Meeting.

Since specific criticisms are required before the data centres can take action Jackson was asked to send to the data centres and committee members the comments of the organisers of the NEA Specialist Meeting on Fission Cross-sections regarding the state of the data provided by the data centres.

Following discussion about who would receive copies of the proceedings of the Meeting Jackson agreed to inform the Committee of the form of their distribution.

It was agreed unanimously that the Committee would like to express its thanks to the organisers of the Meeting and the Chairman was actioned to do this by writing to A. B. Smith and W. Poenitz, with copies to Rogosa and the Director of ANL.

#### (4) Fission product nuclear data

Schmidt discussed the objectives and organisation of the Second IAEA Advisory Group Meeting on Fission Product Nuclear Data to be held in Petten on the 5-9 September 1977. The format of the Meeting will be broadly similar to that of the first meeting at Bologna held in November 1973. The types of data covered will be:

- fission product yields
- fission product neutron cross-sections
- fission product decay data
- delayed neutron data if necessary

Motz drew attention to some IRT work which appeared to indicate that the delayed neutron yields are different for  $UO_2$  and  $U_3O_8$ . He agreed to distribute copies of the IRT document when it is available. He also drew attention to some work of Diiorio and Wehring which was to be presented at the November Meeting of the ANS in Washington. A fission fragment recoil mass spectrometer has been used to measure the fission yields of U-235 thermal fission and some of the results are discrepant with fission yield evaluations.

(5) Nuclear theory in neutron nuclear data evaluations

Schmidt reviewed the IAEA Consultants Meeting on the "Use of Nuclear Theory for Neutron Nuclear Data Evaluation" held in Trieste, 8-12 December 1975 (the proceedings are published as IAEA-190). A number of recommendations were made and in particular it was recommended that an extended seminar of several weeks duration should be held at the International Centre for Theoretical Physics. The purpose of this is to (i) review the contemporary status of research on low energy nuclear theory and (ii) to train scientists, particularly from developing countries, in the application of nuclear theory and its associated computer codes to the interpretation and prediction of neutron nuclear data needed for nuclear reactor calculations. Initially it was planned that the course should last 6 weeks but 4 weeks now appears more likely.

The NEANDC discussed the recommendations made by the Consultants Meeting. Chrien mentioned the correlation being observed, particularly at Oak Ridge by Macklin and his collaborators, between  $\Gamma_n$  and  $\Gamma_\gamma$ . Bergqvist said that this was not discussed at the Consultants Meeting. The importance of good level spacing data was stressed by a number of Committee members and Chrien agreed to impress on NNCSC the importance of generating good values of the mean level spacing during the production of the next edition of the BNL 325 volume on resonance parameters.

VI New and Continuing Nuclear Data Needs

(1) General fission reactor needs

Schmidt reported that the nuclear data needs for transactinium isotope nuclear data had been reviewed at an IAEA Advisory Group Meeting at Karlsruhe in November 1975. One of the outcomes of this is that there will be co-ordinated programmes of research in this area. He added that a Second Advisory Group Meeting on the same topic had been proposed for 1978-9. He also noted that India will probably do a cross-section measurement programme on Th-232 and U-233.

(2) Decay heat

The subject of decay heat was discussed by the NEANDC during the Topical

Conference on "Integral and Differential Afterheat Measurements" held at Studsvik on the 23rd September 1976 but the following additional comments were made during the discussion under this Agenda item.

Schmidt said that the decay times of <10 secs are very important and more data are required. For periods greater than 10 secs the measured data are probably adequate but more evaluations of fission product data are needed. The Committee also noted the importance of independent fission yields. Cross said that Walker had a new version of FISPROD (AECL 5105).

Hellstrand said that the recommended data on decay heat are limiting the power in some early Swedish reactors. If the recommended ANS decay heat curves could be decreased the power of the reactors could be raised. Motz agreed and said that the value of reducing these recommendations is 1M\$/reactor/% reduction.

The NEANDC was not clear on what accuracy is required in decay heat predictions and Hellstrand agreed to ask NEACRP to provide the NEANDC with the accuracy requirements for decay heat together with supporting documentation.

