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NUCLEAR ENERGY AGENCY NUCLEAR DATA COMMITTEE

SUMMARY RECORD

OF THE

TWENTY-SECOND MEETING

AIX-EN-PROVENCE (FRANCE)

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(TECHNICAL SESSIONS)

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APPENDICES

TECHNICAL SESSIONS

National Progress Reports

The national progress reports for the year ending 1980 are in preparation. Preliminary drafts of a few reports are available; the final reports will appear in due course of time.

Advances in Nuclear Data Measurements

Recent advances in nuclear data measurements in the OECD countries related to the following fields are discussed:

i) Data pertaining to Fission Reactor Cores

a) Actinides: Condé reports that a compilation of actinide cross sections has been carried out in Sweden and the report distributed as NEANDC (OR) 153 "L". It is planned to compile group cross sections in the resonance region.

Cierjacks mentions that at Karlsruhe (Germany) a measurement of the capture cross section of ^{243}Am is planned. Vonach informs that a characterization of the ^{252}Cf spectrum in the 5 to 15 MeV region is in progress as a PTB Braunschweig (Germany) and Vienna (Austria) collaboration.

Michaudon reports that at Bruyères-le-Châtel (France) recently scattering cross sections have been measured in the neutron energy range of 0.7 to 3.4 MeV for ^{232}Th, $^{233,235,238}U$ and $^{239,242}Pu$. Furthermore, ν measurements have been performed over a wide energy range for $^{230,232}Th$, ^{237}Np and ^{243}Am. Fission cross sections have been determined at 2.5 MeV for ^{239}Pu and at 14 MeV for ^{237}Np and $^{240,242}Pu$. Fort mentions that some actinide build-up work is going on at Cadarache (France).

Chrien mentions that the U.S. activities in the field of actinides are summarized in the Actinides Newsletter (March 1981) issued by ORNL. The Committee appreciates and recommends continuation of those efforts. It asks Chrien to explore the possibility of distribution of Newsletters on "Capture Cross Sections", "10-50 MeV Cross Sections" and "Actinides" to Committee members. Whetstone points out that experiments are in progress at LANL and at the University of New Mexico (USA) to help solve the long standing discrepancy in the ν value for ^{252}Cf. Motz reports that at RPI low energy capture and total cross sections are being measured for ^{232}Th and ^{248}Cm. A detailed fission cross section measurement for ^{232}Th is underway as a Los Alamos-France collaborative programme. Furthermore, at ANL neutron cross section measurement for ^{240}Pu and at NBS fuel element burn-up measurements for 15 elements are in progress.

Sowerby points out that most of the British activities are summarized in the above mentioned Actinides Newsletter. Among them are newer measurements which include cross sections for the production of $^{242,244}Cm$, and decay heat from ^{235}U.

Igarasi gives a brief account of the recent activities in Japan. A recent measurement of the half-life of ^{242}Cm at JAERI, fission studies on ^{238}U with 14.5 MeV neutrons at KYU, and characterization of the prompt fission neutron spectrum of ^{232}Th at TOH are mentioned.

Böckhoff reports on some recent measurements at CBNM Geel on fission cross sections for ^{240}Pu in the energy region of 10 keV to 10 MeV. Below 400 keV the results show large structures.

In summary it is concluded that the situation regarding the data for actinides is not very satisfactory and further information is needed.

b) Fission products: Chrien reports on some recent results obtained using the reactor on-line isotope separator, TRISTAN, at BNL (USA). Alkali metals Rb and Cs were separated. Q_β-values of the radioisotopes were determined and decay properties investigated. The radioisotopes studied recently included $^{98,99}Rb$ and ^{148}Cs.

Igarasi mentions that independent isomer yields for I, Xe and Cs isotopes produced in the thermal neutron fission of $^{233,235}U$ and ^{239}Pu were measured at KTO (Japan). Decay scheme studies were performed on some fission products in the region of rare earths.

Böckhoff points out that at GELINA an extensive programme to determine the resonance parameters of the stable Pd isotopes has been finished. He mentions that the Proceedings of the Specialists' Meeting on Fission Products held at Bologna in 1979 have been published. That publication sums up the state of knowledge in this field.

c) Structural materials: Böckhoff informs that the measurement programme on separated isotopes of $^{54,56,57}Fe$ and $^{50,52,53}Cr$ performed at GELINA has been finished. Total cross sections were determined between 0.5 keV and 19 MeV and capture measurements were done up to 600 keV. Analysis is in progress.

The (n,α) cross section measurements on Fe and Cr done at the CBNM 7 MV Van de Graaff in the neutron energy region of 5 to 10 MeV have now been extended to Ni.

ii) Data pertaining to Fuel Cycles of Fission Reactors and Waste Management

Chrien describes the view of reactor physicists in USA regarding the development in reactor fuel cycle. He gives a listing of some important considerations which are outlined in Appendix 1. As far as waste management via transmutation or incineration is concerned, no new aspect has been reported. It is believed that the process is technically feasible but other possibilities should also be considered.

No new developments are reported by European or Japanese members.

iii) Data pertaining to Fusion and Intense Neutron Sources

Qaim reviews some recent advances in nuclear data measurements for fusion. The Symposium on Neutron Cross Sections from 10 to 50 MeV held at BNL (USA) in May 1980 has shown that presently the major data needs deal with radiation damage effects. Furthermore, there are discrepancies in the $^{7}Li(n,n'\alpha)T$ cross section, a reaction useful for tritium breeding.

Radiation damage in the low energy region is caused mainly by displacement damage, arising primarily from scattering processes. At 14 MeV, however, hydrogen and helium gas production may result in serious damage effects. Hydrogen is produced via (n,p) and (n,n'p) reactions, and helium via (n,α) and (n,n'α) processes. The (n,n'x) type processes have been relatively little investigated.

Qaim reports further that charged particle detection studies performed at Livermore (USA) and radiochemical measurements done at Jülich (Germany) have shown that at 14 MeV the contribution of (n,n'p) processes is significant. A recent study completed at Jülich has demonstrated that the (n,n'p) reaction is strong for those target nuclei which have higher neutron separation energy than proton separation energy ($S_n > S_p$). For nuclei with $S_n < S_p$, both d emission and (n,pn) process are important; in terms of the absolute cross section, however, the (n,d) channel is rather weak. At energies higher than 14 MeV, for example with 30 MeV d(Be) neutrons, the (n,d)+(n,n'p)+(n,pn) cross section for all the nuclei is comparable to the (n,p) cross section. There is a strong need for further data relevant to FMIT facility.

As far as discrepancy in the tritium breeding reaction $^{7}Li(n,n'\alpha)T$ is concerned, Qaim points out further that data deduced from neutron scattering measurements lie higher than those from tritium counting. Tritium measurements performed at Harwell (U.K.) suggested that the excitation function over the energy range of 4 to 14 MeV is 26 % lower than the ENDF/B-IV data. In order to resolve this discrepancy measurements were started at Argonne (USA), at Geel (direct triton counting) and as a Geel-Jülich collaboration (tritium counting). Argonne results for neutrons in the energy range of 7 to 9 MeV show that the cross section is about 17 % higher than the Harwell results. The Geel-Jülich measurements performed so far cover the energy region of 5 to 8 MeV; the preliminary data are partly in agreement with the Harwell values and partly with the Argonne values. Further extensive measurements are in progress.

Michaudon reports that two experiments are underway at Bruyères-le-Châtel (France). In the first a ^{7}Li-sphere of 40 cm diameter has been constructed and, using a pulsed neutron source, integral measurements have been started. In the second experiment ^{7}Li-glass is irradiated with a pulsed neutron source. Measurement of ^{4}He and ^{3}H is performed in glass and the neutrons are characterized by TOF.

Igarasi mentions that some 14 MeV neutron induced reactions on ^{6}Li and ^{9}Be, of interest to fusion technology, are being studied at YOK (Japan).

Chrien summs up briefly the US activities in the field of data for fusion. A list of experiments is given in Appendix 2.

iv) Data pertaining to Shielding, Safeguards and Dosimetry

There are no specific measurements underway pertaining to data for shielding and safeguards. Data relevant to dosimetry (and also structural materials) are to be treated in the subcommittee on Technical Activities.

v) Biomedical Nuclear Data

Chrien points out that the neutron activation data for detecting some trace elements are not accurately known. Vonach mentions that the cross section data for some light elements in the neutron energy region of 15 to 20 MeV are rather uncertain.

Qaim gives a brief review of nuclear data for medically important short-lived radioisotopes. The choice of a particular radioisotope for in-vivo medical applications depends on several factors, such as nuclear properties suitable

for detection by the available γ-cameras, radiation dose caused to the patient, chemical and biochemical properties of the element, organ specificity, etc. Of all the radioisotopes known today, about fifty qualify for use in diagnostic nuclear medicine.

The decay data (needed for estimating radiation doses) are in most cases well known. Only in the case of some short-lived neutron deficient isotopes, rather away from the stability line of the elements, the decay schemes are rather uncertain. Spectroscopic studies on mass separated samples would be of considerable advantage.

The nuclear reaction cross section data needed for production purposes are well known in the case of reactor produced radionuclides. For production at a cyclotron, however, the cross section data are in many cases rather unknown or conflicting. Theoretical models could predict the cross sections within a factor of about 2. As far as the production yields are concerned, in general such estimates of cross sections may suffice. However, for the most important radioisotopes as well as for keeping a check on the impurities generated in the production process, which often add to the radiation dose and distort the resolution of the pictures, cross section data obtained by theoretical calculations generally do not give the necessary information with the needed accuracy. Experimental studies on nuclear reactions leading to the production of the desired short-lived neutron deficient radionuclides as well as major competing impurities are therefore often essential.

In recent years, with the increasing importance of positron emission tomography in nuclear medicine, the need for sophisticated biomolecules labelled with short-lived β^+ emitters is increasing. Though for routinely used β^+ emitters like ^{11}C, ^{13}N, ^{15}O, etc. the production cross section data are fairly well known, any recommended set of cross section values are not available, and it may be worthwhile to evaluate the data for the production of those radionuclides. For the development of further β^+ emitters considerable amount of cross section work is necessary.

