International Atomic Energy Agency

INDC-34/L

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

TECHNICAL MINUTES OF THE TENTH INDC MEETING

Bucharest, Romania, 3-7 October 1978

Compiled by
H. Motz
Los Alamos

July 1980

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

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10TH INDC MEETING

BUCHAREST, ROMANIA
OCTOBER 3-7, 1978

LIST OF PARTICIPANTS

I. Members and Advisors

CANADA	W. G. CROSS	Chairman
FRANCE	A. MICHAUDON J. LEGRAND *	
GERMANY, FEDERAL REPUBLIC OF	F. FROEHNER	
INDIA	M. K. MEHTA	
JAPAN	T. FUKETA	
ROMANIA	S. N. RAPEANU G. VASILIU *	 Local Secretary
SWEDEN	H. CONDE	
U.S.A	A. B. SMITH P. STONE * H. MOTZ *	 Executive Secretary
U.K.	A. T. G. FERGUSON J. ROWLANDS *	
U.S.S.R.	B. D. KUZMINOV	
I.A.E.A.	J. J. SCHMIDT	Scientific Secretary

II. Observers

E.E.C./CBMN	B. ROSE
GERMAN DEMOCRATIC REPUBLIC	D. SEELIGER
O.E.C.D./NEA	N. TUBBS
ROMANIA	G. SEMENESCU V. ZOITA

* ADVISORS

ABSENT MEMBERS

AUSTRALIA	W. GEMMELL
ISRAEL	S. YIFTAH
ITALY	V. BENZI

TENTH MEETING OF THE INTERNATIONAL NUCLEAR DATA COMMITTEE(INDC)
BUCHAREST, ROMANIA, 3-7 OCTOBER, 1978

ADOPTED AGENDA & TABLE OF CONTENTS

I. INTRODUCTORY ITEMS

The Chairman opened the meeting by thanking our Romanian hosts for their fine arrangements and then introduced the new members at the INDC Meeting. Dr.B.D.Kuzminov has replaced L. Usachev as the USSR Member and Dr. A.T.G.Ferguson has replaced Basil Rose as the U.K. Member. Regrets were expressed that several members (Benzi/Italy, Gemmell/Australia, and Yiftah/Israel) could not attend.

Dr. Brandus of the Romanian State Committee for Nuclear Energy formally welcomed the INDC to Bucharest and to the National Center for Physics where the meeting was being held and he presented a short summary of the Nuclear Energy Program in Romania. Dr. Rapeanu, INDC Member, Scientific Director of the Institute of Power Reactors, and Chairman of the Local Organizing Committee also greeted the visitors and gave a review of the extensive nuclear data activities in Romania.

II. NUCLEAR DATA CENTERS

II.A. Status Reports and Future Activities of Data Centers

Smith gave a summary of the NNDC activities at BNL and associated work in the U.S. NNDC has had some 50 to 75 major data set requests per year. An additional staff person has been added and a new computer (DEC-1091) with 256K internal memory has been ordered. The general purpose evaluated file, ENDF/B Version V, is nearly complete. A late revision of the fission cross section of ^{235}U and related cross sections has been undertaken and this will delay the completion of the new file until about April, 1979. Special purpose files for actinide, dosimetry, gas production, activation and fission product data are being prepared. A more general format for ENDF is being considered in order to handle more easily non-neutron projectiles as well as additional reaction properties. Definitions are being determined and tests are underway for this new format. A number of questions on specific details of this new format were asked and discussed.

A new edition of BNL 325 Resonance Parameters will be issued soon; the first volume should appear in 1979 and the second volume in 1980.

The Berman photonuclear data library which had been previously converted to EXFOR and distributed, is now being upgraded to current EXFOR specifications and should be available soon. It is expected that any revisions and new data will be converted and distributed as time permits.

The Fuller Photonuclear Index published by the National Bureau of Standards has been updated and the new edition is now ready to be published.

The Seventh Edition of the Table of Isotopes will be published by John Wiley and Sons in 1978. Considerably expanded tables of information will be included in this 1523 page edition.

Tubbs discussed activities at the NEA Data Bank, formerly CCDN. The inclusion of the code center functions formerly located at Ispra is going rather well. A PDP-11/70 data base carrier computer is being put into service. A strong increase in input data to be put into EXFOR format has occurred during the first nine months of 1978. A data base management system is being introduced and this will involve more internal use of EXFOR rather than the NEUDATA format. It was remarked that since the NDS and NEA Data Bank have not had similar computers for some time, it is not possible to share systems codes to the extent that was formerly done.

Kuzminov presented a summary of work at Obninsk. A number of papers on evaluated data have been published and many new data sets are being recorded. IBM 360 computer machine language is being used. Recent work includes (n,pn), (n,a) cross sections and Konshin's evaluation of ^{241}Am. Non-neutron work includes ^{242}Pu decay and general radioactive decay data and evaluations. Kuzminov stated that a change of basic format from SOKRATOR to ENDF was initiated. A recent evaluation of error correlations for fission cross sections and alpha for ^{235}U and ^{239}Pu was made available. NDS later agreed to have this Konshin work translated.

Schmidt reviewed the NDS activities which had been made available to the Committee in the NDS Progress Report, INDC(NDS)-97. The NDS service area and the USSR contribute about 30% of the neutron data sets and 15% of the data points to the EXFOR library. The annual rate of measured data shows an increasing tendency, unlike other areas. Special evaluations are being made in the EXFOR-VIEN file described in INDC(NDS)-85. This special library has had definite user interest. The EXFOR data exchange system now involves seven centers and encompasses not only neutron data but both integral and differential charged particle data and photonuclear data.

II.B. Review of Future NDS Program

Discussion was held on the current level of effort and the difficulty in filling vacant positions at the NDS and on the planned future activities. Schmidt presented some informative details concerning the past and of current NDS budgets, services and reviews, many of which are expanding. Vasiliu emphasized the importance of many of the NDS functions to the developing countries. Limited future effort on distributing group constants is planned, but the NDS does not plan to generate group constants. Schmidt agreed that further efforts in some areas, e.g., neutron dosimetry and fission product nuclear data, would be somewhat less than in the past.

The Chairman appointed an Adhoc Subcommittee to review these items and prepare a draft document for later consideration by the Committee. Froehner agreed to chair this subcommittee, whose membership is given in Appendix I.D2. The Committee later discussed this document in detail and approved the version given in Appendix II.B.

III. NEUTRON DATA.

III.A. ICTP Trieste Course on Nuclear Theory for Applications

A Course which had been discussed at the previous INDC Meeting had been held in Trieste in January-February, 1978. Schmidt reported that the ICTP had been very interested in having a second course and one had therefore been planned for 1980. Considerable discussion was held on this subject and an Adhoc Subcommittee chaired by Mehta prepared a document for the Committee to consider. During this discussion the following points were brought up and questions asked concerning the planned courses:

- What are the real objectives and how can these goals be met?
- Are there alternative or other constructive means of accomplishing these objectives?
- Can the NDS afford to support such a program? (Schmidt stated that the 1978 course had cost ICTP some $30,000 for lecturers and NDS had spent about $50,000 for participants.)
- Does ICTP have an interest in active scientific participation?
- Should we have a follow-up questionnaire concerning the effectiveness of the course from both lecturer and participant viewpoints?

The Adhoc Subcommittee had considered a suggestion that lectures on experimental physics should be included in the next course. Although some support was voiced, the committee generally thought that this would be broadening the base too much and that such courses on experimental techniques should be quite limited. The final document version accepted expressed this limited possibilility.

In order to better appraise the real value of the past course and to better judge the next course, the committee requested that Schmidt make a careful follow-up survey on the effectiveness as seen from both the lecturer and participant viewpoints.

The most crucial aspects concerned the appropriateness of the NDS to expend so much of its efforts in such course activities and of the real interest of the ICTP in supporting such activities in a technical and participatory sense.

The committee recognized that the next course set for 1980 was very likely a foregone conclusion, but a desire to limit the extent of the course and to attempt any possible improvements was clearly evident. The Adhoc Subcommittee expressed its willingness to assist in these efforts and included such an offer in the accepted document as presented in Appendix III.A.

III.B. Coordinated Research Programs on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data

The NDS had initiated this coordinated research program which was discussed at the previous meeting and was summarized in INDC/P(78)-20 dated 27 September, 1978. The objectives and effectiveness of the program were discussed in detail. Although it had been understood by several members that

the initial idea was to intercompare existing evaluations and not to initiate or generate any new evaluations, it was not clear that this was ,in fact, the way the program was being organized and was developing. There seems to be considerable redundancy in the efforts undertaken by the nine countries involved (3 research contracts and 6 research agreements), and the time scale for completion of evaluations appears to be quite long. It was stated in INDC(P)-78 that evaluations should, as much as possible, be independent of ENDF/B (except for format specifications). Schmidt acknowledged these points but felt that the countries which did not have complete access to large evaluated files like ENDF needed a program such as this to become involved in evaluation work. Kuzminov stated that the work was valuable in that it allowed people actually working in evaluations to meet and discuss common problems. Froehner and Fuketa expressed the opinion that the meetings had been useful. Mehta was a strong supporter of the program, as were the Romanian representatives. Schmidt agreed that the program should not deviate too far from the intercomparison of planned national evaluations and said that he will limit the activities involved.

III.C. Reactor Dosimetry Data

This subject was not discussed at this point but is covered in Subcommittee A discussions, Agenda IX.C.

III.D. Neutron Data Dissemination

During the past meeting, Smith and Liskien had discussed some problems with obtaining reliable, complete and up-to-date data sets from the data centers. As a result of the discussion held at the Ninth Meeting, Liskien and Smith had listed these problems as they observed them from the user viewpoint. Their memorandum had been sent to the data centers and was distributed to the committee. Some of these points involved: incomplete coverage, the lack of recording clearly the actual ratio values measured so that renormalization and measured accuracies could be extracted, format complications, dimension and error confusion, and lack of removing superseded files. Schmidt agreed that some of the files are incomplete and in some cases not as clear as they should be. He said that an attempt is being made to correct such cases. He reminded the Committee that EXFOR is exclusively an inter-center exchange format and that the creation of a user-oriented compputer format from EXFOR is the responsibility of each center. Producer input data carry the original dimensions and thus lack uniformity; comments are being added to identify status and history qualifications concerning superseded sets. Schmidt agreed to bring up these points at the next Four Centers Meeting and an action was accepted on this point.

Schmidt mentioned that requests for multigroup cross sections are being received at the NDS. This will be discussed in AgendaIX.C.

III.E. Future CINDA Publication

The Archival Issue of CINDA is progressing quite well and will be published in 1979. It will be a single volume and will contain all data thru 1976. Smaller supplements for data after 1976 will be published annually. Each new supplement will replace the previous ones so that only the Archival volume plus the last supplement will be needed. The committee was pleased with the progress in this area and looked forward to a more efficient and cost effective publication schedule.

Fourth and fifth supplements to CINDA 76/77 are being issued as CINDA 78.

IV. OTHER NUCLEAR REACTION DATA

IV.A. Charged Particle Data

The committee had inquired about the real user data needs at the past meeting and two actions had been placed on Schmidt regarding this question. Schmidt stated that most of the actual activities were motivated by different national interests as interpreted by the various data centers. He agreed that from the NDS viewpoint it would be good to understand the user needs so that the INDC could better evaluate the program for the NDS. In general, the idea that neutron source reaction cross sections and some integral cross sections for neutron production were important was evident, but careful avoidance of general differential cross section compilation seemed advisable. (See Meetings Subcommittee Report, Agenda IX.E.). Schmidt accepted that the past actions to pursue this point would be kept.

Ferguson mentioned that Dearnaley of Harwell is publishing a Handbook on Data Compilation related to surface analysis. It is expected that this volume will be published in mid-1979 and Ferguson agreed to obtain detailed information and inform the committee. Ferguson later reported that the handbook would be published initially as a Harwell Report.

Smith reported that the BNL Cinda-like index of CPND, NCS-50640, is being updated and a new, third edition would be published in 1979. Karlsruhe will soon publish an updated volume covering their CPND files.

IV.B. Photonuclear Data

Smith had reported U.S. activities on the Fuller Compilation and the Berman Atlas in Agenda II.A. Fuller has just published a supplement to NBS Special Publication 380, which covers the period 1973-1978.

