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International Atomic Energy Agency

INDC-22/LN

INDC

INTERNATIONAL NUCLEAR DATA COMMITTEE

OFFICIAL MINUTES OF THE EIGHTH INDC MEETING

Vienna, 6-10 October 1975

Compiled by

V. Benzi (CNEN Bologna, Italy)

(Executive Secretary)

Aided by

W. Gemmell (AAEC Lucas Heights, Australia)

(Chairman)

J.J. Schmidt (IAEA)

(Scientific Secretary)

June 1977

IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

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8th INDC MEETING

Vienna, 6-10 October 1975

LIST OF PARTICIPANTS

I. Members (indicated by asterisks) and advisors

Australia	* W. Gemmell (Chairman)
Canada	* W.G. Cross
France	* A. Michaudon R. Joly J. Legrand A.P. Schmitt
Germany, Fed. Rep.	* S. Cierjacks
Hungary	* D. Berenyi
India	* M.K. Mehta
Italy	* V. Benzi (Executive Secretary)
Japan	* T. Fuketa
Netherlands	* A.H. Wapstra
Sweden	* H. Condé T. Wiedling
USA	* A.B. Smith H.T. Motz J. Decker
USSR	* L.N. Usachev G.B. Yankov
UK	* B. Rose J.L. Rowlands
IAEA	* J.J. Schmidt (Scientific Secretary) A. Lorenz (Local Secretary)

II. Observers

CEC-Geel	H. Liskien
OECD-NEA	H. Derrien
Austria	O.J. Eder
Romania	S.N. Rapeanu G. Vasiliu
German Democratic R.	K. Seidel
Israel	S. Amiel
IAEA (Part time)	P. Attree G. Lammer J. Lemley H. Lemmel J. Phillips M. Vlasov

I. INTRODUCTORY ITEMS

Professor Glubrecht, Deputy Director General of the Research and Isotopes Department of the IAEA welcomed the participants to the 8th INDC meeting on behalf of the Director General. In his address, Glubrecht placed importance on the role of NDS in the IAEA work and its future role in the new areas of data for non-energy applications (e.g. material analysis, environment etc.) and for fusion (atomic and molecular interactions), as recommended by the IFRC. He hoped they would be as successful as the work for WRENDA and neutron data for energy production. NDS has played an important role in involving the less developed countries in nuclear data measurements and by encouraging the International Centre for Theoretical Physics, Trieste, to take an interest in theoretical techniques for nuclear data computation. Glubrecht hoped NDS would continue to be useful in encouraging and cross-fertilising such cooperation.

II. COMMITTEEE BUSINESS - PART I

II.A. Consideration and Approval of Complete Minutes of the 7th INDC Meeting.

The edited draft minutes were adopted, subject to incorporation of minor changes (see Action n.1). In particular, referring to the Targets and Samples Program (item IV-B) pg.31), Usachev indicated that loans were available for France and Federal Republic of Germany at 5 per cent of cost per annum.

II.B. Consideration and Adoption of Agenda of 8th INDC Meeting.

The 'Tentative Agenda' (Appendix I) was adopted, with some arrangements in the item sequence, particularly V(C) - A & M data for fusion - to ensure a logical time schedule for Committee and Sub-Committees meetings.(+)

II.C. Attendance of Observers

All the proposals were unanimously accepted.

II.D. Review of Actions arising from the 7th INDC Meeting.

Actions are listed in Appendix XXVII of the minutes of the Seventh Meeting. Only actions subject to significant comments or unfulfilled are itemised below :

(+) In these minutes the various items are ordered following the 'Tentative Agenda'.

2. NDS/INDC Secretariat: Advise NEANDC members of INDC about the required distribution of the future progress reports. Each NEANDC member will issue its own numbered progress report in future.

3. and 4. a) : Send the final'Report of Sub-Committee on discrepancies', etc. to NDS, and b) NDS: issue the Document : see comments on action 29 below.

8. All members. In reviewing WRENDA indicate whether a request is withdrawn because satisfied or no longer required. Only ten requests were withdrawn.

14. Usachev/CJD: Ensure that adequate documentation is included on magnetic tapes containing evaluations sent out by CJD. Usachev indicated that the two last tapes released (i.e. U-235 evaluation by the Minsk group and natural iron by Obninsk) contain a description of the adopted format.

16. NDS/INDC Secretariat: Ask CCDN to distribute information on the results on the CINDA-against-INIS comparison to INDC participants. Lemmel explained that a real computerised check cannot be obtained at present because INIS does not provide suitable Key-words.

25. NDS/INDC Secretariat: Investigate and implement, if possible, the feasibility of journals listing the availability of the evaluated standard data files at NDS, etc. Schmidt informed that copies of CINDU-11, containing relevant information, would be sent to appro priate journals.

29. Joly: Supply to INDC participants a combined 1973-1974 report on discrepancies by 31 Dec. 1974. The combined 1974-75 report will be issued (see Action 2, of this meeting) as soon as possible.

33. NDS/INDC Secretariat: Complete information survey on men and equip ment in developing countries. Not yet fulfilled because of lack of manpower at NDS.

37. NDS/INDC Secretariat: Investigate the possibility of regional data centres distributing INDC documents within their service area, etc. No financial savings over current distribution methods had been found.

41. All members: Send comments to NDS on Lott's proposal. The only comment received was from UK (see Appendix II). Motz explained that the original objection concerned the misleading wording of the Lott's proposal (see Sydney Minutes).

43. Members concerned: Provide NDS with reply to the actions stemming from the two 1974 Non-neutron data specialist meetings. No comments were received.

44. NDS/INDC Secretariat: Ask those journals which have not yet accepted keywords for nuclear data in the abstract, to accept them. Schmidt said that an accepted international keywords system was necessary before this could be done.

57. NDS/Lorenz: Consider including questions regarding usefulness of videos, etc. in the Nuclear Data use questionnaire. Delayed but will be done.

58. All participants: Send to NDS lists of Centres, groups, etc. to which the questionnaire should be sent. Not much information received, except few lists of individual names.

61. Rogosa: Keep INDC informed about his further contacts with Prof. Goldstein on important nuclear data for shielding. Smith summarised the contents of a letter on the subject by Prof. Goldstein. Smith suggested this continuing action be terminated. Agreed.

65. Schmidt: Continue to discuss with Rosen, NEA, about the possibility of issuing an 'Evaluation Newsletter'. Schmidt reported that the Newsletter was not feasible before full release of evaluated data on international scale had been agreed.

II.E. Membership of Sub-Committees

The composition of the four standing Sub-Committees, namely :

i) Nuclear Standard Reference Data
ii) Discrepancies and Important Nuclear Data Evaluations
iii) Energy Applications of Nuclear Data
iv) Non-energy Application of Nuclear Data

was revised, to take account of changes in the participants in the meeting. (Appendix III).

Joint meetings of the Standard and Discrepancies Sub-Committees (like NEANDC) were proposed but after a short discussion it was decided that the two Sub-Committees should meet independently. Sub-Committee's Agendae are given in Appendix IV. Points F, G and H in the Agenda for the Energy Applications Sub-Committee were deleted. Discussion on Transactinium Isotope Nuclear Data (TND) was considered premature and the other points were discussed in the appropriate sections of the main Agenda.

An ad hoc Sub-Committee on International Nuclear Data Conferences was appointed (see Appendix III).

II.F. Final Approval of Revised Draft on INDC Methods of Work

A revised draft on 'INDC Methods of Work' document prepared by the Scientific Secretary on the basis of comments received by members was discussed.

Smith and Motz sought a better definition for Scientific Advisers and Observers and pointed out the importance of having the list of all participants distributed at least four weeks in advance of a Committee Meeting in order to send documents to the appropriate persons. It was agreed that the nomination of observers and ad-hoc members should be left to discretion of the various governmental Agencies in consultation with the IAEA. Gemmel discussed the duration of chairmanship, suggesting a three-meeting period, (the meeting considered this premature), the importance of either Chairman or Secretary being close to Vienna and the desirability of the Executive Secretary speaking English mother-tongue. He noted many minor but important points would arise from the decision to meet every 18 months.

Usachev pointed out that working methods were not defined for the Sub-Committees. Liskien and Joly felt this premature, because of the current proposal for cooperation with similar Sub-Committees of similar organisations (e.g. NEANDC). Usachev replied that the Committee should begin to formulate methods from the general point of view, for example on the basis of a subdivision in 'policy' and 'technical' Sub-Committees.

II.G. Future of the Energy/Non-Energy Applications Sub-Commitees.

The Committee felt that it was not necessary to deal with this item in details, and the discussion was deferred to the Non-energy subcommittee meeting.

II.H. INDC Correspondents and Documents Distribution(+)

Lorenz stressed two points :

- the importance of updating the List of Correspondents
- the need to reduce the cost of L+U documents distribution.

The classification of documents concerning Non-Neutron Nuclear Data was similar to that for Neutron Data. The N-documents correspond to L-documents for Neutron Data, whereas W-documents (a code which has not yet been officially instituted) correspond to U-documents.

Actions were put on all members and NDS/INDC Secretariat (Actions n.3, 4 and 5).

Smith asked members to review the restrictive conditions often listed on the covers of U documents. He noted that some libraries were not prepared to list them and bureaucratic problems ensued. See Action n.6.

II.I. Guidelines for shorter INDC Meeting Minutes(+)

Gemmell opened the discussion, in which views on the pros and cons of shorter minutes were expressed. In particular, Rose and Smith were in favour of complete minutes of a comprehensive nature, whereas the NDS Secretariat suggested a rather concise report.

An action (Action n.7) was put on Chairman and Executive Secretary to work out an acceptable compromise.

(+) Discussed on Tuesday afternoon.

III. NEUTRON NUCLEAR DATA

III.A. Report on 11th Four Centre Meeting

Lemmel provided the background to the discussion by summarising the "Report on the Eleventh Four-Centre-Meeting", INDC(NDS)-68. Smith pointd out that the exchange situation is not good yet. Even if EXFOR is routinely working as a tool, the system is not fully working as far as the compilation and exchange of data is concerned. Derrien, speaking for CCDN, said that this was true for old data, mainly due to EXFOR-NEUDADA interface problems, shortage of manpower and computer change. A short discussion followed the Usachev suggestion that the effectiveness of the 4-Centres in this field by monitoring the turn-around time for response be evaluated. For this purpose, the Committee recommended that :

- the 4-centres indicate on tape the dates on which data (a) were received and (b) became available for exchange
- all members advise the 4-centres on gaps in the Data Centre files avail able (Action n.8)
- all members continue to urge physicists in their respective Countries to send the data to the Centres (Standing Action n.9)
- the 4-centres give maximum priority to the compilation and exchange of important discrepant data and standards, as decided during the Sydney meeting.
- the chairmen of the standing Sub-Committees on Standards and Discrepancies submit to the appropriate Data Centres the names of the reviewers and topics covered by their Sub-Committees (Action n. 10)
- The above mentioned reviewers ask the appropriate Data Centres to send them all available information on their own reviewed topic (Action n.11)

During the discussion of the above mentioned points, Actions n.12, 13 and 14 were decided.

III.B. Additional Information from Neutron Data Centres other than NDS

Smith informed that Brookhaven Laboratory was extending the scope to include the compilation of non-neutron nuclear data at modest level of manpower effort.