(3) Shielding aspects - implications from the NEA Specialist Meeting on Sensitivity Studies and Shielding Benchmarks, Paris, October 1975

Tubbs reported that at the above Meeting it was concluded that a meeting to identify differential and integral data requirements for shielding calculations could appropriately be held in Autumn 1976. It was further proposed that in preparation for this coming meeting a co-ordinated programme of sensitivity studies should be undertaken for shield designs typical of various fast and thermal reactor types, and this is underway.

The meeting on shielding data requirements is to be held on the 12-16 October in Vienna as a joint IAEA-OECD(NEA) technical committee meeting and it is being organised under the scientific patronage of the NEACRP. The objectives of the meeting are:

- (1) To review the overall requirements for basic nuclear data as indicated by the results of the sensitivity studies on typical shielding problems
- (2) To ascertain whether these requirements are met by existing evaluations of differential data; if not, whether:
  - (a) adjustment of the existing differential data utilizing integral benchmark information will suffice to meet these requirements in practice
  - (b) new differential measurements or new evaluations of existing measurements will be required, in which case a preliminary request list should be compiled.

- (3) To review the methodology of sensitivity analysis for shields of complicated geometry and to initiate further studies of practical generic designs that highlight this aspect of the problem
- (4) To review new developments in the continuing programme of benchmark experiments, including intercomparison of results
- (5) To communicate with nuclear data evaluators and measurers via the existing committee structure for the modifications to be subsequently made to the preliminary request list.

The NEANDC decided that at its next meeting it would review the requirements for shielding data and the work in progress to meet them.

#### (4) Safety of liquid metal fast reactors

Cross noted that an adequate knowledge of the change in reactivity with temperature is an essential requirement and that the U-238 contribution to this is dominant. Sowerby said that the Harwell work on the measurement of the transmission of neutrons through heated  $UO_2$  samples in the keV energy range aims to improve the data on U-238 average resonance parameters which are needed to calculate the Doppler effect (i.e. the temperature coefficient of reactivity).

Motz said that it was important to be able to do calculations at high temperatures when the reactor constituents have vaporized. The University of Missouri are studying uranium vapour at pressures of up to 20 Mbars.

The NEANDC noted that the current request lists include entries for U-238 resonance parameters and that in addition to the Harwell work measurements are taking place or are being analysed at Geel, Oak Ridge and JAERI. The situation is also kept under continuous review by the NEANDC Sub-committee on Standards and Discrepancies (and by the corresponding INDC Sub-committee).

Hellstrand pointed out that there were problems associated with the U-238 Doppler effect in thermal reactors.

#### (5) Burn-up calculations

Cross said that the NEACRP had emphasised the needs for data on the inelastic scattering of neutrons from fission products and the cross-sections of the higher actinides. The NEANDC noted that though there was considerable activity on the higher actinide cross-sections (except perhaps on (n,2n) cross-sections), the work on measuring the inelastic scattering cross-sections was still going down. Cierjacks reported that some work on (n,2n) reactions was being done by the University of Hamburg.

#### (6) Fusion

Qaim reviewed the 9th Symposium on Fusion Technology, Garmisch-Partenkirchen

June 1976 and said that nuclear data needs are of two main types:-

- (a) for first wall materials
- (b) for T production

Sensitivity calculations show that on the whole the available data give estimates of T production to the required accuracy; cross-sections of first wall materials are more important.

Motz stressed the importance of the neutron production in Be and said that Los Alamos had measured the neutron production cross-sections of Be at 5.9, 10.1 and 14.2 MeV (Report LA-6257). He also mentioned some work on "Neutron background spectra and signal-to-background ratio for neutron production between 10 and 14 MeV by the reactions  $^3\text{H}(p,n)^3\text{He}$ ,  $^1\text{H}(t,n)^3\text{He}$  and  $^2\text{H}(d,n)^3\text{He}$ " reported in LA-6459-MS.

Cierjacks said that the shielding of the coils was very important. Chrien said that in the U.S. it had been suggested to CESWG that there was a need for evaluations slanted towards fusion applications for the following materials: Fe, Ni, Cr, Cu, Al, Li, Be, B, and C. Sowerby mentioned the work at Harwell on the measurements of T production from  $^7\text{Li}$ .