A question was asked concerning activities in the USSR and Kuzminov replied that this work continues to be centered at Obninsk under Abramov and includes reviews and bibliographic summaries.

IV.C. Heavy Ion Data for Fusion

It was understood that heavy ion data activities should be restricted to applications to fusion reactions. This topic was discussed later by Subcommittee B and appears in Agenda IX.D.

V. NUCLEAR STRUCTURE AND DECAY DATA

V.A. Mass Chain Evaluations

Smith reported on the progress of the international effort designed to update mass chain evaluations on a four year cycle. This is now progressing well as reported in INDC(NDS)-97. It was mentioned that various special lists such as MEDLIST for medical users can be generated automatically from the computer tapes which are a part of the U.S. ENSDF system compiled at ORNL. An illustration of isotopes according to half lives was circulated. This matter was discussed in some detail later in Agenda V.C.

V.B. Coordinated Research Program on Actinide Half-Life Measurements

This topic was to be discussed by Subcommittee A and appears in their report, AgendaIX.C.

V.C. Proposed Comprehensive Half-Life Compilation

During the Ninth INDC Meeting, a request had been made that a nominal list of half-lives might be of value for commercial use. It had been reported that occasionally shipments are not accepted by customs officials because of small disparities between the recorded half-lives of radioisotopes. Schmidt had inquired about the need for and advisability of such a nominal half-life compilation. He found that there was very little interest on the part of IAEA officials. This particular request was, therefore, dropped.

During the Petten Meeting on Fission Product Data, a request had been voiced for a comprehensive list of half lives and decay properties of all isotopes. The committee expressed the feeling that this was a far more demanding endeavor than the nominal list mentioned above and felt that the great majority of data needed for such a compilation had already been compiled in the ENSDF computerized system (see V.A. above). Schmidt felt that the experts who were involved in the Coordinated Research Program (V.B. andIX.C.) should review such a list and perhaps update particular recent items before it would be issued as an INDC document. The Committee recommended that the ENSDF data base should be used (seeIX.C.), but that some minor updating would be permissible. Schmidt agreed to this procedure.

VI. ATOMIC AND MOLECULAR DATA FOR FUSION

VI.A. A+M Program Status

The IFRC had approved of the NDS plan to issue a Quarterly Bulletin on A+M Data and to publish an index of data references in a publication similar to CINDA. Considerable activity has been developing at a number of A+M Data Centers in the U.S., Japan, France, U.S.S.R. and Sweden. An A+M Data Center meeting had been held and several issues of the Bulletin had already appeared. Some difficulty had been experienced in the index, but plans to issue this index were not progressing.

The NDS now has three professional staff working in the A+M Section, but they are all on Special Service Agreements involving temporary appointments. The IAEA had agreed that 1979 would be an evaluation period following the two-year trial program in 1977-78.

VI.B. Report of the Joint IFRC/INDC Subcommittee on A+M Data

The Joint IFRC/INDC Subcommittee on A+M Data had met on September 30 of the previous week in Vienna. Several INDC participants had been present (Stone, Cross, Mehta, Schmidt and Motz). The Subcommittee had issued a number of recommendations which are presented in INDC(SEC)-70/GA, and these were discussed by the INDC. The main points cover the Bulletin, the Index and the possibility of activity related to evaluated data. The subcommittee made no specific recommendation on the administrative structure or organization of an A+M activity, but it did strongly support that the activity be made a permanent one.

The INDC expressed continued concern that, although this was without question an important activity to the fusion community and is strongly endorsed by the IFRC, this A+M effort should not interfere with the nuclear data responsibilities and activities of the NDS. Also the INDC reiterated the belief that the fusion community must be responsible for overseeing and guiding this activity since the INDC members did not have sufficient technical background to do this. In order to formally express these ideas, an Adhoc Subcommittee was formed with P. Stone as Chairman.

VI.C. INDC Recommendations Regarding A+M Data for Fusion

Most of the discussion centered on the previous points mentioned and possible options for administering an A+M activity. It was decided that the IFRC had to exert control by some means, probably via a Subcommittee to the IFRC. In order to assure that the INDC would be kept informed and be able to offer constructive ideas if and when occasions arose, the INDC asked that the Chairman of the INDC or his designated representative be a member of such a Subcommittee. It was agreed that the present Joint IFRC/INDC Subcommmittee should continue during the evaluation year of 1979 if the IAEA desired that it do so. After some revisions, the Adhoc Subcommittee report was unanimously accepted and appears in Appendix VI.C. as approved.

VII. PROGRESS REPORTS

Time was not sufficient to permit a complete review of progress reports. In a number of cases, printed progress reports were distributed since the meeting; these are noted below.

AUSTRALIA

The Australian Progress Report, INDC(AUL)-28/G, has been distributed.

CANADA

Cross mentioned a few items which are contained in INDC(CAN)-19/G:

A high cadmium ratio, low background capture facility is in operation at the NRU reactor, which is useful to measure very small thermal capture cross sections, such as ^{17}O and ^{90}Zr.

Neutron emission from 500 Mev proton bombardment, related to accelerator breeding studies, is continuing at TRIUMPF.

FRANCE

Michaudon discussed some items concerning current activity in French laboratories, some of which are included in CEA-N-2037, INDC(FR)28/L:

Elastic and inelastic scattering from Gd isotopes, ^{232}Th, ^{233}U, ^{238}U, ^{239}Pu, ^{206}, ^{207}, ^{208}Pb and ^{209}Bi, W isotopes, ^{154}Sm, and ^{156}, ^{158}, ^{160}Gd.

Fission cross sections of ^{235}U at 2.5 MeV and a joint program with ORNL and LASL on the anisotropy of ^{232}Th fission.

Capture cross sections from 0.5 to 2.5 MeV for ^{89}Y, Pt Nb and W.

(n,2n) and (n,3n) cross sections for ^{235}U and ^{239}Pu to 13 MeV.

Evaluations of fission products with CNEN/Bologna, sent to the NEA Nuclear Data Bank, and on tritium production in fast reactors.

Volume II, Part 1 of the table of the radionuclides was published in 1978 by LMRI, CEN Saclay. Work on decay schemes ($^{238-241}Pu$ and ^{241}Am) of interest to safeguards, on halflives for medical purposes, and (a,n) reactions on light elements are underway at LMRI.

FEDERAL REPUBLIC OF GERMANY

Froehner added a few comments to the Progress Report for April, 1977, thru March, 1978, INDC(GER)-20/L+SP.

The Karlsruhe synchrocyclotron is now operating with shorter pulses and higher resolution than previously; 0.7 ns at 190 meters for an overall resolution of 500 ps/m. Fission cross sections for ^{235}U and $^{239,240}Pu$ have been reported.

Unusual detector development has permitted capture and fission cross section measurements from radioactive targets with time-of-flight paths of only a few centimeters. Capture and fission results for $^{240,242}Pu$ and ^{241}Am have been reported.

A high precision time-of-flight system is being installed at PTB, Braunschweig. Proton pulses of 2-24 MeV and deuterons of 3-14 MeV with about 1 ns widths are expected.

GERMAN DEMOCRATIC REPUBLIC

The Progress Report for 1978 has been issued as INDC(GDR)-8/G.

INDIA

The 1977 Progress Report is INDC(IND)-24/G. More recent items mentioned by Mehta were:

The variable energy cyclotron at Calcutta has attained an internal target beam of a few microamperes. Civil engineering for the new 100MW research reactor is almost complete.

Evaluation efforts have continued and seven papers were presented at the Harwell Meeting. Data from (p,n) at 5.5 MeV have been fit for ten medium weight nuclei using a consistent set of optical model parameters.

ITALY

The Italian Progress Report, INDC(ITY)-4/G, has been distributed.

JAPAN

The Japanese Progress Report, INDC(JAP)-42/U, has been distributed. Information on the new JAERI Tandem Facility contained in Newsletters 1, 2, and 3 have also been sent to INDC Members. A second version of the Japanese Evaluated Nuclear Data Library (JENDL-2) will be used in benchmark tests in 1979. JENDL-2 will contain data on about 100 nuclides in addition to the revised data of JENDL-1.

ROMANIA

Evaluation work on heavy nuclei, including ^{232}Th and ^{233}U is underway. Doppler data and multigroup data are included. Sensitivity analysis of statistical model calculations versus partial radiative width values for some medium weight nuclei is also reported.

Integral cross sections measurements in the SIGMA-SIGMA-INT assembly related to structural materials and dosimetry are being made.

Photonuclear production of protons from ^{53}Cr is being measured and a new method for absolute thermal neutron flux determination is being developed.

SWEDEN

The Progress Report, INDC(SWD)-12/L has been distributed. Conde mentioned the following:

The Gustav Werner Institute synchrocyclotron at Uppsala is under reconstruction as a sector focused cyclotron. A beam of 10 microamperes of 120-200 MeV protons, and beams of deuterons and helium ions are expected.

Construction is underway for the 100 MeV race-track microtron pulse-stretcher system (MAX) at the Nuclear Physics Department, Lund. This machine will be used for photonuclear reactions studies.

Activation measurements from 1 to 10 MeV are being made at Lund University. Results at 14 MeV for ^{115m}In are in disagreement with the results of Santry and Butler(62.5 vs 54.5 mb).

Fission spectrum neutrons from ^{235}U are being measured to lower neutron energies (30 keV) at Studsvik. Collaboration with The Institute of Atomic Physics in Bucharest involves the neutron induced reactions from 16 to 22 MeV in F, Fe and Co.

Fission cross sections of ^{232}Th relative to ^{235}U have been made at the Tandem Accelerator Laboratory. Results are in good agreement with other data to within the reported accuracy of 5%.

U.S.A.

The U.S. Progress Report is INDC(US)-79/U. Additional items were given by Smith and Motz:

A superconducting heavy ion linac booster(ATLAS) is being installed at the ANL tandem Van de Graaff. An energy doubler system is being added to the MIT electron linac. The Holifield heavy ion accelerator, a folded pelletron design, is on schedule at Oak Ridge. New pulsed neutron sources are being developed and used at ANL(IPNS) and at LASL(WNR). Advanced versions of each of these facilities is under study. Tandem superconducting cyclotrons are under construction at Michigan State University.

Afterheat measurements from fission of $^{233,235}U$ and ^{239}Pu have been completed at Los Alamos. Total gamma spectra from these isotopes have also been made.

Precision actinide half-life results have been reported for Pu isotopes from work at NBS, ANL, Mound and INEL.

Inelastic neutron scattering measurements at Lowell on ^{238}U verify the higher cross sectios at low neutron energies.

ORNL has published work on resonance, capture and fission cross setions for $^{240,241}Pu$, ^{249}Bk and ^{249}Cf; RPI on ^{245}Cm.

$^{6,7}Li(n,xn)$ measurements have been completed at Los Alamos at 6 and 10 MeV; extension to 14 MeV is underway.

U.K.

The U.K. Progress report, INDC(UK)-30/U, has been distributed. Ferguson mentioned that an evaluation of ^{241}Am is almost complete and should be available soon as AERE-R8528.

It is expected that experimental use of the new 136 MeV Electron Linac at Harwell will start in the Spring of 1979.

Work is underway on capture cross sections and resonance parameters for Fe, Ni and Cr. Results to 50 KeV have been reported and analysis of data is being extended to 100 keV. Some results were presented at the Geel Meeting on Structural Materials.

Using the Tandem Generator, tritium production by the $^{7}Li(n,n'a)^{3}H$ reaction has been studied at neutron energies of 5.8, 7.5, 9.8 and 12.8 MeV. Foils of Al, Ni, and Ti were included in the irradiation package to give additional cross section checks on the neutron flux measurements. It is expected to extend these measurements down to 4 MeV using the Birmingham University Dynamitron and to 14 MeV at the Cockroft-Walton.

Measurements of alpha, n reactions on thick targets of Mg, Al, C and Si have been completed, and Fe, U and stainless steel are also being studied. Some data are in disagreement with published results.

U.S.S.R.

Kuzminov distributed the U.S.S.R. Progress Report, which covers the period 1977 thru July, 1978, and has been translated by the IAEA and issued as INDC(CCP)-127/L. Some of the items mentioned in the report are:

The 1.5 meter cyclotron at Kurchatov has been modified to obtain microampere beams of ions from H to Ne.