A large effort continued on data evaluation for fission reactors, and a new BNL-325 curve-book for the actinides had gone to press.

Usachev said that at Obninsk work has begun on those important data assigned high priority by the Sub-Committees on Standards and Discrepancies. Usachev also pointed out that at Obninsk there was some work on data adjustment, an activity that is not typical of other Data Centres.

III.C. Two Years Publication Cycle of CINDA

Working papers by Lemmel and Rose (see Appendices V and VI) provided the basis for the discussion. Lemmel summarised the proposals for changing the present way of publishing CINDA in order to reduce the cost of production.

The pros and cons of two possible solutions, i.e. a two-year publication cycle and a splitting of the book in 'old' and 'new' volumes, were examined by Lemmel, taking into accounto Rose's proposal.

The present way of blocking entries with all references and EXFOR indexes was highly appreciated by the users, so that maximum priority has to be given to a systematic tie up of this type for all references before 1970. For this reason, argued Lemmel, any change in the CINDA publication cycle seemed to be premature at the moment.

Rose replied that the reasons advoaated by Lemmel were rather weak when compared with the problem of reducing costs. Motz expressed the view that maximum effort should be put in updating references through supplements and that periodic publications of a cumulative volume containing 'old' references was of little use for the evaluators. Smith pointed out that CINDA was an outstandind success and a very useful tool for the nuclear data community. His personal view on the matter was that the primary concern of INDC should be on the policies for improving CINDA rather than on the way of reducing costs. Derrien and Joly supported Smith's views. In summarising the discussion the Chairman proposed the following recommendation: "The INDC support the Data Centres in their effort to improve the quality of CINDA, but urge that the 4-centres bear in mind the financial cost of the project and take all the necessary actions to reduce this cost, e.g. by making an 'archive volume'. This was accepted by the meeting.

III.D. International Exchange ed Assessment of Use of Evaluated Data

Smith pointed out that those parts of ENDF/B-IV concerning dosimetry and fission product nuclear data had been released on a world-wide basis. A full description is given in INDC(US)-70/L and INDC(US)-71/L. The dosimetry file is also described in Nuclear Technology, 25, 376, 1975 by Magurno and Ozer.

A comprehensive revision of the files, (ENDF/B-V), will be completed in approximately 18 months. Smith stressed that US was very interested in receiving feedback from the users.

Usachev reported that since the last INDC meeting, tapes containing an evaluation of Pu-239 (Minsk) had been distributed in addition to magnetic tapes containing evaluations of U-235 (Minsk) and of Fe (Obninsk) distributed at the last meeting.

Several other evaluations were available, unfortunately only in internal USSR format at present. As soon as the format translation is complete, they will be distributed. Possibly, evaluation of H, He-3, He-4, D, Pu-238 and Cm-240 will be distributed at the next 4-Centres meeting. Evaluations on Pu-240, Pu-241 and U-233 are going on in Minsk, whereas evaluations of Ni and Cr were completed at Obninsk.

Usachev pointed out that analyses performed at Obninsk and Minsk of ENDF/B data on Gold, He-3 and C-12 were included in ENDF/B-IV. This feedback indicated that the international cooperation in the field of evaluated data was beginning.

Smith noted that an American private industrial foundation, namely the Electrical Power Research Institute, provided additional significant funding to the US program on nuclear data evaluation, thereby demonstrating that the economic importance of the evaluation is largely recognised. Rowlands and Cierjacks indicated that use of ENDF/B data was an important aspect of data work in their respective countries.

IV. NON-NEUTRON NUCLEAR DATA

IV.A. Progress Reports on Activities, Services and Coordination of 'Non-Neutron' Nuclear Data Centres and Groups(+)

Motz informed the Committeee on the development of the Nuclear Data Project in Oak Ridge. The next issue of Nuclear Data Sheets covering the A=75 mass chain, now in print, is completely computerised, like BNL-325. A short 'Report to the INDC on U.S. Data Study' was presented by Smith (see Appendix VII). He informed that about 80% of the requests on non-neutron nuclear data were from basic side.

Wapstra announced that a new issue of the 'Tables of Nuclear Masses' would be ready in one year.

A memorandum by Legrand on the activity of the International Committee on Radiation Metrology was submitted to the Committee. At an ICRM meeting in Saclay, a Working Group was established to determine the real needs and to improve the existing situation in the field of decay data and radioactive nuclei. Füketa indicated that some work on nuclear structure data was being undertaken in Japan in connection with the problem of fission product-decay heat. Seidel said that in the German Democratic Republic there was some work going on in the compilation of decay schemes and charged particle cross-sections for industrial purposes.

Condè explained that in Sweden activities were mainly at individual level. He mentioned the work at Studsvik on charged particle cross-sections for activation analysis and on decay schemes (measurements and compilation) for fission products. Data on photo-reactions are being measured and compiled at Lund University. Cross reported that in Canada Walker was developing his 'FISSPROD' Program, to include all the relevant data of 800 fission product nuclei. This work is partly based on ENDF/B data. In addition two volumes were published (by Plenum Press), giving calculated values of ranges and energy lossess of many ions in various materials which are of interest for ion implantation and damage problems.

(+) Partly discussed on Wednesday morning

The summary of non-neutron nuclear data work in the Federal Republic of Germany by Cierjacks highlighted the activities on charged particle (p,d,α) excitation functions by Münzel in Karlsruhe (see INDC(NDS)-69). Mehta mentioned that an effort on mass-chain compilations was planned in India (Tata Institute). Work on charged particle reactions (d,p reaction and angular distribution compilations) is underway in the Universities. BARC would try to coordinate the activities, with the help of NDS.

A compilation of (α,n) excitation functions up to 5-6 MeV was planned at Trombay.

Rose said that in the UK discussions were underway to contribute to the Oak Ridge program in A-chains. Other activities underway included : preparation of a file on decay schemes of fission products and actinides and compilation of cross-sections for ion beam analysis of materials (see Appendix VIII). Yankov mentioned activities in the USSR on compilation of data concerning charged particle interaction with heavy nuclei. Additional information is contained in the NDS Memo 294 by J.Schmidt (available on request); see also Appendix XXX.

A number of actions were decided during the dicussion of the above mentioned points (Actions 15, 16, 17, 18 and 19).

IV.B. Report on Meeting on Charged Particle Nuclear Data (CPND) for Applications (+)

The Consultant's Meeting on CPND Compilation held in Vienna, 8-12 September 1975, (see INDC(NDS)-69) was briefly reviewed by Lemmel.

IV.C. Discussion on Recommendations from 'Non-Neutron' Nuclear Data Meetings April/May 1974, including plans for 1976 meetings.

This item (Appendix IX) was discussed at the meeting of the Energy Applications Sub-Committee.

(+) Discussed on Wednesday morning

V. ATOMIC AND MOLECULAR DATA FOR FUSION(+)

V.A. Presentation

i) Background. The Scientific Secretary recalled that NDS entered this field at the request of the Director General and Board of Governor following an initiative from the IFCR. The total manpower engaged in this activity at NDS in 1975 was about 1/2 man-year.

The most important points of the development of the 'A & M Data for Fusion' proposal were then summarised by the Scientific Secretary, on the basis of the Memorandum prepared by A. Lorenz (Appendix X). In response to a request raised by Liskien, Schmidt replied that IFRC was an advisory committee of the Agency advising the Director General on fusion programs in addition to the Scientific Advisory Committee which advises on all IAEA programs. In response to a question asked by Rose,Schmidt answered that IFRC considered the compilation and exchange of neutron data for fusion a matter for INDC.

Rowlands asked on what decisions INDC was expected to comment and if the 4-centres have been involved in the A & M work. The anwer to the second question was that only the Agency (as an international body), has been involved at present. In connection with the first question Schmidt replied that the IFRC was strongly of the opinion that an appropriate technical Committee should advise the Agency on A & M data. The INDC, Schmidt said, was probably not the right body, at present, to provide technical guidelines on A & M data; however, as INDC is the advisory body to NDS, INDC is expected to give its general viewpoint on NDS programs.

Cross asked why IFRC did not take the responsibility for A & M data. Rose thought possibly because INDC was already involved on data exchange and compilation, but Motz objected that compilation was only a small part of the effort and stressed that the problem connected with A & M data exchanges are very different from those concerning nuclear data. Schmidt suggested that INDC might propose an appropriate body other than INDC to review the NDS program on A & M data. Berenyi's opinion was that heavy particle interactions were not so far from the scope of INDC and Mehta pointed out that INDC must be concerned with A & M data programs, in that it competed with nuclear data for NDS manpower.

(+) Discussed on Monday afternoon and Thursday morning

ii) Survey Report. A Survey Report on A & M data for fusion by Lorenz et al. (to be attached to the complete Meeting Report) was briefly introduced by Lorenz.

Decker commented that the report was an excellent beginning reflecting the importance of A & M data for fusion by magnetic confinement.

iii) Consultant's Recommendations. The recommendations to the IAEA by the Consultant's Meeting on A & M Data for Fusion (see Attachment A of Appendix XI) were reviewed by the Scientific Secretary. Smith felt that NDS did not have the capability for A & M evaluation work. Schmidt replied that the consultants, not NDS, had made the recommendations. A decision to act on the recommendations must come from the Agency.

Referring to the Consultant's recommendation that the IAEA publish Dr. Barnett'Bigliography of Atomic and Molecular Processes, Schmidt indicated that support for this recommendation by an outside body would help the Agency to publish it. Rose asked why it should not be published by Oak Ridge or commercial publisher. No definite answer was given, and Decker was asked to clarify the position.

The Conclusions and Recommendations of the 6th IFRC Meeting (Appendix XI, Attachment B) were also reviewed. Schmidt pointed out that IFRC Members (Appendix XII) were leading men in the field. Michaudon asked if IFRC had endorsed the Consultants' recommendations: Schmidt answered that they were fully discussed and approved during the 6th IFRC Meeting. Liskien sought information on the effort devoted to fusion research in the major industrialised countries. Motz answered that the US effort in this field is large and growing. A large effort is underway in USSR too, as pointed out by Phillips.

V.B. Manpower Needs for A & M Program Component

Schmidt opened the discussion on the basis of the document 'Additional Staff Requirements for the Nuclear Data Section in 1976 and 1977' (Appendix XI). He explained that the Section Head was at P-5 level; a scientist with at least 10 years experience is at P-4 level and one with more than 6 years experience is at P-3. The first steps, in order to start the A & M program are :

- assessment of current experimental and theoretical research activities in A & M data
- survey of data needs
- identification of the most critical needs

in cooperation with existing compilation and research groups. Thus, Schmidt said, an atomic physicist at P-4 level should be the absolute minimum to start the activity in 1976. Rowlands asked if it would be possible to have someone seconded to the Agency instead of an Agency's employee. Schmidt answered that, on the basis of NDS experience in neutron data, it was necessary to have someone on the IAEA staff in order to ensure continuity of the work. People from outside should help in performing specific tasks, as in the case of fission products in the neutron data field.

In dicussion, Smith did not understand why highly qualified people (e.g.P-3 level) were required to perform rather clerical work. He felt that support-type people would be more adequate for the period 1976/1977. Fuketa wanted to know if the proposed staff of 14 in 1976 was to enable NDS to perform all the work of data compilation retrieval and dissemination. Schmidt answered that this was implied in the Consultants' recommendations (Appendix XI, Attachment A, point B-3). However, from the magnitude of the tasks it was not a project NDS would undertake on its own. Michaudon said that an enquiry among the French specialists showed that support for such an action was limited and it was advisable to leave the decision to IFRC because INDC did not posses the competence to examine the overall proposal.

