International Atomic Energy Agency

INDC-37/U

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

MINUTES

OF THE TWELFTH INDC MEETING

Vienna, 5-9 October 1981

Compiled by

S. Yiftah
Soreq Nuclear Research Centre
Yavne, Israel

August 1982

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

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Note: Items I through X constitute the Agenda of this meeting.

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MEETING SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Twelfth Meeting of the INDC was held at IAEA Headquarters in Vienna from 5-9 October 1981. The meeting was attended by 13 committee members (member from Australia excused), six advisers and three observers from 14 Member States and two international organisations.

The committee reviewed the nuclear data activities of the IAEA, in Member States and in nuclear data centres during the period since its Eleventh Meeting in Vienna in June 1980. It also discussed and reviewed in detail the Agency's future nuclear data programme for the period 1982-84. In general, the IAEA nuclear data programme reflects the trends discussed and detailed at the 11th INDC Meeting (see minutes of the 11th INDC Meeting, INDC-35/U, May 1981).

The official minutes include summaries of the discussions of the agenda items, full reports of Subcommittees, list of actions, together with lists of participants and subcommittee membership. The main conclusions and recommendations of the 12th INDC Meeting are as follows.

The Committee

1. Noted that the Nuclear Data Section has been concentrating and focussing its activities in accordance with the Agency's high-priority programmes (safeguards, nuclear safety and assistance to developing countries) and recommended that it continue to do so in the period 1982-84, while assuring the continued effectiveness of on-going technical responsibilities;

2. Commended the Nuclear Data Section for the activities in the framework of the Interregional Project INT/1/018 for Training in Nuclear Data Techniques and Instrumentation during the last 18 months and recommended that these continue according to the presented programme. This would imply the necessity of significant changes in professional qualifications with stronger emphasis on experimental and instructional capabilities. This should be kept in mind, when filling vacant positions. INDC also strongly supported the Technical Assistance Training Courses in the nuclear data field planned for 1982-84 and the proposed new coordinated research programme on the measurement and analysis of 14 MeV neutron nuclear data. The committee believed that the experimental courses are most valuable when the participants have "hands-on" experience during much of the courses. The Committee strongly recommended coordination with other relevant Sections of the IAEA about the activities foreseen in the Interregional Project;

3. Endorsed the usefulness of the Divisional Symposium on "Significance and Impact of Nuclear Research in Developing Countries: Physical Sciences" planned for 1984 and recommended an active participation of the NDS in its planning and preparation;

4. Felt that the outstanding value of the Agency's Symposia on "Physics and Chemistry of Fission" fully warrants their continuation and, that the Physics and Nuclear Data Sections should use their good offices to encourage a continuation of this series by other organizations;

5. Noted that a planned Conference on "Neutron Physics and Nuclear Data in Science and Technology" may be organized with the co-operation of IAEA (NDS) and OECD/NEA within the framework of Conferences of that type, possibly in the Europe-Japan area around 1988;

6. Reviewed in detail the good results obtained up to now by the two Coordinated Research Programmes: Intercomparison of evaluations of actinide neutron nuclear data, and measurement and evaluation of actinide decay data. The INDC noted that these two Coordinated Research Programmes will be terminated by the end of 1982, and expressed the wish that the results of their work be published and disseminated in an appropriate manner. The INDC recommended that future coordinated research work should complement and extend these results and should be focussed on several possible areas important to the nuclear data field.

7. Noted with satisfaction that a third round of the two ICTP Trieste courses in 1978 and 1980 will be held in 1982, in accordance with its recommendation at the eleventh INDC meeting, and recommended that flexibility be exercised in the selection of participants in these courses by giving participants the option to attend either one or both of the two consecutively offered courses. The course planned for 1984 should concentrate on basic foundations and definitions of nuclear model parameters which are used in nuclear data computations;

8. Reviewed the nuclear data evaluation work that is performed in Member States inside and outside the framework of the NDS Coordinated Research Programmes mentioned under 6, and, noting that the ENDF/B-V format was the de facto accepted format for transfer of evaluated data, recommended that the same reference standards and the same evaluation formats, procedures and, where advantageous, processing programmes be used internationally in order to facilitate intercomparisons and international exchange. The Committee also recommended that the four neutron data centres discuss the deficiencies in ENDF/B-V formats for the specification of nuclear data;

9. Reviewed the publication policies of the Nuclear Data Section and recommended to adopt a two-tiered publication system whereby the distribution of routine reports should proceed via the INDC report series, while important reports having high technical merit or professional status should be published as IAEA Technical Documents or in other publication media of professional excellence. For the latter type of publication the Committee recommended that a scientific-technical reviewing by competent scientists be adopted;

10. In view of the high value and technical usefulness of an international reference file of nuclear data standards for nuclear physics measurements and analysis, the INDC recommended that the INDC/NEANDC Standards File, produced and kept up-to-date by the Standard Subcommittees of the INDC and NEANDC, be periodically published by the IAEA as part of its Technical Report Series, in anticipated intervals of about four years;

11. Reviewed recent problems connected with the international recognition of the "barn" and strongly supported its continued use as the basic unit of nuclear cross sections;

12. Emphasized that the Nuclear Data Section should continue to seek out and address basic physics problems underlying the generation of essential nuclear data, and supported in particular the planned advisory group review of basic and applied nuclear level densities as illustrative;

13. Recommended that the present 18-month interval between meetings be maintained, but be reviewed every three-year period to inquire whether it still meets the needs of the Committee and those of the IAEA.

Detailed conclusions, recommendations and actions arising from the 12th INDC Meeting are included in the body of the minutes.

I. Introductory items

Prof. Maurizio Zifferero (Deputy Director General, Department of Research and Isotopes, IAEA) welcomed the participants to the INDC meeting. He noted that the INDC is emphasizing those programmatic aspects designed to satisfy the data needs in the specific areas of radiation damage and nuclear safety, nuclear material safeguards and fusion, as well as giving increasing attention to the growing data requirements and increasing nuclear data requests from developing countries. Prof. Zifferero emphasized the importance of the Interregional Technical Assistance Project for Training in Nuclear Data Techniques and Instrumentation for developing countries. He also said that in view of the growth in the number, diversity and sophistication of requests for nuclear data, there was a definite need to improve existing evaluated data files, specifically regarding their accuracy, standardization and validation, as well as to develop unique data files tailored for specific applications such as fusion, safeguards, and radiation damage, for eventual international acceptance and use.

II. Committee Business-I

A. Adoption of agenda

The tentative agenda was revised and approved.

B. Attendance of observers

The Chairman read the list of participants and observers and noted changes in membership (see Appendix 1, page 18).

C. Review of actions arising from the 11th INDC Meeting

The 27 actions arising from the previous meeting (see INDC-35/U, pages 3-6) were reviewed. Sensitivity studies (action 17) performed by Salvatores et al. will be distributed to INDC members as per Action 1 of the twelfth INDC meeting. Some of the 46 working papers prepared and distributed at this meeting (see Appendix 4, page 26) summarise in detail what has been done in pursuance of the various actions.

D. Changes in membership and chairmen of the four standing subcommittees

Rowlands will stay as chairman of Subcommittee A. On the other hand the new chairmen of the other Subcommittees will be as follows: Ferguson will chair Subcommittee B, Condé will chair the Standards Subcommittee and Motz will chair the Discrepancies Subcommittee. (See Appendix 8, page 61, which includes also the membership of all subcommittees). The INDC chairman, Michaudon, thanked the previous subcommittee chairmen, Liskien, Smith and Froehner for their efficient work.

E. Scope and agenda of the four standing subcommittees

Michaudon said that there are practically no changes in the scope of the subcommittees compared with what has been reported in the 11th INDC report except that the item of safeguards has been transferred from Subcommittee A to Subcommittee B as proposed and accepted by the two chairmen.

F. Coordination of INDC technical subcommittees with NEANDC

Michaudon mentioned that the chairmen of the INDC Standards and Discrepancies Subcommittee, Condé and Motz are also members of NEANDC, which should ensure proper coordination. Smith noted that in view of the considerable effort for producing and updating the Standards File and since he has received no feedback from users, he is not certain wheter the File is valuable and is being used. Michaudon, Yankov and Schmidt emphasized the good quality and value of the file and said that it is being widely used in various laboratories. It was decided (see Actions 2 and 3) that Condé and Motz will ensure proper coordination with NEANDC and that Michaudon will write to the NEANDC chairman concerning coordination between INDC and NEANDC technical subcommittees.

G. Ad-hoc subcommittees

The two chairmen of the ad-hoc subcommittees, Smith, chairman of the Subcommittee on Meetings and Future Nuclear Data Programmes, and Seeliger, chairman of the Subcommittee on the Interregional Project will continue as chairmen (see Appendix 2, page 19).

H. Report from INDC secretariat

Lorenz called attention to working paper INDC(NDS)-124 and reviewed the items on liaison officers, correspondents, INDC documents and INDC report translations.

Currently, forty member states are represented by liaison officers, about 50 % of whom are active. Six recent changes were noted, one of which is the case of L.T. Auler from Brazil who is participating in this meeting as an observer.

There are about 4000 names on the basic coorespondents file of which the various distributions (U,N,L,A,B, ...) are drawn. It was decided (Actions 4 and 5) that all members screen and possibly cut down (by about 20 %) the number of INDC correspondents in the U,N and L distributions, and that Lorenz screen and review the specialized distributions (A,B, etc....).

Concerning INDC documents Lorenz noted that the 1965 - 1970 documents in the archival collection of INDC documents will be put on microfiche and another year of microfiches will be added each year.

Following some discussions about the nature of national INDC documents it was decided (Actions 6 and 7) that Schmidt will specify criteria for these documents and that all members will encourage sending INDC documents according to these criteria for distribution.

I. Retaining the use of the "barn" as the unit of cross sections

Michaudon recalled the history of the "barn" problem. The "barn" appears now in list No. 10 of the BIPM document on "Systeme International d'Unités" (third edition, 1970). This list contains temporary units to be used in parallel with the SI units. List No. 10 differs from List No. 8, which lists units to be used along side the SI units, and from List No. 12, which list units recommended not to be used.

Several international bodies have intervened and recommended to continue the use of the "barn".

Ferguson mentioned that in the U.K. the situation is very unclear. A "regulation" has been issued which forbids the use of the "barn" in certain specified circumstances, but lawyers do not understand what the effect of this regulation is. One legal opinion is that this "regulation" means that no official regulation or instruction which uses the "barn" may be issued, but that the regulation is not intended to prevent the use of the "barn" in scientific publications. Ferguson felt that it was important to reiterate to the CIPM the position that it is essential that the use of the "barn" be retained for scientific purposes, and that it should be put in List No. 8. Michaudon mentioned that the European community will discuss the problem in the near future following an intervention from France.

Following some discussion it was decided that the Ad-hoc subcommittee on the "barn" (see Appendix 9, page 66) headed by Cross will look into the matter and recommend by the end of the week whether the INDC should intervene again on this topic.

III. IAEA Nuclear Data Programme

A. Review of the recommendations to the IAEA from the 11th INDC Meeting

Schmidt noted that, in general, the recommendations given in detail in the "Minutes of the 11th INDC Meeting" (INDC-35/U, May 1981) have been closely followed and implemented, especially as regards the Interregional Project (INT/1/018), Trieste courses, scientific meetings, etc.

B. Review of recommendations concerning nuclear data from past IAEA/NDS and other meetings

Schmidt mentioned three meetings that had made recommendations to the IAEA:

1) The Consultants Meeting on Nuclear Data for Medical Radioisotope Production made two main recommendations, namely that the data centres should issue a small publication on the excitation functions for the production of medical radioisotopes, and that there is no need for further meetings on this subject.

2) The INTOR Workshop (International Torus, four areas, U.S., U.S.S.R., Japan, Western Europe) recommended that NDS coordinate the performance of benchmark calculations to check deficiencies in nuclear data and calculational methods.

3) The IFRC Subcommittee on A+M Data for Fusion, which met in January 1981, made a number of recommendations with regard to the A+M data for fusion programme of the NDS.

C. Status of IAEA Nuclear Data Programme, and presentation of NDS activities

Schmidt, referring to the Report of the IAEA Nuclear Data Section to the International Nuclear Data Committee (INDC(NDS)-124), summarised the current status of the NDS programme and said that the programme followed the guidance of the INDC as well as of recommendations resulting from the 1980 review of NDS activities and priorities by the Agency's Scientific Advisory Committee (SAC). He emphasized the importance of the INDC recommendations, discussions and other forms of assistance to the NDS programme.

As the NDS programme is not considered by the Agency to be of high priority (high priority areas are safeguards, nuclear safety and technical assistance to developing countries), its 14 professional staff is not likely to increase. However, NDS is orienting its programme more and more to high-priority areas and to the needs of developing countries. There has been a very large increase of requests in the nuclear data field, particularly from developing

countries. There is a growing trend, to deal with nuclear data needs in the fields of actinides, fission products, medical applications etc. Data files for specific applications such as nuclear dosimetry, radiation damage related to safety, nuclear data used in the analysis of safeguards measurements and others, have been or are being developed.

In the framework of data exchange it was interesting to note that while the People's Republic of China is not yet a member of the IAEA, some nuclear data exchange with the IAEA/NDS had been initiated.

The problem of nuclear data testing, validation and quality improvement is becoming more and more important, both for complete evaluated data files as well as for specific nuclear data in given energy ranges.

IV. IAEA/NDS Nuclear data services and support of research in developing countries

A. Interregional Technical Assistance Project (TA/INT/1/018) for Training in Nuclear Data Techniques and Instrumentation Summary of current status

Schmidt referred to the relevant papers, INDC/P(81)-6 and INDC/P(81)-15, and informed the Committee that the Interregional Technical Assistance Project for Training in Nuclear Data Techniques and Instrumentation was approved by the Board of Governors of the IAEA in February 1981. About 20 developing countries subscribed to the project. Several expert missions have already assessed the needs and possibilities in several countries and other expert missions to other countries are being arranged.

It was decided (Actions 9 and 10) that Schmidt together with the Subcommittee on the Interregional Project would formulate a one-page questionnaire to describe facilities existing in Member State laboratories which could be used for training of fellows from developing countries. All members of the INDC would be asked to respond and fill the questionnaire. Details were to be further discussed in the Interregional Project subcommittee.

Rowlands and Michaudon remarked that the new name of the Interregional Project seems to refer only to experimental techniques and not to include theory and nuclear data evaluations. The Subcommittee on the Interregional Project was asked to consider this matter in its deliberations.

B. Report on NDS expert missions to South America and Eastern Europe

Kocherov (IAEA/NDS) reported on his expert mission to laboratories in Poland, Czechoslovakia and Yugoslavia, details of which are described in INDC/P(81)-11.

Schmidt reported on his expert mission to laboratories in Brazil, Argentina, Chile and Bolivia, details of which are described in INDC/P(81)-10.

Schmidt also said that out of about $ 100,000 technical assistance money alloted last year for the Interregional Project, about $ 60,000 was spent, mainly for equipment.

In order to understand the extent of possible cooperation between NDS and the Physics Section of the Agency, several members of the Committee expressed the desire to hear a summary of the Physics Section's activities sometime during the week. This was arranged, and J. Dolnicar (IAEA Physics Section) gave a short resumé of the technical assistance activities of the Physics Section.

C. Interregional Training Courses

Following introductory remarks by Schmidt, Csikai summarised the preliminary information on the planned Interregional Technical Assistance Training Course on the Utilization of Neutron Generators, to be held in Debrecen, Hungary, June-July 1982 (see working paper INDC/P(81)-16). Methods of cross section measurement as well as neutron applications in various fields were included in the course programme.

Cullen (IAEA/NDS) summarised the preliminary information on the planned interregional course on the methodology of evaluation and processing of nuclear data for nuclear reactor applications, planned to be held at the IAEA Headquarters, Vienna, in the spring of 1984 *. The four-week course is planned for about 20 participants from developing countries at the Ph.D. level or equivalent. It will emphasize lectures, discussions and nuclear codes workshops and practical exercises covering nuclear data requirements, evaluation methodology, evaluated libraries and the use of processed nuclear data for design, safety and operation of reactors (see working paper INDC/P(81)-17).

Yankov proposed to hold in 1983 in the USSR a technical assistance 3-weeks training course on experimental measurement techniques in nuclear physics and nuclear data for scientists from developing countries. Following some discussion it was summarised that the Interregional Project Subcommittee chaired by Dr. Seeliger will look into the matter and coordinate this proposal with other courses.

D. Joint IAEA/NDS - ICTP Trieste Courses on Nuclear Theory for Applications

Schmidt summarised the evaluation of the 1980 course (see working paper INDC/P(81)-18), emphasized the large attendance (73 participants from 26 developing countries), and noted that

* Since the INDC Meeting this Course has been deferred from 1983 to 1984.

stricter selection of course participants has led to an overall higher quality and better homogeneity of the course audience. He also mentioned several negative aspects, such as the inadequate level of some participants, the need for better tutored workshops and more explicit lecture notes.

Schmidt also mentioned that these courses were among the better attended ICTP courses, and that from now on they will be funded by ICTP Trieste.