Alpha spectra from rare earth isotopes are being measured on-line following irradiation by 1 GeV protons.

Alpha and gamma-ray decay observations of ^{236}U have been completed.

Further unsuccessful searches for superheavy nuclei have been made at the JINR reactor. Both high energy gamma-ray and neutrons were less than about 10^{-8} per fission.

Assymmetry in the fission of ^{234}U by polarized neutrons has been found to be $2.8 \pm 0.3 \times 10^{-4}$.

Fission measurements have been made for ^{239}Pu and $^{233,235,238}U$ with ^{252}Cf and 14.8 MeV neutrons and ^{237}Np using Cf neutrons.

Energy spectra of fission neutrons from Cf have been measured from 10 keV to 7 MeV using a fast ion chamber and from 15 keV to 2 MeV using LiI detector; ^{235}U spectra have also been made with the ion chamber. Similar measurements using a plastic scintillator have been completed from 0.6 to 10 MeV for $^{233,235}U$ and ^{239}Pu relative to ^{252}Cf.

Fission cross sections of ^{233}U and ^{241}Pu relative to ^{235}U have been made from 24 keV to 7.4 MeV with accuracies of 1.3 to 2.2%; other work has obtained ^{238}U and ^{235}U cross sections from 1-7 MeV with 100-200 keV intervals and errors of 0.5 to 2%.

Filtered reactor beams of 2, 24, 55, and 144 keV have been used to measure fission cross sections of ^{235}U and ^{239}Pu relative to thermal cross sections.

Time-of-flight work on ^{152g}Eu(12.4 year half-life) resonances, and on capture for ^{159}Tb has been completed.

A velocity selector has been used in various ranges up to 1 keV to determine resonance parameters for ^{134}Cs, ^{230}Th, ^{226}Ra, Lu and ^{245}Cm.

Thermal cross sections and resonance integrals have been determined for $^{244-248}Cm$ and ^{250}Cf.

Double differential scattering of 9.1 MeV neutrons from ^{7}Li, and differential elastic and non-elastic neutron scattering at energies of 1.5, 2, 2.5, and 3 MeV for Cr and Zn isotopes have been published.

(n,p) and (n,a) cross sections for Fe, Al and Si isotopes under 14.8 MeV irradiation have been made by activation techniques. A Si detector has been irradiated at 14.1 MeV and both $^{28,29}Si$(n,a) measured.

VIII. COORDINATING ACTIVITIES

VIII.A. National and Regional High Priority Nuclear Data Request Lists

Early in 1977, several OECD countries had generated a short list of high priority, essential cross section needs for fission reactors. This list has now been discussed at both NEACRP and NEANDC Meetings and Michaudon and Rowlands reported on its status and distributed copies of the current list to the INDC. At the 1978 NEANDC Meeting, a further effort to compare national measurement efforts with this list was initiated under the chairmanship of Rowlands, but no information on that comparison was yet available.

The INDC has been concerned about the ever-increasing size of WRENDA and struggled with how one might attempt to streamline WRENDA and sensibly limit entries so that it will be more up-to-date and allow measurers to focus on the most important items. A number of suggestions were made and the Committee wrestled with this problem without any conclusions. Schmidt emphasized that it is a national responsibility to properly screen its own entries. Members were again strongly urged to appeal to their national authorities to make an effort to review their submissions carefully. It was agreed to continue the coverage to include requests for low priority measurements which might be suitable for small laboratories and for developing country activity. Detailed review of NDS or by the INDC prior to publication did not appear to be feasible.

The proper handling of special request lists generated at specialist meetings arose as it had at the 9th INDC Meeting. It was agreed that such lists should be submitted to national review authorities for their consideration. In this way they will be screened with other requests taken in proper context. Such specialist meeting lists should not be included in WRENDA without review by national contributing organizations.

VIII.B. WRENDA Publications

Schmidt summarized the schedule for the next issues of WRENDA. Submissions from member countries are needed by February, 1979, in order that the publication date of April 1, 1979, might be met. It had been agreed that requests for evaluations as well as for measurements could be properly included. Japan, U.K., U.S. and India said they had definite intentions of completing reviews for the NDS schedule. Kuzminov was not certain of the USSR schedule and agreed to inquire and encourage that the USSR submission be made in time for the next publication.

VIII.C. Targets and Samples Program

Schmidt summarized the status of this program which is discussed in INDC(NDS)-97, pages 18 and 33. Although funds in 1977 could fulfill most of the requests, only half of the funding for 1978 was available. A number of new requests have been received and it is hoped that these can be fulfilled in 1979.

Several questions arose concerning this program. It was emphasized that samples should correspond to data needs as specified in WRENDA and should not be for general research purposes. Michaudon inquired if these samples are the property of IAEA and, if they are, therefore available for further loan when the original measurement is complete. Schmidt agreed to look into the availability of samples for further loan and to give their characteristics so that other users could consider their suitability for further use.

A report "Absolute Yields of Delayed Gamma-rays in Uranium Photofission" by G. Baciu, et. al. was made available. These measurements have been completed at the Institute for Physics and Technology of Radiation in Bucharest and utilized enriched uranium samples provided by IAEA.

VIII.D. Research Contracts Program

A detailed list of all Research Agreements and Research Contracts was submitted to the INDC and discussed by Schmidt. A number of questions arose concerning the policy of approving requests from developed countries, two of which were active as given on this list. The Committee had no criticism of the research work involved, but it had been understood that only developing countries were eligible for IAEA Research Contract support. Schmidt said that these were exceptions to the general policy. In order that the committee might be better informed concerning any future possible exceptions, it requested that all requests for support from developed countries be transmitted to the INDC and/or an appropriate subcommittee prior to approval by the IAEA. In addition, the committee would like to be informed about proposals and technical details of work specifically related to subcommittee interest.

VIII.E. Other Coordinated Measurement Programs

There was no progress to report on the India/Bangladesh or the Japan/South Korea cooperative programs. A question concerning the possible increased use of Fellowship Assignments for nuclear applications to either the NDS or to laboratories was raised. The IAEA Technical Assistance Program does support such fellowships and Mehta summarized the experience in India. Quotas for fellowship assignments are issued to developing countries and the country must submit a list of candidates with specific visits suggested. The proposed host country is not always able to accept the fellow, so additional nominations are usually submitted as replacements.

In view of the desire of developing countries to attain a more active role in nuclear applications, as discussed under the Trieste Courses, Agenda III.A., discussion was centered on how to increase the Fellowship Assignments in this area. Several members expressed support for this idea and favorable experiences in a number of cases were mentioned. In order to express the INDC interest in this program, the Chairman appointed an ad hoc subcommittee which was chaired by Rose.

The subcommittee submitted a report to the committee and this was accepted for inclusion in the minutes and transmission to the Director General. The approved statement is given in Appendix VIII.E.

IX. SUBCOMMITTEE REPORTS

IX.A. Standards Subcommittee

Smith summarized the Subcommittee activities and plans. The standards file is being assembled in loose-leaf, uniform format and will be distributed to INDC and NEANDC Members, Data Centers, and users. A number of improvements and a few additions are planned, e.g., precision actinide half-lives. Changes in national assignments are given in the Subcommittee Report.

Two dosimetry standards had been provisionally included during the 9th INDC Meetilng; Al(n,a) and ^{237}Np fission product yields. Although the desired accuracy had been reported by Vlasov, justification for these cross sections as dosimetry standards had not been received as had been expected (see INDC-28, page 115). These dosimetry standards are still provisionally included in the present list, but no strong endorsement has been voiced. They will be removed from this list at the next meeting unless endorsement is made and approved at that time; Schmidt agreed to inquire about this.

Errors and uncertainty aspects were discussed. It is expected that the ENDF/B files, to be distributed in the Spring of 1979, will include such information and a concise summary will be placed into the Standards Files.

Flux measurements were also considered. Ferguson had presented information on planned transfer instruments (fission chambers) which should be useful in the neutron energy range of 100 keV to 20 MeV. Standard foil sets and reference materials for intercomparisons were also discussed and recommendations made. The NDS will consider the possibility of such foils being made a part of the IAEA samples and foils program. The complete report as accepted is included as Appendix IX.A..

IX.B. Discrepancies Subcommittee

Froehner summarized the Subcommittee Report which covered nine of the twelve subjects assigned (see INDC-28, Appendix X.B.-2, page 99). The report had been extensively reviewed by the Subcommittee and very few comments were made by the INDC before approval. Smith stated that some integral checks had supported the higher ^{238}U inelastic scattering cross sections which are now included in the ENDF/B file. A number of actions relative to detailed submissions and schedules were made. The general plan was for members to send written summaries of their assignments to Froehner by December 31st and for Froehner to assemble these for publication by the NDS as an INDC document. This will be titled "INDC Report on the Joint (Common) NEANDC/INDC Discrepancy File". The report will be given appropriate INDC and NEANDC distribution.

IX.C. Subcommittee A

Rowlands reviewed the deliberations, suggestions and recommendations made by the Subcommittee. Items covered in the report (Appendix IX.C.) are:

1. Fission Product Nuclear Data: Petten Meeting Conclusions and Data Requirements and Status.
2. Dosimetry
3. Transactinide Nuclear Data
4. Shielding
5. Alpha,n Reactions
6. Coolant, Moderator and Structural Materials
7. Evaluated Data, Data Files, Multigroup Cross Sections
8. General Policy Matters.

Recommendations were discussed in detail, slightly modified and approved on the following:

Nuclear Data Requirements for Fuel Handling, Processing and Waste Management

Half-Life and Decay Data Compilation and Evaluation.

Radiation Damage and the Activation of Reactor Materials

The subcommittee raised a question concerning recommendations which arise from specialist meetings (See Item 8 of the Report) and suggested that a distinction should be drawn between technical and policy recommendations. It was requested by the Subcommittee, and agreed to, that policy recommendations be referred to the INDC before implementation. Schmidt felt that this procedure was reasonable if two conditions were met: (1) specialist meeting attendees would not be discouraged from making recommendations, and (2) the INDC would give policy matters prompt review for possible consequent action by the NDS.

Several points of clarification and possible changes in scope arose and the report was accepted as given in Appendix IX.C..

IX.D. Subcommittee B

Rose presented the Subcommittee Report which was approved as given in Appendix IX.D. following discussion and slight revision. It was agreed that the recent initiative regarding heavy ion fusion as a new possible method of pellet heating did not at this time involve nuclear data needs which should be of concern to the committee. The heavy ion research that is now in progress is more related to reaction mechanisms and the new heavy ion fusion work is still in the accelertor design and construction phase. Several meetings are to occur in the next year and detailed plans were discussed (TND Data, May '79; Fusion Data, Dec.'78). It was recommended that a specialist meeting on the production and use of radioisotopes be considered by the NDS. Actions concerning papers from the recent Harwell Meeting, INFCE activities and neutron source information were made by the Chairman. A need for n,a cross sections for tissue elements up to 50 MeV was discussed and an action was placed on all members to endeavor to make such measurements, especially where facilites already exist which could be used for this purpose.

X. MEETINGS

X.A. Nuclear Data Conferences

These conferences were discussed under X.C. below.

X.B. Past Meetings

Meetings are summarized in INDC(NDS)-97 and were discussed during the appropriate subcommittee meetings and other meeting agenda items.

X.C. Future Meetings

Smith presented a detailed review of the adhoc subcommittee report which was discussed and approved by the committee. A later written version was distributed and is included as Appendix X.C.

The general policy of having a three-year cycle of regional major data meetings was discussed at some length. Starting in '77, these meetings have been expected to be:

Kiev '77/ Europe '78/ U.S. '79/ Kiev '80/ Europe '81/ U.S. '82/ Kiev '83.

However, the '81 Europe meeting has not been definitely decided upon and the U.S. has not committed to '82. The appropriateness of an '81 Europe meeting and the possibility of an '81 meeting in Japan were discussed. Since this is primarily an NEA matter, it will probably be considered by the NEANDC at their next meeting in 1979. Kuzminov was fairly certain that the U.S.S.R. would have a Kiev Meeting in '83.