Yankov pointed out that at present there is no definite program in A & M data (in the Soviet Union) but needs are dealt with by individual groups. This is probably due to the fact that fusion is developing very rapidly. He felt, however, that international coordination is now required.

Rose pointed out that NDS has not yet fulfilled its tasks in the fission area, and to enter the field of A & M Data would require additional effort. The NDS role, he felt, should be a coordinating one, leaving compilation, dissemination, etc., to the existing specialised centres. Appropriate funding should be provided by the fusion community. In addition, the role of NDS as a 'regional' centre would require, very likely, only a small effort. He also called attention to the fact that there were basic differences between nuclear and A & M Data in the sense that atomic theories are much more reliable than nuclear theories in predicting needed values. For this reason, any experience gained from the activities on nuclear data should be extrapolated very carefully to the A & M Data field. Decker agreed on the role of atomic theories, but was against Nuclear Data Centres becoming engaged in the A & M field. In the US the A & M Data Centres are completely independent from the Nuclear Data Centres, and any activity by the latter in A & M Data would result in a duplication of efforts. Rowlands asked if NDS foresaw any difficulty in getting permission for additional staff from the steering bodies of the Agency. The possibility to get funds directly from Fusion Research Establishment was also raised.

Motz though that funding was the basic problem. He doubted if IFRC realised the complexity of the effort required and whether - at the present time - IFRC would pay the price for such activities. The problem of funding has still to be faced by IFRC. At present IFRC Members have not committed themselves in establishing new Data Centres and/or funding by national organisations of the existing ones. This action could take many years. Rose proposed that INDC recommend the 1976/1977 biennium to be considered an educational period in which the magnitude of the problem involved is assessed. This solution, however, raises a problem because a fraction of NDS, (namely, the two appointed physicists working in the A & M area) would have to report to another master (i.e., IFRC). Apart from this, if after the two-year period it will be decided to have a very large program, it will be necessary to reconsider the whole matter; a separate Data Section might be necessary too.

The above proposal, Rose said, does not imply that the 1976/1977 activity in A & M Data has to be done at the expense of the NDS budget earmarked for activities in the field of fission reactors. Additional expenditures have to be covered by the fusion budget.

On this last point, Gemmell enquired about the IAEA effort in fusion activities and asked for the IAEA budget. Phillips replied that the IAEA fusion programme covered various activities, e.g. large International Conferences, Workshops and Study Groups, publication of the 'Nuclear Fusion' journal, etc. All these activities require a sizeable amount of money. Later on, the IAEA Document GC (XVII)1526 entitled 'The Agency's Program for 1975-80 and Budget for 1975' was distributed.

Reverting back to Rose's proposal, Schmidt, Rose and Decker agreed to prepare a draft document based on Rose's proposal for discussion and the document was presented by Rose on Thursday. After discussion the Committee decided that the final version (+) (see Appendix XIII) would be sent with a covering letter by the Chairman to the Director General and to the Chairman on the IFRC (Action n.21).

This statement on A & M Data for fusion by the INDC included the proposal that a joint INDC/IFRC Sub-Committee on A & M Data be created to examine problems of common interest arising in the next two years. A draft of the letter was to be sent to the members concerned (Action n.20). See also Actions n. 22 and 23.

VI. COORDINATION OF NUCLEAR DATA ACTIVITIES (MEASUREMENTS & EVALUATION)

VI.A. Status of Development of Regional Nuclear Data Centres and National Data Committees (++)

Fuketa indicated that a Nuclear Data Centre was not yet established in Japan. He required support from INDC in this matter in the form of a letter from the INDC Chairman to the Japanese AEC. At present, about 90 people are part-time engaged in nuclear data work at JAERI. Two senior scientists, one junior and an engineer are working full time.

Gemmell had nothing to add to what was said during the Sydney meeting.

(+) The final version was agreed on Friday afternoon

(++) Discussed on Friday Afternoon

Mehta informed that it was difficult to start a formal Nuclear Data Centre in India. An analysis of the material provided by NDS to Indian Laboratories will be sent by NDS to Mehta (Action n. 24) in order to provide elements for judgements on the need for a Nuclear Data Centre.

VI.B. Neutron Data for Reactor Dosimetry

Discussed by the Energy Applications Sub-Committee.

VI.C. FPND Newsletter

As VI.B above.

VI.D. WRENDA for Fission, Fusion and Safeguards

The Chairman recalled that during the Sydney meeting it was decided to have at least one working paper 'for' WRENDA, and one 'against' for discussion at the 8th INDC Meeting.

Rose outlined the arguments against WRENDA (Appendix XIV) and was followed by views in favour of WRENDA by Usachev. In particular, Usachev said that national lists, as proposed by Rose, were a kind of administrative action, whereas WRENDA was much more comprehensive in scope. In fact, it provided: (a) general comments by requestors (see, e.g. WRENDA 75, INDC(SEC)-46/U, page II, ii); (b) a comparison on international basis among various requests, as far as wanted accuracies and areas (fusion, biology, etc.) are concerned; (c) a concise description of achievements and status. NDS experience with the operation of WRENDA was presented by Lemley (Appendix XV). Then participants indicated their views about usefulness of WRENDA. Some members (Smith, Michaudon, Joly, Cierjacks, Rose, Gemmell, Cross) felt that WRENDA had little influence on measurements in their countries because programs in the various laboratories were mainly determined on the basis of the facilities available.

Some of the above mentioned members, however, felt WRENDA to be useful as a tool for discussion about accuracies (Joly) or in order to justify sample requests to the US (Cierjacks). Other participants (Mehta, Fuketa, Liskien, Seidel, Rapenau, Berenyi) felt that WRENDA was of great value to their respective organisations in establishing research programs. WRENDA was also useful for those countries, like the USSR or the Federal Republic of Germany without national request lists. On this basis, it was unanimously agreed that WRENDA should continue.

The committee then considered how WRENDA could be improved by discussing Schmidt's paper 'Proposal on WRENDA' (Appendix XVI).

Specific points discussed and conclusions reached, were as follows :

1. Request list should continue as 4-Centres responsibility.
2. WRENDA publication should contain separate request lists for Fission Reactors, Fusion and Safeguards, and should include requests for measurements, evaluations and information.
3. As far as request file and status file were concerned, the present format of publication was felt acceptable.
4. The word 'measurements' should be dropped from the WRENDA document title.
5. No particular action was requested about Satisfied/Withdrawn requests.
6. About assignment of request numbers, it was recommended to the 4-Centres to move the file number to the right side and to add a sequential number on the left side of the request (Action n. 25).
7. Requests unreviewed for 2 years should be automatically dropped.
8. Delete status comments. The NDS would provide comments on WRENDA 76 using the reports by technical Sub-Committees as guideline. (Action n.26).
9. Uncertainty information from evaluated data files should not be extracted and summarised for WRENDA status comments.

The problem of WRENDA distribution was also discussed. Smith proposed that a fiscal charge for WRENDA (like CINDA) would indicate the real interest.

It was decided that all members would revise the WRENDA distribution list before 31 December 1975 (Actions n.27, 28 and 29).

Two working papers concerning the Japanese Request lists on Fusion and Safeguards were submitted by Fuketa (Appendix XVII and XVIII).

VI.E. Nuclear Data Measurements in Developing Countries

Working papers were submitted by Fuketa, Schmidt, Ferguson (presented by Rose), and Condè (Appendix XIX, XXX, XXI and XXII).

Mehta informed that cooperation between India and Bangladesh was summarised in the Progress Report from India. Schmidt said that IAEA was prepared to help the cooperation between JAERI/KAERI and BARC/Bangladesh by providing targets, fellowships, and research contracts for priority I measurements. See also Action n. 30.

VI.F. Status and NDS Targets and Samples Program

Lemley referred to the NDS Progress Report, where an account of the program was given. There was some difficulty with the supply of targets by BCMN which, Liskien thought, arose because of some arrangement of personnel at BCMN in connection with a program of Safeguards.

Because of the interest at the last INDC meeting in Lithium-fluoride foils made at Argonne, said Smith, fifty of these foils had been prepared and were available on request. There were inquiries in the U.S. as to long-term sample needs with the result of no demand grossly exceeding supply. Smith said that Oak Ridge has considerably reduced its activity in this field. People should bear in mind that the 'form-of-the-sample'cost could be many times the cost of the sample, and loans were easier if materials were to be borrowed in existing form and shape.

VII. NDS PROGRAM

VII.A. NDS Activities and Services

VII.B. NDS Composition and Responsibilities(+)

Schmidt treated items VII.A. and VII.B together, on the basis of the NDS Progress Report and the two memoranda : 'Professional Responsibility Distribution in the IAEA/NDS for 1974/75' and 'Additional Staff Requirements for the NDS in 1976 and 1977'(Appendixes XXIII and XI).

(+) Partly discussed on Thursday

In addition to the above mentioned documents, Schmidt provided the following information:

a) Staff Duties. Technical responsibilities at NDS were shared as follows :

I. Physics/Compilation Unit

H. Lemmel :	CINDA and EXFOR development: Review of 2200m/s data for fissile nuclei;
V. Vlasov :	Reactor Dosimetry Data;
K. Okamoto :	EXFOR (implementation); coordination of activities on charged particle nuclear data (in place of Calamand);
M. Khalil :	Evaluated data (collection and exchange), CINDU;
J.R. Lemley : (now R.Lessler)	WRENDA; targets and samples programme: neutron standard reference data;
A. Calamand :	No more at NDS (he was responsibile for EXFOR);
R. Yaghubian :	Indexing of tapes;
G. Lammer :	CINDA (implementation); FPND Newsletter.

II. Programming Unit

P. Attree :	EXFOR (implementation and development);
P. Smith :	WRENDA & EXFOR programming;
F. Hirschbichler:	CINDA programs (check);administrative programming;
K. McLaughlin :	EXFOR and data processing programming;
E. Barge, C.Manica :	Data processing.

The bulk of the activities was on neutron data; activities on nuclear structure, decay and charged particle nuclear data were also performed, but more as a coordination activity. The Deputy Head of NDS, A. Lorenz, has the responsibility for non-neutron nuclear data and currently for atomic data for fusion.

Then, Schmidt explained the responsibility distribution as percentage of time spent on the various items, for the 1974/1975 period (see Annex to Appendix XXIII). In addition, he pointed out that the breakdown of time spent on data status and needs assessment strongly depended on the number of meetings scheduled during the year. Schmidt said that a noticeable amount of work was done outside working time (e.g. evaluation of 2200 m/s data).

Budget figures was also mentioned by the Scientific Secretary. Total amount for 1975 was about 660.000 US dollars, including about 60.000 US dollars for computer time. This budget represented an expenditure of about 50.000 dollars, on average, for professional man-year, salaries included (about 70%). The NDS total budget represented about 2% of IAEA budget.

Having presented the above items, Schmidt stressed the absolute need for an additional nuclear physicist to be engaged in the neutron nuclear data program. Main reasons given for such an increase are :

1) the number of data libraries available at NDS are continuously increasing;

2) the number of requests from customers in the NDS service area is continuously growing;

3) moving NDS to new premises, about 3 km away from Agency's headquarters, represented a net loss of about 1 man-year.