Following a general discussion it was decided, that the Interregional Project Subcommittee would look at all the weak points identified in the summary of the 1980 course, and make recommendations aiming at improving the 1982 course (INDC/P(81)-19). It was also decided (Action 12) that participation in the two 1982 Trieste courses should be independent, and that flexibility should be exercised with regard to participants who would like to attend either one of the two courses, or both.

E. IAEA/NDS Nuclear Data Services to Developing Countries

Lorenz commented on nuclear data request statistics (summarized in INDC/P(81)-20) which show a significant increase in the rate at which requests have been received since January 1980.

Kocherov(IAEA/NDS) commented on the targets and samples programme which has been going on for 9 or 10 years. About twenty programmes of nuclear data measurements using IAEA-loaned targets and samples are now going on.

Kocherov also commented on the research contracts, some of which were let in the framework of the two coordinated research programmes (CRP) on actinide nuclear data. These are reviewed in the yearly CRP meetings. Specifically, there are three contracts as part of the CRP on intercomparison of actinide neutron data evaluations (Mehta, Vasiliu, Yiftah), about 12 research agreements, and 6 individual research contracts.

V. Coordinating Activities

A. WRENDA 81/82 and future WRENDA publications

Dayday (IAEA/NDS) noted that the 1981/1982 edition of WRENDA was published in July 1981 and distributed to about 890 scientists, mostly in developing countries. In reply to a question by Froehner, Dayday said that, compared with the previous edition of WRENDA, in WRENDA 81/82, 937 requests were withdrawn, 331 modified, and 271 new requests were added. The total number of requests related to fission reactors in WRENDA 81/82 is 1352. The number of requests for fusion reactors rose from 449 to 594. Dayday also mentioned that WRENDA 83/84 was planned for the summer of 1983, and therefore the deadline for new requests to be

received by the Agency is 1 February 1983. Schmidt noted that the screening of requests was not done by the NDS, but only by national nuclear data committees and liaison officers. The NDS tries to get better feedback to the requesters directly, for instance by distributing to them the standards and discrepancies reports.

Rowlands mentioned that most priority 1 requests come from the USA, so that if the number of priority 1 requests could be reduced, this would enhance the international value of WRENDA.

B. IAEA/NDS Coordinated Research Programmes (CRP)

1) Lemmel (IAEA/NDS) commented on the CRP on Intercomparison of Evaluations of Actinide Neutron Nuclear Data and on the Agenda of the following week's yearly CRP meeting. He said that the IAEA Nuclear Data Library INDL/A for actinide data, put together so far, was stored in different formats, ENDF/B, UK and KEDAK formats, and that it was desirable to have these data converted to the standard ENDF/B format. Another problem is the incompleteness of some of the evaluations. In a general discussion the following points were clarified:

   - This CRP terminates at the end of 1982.

   - Not much testing, benchmark testing, and intercomparison have been or will be performed by the end of 1982, and these will probably be part of a follow-up CRP.

   - Although initially intended not to include data on the main isotopes (^{235}U, ^{239}Pu, ^{238}U), new groups that joined recently, (Dresden, Leningrad) will probably make contributions pertaining to precision measurements of the main isotopes.

   - In accordance with Action 14, the summary of the October 1981 meeting of this CRP is included as Appendix 13 to this report, also NDS would summarise in graphical form, relevant important results from intercomparisons performed and distribute these to INDC members (Action 15). See also Actions 16 and 17 concerning new CRP programmes to begin after 1982.

2) Lorenz referred to the two working papers INDC(NDS)-118 and INDC(NDS)-121. The CRP meeting on the measurement and evaluation of actinide decay data was held in Vienna during the week after the INDC meeting. (The summary of this meeting is included as Appendix 13 to this report). When this CRP will expire, it is intended to publish the results of its recommendations in the form of an Agency report. See also Action 17 dealing with a follow-up when this CRP expires.

3) Schmidt commented on working paper INDC/P(81)-21 regarding the CRP on the measurement and analysis of fast neutron cross sections. This programme is planned to last for three years, in parallel with the Interregional Project. This CRP will not delay or impair the continuation of the two other CRP's.

C) Nuclear data for radiation damage and nuclear safety

Ertek (IAEA) described the current status of the REAL-80 project, intercomparison of radiation damage estimates for fission and fusion reactors (working paper INDC/P(81)-22). He reported on the first round of the REAL-80 project, consisting of the analysis of two fission reactor spectra, which started February 1981 with the participation of 30 laboratories. Preliminary results and conclusions were to be presented at the IAEA Advisory Group Meeting (AGM) on nuclear data for Radiation Damage Assessment and Reactor Safety Aspects, Vienna, 12-16 October 1981. Kocherov (IAEA/NDS) referring to working paper INDC/P(81)-23, gave some details about this AGM and informed the Committee that about 30 participants from 10 countries were expected and about 35 papers were to be presented. The overall goal of this AGM was to summarize recommendations on how to proceed with the creation of recommended data files for assessment of radiation damage and some aspects of reactor safety. Schmidt mentioned that this meeting is one of a series of coordinated meetings organised by the Physics Section, the IAEA Nuclear Power Division and the NDS.

D. Nuclear data for safeguards

The topic of nuclear data for safeguards was discussed by Subcommittee B.

E. Standards

1) International exchange of standard reference U-235 foils (discussed by Subcommittee)

2) Fission cross section transfer instruments (discussed by Subcommittee)

3) Lorenz called attention to working paper INDC/P(81)-8 outlining plans on a new edition of the IAEA "Nuclear Activation Data Handbook". Since the publication of the first edition in 1974, new information and new data had become available. The handbook has been used extensively by various laboratories and should be improved, reedited and republished. Several points were raised in the discussion about the table of contents. It was decided that these will be discussed by Subcommittee B.

4) Lorenz commented on working paper INDC/P(81)-25 dealing with decay data for calibration standards. The topic was also to be discussed by the standards subcommittee. Seeliger mentioned that an atlas of γ-ray spectra measured by semiconductor detectors in various laboratories was to be sent to IAEA/NDS for distribution.

F) Nuclear data for fusion: requirements for INTOR

Pronyaev (IAEA/NDS) commented on working papers INDC/P(81)-26 and 27 on nuclear data for INTOR. A comparison of calculations performed by several countries revealed discrepancies. The objective of this IAEA/NDS effort is to recommend a self-consistent set of data extracted from available data files for INTOR neutronic and shielding calculations to be used by the INTOR project. The IAEA/NDS objective is not to develop or recommend a universal file for fusion calculations. The discrepancies discovered so far have emphasized the need for theoretical model calculations, such as preequilibrium and direct interaction models. Michaudon and Seeliger noted that apart from model calculations, measurements were also needed in certain areas. Ferguson remarked that his subcommittee encouraged the meeting on nuclear data for fusion proposed for 1984. Smith questioned whether NDS should or could start a benchmark activity for INTOR. Schmidt said that the NDS could only coordinate such an activity which would be performed mainly by INTOR participants. Further discussions of this topic were relegated to Subcommittee B.

G. Conclusions and recommendations from recent IAEA/NDS Meetings

1) Okamoto (IAEA/NDS) commented on INDC(NDS)-123/G concerning the consultants' meeting on Nuclear Data for Medical Radioisotope Production. One of the recommendations was that a small publication on excitation functions for the production of medical radioisotopes, to be presumably issued by the data centers, would be advisable. The general conclusion was that no follow-up meeting on this topic was needed.

2) Froehner summarised in detail the results of the Consultants' Meeting on Uranium and Plutonium Isotope Resonance Parameters held in Vienna, 28 September - 2 October 1981, (see INDC/P(81)-28), together with its specific recommendations. Froehner noted that no participants from Japan and the USSR attended the meeting, although contributions from these countries were received.

H. Non-OECD participation in NEANDC/NEA-DB nuclear data projects

Schmidt commented on the coupled-channel nuclear model code comparison exercise (working paper INDC/P(81)-35). The results of

this exercise will be summarized by Sartori (IAEA/NEA-DB) by the end of October 1981 and will be distributed as INDC(NEA)-3 report.

Froehner commented on the NEANDC-sponsored exercise for the determination of resonance level densities, and missing levels. Initial results of this exercise indicated that the number of missing levels was underestimated. A workshop on this exercise was to be held in Paris in November 1981.

VI. Nuclear data centres

A. Status reports and future activities of nuclear reaction data centres and groups

Smith summarized several items concerning the neutron data activities of the Brookhaven National Nuclear Data Centre (NNDC). Volume I (mass numbers 1-60) of the new edition of BNL-325 was sent to Academic Press for publication; it was to be ready by February 1982 and would cost about US $ 100. Volume II of BNL-325, containing the graphs, will be sent to press by Mid-1982. A compilation of Actinide Half-lives was planned to be issued, as a BNL publication, in about 9 months.

In the absence of a respresentative from NEA, Lemmel (IAEA/NDS) commented on the work of the OECD NEA Data Bank (working paper INDC/P(81)-36). He reported that there had been a tremendous recent effort at NEA/DB to convert all data into the EXFOR format. Another area was the improvement of customer services for evaluated data (about 200-250 requests per year) and especially for the computer programme library (about 1200 requests per year). To a question by Yiftah regarding the Joint European/Japanese file of evaluated neutron data (mentioned on page 3 of INDC/P(81)-36) Michaudon answered that since the U.S. ENDF/B-V was not universally distributed, it had been decided by the European countries, to assemble a European/Japanese evaluation group for the preparation of this particular evaluated file. After a long discussion it was decided (Action 44) that NDS would approach NEA with the request to have parts of the NEA joint file made available internationally, as are some parts of ENDF/B-V (actinides, fission products, standards, dosimetry).

Kuzminov commented on some aspects of USSR activities in the fields of nuclear, atomic and molecular data (working paper INDC/P(81)-40).

Lemmel (IAEA/NDS) reported on the statistics of the IAEA data centre (working paper INDC/P(81)-20). He noted the increase in the number of requests from the IAEA/NDS service area, consisting primarily of developing countries, and noted that about 15 % of the experimental data in the EXFOR library originated from these countries. The Nuclear Data Newsletter is distributed to about 2000 correspondents in the IAEA/NDS service area to inform users of the availability of data. As regards intercentre coordination,

Lemmel said that since the Four-Centre meeting in 1980 there had been no problems with EXFOR, a system which had stabilised and become routine. The four centre coordination is now fully integrated for neutron-induced nuclear reaction data. INDC expressed concern about the termination of the work of the Kachapag (Karlsruhe Charged Particle Group) by the end of 1981 and the continuation of this important work (see Action 43, proposed by Froehner).

Harada reported on the Japanese charged particle nuclear data effort, led by Prof. Tanaka and coworkers at Hokkaido; that compilation group uses a Japanese format which has to be transformed into the EXFOR format. Smith noted the lack of differential charged particle data compilations.

In answer to a question by Michaudon, Harada said that the Japanese charged particle data would be distributed once the transformation to the EXFOR format was terminated. Harada would try to ensure this, and will also transfer the charged particle data in the present Japanese format to the NDS, as requested by Schmidt.

B. Current status of evaluated neutron data

Smith summarized the activities of the US Cross Section Evaluation Working Group (CSEWG) and its three subcommittees on Evaluations, Testing, Methods and Formats, which are responsible for the development of ENDF.

The two main activities are now testing of data for ENDF/B-V, and activities connected with ENDF/B-VI. Part of this includes review of discrepancies and of the need for new measurements. (U.S. request list BNL/51-354 reflects a correlated effort between compilers, evaluators and measurers). Some of the general goals for ENDF/B-VI are: to identify a standard basis by mid-1983; to revise the actinide files and fission product files; to improve the 5-15 Mev range for fusion data, fission spectra, $\bar{\upsilon}$ and self shielding effects mainly of actinides; to extend certain selected evaluations from 20 to 50 MeV, mainly of the structural materials important for fusion. Smith announced the publication of an updated ENDF-300 which would be a combined standards and discrepancies report. He also announced a new edition of BNL/102 on formats and procedures, a supplement to which will cover ENDF/B-VI procedures (action 45). The detailed schedule for ENDF/B-VI was to be discussed at the next CSEWG meeting at BNL in October 1981. According to past practices it is probable that when ENDF/B-VI is released, ENDF/B-V will become freely available. Benchmark calculations and testing are not terminated when the file is released. Yiftah asked about burnup benchmarks. (See Actions 46 and 47).

Harada noted that benchmark testing of JENDL-II was terminated, and pointed to some defects in the evaluated data for some nuclides. The compilation of JENDL-III, which was being started,

aimed at a more complete evaluated file to include nuclear data for the development of fusion reactors, the design of breeder reactors and the operation of thermal reactors. Also, data for safety evaluations and the various aspects of the full cycle would be added. In general the aim would be to improve the quality of the evaluated data.

Yiftah referred to working paper INDC/P(81)-30 which mentions that the ENDF/B-V format is the international universally accepted format for all future evluations. Did this imply that the KEDAK and UK format would not be used anymore? Froehner and Rowlands said that their countries would continue to use KEDAK and the UK format but that the NEA Data Bank would translate these formats to ENDF, which would be considered the international format for the exchange of evaluated data.

Seeliger said that the East European countries had decided last year to use the ENDF/B-V format for all evaluations in these countries.

Kuzminov proposed to form a small group of experts to discuss defects of the ENDF/B-V format and ways to correct them.

Following a general discussion, it was decided to take two actions, Action 48 on all participants encouraging them to use ENDF/B-V, and later ENDF/B-VI, formats, procedures and processing programmes for evaluations, and Action 49 on NDS, to raise the problem of standard evaluation format, procedures and processing programmes at the next four-centre meeting.

C. Status of mass chain data evaluation (NSDD network)

Lorenz commented briefly on the report INDC(NDS)-115 (issued in October 1980) on the status of mass chain data evaluation as of May 1980. As of that date, fifteen evaluation groups were involved in this cooperative activity.

Yankov noted the relatively long delay in publishing and distributing mass chain data.

Smith noted that the US coordination of this activity, which started at Oak Ridge, was recently transferred to Brookhaven. The transfer had been completed, which will probably reduce the delay. He also said that the cycle time for complete updating was four years for high-priority nuclides and six years otherwise.

VII. Progress reports

In the course of discussions during Session X (Committee Business-II), a decision was taken (Action 53) that all participants would send short statements updating their progress reports.

VIII. Meetings

See report of the subcommittee on Meetings and Future NDS Programmes (Appendix 10).

IX. Reports of technical, policy and ad-hoc subcommittees

The subcommittee reports are attached as appendices as follows:

Subcommittee A - Appendix 5
Subcommittee B - Appendix 6
Standards Subcommittee - Appendix 7
Discrepancies Subcommittee - Appendix 8
Subcommittee on the Barn - Appendix 9
Subcommittee on Meetings and Future NDS Programmes - Appendix 10
Subcommittee on the Interregional Project - Appendix 11

The actions arising out of discussions of subcommittee reports are included in the list of actions. Some of the important recommendations appear in the "Summary, conclusions and recommendations" at the beginning of these minutes.

A detailed discussion was held and various proposals were raised during the full committee's review of the subcommittee on meetings and future NDS Programmes. In particular, the composition and methods of work of both the NDS and the INDC were discussed. After a detailed discussion it was concluded that no significant changes in the methods of work were warranted at this time, and that possible changes would be considered following the 1984 IAEA Divisional Symposium on "Significance and Impact of Nuclear Research in Developing Countries: Physical Sciences".

At the same time it was concluded to change the ad-hoc nature of the Interregional Project Subcommittee. This subcommittee would therefore become a standing subcommittee of the INDC, named "Subcommittee on the Transfer of Nuclear Data Expertise to Developing Countries", as proposed by Schmidt.

X. Committee Business - II

A review was made of all the 54 actions raised during the 12th INDC Meeting (see Appendix 3).

It was decided (Action 52) that the summary, conclusions, recommendations, revised list of actions and subcommittee membership would be sent to participants within two weeks after the INDC meeting.

It was also decided (Action 54) that Schmidt and Seeliger, the INDC Chairman as of January 1983 would plan a half-day technical session on an appropriate scientific topic (such as "Uncertainties") for the next INDC meeting. The programme would be sent to participants at least six months before the next INDC meeting.

