NEANDC 103 "U"

SUMMARY RECORD OF THE EIGHTEENTH MEETING OF THE COMMITTEE

(Technical Sessions)

Harwell, U.K.

7-11 March 1975

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Nuclear Energy Agency Nuclear Data Committee

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Highlights

The major topics of the meeting concerned the future role of the Committee and its relationships with other international committees. Though final conclusions could not be reached as other committees and organisations are involved it was agreed that there is a need for a data committee covering the NEA member and North American countries. The role of this committee is largely technical in character as the questions of broad policies in the international exchange of data can be left to the INDC. Six roles for the committee were identified:-

1. To suggest technical workshops to review critical areas where international collaboration would be profitable
2. To arrange for exchanges of personnel
3. To co-ordinate research programmes of member countries on an international basis, particularly in relation to future activities
4. To sponsor technical meetings, preferably with some help from the NEA
5. To sponsor extensive technical review papers at major conferences and in technical journals
6. To co-ordinate evaluation efforts within the OECD area.

Actions were placed at the meeting which should enable progress under items 1, 3 and 6 to be made, hopefully before the next meeting, as the Committee feel that it is necessary to make a definite impact in the intervening period.

A proposal from INDC that both INDC and NEANDC extend their meeting intervals from 12 to approximately 18 months with the meetings staggered at 9 month intervals was accepted as was their proposal that the two Committees establish a common technical information base in the areas of standards and discrepancies. During the meeting Committee members generated a number of files on standards as a first step in this direction and actions were placed to ensure the production of the necessary discrepancy files.

Steps were taken to make the necessary improved communications between the NEANDC and the NEACRP possible and it was agreed that the NEANDC was willing to

give the CPL and the CCDN and their respective steering committees informal guidance on topics brought to the Committee's attention.

The European members of the NEANDC considered the future of data committees in the area. The need for a committee covering the Western European countries and having strong reactor physics participation was identified and it was proposed that this should be formed by expanding the NEANDC Regional Sub-committee. This proposal was therefore transmitted for consideration by the Joint Euratom Committee on Nuclear Data and Reactor Physics (JENDRPC) and the NEACRP.

The Committee spent a considerable part of the meeting discussing the progress in the measurement and evaluation activities, standards and discrepancies. Though there has been a continuing reduction in facilities available for data measurements the Committee was informed of improved facilities being installed at Geel, Harwell and in Japan. Many data measurements were reported but, because of the proximity of the Washington Conference on Nuclear Cross-sections and Technology, a substantial fraction had already been presented elsewhere. The discrepancies in the measurements on the $^{6}Li(n,\alpha)$ cross-section still exist which may in part be due to uncertainties in the composition of Li loaded glass scintillators. Some exchanges of glasses were arranged to try to solve this problem. The Committee heard of many measurements being made on the important parameters such as for example the fission cross-sections of ^{235}U, ^{238}U and ^{239}Pu, the shape of the fission neutron energy spectrum, the inelastic scattering cross-section of ^{238}U and the capture cross-sections of structural materials. In all cases the new measurements are gradually resolving the most serious discrepancies.

Sessions were held on the thermal data for the main fissile isotopes, activation detector cross-sections and fission product nuclear data. The Committee discussed new needs for data and noted an increased emphasis on measurements for the higher actinides. The U.S. request lists for fusion applications and safeguards have been revised. For fusion the majority of requests are for evaluations and there is an increased emphasis on (n,p) and (n,α) data for structural materials.

Work on the measurement of the half lives of fissile and fertile nuclei is being performed in Europe and the U.S.A. and the Committee aims to improve the

collaboration and co-ordination between the various programmes.

A proposal was made and endorsed that the World's major meetings on nuclear data for applied purposes should occur at annual intervals and be held sequentially in the USSR, Europe and the U.S.A.

In view of satisfactory operation of the scheme for the international loan of samples from the ERDA research pool it was decided to discontinue the NEANDC Isotope Sub-committee.

An afternoon's topical discussion was held on the 9th April on capture cross-section measurements.

List of Participants

1. NEANDC Members

Dr. R. Batchelor, BCMN, Geel, Belgium

Dr. R. E. Chrien, BNL, Brookhaven, USA

Dr. C. Coceva, CNEN, Bologna, Italy

Dr. H. Condé, FOA , Stockholm, Sweden

Dr. W. G. Cross, AECL, Chalk River, Canada (Acting Chairman)

Dr. O. J. Eder, Seibersdorf, Austria

Dr. F. H. Fröhner*, KFK, Karlsruhe, Germany

Dr. H. E. Jackson, ANL, Argonne, USA

Dr. A. Michaudon, CEA, Bruyéres le Chatel, France

Dr. H. T. Motz, LASL, Los Alamos, USA

Mr. J. A. G. Rosen, NEA, Paris, France

Mr. J. L. Rowlands, AEE, Winfrith, UK

Dr. J. Royen, NEA, Paris, France (Secretary)

Dr. A. P. Schmitt, CEA, Cadarache, France

Dr. A. B. Smith*, ANL, Argonne, USA

Dr. M. G. Sowerby, AERE, Harwell, UK (Scientific Secretary)

Mr. J. S. Story, AEE, Winfrith, UK

Dr. K. Tsukada, JAERI, Tokai Mura, Japan

2. Observers

Mr. E. A. C. Crouch(1), AERE, Harwell, UK

Prof. U. Farinelli, CNEN, Casaccia, Italy (NEACRP observer)

Dr. G. D. James, AERE, Harwell, UK (Local Secretary)

Dr. J. E. Lynn(2), AERE, Harwell, UK

Mr. J. De Meulder(3), BCMN, Geel, Belgium

Dr. A. L. Nichols(4), AERE, Harwell, UK

Dr. B. Rose(5), AERE, Harwell, UK

Dr. J. J. Schmidt(6), IAEA, Vienna, Austria

Dr. S. M. Qaim(7), Jülich, Germany

* Ad hoc members: Dr. Frohner attended in place of Dr. S. W. Cierjacks

Dr. Smith attended in place of Dr. G. L. Rogosa

(1) Attended Sessions 6c, 9a and 9b

(2) Attended Session 5

(3) Attended Sub-committee on future role of the NEANDC Regional Sub-committee

(4) Attended Sessions 6c, 7, 8a, 9a and 9b

(5) Attended Sessions 2(i), 10, 13 and Sub-committee on future role of the NEANDC Regional Sub-committee

(6) Attended Sessions 4, 5, 6, 7, 8, 9, 10, 11 and 13 and Sub-committee on standards and discrepancies

(7) Attended Sessions 4, 5, 6, 7, 8, 9, 10 and 11

1. Opening of Meeting

The Committee was welcomed by Dr. J. Williams, Assistant Director of A.E.R.E., Harwell, who described briefly the present programme and plans for nuclear data in the United Kingdom; notably, Dr. Williams mentioned the new electron linac which would be constructed at Harwell for research in support of advanced nuclear power systems.

Cross, the Vice-chairman of the Committee, thanked Dr. Williams and welcomed the members and observers attending the meeting. He referred to the unfortunate absence of the Chairman, Cierjacks, due to ill health and said that he had seen Cierjacks in the Black Forest where he was recovering. Cierjacks sent his best wishes and said that he hoped to be able to come to the meeting at the end of the week.

2. Review of recent meetings of other International Committees

The Committee was given brief reports on the highlights of recent meetings of other International Committees whose activities were connected to those of NEANDC.

(a) 7th Meeting of the IAEA International Nuclear Data Committee, Lucas Heights (Australia), 7th-11th October 1974

The Committee took note of the following points:

- INDC had tried at its 7th meeting, for the first time, to cover the whole field of nuclear data. The Committee had then set up four standing sub-committees: standard reference data, discrepancies, nuclear data for energy applications, nuclear data for non-energy applications.
- Measurements: except for the US and USSR, no country was in a position to answer all its nuclear data needs; in spite of its shortcomings WRENDA (the World REquest List for Neutron Data Measurements) was considered to be still useful; a number of measurement programmes in developing countries were described.
- Evaluations: important efforts were said to be under way in the USSR; good quality evaluated data for ^{238}U and ^{239}Pu had been made available to the rest of the world.
- For all types of nuclear data (neutron and non-neutron), the IAEA Nuclear Data Section would operate a Central Information Office, to bridge the information gap between the various data centres and the applied users (by maintaining a catalogue of compilations and evaluations, etc.). INDC had been concerned that the NDS should not engage in too many activities with, perhaps, an imperfect idea of what priorities should be. In the meantime, it had been recommended by the IAEA International Fusion Research Council that NDS should also collect atomic and molecular data for fusion and plasma research and technology.
- Participants in the 7th INDC meeting had felt there was too much to discuss in a too short time. It had been proposed that the meetings of

the Committee should allow more time for discussions of a political nature, while technical issues would be shifted more to the preparation period and restricted in the meeting to strictly relevant items.

- Relations between the INDC and the NEANDC had been discussed informally as well as the overlap of the functions in several areas. A number of suggestions had been made.
- Participants in the INDC meetings from industrialised countries would no longer be supported financially by the IAEA.

(b) 17th Meeting of the NEA Committee on Reactor Physics, CEN Cadarache (France), 4th-7th June 1974:

The Committee took note of a report (see Appendix 3) which had been prepared by the NEANDC observer at the meeting and of additional information given by the NEACRP observer at the present meeting; inter alia:

- results of technical discussions of the NEACRP, and their influence on nuclear data activities (including specific requests addressed to the NEANDC) were underlined;
- outcomes of specialists' meetings sponsored by the NEACRP and programmes of future meetings were summarised;
- the NEACRP observer confirmed that accurate nuclear data were still needed by reactor physicists, although it was possible sometimes to do without, thanks to integral experiments;
- NEACRP's increased interest in fusion reactors, in particular in neutronic problems, stemmed from the mandate of the Committee to explore new avenues in reactor physics. While in the case of fission reactors studies were concerned more and more with economics and, sometimes, safety problems, in the case of fusion feasibility was still the big question.
- NEANDC decided that its observer in the NEACRP meetings should, henceforth, distribute its report, including a list of documents presented, immediately after the meetings.