It is worth mentioning that most of the larger laboratories engaged in research and development work related to the production of medically important radioisotopes (e.g. BNL (USA), Jülich (Germany), etc.) are also doing nuclear data measurements. The nuclear data needs are often too specific and depend on several factors such as the maximum particle energy available at the cyclotron, the types of accelerated particles, the chemical form and enrichment of the target material, etc. The higher the energy of the incident particles, the more are the data needs, since many reaction channels open up which lead to undesired impurities.

vi) Other Activities

Böckhoff underlines the importance of the charged particle asymmetry of the $^6Li(n,\alpha)T$ reaction for its use as a standard. He mentions that at CBNM the angular distribution of tritons from this reaction is being measured up to 500 keV by means of an ionization chamber.

Perey points out that the shape of the ^{252}Cf neutron spectrum is important and some measurements have been started at ORNL (USA).

Böckhoff mentions that at Geel a measurement of total and scattering cross sections of S has been done.

Qaim gives a brief resumé of the Kiev Conference held in September 1980. In contrast to the nuclear data conferences organized by the NEANDC, a considerable number of papers dealt with the basic physics. The number of papers on the measurement and evaluation of nuclear data was relatively small, but selective. Measurements were reported for thermal, resonance as well as MeV regions, and

the processes investigated included elastic and inelastic scattering, radiative capture, (n,particle emission) reactions and fission. Data were reported both for fissile and non-fissile materials. Data evaluations were presented for transactinides, some threshold reactions (like $^{238}U(n,2n)^{237}U$) as well as some light mass elements (like silicon). The role of integral experiments in nuclear data testing was also discussed.

Newer Facilities, Instrumentation, Separated Isotopes

Some of the newer developments in facilities and instrumentation, and the situation regarding the availability of separated isotopes get attention.

Condé reports that the 6 MV Van de Graaff accelerator at NFL Studsvik (Sweden) has been equipped with post-acceleration, picosecond bunching system (FWHM = 150 ps, I_{mean} = 7 μA, f = 1 MHz). Furthermore, a neutron spectrometer suitable for fusion plasma diagnostics at the Joint European Torus (JET) has been developed by the Institute of Technology at Stockholm and the NFL Studsvik.

Cierjacks gives some more details of the Spallation Neutron Source planned in Germany (cf. NEANDC 125 "A"). The 1 GeV LINAC would deliver protons at average currents of 5 mA. In the pulsed mode 100 mA would be available. An option of storage ring is considered to change the current and repetition rate. The Committee asks Cierjacks to send the relevant information in a condensed form to all the members. Cierjacks reports further that the cyclotron at Karlsruhe has been rebuilt to give a polarized beam for few nucleon problems. A further cyclotron is to be built at Karlsruhe. Qaim mentions that the Compact Cyclotron CV 28 at Jülich is a multipurpose machine, involving a considerable amount of radiopharmaceutical work. A dd-gas target is under construction for radiochemical measurements on low yield reactions in the neutron energy region of 3 to 10 MeV.

Michaudon mentions that a buncher system is to be installed at the Tandem-accelerator in Bruyères-le-Châtel (France) and the project GANYL is making satisfactory progress.

Chrien reports that the TRISTAN on-line separator at the BNL (cf. NEANDC 125 "A") is running well and producing lot of data. Whetstone summarizes the characteristics of the Intense Pulsed Neutron Source (IPNS) at Argonne (USA). It is scheduled for initial operation during 1981, with full characteristics to be achieved in mid 1983. The performance goals are:

	1981	1983
Protons/pulse	2×10^{12}	3×10^{12}
Proton energy	500 MeV	5-600 MeV
Repetition rate	30 Hz	45 Hz
Peak thermal flux	4×10^{14} n/cm^{2}s	7.5×10^{14} n/cm^{2}s
Peak epithermal flux (1 eV)	10^{15} n/cm^{2}s	2×10^{15} n/cm^{2}s
Time-avg. fast flux (>0.1 MeV)	2×10^{12} n/cm^{2}s	5×10^{12} n/cm^{2}s

The neutron scattering facility has the capability for as many as eight beam lines, some of which can be split for greater usage. The radiation effects facility, operating from a second target, has two cryogenic experimental stations for controlled temperature radiation damage experiments.

The authorized construction cost for IPNS was $ 6.4 million and provided for beam transfer from the proton synchrotron, and construction of the spallation target area. In addition, $ 2.4 million was provided to upgrade experimental capability with a variety of spectrometers, detectors and computer interfaces. The operating costs in the fiscal year 1982 are estimated to be $ 3.6 million and research costs are estimated to be $ 1.9 million.

Whetstone mentions further the development of polarized neutron beams at TUNL by upgrading the polarized ion source that feeds the FN Tandem part of the cyclograph. The key development was the achievement of a high efficiency buncher.

Motz outlines the status of facilities at the Los Alamos National Laboratory (USA). The pulsed spallation neutron source at the LAMPF facility, WNR, is progressing well. Instrumentation and experiments continue to be developed for both nuclear physics and materials research. The design work on the storage ring, PSR, to be added to the WNR is very active. It is expected that the remaining final funds for construction will be made available this year. The low energy facility (10-100 keV) for thermonuclear cross section measurements is now in operation. The angular distribution of products from the dd-reaction has been measured. The target is gaseous and is "contained" in a cryogenically cooled volume without windows for the charged particles. The dt and tt studies will be started soon. A new, precise beam energy technique is being used. The continuous negatively charged beam is "chopped" by irradiating it with a pulsed laser which photo-detaches the bound electrons. Thus a neutral "pulse" is created in the beams. Magnetic separation then permits detection of this short pulsed beam by time-of-flight. Motz mentions further that the accelerator design for the FMIT (Fusion Materials Irradiation Test) facility is underway. Although the construction of FMIT itself may be postponed, it is hoped that the 40 MeV, 100 mA deuteron accelerator will be completed. Perey points out that preliminary studies on next generation of accelerators are going on at ORNL (USA).

Sowerby reviews the newer facilities in U.K. The commissioning of the LINAC at Harwell has been somewhat delayed. The accelerator has been provisionally accepted for use from the manufacturers. It has now satisfied all its commissioning tests except that of the specified current at short pulses (4 A instead of 6 A, at 10 ns 2000 pps). There has been a period of formal operator training and now the beam lines are being commissioned. When operational the LINAC will average 5 d of 24 h running per week. The problem of 4 A instead of 6 A will be dealt with by the manufacturers later this year. Sowerby mentions further that the first beam at the Nuclear Structures Laboratory in Daresbury is planned for April 1981 whereas the progress in the Spallation Neutron Source has been slower than planned. It is now scheduled for 1984-85. The Van de Graaff at NPL can now be pulsed in the ns region.

Böckhoff reports that a post-acceleration pulse compression magnet will be installed at GELINA in April 1982. This will allow a compression of 15 nsec pulses down to about 4 nsec, thereby increasing the peak electron current to 30-40 A. The potential of compressing pulses to values below 4 nsec will be investigated after the installation of the magnet.

Coceva gives a short report on a new nuclear physics laboratory, called Laboratorio Nazionale del Sud of the National Institute of Nuclear Physics, being set up in Catania (Italy). The main facility will be a tandem Van de Graaff accelerator (model SMP) produced by High Voltage, having a maximum terminal voltage of 15 MV. A new double stripping system will allow the acceleration, for instance, of iodine ions up to 200 MeV. The injection system will have an analyzing magnet with a mass resolution better than 1 %. There will be three types of ion sources. The accelerated ions will be analyzed with a magnet and distributed in the experimental halls by a bending magnet having output lines at 10° intervals between -70° and $+70^{\circ}$. The data will be collected with an on line computer system (VAX 11/780 and PDP 11/34). All the equipment is now ready, and it will be installed when the buildings will be completed. Installation of the Van de Graaff will begin in October 1981.

It has also been decided to set up a post-acceleration system consisting of a superconducting cyclotron. Construction of this machine has begun in the first months of this year at the Milano University. This cyclotron will have a diameter of 180 cm and a magnetic field of 5 Tesla; it will be able to accelerate any kind of stable ions, up to uranium. The maximum final energy will range from 100 MeV/nucleon for light ions to about 20 MeV/nucleon for heavy ions. This will be the first European machine of this kind and the third in the world (after U.S. and Canada). Construction time is foreseen to be approximately 6 years.

Coceva also reviews the information published in the September 1980 issue of Physics Reports on the possible use of synchroton radiation from the large electron-positron (LEP) storage ring being planned at CERN, Geneva for nuclear physics research. The LEP will operate at energies up to 85 GeV per beam. Out of the different devices which can be used to produce radiation without perturbing the operation of LEP, the "wiggler" is the most interesting for the purpose of neutron cross section measurements. In fact, from a wiggler, a very attractive pulsed photo-neutron source can be obtained, characterised by a pulse-width of a fraction of nanosecond and a repetition frequency of 44700 pps. The photons to be used for neutron production are confined in a very narrow cone and, to a large extent, they are polarized.

The construction of LEP will proceed stepwise: in the first phase only 1/6 of the total radio-frequency power will be installed, reaching an energy of 50 GeV. For this first phase the intensity calculation of the photons which can be obtained with a wiggler are not yet available.

The official approval of the LEP project is foreseen for next June, and the construction will start next year. The completion of "phase one" is foreseen for the years 1987-1988.

The Committee asks Coceva to follow the developments in the LEP machine further and to report to it from time to time.

Igarasi reports on the newer facilities in Japan. The 20 MV tandem accelerator at JAERI is now in a test operation to generate the maximum specified voltage. A pulsed beam of 0.7 ns duration is available from both the negative ion source outside the pressure vessel and the terminal ion source in the pressure vessel. The fast neutron TOF facility is under construction. Igarasi mentions further that a He-jet type ISOL was constructed and installed at the Kyoto University Reactor (KUR). Decay scheme studies are presently performed on ^{95}Rb and ^{90m,g}Rb.