Twelfth INDC Meeting

Vienna, 5-9 October 1981

List of participants

Members:	H. Condé	Sweden
	W.G. Cross	Canada
	A.T.G. Ferguson	United Kingdom
	F. Fröhner	Fed. Rep. of Germany
	K. Harada	Japan
	S.S. Kapoor	India
	E. Menapace	Italy
	A. Michaudon	France (Chairman)
	J.J. Schmidt	IAEA (Scientific Secretary)
	D. Seeliger	German Democratic Republic
	A.B. Smith	U.S.A.
	G.B. Yankov	U.S.S.R.
	Sh. Yiftah	Israel (Executive Secretary)
Advisers:	H. Derrien	France
	R. Haight	U.S.A.
	B.D. Kuzminov	U.S.S.R.
	A. Lorenz	IAEA (Local Secretary)
	H. Motz	U.S.A.
	J. Rowlands	United Kingdom
Observers:	L.T. Auler	Brazil
	J. Csikai	Hungary
	A. Deruytter	CEC/BCMN Geel

Subcommittee A

Chairman: J.L. Rowlands

F. Froehner
H. Derrien
E. Menapace
B.D. Kuzminov
H. Condé
J.J. Schmidt
H.D. Lemmel
N. Kocherov
D.E. Cullen
S. Yiftah
L.T. Auler
C. Ertek

Subcommittee B

Chairman: A.T.G. Ferguson

D. Seeliger
S.S. Kapoor
A. Michaudon
A.J. Deruytter
G.B. Yankov
M. Lammer
K. Harada
A. Lorenz
R.G. Haight
K. Okamoto
J. Csikai
W.G. Cross
E. Menapace
V. Pronyaev

Standards Subcommittee

Chairman: H. Condé

A.B. Smith
S.S. Kapoor
A.J. Deruytter
G.B. Yankov
A. Lorenz
A.T.G. Ferguson
H.D. Lemmel
J.J. Schmidt
A. Michaudon
W.G. Cross

Subcommittee on the "Barn"

Chairman: W.G. Cross

A.T.G. Ferguson
A. Michaudon
G.B. Yankov

(ad-hoc committee)

Discrepancies Subcommittee

Chairman: H.T. Motz

F. Froehner
H. Derrien
B.D. Kuzminov
K. Harada
J.L. Rowlands
K. Okamoto
J.J. Schmidt
O. Schwerer
V. Pronyaev
L.T. Auler

Subcommittee on Meetings and Future Nuclear Data Programmes

Chairman: A.B. Smith

B.D. Kuzminov
A. Lorenz
F. Froehner
J. Csikai
J.J. Schmidt
E. Menapace
S. Yiftah
J.L. Rowlands
L.T. Auler

(ad-hoc committee)

Subcommittee on the Interregional Project etc.

Chairman: D. Seeliger

A.J. Deruytter
J.J. Schmidt
D.E. Cullen
N. Kocherov
K. Okamoto
S.S. Kapoor
G.B. Yankov
E. Menapace
H. Condé
A. Michaudon
K. Harada
R.G. Haight
J. Csikai
L.T. Auler
W.G. Cross
N. DayDay

Actions arising from the 12th INDC Meeting

No.	Session	Person	Action
1	II.C.	H. Derrien J.J. Schmidt	Distribute to INDC members sensitivity studies performed by Salvatores et al.
2	II.F.	H. Condé H.T. Motz	Ensure proper coordination of INDC technical subcommittees with NEANDC
3	II.F.	A. Michaudon	Write a letter to NEANDC chairman concerning coordination between INDC and NEANDC technical subcommittees
4	II.H.	All members	Screen and possibly cut down number of INDC correspondents (U, N, L distributions)
5	II.H.	A. Lorenz	Screen and review distribution lists for specialized subjects (A, B, etc...)
6	II.H.	J.J. Schmidt	Specify criteria for technical INDC documents
7	II.H.	All members	Encourage sending INDC documents (according to criteria of action 6) for distribution
8	II.H.	H.D. Lemmel	Circulate to INDC members the recommendation which resulted from the 1980 NRDC Meeting regarding error files required in EXFOR
9	IV.A.	J.J. Schmidt, members of I.P. subcommittee	Formulate a one-page questionnaire to describe facilities existing in Member State Laboratories which could be used for training of fellows from developing countries
10	IV.A.	All members	Using the questionnaire devised by J.J. Schmidt, send to NDS information on existing laboratory facilities which could be used for the training of fellows from developing countries
11	IV.B.	J.J. Schmidt	Summarise in 1-2 pages and distribute to INDC members the experimental facilities and personnel for nuclear data measurements in South American countries

No.	Session	Person	Action
12	IV.D.	J.J. Schmidt	The participation in the two Trieste courses should be independent. Exercise flexibility concerning participants that should have choice either to select one of the two courses or both
13	IV.E.	All members	Inform the Nuclear Data Section of the names of scientists from developing countries, doing work as fellows in the nuclear data field, in laboratories of developed Member States
14	V.B.	S. Yiftah	Include summaries of two October 1981 CRP meetings as Appendices to INDC minutes
15	V.B.	NDS	Summarise in graphical form, and otherwise, relevant important results from intercomparisons performed in the framework of the CRP programme and distribute to INDC members
16	SC/A	NDS	Define the objectives for a new CRP to begin when the present CRP on intercomparisons of evaluations of actinide neutron nuclear data is completed at the end of 1982.
17	SC/A	NDS	Formulate the future course of the CRP on the measurement and evaluation of transactinium isotope nuclear decay data
18	SC/A	All participts.	Make recommendations to the next INDC meeting on the value of a TND meeting in 1984
19	SC/A	All participts.	Make recommendations to the next INDC meeting on the value of a specialist meeting on nuclear data for safety applications in 1984
20	SC/B	All participts.	Contact the Safeguards Authorities in their countries and the Safeguards R & D projects regarding need and use of nuclear data in this field and report to NDS

No.	Session	Person	Action
21	SC/B	Deruytter	Make available copies of European Applied Research Reports to INDC members upon request
22	SC/B	NDS	Write a paper on deficiencies of the available evaluated data sets for INTOR after giving the matter further study
23	SC/B	NDS	Proceed with organization of Advisory Group Meeting on Nuclear Data for Fusion to be held in 1985
24	SC/B	Haight	Write short paper on the nuclear data needs for Intertial Confinement Fusion for presentation to the next INDC meeting
25	SC/Standards	Deruytter	Investigate the BCMN possibilities to take the responsibility for updating the $^{197}Au(n,\gamma)$ cross section status
26	SC/Standards	Lorenz	Contact the secretary of ICRM concerning the INDC/NEANDC decay data list for calibration standards
27	SC/Standards	Condé	Inform the Chairman of the NEANDC Standard S.C. about the procedure approved by INDC to publish the Standard File
28	SC/Standards	Lorenz	Explore the possibility to include a list of x-ray emission probabilities in the Standard File
29	SC/Discrepancies	J.J. Schmidt	Review the status of $^{93}Nb(n,n')$ and submit to Motz for Discrepancy Subcommittee report
30	SC/Discrepancies	Kocherov	Review the status of $^{103}Rh(n,n')$ and submit to Motz for Discrepancy Subcommittee report
31	SC/Discrepancies	All participts.	Transmit any new information on discrepancies to Motz

No.	Session	Person	Action
32	SC/Discre-pancies	All participts.	Inform interested national committees and laboratories about status of discrepancies
33	SC/IP	J.J. Schmidt	Further implement the "Interregional Project on training in nuclear data techniques and instrumentation" (TA/INT/1/018) keeping close contact with other relevant sections of the IAEA
34	SC/IP	J.J. Schmidt Menapace	Explore the possibility for demonstrating and/or carrying out experiments at the Legnaro laboratory facilities after the ICTP Trieste Course planned for Winter 1984
35	SC/IP	Menapace J.J. Schmidt	Discuss with ICTP the possibilities of tutored extended evaluation work to be performed at the Centre
36	SC/IP	Seeliger	Inquire into the possibility of holding a research coordination meeting of the new "14 MeV neutron cross section Coordinated Research Programme" in conjunction with the 1983 Gaussig Symposium
37	SC/IP	All members	Inform the members of the Scientific Advisory Committee of the IAEA about the main conclusions and recommendations of this INDC meeting as regards the future NDS programme in 1983 and 1984 versus the plans for the years 1985-1988. Also, inform them about IP and the aim of the 1984 IAEA Symposium on "Significance and Impact of Nuclear Research in Developing Countries"
38	SC/Meetings & Future Programmes	J.J. Schmidt	Adopt a two-tiered publication system, whereby contemporary documentation proceeds via the INDC report series, while important professional reports should be edited and published in a manner which would enhance recognition of excellence
39	SC/Meetings & Future Programmes	A.B. Smith and NDS	Contact Pearlstein and Fröhner and resolve problem of location of the Advisory Group Meeting on Basic and Applied Nuclear Level Densities

No.	Session	Person	Action
40	SC/barn	Deruytter, Ferguson, Fröhner, Menapace, Michaudon	Ensure that their national representatives to the EEC Comité Scientifique et Technique are well informed, before their upcoming meeting, on the importance of the barn to the international nuclear data community and of INDC's position
41	SC/barn	A.B. Smith	Ensure that U. Gat is informed of the importance of the continued use of the barn and of INDC's position
42	SC/barn	All participts.	Inform the INDC chairman promptly of any national developments on the barn that are not in accord with the present position of CIPM
43	VI.A.	Fröhner	Try to ensure that the data files, data handling methods and processing programmes developed by the Karlsruhe charged particle group (KaChaPaG) be saved and transferred to other data centres before KaChaPaG will be terminated by the end of 1981
44	VI.A.	NDS	Approach NEA to recommend that parts of the NEA Joint Evaluated Data File be made available internationally
45	VI.B.	A.B. Smith	Ensure that NDS receives ENDF/102 and supplement on formats and procedures
46	VI.B.	A.B. Smith	When possible, provide information on U.S. actinide burnup benchmark data to Yiftah and NDS
47	VI.B.	A.B. Smith	When possible, make available to INDC members contents of U.S. "Benchmark Book"
48	VI.B.	All participts.	Encourage the use of ENDF-B/V and later ENDF-B/VI formats, procedures and processing programmes for evaluations

No.	Session	Person	Action
49	VI.B.	NDS	Raise problem of standard evaluation format, procedures and processing programmes in next four-centre meeting
50	IX.	Subcommittee chairmen	Provide final Subcommittee Reports for official minutes within 30 days after 12th INDC meeting
51	IX.E.	J.J. Schmidt	Adopt a Scientific-Technical Reviewing Process by competent reviewers for INDC publications of importance
52	X.	S. Yiftah J.J. Schmidt	Send Summary Conclusions, Recommendations, Revised List of Actions and Subcommittee membership to participants within two weeks
53	X.	All participts.	Send short statement updating Progress Reports within 30 days
54	X.	J.J. Schmidt New INDC Chairman	Organise for next INDC meeting a half-day technical session on an appropriate scientific topic (such as uncertainties). Send programme to participants at least six months before next INDC meeting

Appendix 4

INDC/P(81) - Working Papers Prepared for the Twelfth INDC Meeting

INDC/P(81)- 1	9 Jan	K. Okamoto	IAEA Consultants' Meeting on Nuclear Data for Medical Radioisotope Production, Vienna, 13-15 April 1981
INDC/P(81)- 2	11 Jan	J.J. Schmidt	NDS Meeting Schedule for 1981 (Superseded by INDC/P(81)-29)
INDC/P(81)- 3	15 Jan	J.J. Schmidt	Advisory Group Meeting on Nuclear Data for Radiation Damage Assessment and Safety Aspects, Vienna, 12-16 October 1981
INDC/P(81)- 4	13 Feb	A. Lorenz	Compilation of National Nuclear Data Committees (memorandum)
INDC/P(81)- 5	26 Mar	J.J. Schmidt	Meetings planned by the IAEA Nuclear Data Section for the years 1981, 1982 and 1983
INDC/P(81)- 6	25 Mar	J.J. Schmidt	IAEA Technical Assistance Interregional Project (IP) TA/INT/1/018) for Nuclear Data Techniques and Instrumentation
INDC/P(81)- 7	31 Mar	J.J. Schmidt	Selected Highlights from the Workshop on Evaluation Methods and Procedures, Brookhaven, 22-25 September 1980
INDC/P(81)- 8	31 Mar	A. Lorenz	Publication of new "Nuclear Activation Data Handbook"
INDC/P(81)- 9	19 May	A. Lorenz	The "barn" and INDC
INDC/P(81)-10	17 Sep	J.J. Schmidt	Report on Travel to Brazil, (4-14 May 1981), Argentina (18-21 May 1981), Chile (23-25 May 1981) and Bolivia (26-28 May 1981)
INDC/P(81)-11	10 Sep	N. Kocherov	Expert Missions to Laboratories in Eastern Europe for Interregional Project TA/INT/1/018
INDC/P(81)-12	3 Sep	A. Lorenz	Summary of Recommendations Concerning Nuclear Data from Past IAEA/NDS and Other Meetings
INDC/P(81)-13	3 Sep	K. Okamoto	Information on Nuclear Data Activities in the People's Republic of China

INDC/P(81)-14	9 Sep	D.E. Cullen	Report on Visit to the Institute for Heat and Mass Transfer of the Belorussia Academy of Science, Minsk, 25-29 May, 1981
INDC/P(81)-15	30 Sep	J.J. Schmidt N. Kocherov	Progress report on the Interregional Project (TA/INT/1/018) on Training in Nuclear Data Techniques and Instrumentation
INDC/P(81)-16	8 Sep	J.J. Schmidt	Preliminary Information on planned Interregional Technical Assistance Training Course on Utilization of Neutron Generators, Institute of Experimental Physics, Kossuth University, Debrecen, Hungary, June/July 1982
INDC/P(81)-17	9 Sep	D.E. Cullen	Preliminary Information on Interregional Training Course on Methodology of Evaluation and Processing of Nuclear Data for Nuclear Reactor Applications
INDC/P(81)-18	15 Sep	J.J. Schmidt	Interregional Advanced Training Course on Applications of Nuclear Theory to Nuclear Data Calculations, jointly organized by the IAEA Nuclear Data Section (NDS) and the International Centre for Theoretical Physics (ICTP) and held at the ICTP, Trieste, from 17 January to 10 February 1980 - Evaluation of the effectiveness of the course
INDC/P(81)-19	7 Sep	J.J. Schmidt	Winter College on Nuclear Physics and Reactors, 25 Jan-19 March 1982 - - Preliminary Programme
INDC/P(81)-20	9 Sep	A. Lorenz	Nuclear Data Section Statistics
INDC/P(81)-21	29 Sep	J.J. Schmidt	Proposal for a Coordinated Research Programme on Measurement and Analysis of 14 MeV Neutron Nuclear Data
INDC/P(81)-22	16 Sep	C. Ertek	Status Report on the First Exercise of the IAEA International Neutron Flux Density Comparison REAL-80
INDC/P(81)-23	3 Sep	N. Kocherov	IAEA Advisory Group Meeting on Nuclear Data for Radiation Damage Assessment and Reactor Safety Analysis, Vienna, 12-16 Oct. 1981
INDC/P(81)-24	2 Oct	M. Lammer	Nuclear Data for Safeguards
INDC/P(81)-25	3 Sep	A. Lorenz	Decay Data for Isotopes Used as Calibration Standards - Proposed Recommended Values Submitted for the 1980 INDC/NEANDC Standards File

INDC/P(81)-26	21 Sep	V. Pronjaev/ J.J. Schmidt	Preliminary Survey on the Availability and Quality of Evaluated Nuclear Data Important for INTOR Design Calculations
INDC/P(81)-27	3 Sep	A. Lorenz	Nuclear Data for INTOR
INDC/P(81)-28	7 Sep	D.E. Cullen	Programme of IAEA Consultants' Meeting on Uranium and Plutonium Isotope Resonance Parameters, 28 Sep - 2 Oct 1981, Vienna
INDC/P(81)-29	3 Sep	A. Lorenz	NDS Meetings Proposed for 1982, 1983 and 1984 and IAEA/NDS Conference proposed for 1986
INDC/P(81)-30	8 Sep	D.E. Cullen	Validation of Evaluated Data at the Nuclear Data Section
INDC/P(81)-31	9 Sep	H.D. Lemmel	Fourth Meeting of the Coordinated Research Project on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data, Vienna, 12-13 October 1981
INDC/P(81)-32	5 Jun	A. Lorenz	Memorandum to Members of the IAEA CRP on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data
INDC/P(81)-33	7 Sep	J.J. Schmidt	Preliminary Information on planned IAEA Advisory Group Meeting on Basic and Applied Nuclear Level Densities planned to be held in Brookhaven National Laboratory, USA, early 1983
INDC/P(81)-34	28 Sep	K. Okamoto	The result of the questionnaire concerning the Nuclear Data Needs for Medical Radionuclide Productions
INDC/P(81)-35	28 Sep	NEA Data Bank	Participants in the Nuclear Model Exercises
INDC/P(81)-36	28 Sep	NEA Data Bank	Activity Report - NEA Data Bank
INDC/P(81)-37	30 Sep	P. Ribon	NEA Nuclear Data Committee - Intercomparisons of Methods used to Determine Average Resonance Parameters
INDC/P(81)-38	June	H.D. Lemmel	INDL/A - IAEA Nuclear Data Library for Evaluated Neutron Reaction Data of Actinides

INDC/P(81)-39	July	V. Pronyaev, D. Cullen, H.D. Lemmel, O. Schwerer	INDL/V - IAEA Nuclear Data Library for various neutron data evaluations in ENDF/B-5 format
INDC/P(81)-40		G.B. Yankov	Some Aspects of USSR Activities in the Fields of Nuclear, Atomic and Molecular Data
INDC/P(81)-41		B.D. Kuzminov	Annotated Survey of Works performed Soviet Scientists in the Measurement of Neutron Data
INDC/P(81)-42		W.G. Cross, J.S. Merritt	Half-Lives of Commercial and Biomedical Isotopes 1981
INDC/P(81)-43	7 Oct	J.J. Schmidt	List of facilities visited in several South American countries
INDC/P(81)-44		J.J. Schmidt	Facility Questionnaire
INDC/P(81)-45	Sept	H.D. Lemmel	Cf-252 spontaneous-fission neutrum spectrum
INDC/P(81)-46			Maintien du Barn comme Unité des Sections Efficaces en Physique Nucléaire
INDC/P(81)-47		V.V. Malinovskij et al	The Energy Dependence of the Average Number of Prompt Neutrons Resulting from Neutron Fission of U-236
INDC/P(81)-48		G.N. Lovchikova, et al	The Non-Statistical Contribution to the Neutron Flux from the (p,n) and (n,n') reactions, and its comparison with theoretical model predictions
INDC/P(81)-49		B.D. Kuz'minov, N.M. Shagalin	Tritium Yield from Fast Neutron Fission
INDC/P(81)-50		V.M. Kulakov	Report to the Fourth Meeting of the Co-ordinated Research Programme on the Measurement and Evaluation of Transactinium Nuclear Data
INDC/P(81)-51		A.J. Deruytter	Additional Information compared to INDC(EUR)-014/G
INDC/P(81)-52	Dec		USSR State Standards for the Publication of Experimental Data
INDC/P(81)-53	Dec		Complete List of INDC/P Documents Distributed to INDC Participants during 1981

Appendix 5

Report of Subcommittee A

by

J. Rowlands, Chairman

1 International cooperation in the production of files of evaluated data

There is a demand for greater sophistication in evaluated nuclear data for important substances and for the provision of evaluations for a much larger number of substances than in the past. (Current evaluations for many important substances do not take into account important recent measurements and analyses and employ unsuitable resonance formalisms). The effort required to meet this demand is very large and international collaboration on the production of files of evaluated data should be encouraged. The developing countries can make a useful contribution and are already doing so, for example in the CRP on actinide evaluations.