Understaffing prevented NDS from accomplishing all its tasks on time and often activities requested by INDC were delayed or unfulfilled. Schmidt believed short term contracts were unsuitable for continuing work like nuclear data and asked the INDC members to recommend long term contracts. Finally Schmidt mentioned that NDS was a misleading name. A better name for NDS would be, Schmidt said, International Center for Nuclear Data, being more akin to the ICTP in Trieste.

Participants sought clarification on a number of issues. Joly asked if NDS could invite experienced physicists for a limited period (e.g., one year) at IAEA expenses. Schmidt answered that this would be possible in principle, but very difficult in practice, because temporary assistance is only granted to non-professional personnel. In addition, high level work should be of continuining nature, as he had previously indicated. Rowlands wanted to know more details on CINDA abstracting work and data services. Lemmel answered that all work cn CINDA related to the NDS service area was done at NDS, with the exception of one external compiler in India. With respect to EXFOR the NDS service area did not include a large number of data producers. Data services were practically confined to the sending of data available, but extra services (e.g. plotting) were at very low level because of lack of manpower. On the whole, Lemmel concluded the work load could not be reduced. Joly asked how NDS could get about 20% increase for staffing in the 1977 budget if the budget is prepared two years in advance. Schmidt explained that an internal Agency Committee reviewed the budget. Thus, although there were no free posts available in the Department of Research and Isotopes, an INDC recommendation would help obtain temporary staff for an A & M Data program from other Departments, without increasing the budget.

Smith, whilst appreciating very much Schmidt's report, was concerned about some points. For example, the effort devoted to nuclear structure, A & M and charged particle data was too a large fraction (about 50%; see Annex to Appendix XXIII)of the total manpower effort in Data Status and Needs Assessment.

About CINDA, Smith wondered whether NDS should devote much effort to the producing of computer programs. He stressed that :

(a) NDS should establish priorities in its activity;

(b) the occupant of any new position should be technically qualified; and

(c) in order to have a strong impact, increase in manpower should not be distributed among various activities.

Schmidt replied that the fifty-fifty breakdown for Data Status and Needs was misleading because it was strongly influenced by the organisation of panel meetings in non-energy nuclear data. As a matter of fact, activities on non-neutron nuclear data were not spread over several people. In the future A & M Data would be under its own heading, and only one to two manyears would be necessary to manage Charged Particle and Nuclear Structure Data. Mrs. Attree pointed out that NDS programming efforts are confined to the development of programmes for the data handling and CINDA input checking at NDS and for improving NDS' services for customers. Some of these program mes are developed in cooperation with CCDN. For evaluated data handling as fas as possible NDS uses programmes developed elsewhere. The programming effort on WRENDA was finished, but the system required continuous maintenance.

Rose wondered whether a two-year cycle for WRENDA and CINDA would have any impact on reducing the need for manpower: Lemmel pointed out that, for both cases, the input would be supplied at the same rate so that the amount of work would not be affected by the publication cycle.

Schmidt reiterated that manpower deficiencies prevented NDS to perform all its tasks. Lemmel pointed out that 1975 was a notable year, in that it was the first time for several years that the NDS staff complement was complete. However, vacancies should be foreseen in the future, due to the two-year turn-over of several contracts. Rose thought that the NDS effort on non-energy applications (about one manyear) was premature in that INDC had not identified any particular field. Schmidt replied that such an effort was only about 10% of the technical staff. Gemmell enquired about the duties to be assigned to the additional staff required. Schmidt answered that this would depend on the turn-over of NDS personnel. In any case, an additional member should help to improve the services of NDS.

The Chairman asked Committee's views on staff increase. In the discussion which followed, it was clear that :

- 'small' countries are strongly interested in an improved NDS service with broader coverage;
- INDC supported the case for the increase of one staff in the complement of NDS provided that it would be devoted to a well-defined, high priority task in a nuclear data area related to nuclear energy.

A formal statement to the Director General was approved by the Committee.(Appendix XXIV).

VIII. PROGRESS REPORTS ON NUCLEAR DATA MEASUREMENTS, FACILITIES AND EVALUATIONS.

VIII.A. Additions to submitted progress reports

AUSTRALIA

Gemmell mentioned the following activities.

A) Measurements

The energy dependence of $\bar{\nu}$ was studied on Th-230 and Th-232. Some structure was found in Th-232. The analysis of capture cross-sections of Cr-50, Cr-52 and Cr-54, in cooperation with Macklin, is going on.

The analysis of resonances of the above mentioned nuclei was completed.

B) The evaluation on FP performed at AAEC will be distributed in ENDF/B format.

AUSTRIA

In the absence of Eder, Condê drew attention to the "Progress Report to NEANDC and INDC from Austria" distributed as INDC(SEC)-51/L.

CANADA

Cross referred to INDC(Can)-15/G underscoring the measurements by Santry on the excitation curves for $^{113}In(n,n')^{113m}In$ and $^{115}(n,2n)$ ^{114m}In. A search for two photon decay in thermal (n,p) capture, by Earl et al. was noted.

FRANCE

In addition to the progress Report NEANDC(E)162"U", vol.IV (France), the following information was given by the French delegation (Michaudon, Schmitt, Legrand).

A) Measurements

a) Work in progress at Cadarache.

i) Self-shielding factor measurements on natural Ni and Ni isotopes. This work was carried out in cooperation with F. Perey's group at

ORNL in order to improve the evaluation of resonance parameters for these isotopes.

ii) Extension of U-235 fission cross section measurements up to neutron energy 3.6 MeV.

b) Work in progress at Bruyères - Le-Châtel

i) Elastic and inelastic cross section measurements at 4.1 and 7 MeV incident neutron energies on even Nd isotopes and at 4.1 MeV for even Sm isotopes. These measurements were made in order to study the effect of deformation on the cross sections. This effect is a minimum at 4.1 MeV and maximum at 7 MeV on the total cross section of these nuclei.

ii) Measurements of (n,2n) cross sections on a series of nuclei, using big scintillator technique, from near threshold to 15 MeV. Since January 1975, measurements were made on Sm and Nd separated isotopes and on V, Ti, Cr, Cu, Zr, Mo, Pb natural elements.

iii) Fission cross section measurements of the following nuclei: Am-241 (in the energy range 1.1-1.7 and at 1.9 MeV), U-235, U-238 (from 0.5 to 3.2 MeV and at 14.6 MeV).

iv) Measurements of the fission neutron energy spectrum for fission induced by 7 MeV neutrons in U-238 and by 0.6 and 7 MeV neutrons in U-235.

v) Detailed study of the ^{233}U(d,pf) reaction, by measuring the kinetic energy and mass distribution of the fission fragments.

The purpose of this study is to see whether the fission process for U-234 varies as a function of the excitation energy as it does for Pu-240.

Additional information of the activities at Bruyères-Le-Châtel is given in the report CEA-N-1978/INDC(FR)-6/L.

c) Work in progress at L.M.R.I. - Saclay

An internal progress report of L.M.R.I. is available upon request. The following activities were mentioned.

i) Accurate measurements of the half-life of Cf-252

ii) Development of a method to measure the activity of sulfur detectors by liquid scintillation counters

iii) Decay schemes of ^{64}Cu, ^{93m}Nb, and ^{103m}Rh (measurements and evaluation)

iv) Neutron Spectrometry with proportional counters and liquid scintillators using ^{252}Cf sources

v) ^{252}Cf fast neutron standard (energy spectrum and fluence)

vi) Dosimetry by calorimetric methods for high energy photons and electrons (observed dose)

vii) Multi-γ-ray-standard (^{152}Eu) and high-energy γ-ray standard (6.1 MeV) studies.

B) Facilities

Construction of the accelerator GANIL (Grand Accelerateur National à Ions Lourds) has been definitely approved by the French Government, and would be built at CAEN (Calvados) in Normandy, about 200 Km north-west from Paris. GANIL comprises a two sector-focused cyclotron (CSS), having a K-value of 400, with one compact cyclotron as injector. Provision was made also to install a Tandem VdG accelerator. With the CSS, it is expected that light ions can be accelerated up to 100MeV/nucleon and heavy ions, up to Uranium, to about 10 MeV/nucleon. Particle current should reach 10^{14} particles/second for light and 10^{13} particles/second for heavy ions.

The total cost of the facility (without Tandem VdG) was estimated to be about 175 millions of FF.Construction would take 5 years.

GANIL represents the second big investment in the France 5-year plan (1975/1979) for nuclear physics. The first one was the modernisation of Saturne, an old elementary particle physics machine which will then become a medium-energy nuclear physics facility.

C) Evaluation

i) At Cadarache, Au-197 capture cross-section between 20 and 550 KeV was evaluated using the experimental results obtained by Le rigoleur with the Maier-Leibniz technique and those by Fort by activation.

ii) At Bruyères-Le-Châtel, a complete evaluation of C-12 was performed and sent to CCDN in ENDF/B format. Evaluations of the energy-dependence of $\bar{\nu}_p$ for isotopes of Th, U and Pu, was also carried out.

iii) At L.M.R.I., Saclay, evaluated tables of radionuclides decay-schemes were produced.

GERMAN DEMOCRATIC REPUBLIC

Seidel said that a progress report will be distributed at L-level by NDS. The following activities were underscored.

A) Measurements

i) Measurements of cross-sections for double differential neutron emission at 14 MeV for 34 elements in the mass range $9 \leq A \leq 209$. Results, which meet about 40 WRENDA requests, are available from NDS in EXFOR format. A report will be distributed at L-level.

ii) Measurements of differential elastic and inelastic scattering cross sections at 3.4 MeV incident neutron energy for a number of elements with $24 \leq A \leq 209$.

B) Evaluation

i) The influence of the pre-compound process on (n,np), (n,pn),(n,2n), ..., cross sections was studied for many nuclei.

ii) A cooperation was established with Obninsk to perform the evaluation of fast neutron data in SOKRATOR format.

FEDERAL REPUBLIC OF GERMANY

A) Measurements

1. At Karlsruhe. At the 3 MeV VdG
   - $\bar{\nu}_p$ measurements for ^{239}Pu were in progress
   - Capture cross-section measurements on noble gases in the 10-20 KeV neutron energy range had been performed.
   - Cross sections for γ-ray productions for natural iron and Ni-isotopes were evaluated.

- Capture cross sections of ^{240}Pu and ^{242}Pu were investigated in the 10-200 KeV energy range. A sample of ^{241}Am was prepared for σ_c measurements.

At the Cyclotron :

- Elastic scattering cross sections at 10 angles in the energy range 0.5-10 MeV for Fe, O,S were evaluated.
- The analysis of γ-ray production cross sections of Ni and Cr isotopes in the energy range 0.5-20 MeV was completed.

2. At the European Institute for Transuranium Elements.

Irradiation in RAPSODIE of samples of Np-237, U-233, Pu-239 and Pu-241 for determination of fast fission yields were continued. Besides the yield for Sb-125, Cs and Xe isotopes, bulk fission yields for Nd-isotopes were examined.

3. At Hamburg University

Studies on systematic of (n,x) reactions were continued. Experimental results measured by the University were compared with predictions of pre-compound model.