Regarding the Production and Supply of Separated Stable and Heavy Element Isotopes by the U.S. Department of Energy, Whetstone reports as follows:

(i) The ^{242}Pu calutron separation resulted in 250 g of 99.932 % ^{242}Pu from one kilogram of 95.1 % ^{242}Pu feedstock. A negligible amount of ^{244}Pu of low enrichment was obtained. Fifty of the 250 grams have been reserved for sales. The next separation of ^{242}Pu has been set tentatively for 1985.

(ii) Operations are currently (March 81) devoted to the separation of the stable isotopes: Zn, Te, and Pb. Two calutron segments (16 tanks) will be run as long as funding permits. Separations planned for the fiscal year 1982 include the stable isotopes of Tl, Os, and Yb. With current funding levels, the sales pool is rapidly being depleted with little hope for relief before 1983.

(iii) The computer-based inventory system for heavy element materials will also not be operational, as planned, in 1981.

In reply to questions from a few European members Whetstone remarks that there is no change in the policy regarding the loan of separated isotopes; the whole production programme, however, is running at a minimum level.

Böckhoff reports that at CBNM Geel a feasibility study of a mass separator for the separation of small quantities of actinides is in progress.

Advances in Nuclear Data Evaluations

i) Regional Activities

Chrien gives a brief report on the activities of the Cross Section Evaluation Working Group (CSEWG) in the USA and informs that currently the main CSEWG activities are the testing of ENDF/B-V and planning for ENDF/B-VI. He further mentions that high priority has been given to the transfer of the responsibility for publication of Nuclear Data Sheets to NNDC at BNL, USA. The NNDC will prepare level diagrams and decay data for publication from July 1, 1981 onwards.

Cierjacks reports on the evaluation activities in Germany. At Karlsruhe evaluation work is going on mainly on ^{235}U, ^{239}Pu, ^{241}Am, $^{242,244}Cm$ and ^{232}Th. The details are to be found in the national progress report. Condé mentions that Sweden is contributing to the Nuclear Structure and Decay Data Network and that this contribution will continue for the next few years. Fort outlines the evaluation work at Cadarache (France). An evaluation of ^{237}Np data in the ENDF/B format has been finished. Data evaluations for ^{238}U, ^{58}Ni and other isotopes of nickel are in progress. Michaudon describes the evaluation work at Bruyères-le-Châtel (France). Evaluation of Ti(nat) has been done in collaboration with USA. Dosimetry data for $^{46,47,48}Ti$ as well as evaluations for $^{182,183,184,186}W$, ^{209}Bi and $^{85,87}Rb$ are available. Coceva mentions that at Bologna (Italy) evaluation of ^{241}Am and $^{246,248}Cm$ has been completed and published, that of $^{242,243,245,247}Cm$ is in progress. Sowerby informs that at Harwell (U.K.) evaluation of ^{243}Am has been completed and that on Fe(nat) is underway. Other activities such as those in the fields of heavy element decay data, fission product data, etc. are amply described in the progress report. Igarasi points out that the Japanese activities in the field of evaluations are given in the progress report. Among the actinides, an evaluation of ^{243}Cm is in progress. Schmidt informs that the IAEA-NDS has learnt that the ENDF/B format is being adopted by the USSR also.

Perey touches upon the question of including uncertainties in evaluations. It is generally agreed that there are considerable problems in translating the data in the new format. Chrien is asked by the Committee to investigate the possibility of communicating the code used in the translation of ENDF/B-IV to ENDF/B-V.

ii) Joint Working Group on Evaluation Coordination

Bouchard reports briefly that in the absence of a timetable for general release of the US ENDF/B-V file, and in view of the fragmented nature of nuclear data evaluation work in the European member countries, at the incentive of the NEACRP an ad-hoc Working Group was set up jointly by the NEACRP and NEANDC to coordinate evaluation activities in Western Europe. The first meeting of the Group was held in November 1980 in Paris, a summary record of which has been written by Johnston (cf. NEANDC 127 "A" and NEACRP 442 "A"). From the standpoint of the NEACRP the objectives of this ad-hoc meeting were defined to

- agree on a common format for evaluated files
- discuss common evaluation procedures
- establish a mechanism for selection of existing evaluations, and coordination and review of new evaluations
- establish a common data file.

US members show keen interest and would like to be informed about the developments. Japan will decide whether or not to join the common evaluation work after the activities of the Group have been defined more specifically. Tubbs informs that a second meeting of the ad-hoc group is planned during the present Committee meeting to discuss the framework for establishing the group on a firm basis. Johnston mentions that the group will work closely with NEANDC and NEACRP. If the Steering Committee approves the existence of this group, its mandate will be initially for 3 years.

A meeting of the ad-hoc group is held on 9 April 1981, the summary record of which is to be written subsequently (cf. NEANDC 144 "A" and NEACRP 443 "A"). Michaudon reports briefly on the outcome of the meeting of the group to the Committee: A detailed survey of evaluated data files for natural iron and a review of fission product evaluations were presented. The group envisages to complete by the end of 1981 the files on structural materials, titanium and fission products. Further evaluations are envisaged for $^{235,238}U$, ^{237}Np, $^{240,241,242}Pu$, ^{50}Cr, ^{54}Fe, $^{58,62,64}Ni$ and ^{64}Zn. However, no work is planned on the standards. The files will be available to participating countries of NEA Data Bank. The adopted format of the files is the same as that for the ENDF/B-V. Some members of the group showed concern that the current format specifications in the ENDF/B-V system do not allow a convenient representation of total particle emission spectra, particularly the total neutron emission spectrum. A proposal for a suitable change in format specifications had already been made to the appropriate CSEWG subcommittee. Perey informs that those proposals had already been accepted. In reply to a question from Chrien, Michaudon informs that the emphasis in the joint data file will be on fission reactors but no cut-off energy will be defined. The Committee agrees that the question of correspondence between the two evaluation groups (USA, Europe/Japan) should be discussed at its next meeting.

iii) Workshop on Evaluation Methods and Procedures, BNL, Sept. 1980

Schmidt presents some selected highlights of the above Workshop. In his opinion the Workshop covered in full detail the contemporary status and problems of nuclear data evaluation. He emphasizes the following six aspects of the Workshop:

- necessity of large data files or smaller specialised data files?
- need of uncertainty estimates in the form of full variance-covariance matrices, only for limited application or universal generation?
- recent improvements in calculational methods and computer codes
- importance of level density parameter
- adjustment of microscopic data to simple clean integral data
- decision between re-evaluation and new measurement in case of discrepant data

Schmidt's observations are given in more detail in the document INDC/P(81)-7. Perey objects strongly to Schmidt's remarks on the question of uncertainties. The matter is to be discussed in detail later. The Committee members are of the opinion that the BNL conferences are very useful and ask Chrien to explore the possibility of adding the names of NEANDC members to the mailing list for those conferences.

Activities of Nuclear Data Centres

A written report on the activities of the NEA Data Bank is available (cf. NEANDC 135 "A"). Tubbs highlights some of those activities. The conversion and recompilation of experiments from the old NEUDADA system into EXFOR was finished in April 1980 and by October 1980 it was possible to eliminate the backlog of not yet compiled experiments. The future work in this section of the NEA Data Bank would involve continuing compilation of neutron data and also the assembly of the proposed combined European/Japanese joint evaluated data file. Regarding the computer program activities, the testing and distribution of computer programs has continued at a rate similar to that in previous years. A new edition of the "Computer Program Abstracts" in book and microfiche forms was issued in November 1980.

In reply to a question from Böckhoff whether establishing the joint evaluated data file will cause personnel constraints at the Data Bank, Tubbs mentions that the problems will have to be overcome by the presently available manpower. Cierjacks asks about the extent of information supplied by the Data Bank to the industry. Johnston replies that about 15-20 % of the total use of the computer programs is in industry.

Chrien reports on the activities of the National Nuclear Data Center (NNDC) at BNL, USA. Parallel to the normal neutron data compilation, work on the nuclear structure and decay data evaluated file and on the BNL-325 Neutron Cross Section book, is also going on. More details on the activities of the NNDC are to be found in Appendix 3.

Schmidt gives a brief review of the activities of the Nuclear Data Section (NDS) of the IAEA. The EXFOR system has reached a stage where it can now accomodate all experimental nuclear reaction data. The new issue of the WRENDA is under preparation and will be issued shortly. The ENDF/B format for evaluated nuclear data has been adopted by the USSR also. More details on the activities of NDS are given in Appendix 4.

Igarasi mentions briefly the activities of the JAERI Nuclear Data Center. In addition to supplying Japanese contributions to CINDA and WRENDA it is engaged in research work relevant to evaluation of nuclear data as well as atomic and molecular data for fusion.

Technical Discussions

i) Intercomparison of Derived Average Resonance Parameters

Following the proposal at the last NEANDC meeting, that a benchmark intercomparison study of methods used to determine average parameters from resolved resonance parameters be carried out, a report (cf. NEANDC 213 "AL") was prepared and sent out in September 1980 to prospective participants. Participation in the exercise was rather small (only 9 groups had participated till March 1981); the preliminary results were interpreted by Ribon and Johnston (cf. NEANDC(E) 213 "AL"). Johnston reports to the Committee that the results showed important systematic discrepancies between the sets of solutions obtained by participants using essentially the same approach to the calculation of average level spacings, strength functions and radiation widths in the two hypothetical nuclei for which artificially generated resonance parameters were supplied. It is regretted that there was no participant from the USA. Chrien replies that due to lack of manpower Pearlstein could not arrange for a participant.