(c) Sub-committee on Nuclear Data of the Advisory Committee on the Management of Programmes of Euratom's Central Bureau for Nuclear Measurements

NEANDC took note of the following report:

- According to a 1972 decision of the Council of Ministers of the European Communities, an Advisory Committee on the Management of Programmes of the CBNM had been set up. ACMP's role - the first meeting had been held in January 1975 - was to advise the European Commission on the accepted programmes of work of CBNM, to specify details of these programmes and to give opinions on the results obtained, taking into account work carried out in national laboratories of the countries of the European Communities.
- ACMP's advisory functions had been fulfilled in the past, to some extent, by the Joint Euratom Nuclear Data and Reactor Physics Committee, which was an unofficial, rather informal group sponsored merely by CBNM. JENDRPC's future was now very much in question, in spite of the usefulness and the quality of some of its activities, as CBNM felt it could no longer support the group financially.
- ACMP had decided to split into smaller committees, on neutron data, on non-neutron data, on reference materials.
- Any recommendation by NEANDC concerning the work of CBNM would still be welcome and would continue to be seriously taken into consideration.

(d) 15th Meeting of the NEANDC Regional Sub-committee, OECD Headquarters, 16th-17th January 1975

NEANDC took note of the report of the Chairman of the Regional Sub-committee, which had been distributed as document SEN/DATA(75)1 (with appendices: NEANDC(OR)-141"A").

(e) 13th Meeting of the Committee of the NEA Neutron Data Compilation Centre; OECD Headquarters, 12th-14th June 1974

The prominent feature of that meeting had been a thorough review of CCDN's present and future role; a detailed analysis of the activities of CCDN and their possible extensions had been circulated to the members of NEANDC as

document NEANDC-100"A".

NEANDC concurred with the conclusions of the CCDN Committee, namely that the Centre should strengthen its traditional compilation activities in the field of neutron cross sections and related data for energy applications before extending its scope of work, and that within the present scope the following topics should receive special attention:

- gamma ray spectra following neutron-induced reactions;
- fission product nuclear data, with highest priority given to data on thermal fission of ^{235}U;
- actinium, thorium and transplutonium isotopes nuclear data;
- neutron data for fusion reactors.

The Committee also agreed that NEANDC had a role to play in giving scientific guidance as appropriate to the committee of the CCDN, as provided for in the Statute and Tasks of the Centre. This was because the committee of the CCDN was truly a management committee, whose primary concern was the good operation of the Centre, not the nuclear data themselves.

At the 4 Centres Meeting at NNCSC in March 1975 the following points relevant to the CCDN and NEANDC were discussed:

- CINDA (Computer Index of Neutron DAta): it has been recommended to publish the CINDA book on a bi-annual basis, with two supplements, thereby reducing production costs by 20%. Stressing that such a decision would not be binding on CCDN until endorsed by the Committee of the Centre, Mr. Rosen urged NEANDC to comment on such a recommendation from the scientist/user point of view.
- CINDA coverage: all centres - CCDN, NNCSC, NDS and the USSR Nuclear Data Center CJD - had been especially concerned about ensuring the completeness of CINDA. At NNCSC, NDS and CJD, where coverage of literature was done at the Centres, one person at each Centre was assigned to that task. The situation at CCDN was different as the coverage was done by CINDA indexers in different countries of the CCDN service area. The CCDN was nevertheless responsible for the

completeness and accuracy of the coverage, and it had been considered unsatisfactory that the CCDN had to rely on the efficiency of the CINDA indexer network if nobody was available at the Centre for the necessary scanning of literature and coding of missing information. Indeed, in spite of general satisfaction expressed by the users of CINDA, test comparisons between CINDA and other information systems had shown that the percentage of references missing in CINDA was of the order of 30%: omissions were discovered even in some important journals, and in report series, in particular in the field of radiochemistry; the gaps concerned the service areas of the four Centres. CCDN intended to undertake a major effort to improve the coverage of CINDA, but the efficiency of the indexer network had to be increased at the same time; NEANDC pledged to collaborate.

- EXFOR (EXchange FORmat): the completeness of the EXFOR data exchange had also been of concern at the 4-Centres meeting; in the case of CCDN, only 49.4% of works published after 1969 and compiled in the NEUDADA (NEUtron DAta under Direct Access) format had been exchanged in the EXFOR format. It was stressed, however, that conversion of all experimental data to EXFOR now received highest priority at CCDN. In connection with this format question, the Committee regretted that the EXFOR format, contrary to the NEUDADA format, still accepted esoteric units; the Committee also declared against using a multitude of formats because, for instance, they made comparisons of data evaluations very difficult.

(f) 13th Meeting of the Committee of the NEA Computer Program Library; CPL, 20th-21st June 1974

The following points were of interest to NEANDC:

- The CPL Committee had discussed an analysis, made by the NEACRP of the final report on the "Service on Experience of Code Utilization" pilot study with shielding programs. A follow-up SECU activity on these programs had been decided, and steps had been taken towards the initiation of a second SECU study,

devoted to nuclear data file processing codes, again in collaboration with the NEACRP.

- CPL had been instructed to start collecting limited numbers of fusion programs and of codes for nuclear model computations. In the latter case, active participation of members of the NEANDC in the selection and implementation of such codes at CPL had been requested. NEANDC would see to it that proper attention be given to a "List of Computer Programs for Neutron Cross Section Calculations and Analysis" (NEANDC-97"U") and to an accompanying memorandum distributed by the NEANDC Secretariat in August 1974.

3. National Progress Reports on Nuclear Data

Batchelor told the Committee that the European Communities progress report will no longer be issued as a combined document. Each country or organisation will issue their own report which will be identified as separate volumes of a single NEANDC(E) report number (e.g. the report from the Euratom Laboratories for the year 1974 is NEANDC(E)162"U" Vol. 3).

It was noted that the progress reports from the "OR" countries were now identified by the same report number. As there were several reports with the same number this was leading to some confusion and Royen was asked to allocate volume numbers so that the reports are uniquely identified (Action 8).

The contributions made under this Agenda item were made in the order the Committee was sitting round the table. In this record the contributions have been put in alphabetical order of the countries. Many contributions included references to papers presented at the Washington Conference on Nuclear Cross-sections and Technology and these are referenced by paper number.

(a) Short additions (no presentations) to printed progress reports on measurements and facilities

Austria

Eder referred to report NEANDC(OR)140L and discussed the following work:

The Atominstitut der Österreichischen Hochschulen, Wien, are planning measurements of the fission probability of heavy nuclei induced by light and heavy ions using the SIN accelerator. At the same institute measurements of the angular correlations of gamma-rays produced by thermal neutron capture and the radioactive decay of oriented nuclei are being made. Fe, Cr and Mo are being tested to see if they are suitable burn-up monitors for reactor operations and safeguards.

At the Institut für Radiumforschung und Kernphysik der Österreichischen Akademie der Wissenschasften, Wien, a pulsed neutron generator, which has a 1 nsec burst width and > 10 ma peak current of deuterons, is being used to study the $^{56}Fe(n,n'\gamma)$ reaction.

Canada

Cross reported that the TRIUMF accelerator has been operating since December 1974. Although tested up to 10 μa on pulsed the output is at present limited to 0.1 μ a due to lack of shielding. The beam intensity will be increased towards the full 100 μa output over the next year. Among the experiments being carried out is a measurement of n,p scattering which is being made in collaboration with a group from the U.K. Minor mechanical changes have been made to the peletron charging system of the Chalk River Tandem and improvements have been made to the Bremstrahlung Monochromator at the University of Toronto. A 14 MeV T-D neutron generator with an output of 4×10^{12} n/sec is being built and will be used for radiation protection studies and for damage studies related to fusion.

Cross referred to the Canadian Progress Report (NEANDC(CAN)-48/L) and drew the Committee's attention to the measurements of the $^{59}Ni(n,\alpha)$ cross-section at thermal energies and the measurements of the $^{103}Rh(n,n')^{103m}Rh$ and $^{115}In(n,n')^{115m}In$ cross-sections between their thresholds and 14.74 MeV.

Euratom Laboratories

Batchelor referred to the progress report NEANDC(E)162"U" Vol. 3 and reported on the modernisation of the accelerators taking place at CBNM. It is planned to shut down the present linac in July 1975; the new components for the machine will be delivered in the Autumn and it is hoped that the modernised facility will be running in Spring 1976. The new Van de Graaff accelerator is due to be delivered in December 1975 and it is hoped the acceptance tests will take place 6 to 7 months later.

Batchelor drew particular attention to the following measurements:

The fission neutron spectrum of ^{239}Pu has been measured at an incident neutron energy of 0.215 MeV. The results show no high energy tail and are consistent with a Maxwellian distribution ($\bar{E}$ = 2.136±0.045 MeV).

A determination of the ^{236}U resonance parameters has been performed (Washington paper HB 2).

Measurements of the scattering and capture cross-sections of ^{238}U have been

made for resonance parameter determination.

Measurements leading to p-wave assignments of ^{238}U resonances have been reported (Washington Paper HB 3).

Programme of measurements related to the $^{6}Li(n,\alpha)$ cross-section is underway. This includes measurements of the total cross-section of ^{6}Li between 1 keV and 2 MeV (Linac) and between 0.1 to 2.4 MeV (Van de Graaff), a measurement of ^{6}Li differential elastic scattering cross-section between 0.25 and 0.95 MeV and a measurement of the $^{6}Li(n,\alpha)$ to $^{10}B(n,\alpha)$ cross-section ratio planned between 100 eV and ~1 MeV.

The capture cross-section measurements for ^{197}Au between 0.1 and 3 MeV made by the activation technique are nearly complete.

France

The most recent published progress report from France is NEANDC(E)162U Vol. 4.

Michaudon reported that the project of a new National Heavy Ion Accelerator (GANIL) is being actively studied by a group of about 10 experts in accelerator technology and another group of physicists. The first group will issue shortly a detailed description of the facility as envisaged at present - no major changes are proposed. The second group produces a reular newsletter; the latest No. 2 was issued February 1975.

Other items of news from France concerning facilities were:

The EN tandem at Bruyeres le Chatel has been upgraded from 6 MV to 7 MV.

A random pulsing device has been installed on the 5 MV Van de Graaff at Cadarache. This will be used to perform neutron spectrum measurements by the time of flight technique on beams extracted from sub-critical uranium and plutonium assemblies.

The Saclay Linac is not being used any more for neutron physics.

Michaudon said that a full report of the activities of Bruyeres le Chatel is being edited as a note CEA-1798. He highlighted the following experiments:

(a) Elastic and Inelastic Scattering:

^{12}C from 8 to 14.5 MeV in 0.5 MeV steps. Significant discrepancies from ENDF/B III. Work supplemented by measurement of $^{12}C(n,n'3\alpha)$ reaction at 14 MeV. Results will all be used in full evaluation of ^{12}C.