ENDF/B is gaining acceptance as the standard international format for evaluated data files. The NDS could provide a valuable service by converting data provided in other formats to ENDF/B and carrying out tests on the consistency and compatibility of files in ENDF/B format with the processing codes. Indeed, such work has been done by the NDS. ENDF/B is the appropriate format for international files of reference data for specific applications, such as dosimetry, which the NDS is providing. There is a demand from both developing and developed countries for the provision of group averaged cross-section data and the NDS should have the capacity to meet this demand.

One aspect of the increasing sophistication required in evaluated data files is the provision of carefully assessed uncertainty information (either in the files or in the evaluation reports). Some reactor physicists consider this to be the most important nuclear data requirement at present. Uncertainty estimation is also required in connection with criticality predictions for fuel storage, transportation and reprocessing plant design and operation. Pessimistic uncertainty assumptions often carry a significant economic penalty.

The USA has provided the bulk of the evaluations which have been accepted as reference evaluations for standards and dosimetry applications. The USSR has produced high quality evaluations for a number of important substances. Many other countries have also contributed evaluations.

Recommendation

The NDS is asked to encourage the production of evaluated nuclear data files in ENDF/B format and to convert recent evaluations to this format (or compile them) where necessary. The NDS is also requested to provide format testing and format conversion as a service to data evaluators.

2 Estimation of uncertainties in nuclear data

A key problem when deriving, specifying and interpreting accuracy requirements in WRENDA and when assessing uncertainties in measured and evaluated data is connected with correlations in the uncertainties in cross-section values in different energy ranges and between different reactions and substances. This problem has been considered at a number of meetings but no general guide has been formulated.

For secondary substances, for which the cross-sections do not have a significant effect on the neutron spectrum, the requirement is for a specified accuracy in the value averaged over a defined neutron spectrum, such as a fast or thermal reactor spectrum. The accuracy requirements and cross-section uncertainties can be expressed in a simple form in this case (although estimation of the uncertainty in the spectrum averaged value is often not a simple matter). For some specific applications, (in particular,dosimetry), general approaches have been formulated.

When the cross-sections influence the neutron spectrum, (for example, when resonance shielding effects are important) and when the uncertainties in the effects of temperature changes and composition changes on the spectrum averaged cross-sections must be predicted, specification of accuracy requirements and of the uncertainties in measured and evaluated data is more complicated. Assumptions must be made about the likely form of the covariances when specifying the accuracy requirements. Measurers should be encouraged to give guidance to data requestors on likely covariances and publication of a general guide would be valuable. Specification of requirements in resonance regions was discussed at the U+Pu resonance parameter meeting as described later in this report. The information provided in measured and evaluated data files (or the reports describing the evaluations) must also be sufficient to enable the uncertainties in spectrum averaged values and in the changes resulting from changes in spectrum to be predicted. Uncertainties which are systematic over broad energy ranges and correlated between cross-sections are particularly important.

When measured and evaluated data are provided in the form of resonance parameters then the covariances between the parameters must be provided (typically for the 1 to 3 lowest energy resonances and for averages over broad energy ranges at higher energies). Alternatively the uncertainties in infinite dilute cross-sections, resonance shielding factors and their temperatures dependence could be specified, as discussed at the U+Pu resonance parameter meeting.

In his evaluations of resonance parameters for Fe and Ni, Perey has given covariance information in a greatly simplified but adequate form. This work is an example of how error information can be condensed.

Recommendation

The production of a guide for requestors, measurers and evaluators on the treatment of nuclear data uncertainties is urged.

3 Fuel handling, reprocessing and waste management

3.1 CRP on the intercomparisons of evaluations of actinide neutron nuclear data

Dr Lemmel summarized the objectives and achievements of the CRP, which will be concluded at the end of 1982.

(a) An IAEA file of good quality evaluations has been established.

(b) Several less experienced countries have gained the necessary expertise by intercomparing their work with that of others who have been making evaluations for many years.

(c) A methodology for making intercomparisons has been established.

(d) All participants have found the intercomparisons valuable in revealing deficiencies in their data and methods, or alternative valid approaches.

Four participants in the CRP are members of Subcommittee A and all agreed that the CRP is very valuable. The next meeting is scheduled for October 12 - 13 (1981). In the last phase (until the end of 1982), which will be discussed in detail at the meeting, the proposed aims would be:

(i) To complete partial evaluations

(ii) To extend the intercomparisons to make them more complete

(iii) To consider the possibility of independent review

(iv) To carry out some benchmark testing

(v) To understand the reasons for differences between evaluations and decide whether one is to be preferred

(vi) To translate all the evaluations to a common format (ENDF/B-V)

(vii) To work towards a well tested actinide library in ENDF/B-V format to be recommended for international use

Participants in the CRP, in collaboration with NDS staff, provide a graphical and group cross-section intercomparison of data, and test data provided in ENDF/B format for consistency with ENDF/B processing codes.

Recommendation

The subcommittee consider that the INDC should recommend a new CRP to follow on from the present one. The aim would be to build on the experience gained to produce higher quality and well validated evaluations which would have an international reference status. An extension of the range of nuclides evaluated (for example, to include structural materials) could also be considered.

3.2 CRP on the measurement and evaluation of transactinium isotope nuclear decay data

Dr Lorenz reported that the CRP, which will be completed by the end of 1982, is meeting its objectives.

(a) A proposed recommended list of half-lives and associated uncertainties has been compiled and is revised at CRP meetings to take account of new measurements.

(b) The status of the decay data in relation to the requirements is reviewed and new measurements are made to improve the status.

(c) Alpha and gamma decay data are currently being compiled.

The recommended data will be issued as a handbook. The work which the experts had been stimulated to carry out by the CRP would, no doubt, continue after its completion.

Recommendation

The subcommittee considered that the reports already produced by the CRP were most valuable and expected the handbook to gain general acceptance as a reference in this field. The subcommittee would like the INDC to recommend a new CRP which would bring together experts in decay data to review another area, one possibility being spontaneous fission data.

3.3 Status of neutron nuclear data for actinides

Dr Menapace reviewed the status of the data in relation to the accuracy requirements. Some general conclusions will be available in the report from the meeting on U+Pu resonance data and from the two CRP meetings to be held shortly.

Tables 1 and 2 (which are at the end of the Subcommittee Report) summarise the status for the primary and secondary actinides, respectively, with respect to the Priority 1 data requirements.

For the primary actinides the situation is broadly as follows:

(i) ν_p: For energies above the thermal region a typical accuracy requirement is $\pm$ 1% and the accuracy achieved is typically $\pm$ 2%.

(ii) Fission cross section: For energies above the thermal region a typical accuracy requirement is $\pm$ 2 - 3% and the achieved accuracy is typically $\pm$ 5%.

(iii) Capture cross section and Alpha: The requirements are not met in general by the presently achieved accuracy of from $\pm$ 5 to 20% .

(iv) Inelastic scattering cross section: For U238 the accuracy achieved is ± 10 - 20% compared with the requested accuracy of ± 5%.

(v) Elastic scattering data: For U238 from 1 keV to 10 MeV the present accuracy is ± 10% vs ± 5 - 10% requested.

(vi) Total cross section: The requested accuracies of ± 0.5 to 3% are not met by the achieved ones (± 3 to 10%).

For secondary actinides the requirements are for 10 - 20% precision for capture and fission cross sections, with the exception of a 3% accuracy request (US) for Pu238 (n,f). For these nuclides the achieved accuracy was considered to be not much better than 20 - 50% at the last INDC meeting and the experimental situation is practically the same now.

Summary

To summarise, there are many priority 1 measurement and evaluation requirements which have still to be met. There is a trend for higher accuracy requests, and for requests for additional higher actinides. Progress in meeting the requirements is slow.

3.4 TND Meeting

Recommendation

The changes in the requirements and the new differential and integral measurements, evaluations and benchmark testing, which are now being completed, were considered. It was judged best to tentatively propose a TND meeting for 1984, with the need for a TND meeting being reviewed at the next INDC meeting.

Radiation Damage, Nuclear Safety and Dosimetry

4.1 IAEA Advisory Group Meeting on Nuclear Data for Radiation Damage, October, 1981

Previous meetings on radiation damage have recommended standardisation of the data used to predict damage effects so that the comparisons of measured and calculated effects made in one country can be used directly to deduce effects by other countries. It is anticipated that, as well as identifying nuclear data needs, the Advisory Group will request the establishment of an international file of reference data. A specialist meeting to review progress in the production of such a file might be

appropriate at some tine during the next two years. A compilation of relevant atomic and molecular data might also be requested and this aspect might be appropriate for discussion at the proposed meeting on A and M Data for Fusion.

4.2 The REAL-80 Project

Dr Ertek described the REAL-80 project. This is an intercomparison of methods used for spectrum unfolding. Sets of dosimetry reaction rates for two reactor spectra (the thermal reactor ORR and the fast reactor YAYOI) have been provided to the 30 participating laboratories, together with reference dosimetry reaction cross sections. Covariance data for dosimetry reactions have also been provided, although these are not used by all participants. The aim is to intercompare the values derived by the participants for the flux spectra obtained by unfolding the dosimetry reaction rate data, integral properties calculated in these fluxes (in particular, atomic displacement rates) and the associated uncertainties.

The exercise will also give some insight into the relative sensitivity of the integral properties being predicted to different dosimetry reaction rate measurements and into the importance of cross section covariance data.

Dr Ertek described the generation of covariance matrices in a 100 group structure which is a condensation of the SAND II 620 group scheme. The 100 x 100 covariance matrices can now be generated routinely from ENDFB/B-V covariance files.

Some dosimetry cross sections should now be examined to see if a new evaluation is needed. The file for In (n,γ) is one example. This is an old evaluation and the detail of representation and covariance data in the resonance region could be improved. Activation product decay data also merit reassessment.

4.3 Dosimetry and IRDF Status

Dr Cullen reported on the status of the International Reactor Dosimetry File (IRDF-81).

The first version is now being assembled by the NDS for distribution in November, 1981. The cross sections for this version will be composed of the contents of the ENDF/B-V Dosimetry library, plus six reactions from Vonach, together with Patrick's 241Am (n,f) evaluation. In addition the file will contain eight standard spectra (eg BIG-TEN, SIGMA-SIGMA, YAY01, 252Cf Spontaneous Fission etc). All of these data will be distributed in ENDF/B-V format with cross sections and spectra in the SAND-II group structure.

4.4 IAEA Consultants Meeting on Uranium and Plutonium Isotopes

Vienna, 28 September - 2 October, 1981

Dr Froehner presented the report on this meeting.

The meeting was organised by IAEA/NDS with the cooperation of OECD/NEANDC, under the chairmanship of G de Saussure (ORNL). The objectives were:

- review of accuracy requirements
- review of current status including intercomparison of currently used evaluations
- assessment of needs for future work on the resolved and average resonance parameters for 235U, 238U, 239Pu, 240Pu, 241Pu and 242Pu.

(a) Accuracy requirements

Various ways to specify accuracies were discussed. It was considered impractical to use full covariance parameters. Instead, required accuracies were specified for the parameters of the first or the first few resonances that dominate the thermal region and the resonance integrals $\int \sigma dE/E$. Thus, the requirements for thermal reactors were expressed as $\pm$ 1 meV for Γ_γ and 3 - 5% for Γ_n for the three lowest-energy s-wave resonances of 238U and for the first resonance in 240Pu. The exact shapes of the 235U(n,f), 239Pu(n,f) and 238U(n,γ) cross sections and eta in the thermal energy region are needed to an accuracy of better than 1%. In the resolved resonance region uncertainties of $\pm$ 5% for average resonance parameters were said to be acceptable. The strong covariances among these, however, weaken the usefulness of this statement. Therefore accuracies for fast-reactor applications were also stated in terms of infinite-dilution cross sections σ_∞, self-shielding factors, f, and their derivations with respect to temperature. For the range 100 eV to 100 keV (roughly) one estimates the following

accuracy requirements:

	σ_∞	f	df/dT
239Pu(n,f)	3%	0.5%	20%
(n,γ)	10%	2%	20%
238U (n,γ)	3%	1%	5%
240Pu(n,γ)	10%	5%	30%

For 235U the needs are similar to those for 239Pu but have a lower priority. The f and df/dT values are to be calculated for dilution cross sections of 30b for 238U, 300b for 239Pu and 1000b for 240Pu.

The discussion showed that reasonably accurate but simple rules and conventions for error specification are lacking. The provision of uncertainty information in the files or at least in the associated documentation was considered to be possibly the most urgent requirement. It was considered important that thick-sample transmission and self-indication measurements should be compiled and used as benchmarks for testing evaluations.

(b) Status

Most of the evaluated files make use of so-called smooth cross sections which compensate for differences between single-level Breit-Wigner (SLBW) calculations and measured resonance data. Since these "smooth" cross sections are anything but smooth they must be kernel-broadened for non-zero temperatures. The main advantage of the SLBW representation is thus lost.

It was found that there are important experimental results which were not taken into account in most evaluations. Only one evaluation, for instance, utilizes the polarization measurement of Moore etal. on 235U(n,f).

Experimental data in many cases have not be analysed with the most appropriate multi-level formalism, while multi-level parameter sets that have been available for many years, eg for 239Pu are not incorporated in most files. Radiation widths of p-wave levels are virtually unknown. In the thermal region, there is still a 2% discrepancy for 235U between the measured Maxwellian average fission cross section and that calculated from the recommended 2200 m/s value and the Westcott factor representing the shape. In the unresolved region, problems exist due to the lack of measured total cross sections (for 241Pu and 242Pu) and accurate subthreshold fission data. These have little impact on reactor calculations but are needed in evaluation work. A reliable assessment of the adequacy of experimental and evaluated data in the unresolved region is severely hampered by a lack of good benchmark data, especially with respect to dilution and temperature effects.

(c) Recommendations

- The fission cross section shape of 235U should be measured down to at least 10 meV.
- Continuation and completion of Leonard's least-squares adjustment of the 239Pu and 241Pu cross sections below 1 eV is recommended.
- Multilevel representations should be used whenever the quality of the data makes this meaningful and an SLBW description without "smooth' cross section is not possible.
- Only one total cross section measurement exists for 235U and 239Pu. These data are more than 15 years old. With present-day intense pulsed neutron sources background problems are greatly reduced and much higher accuracy is possible. Such measurements are recommended.
- The most accurate experimental cross section data and resonance parameter sets are not taken into account in current evaluations for some isotopes (eg for 235U and 239Pu). This should be remedied with high priority.
- Crystal effects in Doppler-broadening of low-energy resonances can cause errors in derived values of Γ_γ of several percent.

Consequently average radiation width estimates based mainly on the first few resonances must be checked.

- A covariance matrix should be established for the parameters of the first 3 resonances of 238U and the first resonance of 240Pu. Resonance analysts are urged to supply more general covariance information to the data centres.
- It is recommended that the resolved resonance region for 238U should be extended to 10 keV. At least the strong s-wave levels should be analysed. This would put calculations of self-shielding and Doppler effects on a firm basis as 90% of these effects are due to energies below 10 keV. An extension to 10 keV for 240Pu is desirable but has lower priority.
- Since no direct measurement of any p-wave radiation width is available, a fresh attempt should be made to determine Γ_γ for one or more suitable p-wave levels of 238U.
- The problem of conflicting evidence as to the fraction of p-wave levels among presently known 240Pu and 242Pu resonances should be clarified.
- All evaluations should use the energy scale established for 238U. (James, Standards Meeting).
- An accurate set of benchmark data for the testing of self-shielding calculations should be established with high priority. It should comprise broad-group, thick-sample transmission data, capture self-indication data and temperature-dependent transmission data. These data must be fully documented and be available at the data centres.
- The total cross sections of 241Pu and 242Pu should be measured with good accuracy (2 - 4%) below 200 KeV. This would define the strength functions needed for capture, fission and especially elastic and inelastic scattering calculations.
- Full use should be made of reaction theory and nuclear models in evaluation work. Theoretical methods should be adequately documented. At the same time it must be kept in mind that theory cannot replace good measurements.