Coceva remarks that some of the given error values are too low. The results should be analysed not only for values but also for the size of the quoted errors. Johnston replies that the problem lies not in the method but in the application of the method. Perey would like to know more about the formula used so that he may also consider participating in the exercise. Fort is of the opinion that no two methods give the same results even if the same parameters are used. All the results underestimate the true values since one cannot separate p-wave contamination. Perey asks if the set of parameters generated by Ribon correspond to the true values. Johnston replies that there is certainly not one to one correspondence between the given and derived parameters.

The Committee thanks Johnston for this heavy task and asks the Chairman to convey its thanks also to Ribon. The Committee endorses the continuation of this exercise. Since the "true values" are now available, it encourages the participants to concentrate on a study of the sensitivity of their derived values to true energy range selected from the resonance parameter sets. It recommends convening a Workshop at the NEA Data Bank in October 1981 for the participants to identify the origin of the discrepancies, and would like to be informed of the results by December 1981.

ii) Reporting of Data Uncertainties in Nuclear Measurements

The past few years have witnessed a growing interest in more complete uncertainty description of nuclear data. Many evaluators have developed different evaluation techniques relying on a description of the correlations between measured cross sections. This makes it easier not only to combine the same cross sections at different energies but also to estimate correlation coefficients between cross section uncertainties for different reactions. Realizing the importance of detailed description of the different uncertainties in the data sets, a working paper was prepared (cf. NEANDC 134 "A"). Johnston initiates the discussion by proposing that NEANDC strongly recommends that experimentalists should publish the uncertainties in measurements in a way in which the covariance matrix of their results can be generated. This means that

- statistical and systematic uncertainties should be given separately,
- systematic uncertainties should be broken down into individual independent components and these components should be given as a function of energy,
- uncertainties should be given as one standard deviation or the equivalent for systematic uncertainties.

Smith and Cierjacks remark that inclusion of excessive details and covariance matrices in research papers generally causes difficulty in the acceptance of the work for publication in a refereed journal. Perey is of the opinion that the breaking down of the uncertainty into various components is very important and application oriented measurements should specifically follow this practice. Böckhoff observes that two things are demanded from the experimentalist; firstly, the quoted errors and, secondly, supplementary information for the evaluator. He further thinks that some fundamental paper dealing with the basic matter is needed to provide guidelines for the experimentalist. Perey mentions that he is writing a book which will deal with the matter in detail. Chrien is of the opinion that the experimentalists are not describing all the details in a coherent way. He suggests that proper publications giving enough details should be encouraged. Qaim finds unrefereed publications of data measurements in conference proceedings as rudimentary, and Vonach suggests that at conferences only abstracts should be printed.

In connection with a discussion on the importance of uncertainty correlations for the evaluation of experimental data the Committee endorses the proposal that the authors of nuclear data articles should specify carefully all the sources of uncertainty in the results. It feels that a set of proposed guidelines for authors of experimental papers on nuclear data is essential. Perey is asked to write those guidelines. Once those guidelines are available, the Chairmen of NEANDC and INDC should write jointly to the editors of a few selected journals on nuclear data, summarizing the concern of the Committee regarding the presentation of data. A set of guidelines should be sent to those editors, asking them to send those guidelines to the referees reviewing the papers.

iii) Intercomparison of Nuclear Model Codes

At the last NEANDC meeting an intercomparison of nuclear model computer codes for calculation of fast neutron cross sections was proposed. Johnston reports that the proposal was outlined in the document NEANDC 128 "A" and three technical exercises were developed. The first, Coupled Channel Exercise, dealing with different versions of JUPITOR and other codes, has been finished and a preliminary report presented as NEANDC 136 "A". The exercise concerned the calculation of inelastic cross sections and neutron angular distributions for low energy neutrons exciting the lowest levels of ^{238}U. In general the submitted results were in good agreement with one another.

The second exercise deals with the calculation of cross sections using Spherical Optical Model and Statistical Model. It aims at calculating (n,n'), (n,2n), (n,p), (n,α), (n,^{3}He), etc. reaction cross sections at 14.6 MeV. The exercise is still underway and is expected to be finished in the autumn of 1981.

The third exercise will deal with Pre-equilibrium Effects in Nuclear Model Calculations, and preparation of the exercise has been initiated. A Working Group met recently at the NEA Data Bank to investigate possibilities for an intercomparison of computer codes including pre-equilibrium effects in neutron-induced nuclear reactions. A preliminary report on the conclusions is given in the document NEANDC 137 "A". Since pre-equilibrium effects in neutron induced reacti have not yet reached a standardisation in the formalisms used in current compute codes, the proposed intercomparison should consist of two phases. In the first phase, participants should use the optical and statistical model parameters established in the second exercise, and include pre-equilibrium effects, to fit experimental values for the total neutron emission spectrum from ^{59}Co with incident neutron energy of 14.6 MeV. In the second phase, using these same parameters, the participants should calculate particle emission spectra from the (n,n'), (n,2n), (n,p) and (n,α) reactions, at both 14.6 and 20 MeV. Two further suggestions for calculations are fission and radiative capture.

Topical Conference

A topical conference on "Convergence of Integral and Microscopic Nuclear Data" was held in the morning of 9 April 1981. The programme of the meeting and a short summary of the deliberations are given in Appendix 5.

Subcommittee Reports

The five subcommittees met on various occasions during the week. Detailed writte reports are presented to the Committee on the last day of the meeting by the respective subcommittee chairman. These reports will be printed separately by the NEA as an NEANDC "A" document. Highlights of the activities are, however, given in Appendices 6 to 10. Following comments and recommendations are made by the Committee on those reports.

i) Discrepancies

The highlights of this subcommittee are given in Appendix 6. The Committee endorses the proposal of setting up a Loose Leaf discrepancy file, whose sections could be updated alternately by the Discrepancies subcommittees of NEANDC and INDC. A bound copy should, however, be produced every 3 years. Both Michaudon and Schmidt agree in principle on behalf of the INDC but the Chairman NEANDC is asked to inform the Chairman INDC officially about this proposal.

The Committee decides that in addition to the new entries recommended by the subcommittee for several existing discrepancies, a new entry for the $^{7}Li(n,n'\alpha)T$ reaction is also necessary and Qaim is asked to supply the relevant information.

ii) Standards

A short report of the subcommittee on Standards is given in Appendix 7. Regarding the INDC/NEANDC cooperation the Chairman of the Committee seeks opinion whether a Loose Leaf file system, similar to the one in the case of Discrepancies, would be useful. Sowerby comments that in the case of Discrepancies changes occur rather fast, justifying a Loose Leaf system. In the case of Standards, on the other hand, changes take place rather slowly. The general consensus is against a Loose Leaf system for Standards.

iii) Technical Activities

A brief summary of the report of the subcommittee on Technical Activities is given in Appendix 8. The Committee appreciates the hard work put in by this subcommittee and endorses all the proposals. Members are urged to provide more information on nuclear data programmes running in their respective countries.

iv) Monographs

A short summary of the report of the subcommittee on Monographs is given in Appendix 9. The Committee commends Michaudon's efforts in successfully getting the first book in the NEA Series on Nuclear Data entitled "Nuclear Fission and Neutron Induced Fission Cross Sections", published by the Pergamon Press.

Hope is expressed that the books on "Neutron Radiative Capture" (editor R.E. Chrien) and "Neutron Sources" (editor S.W. Cierjacks) will be forthcoming soon.

Perey informs that he is writing a book on "Theory of Inductive Logic" and will be happy to get it published in the NEA Series. The General Editors of the Series agree to go through the manuscript when available.

Qaim remarks that the title "Neutron Activation Cross Sections", mentioned in the subcommittee report for the book to be written by the prospective authors Liskien, Qaim, Smith and Vonach is a misnomer since it does not describe fully the scope of the proposed book. In addition to scattering, radiative capture and fission the phenomenon of particle emission (both nucleons and complex particles) is very important. Item 6 of the Information Sheet of Pergamon Press mentions (n,2n), (n,p) and (n,α) reactions and the authors aim at dealing with this phenomenon of particle emission, with a slightly wider scope, i.e. including also weak reaction channels like (n,d), (n,t) and (n,^{3}He). Several techniques are used for studying such reactions, the activation technique being one of them. The book should include a description of all the complementary methods and not only the activation method. A suitable title of the book would be: "Fast Neutron Induced Particle Emission Reactions". Cierjacks remarks that the proposal is logical since both the experimental techniques and calculational methods are

the same for all the (n,x)-reactions. Michaudon is, however, still reserved about such a wide scope which, in his opinion, deviates from the concept of monographs as presented originally to Pergamon Press. Qaim replies that the title "Activation Cross Sections" is too narrow and, in his opinion, would not justify writing a monograph. Motz remarks that, whatever the final form of the monograph be, the activation cross sections in the low energy region should also be treated. After some discussion it is suggested that a new proposal for the outline be written. The General Editors will then decide what to do, taking into account the reactions of the scientific community and Pergamon Press after the launching of the first book. In the meantime, Michaudon shall discuss this question with Liskien.

Two more books are envisaged. J. Garg proposed to Michaudon to write a book on "Neutron Total Cross Sections", but nobody seems to have any news on the progress achieved so far. Chrien is asked to inquire about the present status of the book. Michaudon also proposes to launch a book on "Fast Neutron Scattering" and, in this respect, will contact Lachkar and A.B. Smith.

In general, Michaudon emphasizes the need of good will and flexibility on the part of authors and editors in order to make this undertaking a success.

v) Meetings

The subcommittee report is given in Appendix 10 and a list of the meetings planned by the IAEA/NDS in Appendix 11.

The Committee supports strongly that the Specialists' Meeting on "Fast Neutron Capture" be held at the ANL in March 1982. NEA is urged to contact A.B. Smith as soon as possible.

The Committee endorses the proposal that a Specialists' Meeting on "Yields and Decay Properties of Fission Products" be held in 1983.

CONCLUDING SESSION

i) General

A list of documents distributed during this Meeting is presented by the Secretary (Nordborg) and is given in Appendix 12.

The Committee shows concern over the anticipated frequent change of the Secretary and asks the Chairman to convey its concern to the NEA.