^{148}Sm, ^{150}Sm, ^{152}Sm, ^{154}Sm, ^{146}Nd. Studied at 7 MeV to see effects of deformation. Will be studied in 1975 at around 4 MeV where deformation effect on σ_{nT} is a minimum.

^{76}Se, ^{78}Se, ^{80}Se, ^{82}Se. Measurements at 8 MeV and at 6 and 10 MeV for ^{76}Se and ^{82}Se aimed at investigating the effect of isospin. The studies will be supplemented by (p,p) and (p,p') experiments.

(b) (n,2n) cross-sections:

Measured from threshold to 15 MeV using large liquid scintillator. Data obtained for ^{93}Nb, ^{103}Rh, W, Ni, Pt and even isotopes of Se. Se, ^{75}As, Ga and D will be measured in 1975. Preliminary data on (n,2n) and (n,3n) cross-sections are available for ^{235}U and ^{239}Pu.

(c) Fission Studies:

σ_{nf} for ^{235}U and ^{238}U has been measured at 14 MeV and between 0.8 and 3.4 MeV.

Studies of fission of ^{240}Pu compound nucleus by measuring fragment properties in $^{239}Pu(d,pf)$ reaction.

Measurements of $\bar{\nu}$ (E). Previously published values for ^{235}U, ^{238}U and ^{239}Pu have been revised due to a change in background correction.

At Saclay a number of measurements have been made with the Linac as listed below:

Study of (n,Y,f) reaction for ^{241}Pu. 2 to 100 eV shows effect very weak.

Fission cross-sections of ^{237}Np, ^{232}Th and ^{238}U have been measured. Data on ^{232}Th and ^{238}U published (Washington Paper GB 27).

Total cross-section of ^{241}Am. Resonance parameters have been obtained below 150 eV. The values of Γ_f are not in agreement with Los Alamos data.

Capture cross-section of Au measured from 58 eV to 47 keV and values of Γ_γ obtained.

Schmitt reported that the following experiments had been performed at Cadarache:

Capture cross-sections have been measured between 15 keV and 550 keV for ^{23}Na, Fe, Cr, Ni, ^{103}Rh, Au, Ta, ^{55}Mn and ^{238}U using Maier Leibnitz detector.

Self shielding factors for natural Fe have been measured between 24 and 160 keV.

The capture cross-section of Au measured by activation technique between 10 and 500 keV agrees well with measurements with Maier Leibnitz detector.

Measurement of prompt fission neutron spectra for ^{235}U and ^{239}Pu for incident neutrons of ~30 keV.

Some work on neutron flux measurements has been done - Cadarache is the French Standard Laboratory in this field and is participating in BIPM organised comparison.

Schmitt also said that Devilliers at Saclay is improving his fission product file by adding new data and new fission products.

At Fontenay aux Roses the fission product data are being verified by making colorometric measurements of decay heat produced by fission products of ^{239}Pu and ^{233}U.

The Department of Fundamental Research at Grenoble is working on fission yields. In particular measurements have been made for ^{252}Cf spontaneous fission and for the thermal fission of ^{233}U and ^{235}U.

Germany

A draft copy of the German progress report (NEANDC(E)162"U" Vol. 5) was distributed and Frőhner highlighted the following measurements made at Karlsruhe.

Capture cross-section measurements on structural materials are now mainly completed and data are available for ^{50}Cr, ^{52}Cr, ^{53}Cr, ^{54}Fe, ^{57}Fe, ^{62}Ni, ^{64}Ni and Co. The data reduction has been repeated and improved for the Fe and Ni isotopes.

Measurements of $\bar{\nu}_p$ for ^{235}U have been made between 0.2 and 1.4 MeV and reported at Washington (Paper GB 2).

The capture cross-sections of Au and ^{238}U have been measured relative to the ^{235}U fission cross-section. The data for ^{238}U below 140 keV are in good agreement with Oak Ridge (N.S.E. 51, 385, 1973).

Gamma-ray production cross-sections have been measured for ^{58}Ni, ^{60}Ni and natural Fe.

Evaluation of the high resolution cyclotron measurements of neutron transmission of O, Mg, Al and Fe has continued. An R-matrix fit to the preliminary Fe data between 500 and 850 keV was presented at Washington (Paper HB 8).

The measurements of the elastic scattering cross-section at 10 angles of ^{40}Ca between 1 and 6 MeV have been analysed. Further data have been obtained for O, Si and Fe.

A measurement of α for ^{235}U between 200 eV and 15 keV has been made using the Pb slowing down spectrometer. Between 200 eV and 1 keV the data are significantly higher than earlier data.

Qaim reported that many nuclear chemistry measurements were being made at Julich which are related to the fusion programme. Measurements are made at ~14 MeV to study the systematics of reactions. (n,2n), (n,p) and (n,α) reactions have been measured for 35, 15 and 12 medium and heavy mass nuclides respectively.

Measurements have also been made of [(n,d) + (n,n'p) + (n,pn)] for 9 nuclides and of [(n,n'α) + (n,αn)] for 5 nuclides. In many cases the cross-sections are comparable to the values for the (n,p) and (n,α) reactions.

(n,t) and (n,^{3}He) cross-sections, which are typically in the μ b region, have been determined for 8 nuclides. The results are fitted well by the systematics developed at Julich.

Measurements are being made at Julich on the excitation functions for charged particle induced reactions important for the production of radioisotopes for life sciences.

Determinations are being made of the tritium production and the neutron spectrum in a Li assembly weighing 700 kg which is the model of a fusion reactor blanket.

Qaim reported that radiochemical data are being measured at a large number of other places in Germany, in particular at Mainz, Darmstadt, Giessen, Cologne, Munich, Marburg and Berlin. Data being investigated includes fission yields, delayed fission neutrons and decay schemes.

Italy

Coceva said that the fast thermal reactor RB-2/TV at Bologna went critical in September 1974. Integral measurements based on the hull reactivity method will be carried out to get the average capture cross-sections of Fe, Ni and Cr in neutron spectra similar to those in fast reactors. Work on Fe has started.

The research activity of the CNEN-Bologna team working at Geel on capture gamma-ray studies is reported in the Euratom progress report (NEANDC(E) 162"U" Vol. 3).

Coceva highlighted the following experimental work:

University of Padua have measured the forward scattering of 2 MeV neutrons from ^{165}Ho oriented normally to the scattering plane.

At Trieste the differential elastic scattering of neutrons by ^{6}Li has been measured between 1.98 and 4.64 MeV at 13 angles in the range 30° and 140° in the laboratory frame of reference. Coceva agreed to check that these data had been sent to Smith as requested (Action 9).

The Pavia group have measured the angular distribution and angle energy correlations of ^{4}He, ^{6}He and ^{3}H particles emitted in ^{239}Pu thermal fission. The results show that one mechanism is responsible for the emission of these particles.

The Cassaccia Group have made an integral measurement of the ^{23}Na(n,2n) cross-section in a fast spectrum.

Japan

Tsukada reported that the budget of the JAERI 20 MV tandem has been authorised and the scheduled operation of the accelerator will start in 1978. The main subjects are nuclear physics, nuclear chemistry, solid state physics and material testing. The 12 MV Pelletron tandem of Tsukuba University will be completed by the end of this year. The 12 MV tandem accelerator of Kyushu

University, which is home-made, will be completed in spring of next year. Both of these tandems will be used for the heavy ion acceleration.

The AVF cyclotron of Research Center for Nuclear Physics, Osaka University, was completed last fall. The energy is $E_p \leq 75$ MeV and $E_\alpha \leq 120$ MeV. The SF (Sector Focused) cyclotron of Institute of Nuclear Study, Tokyo University, was completed last year. The energy is $E_p \leq 35$ MeV and $E_\alpha \leq 68$ MeV. The external ion sources for Li ions and polarized protons are now under test. The main subject of both cyclotrons is nuclear physics. The AVF cyclotron of Tohoku University will be completed in 1977. The energy is $E_p \leq 40$ MeV and $E_\alpha \leq 50$ MeV. The heavy ion acceleration ($\lesssim$ Ne) is planned in all of these three cyclotrons.

The heavy ion linear accelerator of Institute of Physical and Chemical Research, Tokyo, is under construction, and it will be completed by the end of 1977. It is of Wideroe type, and the maximum energy is 6 MeV/amu for Ne and 1.5 MeV/amu for Xe.

The electron linear accelerator of Nuclear Engineering Research Laboratory at Tokai, Tokyo University, is scheduled to be completed by the end of next year. The energy is 35 MeV at zero current and 25 MeV at 200 mA and the pulse width is 10 nsec to 4 μ sec. It will be used for (1) neutron experiments for reactor physics and engineering combined with a fast neutron source reactor as a booster, and (2) pulse radiolysis by using electron beams.

Tsukada distributed an addendum to the most recent Japanese progress report (NEANDC(J)36L) which is mainly a list of abstracts of recent papers. Among these are the following:

Neutron resonance parameters of ^{238}U (Washington Paper HB 4)

Measurement of neutron capture cross-sections near 24 keV (Washington Paper HB 22)

Multiple scattering of neutrons impinging on thick materials in the resonance energy region (JAERI - M 6034).

Sweden

Conde said that the University of Lund tandem Pelletron will be delivered later than planned (May 1975) but otherwise the plans for the facility are unchanged.

In reporting on the data measurements Conde referred to NEANDC(OR)140/L and then pointed out some new measurements and results not in the report.

At Studsvik a new measurement is in progress on ^{238}U inelastic scattering in the keV energy. The measurements on fission neutron spectra were reported at Washington (Papers GB 8 and 24). Measurements are taking place on the delayed gamma-rays (time range 1 to 10^3 secs) and delayed neutrons from the thermal fission of ^{235}U. A programme of work on (p,n) and (α,n) reactions of importance to astrophysics has also been started. Calorimetric measurements of fission product after heat starting 20-30 secs after the end of the irradiation are being made.

At the Swedish Research Councils Laboratory half life data in the range 1 sec to 10 minutes have been obtained for 85 fission products.

At the Chalmers University of Technology studies are in progress on the decay schemes of fission products using a rapid chemical separation technique (SISAK). A measurement of the $^{59}Ni(n,\alpha)$ cross-section was reported at Washington (Paper HB 25) and the result (22.4$\pm$1.7 b) is consistent with the Canadian measurement (18.0$\pm$1.6 b) reported above but is much higher than the KAPL value of 13.7$\pm$0.6 b (N.S.E. 53, 1, 1974).