4. At the Institut für Nuklearchemie, Jülich.

- Measurements of (n,p), (n,α), (n,2n), (n,n'p), (n,n'α) cross sections on several nuclei were continued. Results at 14 MeV were reported during the Washington Conference.
- Further work was devoted to measurement and interpretation of tritium production rate in a Li-model blanket.

5. At Technische Universität, München

- Nuclear structure studies by thermal neutron capture were continued
- Some coherent neutron scattering amplitudes were measured
- Slow neutron transmission and scattering measurements at 1.26, 1.46 and 5.2 MeV were continued.

B) Evaluation

At Karlsruhe, the work on KEDAK 3 was nearly completed. Evaluated files were available; details were given in various progress reports.

New calculations and systematics were performed in order to compare predictions of the pre-compound models with the results of high energy neutron scattering.

HUNGARY

Berenyi indicated that in addition to the four Institutions mentioned in the Report to INDC, the Isotopes Institut was also dealing with applied research.

At the Institut for Nuclear Research (Debrecen) a superconducting magnet for a two Si(Li) electron spectrometer was under construction.

The goal of the programme would be to measure conversion electrons from transition of final nuclei.

INDIA

In addition to the report on the activities of the Indian laboratories included in the general document INDC(SEC)50, the following points were added by Mehta.

A) Measurements

i) ^{232}Th(n,γ) cross section; in order to study the feasibility of accurate measurement for (n,γ)cross section on ^{232}Th up to 3 MeV, an experimental programme has been started utilising a 30 cc Ge-Li detector at Trombay.
The secondary gamma spectrum from the decay of ^{233}Th, after thermal capture, has been measured with respect to gold. The aim is to determine the accuracy which Ge-Li measurements could yield. The next step would be to extend the measurements to higher energies utilising the Van der Graaf accelerator. A programme of developing a "surface barrier detector - Li sandwich" neutron counter for flux measurements has also been taken up.

ii) 25 KeV capture cross section: A 25 KeV filter has been installed on the 40 MW CIRUS reactor which yields a flux of about $10^5 n/cm^2/sec$. 25 KeV capture cross sections with respect to thermal capture cross sections have been measured for 19 isotopes ranging from ^{51}V to ^{181}Re.

iii) Charged Particles: The (p,n) and (α,n) cross section measurements have been continued with the 5.5 MeV Van de Graaf at BARC. The measurements of (p,n) reaction cross sections on ^{55}Mn up to 5 MeV have been completed.
Hauser-Feshbach and optical model analysis of the excitation functions and the shape analysis of the observed isobaric analog resonances have been carried out. The work on the study of ^{19}F (α,n) reaction is also completed. Multilevel-multichannel analysis of the alpha particle elastic scattering cross section for ^{24}Mg measured at four angles is underway. The work on $^{26}Mg(\alpha,\alpha)$ ^{26}Mg reaction is completed.

iv) Fission: Main thrust of the work done in the Fission Physics Section of the Nuclear Physics Division at Trombay has been towards theoretical investigation of ternary and quaternary fission of ^{252}Cf.

B) Facilities

The Variable Energy Cyclotron installation at Calcutta has proceeded to a stage such that beam trials are expected to begin within a few weeks.

A series of seminars oriented towards the utilisation of the Cyclotron are planned during the forthcoming Annual Nuclear Physics and Solid State Physics Symposium which will meet in Calcutta this year in the last week of December. The design of the 100 MW thermal research reactor at Trombay has been frozen and the civil works have started.

The reactor at Trombay is expected to be operative in 1979.

Two 14 MeV neutron generators (H.V.E.C. made PN-400 machines) have been installed one each at the Banaras Hindu University and at the Punjab University respectively. It is expected that some 14 MeV neutron data work will be started at both the places.

C) Evaluation and Compilation

In addition to the work reported in the progress report (item A-22), the Theoretical Reactor Physics Section at Trombay has carried out the following programmes :

1. Evaluation of neutron cross-sections in the resolved and unresolved resonance regions.

   i) A computer code RESEND to evaluate the neutron cross-section in the resolved and unresolved resonance regions was modified and commissioned on CDC-3600 computer. The code consists of two overlays and is based on single and multilevel Breit Wigner theory, Adler and Adler formalism in the resolved resonance region, and Lane and Lynn theory in the unresolved resonance region.

   ii) Cross-sections for Na, Fe, Cr, Ni, Th-232, Pa-233, U-233, U-234, U-235, U-236, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-243 and Cm-244 were evaluated in resonance regions with the resonance parameters taken from ENDF - data files and the point cross-sections thus generated were combined with the background corrections listed in ENDF-files. These cross-sections can now directly be used in generating the unbroadened dilute multigroup cross-sections for reactor physics studies.

2. Generation of Legendre Coefficients and Transformation Matrices.

   Using the updated scattering cross-section data from ENDF-files Legendre coefficients have been generated at 1021 energy points in the energy range 0.4 eV to 10 MeV with a constant lethargy width of 1/60 for nuclides B,C,Be,O,Na,Cr,Fe and Ni.

3. Generation of Multigroup Cross-sections.

   To carry out the reactor physics studies multigroup cross-sections for fissile, fertile and structural materials have been generated in the energy range 0.2 eV to 15 MeV using the point cross-section data from ENDF-files. The discrete level, inelastic and (n,2n) scattering matrices have also been evaluated.

4. Compilation

A compilation programme for charged particle reaction data has been started at the Banaras Hindu University, where a group has started compilation on (d,d)and (d,p) reaction data for all targets at all energies. The interest there is the development of a proper coupled channel reaction theory and computer codes to account for angular distributions and absolute cross-section in a global way.

ISRAEL

In addition to the Progress Report to INDC, the following items were mentioned by Amiel.

- Independent, partial and cumulative fission yields from ^{232}Th and ^{235}U fission produced by fission neutrons,and from ^{252}Cf spontaneous fission
- Thermal neutron fission yields of ^{233}U and ^{235} (published in the 1975 March issue of Phys. Rev. C.)
- Re-evaluation of delayed neutron data previously reported by Amiel et al. in Nucl. Sci.Eng.
- New data on nuclear properties of very short-lived nuclei produced from fission and separated by an on-line isotope separator (SOLIS).

ITALY

Benzi informed that a detailed progress report would be published as NEANDC (E) 162 vol. 7. The following points were underscored :

A) Measurements

i) Level schemes

At Florence University, experimental work carried out on ^{49}V, ^{46}Ca, ^{54}Mn, ^{45}Sc, ^{96}Tc.

ii) Charged particle reactions.

The T(^{3}He,n)^{5} Li reaction was studied by the Trieste University group at incident ^{3}He energies from 2 to 5.5 MeV using the pulsed-beam time-of-flight method.

The experimental differential cross sections for neutron arising from the ground and first excited state of ^{5}Li were compared with theoretical curves, which are in reasonable agreement with the experimental data.

The Catania group extended the study of the $^{7}Li+d \rightarrow 2\alpha + n$ to E_d=7 MeV. Preliminary results show a cross-section at least one order of magnitude lower than at E_d = 1 MeV.

A similar study was carried out for the reaction $^{9}Be+d \rightarrow t+2$ at E_d = 1.7 MeV. The analysis of the results is underway.

iii) Average cross section measurements of structural materials in fast neutron spectra.

These measurements, based on the null-reactivity method, are carried out at Bologna (by CNEN, AGIP-N, and CCR-Ispra) by using the RB-2 fast-thermal reactor.

Very preliminary results obtained for Iron seem to indicate a $\bar{\sigma}_c^{Fe}/\bar{\sigma}_f^{5}$ experimental ratio about 30% lower than the one predicted by using ENDF/B-I for Iron capture.

Measurements on Ni, Cr and SS are underway or scheduled for the end of this year.

B) Evaluation

The evaluation of 22 fission products underway at the CNEN (Bologna) in the framework of French-Italian cooperation for fast reactors has been completed.

JAPAN

In addition to the Progress Report (INDC(JAP)-28"L"), Fuketa informed that a 20 MV tandem machine would be ordered by JAERI from the National Electrostatics Corporation of the United States.

This is a vertical folded type machine, whose guaranteed performance are as follows :

5.0 μA at 20.0 MV terminal voltage for proton DC beam,
0.5 μA at 20.0 MV terminal voltage for iodine DC beam,
0.8 mA at 20.0 MV for $\leq$ 1.0 nanosecond FWHM, 1 MHz pulsed proton beam.

NETHERLANDS

The only remark by Waspra was that the organization for Atomic Energy in Netherlands, formerly RCN-Petten, changed its name to Netherlands Energy Development Agency.

ROMANIA

In addition to a short description of several codes for the production and handling of nuclear data libraries, the following activities carried out at the Institute for Atomic Physics (IAP), Bucharest, were mentioned by Rapeanu.

A) Measurements

- Measurements of neutron interaction with Boron isotopes in the MeV neutron energy range
- Production and study of new fissionable isomers in the U, Pu and Am region
- Measurements of angular distribution of neutrons produced in (p,n) and (α,n) reaction on medium nuclei
- Simulation of irradiation with fast neutrons by irradiation with alpha-particles
- Measurements of excitation functions of some reactions in order to determine the optimum conditions for producing new radioisotopes
- Measurements of cross-sections for X-ray fluorescence by charged particle and neutron activation
- Measurements of the lifetime of excited nuclear states via Doppler and Planger shift.
- Production of new isomers and g-factor determination for medium nuclei.

The above mentioned measurements were carried out by means of the U-120 cyclotron. Measurements performed by using the IAP tandem and betatron in the field of fundamental nuclear physics were also mentioned.

A high accuracy absolute determination of neutron fission cross section of ^{235}U was carried out by using the IAP reactor, under IAEA contract.

B) Facilities

A facility for generating a neutron standard spectrum was built at the Institute for Nuclear Technology, Bucharest, in order to improve multigroup nuclear data by means of integral experiments.

SWEDEN

A) Measurements

Condé reported that at the Neutron Physics Laboratory at Studsvik earlier measurements on elastic neutron scattering performed on a large number of elements at several energies in the energy region from 1.5 to 8 MeV, have been somewhat extended recently. New experiments are in progress at about 10 MeV neutron energy for the same elements as in the previous study.

Furthermore, to test the optical model calculations in more details, experiments have been made in an angular region extending up to 174°. It was concluded that the previous calculations give a satisfactory description even in the increased angular interval.

From a systematic study of neutron inelastic scattering in the energy range 2.0 to 4.5 MeV it has been found that the H-F-Moldauer formalism well describes the experimental data in most cases. However a discrepancy of a factor 2 has been observed for some levels in odd-mass nuclei. The discrepancy might be due to collective states in the odd-mass nuclei which are not taken into account in the formalism.

Studies are underway at the Neutron Physics Laboratory on decay heat problems by measuring the delayed gamma-rays from thermal fission of ^{235}U. The gamma-ray emission is studied from a few seconds up to about 30 minutes after fission.

The measurements of the $^{59}Ni(n,\alpha)$ cross section at the Department of Reactor Physics at Chalmer University of Technology was reported to the Washington Conference. The result for the $^{59}Ni(n,\alpha)$ thermal cross section was 22.2±1.7 barns, which is higher than the value by Eiland and Kirouac (13.7±1.2 b) but also slightly higher than the value by Werner and Santry (18.0±1.6 b).