4.5 Specialist Meeting on Nuclear Data For Safety Applications

Recommendation

It is recommended that the usefulness and timeliness of a specialist meeting on nuclear data for safety applications (to be held in 1984) should be reviewed at the next INDC meeting.

5 Fission Product Nuclear Data

5.1 NDS annual report series on progress in fission product nuclear data

Recommendation

It was noted that this is attracting more contributions each year and is found to be valuable by those working in this field. Its continued production is supported by the Subcommittee.

5.2 Status of fission product cross section data

Dr Menapace reviewed the status of these data.
The main conclusions and recommendations from the 11th INDC Meeting are still valid. Only for 2 long-lived unstable isotopes, ie Ru-103 and Pd-107 have new experimental resonance data been produced (by Anufriev et al at the 1980 Kiev Conference on Neutron Physics). Resonance measurements for Cs-135 are in progress (only data for 1 resonance is currently available) by Priesmeyer et al. These results are highly desirable in order to reduce the discrepancies (of a factor of 2 or more) between the existing evaluations, due to the uncertainty in mean parameters presently deduced from systematics. Further developments of microscopic theories and macroscopic systematics on level density and radiative width estimation have been achieved and published and the proposed specialists meeting on this topic is supported. A related intercomparison of methods concerning the mean level spacing and strength function determination was undertaken with the participation of 9 physicists from 6 different laboratories (namely CBNM Geel - Euratom, LASL - USA, CEN Cadarache - France, KFK Karlsruhe - FRG, ECN Petten - The Netherlands, Soreq - Israel). The results show that the disagreements are systematic as the standard deviations are small compared to the differences between average ratios (ie estimated D_o divided by the "true" reference value) and unity.

Concerning Priority 1 accuracy requirements for FP capture cross sections, a new list of requests for fast reactor calculations is compared with the status in Table 3.

For thermal reactor applications there are Priority 1 requirements for low energy capture data of fission products and for control absorber isotopes which fall in the same mass range. These are given in Table 4. Some of these requests are for a very high accuracy (2%).

Dr Smith reported that total cross section measurements have recently been completed for all the stable nuclides in the mass range A=85 to 120 (including some individual isotopes), in the energy range 10 keV to 5 MeV, to an accuracy of 1 to 2%. The measurements show that data being derived theoretically using an optical model are typically discrepant by 10% to 20%. This is partly because of the use of the wrong parameters and partly from the choice of model. The use of a Lane potential with an isospin term is inappropriate. Studies will now be extended to the deformed region. In some earlier work the problem of self-shielding effects in the samples (although thin) has not been recognised.

5.3 Fission product yields and decay data, delayed neutron data and decay heating

The NEANDC has proposed a meeting on fission product yield and decay data to be held at Brookhaven in 1983 at which these topics will be discussed.

Compilations of tritium yields in fission have been made recently in the USSR. The accuracy of available data is considered to be unsatisfactory in the fast reactor energy region (see the report INDC(CCP)-.../. by Kuzminov, to be published).

6 Nuclear Data for Shielding

The NEA has organised a number of meetings relating to nuclear data for shielding. Benchmark measurements have been carried out and the results compiled. Sensitivity studies have also been made. A meeting in 1982 is being planned (possible venue, Tokyo).

Table 1

PRIMARY ACTINIDES

(1st priority requests)

Isotope	Energy Range	Typical Accuracy Requirement (percent)	Requester	Status (percent)	Measurement Programme
(a) $\bar{\nu}_p$					
233U	1m - 30eV	0.25*	US	1	US
	30eV-10K	1 to 2	US	2	
235U	1m-1eV	0.2*	US	0.2*	US
	Th-3M	1	US	2	
	Th-15M	1-2	F		
238U	<15M	1	US,F	2	US
239Pu	1m-1eV	0.2*	US	0.2*	
	Th-3M, 3-10M	0.3,1	US	0.2*	
	<15M	0.5	J	2	
	Th-2.5M	0.5	CCP		
241Pu	1K-1M	2	US	2-3	
(*denotes relative accuracy, in particular to 252Cf spontaneous fission)					
(b) Eta					
233U	1m -1eV	0.4	US		
235U	1m -1eV	0.4	US		) H
	10m -0.4eV	0.5	UK,F		)
239Pu	10m -0.5eV	.5-0.75	CCP, UK,F		H
241Pu	10m -1eV	2	UK		
	1eV-15eV	6	UK		
(c) Resonance Parameters					
232Th		10	G		J,US,BCMN
235U	<200eV	10	US		
238U	<5K	3	US		)
	<20K	10	US		)BCMN,J,US,
	<10K	3*	UK		)H
	Th-5K	(**)	CCP		
240Pu	1eV	1	US		
	1eV-10K	5	J		
* 3% in the calculation of resonance shielding factors					
(d) Fission					
233U	1m-100eV	1	US	)	US
	100eV-1K	5	US	) 5	
	1K-10M	1	US	)	J

** Observation of very week p-wave resonances desired for p-wave strength function estimate to self-shielding corrections in the unresolved region.

Itotopes	Energy Range	Typical Accuracy Requirement (percent)	Requester	Status (percent)	Measurement Programme
235U (Standard above 1keV)	5m-1K	1	US		
238U	Thr-15M	2-3	US,F	3-10	US,H
239Pu	1eV-14M	2-3	US	)	)
	1 -100K	2-3	G	) 5-10	) US
	10k-20M	3	J,UK	)	)
	1K-4M	<2	CCP		
	Th-15M	1-2	F		
240Pu	Th-1M	10	J	5-10	US
	1K-15M	5	G		
241Pu	1m -3eV	1	US	)	) US
	Th-10eV	3	US	) 5	) (<100 keV)
	10eV-30K	10	US	)	)
	20 -400K	3	US	)	)
	1eV-1M	5	RUM		
(e) Capture and Alpha					
232Th	1m-20eV	2	US	10	)
	20eV-5K	5	US		) US,J
	4K-10M	5-10	G		)
233U	1m -2eV	1-2	US	5	)
	60eV-3M	5-20	US	) 10-20	) US
	Th-1M	20	G	)	)
	1M-20M	10	J		
235U	1m-1eV	1-5	US	10	US (thermal)
	1M-10M	5-10	J		
	Th-3M	5	F		
	0.1K-0.8M	5-7	CCP		
238U	0.1 -6eV	0.5	US	)	)
	6eV-1K	5	US	)	)
	1K-10M	1-2	US	)5-10	)US,H,
	0.5K-10M	4-10	US	)	)BRC,J
	Th-80K	3	UK	)	)
	0.5K-1.4M	2-3	CCP		
239Pu	0.1K to 10M	4-10	US	10-20	
	1K-3M	5	F		
	0.1K-0.8M	4-7	CCP		
240Pu	Th-100eV	3	US	) 10-20	) US
	500eV-1M	5-10	US	)	)
241Pu	Th-30K	3	US	) 10-20	) US
	30K-2M	10	US	)	)
(f) (n,2n)					
233U	Thr-20M	10	J		

Isotopes	Energy Range	Typical Accuracy Requirement (percent)	Requester	Status (Percent)	Measurement Programme
239Pu	Thr-15M	10	F		
	Thr-15M	5	US		
(g) Inelastic scattering					
238U	Thr-15M	5	US,F	) 10-20	)US
	0.5-5M	5	E	)	)BRC
	50K-15M	1.5-5	CCP		
239Pu	Thr-10M	20	US	20-30	BRC
(h) Elastic Scattering					
235U	1K-15M	10	F		
238U	1K-10M	5-10	US	10	US
239Pu	1K-15M	5	F		
(i) Total cross section					
232Th	60eV-100k	2	US	5	US
233U	60eV-100k	3	US		
235U	1m -1eV	0.5	US	2-3	US
239Pu	0.5 -5eV	1	US	3-5	US
	5eV-500K	3	US	)	)
	1 -200K	2	J	) 5-10	) US
241Pu	10m-3eV	1	US		
(j) Fisson spectrum					
233U		1	US		
235U		1 ; 5	US,F		
238U		2 ; 5	F,US		
239Pu	Mean E and fractions >5M; <300K	2	UK,G		
	⩽ 15M	1	F		
(k) Total Photon Production cross section					
235U	1K-15M	10	F		
239Pu	1K-15M	10	F		

Table 2

SECONDARY ACTINIDES

(1st priority requests)

Isotope	Reaction	Energy Range	Accuracy (percent)	Requester	Status Thermal	Status RI	Status Fast	Measurement Programme
233Pa	(n,γ)	20eV-15M	10	J	15%			
233Pa	RI_{Abs}		10	G				
234U	(n,2n)	Thr-15M	10	F				
237Np	(n,γ)	0.025eV-1K	10	J	2%	8%		
		1K-15M	20	J				
	(n,2n)	Thr-15M	10-15	F, BLG				
236Pu	(n,γ)	1K-2M	10	F				
	(n,f)	1K-2M	10	F				
238Pu	(n,f)	10K-5M	3	US				
		1K-15M	15-20	F				
	(n,γ)	1K-3M	15	F				
	(n,2n)	Thr-15M	10-15	F				
242Pu	(n,γ)	Th-7M	3-20	US	2%	5%	10%	US
		Th	5	F				
		1K-3M	10	F				
	(n,f)	1K-3M	10	F				
	Total	10K-15M	10	G				
241Am	(n,γ)	100eV-15M	8-20	J,UK,US,F			10%	KFK,H,BCMN
		Branching Ratio	20	UK,J				
		Th-15M	20	G				
	(n,f)	1K-15M	3	F				
		Th-15M	20	G				
	Total	Th-1M	10	G				
	$\bar{\nu}_p$	Th-15M	20	G				
242Am	(n,γ)	Th-100K	5-20	J				
		Th-15M	30	UK,G				
	(n,f)	Th-15M	15	UK,G				
	Total	Th-15M	10	G				
	$\bar{\nu}_p$	Th-15M	15	UK,G				
243Am	(n,γ)	Th-15M	10-30	J,UK,US,F,G	2%	4%	25%	H
243Am	(n,f)	Th-15M	10-15	UK,G,F				
	Total	Th-15M	10	G				
	$\bar{\nu}_p$	Th-15M	15	UK,G				
242Cm	(n,γ)	0.025eV-15M	10-30	UK,G,J	40%	40%		
	(n,f)	0.025eV-15M	10-30	UK,G,J				BRC
	(n,2n)	Thr-15M	30	UK,G				
	$\bar{\nu}_p$	< 15M	30	UK,G				
243Cm	(n,γ)	20eV-10M	10-20	J	40%	40%		
	(n,f)	3M-10M	10-20	J				

Isotope	Reaction	Energy Range	Accuracy (percent)	Requester	Status			Measurement Programme
					Thermal	RI	Fast	
243Cm	(n,γ)	Th-15M	30	US,G				
	(n,f)	Th-15M	30	US,G				
244Cm	(n,γ)	Th-15M	30	US,G				
	(n,f)	Th-15M	30	US,G				
	(n,2n)	Thr-15M	30	US,G				
	$\bar{\nu}_p$	Th-15M	30	US,G				
245Cm	(n,γ)	Th-15M	30	US,G				
	(n,f)	Th-15M	30	US,G				
247Cm	Res. Param.	Th-10K	20	US				
250Cf	(n,f)	Th-10K	10	US	7%	17%		
250Cf	(n,γ)	Th-10K	10	US				
251Cf	(n,γ)	Th-10K	20	US	5%	2%		

TABLE 3

Status of Fission Product Capture Cross-Sections

Isotope	Energy Range	Accuracy (%)	Requester	Status Report
99Tc	20eV-400K 25K	10	D J	Discrepancies between measurements
107Pd	100eV-500K	10	D,J	RPI data to 660 eV
131Xe	1m -1K	10	US	
	100eV-500K	20	J	Resonance data to 4 KeV
135Xe	1m -5eV	2	US	
	5eV-5K	5	US	
135Cs	100eV-500K Res. Param.	10 10	J J	Only 1 resonance identified (42.1eV)
143Nd	0.5eV-1K	5	US	
145Nd	0.5eV-1K	10	US	Almost satisfied. Resonance integral is 240 ± 35b
147Nd	1m -1K	5-10	US	No resonance parameters known
147Pm	100eV-500K	10	D,J	Resonance data to 316 KeV (KAP)
149Sm	25K	5	J	25 KeV measurement could resolve discrepancies
151Sm	1eV-500K 100eV-500K	10	D. J	Resolved resonance data to 105eV (KAP). New data to 17 eV (NR)

TABLE 4

Fission Products as Control Absorbers

Isotope	Energy Range	Accuracy (%)	Requester
151Eu	0.5eV-1M	5	US
152Eu	1m -1K	10	US
	100eV-500K	10	J
	Res.Param.	10	J
153Eu	1m -1K	2-5	US
154Eu	100eV-500K	10	J
	Res. Param.	10	J
167Er	1m -1eV	2	US
Hf	1m -1eV	2	US
176Hf	1m -5K	10-40	US
	10m -5K	5	F
177Hf	1m -5K	4-20	US
	10m -5K	5	F
178Hf	1m -5K	3-20	US
	10m -5K	5	F
179Hf	1m -5K	5-20	US
	10m -5K	5	F
180Hf	1m -5K	4-20	US
	10m -5K	5	F

Key:

F = French
J = Japanese
US = USA

Report of Subcommittee B

by

A.T.G. Ferguson, Chairman

1. Aims and methods of working of the Subcommittee

The subcommittee reviewed the field of work to be covered and restated its aims. It was agreed that nuclear data for analysis, biomedical applications of nuclear techniques, and fusion (both inertial and magnetic confinement) continued to be of high relevance and would form the basis of the subcommittee's work. It was proposed and accepted that nuclear data for Safeguards should be added to the agenda. The topic of low energy photon data was dropped as the committee no longer had a member with appropriate expertise and interest. The aims of the subcommittee were then agreed to be as follows:

- To review the needs for data in our fields of interest
- To initiate studies of the nuclear data requirements by all appropriate means, e.g. specialist meetings
- To review the availability of nuclear data and its presentation in a form suitable for the practitioners in these fields
- To consider outstanding data problems relevant to these areas and make recommendations for their resolution

It was recognised that the committee required a core of permanent members to give continuity and leadership to the discussions. It was agreed that we would continue the practice of having a nominated individual responsible for maintaining continuous review of his topic between meetings and leading its discussions. The following arrangements were agreed:

Nuclear Data for Fusion	-	A Deruytter
Analysis	-	A. Ferguson
Biomedical	-	W. Cross
Safeguards	-	M. Lammer

2, Nuclear Data for Fusion

This topic was introduced by Dr. Deruytter who presented to members a report reviewing the need for data for fusion by O. N. Jarvis, commissioned by CBMN, Geel. It had been published as a European Applied Research Report. Dr. Deruytter agreed to supply copies for distribution to interested INDC members. As well as reviewing needs, this report pointed out serious deficiencies in evaluated N.D. files with new and better experimental data not yet included. This report claimed that within three years of the publishing of a request list in this field a measurement was very likely to appear in the literature, provided it could be made with existing facilities.

The subcommittee considered paper INDC/P(81)-26 which discussed nuclear data needs for INTOR. It was explained that the INTOR W.G. on Neutronic calculations had approached NDS with a request to prepare a data file to be used for INTOR calculations. As a preliminary a rapid review had been made of existing available evaluated cross-section files. This revealed that there were considerable gaps in the available data, which would have to be filled by experiments or calculations. The subcommittee agreed that this task was an appropriate one for NDS, but pointed out that to find the augmented data required considerable effort which they were unlikely to be able to find from their own resources.

The short note INDC/P(81)27 was also tabled. This sets out the need for benchmarks against which the data set for INTOR may be checked. Dr. Lorenz asked members to advise NDS of any relevant benchmark experiments known to them. The chairman questioned whether such integral benchmark experiments fell properly within the field of NDS activity. The sub-committee agreed to recommend that NDS should not involve itself in the calculation of benchmark experiments. This, however, does not preclude NDS from coordinating inter-laboratory comparisons of benchmark calculations for the purpose of comparing nuclear data libraries.

It was reported that some progress had been made towards resolving the discrepancy in the lithium-7 (n,n'α) T cross-sections. New measurements of T production from a Geel-Juelich collaboration had been made, some of which agree with the Harwell (low) results and some with the higher results obtained at Argonne. The Geel-Juelich collaboration had now made measurements at many more energies in an attempt to see if there might be structure. Dr. Seeliger reported measurements at Dresden of the secondary neutron spectrum from this reaction. He had not yet analysed this data in terms of cross-sections for T production but would do so. At Bruyères-le-Châtel measurements were in progress of the $^{7}Li(n,n'\alpha)^{3}H$ reaction by bombarding a ^{7}Li glass target. Measurements of the leakage neutron spectrum from a sphere of ^{7}Li with a pulsed neutron source at its centre were planned for 1982.