#### (7) Cross-section units

Cross presented the memorandum on the loss of the barn which he had prepared following the discussions of the ad hoc Sub-committee on this topic. Following discussions the NEANDC agreed unanimously that the barn should be retained as the unit of nuclear cross-section. It also agreed that it was necessary to publicise the present position and get support from other bodies as well as raising formal objections to the proposed abolition of the barn. The following actions were placed:

The Chairman agreed to enlist the support of NEACRP and write to the EEC and BIPM giving the Committee's views on the proposed abolition of the barn as an approved unit

All members were requested to raise the question of the proposed abolition of the barn with the appropriate bodies in their own countries and organisations

Since the EEC documents on the abolition of the barn were not known to members Bockhoff was asked to find the appropriate EEC documents on the abolition of the barn and send them to the Chairman and Cross as soon as possible

Cross agreed to publish in Physics Today on behalf of the Committee an appropriate letter on the abolition of the barn

## VII International Co-operation in Nuclear Data Measurements, Analyses and Evaluation

### (1) U.S. programme on mass chain evaluations

Chrien said that it had been apparent for some time that improved co-ordination and efficiency in the U.S. national effort in nuclear structure data compilation was required in view of the decreasing ERDA support for nuclear physics. In 1975 ERDA requested BNL NNCSC to review these activities with a view of establishing a fully co-ordinated effort on both a national and international level. The BNL study sought to (a) reduce the cycle time of A chain evaluations without reducing quality and (b) achieve stability in the organisation of the work. BNL proposed that the above aims could be achieved by (i) co-ordinating the existing U.S. effort so as to eliminate duplication, (ii) centralising programming support and publication functions, (iii) setting up a standing advisory panel and (iv) establishing a CESWG like network of evaluators, measurers and users. The BNL proposals were endorsed in the U.S. with some changes of emphasis. The Nuclear Data Project at ORNL was strongly supported and an increase in their staff was proposed.

Subsequently a U.S. X-Centre Meeting was held at Brookhaven and an International X-Centre Meeting was held at Vienna. At these the Oak Ridge (ENSDF) format was accepted as the X-Centre network format and the Recent References adopted for exchange of bibliographic information.

The Vienna X-Centre Meeting saw strong support for international co-operation in A-chain evaluations and Germany, USSR and the UK offered to perform some of the work. Other countries such as Sweden, Kuwait and Japan also indicated interest.

In the U.S. services to the evaluators are provided by ORNL but customer services are the responsibility of BNL which will also co-ordinate U.S. effort and act as the international interface.

Chrien then went on to discuss charged particle nuclear data (CPND). Meetings on this topic have been held in Vienna in September 1975 and April 1976 and CPND will continue to emphasize excitation functions and thick target yield data. The first data tapes in XFOR format have been exchanged. BNL have agreed to produce a CINDA like index.

In July 1976 BNL-NNCSC received additional funding for its increased data service activities and in October will start A chain evaluations. An expanded advisory panel for NNCSC has been created with extra members to reflect its broader scope and there is another panel to advise on nuclear structure compilation.

The most important recent NNCSC publication is Volume 11 of the 3rd Edition of BNL 325 - the curves book. Suggestions are invited on how to improve it.

Schmidt said that the IAEA were planning a training seminar on A-chain evaluation in 1978.

(2) Sample production

Bockhoff reported that Geel, Karlsruhe and Harwell were attempting to obtain a metal sample of Am-241 (a disc 65 mm in diameter weighing ~20 g) which could be used in the 3 laboratories. It had been agreed to share the costs. (This item is also discussed in the report of the Isotope Sub-committee.

(3) Flux intercomparison

The BIPM comparison of flux measurements was discussed by the Committee.

(4) Half life measurements

It was agreed that co-operation in half life measurements should be discussed at the next meeting and an action was placed on the Chairman to arrange this.

(5) New proposals for co-operation

Michaudon reported that Bruyeres-le-Châtel were co-operating with the U.S. in the evaluation of Ti. Cierjacks said that all co-operation should be encouraged and Chrien was asked to enquire if co-operation by European laboratories would be welcomed in the production of ENDF/B evaluations.

It was agreed that to stimulate co-operation the ad-hoc Sub-committee on the Co-ordination of Measurements and Evaluations should be made a standing Sub-committee. The Chairman of this (Story) was asked to write to Pearlstein requesting detailed ENDF/B time scales and inform the Committee of these.

## VIII Data Indexing Compilation and Evaluation

Owing to shortage of time there was only very limited discussion on this topic.

Chrien reported that ENDF/BV would be released in January 1978. CESWG is now 10 years old, the first meeting having been held in June 1966.