The INDC has had a continued interest and involvement in all aspects of fission and thus in the Symposia on the Physics and Chemistry of Fission under the Physics Section of the IAEA. Although the NDS is not directly involved in such meetings, the question was asked as to why early and reasonably complete information on the 1979 Symposium had not been made available to the INDC. The meeting has recently been scheduled for May, 1979 at Julich. It was requested that in the future, the INDC be kept informed early about plans and have an opportunity to assist regarding arrangements insofar as their interest and expertise might be useful to the Physics Section. Schmidt and Cross agreed to express the regrets of the INDC and inquire about the circumstances of the Symposium.

The INDC considered the merit of various types and frequency of meetings and the question arose as to the costs of meetings and of other related programs. In particular, the relatively high cost of the Trieste Course as compared to specialist meetings had arisen earlier. Schmidt was not certain that the cost information could be distributed, but he accepted an action to ask about what might be done and to inform the INDC.

APPENDICES

10TH INDC MEETING

BUCHAREST, ROMANIA

OCTOBER 3-7, 1978

Note: Appendices are numbered to correspond to the appropriate Agenda Item in the minutes.

Not available

APPENDIX I.D1.

MEMBERSHIP OF STANDING SUBCOMMITTEES

10TH INDC MEETING
October 3-7, 1978

TOPIC A

Present	Absent
Rowlands (Chairman)	Benzi
Froehner	Gemmell
Michaudon	Usachev
Rapeanu	Yiftah
Schmidt	
Tubbs	
	Lammer*
	Lemmell*
	Vlasov*

TOPIC B

Present	Absent
Rose (Chairman)	Lorenz*
Conde	Muir*
Cross	Okamoto*
Ferguson	
Fuketa	
Legrand	
Kuzminov	
Mehta	
Seeliger	
Stone	
Vasiliu	

STANDARDS

Present	Absent
Smith (Chairman)	Perey+
Conde	Lemmel*
Ferguson	Okamato*
Fuketa	
Kuzminov	
Legrand	
Rapeanu	
Rose	
Semenescu	

DISCREPANCIES

Present	Absent
Froehner (Chairman)	Benzi
Mehta	Yiftah
Michaudon	
Rowlands	Schwerer*
Schmidt	Sowerby+
Seeliger	Usachev#

* Ex-officio, NDS
\# Corresponding Member
\+ Corresponding NEANDC Member

APPENDIX I.D2.

MEMBERSHIP OF AD-HOC SUBCOMMITTEES

10th INDC MEETING
BUCHAREST, ROMANIA
OCTOBER 3-7, 1978

FUTURE MEETINGS

Smith (Chairman)
Ferguson
Fuketa
Kuzminov
Michaudon
Rose
Schmidt
Tubbs

TRIESTE COURSES

Mehta (Chairman)
Froehner
Michaudon
Schmidt
Seeliger
Vasiliu

A + M DATA FOR FUSION

Stone (Chairman)
Conde
Fuketa
Mehta
Michaudon
Schmidt
Zoita

FELLOWSHIP PROGRAMS

Rose (Chairman)
Mehta
Vasiliu

FUTURE NDS PROGRAM

Froehner (Chairman)
Ferguson
Mehta
Stone
Vasiliu

APPENDIX II.B.

COMMENTS ON THE PROGRAMME OF THE NUCLEAR DATA SECTION

INDC has reviewed the present and future programme and work load of the Nuclear Data Section. In general, the committee approved of the NDS proposed programmes[1a] and commended its work in the period of review.

The present balance of the distribution of effort between the various activities of the Section appeared correct and should be maintained. It was recognized that the demands on the NDS were increasing as a consequence, e.g., of new experimental and computing facilities coming into operation in its service area. The committee approved the Section's aim of maintaining the quality of service by increased automation and streamlining of procedures. It felt, however, that there is a limit to the gain obtainable from this process and further reduction in budget must inevitably result in an unacceptable decrease in the service which NDS could offer. The committee was concerned that in particular a new commitment to Atomic and Molecular Data for Fusion[2] should in no way be at the expense of the nuclear data activities of the Section.

The committee encourages the Section to concentrate on the compilation and dissemination of data (including such extensions of the categories of data covered as may be endorsed by the INDC) rather than on the evaluation efforts.

The target and sample programme appeared to be working smoothly and to be satisfying an important need.[1b] The Nuclear Data Section should continue to maintain a general policy of providing samples only for measurements related to requests in WRENDA.

Research contract proposals submitted by developed countries should be submitted to the INDC for review prior to action by the NDS.

The timeliness of scientific meetings is important and the Committee regretted that budgetary restrictions have made it necessary to delay certain meetings recommended by the INDC. The specialist meeting programme is one of the most important and successful of the NDS activities and the committee expects that NDS will maintain their high standards.

The Trieste Winter Course held in 1978 was on the whole a success.(3) If budgetary limitations permit a follow-up course in early 1980, we would encourage the NDS and the ICTP to take note of the valuable experience gained from the first course.

Approved by the INDC
Bucharest, Romania
October 7, 1978

(1a) Workload Distribution in the IAEA Nuclear Data Section, INDC/P(78)-7.
Report of the Nuclear Data Section to the INDC, INDC(NDS)-97LNA.

(1b) ibid. pages 18 and 33.

(2) Final Recommendation by the Joint IFRC/INDC Subcommittee, INDC/P(78)-22.

(3) INDC/P(78)-11 and Report of the Ad-Hoc Subcommittee on the Trieste Winter Course, INDC statement of October 7, 1978.

APPENDIX III.A.

REPORT OF THE AD-HOC SUBCOMMITTEE ON THE TRIESTE WINTER COURSE

The subcommittee considered the NDS report[1] on the Winter Course on Nuclear Theory for Applications conducted jointly by NDS and the International Centre for Theoretical Physics at Trieste in January/February 1978. It also solicited critical comments from the organizers and the lecturers of the course. A feedback questionnaire distributed to participants (numbering over a hundred) also received a very good response.

The course can be considered an overall success. It helped in bringing together a large number of active and potential workers in the areas covered by the course from a wide range of developing countries and exposed them to the use of basic nuclear theory in the applied area of nuclear data for reactors. Despite the heavy workload, the response from the large participant community was very positive and the ICTP organizers were impressed enough to concede the request for a second, similar course in the early part of 1980. In the meantime, the NDS will enquire more thoroughly into the effectiveness of the first course.

The course was also quite educational for the lecturers and organizers. The feedback questionnaire and individual interactions with the participants exposed a few weak points which should be kept in view in planning for the next course.

The main weak points were:

(a) the very heterogenous nature of the scientific background of the participants which was somehow not anticipated during the planning of the course content,

(b) the lecture load was too heavy and not enough time was given for working groups to fill in the gaps and expand upon the material covered in the lectures, and

(c) the lack of a continuing nuclear physics interest at the ICTP.

The subcommittee felt that the follow-up actions on this course should have short and long term aspects. As ICTP has already scheduled the second course for early 1980, this can be considered as a short term followup step. The content of this second course should be planned based upon experience gained from the earlier one. The proposed framework of the second course is envisaged to have three major components:

(a) Processing (preparing) of nuclear data for reactor calculations and other applications. (Would enlarge upon the introductory lectures of Joe Schmidt given in the last course.)

(b) Reaction mechanism theories for fast neutrons. (The resonances, statistical theory, level densities and optical model have been well covered in the first course. The topics in this will include unified shell model theory of nuclear reactions, doorway states, etc. and preequilibrium models).

(c) Nuclear Fission.
(Would present understanding of nuclear fission phenomena with emphasis on the current status of the theory.)

It might be beneficial to include a brief survey of a few suitable topics concerning experimental techniques. The working groups on each component will provide more detailed exposure to the matter covered in the lectures and also will discuss additional material to provide the wider perspective and to fill in gaps specifically aimed at participants with insufficient background. The heterogenous nature of the level of the participants can be put to advantage by inviting more experienced participants in each working group to act as leaders and experts to provide guidance for the less experienced. If necessary, these more experienced participants can be selected and assigned specific working group responsibilities prior to commencement of the course so that they may also come with some preparation.

The detailed programme of the course including the list of lecturers may be developed by the NDS in consultation with this subcommittee via correspondence and with the newly formed Nuclear Physics Advisory Committee of the ICTP.

Possible long-term aspects of the program will be examined by the INDC in the future. The subcommittee recommends that the action outlined above should be initiated in order to take advantage of the momentum generated by the success of the first course.

Submitted by the Ad-Hoc Committee
M. Mehta, Chairman

F. Froehner
A. Michaudon
J. Schmidt
D. Seeliger
G. Vasiliu

Approved by the INDC
Bucharest, Romania
October 7, 1978

(1) INDC/P(78)-11

APPENDIX VI.C.

INDC STATEMENT ON THE A+M DATA UNIT

The INDC at its 10th Meeting in Bucharest has reviewed the activities of the A+M Data Unit of the Nuclear Data Section and its future program. Taking into account the strong support given by the IFRC at its August meeting in Innsbruck and the favorable recommendation of the Joint INDC/IFRC Subcommittee at its meeting September 30 (INDC/P(78)-22), the Committee submits the following statements to the IAEA.

- The INDC endorses and supports the recommendation of the joint subcommittee to regularize the trial program of the A+M Data Unit in 1980.

- The future program, personnel level and total budget from the A+M Data Unit as described in the memorandum from E. C. Beaty and J. J. Schmidt dated July 26, 1978 (INDC/P(78)-6), is appropriate.

- The nuclear data activities of the Nuclear Data Section should not be decreased to provide resources for the A+M data activity.

The mandate of the Joint IFRC/INDC Subcommittee expires on 31 December, 1978. The INDC agrees to extend the mandate through the evaluation year of 1979 if this is requested by the IAEA.

The INDC has considered possible options for overview of the A+M Data Unit and suggests that its future activities be reviewed by a small subcommittee of the IFRC composed of atomic and fusion scientists and including the Chairman of the INDC or his nominee as an additional member.

Approved by the INDC
Bucharest, Romania
October 7, 1978

APPENDIX VIII.E.

IAEA FELLOWSHIP PROGRAMME

At its 10th meeting in Bucharest, Romania, October 1978, the INDC expressed its strong support for the IAEA Fellowship programme for the following reasons.

The employment of Fellows both at the NDS in Vienna and in laboratories of the member states gives them valuable experience in many facets of work in the nuclear data field which remains one of great importance for the world power problem.

However the techniques involved in this area of scientific work are also relevant to a wide range of other subjects in which nuclear data has an important role to play. This range was demonstrated both at the Paris Symposium (1973) on "Nuclear Structure and Decay Data for Applications" and at the recent Harwell Conference (September 1978) on "Neutron Physics and Nuclear Data for Reactors and other Applied Purposes." Among the most important of these are medical applications, materials analysis, safeguards, radiation dosimetry and the production of isotopes of medical interest.

Many of the techniques required, such as modern electronics, computer programming, systems analysis and the handling of large amounts of data are important in a wide field completely outside the nuclear area and can be learned by IAEA Fellows on a "nuclear data" assignment.

For these reasons the INDC is convinced of the value of the IAEA Fellowship scheme applied in the nuclear data area and urges the Director General to take these considerations fully into account in the allocation of Fellowships.

Approved by the INDC
Bucharest, Romania
October 7, 1978

Standards Subcommittee Report, 10th INDC Meeting, 3-7 October 1978.

Agenda of Subcommittee Meeting

I. REVIEW OF AGENDA

II. REVIEW AND STATUS OF 1977-78 ACTIVITIES

A. Membership and Responsibilities

B. Status Review

1. Policies and Objectives
2. Distribution and Communication

C. Review of Technical Topics

III. ERRORS AND UNCERTAINTIES

IV. STATUS OF ENDF-V STANDARD FILES

V. GENERAL AND SPECIAL MEETING PROPOSALS

A. General Standards Meeting

B. Specialists Meetings

1. Neutron Source Properties
2. U-235 and Associated Fast-Fission Cross Sections

VI. PROPOSALS FOR COORDINATION ACTIVITIES

A. Fission Transfer Instrument

B. NBS Standard Foil Proposal

VII. SUBCOMMITTEE REPORT

VIII. SCHEDULE FOR STATUS-FILE

Subcommittee Report and Record of the Meeting

I. Review of Agenda

The above agenda was distributed in draft form, reviewed and accepted as the basis for subsequent discussions.