A new evaluation of the Li cross-sections has been made by Young and Arthur. This took account of all data and included Variance and Covariance matrices. The cross-section for $^{7}Li(n,n'\alpha)^{3}H$ so evaluated passed through the data points measured at Argonne. Cross checks had been made on Tritium assay which so far showed no departure from the evaluation of more than 2%.

It was agreed that an advisory group meeting on Nuclear Data for fusion should be held in 1984; the last meeting on this topic being in 1978. It was considered to be too early to suggest speakers but in addition to the conventional agenda for such a meeting the following topics were proposed, viz. Review of benchmark experiments; Neutron diagnostics for magnetically confined fusion and for inertially confined systems. INTOR - outline of the project and its data requirements.

There was a brief discussion of inertial confinement fusion and Dr. Haight agreed to write a short paper on the nuclear data needs for this activity for presentation to the next INDC meeting.

3. Nuclear data needs for analysis

Dr. Ferguson introduced this topic. For conventional analysis of small samples with thermal and fast neutrons adequate data in general exists but its presentation in handbooks may need revision (see 3.1 below). On the other hand there was increasing use of neutrons (particularly 14 MeV) as an analytical tool in mining, quarrying and in industry for analysis of bulk materials, e.g. coal, blast furnace mix, etc. Much of this work depended on the observation of prompt γ-rays from neutron capture and inelastic scattering. The people working in this field were conscious of deficiencies in cross-section data for gamma-ray production especially in the range of neutron energies above 6 MeV even for the most common matrix materials Si, O and C as well as for many other metallic species which were of interest to industry in general. In the subsequent discussion the following points were made:

- Dr. Cross reported on a new Chalk River compilation of γ-rays from thermal neutron capture and thermal cross-sections which would be most useful to analysts. He pointed out that the rock matrix materials were also important in the nuclear industry as shielding materials.

It was proposed that NDS hold a Specialist Meeting consisting of about 10 people (6 users, 4 data producers) to review the needs for and status of data for bulk material analysis in mining and general industry.

The subcommittee considered the update and reissue of the Nuclear Activation Data Handbook. They recommended as follows:

- That the proposed contents of the "neutrons" section given in papers INDC/P(81)-8, P(81)-25 was excellent and could be the basis of a book without further additions.

- Further thought and consultations with workers in the field was needed before proceeding with the section on photonuclear analysis. The inclusion of data on yields from thin and thick target-Bremsstrahlung was suggested subject to expert advice.

- It was felt that the Handbook should be issued in two volumes. The first devoted to neutron and photon analysis, the second to charged particle analysis.

- The subcommittee felt that the subject matter of the charged particle Handbook needed careful reconsideration to meet the needs of analysis as currently practised.

4. Nuclear Data for Biomedical Applications

Dr. Cross introduced this topic. He reported that there had been little progress in measurements of nuclear data needed for neutron therapy and indeed one of the few groups working in this area might have to cease work due to the low priority given to nuclear data in the cancer therapy field. There was continued interest in data on $\bar{W}$ and dE/dx and these topics are frequently discussed at biennial conferences held at Neuherberg near

Munich. Dr. Ferguson reported the funding of the cyclotron in the UK exclusively for neutron therapy and Dr. Deruytter pointed out that similar work was done with a cyclotron at Louvain la Neuve in Belgium where a substantial fraction of the machine time was so used.

After some discussion on the best way to formulate the needs for nuclear data in this field it was left to Drs. Cross, Ferguson and the NDS to make enquiries with their medical contacts and report back to the committee.

5. Nuclear Data for Safeguards

This matter could not be adequately dealt with in the time available. Dr. Lammer presented INDC/P(81)-24 which reviewed this topic. He was congratulated on producing what seemed the first serious attempt to analyse this question. Time would be needed to study this report and consider what future action would be required. It would provide a challenging starting point for discussions between INDC members and National Safeguarding Authorities.

INDC STANDARDS SUBCOMMITTEE

Report to the 12th INDC Meeting, October 5-9, 1981

I Subcommittee membership

H Condé	(SWD)	(Chairman)	A Lorenz	(NDS)
W Cross	(CAN)		A Michaudon	(FRA)
A Deruytter	(EEC)		J Schmidt	(NDS)
A Ferguson	(UK)		A Smith	(US)
S Kapoor	(IND)		G Yankov	(USSR)
H Lemmel	(NDS)			

II Aims and objectives

The main objective of the Standards Subcommittee is to maintain and update the nuclear data standard file in close cooperation with the NEANDC counterpart. In doing this the Committee shall judge the status of the file in relation to requested accuracies and to the particular needs of the IAEA/NDS different data programmes and point out deficiencies.

The Subcommittee shall recommend cooperative actions, in particular meetings, to be arranged by NDS in order to fulfil the above objective.

III Review of technical content of INDC-36/LN

The Subcommittee reviewed the technical content of INDC/NEANDC Nuclear Standards File, 1980 Version and commented on 1) relevant contemporary works and 2) recommendations given.

1 H(n,n)

Comment by the Subcommittee on contemporary work was:

a) A measurement with polarized protons is underway at the Indiana University cyclotron which may contribute to the understanding of the underlying reaction mechanism.

Recommendation: The Subcommittee decided to abolish its recommendation given at the 11th INDC Meeting to extend the H(n,n) cross section up to 40 MeV. This earlier recommendation was based on needs primarily presented by the US in the connection with the FMIT project - now being reconsidered.

2 $^{6}Li(n,\alpha)$

Comments by the Subcommittee on contemporary works were:

a) Institut für Experimentalphysik, University of Vienna/LASL; New data of the $^{6}Li(n,t)^{4}He$ reaction were obtained from its reciprocal reaction $^{4}He(t,n)^{6}Li$. The 0^{o} excitation function was measured between 0.079 MeV and 5.37 MeV neutron energy. In addition, angular distributions were measured at 0.236, 2.99 and 5.37 MeV neutron energy.

b) BCMN; Triton angular distributions and anisotropy measurements ($0^{o}/180^{o}$) of the $^{6}Li(n,t)^{4}He$ reaction are underway between 30 eV and 1 MeV. Results soon to be published.

c) TLU, Uppsala; Excitation function and angular distributions of the $T(\alpha,^{6}Li)n$ reaction are measured between 0.2 and 3.5 MeV.

d) ANL; Measurements underway of neutron total, scattering and (n,α) cross sections of ^{6}Li below 1 MeV.

e) Ohio University; Scattering measurements on ^{6}Li underway between 2 and 10 MeV, including R-matrix analysis.

f) JAERI; The effect of the 56 keV resonance of ^{28}Si on the detection efficiency of a ^{6}Li-glass detector has been calculated by a Monte Carlo method.

Recommendation: An appropriate goal is to extend the $^{6}Li(n,t)$ evaluation to energies of the order of 2-3 MeV. At the same time a warning statement should be included concerning the use of this standard in the region of the 240 keV resonance.

3 $^{10}B(n,\alpha_0)$ and (n,α_1)

The Subcommittee remarked that the requested accuracy of 2 % below 1 MeV is not yet achieved. Contemporary measurements were:

a) NBS; Recent measurements of $^{10}B(n,\alpha)$ to $^{6}Li(n,\alpha)$ below 1 keV are about 2 % discrepant with ENDF/B V ratios below ~20 eV.

b) BCMN; $^{10}B(n,\alpha)$ to $^{6}Li(n,\alpha)$ feasibility studies below 100 keV.

4 $^{197}Au(n,\gamma)$

Recommendation: The Subcommittee recommended to introduce a statement telling that this reaction should only be used when fluctuations in the cross section can be properly averaged. The averaging should be over at least 10 keV intervals.

5 $^{235}U(n,f)$

The Subcommittee agreed to a proposal by Kapoor to explore and if feasible include the fission fragment angular distribution in the file.

6 ^{252}Cf prompt fission neutron spectrum

Comments on contemporary works were partly given in a paper (INDC/P(81)-45) presented to the Subcommittee by Lemmel.

a) Leningrad (Blinov); Maxwellian spectrum with T=1.42 MeV. No significant deviation from Maxwellian from 1 keV to 3 MeV.

b) Dimitrovgrad (Starostov +); Maxwellian temperature 1.43 MeV. Significant deviation from Maxwellian between 50 and 500 keV.

c) Peking (Mon Jiangshen +); Maxwellian temperature 1.416±0.023 MeV. Deviation from Maxwellian between 11-15 MeV by a factor of 2.

d) Lucas Heights (Boldeman); Maxwellian temperature T=1.426±0.003 MeV.

e) ORNL (Spencer); Measurement underway.

f) Technical University Dresden (Maerten); Measurement of spectrum between 5 and 30 MeV. Deviation observed from Maxwellian at high energies.

g) ANL; Measurement planned at low energies.

h) LASL (Nix and Madland); Semi-emperical calculations of the spectrum.

Comment: The previous recommendation of a Maxwell spectrum with T=1.42 MeV was accepted as a contemporary standard.

7 $\bar{\nu}$ of ^{252}Cf

Comments made by the Subcommittee on contemporary works were as follows:

a) R I Leningrad (Aleksandrov +); Reinvestigation made of earlier Mn-bath measurement resulting in $\bar{\nu}$=3.758±0.015, which is 0.3 % higher than the old value.

b) LASL (Jurney +); The observed absorption cross section at thermal energy for sulphur (513±15b) cannot describe the discrepancy between $MnSO_4$-bath and liquid scintillator measurements of $^{252}Cf(\bar{\nu})$.

c) University of Arizona (Robertsson); Measurement underway of $\sigma_{abs}(S)$ at thermal.

8 Actinide half-lives

The Subcommittee noted that a review of this item will take place at the CRP Meeting in Vienna, October 12-13, 1981. The December 1981 Edition of the Proposed Recommended List of Heavy Element Radionuclide Decay Data. Part I: Half-Lives will be published in December 1981 as INDC(NDS)-127/NE.

9 Neutron energy standards

Recommendation: The Subcommittee recommended to update the status report to be better in line with the rest of the reports in the file.

10 Neutron-flux comparison

The comment made by the Subcommittee was:

a) BCMN (Liskien); As a BIPM action, flux-intercomparisons based on the $^{115}In(n,n')$ activation cross section were underway at 12 laboratories. In-samples and ^{51}Cr-samples for calibration.were distributed in May 1981. Results were expected in late 1981.

11 Gamma-ray standards

The subcommittee acknowledged the continuing effort of the IAEA Nuclear Data Section to compile decay data for radionuclides used as calibration standards; an updated compilation of these data is being prepared for inclusion in the 1982 INDC/NEANDC Standards File".

IV Printing and distribution of INDC-36/LN

The Subcommittee agreed to recommend the following procedure concerning the printing and distribution of the Standards File (INDC-36/LN):

The goal should be an IAEA publication ready for distribution in about one year's time (October 1982).

The content should be section A (numerical values) and section B (updated status reports) of INDC-36/LN.

It was agreed that the reviewers (see V) would be asked to update the file by January 1, 1982.

The editing would be a responsibility shared by A Smith, H Condé and the NDS.

Special comments: In view of the forthcoming publication of a book on neutron sources within the NEANDC Monograph Series the Subcommittee decided to omit the topic of "Monoenergetic Sources" from the 1982 publication of the Standards File. However, as the contents of the NEANDC book is not yet known, NDS (in contact with experts) should continue to

review the necessity for further data compilation and data evaluation activities in the field of neutron-source nuclear data, with the goal of obtaining an internationally recommended reference data file.

It was also recommended to have included a short statement about the use of correlation matrices and requested accuracies for each cross section.

V Appointment of reviewers

H(n,n)H	C Uttley
$^{6}Li(n,t)^{4}He$	A Smith
$^{10}B(n,\alpha)^{7}Li$	A Deruytter/E Wattecamps
C(n,n)C	A Smith
$^{197}Au(n,\gamma)^{198}Au$	To be decided
$^{235}U(n,f)$	G Yankov
^{235}U fiss fragment ang distr	S Kapoor
^{252}Cf fiss spectr	H Lemmel/G Yankov/H Condé
$\bar{\nu}$ of ^{252}Cf	A Smith/A Carlsson
Actinide half-lives	A Lorenz/Vaninbroukx
Thermal constants	A Smith/N Holden
Gamma ray standards	A Lorenz/LMRI (Legrand) (to be confirmed)
Neutron Flux Comp	A Michaudon/G Grenier
Neutron Energy Standards	D James/H Condé
$^{27}Al(n,\alpha)$	H Vonach
$^{238}U(n,f)$	A Smith

VI Coordination with NEANDC

The Subcommittee was informed about the decision of the NEANDC Standards Subcommittee to take the responsibility for the next updating of the file. The understanding of the NEANDC Subcommittee was that the updating responsibility should alternate between the two subcommittees with a frequency of about 4 years.

An action was placed on the Chairman of the Subcommittee to inform the NEANDC Standard Subcommittee Chairman about the proposed procedure of reviewing, editing and printing the present file.

VII IAEA/NDS coordinating activities

A Smith informed the Subcommittee about the status of the International Exchange of standard reference ^{235}U fission foils. Participating laboratories were ANL, NBS and Leningrad. Exchange of foils were underway.

A Ferguson informed the Subcommittee about the progress in the BIPM correlated activity on Fission cross section transfer instruments. The fission chambers had been tested at the IBIS machine in Harwell. The chambers were going to be used for flux intercomparison at 2.5 and 14.7 MeV at a large number of laboratories.

The Subcommittee screened the report on "Decay Data for Calibration Standards" (INDC/P(81)-25) and found it a very useful document, which should be published as an INDC report. The International Committee for Radionuclide Metrology (ICRM) has collected radionuclide data, which are in use in National Metrology Laboratories. The material is under review for publication as a NBS special publication. An action was put on Lorenz to keep contact in this matter with Bambynek, BCMN who is the Secretary of ICRM.

Lorenz was also asked to explore the possibility to include a list of X-ray emission probabilities (see Nuclear Data Tables) for the benefit of PIXE analysis.

VIII Meetings

The Subcommittee endorsed the proposals to hold a Specialist Meeting in 1982 on "Fission cross section for ^{235}U", and an Advisory Group Meeting on "Standard Reference Data" in 1984.

IX Recommendation

The Subcommittee asked for endorsement of the following recommendation to be sent from the INDC to the IAEA.

"In view of the high value of an international file of nuclear data standards for measurements of nuclear data to scientists in all Member

States, the INDC recommends that the INDC/NEANDC Nuclear Standards File, produced and kept up-to-date by members of the INDC and NEANDC, be periodically published; the frequency of publication is anticipated to be four years. The value of the publication depends heavily on a minimum time delay between the production of the final version of the manuscript and its publication."

Appendix 8

REPORT OF THE DISCREPANCY SUBCOMMITTEE

October 9, 1981

Members: L. Auler, H. Derrien, F. Froehner, R. Haight, K. Harada, B. Kuzminov, K. Okamoto, J. Rowlands, J. Schmidt, and H. Motz (Chairman)

The Subcommittee reviewed the reports from the 11th INDC Meeting and from the NEANDC Meeting in April, 1981. It was agreed that both committees would drop the $^{63}Cu(n,\alpha)^{60}Co$ discrepancy entry since there is good agreement between calculations based on microscopic cross sections and integral measurements. The subcommittee agreed to remove thorium and ^{233}U from the list.

Three new items were added to the discrepancy list:

- Scandium - minimum cross section value at 2 keV
- $\bar{\nu}$ for ^{237}Np.
- Cr and Ni total and inelastic cross sections

The subcommittee agreed that only high-priority, important discrepant data should be included in the current list. Also, cross sections crucial to the optimum design and characterization of essential neutron sources or techniques should be included. This latter aspect applies to Sc (neutron source) and Np (technique).

The objective of the committee is to review the status of these cross-sections, remove them when deemed appropriate, and to add new significant discrepancies when required.

A suggestion was made that the effectiveness of the INDC Discrepancy List might be increased if a summary could be published in a generally circulated technical journal. Cooperation and coordination with NEANDC seems reasonably strong at the present time and continued effort will be made to strengthen this mutual effort. A common file will be distributed soon to both committees.

STATUS OF INDC DISCREPANCY LIST

1. $^{7}Li(n,n'\alpha)t$ - Referred to Subcommittee B
2. Cr, Fe and Ni capture - F. Froehner
2a. Cr and Ni total/inelastic - A.B. Smith
3. $^{63}Cu(n,\alpha)^{60}Co$ - removed from list
4. $^{93}Nb(n,n')^{93m}Nb$ - to be submitted by J.J. Schmidt
5. ^{232}Th capture - removed from list
6. ^{232}Th fission - removed from list
7. ^{233}U fission - removed from list
8. ^{235}U fission - referred to Standards Subcommittee
9. ^{238}U capture - J. Rowlands
10. $^{238}U(n,n')$ - A. B. Smith
11. $^{237}Np(n,2n)^{236}Np$ - H. Derrien
12. ^{239}Pu decay power - H. Motz
13. ^{241}Am fission - F. Froehner
14. ^{235}U and ^{239}Pu resonance parameters
15. $^{103}Rh(n,n')^{103m}Rh$ - to be submitted by N. Kocherov
16. Sc - 2 keV minimum - R. Chrien (NEANDC)
17. $\overline{\nu}$ for ^{237}Np -B. Kuzminov

Detailed comments on most of the items follow.