At the Department of Nuclear Physics of Lund University measurements of fast neutron capture cross sections using activation techniques have continued. The activation capture cross section of ^{115}In (n,γ) ^{116}In at 15 MeV is about 0.9 mb which is an order of magnitude lower than the results from previous measurements using activation techniques. The discrepancy might be due to low energy secondary neutrons which were not properly taken into account in those latter measurements.

At the Swedish Research Council's Laboratory at Studsvik studies on decay data (γ- rays, conversion electron, half lives, delayed neutrons) of short lived fission products have continued by use of the isotope separator on-line with the R20 reactor.

Fast neutron capture reaction studies have continued at the Tandem Accelerator Laboratory at Uppsala. A better theoretical description of the mechanism has been developed by introducing collective effects in the direct-semi-direct capture model.

The studies of the gamma-ray production cross section in light nuclei, and of fission cross section and fragment angular distribution have also continued in the neutron energy range 5-11 MeV, but no final data yet exist.

B) Facilities

The 6 MeV tandem-pelletron has been delivered to the Nuclear Physics Laboratory at Lund University. The machine is equipped with a duoplasmatron ion-source for the acceleration of p, d and He-ions. The research program will include neutron physics.

U K

Rose reported the following additional items to the UK Annual Progress Report.

A) Measurements

In high energy neutron capture work on the Harwell linac, it has been found possible to improve the signal/background ratio, by about a factor of

10 at 150 keV, by the use of a 30 cm liquid He filter to remove the high energy neutrons which otherwise arrive early and, after moderation, are detected at the same time as the lower energy neutrons of interest.

A depletion of the Li content of two samples of Li-glass, around the cylindrical surface, was discovered recently. (Nothing is known about the flat surfaces, or the effects on scintillation properties).

This depletion, which extends up to 1 mm from the surface, was measured by a neutron transmission method, which also revealed some different materials replacing the lithium. A tempting theory to explain the effect is that such glasses are ground under water and that as lithium is a very mobile element, it has moved and been replaced at least partly by hydrogen. This effect is unimportant in many experiments, where a neutron beam is collimated through the centre of the glass, but it may be important in others where the whole glass is irradiated.

B) Facilities

At Harwell approval was received to build a 136 MeV (unloaded energy) electron linear accelerator to inject into the existing neutron booster and flight paths, though one or more additional target cells will also be built. Its overall parameters will be similar to ORELA. The new machine should be operational in the middle of 1978 and the existing machine should operate at least until the end of 1976.

A new 30 MeV linac, primarily for neutron studies and photoneutron reactions, is being built at the Kelvin laboratory of the U. of Glasgow.

The beam from this machine will also be directed into either an existing target cell for neutron work or into a new cell. This machine should be operational some time in 1976.

C) Evaluation

A new programme has been started up on the study of nuclear incineration, to examine whether it is technically feasible to destroy radio nuclides (primarily the actinides) by transmutation in a reactor. The first objective is to investigate whether the nuclear physics "is on our side" in this matter. Calculations have been carried of the quantities of high actinide remaining after continuous irradiation for up to 32 years in hard and soft spectrum fast reactors and of the potential hazard remaining at any time, and the initial results are encouraging.

It is already clear that hard spectrum reactors are better than those with softer spectrum and that, for example, if a fuel could be left to 100% burn-up, with fission products extracted, there would be a slight improvement to the neutron economy in a CFR and a marked benefit in a DFR spectrum.

Sensitivity studies have begun to show how sensitive the calculations are to the assumed cross sections, which were themselves a mixture of the rather scanty experimental data with theoretical values derived in recent work by J.E. Lynn. As expected, the preliminary indications are that the most important cross sections will be those of Am-241, Am-243 and Cm-244.

U.S.A.

Motz and Smith confined their remarks mainly to highlights of INDC (USA)-72/U.

A) Measurements

a) At Brookhaven National Laboratory, a number of activation cross sections at 24 KeV were measured making use of the HFBR tailored-beam facility.

b) At Lawrence Livermore Laboratory. The Linac was used to perform $\bar{\nu}$ prompt measurements for ^{235}U in the 0.5-20 MeV neutron energy range. Preliminary results were shown in INDC(USA)-72/U. Fission cross section ratios $^{233,4,6,8}U/U^{235}$ (see UCRL-76219) and $^{241}Pu/^{235}U$ (see UCID-16878) were measured in the energy range 1 KeV-30 MeV and 100 KeV-20 MeV, respectively.

c) At Los Alamos Scientific Laboratory thermal neutron capture were measured for Th, U,Nb and ^{59}Ni with very low background. The experimental set-up allows measurements of μbarn cross-sections. Motz called attention upon the measurements on ^{59}Ni, reported at pg.28 and 89 of INDC(USA)-72/U. The results had to be renormalized, due to a misinterpretation of sample composition. Neutron spectrum sources through $T(p,n)^3$ He and $H(t,n)^3$ were studied at ∿ 10 MeV. Measurements on neutron production from Be at 10 MeV were also carried out at LASL. Experimental results show large discrepancies when compared with theoretical estimates. Motz mentioned that commercially available ^{3}He neutron counters could be unsatisfactory for long irradiation periods. Technical development for this kind of counters which are important for safeguards were studied. Bayhurst et al, measured threshold neutron cross section for a large number of nuclei in the 7.5-28 MeV energy range (see Phys.Rev.C,12, 451,1975). The results of radio chemical analysis of fission products yields in twelve fast assemblies were tabulated and would be published at the end of 1975.

d) At Oak Ridge National Laboratory, Physics Division. Motz called attention to the following experimental work (see ORNL-5025 Progress Report).

- neutron capture and absorption measurements of ^{59}Ni for thermal and resonance energy neutrons (Raman et al)
- absolute neutron detector calibration in the 10-30 MeV energy range (Fowler)
- measurements on neutron spectra from Ta,H_2O and Be target used at ORELA (Harvey)

  In addition Motz informed that the two photons decay in H(n,γ)D, as indicated by the"Grenoble experiment", was not, very likely, a real effect.

e) At Argonne National Laboratory. Studies on the delayed neutron yields as a function of the incident neutron energy were mentioned by Smith, who mentioned also the programme on ^{238}U, Pu and Am fission cross ratios to ^{235}U and the Interlab Committee Programme on Half-Lives. In particular, he pointed out that recent measurements support the ^{239}Pu half-life obtained via calorimetric determination.

f) The extensive study of neutron elastic and inelastic scattering in the mass region A $\sim$ 90-100 underway at the University of Kentucky was mentioned by Motz.

B) Facilities

The following information was provided by the US delegation.

- A pulsed neutron facility (WNR) was developed at LAMPF. Pulse width can vary from few nanoseconds to several microseconds. The source, comparable with or better than ORELA, should be ready to operate in 1976. Total expenditure: about 5.5 million dollars.

- A 400.000 US $ budget was available in 1975 in order to improve the ORELA injection system by a factor 6-10, with a pulse of 3ns at the target. The system should be completed in 1977.
- A new 14 MeV Intense Neutron Source (INS) for CTR studies was developed at LASL. The "marriage" between beam and target was scheduled for Spring 1976.
- Columbia University Synchro-Cyclotron will operate at full energy at the end of 1975.

C) Evaluation

Several reports were distributed by Smith (available through NDS), who drew attention on Moldauer's paper "Why the Hauser - Feshbach formula works", published in Phys.Rev. C,11,426 (1975). Motz mentioned error function studies performed at Idaho for after heat by fission products.

Old D(d,n) and T(d,n) cross section measurements by Arnold et al (see Phys.Rev.,93,483,1954), were analysed in the framework of R-matrix theory at LASL (see USNDC - CTR-2). In the original work experimental data below 16 KeV were neglected because they were appreciably below the Gamow theoretical curve. New fits have indicated about 8% increase of the cross sections below 10 KeV.

USSR

Yankov highlighted the Proceedings of the 3rd All-Union Conference on Neutron Physics, (Kiev, June 1975)

A) Measurements(+)

The radiative capture cross section of ^{197}Au for a neutron energy in the neighbourhood of 600 KeV was measured by the activation method(1). The source of neutrons was the T(p,n) reaction. The induced activity was measured by means of a γ spectrometer having a Ge(Li) detector with known efficiency; the neutron flux was measured by gaseous hydrogen counters of different constructions.

The radiative capture cross section of gold, tantalum and indium was measured in the neutron energy interval 4 - 380 KeV (2). The relative cross section was determined by means of the known dependence on energy of the ^{10}B (n,$\alpha\gamma$) reaction cross section. In order to obtain the absolute

(+) References are given in Appendix XXV.

value, the gold relative capture cross section at 30 KeV energy was used. The error in the cross section was established to be 5-7.5% for gold and 7.5-9% for tantalum and indium.

Absolute measurements of the fission cross section of ^{235}U at 14.8 MeV neutron energy were carried out by the associated particle method (3) with a 1.7% accuracy. The value obtained is 2.35 $\pm$ 0.04 barns.

Absolute measurements of the ^{235}U and ^{238}U cross sections for fission by ^{252}Cf fission spectrum neutrons where performed (4). Recorded were coincidences of fragments from the Californium fission with fragments from the fission of the studied targets. The following cross section values were obtained: 1265$\pm$ 19 mb for ^{235}U and 347$\pm$6 mb for ^{238}U.

Comparisons of the obtained data with the results of Grundl et al. (1972) (1207$\pm$52 mb and 324$\pm$14 mb, respectively) and also with the calculated values of 1281 and 352 mb, respectively, were performed.

The measurement of the energy spectrum of prompt neutrons from spontaneous fission of ^{252}Cf was performed by the time-of-flight method (5).

The spectrometer resolution was 4 ns and the flight distance 140 cm.

The fragments were detected by a silicon surface barrier detector and the neutrons by a scintillation detector with known (within 3.5% accuracy) relative efficiency. For the energy interval 0.5-7.0 MeV, T = 1.46$\pm$0.02 MeV.

The investigation of the neutron spectrum from ^{252}Cf fission in the neutron energy region 0.02-2MeV was continued (6). The time-of-flight method based on 12.5, 25, and 37.5 cm was employed. A $^{6}LiI(Eu)$ crystal of 1.9mm thickness was the neutron detector. The full width at the half-maximum of the line was around 1 ns. The energy relation between the cross section for the $^{6}Li(n,\alpha)$ reaction and the calculated cross section values obtained in the recent years was used in refining the dependence of the detector efficiency on neutron energy.

For neutron energies below 200 KeV, the new data agree with the results published by the same authors at the 2nd Neutron Physics Conference (Kiev, 1973). In the neutron energy interval 0.8-2MeV, the results obtained agree satisfactorily with the Maxwell distribution with T = 1.40 MeV; at lower energies, an excess (of 10-15%) over the Maxwell distribution was observed. The data are preliminary.

The experimental determination of the neutron emission probability for ^{252}Cf fission for the times exceeding 10^{-14} sec was carried out (7). For this purpose, a comparative study on neutron spectra from Californium fission fragments moving in vacuum in a dense medium was performed.

Within the limits of experimental error, the spectra have coincided in the interval where the comparison was made, namely 0.05-7 MeV. The emission time for neutrons with energies above 500 KeV (laboratory coordinate system) was less than $2x10^{-14}$ sec and the fraction of neutrons with emission time $t > 10^{-12}$ sec does not exceed 1 - 1.5%. The upper limit of emission time for neutrons with energies below 500 KeV is 10^{-13} sec and the fraction of neutrons with emission time $t > 10^{-12}$ sec is less than 5%.