II. Review and Status of 1977-78 Activities

A. Membership and Responsibilities

The subcommittee membership was re-established as directed by the Committee Chairman, W. Cross, and as given in Attachment 1. The technical areas were reviewed with attention to completness. All items were retained from the previous listing including X-ray standards. It was understood that there was no explicit review of the latter nor any subcommittee competence in the area but it was felt that the topic could be of forthcoming importance and should be retained by title only. It was felt that the continued inclusion of the $^{27}Al(n:\alpha)$ and $^{237}Np(\sigma_f)$ reactions in the file should be better justified by the NDS (the originator). The individual technical responsibilities were then redefined. The only immediate membership change was the replacement of Kulakov by Kuzminov which, of course, retained the same national responsibility. The NDS also expressed a desire to terminate their responsibility for thermal-constant values. The replacement responsibility must be sought by the next meeting. With that consideration, the current responsibilities are defined in Attachment 2.

B. Status Review

1. Policies and Objectives

The subcommittee chairman outlined the objectives followed in preparing the standard file for the present meeting. The increased scope includes:

a. Provision of brief technical statements of status as provided by outstanding specialists.

b. Updating of the status statements with editorial comments provided by the chairman and/or the executive secretary.

c. Encouragement of common use by skilled personnel thereby leading to a critical review of the content of the file.

d. Stimulating measurements resulting in the improvement of the standard data.

e. Provision of a suggested numerical data base for quantitative comparisons. The ENDF, internationally available, standard files were chosen for this purpose.

The chairman pointed out that CSEWG has set up a formal mechanism for the consideration of standard-file comments and their use in subsequent evaluations. Thus a proper feedback mechanism exists. A loose-leaf format was chosen for ease of updating and also to make the file simply usable for both review and reference.

It was noted that the file was a joint NEANDC-INDC document and thus should be updated and distributed on a 9-month cycle consistent with the two parent-committee meeting schedules. That policy be followed.

2. Distribution and Communication

Beyond the transmission of the INDC standard file to the corresponding NEANDC Subcommittee, methods were sought for effectively bringing the file to the attention of a wider community of users. It was noted that the NDS (J. Schmidt) had requested that the file be distributed to the 4-Centers. This had not yet been done as the chairman felt the Subcommittee should approve such a wider distribution. After discussion it was recommended that the NDS distribute the file to a select group of users (approximately 50), including the 4-Centers, chosen so as to encourage the review and improvement of the file and the nuclear standard field generally. The Subcommittee Chairman will provide "copy-ready" master proofs to the NDS for reproduction and distribution. The subcommittee will assist the NDS in formulating the distribution list as requested.

The above distribution practices should be reviewed following the next INDC-NEANDC meetings and revised as warranted by experience.

C. Review of Technical Topics

The technical topics of Attachment 2 were reviewed item by item. The detailed comments and the status reports will be distributed in accordance with the schedule set forth in Section VIII, below, for the complete file. There was some discussion as to what extent the file should contain support documentation, particularly in the form of reprints and preprints. Some such documents can be very extensive. It was concluded that the Chairman and the Executive Secretary should exercise judgement including documents of a unique nature and of high relevance and referencing those available through the formal literature.

III. Errors and Uncertainties

The importance of error-uncertainity statements has been widely recognized -- e.g. memorandum of Rose (9/77) —. It was concluded that a definitive standard statement was difficult or impossible without a corresponding statement of uncertainty. It was suggested that a simplified and user oriented uncertainty file should accompany each numerical reference entry and that such uncertainty files should be drawn from the more comprehensive ENDF-V uncertainty files yet be free of the latter's complexity in so far as possible. The corresponding NEANDC Subcommittee Chairman-F. Perey--is particularly conversant with the ENDF-V error file system and will be asked to provide the respective numerical information as an NEANDC contribution to the correlated standard file. In one instance --i.e. carbon-- the error statements are already available and serve as an illustration of the suggested error-statement procedures recommended for inclsion throughout the standard file.

IV. Status of ENDF-V Standard Files

The status of the internationally available ENDF standard file was defined for the Subcommittee. It was noted that the draft standard file available to the Subcommittee contained either ENDF-V preliminary standard files, or, when not available, ENDF-IV versions. It was further noted that the ENDF-V standard file is now under revision due to necessary changes in the U-235 fission cross sections. These changes will impact on other portions of the file as internal consistency is required. In some cases where ratio values are relied upon the changes may be significant. In other portions derived largely from theory --e.g. H(n,n)--the impact of U-235 changes will be very small if at all. The re-evaluation of U-235 should be completed in 30 days and the entire file revised by 3/79. Therefore the Subcommittee concluded that the complete version of the standard file should not be given wider distribution until the final ENDF-V values are available. This determines the scheduling set forth in title VIII, below.

The Subcommittee felt that the numerical contents of the standard file should be formally referencable and clearly identified by date. These policies present no problem with the planned scheduling as the ENDF-V documentation and dating are inherent in the release of this file. However, there may remain some uncertainty as to the exact cutoff dates and data references employed in the particular evaluations. Hopefully, the ENDF-V documentation will provide this information in sufficient detail.

V. General and Special Meeting Proposals

A. General Meetings

The Subcommittee re-affirmed the desireability of a general IAEA-NDS Advisory Group meeting on Nuclear Standard Reference data on a 5-7 year cycle. The last previous meeting of this type was at the National Bureau of Standards in 1977. Thus the NDS should consider scheduling such a meeting during the period 1982-84. It is premature to give explicit attention to content and scheduling at this time.

B. Specialist Meetings

Two specialists meetings were recommended as per the following subtopics. In each case it is suggested that the NDS seek consultation in planning and guiding these specialized meetings. The Subcommittee can provide such guidance upon request.

1. Neutron Source Properties

It was proposed at the 9th INDC meeting that a specialists meeting on the properties of neutron sources as they impact upon precise standard measurements could significantly improve the status of standard cross section measurements. The NDS has scheduled this meeting for 3/80. The Subcommittee suggests a meeting content as outlined in Attachment 3 extending from thermal energies to 40 MeV and above. In doing so it was recognized that discretion must be exercized on the part of the NDS so as to focus on the most productive topics. Inclusion of all the topics of Attachment 3 will result in too diffuse a meeting.

2. Fast-Fission Cross Sections of U-235 and Associated Absolute Fission Cross Section Determinations

The Subcommittee noted the very central position of the U-235 standard in the area of fission cross section measurements and its impact on a wide range of applied standard problems. The results of a recent workshop held at NBS were reviewed and it was noted that the current limitations in accuracy are in the range 2-3 percent. The problem area is now being addressed in a number of countries with measurement programs that indicate ultimate accuracies in the vicinity of 1 percent in several years time. Thus in 2-3 years the results of work now in progress should become available and warrant a detailed assessment by a group of specialists. A meeting with this objective may have the potential of resolving differences and reaching the long-sought goal of 1 percent accuracies in the U-235 fast fission cross section. Other prominent fission cross sections of high-importance nuclides should be included (e.g. Pu-239) where the results of the work are directly relevent to establishing the fission cross section standard reference to 1 percent accuracy.

VI. Proposals for Coordination Activities

A. Fission Transfer Instruments

Ferguson outlined the fission-cross-section transfer instrument designed and now under construction at AERE Harwell (Gayther et al.). The concept is a pair of fission chambers (U-235 and U-238) of rather large dimension suitable for use at both white- and mono-energetic facilities over the energy range $\approx$0.1-20 MeV. The Subcommittee felt the concept had the potential for establishing consistent flux scales at a number of facilities. Steps toward such intercomparisons have been taken via AERE and BPIM. The potential of these two instruments could be exploited on a wider scale. Therefore a technical statement of the chamber concept and capability will be included in the Standard File. Interested parties are encouraged to directly contact Drs. Ferguson and/or Gayther (AERE) for information dealing with this intercomparison program. Limitations on participation appear to be primarily those of instrument availability and cost. Interested parties might find very useful detailed specifications and designs from which to construct their own "secondary standard" chambers which could be referenced to the primary units.

B. Standard U-235 Reference Foils

The Chairman outlined problems associated with precise U-235 foils used in cross section measurments and the impact on precise fission cross section measurements. He noted that U.S. experience indicates mass uncertainties of 1-2% and these are the largest single error contributions to the overall U-235 fission-cross-section uncertainties. Technology seems to indicate a potential foil accuracy of 0.1-0.3% as illustrated by recent half-lives measurement programs. Thus U-235 standard reference fission foils to accuracies of $\lesssim$0.5% appear feasible and are essential if the goal of an overall U-235 fast fission cross section accuracy of $\approx$1% is to be achieved.

A proposal to provide a national (U.S.) standard U-235 foil system centered at the NBS was outlined for the Subcommittee. The proposal was well received. Further, it appears to have potential merit in the context of the IAEA(NDS) stimulation of measurement programs in developing countries. Thus the Subcommittee suggests that the NBS (U.S.) foil proposal receive wider attention and for this purpose it is recommended that a resume' of it be attached to the INDC Standard File. In addition, standard laboratories (e.g. CBNM) will examine the proposal in detail with the objective of determining the feasibility of its implementation on an international basis. The Subcommittee Chairman and/or Dr. C. Bowman (NBS) will respond to technical inquiries.

VII. Subcommittee Report

The Subcommittee Chairman will prepare a draft report. That report will be promptly distributed to Subcommittee members. Thirty days from time of receipt will be allowed for amendments after which the final document will be transmitted to the parent Committee and the NDS.

VIII. Schedule for Status File

After consideration of the general and specific agenda items, the Subcommittee recommended that the Standard-file be updated and distributed in accord with the above policies with a target distribution date of 3/79. The date was selected to be consistent with the planned international availability of the final ENDF-V standard file. The latter file shall be contained in the numerical tables associated with the document rather than the present, and interium, preliminary ENDF values. Updates of the individulal status summaries are requested by 2/79 so they can be included in the final form. If updates are not always available the current contributions will be retained with editor's comments.

Submitted by

Alan Bowen Smith, Chairman
Argonne, 1/19/79

Attachment 1

MEMBERSHIP (1978)*

Name	Representation
J. Legrand**	France
B. Kuzminov**	USSR
S. Rapeanu**	Romania
T. Fuketa**	Japan
H. Condé**	Sweden
H. Lemmel/A. Lorenz[a]	IAEA
J. Schmidt**	IAEA
F. Perey[b]	NEA
A. Ferguson**	U.K.
B. Rose**	EEC
D. Seeliger[a]**	DDR
A. Smith, Chrm.**	USA
W. Poenitz, Exec. Sec.	USA

[a]Observer.
[b]NEANDC subcommittee chairman.
*As active at the 10th INDC Meeting.
**Present at meeting.

Attachment 2

REFERENCE-DATA-TYPE AND REVIEW RESPONSIBILITIES (1978)

	Reference-Data-Type	Responsibility	
		National	Current Personnel
I.	H(n;n)H	U.K.	C. Uttley
II.	$^{6}Li(n;t)^{4}He$	U.S.	A. Smith/H. Motz
III.	$^{10}B(n;\alpha)^{7}Li$	CEE	E. Wattecamps
IV.	C(n;n)C	U.S.	A. Smith
V.	$^{197}Au(n;\gamma)^{198}Au$	U.S.	A. Smith
VI.	$^{235}U(\sigma_f)$	USSR	B. Kuzminov
VII.	^{252}Cf Fission Spec.	USSR	B. Kuzminov
VIII.	$\bar{\nu}$ of ^{252}Cf	IAEA	H. Lemmel
IX.	$\tau_{1/2}$; ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu	IAEA	A. Lorenz
X.	Thermal Constants: ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu	IAEA	H. Lemmel*
XI.	γ-ray Standards	France	A. Michaudon/J. Legrand
XII.	X-ray Standards	France/EEC	J. Legrand/B. Rose
XIII.	Neutron Flux Methods	France	A. Michaudon/G. Grenier
XIV.	Neutron Energy Standards	U.K.	D. James
XV.	$^{27}Al(n;\alpha)$	IAEA	J. Schmidt/H. Vonach
XVI.	$^{237}Np(\sigma_f)$	IAEA	J. Schmidt

*Responsible only through this meeting.