The immediate past Chairman (Chrien) and Scientific Secretary (Coceva) are asked to produce a trienniel report for the Period of Office from January 1978 to December 1980.

Rowlands is asked to participate in the next NEACRP Meeting in Winfrith as an NEANDC observer.

ii) Actions endorsed at the 22nd Meeting of the Committee

The Scientific Secretary (Qaim) reads out the Actions endorsed at this meeting. Since the list is not complete, it is suggested that it may be distributed as soon as possible. A complete list of the Actions endorsed is now given in Appendix 13.

iii) Plans for future Meetings of the Committee

The suggested date for the 23rd Meeting is autumn 1982 and the suggested country is Canada. In case of difficulties the venue of the Meeting could be USA; the Chairman should then contact Whetstone.

Following agenda items were tentatively identified for the next meeting:

a) Draft proposal on the longer term objectives of the Committee
b) Progress in the work of the Joint Working Group on Evaluation Coordination. Critical appraisal of the correspondence in the evaluated data from the two groups (USA, Europe/Japan).

The Committee asks Igarasi to explore the possibility of holding the 24th Meeting in Japan.

The Chairman thanks the CEA (France), the local staff and the Local Secretary (E. Fort) for making various local arrangements and declares the Meeting closed.

Developments in Reactor Fuel Cycle in the USA

1. Conceptual design studies of breeding ratios of a heterogeneous oxide fuel cores are underway. These studies are being undertaken to improve analytical techniques involved in the approximations necessary for heterogeneous fuel assemblies.

2. Significant improves in the steel used in fuel cladding and in subassemblies are being made. The new steel alloys show reduced swelling and creep, as well as lower He production. These new steels are ferritic on structure and replace the austenitic steels like the D 316 steel used in FFTF and Clinch River.

3. Remote fuel handling devices are being perfected for the reprocessing of oxide fuels. These are automatic loaders for the pelletized fuel.

4. Some effort is being expended to develop carbide fuels in addition to the presently preferred oxide fuel. Tests for these fuels are scheduled for FFTF, which will begin operation soon.

5. The Fast Mixed Spectrum Reactor (FMSR) concept has been developed to use metallic fuel. However, it has been shown that the FMSR will also work with oxide or carbide fuels. This reactor has been designed for extremely high burn-up, allowing reprocessing of fuel once in 10 years.

In the light water reactor area the chief problem centers on safety, waste disposal, and Pu recycle.

1. The outstanding problem in BWR systems involves the interaction of nuclear physics and hydraulics. The calculational uncertainty of void coefficient in the BWR is about 30 to 40%. There is in fact no direct, controlled measurement of the void coefficient. There is an indication of problems in this area through the measurement of discrepancies in the power distribution throughout operating BWR cores. Agreement can be forced only through arbitrary adjustment of this coefficient. The problem may arise from the sharp energy dependence of the hydrogen scattering cross section in the thermal region.

2. In the area of Pu recycle, improved cross sections of the actinides are required.

3. In the PWR systems, there is 15-20% uncertainty in the moderator temperature coefficient. A better calculation of the effective neutron spectrum in such systems might make it possible to reduce error margins and improve reactor economics.

4. Better knowledge of burnable poisons such as gadolinium and europium is needed. U-238 capture continues to be a problem, even though ENDF/BV is much better than version IV. A better calculation of the effects of these capturing nuclides on the neutron spectrum seems to be required.

5. There is a need to standardize codes and cross section libraries. The universal use of ENDF/BV is to be encouraged.

6. High burn-up fuel cycles are extremely sensitive to fission product cross sections, through their influence on the spectrum of neutrons at the fuel. The sensitivity to the effect of sodium voids is aggravated. The fission product cross sections of ENDF/BV show significantly more effect than do those of version IV, which prompts some concern for better knowledge.

7. The effects of ^{240}Pu cross sections are especially important in high burn-up fuels, since this isotope is more sensitive to the effect of sodium voids. ^{241}Pu is much less sensitive to the nature of the neutron spectrum. Thus improved ^{240}Pu cross sections are desired.

8. The concept of "coast down" power near the end of the fuel cycle appears to achieve higher burn-up. The proper management of coast down requires better treatment of fission product cross sections.

9. Renewed interest is now being expressed in the HTGR concept as a process heat generator. Such a reactor could operate with a ^{233}U-^{232}Th fuel and would require better knowledge of ^{232}Th and ^{233}U cross sections. Approximately $24 million has been appropriated for this project. On the other hand, all research on the Gas Cooled Reactor concept has been terminated.

APPENDIX 2

Important Cross Sections for Fusion Reactor Technology with Work in Progress (1981 DOE/NDC) in the USA

Target	Cross Section Type	Lab	Request No. (1981 RL)
^{3}H	charged particle	LANL	80283, 78069, 78070
^{7}Li	neutron emission	LANL ANL ORNL	(78042 (78159
C	non-elastic	UC-Davis	78009
	c.p. production	UC-Davis	78052, 78061
N	c.p. production	UC-Davis	78109
	c.p. production	Livermore	
O	c.p. production	UC-Davis	78113, 78101
	c.p. production	Livermore	
Al	non-elastic	UC-Davis	78206
	neutron emission	ORNL	78078
Si	c.p. production	Livermore	78054, 78063
Ti	neutron emission	ORNL	78039
Fe	He production	Rockwell Int.	80066
	non-elastic	UC-Davis	78207
	el scattering	TUNL	78030
Ni	el scattering	TUNL	78031
Cu	el scattering	TUNL	78034
	neutron emission	ORNL	78040, 78046
Nb	Neutron emission	ORNL	78222
Mo	He production	Rockwell Int.	78096
Sn	el scattering	TUNL	78035

Notes: a) For first time there are hybrid reactor requests: $\sigma(n,2n)$ & $\sigma(n,3n)$ for ^{232}Th and ^{7}Be;

b) There are no priority I γ-ray production requests--only 3 priority II requests, ^{10}B, ^{11}B, and Ta.

CONTRIBUTION TO THE NEANDC MEETING
HELD IN AIX-EN-PROVENCE, FRANCE, APRIL 6-10, 1981

National Nuclear Data Center
Brookhaven National Laboratory

Cross Section Evaluation Working Group (CSEWG) Activities

The report, Standard Reference and Other Important Nuclear Data, ENDF-300 (BNL-NCS-51123) was issued by the Cross Section Evaluation Working Group in December 1979. The report is a review of nuclear data of special interest intended to point out data discrepancies, recommend new measurements, and compare current versions of the Evaluated Nuclear Data File (ENDF/B) with measured data. Updates are in press for thorium-232 and uranium-238 capture, plutonium-239 decay heat, and the carbon total cross section (figure added).

A revision of the report, Data Formats and Procedures for the Evaluated Nuclear Data File, ENDF-102 (BNL-NCS-50496) dated October 1979, has been issued. This report is a manual for the data appearing in ENDF/B-V. A supplement to the report is available for users of ENDF/B-IV data.

The Committee structure of CSEWG has been revised into 3 main committees; Evaluations, Data Testing and Applications, and Evaluation Methods and Formats, that report to an Executive Committee comprised of the committee chairmen, other CSEWG members and representatives of funding agencies. Currently, the main CSEWG activities are the testing of ENDF/B-V and planning for ENDF/B-VI.

BNL-325, Volume I

The fourth edition of BNL-325, Volume I, Thermal Cross Sections and Resonance Parameters, has been completed for Z=1-60 and runs about 750 pages. The revised schedule calls for completing Volume I by early 1982. The work will include a simultaneous fit of the thermal cross sections of the fissile elements.

Nuclear Data Sheets

High priority has been given to the transfer of the responsibility for publication of Nuclear Data Sheets to NNDC. The year end cumulative issue of 1980 Recent References was prepared by NNDC. The NNDC will prepare level diagrams and decay data tables for publication starting July 1, 1981.

The U.S. is part of an international network of evaluators contributing recommended values of nuclear structure information to the Evaluated Nuclear Structure Reference File (ENSDF). Publication of Nuclear Data Sheets proceeds directly from this computerized file. In addition to the U.S., evaluations have been received or are anticipated from Germany, United Kingdom, U.S.S.R., France, Belgium, Kuwait, Sweden, and Canada. International meetings of the network evaluators are sponsored by the IAEA.

Meetings

A Symposium on Neutron Cross Sections from 10-50 MeV was held at BNL, May 2-14, 1980. It was attended by 96 scientists from the U.S. and abroad. The Proceedings were issued as BNL-NCS-51245.

A conference on Nuclear Data Evaluation Methods and Procedures attended by 61 scientists of which 14 were from outside the U.S. was held at BNL, September 22-25, 1980. The conference used a workshop format to critically review theoretical and semiempirical techniques used to evaluate data required by the nuclear research and the fission and fusion reactor communities. The Proceedings are in the final stage of preparation.

A two-day workshop on Thermal Reactor Benchmark Calculations, Techniques, Results, and Applications is planned at BNL for late 1981. The topics should include U-238 resonance capture, plutonium cross sections, fission products, thermal reference data, and fission spectra.

APPENDIX 4

CONTRIBUTION TO THE NEANDC MEETING
HELD IN AIX-EN-PROVENCE, FRANCE, APRIL 6-10, 1981

Nuclear Data Section
International Atomic Energy Agency

1. EXFOR

The Center for Experimental Photonuclear Data Moscow (CDFE) has joined the EXFOR exchange by submitting a first bunch of Soviet photonuclear data in EXFOR format. The center also provides annually photonuclear data reference lists. The Japanese Study Group is about to join the EXFOR exchange with compilation of CPND.

The EXFOR system has reached a stage when it can accomodate all experimental nuclear reaction data including, if needed perhaps in the future, heavy ion data.

Improved documentation error analysis will be included in EXFOR, in particular for standard and dosimetry data.