The energy dependence of the cross section for the radioactive isotope ^{152}Eu(T=12.4 yr) in the energy interval 0.02 - 02 eV was obtained by the transmission method (8). The cross section value at E_n = 0.0253 was 12.800±600 barn.

The transmission of an ^{243}Am sample was measured for neutrons of 0.4 eV energy and higher by the time-of flight method (9). Parameters for 48 levels and the total resonance integral were computed.

The obtained mean separation between levels is $\bar{D}$ = 0.71 eV and the strength function is $S_o = 0.89x10^{-4}$.

Also measured were total neutron cross sections for ^{226}Ra, ^{181}Ta, ^{182}Ta and ^{147}Pm and the resonance parameters determined (10). The total cross section σ_{tot} for ^{226}Ra for the neutron energy range below 2000 eV, resonance parameters for ^{226}Ra to 880 eV and for ^{181}Ta, ^{182}Ta, and ^{147}Pm in the energy range to 1000 eV were determined. Values of the neutron strenght functions and resonance integrals for ^{182}Ta and ^{147}Pm were also presented for the thermal region.

Resonance parameters for the ^{244,245,246,248}Cm isotopes for neutron energies between 1.5 eV and 200 eV were investigated (11). The transmission through samples with 70 and 140 ns/m was measured by the time-of-flight method. Resonance parameters and total resonance integrals were determined. Statistical analysis for the ^{244}Cm resonances was carried out. The ^{245}Cm data are preliminary.

Thermal cross sections and capture and fission resonance integrals for the ^{241,243}Am, ^{249}Bk, ^{249}Cf isotopes were obtained (12). The measurements were made by the relative method using as reference the capture cross sections of ^{197}Au and ^{59}Co.

The ^{238}U radiative capture cross section for neutrons in the energy interval 0.6 - 1 MeV was measured by the activation method (13).

The cross section value at 1026 KeV energy agrees with earlier results of the same authors published at the First All-Union Congress on Neutron Physics (Kiev, 1971), for which the ^{235}U fission cross section was used as reference. The data for the neutron energies of 590 and 790 KeV are in agreement with the latest data of Pönitz (1974).

More accurate data on $\alpha = \sigma_{n\gamma}/\sigma_{nf}$ for ^{239}Pu in the neutron energy region 0.2 - 30 KeV as well as a comparison with works performed after 1972 are given in Ref.(14).

The fission cross section for ^{235}U was measured with a neutron spectrometer for neutrons from the 60 MeV linear accelerator IAZ with a nominal resolution $\Delta t/2L \approx 3ns/m$. Resonance integrals and fission integrals were computed for the energy region 0.01 - 10 KeV; these values were compared with published data (15).

The energy dependence of the average emission of prompt fission neutrons, $\bar{\nu}$, from ^{233}U, ^{238}U and ^{239}Pu in the primary neutron energy range 0.8-5.0 MeV was investigated (16). Recommended curves $\bar{\nu} = f(E)$ were obtained by means of polynominal representation and the character of the deviation from a linear dependence was studied.

The fission cross section ratio $\sigma_{nf}(^{239}Pu)/\sigma_{nf}(^{235}U)$ in the neutron energy interval 0.024 - 7.4 MeV was measured (17). Monoenergetic neutron sources were used for the Li(p,n), T(p,n), D(d,n) reactions. The fragments were recorded by a ionization chamber. The main source of error (1.6%) was concluded to be in determining the amount of fissioning nuclei in the plutonium and uranium foils. A comparison of the results obtained with experimental data found by other authors was presented.

Cross sections for γ-ray production in inelastic interactions of 14 meV neutrons on 17 nuclei (Li,Be,...Al,...Fe,...^{235}U) were measured (18). The time-of-flight method and a total absorption spectrometer with NaI(Tl) crystal were used.

In order to study the gamma radiation from inelastic scattering of fast neutrons, a nuclear reactor of the IRT type (19) with neutron flux falling as exp(-0.72E) for E > 1 MeV was used as neutron source.

Gamma-ray spectra for most of the elements in the Mendeleev periodic table and for more than 20 separated isotopes were measured in an external neutron beam Ge(Li) detectors. At present, an atlas of energies and intensities of γ radiations from inelastic scattering of fast neutrons on elements for the energy range of E_{γ} from 100 KeV to 2-5 MeV is put together in atomic number order.

B) Facilities

The possibility of obtaining localized pulsed sources of mono-energetic neutrons of nanosecond duration created by laser radiation incident on special targets was investigated (20). In particular, neutron emission (of e.g. up to 10^6 neutrons/sec.), depending on the laser energy, was measured. In order to achieve the conditions of ignition and heating of the thermonuclear plasma by multibeam laser light, a method of preparat ion and selection of spherical shell filled with deuterium-tritium mixture was devised (21). Experimentally supported calculations indicate that for laser energies between 10^2 and 10^4 joules one can obtain 10^9 - 10^{14} neutrons in 10^{-11} sec on a source diameter of approximately 10 microns. By further increasing the laser energy to 10^6 joules, experiments of this type can examine how unique are the possibilities of conducting neutronic and nuclear experiments at neutron densities exceeding solid particle densities, e.g., exotic nuclear reactions with neutrons, neutron-neutron scattering. It was shown that the investigated elements can be inserted in the target composition.

A neutron time-of-flight spectrometer at the exit of the synchro-cyclotron LIYAF(22) in Gatchina was used for studies of the physics of fission and of reactions of the (n,γ) type. A proton beam of 1 GeV energy falls on a lead target; the duration of the neutron pulse without slowing down was 8-10nsec. At a current of 1 μA and 50 Hz frequency the total intensity is approximately 10^{14} neutrons/sec.

CBNM-EURATOM (Geel)

A) Measurements

Liskien informed that CBMN Activities were described in NEA-NDC(E)-162 "U" Volume III.
Two new items were not included in that report

- measurements of neutron total, scattering and capture cross sections in the 10 ev to 4 keV energy range.

These data were needed to normalize integral experiments on fission products performed at RCN Petten.

- Measurements of cross-sections for the reactions $^{103}Rh(n,n')$ and $^{115}In(n,n')$(population of isomeric state) from threshold to 7 MeV. These data were needed for reactor neutron dosimetry. Relative data below 3 MeV are available.

B) Facilities

The modernization of the two accelarators (Linac, VDG) was going on as described in the progress report; the delay was of the order of 1 month.

VIII.B. REPORTS ON NUCLEAR DATA ACTIVITIES IN COUNTRIES NOT REPRESENTED ON INDC

The final report on Nuclear Data activities in the NDS Service area will be published as INDC(SEC)-50 and distributed.

IX. REPORTS OF TECHNICAL AND AD-HOC-SUB-COMMITTEES (+)

IX.A. Standards Sub-Committee

The report was introduced by Liskien, who stressed the importance of good data retrieval from the 4-Centres, and the usefulness of simultaneous evaluation of standards in which ratio measurements were taken into account. The importance of very carefully determined neutron energy and γ-ray intensity standards had led to the establishment of an ad-hoc group to deal with neutron energy standards. He mentioned that a γ -ray standard in the high energy region (above 1.5 MeV) which uses ^{242}Cm and ^{13}C as sources had been set up by Legrand, who expected that the accuracy of this standard should be of the order of 5%.

The final report will be published under separate cover as soon as possible.

(+) Discussed on Friday morning

IX.B. Discrepancies Sub-Committee

The Sub-Committee had been unable to discuss all the points on its agenda, but had agreed to a report format, similar to the one adopted by the corresponding NEANDC Sub-Committee. The Report would consist of three sections, namely: 1) data description, 2) nature of discrepancies, and 3) recommendations and/or suggestions. More detailed information would be given in appropriate Appendices.

Rowlands, Fuketa, Smith, Cierjacks, Usachev and Vlasov highlighted various parts of the report. In particular, Smith mentioned new measurements on ^{238}U inelastic scattering that would be reported in ANL/NDM-16; major changes to existing evaluations were foreseen.

Usachev distributed a paper on cross-section modifications suggested by an analysis of integral measurements (Appendix XXVI).

During the presentation, Action n. 31 was agreed too.

The final report will be published under separate cover as soon as possible.

IX.C. Ad-hoc Sub-Committee on INDC/NEANDC Relationship

A short discussion took place on the coordination of INDC and NEANDC meetings. It was decided that a time schedule for next meetings should be agreed by the Chairmen of the two Committees (Action n. 32). The Sub-Committee was then abolished.

X. REPORTS OF POLICY SUB-COMMITEES(+)

X.A. Energy Application Sub-Committee

The Sub-Committe Report (Appendix XXVII) was limited to the areas of fission product, reactor dosimetry and fusion nuclear data. A short discussion on FPND Newsletter also took place.

Rose, Motz, Smith and Cierjacks pointed out that National Data Centres and INDC members should be informed about the FPND Questionnaire distribution list. This should be done also for any "Questionnaire" circulated by the NDS. (Action n.33). Smith felt that the FPND Newsletter should be monitored by the INDC, and a number of actions were agreed for

(+) Discussed on Friday afternoon

this purpose (see Actions n. 34, 35, 36, 37 and 38). Schmidt said that the next FPND Panel had been deferred to the first half of 1977.

Vlasov commented on nuclear data for reactor dosimetry activities at NDS. Smith and Motz warned against too ambitious programs and redundancy with similar work carried out elsewhere. Schmidt agreed with Smith. Vlasov indicated that NDS activities in reactor dosimetry would be directed towards the following objectives: a) data compilation and evaluation and b) coordination of activities on benchmark measurements for integral testing in microscopic data.

The above activities will be carried out in cooperation with existing groups, for benefit of 'small' and developing countries.

X.B. Non-Energy Applications Sub-Committee

The report is given in Appendix XXVIII. Berenyi pointed out to the Sub-Committee which action(+) should be fulfilled within the next ten months. Rose warned against the complexity of industrial gauging in practical cases.

Cross pointed out that i) a preliminary survey on nuclear structure data requirements for medicine showed that needs were small; and, ii) data needs fot activation analysis were not discussed. A working paper on data needs for biomedical purposes discussed during the Sub-Committee meeting is given in Appendix XXIX. (see Action n. 39).

XI. MEETINGS

XI.A. Past Meetings

Highlights of Washington, Paris (Atomic Masses) and Kiev Conferences were presented. See Appendix XXX and XXVI. See also Appendix XXXII and Action n. 40.

XI.B. Present Meetings

About 30 papers had been submitted to the "Nuclear Theory Consultant Meeting" at ICTP (Trieste) scheduled for December 1975.

(+) NOT reported in the Action list

XI.C. Future Meetings

Schmidt said that the IAEA Specialists Meeting on Nuclear Data Requirements for Shielding had been deferred to October 1976 (see Actions n. 41,42 and 43). Smith indicated that the 1976 Lowell International Conference on the Interactions of Neutrons with Nuclei was shaping up as scheduled.

The scopes of the Seminar on Nuclear Theory for Applications planned to be held at ICTP-Trieste in 1977 were briefly outlined by Schmidt..