Measurements of the ^{238}U to ^{235}U fission cross-section ratio in the energy range 5 to 10 MeV have been measured in the Tandem Accelerator Laboratory, Uppsala. Studies of fast neutron capture gamma-rays have continued in this Laboratory and large improvements have been made in the calculation of these data.

Determinations of fast neutron capture cross-sections using activation techniques have continued at Lund University and a report on these will be presented to the topical conference at this meeting.

United Kingdom

Lynn described the new 136 MeV electron linac which is to be built at Harwell and should be operational in 1978. This is the fourth in a series of machines and it will make use of much of the existing linac equipment including the neutron booster. It will be built at right angles to the present machine which will be used up to a few months before the new one becomes operational. It will be used to provide data for fission and fusion reactors and to study condensed matter.

The accelerator is an 8 section L-Band machine driven by 4 klystrons (20 MW peak 40 kW average power). The guaranteed parameters are as follows:

Maximum current in short pulses (10 ns) is 6A. Minimum pulse width is 5 ns and maximum p.r.f. is 2000 p.p.s.

Maximum current in long pulses (up to 5 μ s) is 1A (for which electron energy is 60 MeV) and for these conditions the maximum p.r.f. is 300 p.p.s. giving 90 kW of beam power. The maximum duty cycle is 0.003.

The following target facilities will be available - Booster, fast neutron target (space for flight paths up to 400 m long), condensed matter cell and low energy cell (beam extracted after first two sections to give beams of 2 to 30 MeV).

There is an article on the facility in the 6th March 1975 issue of the New Scientist.

Sowerby referred to the most recent U.K. progress report (NEANDC(UK)160L) and mentioned the following items which are of particular interest.

The Joint Harwell-Studsvik measurement of the ^{235}U fission neutron energy spectrum was reported at Washington (Paper GB 24). There is no large excess of neutrons at high energies and Adams is trying to examine the data of Rose which exhibited such an excess.

A comprehensive set of measurements of the total capture cross-section of Hf and its isotopes has been performed on the Linac giving resonance parameters in the low energy region and average cross-sections at higher energies.

The programme to measure the capture cross-section of structural materials is underway and will be discussed at the topical conference.

Construction of the equipment to allow measurements with heated UO_2 samples (up to ~2000°C) using the Linac is underway. Transmission, self indication and possibly capture measurements are planned.

Measurements of the ^{239}Pu fission cross-section in the energy range 1 keV to 1 MeV using the Linac and the $^{238}U/^{235}U$ fission ratio from threshold to 22 MeV using the synchrocyclotron were reported at Washington (Papers GB 6 and GB 7).

Work performed at the Kelvin Laboratory, University of Glasgow includes studies of electrofission and of the total cross-section of rare earths.

The National Physical Laboratory have been making improvements in neutron flux measurement techniques.

The work on chemical nuclear data in the U.K. will be discussed under Agenda Item 6(c).

James reported that high resolution measurements had been made of the total cross-sections of Fe and Ni. This work is associated with the capture cross-section programme and the measurements will be analysed to obtain resonance parameters.

The synchrocyclotron has been used for precision measurements of neutron energies between 100 and 300 keV. Energies corresponding to peaks in the total cross-sections have been observed as follows: Al (119.8±.042 and 257.26±.012 keV), Na (299.31±.12 keV) and ^{6}Li (243.32±0.33 keV). These values agree well with other data and in particular the ^{6}Li value agrees with the datum of Uttley.

Story reported that beta decay energies from the fission products produced in ZEBRA irradiations of ^{239}Pu and ^{235}U were being measured for times greater than 20 seconds after the end of the irradiation.

United States of America

Jackson reported about the intense neutron source developments at Argonne:

Until recently the work has been centred on the ZING concept (ZGS Intense neutron generator) in which the 500 MeV Injector Booster proton synchrotron

associated with the ZGS ("Booster II") is used to produce intense neutron fluxes. Some test runs have now been made and 5×10^{12} protons per pulse have been obtained. Further studies now indicate that a separate high intensity synchrotron with a ^{238}U target could provide neutron fluxes 10 times higher than ZING.

Chrien reported on the Rensselaer Intense Neutron Spectrometer (RINS) which is a 75 ton lead slowing down spectrometer driven by the RPI Linac. This gives a useable flux 10^3 - 10^4 times greater than that obtained by a conventional time of flight spectrometer of the same resolution (reported Washington Paper BB 10).

Motz reported that tuning of the WNR pulsed neutron facility on LAMPF will start this year and may be complete by Summer 1976. Research and development work is being performed at Los Alamos aimed at obtaining a device which will produce 10^{14} to 10^{15} 14 MeV neutrons per second. This will have a jet of deuterium as a gas target and a 1 amp tritium beam - beam power 300 kW. It will be used for radiation damage studies.

Chrien, Jackson, Motz and Smith referred to the most recent draft U.S. status report and highlighted the following measurements:

Argonne

The capture cross-sections of Co, Ni, Cu and Zn have been measured between 350 and 750 keV using white spectrum time of flight techniques (Washington Paper IB 13).

Activation cross-sections are being measured for a large number of reactions between threshold and 10 MeV. Data on (n,p) reactions for ^{27}Al, ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{59}Co and ^{64}Zn are reported in ANL/NDM-10.

Capture gamma-ray spectra have been measured for capture in Na at thermal energies and in the 2.8 keV resonance. Very little difference is observed and this suggests that Γ_γ for the resonance should be ~0.3 eV.

Charged particle reactions relevant to fusion are being measured (see Washington Paper HA 9 and ANL 8088). Jackson agreed to distribute ANL 8088 to all members (Action 10).

Measurements have been made on the ^{241}Pu delayed neutron yield and the values appear to decrease with increasing neutron energy. This behaviour is different to that for other nuclei.

Brookhaven

Filtered beams using Fe + Al + S (24 keV) and ^{6}Li (1 keV) have been installed on the HFBR. These have been used for capture gamma-ray spectroscopy (Washington Paper IB 16) and for activation cross-section measurements on ^{197}Au and ^{238}U (Washington Paper IB 18).

Los Alamos

Measurements have been made between 6 and 14 MeV on the differential elastic and inelastic neutron cross-sections of ^{9}Be which are important for fusion reactor development.

R matrix analyses of the light element standards were reported at Washington (Paper EA 4). New measurements of the scattering of 7 to 12 MeV tritons by alpha particles have been made for use in the analysis of the ^{6}Li cross-sections.

For geological surveys of uranium in water neutron activation techniques based on ^{239}U decay have been developed which have a sensitivity of 1 part in 10 billion and can be used for millions of samples.

A cryostat for measurement of fission product after heat has been developed. The response time is a few seconds and the heat is measured by determining the volume of He evaporated.

Lawrence Livermore Laboratory

A number of fission cross-section measurements have been made using the Linac. Measurements on ^{235}U and on the ratios of ^{233}U, ^{234}U, ^{236}U and ^{238}U to ^{235}U were reported at Washington (Papers GB 1, GB 20 and GB 14).

A measurement of the energy dependence of $\bar{\nu}$ has been made between 700 keV and 20 MeV for ^{235}U.

National Bureau of Standards

Measurements are nearly complete of the ^{235}U fission cross-section in the energy range 0.8 to 5 MeV.

Scandium (2 keV) and Fe (24 keV) filtered beams have been installed at NBS (Washington Papers BB 9 and BB 18) and the Fe beam has been used to measure the angular isotropy of the $^{6}Li(n,\alpha)^{3}H$ reaction (Washington Paper DB 3).

Oak Ridge National Laboratory (now officially called Holifield National Laboratory)

Work has started on the efficiency calibration for neutrons of a 1.1 m diameter Gd poisoned large liquid scintillator. The efficiency measurements will be used in an absolute determination of $\bar{\nu}_p$ for ^{252}Cf.

The capture cross-section of ^{93}Nb has been measured between 2.6 and 700 keV.

Precise measurements of the total cross-section of ^{238}U have been made below 1 keV and compared with calculations based on ENDF/B IV. It is found that above 40 eV the calculation based on a single level formalism as recommended in ENDF/B IV does not fit the data between resonances. An R-matrix calculation gives a much better fit.

Rensselaer Polytechnic Institute

Measurements of fission widths of ^{238}U and ^{232}Th have been made with RINS (see above) and (n,α) measurements will be performed in the future. For ^{145}Nd $\alpha\nu$ widths are easily measurable with a 7 gm sample.

The transmission of a Na sample in a Na filtered beam has been measured. The minima in the cross-sections are well fitted by the ENDF/B IV data but the shapes of cross-sections in the regions of the minima are not well represented.

U.S. Army Ballistic Research Laboratory

Measurements are planned on the small angle scattering of neutrons on Nb at ~14 MeV to resolve a 15% discrepancy in data.

(b) Short Reports on Nuclear Data Activities in Countries Participating in the NEANDC Regional Sub-committee

Progress reports were available from Switzerland and Spain (both numbered NEANDC(OR)140"L") and Conde and Eden highlighted a number of items.

In Switzerland the SIN accelerator is now in operation but because this is an expensive facility to operate there is now reduced support for low energy neutron data.

At the University of Fribourg the levels in ^{233}Th have been studied using the ^{232}Th(n,γ) reaction. A level scheme for ^{233}Th has been constructed and the neutron binding energy for ^{233}Th has been found to be 4786.35$\pm$0.25 keV.

In Spain the Atomic Energy Commission has been reorganised and a new research centre is planned outside Madrid. At the Junta de Energia Nuclear, Madrid the effective delayed neutron fraction, β_{eff}, for the zero power fast reactor CORAL-1 has been determined as β_{eff} = 0.00663. The value agrees well with calculation.

Measurements of the ^{16}O(n,p), ^{28}Si(n,p) and ^{23}Na(n,α) cross-sections at 14.1 MeV have been made at the University of Valladolid. The half lives of the activation products was also determined.

(c) Short Reports on Important Research Papers of Interest to NEANDC

There were no comments under this Agenda item.

An action was placed on all members to send a list of NEANDC reports originating in their areas to the secretary before 15th May (Action 11).