2. WRENDA

The new issue of the WRENDA request list, WRENDA 81/82, is under preparation and will shortly be issued. The cooperation of the various data centers and the request-submitting countries in the timely submission of updated requests is gratefully acknowledged.

3. Evaluated Data

The improvement of evaluated data processing is currently receiving high priority in NDS data centre activities, in order to cope with the requests from the NDS service area, which are strongly increasing both in quantity and data detail. Checking, plotting, correcting etc. computer programmes are currently being implemented and critical assessments and comparisons of evaluations are being done.

With the adoption of the ENDF/B-format for evaluated neutron nuclear data by the USSR and probably also by the Joint Evaluation Data Group, ENDF/B can by now be considered to be practically the international exchange format for evaluated neutron nuclear data. The previous SOKRATOR-formatted Soviet data are currently being supplied to the nuclear community in ENDF/B-format.

The new coordinated efforts by the Joint Evaluation Data Group are much welcomed by the NDS, with the hope, and in the interest of developing countries which the NDS serves, that an unrestricted exchange of evaluated data between Western and Eastern countries through the NDS will continue. It is further hoped, that these efforts would not lead to further restrictions in the international exchange of evaluated nuclear data, particularly of those evaluated nuclear data (secondary actinides, standards etc.) which are already freely released and exchanged internationally.

J.J. Schmidt

APPENDIX 5

Topical Discussion

"Convergence of Integral and Microscopic Nuclear Data"
held on 9 April 1981 at Aix-en-Provence, France, during the 22nd NEANDC meeting

PROGRAMME

Session A — Chairman: *E. Fort*

9^{00} - Cross section adjustment using integral data
H. Gruppelaar

9^{30} - A new method of correlation of fuel irradiation experiments and basic nuclear data
M. Salvatores

10^{00} - Integral nuclear data for reactor structural materials
J. Rowlands

Coffee break

Session B — Chairman: *A.M. Michaudon*

10^{50} - Complementarity of integral and differential experiments for reactor physics purposes
H. Tellier

11^{10} - Consistency and complementarity of integral and microscopic data - some examples -
E. Fort

11^{40} - Status of the data base and some integral-differential comparison for non fission threshold dosimetry reactions from ENDF/B-V
D.L. Smith

General discussion

SUMMARY

Six papers were presented. Two of them were related to the methods used for adjusting differential data with respect to integral measurement results. In the first *Gruppelaar* outlined the common basis of most of these methods and the differences between "fitting procedures" applied to group cross sections and adjustments in which integral and differential data are mixed to improve the physical parameters.

Salvatores showed via the particular example of irradiation measurement results how it is possible to get an adjustment of the group cross sections and basic nuclear parameters by use of sensitivity calculations.

In the third paper *Rowlands* reviewed the integral nuclear data for reactor structural materials. His study covered several fields of application such as core design, structure activation and primary coolant contamination, irradiation damage, etc. The major integral experiment techniques were discussed together with recent results.

Tellier's talk was related to the complementarity of integral and differential experiments. He expressed the view that "blind adjustment procedures" must be avoided and replaced by a comprehensive study of discrepancies between integral and microscopic data, both of them including possible sources of errors. He showed via three examples the possibility of achieving important improvements by such a physical study of the discrepancies which required previous adjustments.

The paper presented by *Fort* aimed also to show the consistency and complementarity of integral and microscopic data, taking benefit of some recent evaluations in which the results of integral measurements have been considered on the same level as selected microscopic data. He pointed out the improvement in quality of differential measurements recently performed.

The last presentation by *D.L. Smith* was related to the dosimetry data. In this field the use of integral data is limited due to a non-sufficient knowledge of the spectra. In his review of the various non-fission threshold reactions of interest to the dosimetry community, he concluded that new measurements are necessary.

In the discussion of these papers the problem of uncertainties and correlations was outlined by several participants.

Most of the participants of this technical session expressed their satisfaction over the present situation as expressed in the papers and discussions. The general feeling was that fruitful exchanges occurred between integral and differential data measurers on one side and evaluators on the other.

J. Bouchard

Report of the Discrepancy Sub-Committee to the 22nd NEANDC Meeting

The Sub-Committee met on the morning of the 7th April 1981.

Members K. H. Böckhoff, R. E. Chrien, S. Cierjacks, C. Coceva, H. Condé, E. Fort, S. Igarasi, H. T. Motz, J. L. Rowlands, M. G. Sowerby (Chairman), H. Vonach.

The Sub-Committee based its discussions on the report of the INDC Discrepancy Sub-Committee to the 11th INDC Meeting. The aims of the Committee's deliberations were

(i) to review the status of the discrepancies listed in the report
(ii) to identify any new discrepancies to be included in the NEANDC/INDC discrepancy list and review their status
and (iii) to consider how the co-ordination of the work of the INDC and NEANDC Sub-Committees could be improved.

As far as this co-ordination was concerned, it was decided that it was unrealistic to attempt to produce new versions of the complete discrepancy file every 9 months. In general, the situation does not change significantly on that time scale. A more realistic aim was to set up a Loose Leaf discrepancy file, whose sections could be updated by either Sub-Committee when it considered that it was opportune.* In addition, each Sub-Committee would write a report at its meeting, briefly reviewing the present position and this together with the updated Loose Leaf file, would provide the input to the next meeting of its sister Sub-Committee.

The NEA have agreed in principle to provide suitably labelled files for the use of the Sub-Committees. Further discussions will be held to identify the exact requirements.

The list of discrepancies considered at the Meeting is given below. More details can be found in the full Sub-Committee report.

(1) Li-7(n,n'αT) cross-section
(2) Capture cross-sections of Fe, Ni and Cr
(3) Cu-63(n,α)Co-60 cross-section
(4) Nb-93(n,n')Nb-93m cross-section
(5) Th-232 fast neutron capture cross-section
(6) Th-232 fast neutron fission cross-section
(7) U-233 fission cross-section
(8) U-235 fission cross-section
(9) U-238(n,γ) above 100 eV and resonance parameters
(10) U-238(n,n') cross-section
(11) Np-237(n,2n) cross-section
(12) Pu-239 decay power
(13) Am-241 resonance fission integral
(14) U-235 and Pu-239 resonance parameters
(15) Rh-103(n,n')Rh-103m cross-section
(16) Delayed neutron precursors
(17) Minimum in σ_{nT} for Sc at 2 keV
(18) Zr resonance parameters

Items (17) and (18) are new discrepancies and new entries for the NEANDC/INDC discrepancy file are to be prepared for these and for items (1), (5), (11), (12) and (16).

M. G. Sowerby

*The NEANDC decided at its meeting on the 10th April that a bound copy of the file should be produced every 3 years.

APPENDIX 7

Report of the Standards Subcommittee to the 22nd NEANDC Meeting

The Subcommittee met on 7 April 1981.

Members K.H. Böckhoff, S. Cierjacks, H. Condé, E. Fort, S. Igarasi, P.D. Johnston, C. Nordborg, F. Perey (Chairman), J.J. Schmidt, M.G. Sowerby, N. Tubbs, H. Vonach

A. INDC Cooperation

The chairman received a copy of the minutes of the last INDC Standards subcommittee meeting, held on June 20th, 1981. It was decided that as a rule, such minutes should be made available to all the members of the NEANDC subcommittee and the minutes of the NEANDC subcommittee meeting should be sent immediately to the chairman of the INDC corresponding subcommittee.

The subcommittee noted that the INDC subcommittee intended to update the "INDC/NEANDC Nuclear Standards File, 1978 Version". J. Schmidt reported that this updated material had not been received at the IAEA but he would inquire from current INDC subcommittee chairman and relay the information to the subcommittee members.

The suggestion of the INDC subcommittee that after their next update of the "INDC/NEANDC Nuclear Standards File, 1978 Version" the responsibility for the next updating of the "Standards File" be taken over by the NEANDC subcommittee was approved. Cooperation between the INDC and NEANDC Standards subcommittees should be well defined to be effective and to reflect the different memberships of the two committees. The following plans were adopted:

i) The complete minutes of the NEANDC subcommittee meetings, including copies of technical submissions to the subcommittee, will be sent to the INDC subcommittee chairman following each meeting. It is hoped that the INDC subcommittee would reciprocate.

ii) The main objectives of the cooperation between the two subcommittees should be the updating of a "standards data file". It is not practical to share on a continuing basis this responsibility. Therefore, it should alternate between the two subcommittees. The NEANDC subcommittee has agreed with the INDC subcommittee's suggestion that this responsibility should be with the NEANDC subcommittee after the receipt of the update of the 1978 version file.

B. Plans for Review and Updating of the Standards File

It was agreed that the responsibility for providing technical input to the subcommittee on the content of the current file lies with the various members of the subcommittee, who may discharge this responsibility by seeking assistance from various experts from their countries. The various national delegates are the "entry-points" for these inputs to the subcommittee.

Following standards were considered: H(n,n); ^{6}Li(n,α); ^{10}B(n,α); C(n,n); ^{197}Au(n,γ); ^{235}U(n,f); ^{252}Cf($\bar{\nu}$); ^{252}Cf(χ); actinide ($T_{1/2}$); thermal constants; γ-ray standards; neutron energy standard; ^{27}Al(n,α); ^{237}Np(n,f); and ^{238}U(n,f).

The national responsibilities for providing technical inputs to the subcommittee were reviewed. A complete listing is to be given elsewhere. An ation was placed on each delegate to provide the chairman of the subcommittee by 15 February 1982 a written review of the current "Nuclear Standards File". The chairman will provide all the subcommittee members with a copy of these contributions. The technical reviews will be discussed at the next subcommittee meeting to be held about July 1982. Formal publication of the "Nuclear Standards File" was discussed. It was agreed that it may not occur following the next meeting but could take place following the subcommittee meeting anticipated for 1983. Following the publication of the "Nuclear Standards File" by the NEANDC subcommittee the responsibility for its next publication should normally return to the INDC subcommittee.

C. High Priority Measurement Requests for Standards Cross Sections

The Standards subcommittee reviewed the table of high priority measurement requests of the Technical Activities subcommittee regarding the standards cross sections.