Attachment 3

Suggested Topics for a Specialists Meeting on Neutron Source Properties

I. (α,n) Sources
   1. Spectral districutions and background effects
   2. Intensities
   3. α half-lives
   4. Intensity comparisons and time dependence
   5. Corrections for spectral perturbations

II. (γ,n) Sources
   1. (subtopics as per I, above)

III. Cf-252 Sources
   1. Fission-spectrum distribution
   2. Half lives for fission and α-decay
   3. Fabrication of high intensity sources
   4. Corrections for spectral perturbations
   5. Determinations of absolute intensities

IV. Monoenergetic charged-particle-reaction Sources
   1. T(p,n), T(d,n), D(d,n), T(d,n), V(p,n), etc.
   2. Production cross sections
   3. Angular distributions
   4. Emission spectra including breakup
   5. Polarization effects
   6. Energy determinations
   7. Applications; backings, fabrication, target assemblies, corrections, etc.

V. Filtered Beams
   1. Reactor and accelerator white sources
   2. Spectral distributions and purity
   3. Monitoring techniques

VI. Properties of Accelerator White Sources
   1. Linacs (electron + positive ion), cyclotrons, etc.
   2. Spectrometric methods
   3. Target configurations
   4. Background control

VII. Thermal and Epi-thermal Reactor Beams and Fields
   1. Central thimbles and through-tubes
   2. Thermal columns
   3. Reference cavities
   4. Monochromators and spectrometers

APPENDIX IX.C.

REPORT OF SUBCOMMITTEE A

Members attending the subcommittee meetings(some only parts) were:

V. Cuculeanu	J. Rowlands(Chairman)
J. Schmidt	A. Michaudon
H. Motz	A. Smith
S. Rapeanu	N. Tubbs
F. Froehner	

1. Fission Product Nuclear Data

(a). Conclusions and Recommendations of the Petten Meeting.

(i) The FPND Progress Report

The Petten Meeting recommended that the NDS should continue the annual publication of the FPND Progress Report and include information on FPND requirements and their justification.Some members of the subcommittee considered that some information was included in the FPND Progress Report which was not appropriate, while other information was probably not being submitted which ought to be included. It was suggested that a more detailed definition of the type of information to be included might be helpful. There was some discussion about the need for such Newsletters or Progress Reports. It was suggested that a suitable CINDA retrieval could give references to FPND entries in National Nuclear Data Progress Reports. However, it was argued that these might not be received by the appropriate communities, that there would be a further delay in transmission of the information and that sufficient detail might not be given. Dr. Schmidt reported that a questionaire had been sent to those receiving the FPND Progress Report asking their views on the usefulness of it. The response was generally favorable.

(ii) Compilations of half-life and decay data

The NDS had been asked by the attendees of the Petten Meeting to generate a comprehensive compilation of half-lives and associated decay data for all unstable and metastable nuclei. It was recommended by the Subcommittee that the different half-life and decay data compilations and evaluation activities should be considered in relation to the ENSDF project at Oak Ridge and this became the subject of a recommendation.(See the section on the TND Coordinated Research Programmes).

(iii) Future Meetings on FPND

The NDS was asked at the Petten Meeting to coordinate activities and to convene smaller specialist meetings to improve the knowledge and accuracy of specific types of FPND.
The Subcommittee agreed with this recommendation. The Bologna and Petten Meetings on FPND had been most successful in reviewing the broad field of FPND requirements and data status, but now more specialized small meetings were appropriate. It was noted that an IAEA Meeting on Delayed Neutron Data and an NEA-sponsored meeting on fission product cross section data were to be held.

(iv) Intercomparison of methods for deriving statistical resonance parameters.

An intercomparison had been proposed at the Petten Meeting. This had been discussed by the NEANDC and is to be a topic at the NEA Meeting on Fission Product Cross Section Data

(b) FPND Requirements and Progress Reports.
French Shielding experts have expressed concern at the lack of data for fission products with half-lives of less than 1 hour. In particular, gamma spectra were thought not to be well known. Dr. Motz reported that a new standard for U^{235} decay heat has been proposed and was now being studied by the American Nuclear Society Subcommittee responsible for such standards in the U.S. The new data have an accuracy of $\pm$ 2% for times longer than about ten or 20 seconds. ENDF/B-IV calculations agree with the experimental bench mark experiments to within their accuracy. The Los Alamos calorimetry measurements of decay heat have a high weighting in determining the proposed standard because of their high accuracy. The Los Alamos calorimeter measurements of Pu^{239} decay heat using the same technique (for times up to 100,000 seconds) are not in such good agreement with calculations using ENDF/B-IV, the calculations being some 6 to 8 percent lower than the measurement. This inconsistency between calculations for U^{235} and Pu^{239} is a matter of concern and further comparisons using the improved and extended data base from ENDF/B-V will be made in the near future. Gamma spectra were also obtained in the Los Alamos experiments. Spectral information was obtained for both the gamma rays emitted during the thermal neutron irradiations and during the appropriate decay period applicable to the calorimetry measurements. Information on the radiation emitted during the irradition has been published as LA-7451-MS and the spectra following irradiation will be published as LA-7620-MS.

2. Dosimetry.

It was noted that in addition to the IAEA-sponsored Advisory Group Meeting on Nuclear Data for Reactor Dosimetry planned for November, 1978, a joint ASTM-Euratom Symposium on Reactor Dosimetry was to be held in October, 1979 in Ispra. The view was expressed that there were too many meetings on this subject at present and this might be diluting the effectiveness.

It was considered important that dosimetry cross-section evaluations should include careful attention to the production of error files.

The ENDF/B-V Dosimetry File will be released in the Spring of 1979.

Doubts were expressed by some subcommittee members about the need for all the reactions proposed by the NDS and dosimetry consultants for addition to the ENDF/B file to produce the internationally recommended file of neutron data for reactor dosimetry.

It was reported that a more rigorous approach to spectrum unfolding than the SAND 2 method was being developed and so the effort devoted to the generation of SAND 2 group cross-section data should take account of this.

French shielding experts have expressed a need for dosimetry reaction data up to 50 MeV for measurements of deep penetration in fission reactors. (An extension of energy range is also required for dosimetry for the proposed Hanford Fusion Materials Irradiation Test Facility-FMIT.)

3. Transactinide Nuclear Data.

(a) Requirements for the U233-Thorium Cycle.

Recent measurements and evaluations (in particular those for ENDF/B-V) showed large differences from earlier data and in comparisons with integral measurements. This was particularly so for Th232 capture and U233 fission and total cross sections. At present the data were only sufficiently accurate for survey reactor calculations, and not for detailed design, and more measurements are needed. This subject will be reviewed at the TND Meeting to be held in Europe in May 1979.

(b) Requirements for the Fuel Cycle.

The different requirements proposed by different groups were noted. Some requirements for the secondary actinides proposed in the paper presented by Usachev at the Harwell Conference were less stringent than those requested by other groups, e.g. the Japanese request list and some U.S. requirements. It would be valuable for the criteria used for determining the different requirements to be reported to INDC and to the forthcoming TND Meeting, and intercompared, and INDC Members were asked to report on these various criteria.

The accuracy requirements could determine the role of theory in meeting the requirements. Theory could probably meet requirements in the 15-30% range depending upon the partial data available.

The following recommendaton was made to the committee:

NUCLEAR DATA REQUIREMENTS FOR FUEL HANDLING, PROCESSING AND WASTE MANAGEMENT

There are significant differences between the accuracy requirements for fission, capture and (n,2n) cross sections of the secondary actinides of signifigance in fuel handling, reprocessing and waste management. The extent to which theory can meet some of the requirements is dependent on the required accuracy. Members are asked to inform the committee of the criteria used to determine the requirements.

(c) IAEA/NDS Coordinated Research Programmes on TND.

(i) Intercomparison of evaluations of actinide neutron nuclear data.

A view expressed was that the timescale for completion of evaluations in the coordinated programme reflected a lack of impetus.

(ii) Measurement and Evaluations of Actinide Decay Data.

It was considered that the scientists participating in this project should take into account the ENSDF programme and correlate it with ENSDF where appropriate. The following Recommendation was formulated:

HALF-LIFE AND DECAY DATA COMPILATION AND EVALUATION

The NDS and INDC Members should endeavor to keep scientists who are working on the evaluation and compilation of half-life and decay data informed of the ENSDF programme and ask them to correlate their work with the ENSDF programme where appropriate. The aim shoud be to make the ENSDF data file the international reference source.

4. Shielding.

The nuclear data requirements had been discussed in a paper by Butler at the Harwell Conference. Sensitivity studies were being made and an NEA-sponsored intercomparison study was in progress. This included measurements and calculations for benchmark shields. An informal meeting to discuss progress in this work had been held in November, 1977 and the minutes were awaited with interest. Detailed nuclear data requirements are expected to be formulated following this study and the Subcommittee would like the INDC to be kept informed of progress. No IAEA meeting was proposed to be held before the progress of the NEA-sponsored activity was reported and considered by the INDC.

5. Alpha,n Reaction Data.

The requirements for (alpha, n) data for irradiated fuel neutron emission and reprocessing plant shielding design were noted. Papers at the Harwell Conference had reviewed the relevant measurements and referred to evaluations and the agreement between measurement and calculation. This work was meeting the requirements.

6. Coolant, Moderator and Structural Materials.

Radiation damage and material activation data were discussed leading to the following recommendation:

RADIATION DAMAGE AND THE ACTIVATION OF REACTOR MATERIALS

This is an area of increasing importance. An IAEA Committee on Radiation Damage has recommended standard or reference atomic displacement cross sections. The NDS is asked to consider the possibility of making the multi-group data recommended by this committee available at the Center. The NDS is also asked to consider monitoring the requirements for radiation damage and activation of reactor materials and to the compilation activities which are in progress, e.g. for reactor decommissioning studies.

7. Evaluated Data, Data Files, Multigroup Cross Sections and Codes for Generating These Data.

Many countries have requirements for evaluated nuclear data files and the associated processing codes to produce group cross sections.There are requirements for neutron interaction data (including thermal scattering data) half-lives and decay data, prompt and delayed gamma spectra and gamma interaction data, (alpha, n) reaction data are also required for predicting the neutron emission in irradiated fuel and chemical reprocessing plants. Radiation damage cross section data are also required. Some evaluated files are available at the NDS center and the NDS is asked to ensure the fullest possible coverage. Some processing codes can be obtained from the Saclay NEA Data Bank. Dr. Sartori is the IAEA liason officer at the NEA Data Bank and he can provide information about the codes which are available and enquire about the availability of other codes.

Developing countries have requirements for group cross section sets appropriate to particular reactor types. Although there might be some improvement in efficiency resulting from a central service to generate group data, it was considered that it would be a major extension of the role of the NDS for them to attempt to do this. It was concluded that NDS should not be involved in the generation of group cross section sets but should continue to transmit those which are made available to the center.

It was recommended that evaluated nuclear data files should include provision for the use of the Reich-Moore resonance formula and INDC members were asked to try to influence the definition of evaluated data file formats to provide this. Extensions of energy ranges could be required, for example for dosimetry reactions to 50 MeV, and for radiation damage data.

8. DISCUSSION ON RECOMMENDATIONS FROM SPECIALIST MEETINGS.

It was considered that a distinction should be drawn between technical conclusions and recommendations of specialist meetings and the policy recommendations made. Without wishing to discourage people from making recommendations, it was proposed that policy recommendations should be considered by the INDC before the IAEA takes action on them. In some cases this would require a prompt response by members to communications from the NDS.

Submitted for the Subcommittee
John L. Rowlands, Chairman.

APPENDIX IX.D.

REPORT OF SUBCOMMITTEE B

GENERAL CONSIDERATIONS

The Subcommittee considered principally the possible action to be expected from INDC and NDS in the areas of work for which it has responsibility. It proposed the following principles for consideration by the INDC which may be of more general application.

(i) If there is interest in a particular type of data in only a single country, the role of INDC should be restricted to that of the watching brief, though this could not exclude the calling of the attention of other countries to this field of work if it is felt desirable.

(ii) If there is wider interest, the INDC/NDS role will depend upon whether or not the work appears to be reasonably well coordinated. If there is good interaction between the various laboratories carrying out the work, then the role of INDC should again be largely that of an interested observer, in which it should be alert to see if there are any matters in which it can be helpful.

(iii) If work is wide spread on a particular topic, but is relatively uncoordinated, the INDC/NDS should consider seriously whether it can offer further help to improve the efficiency with which the work is carried out, to remove duplicaton and assist with interchange of ideas and results between participants.