The Zebra 8 test zones have been calculated using ENDF/BIV data. The cross-section data were adjusted to get better fits between experiment and calculation and only in the case of Fe capture and U-238 fission and inelastic scattering were the adjustments over one standard deviation.

New U-238 resonance parameter data have reduced the discrepancy between calculation and experiment for slightly enriched U lattices. The dosimetry files

are to be improved and a special meeting on Cf-252 is planned.

Qaim said that an updated version of the Erdtmann and Soyka Compilation of Gamma-rays from Radionuclides would be available in 1977. The Charged Particle Nuclear Data Compilation of Munzel will also be updated in 1977.

#### IX Meetings and Conferences on Nuclear Data

##### (1) Western European Nuclear Data Conference Series

Sowerby presented NEANDC(UK)167A, which reviewed the present arrangements for the first conference in the series, and invited the comments of the NEANDC.

The NEANDC agreed with the time and place of the conference (A.E.R.E., Harwell starting on the 25th September 1978) and with the proposal that Dr. B. Rose should be the conference chairman. There was some discussion on the composition of the organising committee as it was felt that this should be European in character. It was agreed that the organising committee would consist of the (a) members of the local organising committee, (b) the European members of the NEANDC (Japan is assumed to be in this category) and (c) up to 4 members of the NEACRP. In addition to this there would be international advisors who would consist of the remainder of the NEANDC members plus Dr. J. J. Schmidt and Russian and Indian members who would be invited through the NEA.

There was some discussion on the programme of the conference and its title but the decisions on these points were left to the organising committee which, it was suggested, should meet as soon as possible.

As a result of these discussions the following actions were placed:

NEA Secretariat      Write to Chairman of NEACRP asking for the nomination of 4 members to the organising committee of the European conference

U.K. Members        Pass the Committee's views on the conference to appropriate people in the U.K.

##### (2) Information on future meetings

The NEANDC discussed a list of future meetings of interest to the Committee. They were surprised to learn that the US ERDA-NDC had decided that the International Nuclear Data Conference planned in the USA for 1979 would not be held until 1980 thus breaking the recently established scheme of conferences whereby a major conference would be held once a year alternatively in the USSR, Western Europe and the USA. The Chairman of the NEANDC agreed to express the Committee's regret at this decision and Chrien said he would discuss with other members of the ERDA Nuclear Data Committee the possibility of holding the US Regional Conference on Nuclear Data in 1979 rather than 1980.

X Discussion of the Reports of the Sub-committees

(1) Sub-committee on Standards and Discrepancies

Jackson presented the report which was accepted by the NEANDC. The distribution of the full report of the Sub-committee was discussed and members of the Sub-committee were asked to send contributions to Jackson for inclusion in the report before 15th November 1976 and Jackson agreed to distribute it before the 15th December.

(2) Isotopes Sub-committee

Chrien reviewed the status of the US isotope separation pro and presented the report of the discussions of the Isotopes Sub-committee. A number of problems regarding sample preparation and availability were discussed at the Sub-committee meeting and Chrien agreed to raise these with the appropriate US Authorities. One of the problems associated with obtaining heavy element samples from the US is that there is no catalogue showing the location of samples in the USA. Chrien agreed to ask if such a catalogue could be prepared.

Condé said that the 'OR' countries are inhibited from borrowing samples from the US Research Pool because of the loan and handling charges. Chrien pointed out that a good method of getting samples is through a US visitor at the laboratory.

(3) Sub-committee on the Development of Further Technical Activities

Cierjacks presented the report of the Sub-committee which was accepted by the NEANDC. In order to set up the specialist meeting on 'the cross-sections of structural materials' and to obtain the interest in the proposed meeting on 'cross-sections of relevance to actinide build-up' the following actions were placed on members:

NEA Secretariat      Inform the Chairman of NEACRP on the proposals for the Specialist Meeting on the Capture Cross-sections of Structural Materials

"  
Bockhoff              See that BCMN Geel takes the responsibility for organising the Specialist Meeting on the Capture Cross-sections of Structural Materials

NEA Secretariat      Invite the Chairman of NEACRP to comment on the proposal to have a Specialist Meeting on the 'Cross-sections of relevance to actinide build-up'

All Members              Determine the support in their countries or

organisations for a Specialist Meeting on the 'Cross-sections of relevance to actinide build-up' and report their findings to the Chairman.