4. Achievements on Measurements and Evaluations

(a) Thermal Neutron Data for the main fissile isotopes

Story told the Committee about the present status of the third IAEA review of the thermal parameters of fissile isotopes. It has taken a long time to get the review close to completion but the preliminary findings have now been presented at the Washington Conference by Lemmel (Paper EA 2).

The main changes in input data since the second review are

(a) ^{252}Cf $\bar{\nu}$ data are more consistent, have more weight and have a lower mean value.

(b) New data are available for the half lives of ^{233}U and ^{234}U which are important for the assay of fission foils.

(c) The half life of ^{239}Pu is probably lower than previously expected. A low value results from allowing the half life to be a free parameter in the least squares fit. There is an urgent need for new measurements but these are in progress at a number of laboratories.

(d) Improved 2,200 m/sec data on the fission cross-sections of ^{235}U and ^{239}Pu are available.

In his paper Lemmel shows that there are inconsistencies between the 2,200 m/sec measurements and measurements made in thermal spectra as if either are omitted from the least squares fit a very consistent set of data are obtained. Story felt that this was not too important as the χ^2 value obtained using all the data in the fit is lower than one has a right to expect and this may mean that people have worked too hard to find reasons to increase the errors ascribed to individual measurements.

In the set of recommended values the lower $\bar{\nu}$ values are offset by higher values of fission cross-sections. A common cause for the inconsistencies in data may be connected with the fission counting of uranium samples in a thermal neutron spectrum. The cross-section curve shapes between 0.005 eV and 0.025 eV are a significant source of error in g-values.

Cross reported that Bigham had re-evaluated the Chalk River fission cross-section data measured in thermal spectra to allow for changes in half lives and

to enable improved correction factors to be applied. The new values of cross-section are consistent with the old ones for ^{233}U and ^{239}Pu but for ^{235}U and ^{241}Pu the data have changed by more than 1 standard deviation.

Batchelor said that the team working on precise low energy fission cross-section measurements at BCMN had been changed and that the present team were now working on ^{233}U. When this was complete the people concerned would turn to other things unless some other measurements could be identified and he asked the advice of the NEANDC. Story said that Askew (Winfrith) had argued that the inability to predict the temperature coefficient of thermal reactors could be due to uncertainties in the ^{235}U fission cross-section shape and/or errors in the ^{238}U capture cross-section data in the thermal range. This combined with the problems in the 2,200 m/sec evaluation indicate an important need for measurements below thermal energies.

Frühner said that there were facilities in Germany at the Technical University at Munich which could be used to make these measurements and he undertook to enquire if this could be done (Action 12).

The Committee considered the ^{238}U capture cross-section data in the range below the 6 eV resonance where there are only limited data. It is uncertain how large any deviations from a 1/v energy dependence would have to be to explain the discrepancies and Farinelli agreed to refer this problem to NEACRP

(b) Activation Detector Cross-sections

Smith reported that activation cross-section measurements were an important part of the data programme at the Argonne. As reported under Agenda Item 5 (a) many measurements on (n,p) reactions have been reported in ANL NDM 10 and many other data have been determined. These data, which are all relative to the ^{235}U fission cross-section, are now being extended up to 25 MeV.

Farinelli, who is Chairman of the Euratom Working Group on Reactor Dosimetry, surveyed the present situation. The IAEA held a Consultants Meeting in September 1973 in which members of the Euratom Working Group on Reactor Dosimetry took part. (The papers presented and conclusions reached are given

in INDC(NDS)-56/U). In practical applications the final purpose of measurements is in general to arrive at values for integral quantities, which are not directly measurable, (e.g. radiation damage) accurate to 10-20%. In special cases integral quantities related to fuel are required to ~5%. Sensitivity studies are really necessary before one can convert these values to cross-section accuracies; it is felt, however, that the cross-section data will be needed to similar accuracy.

Two lists of detector cross-sections were defined; Category I being selected according to the following criteria

(a) in terms of energy response, the set provides a reasonable coverage of neutron spectra in most reactor environments

(b) insofar as possible the differential nuclear data for these reactions are among the best known ones today as they are either standards for differential measurements or have been extensively studied. Most other useful reactions were put in Category II. The cross-section data for Category I reactions will be based on differential data and will be checked by using a defined set of Benchmark experiments. The cross-section data for the Category II data will be obtained by integral measurements in the Benchmark spectra.

The Euratom Working Group has reviewed its requests in WRENDA by applying the recommendations of the IAEA meeting and the Euratom requests are now cut down to some integral measurements in a fission spectrum and some differential measurements.

Smith said that he had read a paper by Liskien and Paulsen (INDC(NDS)-56/U Page 111) which showed that cross-section data for any threshold reaction are only needed for 6 MeV above the threshold to find the average in a fission spectrum and he wondered if this was always true. He had also heard statements indicating that since dosimetry instruments are used to relate fluence between different irradiations cross-section data are not important.

Farinelli said that both points were only partially correct. Liskien's statement is correct for fission reactors but would not be true for fusion

applications. Cross-section data are important because there are changes in neutron spectra between irradiation positions and the fluence can only be derived if cross-section shapes are taken into account.

Cross mentioned that a number of papers on integral measurements in fission spectra were reported at the Washington Conference by the National Bureau of Standards and Mol groups. In these it was concluded that the mean energy of the ^{235}U fission neutron spectrum was ~2.03 MeV which is very close to the most recent differential data.

Schmidt said that the second part of INDC(NDS)-47/L by Vlasov was nearing completion. He also noted that the ENDF/B dosimetry data were not up to date as new data are not included.

(c) Fission Product Nuclear Data

Nichols presented to the Committee a report on the activities of the U.K. Chemical Nuclear Data Committee (CNDC). The report will form part of the next U.K. Nuclear Data Progress Report, NEANDC(E)162 Vol. 8. The CNDC, which is a sub-committee of UKNDC, is responsible for the nuclear data which are by tradition obtained from measurements that are made or used by radiochemists (e.g. fission yields, decay scheme data and cross-sections measured by radiochemical methods). The Committee maintains a request list which is revised annually; the latest edition (CNDC(75)P.2) being issued in February 1975. The Committee is composed of measurers, users and compilers and evaluators of data. Compilations and evaluations of data are considered in detail by the Committee and are recommended following appropriate revisions. The Committee has no executive powers and it does not recommend measurements although it is prepared to advise on them. The recommended publications bear a slogan stating the fact and a list of these reports is given in Appendix 4 .

Nichols then highlighted a number of items in the progress report which were felt to be of particular significance at this time. Crouch has made a fine series of compilations and evaluations of fission yield data, which the CNDC consider to be of the highest quality. Rogers has just completed an evaluation of α-decay data which will be published shortly. Measurements are

being made of the half lives of ^{239}Pu, ^{237}Np and ^{241}Pu and a number of people who belong to the Decay Schemes Sub-committee of CNDC are gradually preparing a file, in ENDF/B4 format, of decay scheme data. Other important measurements being performed include determinations of Am capture cross-sections in fast reactor spectra and measurements aimed at understanding the changes in fission yields with neutron energy.

Smith reported that some work at Argonne on monoenergetic fission yields had been terminated. The yields of ^{233}U, ^{235}U and ^{238}U had been determined at $\frac{1}{2}$ MeV intervals up to 6 MeV.

5. New Needs for Nuclear Data

(a) For Fission Reactors

The Committee noted an increasing emphasis throughout the world on the needs for data for the higher actinides. Rowlands felt that many of these data could initially be obtained by a combination of integral measurements and theoretical calculations.

Sowerby reported that the U.K. Nuclear Data Committee has been reorganised so that all data requirements, particularly those not concerned with the cores of fission reactors, can be better identified. The UKNDC now has five sub-committees; two, the Neutron Sub-committee and the Chemical Nuclear Data Committee, are concerned with measurement and evaluation of data particularly those with the data for fission reactors and the other three, the Biomedical, the Fusion and the Nuclear Incineration Sub-committees, are more responsible for identifying new needs. The Chairmen of the Sub-committees are Dr. J. E. Lynn, Mr. J. G. Cuninghame, Mr. J. A. Dennis, Dr. C. A. Uttley and Dr. M. G. Sowerby respectively.

Sowerby said that Harwell had been investigating the reduction of long term hazards associated with higher actinides (e.g. Np, Am and Cm) by nuclear transmutation. (This is called nuclear incineration in the U.K.) If one looks at the cross-section data on these isotopes it is obvious that the burn up of the isotopes in a reactor should be better the harder the reactor spectra. Calculations have shown that the materials can be burnt up in a sodium cooled oxide fuelled fast reactor without too serious a neutron penalty. In a harder spectrum (e.g. in a spectrum like the Dounreay Fast Reactor) the higher actinides would be equivalent to a reasonable fuel. There are many chemical, metallurgical and reprocessing problems in separating Np, Am and Cm from fission products and making them into fuel elements. However, it does appear as if the physics is such that the long term hazards can be reduced. Work is now going on to see which data are important in these studies. It appears that the cross-section data on ^{241}Am, ^{243}Am and ^{244}Cm are particularly important.

Farinelli said that in order to reduce the long term hazards it was necessary to remove greater than 99% of the heavy elements (particularly the plutonium) from the fission products. Otherwise the hazards of the remaining heavy elements in the waste are greater than those of the higher actinides.

(b) For Other Applications

(i) Fusion Reactors

Jackson reported that in the U.S. the request list for fusion applications has been revised. In the new list there are 76 requests, the majority being for evaluations, approximately 6 to 8 requests are for charged particle reaction data and an increased emphasis has been placed on (n,p) and (n,α) data for structural materials. As part of the review of data a critical review of current evaluations has been made (Report USNDC-CTR-1). Jackson said that it was his personal opinion that the new list considered only the short range needs. For instance there is no request for ^{6}Li(n,α) data.

Qaim confirmed that (n,p) and (n,α) reactions are very important since they are needed for damage studies on structural components. For the wall materials 10% accuracy in the data is satisfactory and he considered that the data on the Li cross-sections were adequate.

Farinelli agreed that the Li data are satisfactory at present since the doubling time for breeding T is so short for simplified blanket studies. When a detailed blanket design is available and all the structural material effects are included in the neutronics calculations, the doubling time will be effected.

The important problem at the moment is the activation of the structures which will be so large that the components of the devices will need remote handling. With JET for instance the activation will be serious after 1 pulse. The data are required to 10-15% accuracy to calculate these effects but in some cases e.g. for Fe and Mn above 10 MeV there are some reactions which are not measured. Integral measurements are, however, planned to help fill in the gaps.