PARTICULAR PROGRAMME AREAS

1. FUSION

Fusion data is to be thoroughly reviewed at a meeting to be held at an Advisory Group Meeting at the Agency in December 1978, and the subcommittee did not feel it worth while to consider this subject in detail at this time. However, there was one significant item missing from the programme and that was the need for nuclear data to interpret the results of neutron irradiations for damage studies in the energy range up to about 40 MeV which will be made at the Hanford FMIT project (the intense Li(d,n) source).

Any INDC/NDS follow-up from this meeting will need to be considered, initially by correspondence, when general conclusions and recommendations of this meeting are known.

2. "ALTERNATIVE FUEL CYCLES"

(a) Nuclear Incineration

This is one special possibility of actinide waste disposal that has already had several years of exposure, was considered at a meeting in Ispra in March 1977 and has been a subject of a number of special reports. Sensitivity studies of nuclear data requirements have been carried out, but no detailed request lists have been generated because, though the nuclear physics is favourable (to the present degree to which the data is known), there are formidable chemical and chemical engineering problems to be solved before the general ideas may be considered practicable - and even then the needs will strongly depend on the overall strategy chosen.

However, it is generally recognized that much improved data would be needed for the higher actinides, though these data will be difficult to obtain because of the shortage of suitable samples and the high activity of those that do exist.

The same sort of data will be needed, though to a lower accuracy, for the estimation of the arisings of these actinides in fuel reprocessing plants. However, the accuracy achievable by the state of the art in the next few years is unlikely to be any better than will ultimately be needed.

The policy proposed is then simply to encourage the measurement of such parameters as become measurable during the next few years and so to minimize the areas of ignorance against the time when decisions may be needed.

(b) Electro-breeding and Non-Proliferation

These topics are an integral part of the INFCE study and it was not felt useful at this time to consider the nuclear data requirements until the results of this study had been reported in the next year or two. However, it was felt to be fairly certain that improved data relating to the thorium cycle would almost certainly be needed.

3. WASTE MANAGEMENT

The committee was much influenced by the review talk given by Dr. H. Kusters at the Harwell Nuclear Data Conference in September 1978, and considered that this topic should not be separated from the general topic of data requirements for fuel reporcessing which is at present part of the remit of Subcommittee A. The accuracies for certain types of data may be somehat different, but the types of data needed are basically the same.

There are important radiological hazards associated with mining tailings (pre-processing) but it is unlikely that there are any nuclear data aspects involved here unless extensive chemical treatments of these tailings should be called for.

4. SAFEGUARDS

The committee felt it had not had time fully to digest the detailed paper prepared by Dr. T. Fuketa for the Harwell Conference and it was agreed to deal with this matter by correspondence. The initial impression was again that the majority of the data will be obtained for other purposes, but that there could remain some items to which a specific safeguards label should be attached.

Additional items not considered by Dr. T. Fuketa are the neutron cross sections affecting the build-up of the minor isotopes ^{232}U, ^{234}U and ^{236}U which are beginning to be of importance in safeguards techniques.

5. ENVIRONMENT

Some requirements in the non-neutron area appear to be arising in this field principally from ICRM's subgroup on Life Sciences. Some of these are summarized in an informal paper by W. Bambynek of CBMN, Geel, but it seems appropriate to await the completion of the enquiry and the consequent decision of ICRM before considering any action. A great deal of this data was covered at the recent Petten meeting on fission product data, though this did not cover the actinides.

6. MATERIAL ANALYSIS INCLUDING GEOLOGICAL STUDIES

The majority of the needs for neutron data for these topics appear to be met at present required levels of accuracy by data available for reactor shielding, with the possible exception of the yield of gamma rays from inelastic neutron scattering. However, it was pointed out that it should be possible to interrogate the ENSDF file at Oak Ridge to recover this information.

As the interest in this work seems confined to a single country (UK), it will be its responsibility to pursue this question with the ENSDF programme if it wishes to do so.

It was noted with interest that a project is under way in the UK, partly funded by EPRI, to compile a handbook of data for analysis by charged particle scattering and interaction and that it should be available in about 9 months time.

The lack of wide interest in nuclear data for analytical purposes was emphasized by the lack of any paper on nuclear data needs at a recent conference on activation analysis (both neutron and charged particles) held at Oxford - June, 1978, despite a specific invitation to submit such papers.*

Some interest was shown, however, in low energy photon data for analysis by PIXE. A variety of topics were considered to be of potential importance - X-ray production cross sections from charged particle bombardment, X-ray fluorescent yields for light elements (Z 30), photon attenuation coefficients (8 keV) and calibrated X-ray sources.

* Note added : There are strong pockets of interest, e.g., Prof. Hoste, of Ghent University, who claims that a great deal is still needed.

7. BIOMEDICAL

(a) Charged particle reaction data for radioisotope production.

In consideration of this matter we also had the benefit of Dr. Stocklin's recent survey at the Harwell Conference (September 1978).

The general conclusion was that because of the world wide interest in this topic as evidenced by the number of accelerators round the world producing radioisotopes, it would be valuable to call an IAEA consultants' meeting of a few specialists in radioisotope production and use to consider in what way the IAEA/NDS could be helpful in this matter. Two possible methods of assistance were considered (a) the calling of a larger specialist meeting and (b) the establishment of an isotope production newsletter. It is recognized that in the production of radioisotopes there are many serious problems apart from the nuclear data aspects, but that these could be put into clearer perspective by a suitably constituted consultants' meeting.

(b) Atomic data (W values and stopping powers)

W values were felt to be outside the scope of INDC activities, but stopping power is a marginal matter (e.g. it is of importance for a full interpretation of experiments on (,n) yield for UO_2 and for interpretation of analysis by charged particles - though the latter work seems to be proceeding well enough without "outside" help).

(c) Neutron production and neutron data for radiotherapy

Work in neutron production cross sections (or yields) seems well in hand and for the higher energy beams which may be important in the future is not likely to be of very great importance. Neutron scattering data, for low (up to 14 MeV) energy neutrons is in moderately good shape except for the spectra from inelastic scattering, but the latter is likely to be available from the Dresden Technical University in the not too distant future. There is also information in the Project Report on the Hanford FMIT project. The spectra from (n,a) reactions in materials of biological importance can be produced fairly readily as a simple extension of programmes already under way in laboratories represented at the subcommittee - at least up to E_n 25 MeV.

Above this energy the data are likely to come from similar work under way in connection with the Hanford intense neutron source project (FMIT) in the next year or two.

(d) Low energy photon data

There is some interest in this from a variety of sources for internal dosimetry (UKNDC - biomedical subcommittee, IAEA dosimetry section, ICRM) and this could conveniently be lumped together with similar interests in research using PIXE. However, before making any recommendation for action in this field, it is important to inform ourselves of related work going on at NBS and to study IAEA (NDS)-94/LN, a compilation of compilations on photon data.

M. Legrand agreed to contact M. Bambynek (CBMN) with the object of producing a suitable section in the INDC Standards File.

Final Report of:

The INDC Ad-hoc Subcommittee on Meetings*

I. PREFACE

This document reports the conclusions of the above Subcommittee based upon extensive discussions, submitted documentation (e.g. INDC(NDS)-97/LNA, working paper INDC/P(78)-17, and as explicitly cited herein), and input obtained from the chairmen of each of the four standing INDC subcommittees. It is presented to the parent Committee for consideration and transmittal to the IAEA-NDS as appropriate. The contents generally reflect only Subcommittee views. Subsequent full Committee discussion will be further defined in the Committee Minutes.

Generally, the Subcommittee was gratified by the NDS leadership in the planning and executing of a well-thought-out meeting program. The comments contained herein are made in the full spirit of assistance and guidance and with the realization that the NDS must temper these and other suggestions so as to be consistent with the available support for the meeting program.

Subsequent paragraphs outline the Subcommittee views. These are graphically assembled into a meeting calendar presented as an attachment.

II. A+M DATA-ORIENTED MEETINGS

The Subcommittee noted that A+M data-oriented meetings have had impact on IAEA-NDS resources. As future A+M data activities of the NDS are expected to proceed under the guidance of the IFRC (see minutes of 10th meeting and INDC recommendations on the A+M program) A+M data-oriented meetings are no longer an explicit concern of the INDC. Thus, they were not addressed by the Subcommittee. However, it was emphasized that the support of A+M data meetings should in no way have a detrimental effect on the nuclear data meetings considered by the Subcommittee and of primary INDC interest.

III. MAJOR REGIONAL DATA CONFERENCES

The second three-year cycle of these conferences is now in progress. The U. S. conference is firmly scheduled for 9/79. The USSR Kiev conference will follow in '80. The subcommittee felt that the general concept of these conferences and their relationship to IAEA-NDS meeting schedules was suitable. The NDS should continue cooperative relationships with such regional conferences and avoid independent sponsorship of any similar large-data conference.

There was considerable Subcommittee discussion of the long-term scheduling and scope of these conferences. The views were not always consistent. The USSR apparently is essentially committed to "Kiev" conferences every three years and these are noted on the calendar. Beyond this there were a

*Transmitted to the Chairman, W. Cross 1/79.

number of comments as to the frequency, scope and location of future European-community and U. S. conferences. These included suggestions for a better topical focus, an extended interval between conferences, and a possible Japanese location. In view of these questions the European-U. S. scheduling is outlined only through '81. The conference for '81 is in the OECD-NEA area; the exact location to be resolved by discussions between members of that community.

The Subcommittee felt that the long-term (beyond '81) future of these conferences should be assessed at a later date when the second 3-year cycle is nearing completion. Subsequent discussions before the full Committee (see minutes) reflected some of the above uncertainties as to scope, scheduling and location, and the need for re-assessment of the concept at a future date.

IV. SYMPOSIA

A. Physics and Chemistry of Fission

The Subcommittee noted the continued relevance of these IAEA-sponsored symposia to the nuclear data area (sponsorship by IAEA but not NDS) and encouraged a continuing series of such symposia on a 5-6 year cycle. The next meeting is scheduled for '79 at Julich. Neither the exact nature of this forthcoming meeting nor the organizational mechanism could be identified by any INDC members. There has been an unfortunate lack of communication that was further discussed before the full Committee (see minutes). Hopefully, the correlation with and participation in such data-related meetings will improve in the future.

B. Nuclear Data for Nuclear Energy - Status and Perspective

The Subcommittee concurred with the NDS suggestion for a symposium with the objective of a high-level and broad-scope assessment of the past-present-future status of nuclear data. It could provide the NDS with valuable guidance. The question is one of timing. It was felt that such an overview should be taken when the data field reaches well defined decision points. For example, these might be at the widespread and routine use of fast-breeder reactor systems or a clear demonstration of fusion performance with the consequent construction of pilot fusion power reactors. Such decision points are not clearly defined at present. Thus the suggested symposium should be deferred to the opportune time, yet to be defined. This symposium is noted on the calendar as a matter of record but <u>not</u> implying the endorsement of a scheduled date.

V. SEMINARS - SCHOOLS

The ICTP seminars on nuclear theory for applications are the only NDS-supported events in this category. Planning for the next such seminar is well advanced and it is scheduled for 1/80. In the longer term, the Subcommittee questioned the value, the scope and the long-term future of these

seminars. No firm budget figures were available but estimates indicated that 25-50% of IAEA resources for data-oriented meetings were expended for these seminars. There was question that this reflected a proper balance of available funding and that perhaps the same objectives could be better and more economically achieved by other means, e.g. smaller meetings, fellowships, etc. The future of these ICTP seminars was dealt with in detail by another ad-hoc subcommittee (see minutes). In view of the above uncertainties, the Subcommittee concurs with the scheduling of the 1/80 ICTP seminar and reserves judgement as to any subsequent meetings of this type pending review of value, scope and direction as set forth by the parent Committee.

VI. TECHNICAL COMMITTEES

These are confined to the INDC meetings themselves. The 18-month interval, in coordination with the NEANDC meetings, remains desirable and the calendar is consistent with this view. It is stressed that the extended meeting interval requires between-meeting attention to INDC matters on the part of members.