Chairman

If there is general support see that arrangements are made to hold the Specialist Meeting on 'Cross-sections of relevance to actinide build-up'.

(4) Sub-committee on the Co-ordination of Measurements and Evaluations

Story presented the report of the Sub-committee.

The NEANDC agreed with the Sub-committee's proposals that (a) CINDA type indices should be put in all progress reports and (b) the CINDA type indices should also be published in the Neutron Nuclear Data Evaluation Newsletter (NNDEN). In view of the increased role of the NNDEN the need for a revised distribution list was noted by the Committee. However, even with its revised role the NEANDC considered that the NNDEN should only be published twice a year. The following actions were placed as a result of the discussions:

- |             |  |
|-------------|--|
| All Members | See that a CINDA type index is put in all progress reports and that copies of each index are sent to CCDN for inclusion in NNDEN |
| Lesca       | Arrange that the CINDA type indices from progress reports are put into NNDEN   |
| All Members | Submit to CCDN lists of names to be added to the distribution list of NNDEN in view of the additional role of the newsletter     |
| Lesca       | Inform the CCDN Committee of the proposals on NNDEN including the suggestion that it be produced only twice a year               |

(5) Sub-committee on Monographs

Michaudon presented the report of the Sub-committee.

He reviewed the Committee's discussions leading to the proposal that the series should be commenced with 4 monographs. For each of these an editor was proposed who would select authors and ensure that the monograph is written in the manner envisaged by the NEANDC. The subjects chosen for the first 4 monographs together with their editors are:

- |                           |                   |
|---------------------------|-------------------|
| Radiative Neutron Capture | Editor: Jackson   |
| Fission Cross-sections    | Editor: Michaudon |
| Neutron Detectors         | Editor: Chrien    |
| Neutron Sources           | Editor: Cierjacks |

The NEANDC agreed with this selection of topics and choice of editors. The editors will be responsible for the main reviewing of their volume but the NEANDC would give final approval.

Michaudon then reviewed the discussions of the Sub-committee regarding the publication of the series. Initially it had been thought that the NEA would publish one or two volumes to establish the series. If it were a success then a publisher would willingly take over and publish the remaining volumes. The Sub-committee were unhappy with this as the first volumes would not be produced to the same high standard as the subsequent ones. It was, therefore, agreed that a publisher should be found from the start. It was also felt that the NEA is the correct body to get in touch with publishers and therefore provide authors with a guarantee that the book they write will be published.

The NEANDC agreed with these proposals and went on to discuss the provision of travel funds for authors and editors. It was felt that the NEA should provide some money as the monographs are being sponsored by one of their technical committees. The European Commission might also be able to provide funds and Tubbs and Bockhoff agreed to enquire if funds could be made available from these sources.

Tubbs pointed out that a potential publisher would require a specification of the monograph series and Michaudon and Cierjacks agreed to send one to Tubbs before the 1st November. Tubbs said that he would try to find a publisher for the series when the specification was available and inform the Committee of the outcome. The NEANDC considered that a start should be made as soon as possible on writing the monographs and the editors agreed to make informal approaches to possible authors. The need for an official letter stating the NEANDC's support for the monographs was stressed and Cierjacks agreed to provide one for Bockhoff and the editors. In order that the momentum of starting the monographs be maintained, Tubbs agreed to inform Cierjacks, Michaudon, Chrien and Jackson during the first week of January 1977 of the state of discussions.

The overall title of the series was discussed by the NEANDC and it was agreed that it should be "NEANDC Monographs on Neutron Physics for Science and Technology", the words "Neutron Physics" being emphasised in the title. It was also felt that there should be an overall editor for the series; Michaudon agreed to act in this capacity.

The NEANDC discussed the importance of the NEA support for the monographs and it was agreed that the Committee would welcome an endorsement of the series by the NEA.

## XI Topical Conference and Technical Visits

On Wednesday, 22nd September the NEANDC visited Studsvik. In the morning a Topical Conference on Integral and Differential Afterheat Measurements was held. In the afternoon the Committee visited the Neutron Physics Laboratory and the Swedish Research Council's Laboratory.

## XII Closing of the Meeting

In closing the Meeting the Chairman expressed the Committee's thanks to the FOA, Condé, Stromberg, the secretarial staff and all the other Swedish people who had taken part in the Meeting or who had helped in its organisation.