2. Fe, Ni, Cr Capture

New resonance measurements on Fe and Cr isotopes are under way at Geel, and on Fe and Ni at Harwell. Resonance parameter analysis for Fe and Ni isotopes is in progress at ORNL. A recent analysis of Geel linac data performed at Harwell with the REFIT code gave a radiation width of 0.99 eV for the 27.7 keV resonance of ^{56}Fe in excellent agreement with the result obtained at the KfK Van de Graaff in 1978 with a quite different technique, viz. 1.00 $\pm$ .06 eV. In view of this agreement it may be hoped that the new data, once completely analyzed, and the evaluations in progress at ORNL, Bologna, Japan and Cadarache, help to define the capture cross-sections of Cr, Fe and Ni with the requested accuracies up to 300 keV or higher.

2a. Cr and Ni total/inelastic

Recent measurements (P. Guenther, et al) give concern for neutron total and inelastic scattering cross sections of Cr and Ni. In particular, the totals are larger than commonly accepted in the 1-3 MeV region and the inelastic scattering from the prominent Ni58 isotope considerably smaller within $\sim$1 MeV of threshold.

4. $^{93}Nb(n,n')^{93m}Nb$ - To be submitted by the NDS.

5. ^{232}Th Capture - No new data were reported.

The corrected data from ORNL (Macklin) have now been published: Nuclear Science and Engineering 79(1),p 118-122, 1981. The corrected data are in better agreement with other published data.

6. ^{232}Th Fission - No new data or evaluations reported.

9. ^{238}U Capture

Discrepancies have arisen between integral and differential data in three aspects of the U238 capture cross-section involving:

1. The energy variation at thermal energies below about 1 eV;
2. Thermal reactor lattice resonance integrals;
3. Fast reactor spectrum average values.

The data were reviewed at the U + Pu resonance parameter meeting. Dr. Tellier (France) reported that the thermal region data had been adjusted by changing the slope. The latest resonance region data, combined with a multilevel formalism reproduce the lattice resonance integrals satisfactorily and so there is no longer a discrepancy in resonance region data in thermal reactor applications. There is a discrepancy of 8 % in the Argonne fast reactor critical experiment analysis made of the reaction rate ratio U238 σ c/Pu239 σ f using ENDF/B-V. There is a factor of two discrepancy between measured and calculated self-shielding effects in the energy range 40 - 100 keV reported by Kononov (Kiev Conference, 1980). (The measured factor is 0.82 and the calculated factor is 0.92).

Moxon's measurements of the capture cross-section of U238 below the 6.7 eV resonance show a point at 0.3 eV which is above the 1/v slope. This point might indicate the presence of a small resonance but the accuracy is comparable with the background uncertainties and the effect might be due to ^{235}U contamination.

There is a need to extend the representation of individual large resonances up to about 10 KeV instead of the present statistical treatment above 4 KeV, because the structure is significant.

Covariance data should be given for the three lowest energy resonances and average data at higher energies.

There is evidence of significant crystalline binding effects in the 6.7 eV resonance in uranium compounds in the measurements of Seidel et al (Dresden). Some other measurements in both the thermal and fast region have also indicated a high Debye temperature for oxides, while other measurements do not show these effects. There is, therefore, a discrepancy in the measurement of this effect.

Comparisons of measurement techniques used in differential and integral measurements indicate consistency to within $\sim$ 0.7 %. The metnodology is described in a paper submitted to NIM.

Kuzminov reported that preliminary results from about 10 keV to 1 MeV have been reported at the Kiev Meeting. The self-indication technique was used. The U.S. is planning a detailed review of the intercomparison of integral and differential U-238 capture-rate measurements.

10. $^{238}U(n,n')$

No new data were reported. The Oak Ridge value of 381 ± 21 mb at 82 keV has been published: Nuclear Science an Engineering. Recent ANL results at 1.0, 1.5, 2.0. 2.5 and 3.5 MeV support the evaluation of ANL/NDM-32.

11. $^{237}Np(n,2n)$

A new evaluation has been performed by E. Fort of Cadarache. In this evaluation it was suggested that the discrepancy between the integral data of Paulson et al and the evaluations based on microscopic experimental results can be removed by assuming that: 1) ^{237}Np in its ground state and ^{236m}Np have spin and parity 6- and 1- respectively; 2) the isomer ratio has a strong energy dependence. The second possibility was also suggested by Patrick in his review to NEANDC/INDC discrepancy subcommittees (NEANDC(E)-124 A and INDC(UK)-33/G).

Recommendations should be made for measurements of the isomer ratio and of Np (n,2n) cross-sections between 7 MeV and 10 MeV neutron energy.

12. ^{239}Pu Decay Power

The new Japanese Fission Product Decay Data File (INDC(JAP)-59/L has been used to predict the separate beta- and gamma-ray components of ^{235}U fission versus time. The agreement with experiment is greatly improved over the ENDF/B-V file calculation. The major change is that the inferred beta energy for short-lived, high Q value decay products is modified according to the theory of Yoshida (NSE 63 376 (1977)). This work has now been published in the Journal of Nuclear Science and Technology 18[6], 393-407, June, 1981.

It is not known if this new data file has been used to calculate the total decay heat of ^{239}Pu thermal fission. Such a calculation might indicate whether the Los Alamos or Oak Ridge decay heat for Pu requires renormalization as well as decrease the experiment/calculation difference.

Rowlands described an analysis by N.F. James which shows that the ratio of after heat of ^{239}Pu to ^{235}U from the Los Alamos and the Oak Ridge data are in close agreement. These experimental values, however, disagree with the calculated ratio in magnitude, being greater by ~8 %. The ratio is somewhat time dependent (+ 7 % from the average) and the experimental and calculated time variation shapes agree quite well.

The experimental and experiment vs calculation discrepancy remains, but further analysis might help clarify this situation. Some experimental verification of the Japanese beta-decay energy model might be valuable.

13. $^{241}Am(n,f)$

The discrepancy in the subthreshold region below 100 keV is cleared up. There remains, however, a discrepancy between directly measured fission resonance integrals (Bak et al. 1970, I_f = 21 ± 2 b; Zhuravlev et al. 1976, I_f = 27.7 ± 1.6 b) on one hand and calculations from point data generated from resonance parameters on the other, e.g.

Lynn et al., I_f = 11.1 b for E > 0.4 eV;

KEDAK, I_f = 14.1 b for E > 0.5 eV.

The fission width of the 0.58 eV resonance is known only to about 25 %, but raising it by 2σ reduces the discrepancy ($I_f \simeq$ 17 b) but does not remove it completely. Better and well documented resonance integral measurements are recommended, with due account of the resonance at 0.31 and 0.58 eV.

14. ^{235}U and ^{239} Pu Resonance Parameters

Discussed in Subcommittee A; short report submitted by F. Froehner.

15. $^{103}Rh(n,n')^{103m}Rh$

To be submitted by N. Kocherov.

16. The minimum in the total cross-section of scandium at 2 keV

Recent cross-section measurements near the 2 keV minimum in scandium have thrown doubt on the cross-section value in the minimum. Razbudey et al (79 Knoxville p.890) reported a measurement made at the WWR-M reactor at Kiev of 263 ± 70 mb. More recently Kobayashi (Kyoto University Research Reactor Institute) has reported a value consistent with this. The accepted value for a number of years has been a value of 710 ± 30 mb measured by a RPI/Brookhaven collaboration but there is also an old Idaho measurement by Wilson: Simpson and Miller, Nucl.Inst.Meth. 61,245,'68 of 50^{+120}_{-50} mb. Both of the new results use scandium refined and purified in the USSR while the RPI/BNL result is based on scandium obtained in the U.S.

The explanation for the discrepancy may lie in the purity of the samples used; hence it is of some importance for the users of beam filters to know the correct cross-section. If impurities are the cause of the disagreement then considerably more neutron intensity is available to them by purifying the scandium. Efforts are underway at ORNL, BNL and RPI to understand the discrepancy.

17. $\bar{\nu}_p$ measurement methods and ^{237}Np

Frehaut (Bruyeres-le-Chatel) experimental values of $\bar{\nu}_p$ for ^{237}Np are systematically less than Veeser (Los Alamos) and Malinovsky (Obninsk) values by 4 %. Reanalysis of experimental conditions and corrections are needed. Control measurements would be useful in one or two points.

Appendix 9

Report of the Ad-Hoc Sub-Committee on the "Barn"

The sub-committee has considered what steps should be taken in response to the action of the U.K. Department of Trade, which included the barn in a list of units not to be used after 1 September 1980. It is expected that this action will be discussed at the next meeting of the Comité Scientifique et Technique (CST) of the EEC, before the end of 1981. The history of discussions on the barn between the CIPM and the EEC, and the subsequent issuing of Directive 80/181/EEC, suggest that the EEC is committed to retention of the barn until otherwise advised by the CIPM. It is therefore considered unnecessary and inappropriate for the INDC to approach either the U.K. Department of Trade or the EEC at this time.

The sub-committee recommends that INDC members from EEC countries should ensure, before the next CST meeting, that their national representatives to the CST are well informed of the importance of the barn to the international nuclear data community and of the INDC's support for the continuing use of the barn. Similar information should also be given to Mr. U. Gat of ORNL who is reported to have recently petitioned the Comité Consultatif des Unités to phase out the barn at an early date.

The sub-committee also recommends that the INDC reaffirm its position in support of use of the barn. INDC members should inform the INDC chairman promptly of any national developments not in accord with the stated position of the CIPM on this matter.

W. Cross (Chairman)
A. Ferguson
A. Michaudon
G. Yankov

Appendix 10

Report of Ad-hoc Subcommittee on Meetings and Future NDS Programs*

by

A.B. Smith, Chairman

12th INDC Meeting, Vienna, 5-9 October 1981

It is the charge of this Subcommittee to offer guidance as to the IAEA/NDS program of meetings and as to broad and general aspects of the NDS program.

I. Comments on Future-Program Trends.

The recent IAEA emphasis on reactor safety, safeguards and technical assistance to developing nations is properly reflected in NDS activities. The NDS should continue to productively address data issues in the areas of safeguards and reactor safety. NDS experience, and that elsewhere, suggests a modest need for safeguards nuclear data particularly oriented towards universally accepted data bases for the assay of special nuclear materials. Nuclear data are essential for the safe operation of fission-energy systems and increasingly so as safety requirements become more stringent and public concern increases. The NDS program gives emphasis to safety related data both explicitly (e.g. damage data) and implicitly (e.g. data for neutronic and incident analysis). The new major NDS effort in technical assistance to developing countries is requiring different professional capabilities and management skills that imply changes in established NDS program methodology.

If the NDS technical assistance activities of various forms, grow over the next few years to form a major part of the program, they will demand changes in the NDS personnel capabilities with much more emphasis on experimental and instructional skills. Some of this new competence can be obtained by re-orienting existing personnel but, in addition, the NDS should bias its normal recruitment in favor of personnel skilled in the essential experimental and instructional areas. Similar personnel considerations may very well be reflected in the makeup of the INDC itself.

The Physics Section has broad experience in technical assistance programs particularly involving an experimental capability complementing NDS analytical and data resources. Other complementing skills are available elsewhere in the IAEA. Close cooperation with the Physics and other Sections is encouraged. This could include: joint proposal review, complementary support, and common peer review. Uncorrelated, or even redundant, technical assistance efforts are to be very much avoided. The technical assistance program is an IAEA effort and the NDS should participate within that broad context.

The Subcommittee re-affirms the importance of maintaining a first-rank data-center competence at the NDS in the present changing environment. Toward that end:

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*Reference INDC-35/U, INDC(SEC)-124, INDC/P(81)-29 and reports of other subcommittees.

1) The NDS, in addition to routine center services, should pursue work of professional stature (e.g. the past evaluations of 2200 m/s constants, the present activation handbook, etc.). Professional results should be reported in a manner that assures their recognition and use. A two-tiered publication system is suggested. Routine contemporary documents can proceed via the established INDC report series. Work of higher professional stature (e.g. selected CRP, and Subcommittee reports, activation handbook, etc.) should be published in an alternate manner which establishes international recognition of excellence. The IAEA Technical Report Series may be a suitable vehicle. Such excellence will require commensurate peer review and editorial policies.

2) Continued coordination of evaluation activities on an international basis with increasing involvement of developing countries should be pursued. Initially, developing country contributions could be of a support nature involving nuclides and reactions of modest importance. Subsequently, their contributions should grow to high-quality evaluations including error-uncertainty specification.

3) Specialized and well validated reference files and compilations should be produced in EXFOR and ENDF formats (e.g. benchmark compilations suitable for testing differential data). Such an effort may require study of methods of selection and validation.

4) The transfer of nuclear technologies to developing countries enhances the importance of the NDS role in organizing technical meetings where the status and requirements for nuclear data can be assessed and guidelines formulated for future experimental and theoretical work.

5) The NDS should continue to seek out and address basic physical problems underlying the provision of essential nuclear data. The forthcoming meeting on the physics of level densities is a good example of such an initiative.

The increasing NDS emphasis on relatively extended training programs and the contemporary character of the data field wherein appreciable effort is required for significant improvements suggest that consideration could be given to revising the interval between INDC meetings so as to most efficiently provide consultation and advice. Such a change should only be made in concert with the NEANDC and with the clear understanding that the responsiveness of INDC members between meetings be effective.

II. Meeting Values, Procedures and Policies

The meeting program remains a very major and successful aspect of NDS activities extending from professionally excellent working groups to productive training-oriented programs. In the Subcommittee's view the NDS has reasonably followed meeting guidelines set forth at the 11th INDC meeting (INDC-35/U, Appendix 7). Care should be taken to continue to adhere to these guidelines. Training and assistance meetings tend to be of relatively large size. However, technical meetings are often most productive when well focused and of relatively small size.

III. Meeting Schedule

A. Major Regional Conferences

Three such conferences are planned over the '81-'84 period; 1) Inter. Conf. on Nucl. Data for Science and Technology, Antwerp (6/9/'82), 2) 6th All Union Conf. on Neut. Physics, Kiev (fall of '83), and Conf. on Nucl. Cross Sections for Technology, U.S., possibly BNL ('84). Detailed planning for the Antwerp conference is in progress.

A Conf. on "Nuclear Data for Nucl. Energy-Status and Perspective" may be jointly undertaken by the NDS and NEA in approximately '86. The concept is one of assessing the present and future of the field. The conference may replace a regional European conference projected for about the same period. At the present the concept is speculative.

B. Symposia

An IAEA symposium on the "Significance and Impact of Nuclear Research in Developing Countries" is planned for '84. This division-wide meeting will offer an opportunity to critically assess the IAEA technical assistance efforts.

The Agency's symposia on "Physics and Chemistry of Fission" have made notable contributions to basic understanding directly related to applied data. The Subcommittee recognizes that policies no longer permit the support of this series by the IAEA (Phys. Sec.). However, the Subcommittee felt the outstanding value of these symposia fully warrants their continuation and that appropriate support will be forthcoming from outside the IAEA. The IAEA Physics and ND Sections should use their good offices to encourage a continuation of this series.

C. Seminars and Schools

1) ICTP Training Courses on Theory and Evaluation

These courses are recommended on a biennial basis as being of appropriate technical quality and content and as being responsive to IAEA initiatives toward assisting developing countries in nuclear sciences. Two such courses are scheduled to be held at ICTP, Trieste, in early '82 and '84 respectively.

2) Interregional Technical Assistance Training Course on the Utilization of Neutron Generators

The Subcommittee felt this course was a proper experimental aspect of the more general Interregional Technical Assistance Project (TA/INT/1/018) for Training in Nuclear Data Techniques and Instrumentation. It is scheduled for '82 at Kossuth Univerity, Debrecen, Hungary with a duration of approximately five weeks.

3) Interregional Technical Assistance Training Course on the Methodology of Evaluation and Processing of Nuclear Data for Nuclear Reactor Applications

This course has the objective of an in-depth application of the percepts setforth in Title C-1, above, and is a part of the Project (TA/INT/1/018). It is scheduled for '83 in Vienna for a duration of about 4 weeks.

4) Neutron Physics and Nuclear Data Measurements with Accelerators and Research Reactors

This training course has been suggested for '83, Moscow. Firm scheduling is contingent upon the receipt of a formal proposal from the USSR State Committee and consistency with IAEA scheduling policies. Due to these uncertainties this course is not shown on the calendar, below.

D. Advisory Group Meetings

1) Advisory Group Meeting on Nuclear Data for Radiation Damage and Safety

Scheduled immediately after the 12th INDC Meeting (12/10/'81, Vienna).

2) Advisory Group Meeting on Nuclear Structure and Decay Data

This is a continuation of a series of meetings essential to the success of the international effort in the compilation of nuclear structure and decay data; scheduled for 5/'82, Utrecht.

3) Advisory Group Meeting on Basic and Applied Nuclear Level Densities

This meeting was endorsed for early '83. However, the Subcommittee emphasized that the objective was improved basic understanding relevant to applications. The view was expressed that many of the new developments were in Western Europe and the USSR. With those considerations in mind some reservation was expressed for a possible U.S. location as such would limit European attendance. Possible alternative locations mentioned included KFK. Concern was also expressed for some of the proposed technical content as being too elementary and/or antiquated. Some consultation with top-level theorists should be sought in the planning stages.