VII. ADVISORY GROUPS

A. 1978

1. Nuclear Data for Reactor Dosimetry (11/78, Vienna)

This meeting is firmly scheduled with agenda, speakers, etc. The Subcommittee noted the unfortunate proximity to a number of similar meetings, e.g. EWGRD-Petten (5/78) and ASTM-Ispra (3/79). Generally, the Subcommittee felt possible redundancy of this nature should be avoided in the future. The justification for this particular meeting appears to be largely the formulation of an international dosimetry file, an objective not explicitly addressed at the other meetings.

2. Nuclear Data for Fusion Reactor Technology (12/78, Vienna, see P/78-12)

This meeting is also firmly scheduled. It was noted in the Subcommittee (and full Committee) that the content should be strengthened in the area of high-energy neutron-induced damage, e.g. the type of information to be studied in the U. S. using the FMIT facility. It is desirable that the damage area receive attention as it may be a major issue warranting specific attention at a later date (see below). The NDS will attempt to strengthen the program in this area.

3. IFRC/INDC Subcommittee on A+M Data for Fusion (9/78, Vienna)

The meeting is past and was dealt with in detail elsewhere in full Committee discussions (see minutes).

B. 1979

1. Transactinium Isotope Nuclear Data (5/79, Cadarache, see NDS-97/LNA)

The meeting is in the advanced-planning stage and well coordinated with NDS sponsored evaluation intercomparison and decay research programs and with NEA co-sponsorship. The Subcommittee felt the program was good. There apparently will be only modest overlap with the recent Harwell conference (9/79). It was noted that alternate fuel cycles are a part of the program (e.g. Th-U) and the outcome may be suggestive of interest in a future and more specialized meeting on that topic.

2. Nuclear Structure and Decay Data

The Subcommittee felt that this international compilation and evaluation effort was proceeding well and that the momentum should not be lost. Therefore it is suggested that relevant advisory group meetings be scheduled at approximately 2-year intervals. This is consistent with NDS planning; meetings in '80, '82 and '84. It was noted that the master structure data file is closely related to and should be well correlated with many NDS efforts, e.g. the coordinated research program in TND decay data and planned compilation of half-lives.

C. Potential Advisory Group Meetings for Period '81-'84

1. Nuclear Data for Alternate Fuel Cycles

A meeting of this nature was projected at the past, 9th, INDC meeting. It was now felt it should be deferred until the '81-'84 period pending the outcome of alternate fuel cycle discussions at the above TND meeting and the impact of INFCE studies now in progress. At present it is premature to make a judgement as to the merit of such a meeting or, certainly, as to its exact scheduling.

2. Bio-medical Nuclear Data

It may be desirable to schedule an Advisory Group meeting in the area of nuclear data for medical isotope production and/or therapy pending the recommendations of a consultants meeting suggested for '80 (see below).

3. Nuclear Data for Fusion Damage and Dosimetry

As noted above, fusion damage and dosimetry nuclear data appears to be of increasing interest with large new facilities now under construction for just such studies. The subject will be discussed at the '78 Advisory Group Meeting. That meeting may indicate a major and growing importance of this area, fully warranting a specialized advisory group meeting.

4. Standard Reference Data

The Standard Subcommittee again pointed out that a general Standard-Reference-Data meeting is desirable every 5-7 years. Following the NBS ('77)

meeting, this indicates the scheduling of such a meeting in the '82-'84 period. The NDS should be alert to this need in the planning of long-term meeting schedules.

VIII. CONSULTANTS MEETINGS

A. Meetings of Nuclear-reaction Data Centers (4C+CP)

The NDS will have a continuing and major interest in neutron and charged-particle data compilations and associated center activities. Thus these associated center meetings should continue on an approximately annual cycle. Where possible the actual scheduling should be arranged to properly relate to associated data meetings and, in the long term (e.g. $\gtrsim$'82), considerations should be given to combining neutron, charged-particle and nuclear-structure center meetings where effectively possible.

B. 1978

1. Delayed Neutron Properties (3/78, Vienna)

This meeting is scheduled with program, speakers, etc. It follows the recommendation of the 9th INDC meeting though there was some slippage of the schedule due to limited fiscal support.

C. 1980

1. Nuclear Data for Bio-medical Applications

Subcommittee B gave extensive attention to potential nuclear data needs in the bio-medical area particularly as related to isotope production and therapy. The details are to be found in the Subcommittee B report. The conclusion was that the need should be carefully reviewed by specialists, possibly leading to a full Advisory Group meeting (see above). Such a detailed consultants examination should be undertaken as soon as convenient and an '80 meeting is suggested.

2. Neutron Sources (3/80)

At the prior (9th) INDC meeting the Standard Subcommittee recommended a consultants meeting dealing with neutron sources. That has been scheduled for 3/80. A suggested topical agenda is given in the Standards Subcommittee report. Further, that Subcommittee suggests that technical lead scientists be selected to aid the NDS in the planning and direction of the meeting.

D. Potential Consultants Meetings, '81-'84

1. ^{235}U Fast-fission Cross Sections

The Standards Subcommittee noted the importance of the ^{235}U fast fission cross section as a standard and the detailed work now in progress. In several years results of greatly improved quality will become available

and a detailed assessment should be made. Thus consideration should be given to a consultants meeting the scheduling of which should be determined by experimental progress during the coming several years.

2. Uranium and Plutonium Resonance Parameters

The importance of this area was pointed out at the 9th INDC meeting by Subcommittee A and restated at the present meeting. When substantive new results become available the area should be assessed. New machines will be coming on line (e.g. Harwell linac) with, very likely, improved new results. Thus a consultants meeting is suggested three or four years hence.

3. Fission-product Yields

The NDS has suggested a consultants meeting in this area at a future date. The Committee recognized advances in this work but there was not a strong expression of opinion either in the full Committee or in the Subcommittee. A meeting should be kept in mind but not implemented until stronger support is evident.

4. Low-energy Photon Properties

Members of Subcommittee B felt that there might well be a potential interest in low-energy photon data for applications. The need is not now well defined but developments should be watched. If the interest strongly increases, a consultants meeting should be considered for this period.

IX. COORDINATED RESEARCH PROGRAMS (CRP)

Currently there are two CRP under NDS auspices: 1) Intercomparisons of evaluations of actinide neutron nuclear data, and 2) Transactinium isotope nuclear decay data measurements and evaluation. Generally, such programs are expected to have an approximately three-year life span and to be reviewed in the third year as to continuation or termination. An annual research coordinating meeting is associated with each of these programs and supported under the Agency's research-contract programs. Thus the ongoing CRP imply meetings in '78, '79 and '80. The continuation of such meetings beyond '80 will depend upon the continuation of the above CRPs or the initiation of new such programs.

X. RELEVANT MEETINGS UNDER OTHER AUSPICES

There are a wide range of meetings that have some relevance to the NDS calendar; some very specifically so. The latter are noted by title below; and on the calendar.

a. 41st Meeting of the Euratom Working Group on Reactor Dosimetry, Petten 5/78.

b. Cross Sections for Heavy Plutonium and Americium Isotopes, NEANDC, BNL 11/78.

c. ASTM - Dosimetry, Ispra 3/79.

d. Cross Sections of Fission Product Nuclei, Bologna, late '79, NEANDC.

e. Capture Cross Sections of Important Fissile and Fertile Isotopes, Argonne, late '80, NEANDC.

f. A general NEANDC objective is one specialists meeting per year into the foreseeable future.

XI. SUBCOMMITTEE MEMBERSHIP AND OBSERVERS*

1. T. Fuketa
2. A. Ferguson
3. D. Kuzminov
4. N. Tubbs
5. J. Schmidt
6. B. Rose
7. A. Michaudon
8. A. Smith, Chairman

Respectfully submitted by the Subcommittee Chairman, A. B. Smith, Argonne, 1/79.

*The above individuals were present for all or portions of the discussions through the evening hours of 5 October when most of the Subcommittee discussions occurred.

INDC CALENDAR OF DATA CONFERENCES AND MEETINGS

Category	'77	'78	'79	'80
Major Data Conf. (A)	Kiev, 4/77	AERE, 9/78	U. S., 9/79	Kiev, 80
Symposia			Phy. & Chem. of Fission (B)	
Seminars - Schools		ICTP - Theory 1/78 (D)		ICTP - Theory 1/80 (D)
Tech. Committees		INDC, 10/78		INDC, 6/80
Advisory Groups	FPND, Petten 9/77 NSDD, ORNL 11/77	Dosimetry 11/78 (E) Fusion Data 12/78 (F)	TND, 5/79 (G)	NSDD-Centers (H)
Consultants Meeting	NRD Centers 4/77 (M) A+M Centers 5/77 A+M Sub. Com. 5/77	NRD Centers 6/78 A+M Sub. Com. 5/78 and 9/78	NRD Centers 9/79 Delayed Neuts. 3/79 (N)	NRD Centers 10/80 Bio-Med Data (O) Neut. Sources 3/80 (P)
Coordinated Research Programs		TND-eval. 4/78 (U) TND-Decay 4/78 (V)	TND-eval. 5/79 TND-Decay 5/79	TND-eval. 6/80 TND-Decay 6/80
Relevant Meetings,	Structural Mat. CBNM, 12/77	EWGRD-Dos. 5/78-Petten Pu+Am, BNL-NEANDC, 11/78	ASTM-Dos. Ispra 2/79 FPND-Bologna NEANDC	Capture in Fissile-fertile Nuclides, ANL-NEANDC, 80

INDC CALENDAR OF DATA CONFERENCES AND MEETINGS (Contd.)

Category	'81	'82	'83	'84
Major Data Conf. (A)	OECD-NEA		Kiev, 83	
Symposia				Phy. & Chem. of Fission
				Nucl. Data Overview (C)
Seminars - Schools				
Tech. Committees	INDC, 12/81		INDC, 6/83	
Advisory Groups		NSDD-Centers (H)		NSDD-Centers (H)
	-----Alternate Fuel Cycles (I)-----			
	----------Bio-Med. Data (J)---------			
	----Damage Data for Fusion (K)-----			
		------Standard Ref. Data (L)------		
Consultants Meeting	NRD-Centers	NRD-Centers	NRD-Centers	NRD-Centers
	----------σ_f, U-235 (Q)----------			
	-------U + Pu Res. Para. (R)-------			
	---------FPND - Yields (S)---------			
	------Low-Energy Photons (T)-------			
Coordinated Research Programs	----------Yearly Meeting, Selected Topic----------			
	----------Yearly Meeting, Selected Topic----------			
Relevant Meetings, Other Auspices	---------Yearly NEANDC Specialist Meeting----------			

CALENDAR KEY

A. Major Data Conferences, Cyclic by region (U. S.-OECD-USSR), in cooperation with IAEA-NDS.

B. Symposium on Phy. and Chem. of Fission, Cyclic, under IAEA (non NDS) auspices.

C. Symposium, Nuclear Data for Nuclear Energy, Status and Perspective.

D. ITCP Seminars on Theory, Evaluation and Reactor Physics.

E. Nuclear Data for Reactor Dosimetry, 11/78, Vienna.

F. Nuclear Data for Fusion Technology, 12/78, Vienna.

G. Transactinium Isotope Nuclear Data, 5/79 Cadarache, Co-sponsored by the OECD-NEA.

H. Nuclear Structure and Decay Data, biennial center meetings.

I. Nuclear Data for Alternate Fuel Cycles, potential topic.

J. Bio-medical Nuclear Data, primarily isotope production and therapy usage, potential topic.

K. Nuclear Data for Fusion Damage and Dosimetry, potential topic.

L. Standard Reference Data, general meeting on 5/7 year cycle.

M. Nuclear-reaction-data-centers Meeting, neutron and charged-particle data centers, annual meeting.

N. Delayed Neutron Properties, 3/79 Vienna.

O. Nuclear Data for Bio-medical Applications, recommended consultants meeting.

P. Neutron Sources, 3/80, source properties with emphasis on precision and standard measurements.

Q. U-235 Fast-fission Cross Sections, recommended standard meeting.

R. Uranium and Plutonium Resonance Parameters, recommended meeting.

S. Fission-product Yields, possible meeting.

T. Low-energy Photon Properties, potential area of interest.

U. Intercomparison of Evaluations of Actinide Neutron-nuclear Data, research coordination meeting.

V. Transactinium Isotope Nuclear Decay Data Measurements, research coordination meeting.