Qaim said that at Julich they used activation techniques but when there are stable daughters some reactions of importance cannot be measured. This makes it important to understand systematics.

Smith said that another important area of data needs for fusion concerned shield design since the superconducting coils are very sensitive to heat input.

Royen noted that an International Energy Agency (IEA) has been formed in the OECD. The Agency will be interested in energy research and development and it is anticipated that the NEA will be affected in the long term particularly in the fusion field. The IEA will be represented on the Board of Management on the intense 14 MeV neutron source being considered by Los Alamos and it will also promote the exchange of data. Motz said that it was vital that the channels for the exchange of fusion data should not conflict with the present channels for neutron data.

(ii) Safeguards

It was reported that the U.S. data requirements for safeguards have been revised and there are very few requests in the new request list. (γ,n) data are no longer required and the U.S. approach is now to use reference standards. It is apparent that the previous data needs in the U.S. were overstated. The new needs include requests for the γ-ray spectra following radioactive decay, half-life data (1% accuracy or better is required) and for spontaneous fission properties. A programme of half-life measurements is being funded for safeguards.

(iii) Biomedical Applications

Cross reviewed the situation and said that 120 radioactive nuclides are used for diagnostic purposes in medicine. For all but 9 of these the decay data have been revised since 1968. There are many errors in the recommended values of the numbers of intense γ-rays produced but these errors are only important if they affect routine measurements in the laboratories. However, the medical profession do not know of the errors and so there are few requests for better data.

There appears to be no need for improved data on the nuclides such as ^{14}C and tritium which are used for togging.

There are needs for data on the charged particle reactions used to produce

radionuclides. Many of the needs, however, may be met by calculation.

The needs for data associated with neutron therapy depend on the possibility of developing a 14 MeV source producing 4×10^{13} n/sec. If such a source were available there would be enough data on most things. In the absence of the source (d,n) reactions with a 30-50 MeV cyclotron are being considered and in this case there is a need for neutron cross-sections of body materials in the 15 to 50 MeV range. The data required are elastic, inelastic, (n,α), (n,p) and other charged particle producing reaction cross-sections. The spectra of the secondary charged particles are required and the accuracy requirements are lower at the higher neutron energies. It may be possible to obtain data from proton cross-sections if some checks are made. There are also needs for data associated with materials (e.g. Fe, Pb) used for shielding.

Qaim said that he had the impression from the Nuclear Medical Group at Julich that there is increasing interest in short lived isotopes for diagnostic purposes because they produce less dose. Most of these isotopes are cyclotron produced and it is necessary to find the optimum energy for the production of the isotopes with the minimum contamination. This means that fairly precise data accurate to 10 to 20% are required. Motz confirmed the importance of this type of data as the U.S. laws say that the purity of the isotope has to be certified.

(iv) Industrial Applications

No outstanding needs for industrial applications were identified as the general trend is to use reference standards. A possible exception is to use the $^{16}O(n,p)^{15}N$ reaction at 14 MeV to determine the oxygen content in metals.

6. International Co-operation in Nuclear Data Measurements Analysis and Evaluation

(a) Half-life Measurements

Batchelor reported that at CBNM, Geel the measurement of the half-life of ^{233}U has been completed and the value obtained is $(1.5925 \pm 0.0040) \times 10^3$ years. Work has now commenced using the same methods on ^{239}Pu and measurements on ^{241}Pu are planned. There is a lot of contact and discussion with AERE Harwell on these measurements.

Nichols said that measurements of the ^{239}Pu, ^{241}Pu and ^{237}Np half-lives were being made at Harwell. The measurements on ^{239}Pu are partially completed and the preliminary value is 24115 ± 80 years, which agrees with Oetting's value and is lower than the presently accepted value of 24,300 years. Measurements are to be made (using a specific activity method) on a sample of Oetting's which he had used for a calorimetric determination so that the results by two techniques on a single sample can be compared.

As far as the results on the ^{241}Pu half-life are concerned there are still discrepancies. Wilkins and Cabell have made mass spectrometric measurements over 11 years and obtain a value of 15.02 ± 0.1 y. Crouch has made measurements by a similar technique on two samples of plutonium prepared by pile irradiation of pure ^{240}Pu 5 years ago and obtained values of 14.44 ± 0.14 and 14.31 ± 0.11 years. Whitehead, using the first of Crouch's samples and a counting method depending on the half-life of ^{241}Am, obtained a value of 14.91 ± 0.15 y. The measurements by mass spectroscopy are continuing.

Jackson reported on the activities of the U.S. Half Life Evaluation Committee which is chaired by Walter Strohm of the Mound Laboratory. The objective of the programme is to determine the half-life of the plutonium isotopes to ± 0.1 to 0.2% accuracy. The Committee has met in full twice but they are unwilling to release any results. Measurement methods are being developed and three techniques are being used, mass spectrometry, colorimetry and specific activity. It was felt that there may be difficulties in exchanging samples with non-U.S. laboratories. However, the NEANDC felt that it was vital

that there be international co-operation in this field and Batchelor agreed to co-ordinate European measurement work on actinide half-lives and institute collaboration with the U.S. Half Life Evaluation Committee (Action 14).

(b) Flux Intercomparison

Schmitt reported on the neutron flux intercomparison being organised by BIPM. Five of the laboratories, NRC (Canada), NPL (U.K.), BCNM (Euratom), Cadarache (France) and BIPM have performed their calibration of the transfer instruments and the remaining four, NBS (U.S.A.), ETL (Japan), PTB (Germany) and IMM (U.S.S.R.) should do so during 1975. The transfer instruments are as follows:

20 cm moderating sphere with BF_3 counter	250 keV 565 keV 2.2 MeV and 2.5 MeV
^{3}He proportional counter	250 and 565 keV
^{238}U fission chamber and Fe foil	14.8 MeV

To date no measurement using the Fe foils, which are available from the NPL, has been made.

Schmitt said that there were large disagreements, up to ~20%, between laboratories and that these occur mainly at 565 keV. It is planned to issue a report on the intercomparison later this year.

Batchelor said that he felt that the intercomparison should have been organised by EANDC and not the BIPM. Smith said that he did not like the transfer instruments as in general they could not be used in time of flight experiments. Story said that the reason that BIPM organised the comparison is that the National Standards Laboratories were the main organisations wishing to support and partake in it.

The NEANDC decided that it did not wish to get involved in the organisation of the intercomparison but that it would like to be kept informed on the results.

7. Data Indexing, Compilation and Evaluation

(a) Short additions to progress reports on data compilations and evaluations

(b) Brief reports on recent co-operative activities in Europe

For convenience the discussions on the above agenda items were taken together.

Qaim reported that the following work had been performed in the Federal Republic of Germany.

(i) A comprehensive compilation of Y-ray data associated with the decay of neutron excess as well as neutron deficient isotopes by W. Soyka and G. Erdtmann (Jülich) (available as 3 volumes of a Jülich report Jül-1003-AC)

(ii) A compilation of activation cross-sections and excitation functions for (n,2n), (n,p) and (n,α) reactions over the energy range 13 to 31 MeV M. Bormann, H. Nevert and W. Scobel in Handbook on Nuclear Activation Cross-sections Technical Report Series No. 156, IAEA Vienna (1974) p.87

(iii) A compilation of excitation functions of charged particle induced nuclear reactions in 2 volumes (Landolt-Börnstein Series) H. Munzel et al

(iv) A summary of the systematics of 14 MeV neutron induced nuclear reaction cross-sections S. M. Qaim Washington Conference March 1975, Paper HA 4.

(v) KEDAK. Complete re-evaluation of ^{238}U and ^{239}Pu above the resonance region for KEDAK 3.

Frühner added that Munzel was now working on another volume; the data for which are going into a computer file in EXFOR format. Qaim said that the main use of Munzel will be for the production of isotopes for medical purposes.

Chrien reported that in the USA the responsibility for CINDA had been from the Technical Information Centre of the USAEC at Oak Ridge to the NNCSC at Brookhaven and that work was in progress to improve the US entries. The new curves book of BNL 325 should be complete this summer. It will contain all the

references to data but only selected points will be plotted.

Motz discussed a review of the T(d,n)^{4}He and T(t,2n) cross-sections at low energies (USNDC-CTR-2, LA-5828-MS) which are important for fusion calculations. It is concluded from the work that a comprehensive evaluation of the T(d,n) cross-section based on an R-matrix analysis is required so that a more reliable set of data can be used in fusion studies below 20 keV. For the T(t,2n) reaction more measurements are required at energies down to 20 keV.

Jackson reported that during 1974 the nuclear data project at Oak Ridge published 31 mass chain compilations and 3 issues of recent references. Work in progress includes the preparation of 20 mass chain compilations by the project, the production of 11 NIRA compilations and the preparation of radioactive decay data on about 190 radionuclides for inclusion in a forthcoming handbook of the National Bureau of Standards. A reaction list for charged particle induced nuclear reactions has been prepared and published.

Jackson said that the Tables of Isotopes project at Berkeley hoped to produce their next edition in 1976. Other work of interest is a catalogue of radioactive decay spectra from Ge-Li detectors (ANCR-1000) produced by R. Heath.

Schmitt told the Committee that the evaluation work performed at Saclay by Ribon and his group would now be done at Cadarache. Work recently completed at Saclay included an evaluation of Hf and its isotopes and an evaluation of the resonance parameters of ^{232}Th. At Cadarache an evaluation of Cr has been performed and work on fission products is being done in co-operation with Gruppelaar and Benzi.

Michaudon said that the evaluation work at Bruyeres le Chatel was of two types; evaluation of experimental data and model calculations. Evaluations of experimental data included (n,2n) data for ^{89}Y, ^{93}Nb and ^{169}Tm, (n,Y) for ^{203}Tl and ^{205}Tl and all cross-sections of ^{12}C. Model calculations include (n,xn) and (n,xnf) reactions for U and Pu isotopes, (n,Y), (n,2n) and (n,3n) data for medium mass nuclei, (n,n'Y) for Cr and Ni and (n,Y) for ^{236}U, ^{238}U, ^{240}Pu and Y isotopes. A complete coupled channel calculation of ^{238}U is in progress.