4) Standard Reference Data

The Standards Subcommittee has repeatedly recommended this broad-scope meeting for '84 as appropriate to the development of the field. A possible location is CBNM.

5) Nuclear Data for Fusion

This meeting was recommended by the Advisory Group Meeting of '78 and repeatedly endorsed by Subcommittee B. A possible date is '85 at Juelich. The original schedule was for '84 but there is a conflict with the TND meeting, below. In any event, the matter can be reviewed by the INDC at its next meeting.

6) Advisory Group Meeting on Transactinium Nuclear Data

Subcommittee A considered this meeting in some detail. It was acknowledged that the field was of importance but several NEANDC specialists meetings (see H, below) will address portions of the field in the next several years. Therefore this broader meeting was deferred until '84 with the possible location in Sweden. The INDC will review this program at its next meeting.

7) Unapproved

An Advisory Group meeting on "Nuclear Data for Medical Radioisotope Productions", projected at the 11th. INDC meeting, was not endorsed in accord with the recommendations of the relevant consultants meeting of '81.

E. Technical Committee Meetings

1) International Nuclear Data Committee (INDC)

The accepted 18 month meeting interval implies meetings in 5/'83 and 10/'84, the former outside Vienna, the latter in Vienna.

2) IFRC Subcommittee on Atomic and Molecular Data for Fusion

Two meetings of this subcommittee are scheduled ('82 and '84) but are not a part of the INDC meeting considerations.

F. Consultant's and Specialist's Meetings

1) U and Pu Resonance Parameters

Past, 9/'81.

2) Nuclear Data for Medical Radioisotope Production

Past, 4/'81.

3) Nuclear Reaction Data Centers (NRDC)

These centers are working smoothly and the Subcommittee is pleased to note that, as a consequence, the schedule of these meetings can be stretched from 12 to 18 month intervals. Meetings are planned for 5/'82 (Vienna) and 11/'83 (USSR).

4) U-235 Fast-fission Cross Sections

This meeting has been strongly recommended by the Standards Subcommittee at several of its last meetings. The schedule calls for 11/'82 and should be consistent with the international comparison of fissile foils.

5) Nuclear Structure and Decay Data Network (NSDD)

This meeting continues the schedule of NSDD network meetings but at a reduced frequency. It is scheduled for 5/'84 (Vienna).

6) Bore-hole and Bulk-media Assay Using Nuclear Technologies

Subcommittee B suggests a small meeting to assess the data needs of this application area. The suggested schedule is '83 (Vienna).

7) Nuclear Data for Safeguards or Safety

Subcommittee B suggested a consultant's meeting to assess data needs and status in the safeguards area. It was recognized that safeguards efforts do employ significant nuclear data in their assay techniques. It was less certain that safeguards efforts appreciate the potential of highly accurate and reliable data in their work. The objective of the meeting would be an in-depth assay of nuclear data for safeguards.

Subcommittee A suggested an alternative meeting dealing with nuclear data for reactor safety. Again it is not clear that the potential of highly accurate data is fully appreciated.

It is not evident at this time which of the above two topics is preferable and the choice is deferred until the 13th INDC meeting. The latter will occur well before the scheduled '84 date.

8) Atomic and Molecular Data Meetings (A & M)

These are not of direct relevance to the INDC but they are title:

--- Meetings of the A+M data-center network in '82 and '84.
--- Meetings of the coordinated research program on atomic collision data for plasma diagnostics in '82, '83 and '84.
--- Specialists meeting addressing high-priority A+M collision data for fusion in '83.

G. Meetings of Coordinated Research Projects (CRP)

1) Intercomparison of Actinide Neutron Nuclear Data Evaluations:

Two meetings are scheduled as per recommendations of Subcommittee A, 10/'81 (Vienna) and 9/'82 (Antwerp). With these two meetings this program is terminated.

2) Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data

Two meetings are scheduled, 10/'81 (Vienna) and 9/'82 (Antwerp). Again with these two meetings this program is terminated.

3) Actinide Neutron Reaction Data

Two meetings are planned for '83 and '84 as part of a new CRP complementing the previous effort (G-1, above). Subcommittee A suggests two possible topics: i) testing of previously submitted actinide evaluations, or 2) comparisons of neutron evaluations in the structural-material area. The exact future course should be considered by the CRP Group in its remaining two meetings (G-1, above).

4) Actinide Nuclear Decay Data

This CRP is a follow-on of G-2 above. Two meetings are now planned ('83 and '84). This effort has been remarkably successful with particularly competent people working to a high professional standard. In view of this excellence, participants in the present CRP(G-2) are best able to judge their future course.

5) Measurement and Analysis of 14 MeV Neutron Cross Sections

This CRP is endorsed by the ad-hoc Subcommittee on the Interugeerial Project Activities as a proper facet of the NDS program of assistance to developing countries and as complementing seminars and schools noted above. Three meetings are planned ('82, '83 and '84). The emphasis will be on 14 MeV neutron cross sections, their measurement and their evaluation.

H. Relevant Meetings Under Other Than IAEA/NDS Auspices

1) Actinide inelastic neutron scattering, Paris 11/'81 (NEANDC).

2) Capture gamma-ray properties, Grenoble, 9/'81.

3) Properties of Nuclei Far from Stability, Denmark, 6/'81.

4) Average Resonance Spacings, Paris, 10/'81 (NEANDC).

5) 50th Anniversary of the Neutron, Cambridge, 9/'82.

6) Fast-neutron Capture, Argonne, 4/'82 (NEANDC).

7) Thermal-reactor Benchmarks, Brookhaven, 5/'82.

8) 4th ASTM Conference, Washington, 3/'82.

9) Shielding Benchmark Meeting, Japan, '82 (NEACRP).

10) Possible INTOR Benchmark Meeting, Vienna, 3/'82.

11) Fission-product Yield and Decay Properties, Brookhave or UK, '83 (NEANDC).

12) Optical Potentials for Applied Nuclear Calculations, '84 (NEANDC).

CALENDAR

	'81	'82	'83	'84	>'84
Major Conference	None	Antwerp (6/9/82)	Kiev (fall)	U.S. (fall)	NDS/NEANDC(?) '86
Symposia	None	None	None	Impact of Tech. Assist. Vienna	
Training Courses	None	ICTP, Trieste, 1/'82 14 MeV Generators, Debrecen, 6/'82	Methods of Evaluation (Vienna)(Deferred to 1984)	ICTP, Trieste, 1/'84	
Adv. Group. Mtgs.	Radiation Damage, Vienna, 10/'81	NSDD, Utrecht, 5/'82	Level Densities 3/'83	Standard Ref. Data, CBNM Trans. Act. Data, Sweden(?)	Fusion Data, Julich, '85
Tech. Com. Mtgs.	INDC, Vienna 10/'81	IFRC (A & M)	INDC, Outside Vienna, 5/'83	INDC, Vienna 10/'84 IFRC (A & M)	
Consultant's & Specialist's Mtgs.	U & Pu Reson. Par., Vienna, 9/'81 Bio-med Data, Vienna, 4/'81	NRDC, Vienna, 5/'82 U-235 σ_f, Vienna 11/'82 A & M Network 11/'82	NRDC, USSR, 11/'83 Bore-hole and Bulk-media Assay **Radiation damage of structural materials** **A & M Fusion Data**	NSDD, Vienna, 5/'84 Safeguards or Safety Data A & M Network	
CRP Mtgs.	Actinide Eval. Vienna, 10/'81 Actinide Decay, Vienna, 10/'81	Actinide Eval. Antwerp, 9/'82 Actinide Decay, Antwerp, 9/'82 Neut. Cross Sec. Meas. Vienna, 6/'82 A & M Diagnostics Vienna, 4/'82	Actinide Eval. (follow-on) Actinide Decay, (follow-on) Neut. Cross Sec. Meas. A & M Diagnostics	Actinide Eval. (follow-on) Actinide Decay, (follow-on) A & M Diagnostics Neut. Cross Sec. Meas.	
Others	Inel. Scat. Paris, 11/'81 (NEA) Capture γ-ray, Grenoble Ave. Res. Spacings Paris (NEA) Nuclides far from Stability, Denmark	50th Ann. of Neut. Cambridge, 9/'82 Fast Capture, ANL 4/'82 (NEA) Shielding Benchmarks, Japan 4th ASTM, Washington	Fission-Products, BNL (NEA)	Optical Potentials (NEANDC)	

Appendix 11

Report of the Interregional Project Subcommittee

1. Interregional Project

The INDC acknowledges the activities by the NDS for implementation of the "Interregional Project on training in nuclear data techniques and instrumentation" (TA/INT/1/018), as they are reviewed in the reports INDC/P(81)-6, 10, 11, 15.

Keeping in mind the increasing importance of contributions by the NDS to the IAEA areas of high priority, such as the technical assistance to the developing countries, the INDC subcommittee definitely supports this project. Also taking into consideration the objectives of INDC and the NDS the subcommittee confirms its recommendation at its previous meeting, that the topics of cooperation selected for the IP should be directly related with the nuclear data field, including data measurements as well as the development of the corresponding instrumentation, theoretical calculations, evaluations etc.

A controlled flexibility is recommended in the selection of projects, institutes and persons, which are foreseen for fellowships and expert missions, having in mind the overlapping between nuclear data and other fields of applied nuclear research. The INDC subcommittee, therefore, strongly recommends close contacts and coordination between the NDS and particularly the Physics Section especially during the phase of planning new acvtivities (fellowships, expert missions, research contracts) resulting, if possible, in common proposals of both sections to the IAEA Technical Assistance Division.

The INDC subcommittee further recommends an increase of financial support for the IP by IAEA Technical Assistance, particularly for equipment and materials, considering, that the financial resources which were so far foreseen in the 1981/82 Regular Budget of Technical Assistance are not considered to be sufficient. The subcommittee would also like to strongly endorse the importance of fellowships and scientific visits for furthering the training objectives of the IP and encourages the Agency to support appropriate applicants to its fellowships programme in the context of this project.

2. Interregional Training Courses

2.1. Utilization of Neutron Generators, Debrecen, Kossuth University, in June/July 1982

The objective of this training course is to enable scientists in developing countries to achieve the required expertise in fast neutron data measurements, the study of neutron interactions with reactor structural materials and the technological applications of immediate benefit to these countries.

Guidelines for standard measurements and a laboratory manual to the exercises including about 12 measurements in the field of neutron data and the application of nuclear methods will be prepared in advance by an international group of advanced laboratories.

The participants should have basic knowledge of nuclear physics and some experience in the work with fast neutrons.

The INDC Subcommittee supports the general scope, preliminary programme, and list of invited speakers. The final programme, the list of invited speakers, the guidelines and the laboratory manual should be prepared until the end of January 1982 by the host institute in connection with the NDS.

2.2. Methodology of Evaluation and Processing of Nuclear Data for Nuclear Reactor Applications, Vienna, 1983

Having in mind the growing interest of developing countries in nuclear reactor programmes, the subcommittee supports the proposal to organize a Training Course on Methodology of Evaluation and Processing of Nuclear Data for Nuclear Data Applications. The Technical equipment of the IAEA and the experience of the NDS staff are considered as a propriate base for such a training course. During this course a close contact between highly qualified specialists in nuclear data evaluation and multigroup cross section processing from developed countries with participants from developing countries should be ensured, for making them familiar with data evaluation and processing methods used in developed countries. For an intensive training the number of participants should be limited to about 15 - 20.

2.3. Training Course on Neutron Physics and Nuclear Data Measurements with Accelerators and Research Reactors, Moscow, 1983

The proposal of the USSR State Committee on Atomic Energy to organize a special training course in connection with a study tour to several laboratories including Kurchatov Institute in Moscow in the second half of 1983 was discussed. The main emphasis will be placed on neutron physics and neutron nuclear data measurements currently performed with electrostatics generators, cyclotrons Linac and research reactors in the Institutes to be visited. It is understood that this course will be financed through the USSR voluntary contribution to the Technical Assistance fund in the IAEA.

The INDC supports the idea of organizing of such courses and proposed also to consider the possibilities to include some experimental exercises for participants for an increase of the training effect.

The NDS in contact with IAEA Technical Assistance should clear up the possibilities of organization of the two training courses mentioned above in the same year, having in mind that the potential participants for both courses are quite different.

3. ICTP Trieste Courses

The IP subcommittee acknowledges the evaluation of the 1980 Trieste Course, as it was presented by the NDS (INDC/P(81)-18) and recommends an evaluation of the usefulness of the courses over a longer period of several years at an appropriate time in the future.

Further courses mainly should deal with fundamental and applied nuclear theory, including the theoretical interpretation of experiments, in close contact with the nuclear data evaluation. Therefore, computer exericses and correpsonding workshops should be foreseen necessarily. The availability of appropriate computer facilities will be a pre-requisite for conducting of useful computer exercises at the ICTP.

It is proposed by the subcommittee to concentrate the 1984 Trieste Course on Basic foundations and definitions of nuclear model parameters, which are used in nuclear data calculations, closely connected with corresponding computer exercises. This will prevent a strong overlapping with Trieste meetings on basic nuclear physics.

For the future it should be recognized, whether it is possible to include experimental exercises for the course participants at the Legnaro nuclear center.

4. Other Activities associated with the IP

4.1. Coordinated Research Programme on the Measurement of Fast Neutron Cross-Sections

The proposal of the NDS for a Coordinated Research Programme on "Measurement and analysis of 14 MeV neutron nuclear data needed for fisson and fusion reactor technology" (INDC/P(81)-21) is strongly supported by the members of the IP subcommittee. Of special interest in connection with this CRP is the close contact between several advanced laboratories with corresponding groups in developing countries on well-defined limited topics around 14 MeV nuclear data measurements and analysis. This programme could be a realistic step to train nuclear scientists from developing countries as well as to improve the status and accuracy of 14 MeV neutron nuclear data.

4.2. Divisional Symposium on "Significance and Impact of Nuclear Research in Developing Countries: Physical Sciences", 1984

Dr. J. Schmidt informed the members of the subcommitte about plans for a Symposium, organized by the sections of the IAEA Division of Sciences on "Significance and Impact of Nuclear Research in Developing Countries". The INDC subcommittee members endorse the usefulness of this symposium and recommended an active participation of the NDS in the planning and preparation of this symposium. The subcommittee of IP proposes, that all INDC members should inform the national members of the SAC about this symposium and other recommendations of the INDC in connection with the IP.

The 1984 Symposium could be used also for discussions on the future scope of INDC and NDS activities in connection with the support to developing countries.

Summary on the Fourth Meeting of the Coordinated Research Programme (CRP) on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data

The Fourth Research Coordination Meeting of this Project took place in Vienna, 12-13 October 1981. See INDC(NDS)-131 for a summary report.

Main Objectives

The objectives of the CRP are, to intercompare existing evaluations of actinide neutron data, to produce improved evaluations and, finally, to arrive at an international data file for actinide evaluations.

In addition, the CRP aims at coordinating evaluation activities, and to bring new evaluators in contact with more experienced evaluators.

Conclusions and Results of the Meeting

The preliminary version of INDL/A, the IAEA Nuclear Data File for Actinides, consists of 20 complete evaluations and some incomplete ones (resonance region only), which have been intercompared with ENDF/B-5 and other available evaluations. For further details see document IAEA-NDS-12, which includes documentations and graphical plots.

By the end of 1982 INDL/A is planned to be finalized and released for testing and validation in benchmark experiments. A new CRP is envisaged on the validation and further improvement of INDL/A.

Summary on the Fourth Meeting of the Coordinated Research Programme (CRP) on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data

Introduction

The fourth meeting of the participants in the IAEA Coordinated Research Programme (CRP) on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data was convened by the IAEA Nuclear Data Section on 12-13 October 1981, at IAEA Headquarters, Vienna. The meeting was chaired by A. Lorenz, IAEA Nuclear Data Section.

Main Objectives

The principal objectives of this meeting were to review the status of measurements performed by the participants in this programme, to review and extend the list of proposed half-lives, and to continue the review of the status and accuracy of gamma-ray and alpha emission spectra for the heavy element radionuclides.

Conclusions and Results of the Meeting

The meeting reviewed the existing and planned programme for the measurement and evaluation of heavy element radionuclide nuclear decay data of each participating research group. In particular, the meeting

- updated the list of proposed heavy element radionuclide half-lives published in INDC(NDS)-121/NE (December 1980), and decided to release the new version of this list;
- agreed to issue a provisional list of proposed recommended list of alpha radiation spectra (E_α / I_α) emitted in the decay of heavy element radionuclides
- continued the detailed review of the status and accuracies of the gamma radiation spectra (E_γ / I_γ) emitted in the decay of heavy element radionuclides.

The participants of this CRP agreed on the date of their meeting: it was proposed to be on 1, 2 and 3 September 1982 in Antwerp, Belgium directly preceding the scheduled International Conference on Nuclear Data for Science and Technology, 6-10 September 1982, Antwerp, Belgium.

The Summary Report of this meeting will be published as INDC(NDS)-126/NE, and will be available on request from the Nuclear Data Section.