The task of the subcommittee was interpreted to review the "Status remarks".

i) H(n,n) The KFK measurements extend to 50 MeV.

ii) ^{10}B(n,α) Wattekamp's independent evaluation suggests that below 1 MeV larger uncertainties may be warranted than those given in the ENDF/B-V.

iii) ^{197}Au(n,γ) This reaction should only be used as a standard when fluctuations in the cross section can be properly averaged. The accuracy requirement is for averaged cross section over 10 keV intervals.

iv) ^{235}U(n,f) The ENDF/B-V evaluation is said to have an error of approximately 3 % only in the range of 150 keV to 10 MeV.

v) ^{252}Cf(χ(E)) Measurements are also in progress in Austria/FRG and the U.S.

D. NEA Data Bank Request

The NEA Data Bank submitted document NEANDC 132 "A" to the subcommittee.

The NEA Data Bank has compiled a set of 30 cross section evaluations which they plan to use to renormalize data currently in their file which is entered as having been measured relative to one of those cross sections. Considerable discussion took place concerning the meaning of ratio measurements. There was unanimity concerning the "traceability" of numbers distributed by the NEA Data Bank. The NEA Data Bank plans to provide requestors of data the ratio and their normalization to these evaluations. The subcommittee endorses such a practice and the users of the data should be cautioned regarding the "validity" of the evaluations and given their source in a way such that their origin can be traced.

F.G. Perey

APPENDIX 8

Report of the Subcommittee on Technical Activities to the 22nd NEANDC Meeting

The Subcommittee met on the afternoon of 7 April 1981.

Members: K.H. Böckhoff, R.E. Chrien, H. Condé, C. Coceva, E. Fort, S. Igarasi, P.D. Johnston, H.T. Motz, C. Nordborg, S.M. Qaim, J. Rowlands (Chairman), N. Tubbs, H. Vonach, S.L. Whetstone

1. The High Priority Measurement Request List

A draft revision had been made to the request list produced at the time of the last NEANDC meeting and was distributed to NEANDC members. This revised version includes the high priority requirements for fission product capture cross sections in the Dutch fission product request list. The dosimetry requirements are those in Priority 1 in the EWGRD request list compiled by Zijp (Petten). Revisions to the Japanese and UK request lists had been taken into account. A revised US high priority request list for fusion was provided by Chrien together with the revised US Priority 1 request list. These will be taken into account in a redraft of the High Priority Request List.

Igarasi recommended that the Japanese Priority 1 requirements for safeguards should not be kept in the final version, because they had not been identified as high priority requests and were to be revised.

It was agreed to include fusion requirements in an Appendix, as in the present version. The Japanese Priority 1 requests would be kept in this list, which would also include the revised US requests and any additional requests submitted.

The requirements for Standards had been accepted for review by the Standards subcommittee. The status of the data for other requirements was reviewed briefly.

i) Dosimetry: Four of the six requirements were for average values in a ^{235}U fission spectrum to an accuracy of 2 %. The status was reported as about 2 % accuracy in a ^{252}Cf fission spectrum but only about 5 % in a ^{235}U fission spectrum. It was considered that the uncertainties in the relative shapes of the fission spectra were such that it is not possible to deduce more accurate values of the averages in a ^{235}U fission spectrum from the averages in a ^{252}Cf fission spectrum. Some new measurements are in progress.

ii) Structural materials: Capture cross sections of Cr, Fe, Ni and Zr were considered by the Discrepancies subcommittee. Reviews of recently completed measurements are required to establish the remaining uncertainties and to throw light on the possible sources of discrepancies.

iii) Fission product capture cross sections: France had no differential cross-section requirements because reliance was placed on integral measurements.

It was considered that differential cross-section measurements for $^{152,154}Eu$ would be difficult to make because of the $\sim$ 10 year half-lives. Integral measurements on irradiated samples of stable Eu isotopes might be a more fruitful approach.

iv) Primary actinides: A Workshop on $\bar{\nu}$ had been held in November 1980. Investigations of possible sources of error in the Manganese Bath measurements of ^{252}Cf $\bar{\nu}$ were in progress. Madelin had concluded that the shape of $\bar{\nu}$ at MeV incident neutron energies could be determined by just a few measurements.

The absence of a request for resonance parameters for ^{239}Pu was considered surprising.

Geel measurements on the capture cross section for ^{235}U up to about 100 keV were in agreement with the ENDF/B-V data. It was considered likely that the (n,2n) cross-section requirements for ^{232}Th and ^{238}U were met.

2. Compilation of Simple Integral Data

Rowlands introduced a proposal for the separate compilation of a library of simple integral data, such as reaction rates and reaction rate ratios in a specified spectrum. Such data could be compiled in a NEA Data Bank File provided that a suitable format for representing spectra can be formulated.

3. Interlaboratory Intercomparison Projects

Following a discussion of the "Intercomparison of methods used to determine average resonance parameters" (cf. NEANDC (E) 213-AL), Johnston agreed to make proposals for possible future participation and a follow up to the exercise.

There was a discussion about methods used in different laboratories to analyse cross-section measurements to determine resonance parameters. Codes used at some laboratories include the resolution broadening corrections, whereas at other labs this is treated by a separate code. This difference complicates possible intercomparisons. Perey described the development of the ORNL code SAMMY and the principles involved in the method. He agreed to issue the code to members of NEANDC.

4. Interlaboratory Cooperation

There was already good cooperation between laboratories. The European Interlaboratory Seminars were mentioned. Staff at different laboratories in America, Japan and Europe collaborate on experiments and on the analysis of data. More such collaboration should be encouraged.

5. Topics for Technical Discussions at NEANDC Meetings: Research Papers

Böckhoff proposed that consideration should be given to the production of research papers for technical discussions at NEANDC Meetings. One proposed topic was the influence of Nuclear Data Uncertainties on the Economics of Nuclear Power and Electricity Generating Costs.

J. Rowlands

APPENDIX 9

Report of the Subcommittee on Monographs to the 22nd NEANDC Meeting

The Subcommittee met on 5 April 1981.

Members: K.H. Böckhoff, R. Chrien, S. Cierjacks, C. Coceva, P.D. Johnston, A. Michaudon (Chairman), H.T. Motz, C. Nordborg, F. Perey, S.M. Qaim, H. Vonach

The subcommittee examined the present status and the future of the NEANDC Series "Neutron Physics and Nuclear Data in Science and Technology" published by Pergamon Press under the responsibility of three General Editors: A. Michaudon, S.W. Cierjacks and R.E. Chrien, all three being NEANDC members.

Great progress has been made since the last NEANDC Meeting in the writing of several volumes of this Series. Each volume is discussed below according to its date or anticipated date of publication.

I. "Nuclear Fission and Neutron-Induced Fission Cross-Sections"
Editor : A. Michaudon
Authors: G.D. James, J.E. Lynn, A. Michaudon, J. Rowlands, G. de Saussure

This is the first book of the Series and has now been published. It is already available through booksellers at the cost of $ 50 or £ 21.

Based on the experience gained during the preparation of the manuscript of this book, it is emphasized that great care and flexibility on the parts of editors, authors and typists are needed. The presentation and the character of the future volumes should conform as closely as possible to those of Volume 1.

The size of the future books can be extended to 250-300 pages, if necessary (the book on Fission contains about 250 pages). Nevertheless, in view of the early recommendations from Pergamon Press, it is preferable to write books on well-defined topics and of a reduced size (120-150 pages), if possible.

II. "Neutron Radiative Capture"
Editor : R.E. Chrien
Authors: B.J. Allen, I. Bergqvist, R.E. Chrien, D. Gardner

The present status of this project is that virtually all of the individual contributions have been received by the editor. He has started the process of editing and proposes to have a rough draft version of the editing done before July 1, 1981. Thereafter, the whole manuscript will have to be retyped, preferably on a word processor, if at all possible. This operation will take place at BNL. He proposes November 1, 1981 as a reasonable deadline for the submission of the manuscript to the Pergamon Press.

III. "Neutron Sources"
Editor : S.W. Cierjacks
Authors: Barshall, Bartholomew, Bigham, Block, Brugger, Chrien, Cierjacks, Conrads, Fraser, Knoll, Lone, Syme, Uttley, Whittemore

The book will cover in its final form approximately 300 pages. The material is organized in ten major chapters. A draft of the whole manuscript is almost completed. Eight of the ten main chapters are in an almost final shape and need only minor changes and additions which can partly be provided by the editor himself, if necessary. For the remaining two chapters, revised or complemented versions are expected - according to recent correspondence - at the latest within the next two months.

An unforeseen problem arose only recently, when it became obvious that the topics of polarized neutron sources and neutron moderations aspects could not be covered by the authors of the corresponding chapters in a completely satisfactory manner. Therefore, short-term arrangements became necessary. In the meantime, competent individuals have been approached who indicated that they are willing and able to provide the corresponding additions in due time. From their informations it appears to be possible to finalize the work on the book without additional delay.

IV. F. Perey informed the subcommittee about a book he is writing on the "Theory of Inductive Logic", and its applications to nuclear data uncertainties.

This book should be finished by June 30, 1981. From the oral presentation made by Perey before the subcommittee, it seems possible that the NEANDC Series could provide a framework for publication of this important and original work. Nevertheless, the General Editors would like to have a look at the manuscript when it is finished, to see whether the NEANDC Series is the best place for its publication.

V. "Neutron Activation Cross-Sections" (tentative title)

At the Geel Meeting, a group of scientists were interested in the writing of such a book though with a wider scope so as to include all reaction cross sections. However, since at that time the book on Fission was not yet issued, and the position of Pergamon Press as to the larger size of the books was not known, Michaudon recommended to the authors to remain in a 'stand by' position until the NEANDC Meeting.