Coceva said that all the evaluation work at CNEN Bologna is reported in the Neutron Nuclear Data Evaluation Newsletter. An evaluation of Cu and its isotopes has been prepared in UKNDL format and is available from CCDN. The main emphasis is now on the joint evaluation of 24 fission products mentioned by Schmitt ($^{95,97,98,100}Mo$, ^{99}Tc, $^{101,102,103,104}Ru$, ^{103}Rh, $^{105,107}Pd$, ^{109}Ag, $^{133,135}Cs$, ^{141}Pr, $^{143,145,146,148}Nd$, ^{147}Pm, $^{149,151}Sm$ and ^{153}Eu).

Conde reported on the Swedish work and in particular he noted the compilation of infinite dilution resonance integrals of Albinsson (in IAEA Technical report series No. 156) and the work on short lived fission products by Rudstam and his collaborators published in the report of the IAEA Panel Meeting on Fission Product Nuclear Data, Bologna November 1973.

Tsukada referred to the addendum to the Japanese progress report and noted the evaluation of 28 fission products reported in JAERI-M 5752 and at the Washington Conference (Paper EB 4). The evaluations in ENDF/B format are now available at CCDN and the work will be continued to include more nuclei. He also said that it was hoped to complete the first version of the Japanese library of evaluated data in 1976. Progress in this area is limited by a shortage of manpower.

Nichols said that the decay sub-committee of the CNDC aimed to produce in the UK a file in ENDF/B format of decay scheme data for fission products, actinides and other $\beta\gamma$ emitters, along with the relevant data such as fission yields. The first round of fission yield evaluations by Crouch has now been completed and an evaluation of α-decay data by Rogers is also available. For fission products the Tobias Library (CEGB Report RD/B/M 2669) has been accepted and will be modified as necessary. The gamma-ray compilation from Jülich (Jül-1003-AC) is being acquired for use as an interim gamma-decay file. There have been meetings with the French with the aim of producing a joint file as neither country has the effort to perform all the necessary work.

Story added that other work of interest in the UK included the work of Lynn (AERE - R 7468) on the systematics for neutron reactions of the actinide nuclei and the evaluation in the thermal region at Winfrith of ^{149}Sm, ^{155}Gd and

^{157}Gd. The code GALAXY used for generating group constants from the UKNDL has been sent to the Computer Programme Library at Ispra.

Cross reported that on two compilations made in Canada. The first by himself and Ing was on the energy spectra of neutrons transmitted through H_2O, D_2O, C, Fe, Pb and concrete for the following neutron sources - fission spectra, water and D_2O moderated fission spectra and 14 MeV neutrons. The second was by Winterborne and Brice on range and energy distributions associated with ion implantation. This would be published by Plenum Press and would also be an IAEA report.

Rosen said that all the CCDN compilation activities had been fully reported under Agenda Item 4(e).

Schmidt said that the second part of the report on the status of neutron cross-section data for reactor radiation measurements was nearing completion. CINDA 75 was under preparation and CCDN were to be praised for their work on this. WRENDA 75 was also being prepared and would be available in a few months. CINDU 11 an index of evaluated data was available from the IAEA.

Story drew attention to the CINDA publication policy which is discussed in the report of the Sub-committee on Relations of NEANDC with other International Committees given in Appendix 5 and discussed under Agenda Item 12(b).

Batchelor said that Bambynek and others at Geel had made a comprehensive review of orbital electron capture.

Smith raised the question of keeping up to date the two compilations NEANDC 95U (Compilation of threshold reaction neutron cross-sections for neutron dosimetry and other applications) and IAEA Technical Report Series No. 156 (Handbook on Nuclear Activation Cross-sections). Though these overlap to a certain extent the Committee agreed that they were for different purposes and should be kept up to date. Smith felt that some recent data were missing from NEANDC 95U and suggested that these areas should be revised. Rosen agreed to ask the CCDN Committee to consider the revision of these areas (Action 15) and Smith agreed to advise the CCDN on the areas requiring revision (Action 16).

(c) Status of ENDF/B IV

Chrien reported that ENDF/B IV was now complete and that the library consists of 90 materials in the general purpose file, 27 materials in the dosimetry file and 770 materials in the fission product file; most of these fission product files only contain decay data. The codes and procedures for ENDF/B IV are nearly ready for issue. The curves book associated with the library will only be available in the U.S. A series of benchmark tests have been made with the library and these show that the data are good for fast reactor calculations except for a problem with central worths but the situation for thermal reactors is less satisfactory.

Two special purpose libraries have been prepared by NNCSC in the past year; a charged particle library in ENDF format for CTR purposes and a conversion into CSISRS format of the LLL photoneutron experimental data library.

The planning for ENDF/B V has been started and completion is estimated for late 1977. The main emphasis will be on actinide nuclei but full error files will not be provided for all nuclei.

Rowlands asked if any account had been taken of benchmark data in preparing ENDF/B IV. The U.S. members said that the philosophy was the same as before; a number of adjustments had been made to the data but these were generally within the experimental errors.

8. Meetings and Conferences on Nuclear Data

A list of past and future meetings was distributed to the Committee

(a) Past Meetings

The Committee agreed that the Washington Conference on Nuclear Cross-sections and Technology held 3-7 March 1975 had been very good. Smith said that in one respect he was disappointed as, with the exception of the new fission counter by Dabbs et al (paper BB 7), he could see few developments of techniques and ideas.

(b) Future Meetings

Rose presented a proposal for holding regional meetings on nuclear data for applied purposes on a regular 3 year cycle. The principal topic would be neutron interactions and its ramifications - because that remains the principal applied topic and is likely to do so for a number of years - but the balance between the various applications would clearly be a matter for local decision.

The conferences would be held sequentially in USA, USSR and Western Europe and those in the first two places would supersede the so-called Washington conferences and Kiev meetings. The European meeting would be a new one and would need to find a sponsor. Attendance from outside the regions would be welcome.

Rose made the following points

(i) The IAEA would no longer need to consider the organisation of a general world conference at regular intervals in the Paris-Helsinki series because the need would be met. It could devote the money so saved to specialist meetings.

(ii) Since each region would have a meeting every three years, this would cover the needs for a general meeting with a wide local representation.

(iii) Since there will be a major meeting annually somewhere in the world, important information could be presented without undue delay to an international forum.

(iv) Because of travel costs, attendance from outside the regions would always be limited, but by arranging meetings in such a sequence we

would avoid the clash of two large meetings in other regions in the same year (e.g. 1975 Washington and Kiev) and the consequent strain on budgets.

The proposal met with the approval of the NEANDC though Qaim and Schmidt felt that there was a danger that scientists from developing countries and the Eastern block may find it difficult to attend conferences which were not sponsored by the IAEA. It was agreed that a suitable sequence of meetings would be: 1977 USSR - Kiev, 1978 W. Europe, 1979 USA - Washington, 1980 USSR. The Committee agreed that the members of the proposed NEANDC European Sub-committee (or of JENDRPC) should consider holding the first European Meeting on Nuclear Data for Applications in 1978 (Action 17), the Chairman should approach the IAEA regarding the proposal for having major nuclear data conferences sequentially in the USSR, Europe and the USA at yearly intervals (Action 18) and that Rose should make informal approaches to the USSR regarding the proposals (Action 19).

9. Reports of Standing Sub-committees and Discussion of related topics

(a) Sub-committee on Standards and Discrepancies

(b) Fast neutron fission cross-sections

(c) Fission neutron spectra

Jackson reported that the Sub-committee had convened as circumstances permitted during the week. Participants included Drs. Jackson (Chairman), Sowerby, Smith, Frühner, Tsukada, Batchelor, Rowlands, Qaim, Schmidt. The relationship of the committee's activities to those of the corresponding sub-committees of the INDC was of major concern. The recent INDC review of Standard Reference Data and Discrepancies, i.e. November 1974, covered largely the same body of information of interest to the NEANDC Sub-committee and in this way highlighted the overlap and redundancy in the activities of the INDC and NEANDC Sub-committees. Sub-committee members were well aware of this situation and enthusiastically endorsed the concept of a standing status file under the joint maintenance of the two data committees. To facilitate this approach it was agreed that continuing responsibility for individual reference standards and discrepancies entries should be assigned to Sub-committee members so as to coincide where possible to the geographical or organisational assignment in the INDC Sub-committee. Furthermore, in order to ensure the early availability to the sister committee, it was recommended that in the future each review be completed and available at the time of the meeting of the respective parent committee. Areas of non-overlapping responsibility may arise from time to time corresponding to changing initiatives and interests of the two committees. However, it anticipated that such instances will constitute a minor portion of the respective data sets. Such cases can be regarded as the individual responsibility of the appropriate group.

The Committee members developed during the week the nucleus of a standard reference file; the national and individual responsibilities for the different items are given below. These assignments are intended to be continuing responsibilities for future meetings. Draft copies of the entries to file had been distributed to the NEANDC members.

(i) (n,p) scattering cross-section - UK (Rowlands)

(ii) $^{3}He(n,p)$ - US (Jackson)

(iii) $^{6}Li(n,\alpha)$ - US (Motz)

(iv) $^{10}B(n,\alpha)$ - BCMN (Batchelor)

(v) Carbon (σ_{nT} and σ_{nn}) - US (Smith)

(vi) $^{197}Au(n,\gamma)$ - US (Jackson)

(vii) $^{235}U(n,f)$ - UK (Sowerby)

(viii) $\bar{\nu}$ and $\chi(E)$ for ^{252}Cf - IAEA (Schmidt)

(ix) Half life of ^{239}Pu - BCMN (Batchelor)

The Sub-committee had also assigned its responsibilities for the proposed joint NEANDC-INDC discrepancy files as follows:

1. $\sigma(n,f)$ and fission ratios for ^{235}U (100 eV - 15 MeV), ^{239}Pu (15 eV - 100 keV), and ^{233}U (100 keV - 10 MeV) - France and UK (Schmitt and Sowerby)
2. $\sigma(n,\gamma)$ for ^{238}U (1 keV - 1 MeV) and resolved resonance parameters - UK (Rowlands)
3. $\sigma(n,n')$ for ^{238}U (particularly for 45 keV state) and for the range (1 - 3 MeV) - USA (Smith)
4. $\sigma(n,f)$ and $\bar{\sigma}(n,f)$ in fission spectrum for ^{238}U and the $^{238}U/^{235}U$ ratio (threshold - 20 MeV) - BCMN (Batchelor)
5. Thermal parameters for the fissile nuclei - IAEA (Schmidt)
6. Delayed neutron yield for ^{238}U (2 - 3 MeV) - USA (Smith)
7. $\sigma(n,\gamma)$ for structural materials (1 keV - 200 keV) - Germany (Frőhner)
8. Γ_{γ} for 2.85 keV resonance in ^{23}Na - USA (Jackson)
9. $\bar{\nu}_{p}(E)$ for ^{235}U and ^{239}Pu in the 1 keV to 14 MeV region - Japan (Tsukada)

Jackson said that the Sub-committee had considered the sponsorship of specialist meetings. It felt that a meeting to discuss the $^{6}Li(n,\alpha)$ cross-section was desirable but it was difficult to propose when this should take place because among other things some of the major discrepancies might vanish when the investigations on scintillator compositions were complete. The

Sub-committee, however, proposed that a meeting on fission cross-sections should be held in the period 9-18 months hence. An evaluation of the measurements would be an important feature of the meeting. A large number of laboratories, e.g. Cadarache, Geel, Harwell, Livermore, Argonne, NBS, NPL, Karlsruhe, were making or planning to make measurements so this was an area where such a meeting would be extremely valuable. There would be no problem in sponsoring such a meeting in the U.S.A. Smith commented that he felt that it was necessary to produce a definitive document at the end of such a meeting.

The NEANDC then discussed in general the area of standards and discrepancies. Jackson proposed that consideration should be given to removing the $^{3}He(n,p)$ reaction from the list of standards as it is little used and little work is being done on the cross-section. Batchelor said that $^{6}Li(n,\alpha)$ is not a good standard above 100 keV because of the resonance and so there is a case for limiting the energy range of discussion. Jackson said that the $^{197}Au(n,\gamma)$ cross-section now appears to be well known and that the time is appropriate for a detailed review and evaluation of the data.

Chrien presented a brief report on the Seminar on ^{238}U Resonance Capture held at Brookhaven, 18-20 March 1975. The meeting had sessions on

(i) Analysis of critical and sub-critical assemblies

(ii) Experimental differential data

(iii) Integral measurements and analysis

(iv) Methods of calculating self shielding

(v) Resonance description

The errors between calculation and experimental values of integral properties are large, e.g. there is a 10% difference in the shielded resonance integral, and these are most likely due to errors in data. If the between resonance cross-section were changed by 0.2 b at all energies the discrepancies could be removed. The main conclusions of the meeting were

(a) The resonance parameters of the first few ^{238}U levels should be critically re-examined or re-measured as the errors quoted appear unrealistic

(b) Calculations should be performed to see how much Γ_γ needs to be altered to get calculation and experiment to agree

(c) Discrepancies in the resonance parameter data at energies above 1.5 keV need resolving

(d) The p-wave strength function for ^{238}U is 2.2×10^{-4}

(e) There are no p-wave levels below the Cd cut off and careful measurements are required to see if there are assymetries in the 6.6 eV level

(f) Self indication measurements are required for different sample thicknesses and temperatures.

Chrien added that the proceedings of the seminar will be issued as a BNL report. At Brookhaven they plan to measure the ^{238}U capture cross-section below 20 eV and investigate the resonance parameters of the first few levels. Frøhner said that Würenlingen have facilities for capture measurements in this energy range and it was noted that Moxon at Harwell has made low energy capture measurements for ^{238}U.

Smith discussed the discrepancies in the ^{238}U inelastic scattering cross-sections highlighting the uncertainties in the excitation of the 45 keV level below 500 keV incident energies and the excitation of levels above 1 MeV excitation in the MeV energy range.

Motz discussed the uncertainties in the ^{238}U fission cross-section data. In the plateau region of 2 to 3 MeV there is a spread of ~4% between the data of Stein et al and other data such as Meadows and White and Warner. Evaluations based on these data give the average value of the cross-section in a fission spectrum approximately 10% lower than measured. New measurements of the fission spectrum are tending to give a harder spectrum and the new data on fission cross-sections tend to give slightly higher data. There are, however, differences between the recent measurements of the $^{238}U/^{235}U$ fission cross-section ratios by Coates et al and Behrens et al which could be due to energy shifts.

Frøhner said that during the topical conference the committee had heard of some of the problems in capture measurements for structural materials. The

talk of Moxon had highlighted the experimental difficulties. One of the needs in this area was good total cross-section data of high resolution and he would like the data on Cr, Fe and Ni which had been taken with ORELA to be published. It was not possible to say at the present time that good capture cross-section data were available for these materials. Schmitt amplified this conclusion by quoting differences in the keV energy range of up to a factor 4 between a recent Cadarache evaluation for Cr (Washington Conference Paper EB 18) and earlier work.

Batchelor wondered if there was enough work going on in this difficult area. The committee noted that a number of laboratories were active but in general there was a gradual reduction of effort.

Jackson noted the work at Argonne relevant to the discrepancy in the capture width of the 2.8 keV Na resonance (see Agenda item 5). Rowlands said that this problem was important as most activation of Na in fast reactors was through this resonance and that the width was required to ±20-30%.

Farinelli wondered why the fission neutron energy spectrum was not on the discrepancy list. Sowerby replied that recent work at Harwell, Studsvik, Geel, Cadarache and Bruyeres le Chatel had shown that there was no excess of neutrons above a Watt spectrum at high energies but that the mean energy of the secondary neutrons (~2 MeV for ^{235}U) was 3% higher than earlier measurements suggested. The fission spectrum measurements and ^{238}U inelastic scattering were to be discussed at a specialist meeting at Harwell sponsored by JENDRPC on the 14-16th April.

The NEANDC accepted the report of the sub-committee and its recommendations regarding the specialist meeting and placed the following actions on its members.

Jackson	Write to the Chairmen of the INDC Sub-committees on Standard Reference Data (Liskien) and Discrepancies (Joly) regarding the NEANDC response to the proposals to keep joint status files on standards and discrepancies

Members of Standards and Discrepancies Sub-Committee	Complete status files on standards and discrepancies and send to Jackson within 30 days
Chairman	Reply to Chairman of INDC regarding INDC proposals for co-operation on standards and discrepancies (Action 22)
Schmitt Smith Sowerby	Co-ordinate exchange of Li glass scintillators and the measurement of their ^{6}Li content so that the discrepancies in the $^{6}Li(n,\alpha)$ measurements due to errors in glass composition are reduced
All Members	Contact laboratories in their countries and areas making fission cross-section measurements and send Jackson details of their current and planned measurements within 30 days
Jackson	Having received details of fission cross-section measurements make proposals for the fission cross-sections specialist meeting
All Members	Inform data committees in their countries and areas of the names of the people responsible for the status files on standards and discrepancies and ensure that all work of relevance is reported to the appropriate persons
Jackson	Circulate a list of the people responsible for the status files on standards in the INDC and the NEANDC
Farinelli	Submit the discrepancy list to NEACRP so that they can consider the relevance of the items
Jackson	Complete report of Sub-committee of Standards and Discrepancies and circulate on an A distribution list and to the INDC

(d) Isotope Sub-committee and discussion of sample requests

Chrien presented the report of the Isotope Sub-committee, whose members were Chrien (Chairman), Batchelor, Conde, Schmitt and Sowerby, given below.

"The Sub-committee took note of the fact that the current practice for the arrangements of loans from the US isotopes pool does not directly involve the

NEANDC. Requesters have been applying directly to the Division of Research, ERDA. They in turn have been circulating these requests in an internal review. In some cases, the NEANDC review has also taken place, but has taken too long to be a factor in the decision. In practice this arrangement seems to be working satisfactorily. Two problems, however, have been noted

(a) information on loan approval does not reach the requester in sufficient time to allow him to plan his program properly

We recommend that NEANDC ask DPR to notify the requester when his report has been approved by DPR and forwarded to DIP (International Programs). Information on sample availability should be forwarded promptly to the requester.

(b) in the event the local or US review be indecisive in recommending approval, NEANDC endorsement could conceivably be crucial in obtaining loan approval

We recommend that NEANDC endorsement be requested by DPR in these cases where local review has not adequately resolved the question of loan approval.

In view of the smooth functioning of international sample exchange under the present arrangement it does not seem necessary to us to continue the Isotopes Sub-committee as a standing NEANDC Sub-committee.

We recommend that the Isotopes Committee be discontinued as a standing sub-committee."

The NEANDC accepted the Sub-committee's report and recommendations and placed an action on the Chairman to write to the Director, Division of Physical Research, ERDA on the problems raised in the report (Action 30).

Chrien went on to describe the Oak Ridge Isotopes separation programme and said that fourteen separators were functional at the end of 1974 and were engaged in isotope separations of Se, Te and Sn. The Se separator is designed to separate 1.5 to 2 g of >75% ^{74}Se for the sales inventory. ^{74}Se is a precursor of ^{75}Se, used as a diagnostic scanning agent. Te and Sn isotopes are also used in the preparation of medically useful radioisotopes.

All separations **are being** made on a 8 hr/day, 5 day/week basis. In order to use available separators and manpower a calcium separation was terminated

(2.5 g of a total goal of 10 g of ^{48}Ca were obtained). Pd and Ru separations for RMC requirements were also terminated short of requirements.

Radioisotope separation activity was as follows:

(a) ^{230}Th, initiated in a doubly contained separator in January 1974 was terminated in October 1974 on collecting > 10 g of 90% ^{230}Th. 3.08 gms of 91.54% ^{230}Th were added to the pool, while 14 gms of 89% material will be recycled to produce 1 g of 99.9% ^{230}Th early this year.

(b) ^{232}Th, from which the ^{228}Th decay product is removed, was started in 4 singly-contained separators and completed in September 1974 with >100 g of ^{232}Th.

(c) ^{235}U, a program to obtain 500 g of 99.9% ^{235}U, started in October 1974, is continuing in 4 single-contained separators. Preliminary analysis indicates that the product will consist of 99.92 to 99.96% ^{235}U.

(d) ^{244}Pu, 1.16 g of ^{244}Pu, 98% enrichment was completed in a doubly-contained separator.

Chrien said at the end of his report that the desire of Beer and Käppeler for 10 grms each of the isotopes of Ge and Zn by 1977 had been noted and would be conveyed to the appropriate people.

Qaim commented that isotope enrichment could be performed at Julich by using mass spectrographs.

10. Topical Discussion

A topical discussion was held on the afternoon of 9th April on capture cross-section measurements. It was attended by 42 people and summaries and abstracts of the papers presented have been published in Harwell Report AERE-R 8082 (NEANDC(UK)163L).

At the close of the meeting the Chairman expressed the Committee's thanks to the people responsible for the local arrangements and to the Harwell Authorities.