The situation is now more favourable to discuss this project. Nevertheless, it was not clear whether the subcommittee should give its approval to the title (Fast Neutron Induced Reactions) and outline, as proposed by the authors, or whether it should stick to a narrower title "Neutron Activation Cross-Sections". After a long discussion during which both points of view were supported by some members, Qaim and Vonach were asked to contact Liskien on telephone and to find a title with a more limited scope and to reorganize the outline accordingly. Further contacts will take place between Michaudon and Liskien after the NEANDC Meeting.

VI. "Neutron Total Cross-Sections"

Michaudon encouraged J.B. Garg to start writing this book and mentioned that the NEANDC Series could provide a good framework for such a publication. The subcommittee asked Chrien to get in touch with Garg and to inquire about the present status of the book.

VII. "Fast Neutron Scattering"

The writing of such a book would be interesting, especially after the Specialists' meeting envisaged at Bruyères-le-Châtel on this subject. Michaudon will contact A.B. Smith about the possibility of writing such a book.

VIII. "Neutron Detectors"

This book was originally proposed by Chrien. Because of the work required for the other volumes, publication of this book cannot be envisaged before 1983.

A. Michaudon

APPENDIX 10

Report of the Subcommittee on Meetings to the 22nd NEANDC Meeting

The Subcommittee met in the afternoon of 6 April 1981.

Members K.H. Böckhoff, R.E. Chrien, S. Cierjacks, P.D. Johnston, A. Michaudon, C. Nordborg, S.M. Qaim, J. Rowlands, M.G. Sowerby, N. Tubbs, H. Vonach, S.L. Whetstone (Chairman)

A. Major Conferences

It was reconfirmed that the three-year cycle of major "regional-international" conferences on Nuclear Data for Technologies was terminated in 1980, at the end of the Harwell-Knoxville-Kiev-sequence. The next conference of the series will be organized by the CBNM and held in Antwerp in September 1982. It was recommended that planning be initiated for a conference to be held in the US in the fall of 1984. A likely and logical locale would be Brookhaven.

Böckhoff reported on the planning underway for the Antwerp meeting (ref. KHB/NEANDC Mbrs. letter of 31 March 81). The NEA Secretariat is content with the arrangements made for involvement of the NEA in the Conference, although details of the acknowledgement and participation of the NEANDC itself in the planning are still being refined.

To facilitate input from the Committee, Böckhoff has prepared an "Advice Questionnaire" form.

B. Proposed IAEA Symposia, Advisory Group, Consultants' and Specialists' Meetings

These were discussed as presented in the Draft Report submitted on 22 July, 1980 by Alan B. Smith, for the INDC Subcommittee on Meetings and Future NDS Program.

The members of the NEANDC Subcommittee agreed that a Symposium on the "Physics and Chemistry of Fission" in 1984 or 1985, following the last one in 1979, would be valuable in promoting the basic fission physics research that underlies much of the nuclear data activities but felt, as it has in the past, that a shift in emphasis to heavy-ion reactions should be resisted, despite the current popularity of the latter work among nuclear physicists.

The proposed meeting on "Nuclear Data for Energy" to be held in the post-1984 period, was questioned with regard to its possible conflicts with the major nuclear data conference series. It is proposed by the NEANDC Subcommittee that such a Conference, of wider scope (including non-neutron nuclear data) could be sponsored by the IAEA, with NEA cooperation, to replace the tentatively planned European major conference in 1986.

C. Previously Approved NEA Specialist Meetings

The jointly sponsored IAEA/NEA Specialist Meeting on "Resonance Parameters of Uranium and Plutonium Isotopes" has been scheduled for 28 Sept. - 2 Oct. 1981 in Vienna.

The Working Group meeting on "The Derivation of Average Level Spacings" is to be held in Paris (or Saclay) on 15-16 Oct. 1981. This will complete and summarize the intercomparison exercise being conducted by Ribon.

The Committee reconfirms its endorsement of the meeting on "Fast Neutron Scattering on Actinides" to be held in November, 1981 in Paris. This meeting will be sponsored by NEA with technical guidance from Bruyères-le-Châtel.

Due to the involvement of participants in the above meeting, the meeting on "Fast Neutron Capture" originally scheduled for 1980 will be postponed to March 1982, as proposed by the U.S. delegates and the ANL host scientist.

D. Proposed New NEA Specialist Meetings

For 1983 it is proposed that a meeting be held on "Yields and Decay Properties of Fission Products". This meeting would be relevant to reactor problems involving decay heat calculations as well as delayed neutron emission. A proposal from the U.S. delegation that the meeting be held at BNL, where a large and active program of fission product spectroscopy exists, met with general approval. Plans for an alternate location in the U.K. will be pursued, where there are active evaluation programs at the Winfrith and Berkeley laboratories.

For 1984 a meeting on "Optical Potentials for the Prediction of Neutron Cross Sections" is proposed. Plans for this meeting will be discussed at the next NEANDC meeting.

Stanley L. Whetstone

APPENDIX 11

Meetings Planned by the IAEA/NDS

1981

1. Joint IAEA/NEANDC Specialists' Meeting on Uranium and Plutonium Resonance Parameter Data for Nuclear Reactor Safety, IAEA, Vienna, 28 September - 2 October 1981
2. 12th Meeting of the International Nuclear Data Committee, Vienna, 5-9 October 1981
3. Research Coordination Meeting on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data, Vienna, 12-13 October 1981
4. Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data, Vienna, 12-13 October 1981
5. Advisory Group Meeting on Nuclear Data for Radiation Damage and Safety, IAEA, 12-16 October 1981

1982

1. Course on Advances in Nuclear Theory and Nuclear Data for Reactor Applications, ICTP Trieste, 25 January - 19 February 1982
2. Advisory Group Meeting on Nuclear Structure and Decay Data, Utrecht, Netherlands, May 1982
3. Seventh Annual Meeting of the Nuclear Reaction Data Centres, Vienna, May 1982
4. Interregional Technical Assistance Training Course on the Utilization of Neutron Generators, Debrecen, Hungary, 5 weeks, June/July
5. Specialists' Meeting on Actinide Fast Fission Cross Section, 1982
6. Research Coordination Meeting on the Intercomparison of Actinide Neutron Nuclear Data Evaluations, Antwerp, Belgium, September 1982
7. Research Coordination Meeting on the Measurement and Evaluation of Transactinium Isotope Nuclear Data, Antwerp, Belgium, September 1982
8. Research Coordination Meeting on the Measurement and Analysis of Fast Neutron Cross-Sections, Vienna, date to be fixed

1983 (Major Meetings only)

1. Advisory Group Meeting on Basic and Applied Nuclear Level Densities, Brookhaven (?), beginning 1983
2. Advisory Group Meeting on Nuclear Data for Fusion, or Advisory Group Meeting on Transactinium Isotope Nuclear Data
3. 13th INDC Meeting, spring 1983, place to be determined (outside Vienna)
4. Interregional Technical Assistance Training Course on Methodology of Evaluation and Processing of Nuclear Data for Nuclear Reactor Applications

APPENDIX 12

List of Papers distributed during the

22nd NEANDC Meeting

April 1981

NEANDC(E)-213AL	Intercomparison of methods used to determine average parameters from sets of resonance parameters. Second Part: Results and their Interpretation
NEANDC-128"U"	International nuclear model codes comparison study
NEANDC-130"U"	International nuclear model comparison - Spherical optical and statistical model study
NEANDC-A-132	Submission to NEANDC Standards Subcommittee and to the Joint Nuclear Data Evaluation Working Group: April 1981
NEANDC-A-133	Summary of the Specialists' Meeting on Nuclear Data and Benchmarks for Reactor Shielding
NEANDC-A-134	Treatment of data uncertainties in the EXFOR International Data Exchange Files and Recommendations from NEANDC to Experimentalists and Evaluators
NEANDC-A-135	NEA Data Bank - Progress Report: May 1980 to April 1981
NEANDC-A-136	Preliminary Results of the Comparison of Different Versions of JUPITOR and other coupled channel Computer Codes
NEANDC-A-137	Working Group Meeting on Pre-Equilibrium Effects in Nuclear Model Calculations - Preliminary Report
NEANDC-A-138	Activities of JAERI Nuclear Data Center and Japanese Nuclear Data Committee - April 1980 to March 1981
NEANDC-A-139	New Facilities, Instruments and Methods in Japan
NEANDC-A-140	A Summary of Japanese Nuclear Data Progress Report
NEANDC-A-141	Japanese List of Requests for Nuclear Data
NEANDC-A-142	JENDL-3 Plan
NEANDC-A-143	Progress Report on Nuclear Data Activities and related Nuclear Physics Activities at the Energy Research Centre at Petten (the Netherlands), September 1979 to March 1981
NEANDC(J)-70/4	*Chart of the Nuclides - 1980*
INDC/P(81)5	Meetings planned by the IAEA Nuclear Data Section for the years 1981, 1982 and 1983
INDC/P(81)6	IAEA Technical Assistance Interregional Project (IP) for Nuclear Data Techniques and Instrumentation
INDC/P(81)7	Selected Highlights from the Workshop on Evaluation Methods and Procedures
FYS-STEK-Memo 90 (revised)	Dutch request list for fission-product capture cross sections
Committee notes:	1. Nuclear data for medically important radioisotopes 2. Fifth National Soviet Conference on Neutron Physics, Kiev, USSR, 15th to 19th September 1980. 3. Important cross sections for fusion reactors with work in progress (1981 DOE/NDC) 4. Developments in Reactor Fuel Cycle in the USA 5. Nuclear data for fusion reactor technology 6. General LEP parameters 7. Proposals for continuation of the intercomparison of derived average level spacings
Research papers:	1. Neutron induced fission cross section of ^{240}Pu in the energy range from 10 keV to 10 MeVby C. Budtz-Jørgensen and H.-H. Knitter 2. A systematic study of (n,d), (n,n'p) and (n,pn) reactions at 14.7 MeV by S.M. Qaim 3. Determination of $^{7}Li(n,t)$ cross sections between 6 and 10 MeV by H. Liskien and A. Paulsen