The Seminar will consist of three workshops, each about 2 weeks long, on

(a) Nuclear reaction theories
(b) Nuclear fission theory
(c) Nuclear theory computer codes

The subject matter will be directed towards applications and be mainly for benefit of developing countries.

The discussion on an IAEA International Nuclear Data Conference, to be held in the 1978/79 period, was mainly focused on the usefulness of such a Conference (Appendices XXXI and XXXII). The prevailing belief was that the Conference should be dropped in favour of relatively small meetings (e.g. specialist meetings), felt to be more effective.

Alternatively, IAEA co-sponsorship to national or regional conferences on nuclear data was strongly recommended in order to ensure participation of developing countries at the most important meetings.

After discussion of the proposed sequence of conferences outlined in Rose's paper, the IAEA co-sponsorship of the 1979 "Washington Conference" (to be held probably at Seattle) was recommended.

In addition the possibility of having an IAEA co-sponsorship to the next NBS Panel on Nuclear Standard Reference Data, to be held in Spring 1977, will be explored (Actions n. 44 and 45). It was clearly stated that these actions would not imply, for the moment, any official commitment for the organisations concerned.

XII. COMMITTEE BUSINESS (PART II)

XII.A. Review of Actions Decided During the Meeting

Schmidt reviewed a preliminary "List of Actions" prepared by Benzi.

XII.B. Other Business

The revised version of "INDC Terms of Reference", prepared by the NDS/INDC Secretariat will be submitted to the members for comments (Actions n. 46 and 47).

It was decided that Gemmell would continue as Chairman until 1st October 1976, when according to the INDC Methods of Work, the next Chairman will be W.Cross, Canada. Gemmell will try to resolve by letter the problem of the Executive Secretary for the next period (Action n. 48). The NDS/INDC Secretariat will investigate about the possibility of having a 3-year attendance period for the INDC members. (Action n. 49).

Following suggestions by Schmidt and Rose, two actions were decided in order to improve the efficiency in exchanging documents among INDC Members (Action n. 50 and 51).

XIII.C. Next INDC Meeting and Adjournement

The next (9th) INDC meeting will be held in Spring 1977 in Vienna (Action n. 52). The NDS/INDC Secretariat will investigate about the possibility of having the 10th INDC Meeting in Hungary (Action n. 53).

Gemmell and Schmidt thanked members for their assistance, and IAEA staff, interprepeters and technicians for running the meeting in a smooth manner.

The meeting was adjourned.

A P P E N D I C E S

AGENDA

8th INDC Meeting, Vienna, 6-10 October 1975

(Background references are listed in Attachment A)

(WP = Working paper; names = lead speakers)

MONDAY SESSION A	I.	Introductory Items (15 m)
9:30 - 9:40	-	Opening of the meeting (10 m)
9:40 - 9:45	-	Announcements (5 m)
MONDAY SESSIONS A+B	II.	Committee Business (2 h 45 m)
9:45 - 9:55	A.	Consideration and approval of complete minutes of the 7th INDC Meeting (10 m)
9:55 - 10:05	B.	Consideration and adoption of agenda of 8th INDC Meeting (10 m)
10:05 - 10:15	C.	Attendance of Observers (10 m)
10:15 - 10:45	D.	Review of actions arising from the 7th INDC Meeting (30 m)
10:45 - 11:00	E.	Membership of standing, and new and old ad-hoc subcommittees (15 m) (e.g. new ad-hoc Subcommittee on INDC/NEANDC Relationship)
11:00 - 11:30		Coffee break (30 m)
11:30 - 12:00	F.	Final approval of Revised Draft of INDC Methods of Work (Schmidt) (30 m)
12:00 - 12:30	G.	Future of the Energy/Non-energy Applications Subcommittee (30 m)

12:30 - 12:45	H.	INDC Correspondents and documents distribution, new items (atomic and molecular data for fusion, reduction of L-distribution, etc.)(Lorenz) (15 m)
12:45 - 13:00	I.	Guidelines for shorter INDC Meetings minutes (Chairman) (15 m)

13:00 - 14:00 Lunch Break

MONDAY
SESSIONS C+D

Meetings of all four standing subcommittees (3 h)

14:00 - 17:30

TUESDAY
SESSIONS A+B

III. Neutron nuclear data (1 h 30 m)

9:30 - 9:45	A.	Report on 11th Four Centre Meeting (Lemmel) (15 m)
9:45 - 10:00	B.	Additional information from neutron data centres other than NDS (15 m)
10:00 - 10:30	C.	Two years publication cycle of CINDA (WP Lemmel) (30 m)
10:30 - 11:00	D.	International exchange and assessment of use of evaluated neutron data (Smith, Usachev) (30 m)

11:00 - 11:30 Coffee break (30 m)

IV. "Non-neutron" nuclear data (1 h 30 m)

11:30 - 12:00	A.	Progress reports on activities, services and co-ordination of "non-neutron" nuclear data centres and groups (WPs all members concerned) (30 m)

12:00 - 12:30	B.	Report on meeting on CPND* compilation for applications (Lemmel) (30 m)
12:30 - 13:00	C.	Discussion of recommendations from "non-neutron" nuclear data meetings April/May 1974, including plans for 1976 meeting (WP Lorenz) (30 m)
13:00 - 14:00		Lunch break (60 m)
<u>TUESDAY SESSION C</u>	<u>V.</u>	<u>Atomic and Molecular Data for Fusion</u> (2 h)
14:00 - 14:30	A.	Presentation (Schmidt, Lorenz, Phillips) (30 m) - Background - Survey report - Consultants' Recommendations - Recommendations by IFRC
14:30 - 15:00	B.	Manpower needs for A+M programme component (Schmidt) (30 m)
15:00 - 16:00	C.	Discussion (60 m)
16:00 - 16:30		Tea/Coffee break (30 m)
<u>TUESDAY SESSION D</u>	<u>VI.</u>	<u>Coordination of nuclear data activities (measurements and evaluations)</u> (1 h)
16:30 - 16:50	A.	Status of development of regional nuclear data centres (Fuketa, Gemmell, Mehta) and of national nuclear data committees (Lorenz, members) (20 m)
16:50 - 17:15	B.	Neutron data for reactor neutron dosimetry (Vlasov) (25 m)
17:15 - 17:30	C.	FPND Newsletter (Lammer) (15 m)

* CPND = Charged Particle Nuclear Data

WEDNESDAY SESSIONS A+B	VI.	Coordination of nuclear data activities (measurements and evaluations) (cont'd) (3 h)
9:30 - 11:00	D.	WRENDA for fission, fusion and safeguards (WP Rose, WP Usachev, WP Lemley) (90 m)
11:00 - 11:30		Coffee break (30 m)
11:30 - 11:50	D.	WRENDA (continued) (20 m)
11:50 - 12:35	E.	Nuclear data measurement in developing countries, etc. (WP Fuketa, WP Mehta, WP Rose, WP Schmidt) (45 m)
12:35 - 13:00	F.	Status of NDS targets and samples programme (Lemley) (25 m)
13:00 - 14:00		Lunch break (60 m)
WEDNESDAY SESSIONS C+D	VII.	NDS programme (3 h)
14:00 - 14:30	A.	NDS activities and services (Schmidt/NDS Staff) (30 m)
14:30 - 15:30	B.	NDS composition and responsibilities (Schmidt/Lorenz) (60 m)
15:30 - 16:00		Discussion (30 m)
16:00 - 16:30		Tea/Coffee break (30 m)
16:30 - 17:30		Discussion (continued) (60 m)

THURSDAY SESSIONS A+B	VIII.	Progress reports on nuclear data measurements, facilities and evaluations (3 h)
9:30 - 11:00	A.	Additions to submitted progress reports (90 m)
11:00 - 11:30		Coffee break (30 m)
11:30 - 12:30	A.	Additions to submitted progress reports (cont'd) (60 m)
12:30 - 13:00	B.	Reports on nuclear data activities in countries not represented on INDC (30 m)
13:00 - 14:00		Lunch break (60 m)
THURSDAY SESSIONS C+D	IX.	Reports of technical and ad-hoc subcommittees (2.5 h)
14:00 - 15:00	A.	Standards subcommittee (60 m)
15:00 - 16:00	B.	Discrepancies subcommittee (60 m)
16:00 - 16:30		Tea/Coffee break
16:30 - 17:00	C.	Ad-hoc subcommittee on INDC/NEANDC relationship (30 m)
17:00 - 17:30	Non-Agenda items (30 m)	
FRIDAY SESSIONS A+B	X.	Reports of policy subcommittees (3 h)
9:30 - 11:00	A.	Energy applications subcommittee (90 m)
11:00 - 11:30		Coffee break (30 m)
11:30 - 13:00	B.	Non-energy applications subcommittee (90 m)

FRIDAY SESSIONS C+D — XI. Meetings (2 h)

14:00 - 14:40 — A. Past meetings (40 m)

- Washington Conference, March 1975 (Motz)
- Atomic Masses etc. Conference, Paris, June 1975 (Wapstra)
- Kiev Conference, June 1975 (Usachev)

14:40 - 15:00 — B. Present meetings (20 m)

- TND Advisory Group Meeting, Karlsruhe, November 1975 (Lorenz)
- Nuclear Theory Meeting, Trieste, December 1975 (Schmidt)

15:00 - 16:00 — C. Future meetings (90 m)

1. 1976 IAEA Advisory Group Meeting on A+M data for fusion (10 m)
2. 1976 IAEA Specialists Meeting on Nuclear Data Requirements for Shielding (10 m)
3. 1976 Lowell International Conference on the Interactions of Neutrons with Nuclei (Smith) (10 m)
4. 1977 Seminar on Nuclear Theory for Applications (10 m)
5. 1978 IAEA Advisory Group Meeting on Nuclear Data for Fusion (10 m)
6. 1978/79 Advisory Group Meeting on Nuclear and Atomic Data for Medical Purposes (10 m)

16:00 - 16:30 — Tea/Coffee break (30 m)

16:30 - 17:00 — 7. 1978/79 International IAEA Nuclear Data Conference (WP Rose) (30 m)

17:00 - 17:30 — XII. Committee business (Part II) (30 m)

A. Review of actions arising from this meeting (Benzi) (15 m)

B. Other business (10 m)

C. Next (9th) INDC Meeting and adjournement (5 m)

UK Response to the Lott Proposal

Action 41. (Lott proposal on fission product energy release).

The Lott proposal for benchmark experiments on fission product energy release has been considered by the group working on Zebra at Winfrith. They think the proposal is basically good but would like to make one particular point, of which Dr. Lott is undoubtedly aware, but which they feel has not been sufficiently stressed.

A fuel element in a typical power reactor will usually remain there for several months before being removed and it is to calculate the energy release after such an irradiation that the decay data are mainly needed. Very large and totally unacceptable errors may result if data are used which have been obtained from an irradiation of 10^5 secs and a measurement of the energy release made over a comparable period of time. If these errors are to be avoided, either the irradiation must be done for a time similar to that for the normal residence of a fuel element in a power reactor ($\sim$6 months) or the decay of the sample must be followed for $\sim$6 months following a relatively short irradiation (say 10^5 secs). Clearly the former is not very practical and it is necessary to resort to the latter method. This means that high neutron fluxes must be used in the irradiation if sufficiently high counting rates of the long-lived activities are to be obtained.

The Zebra group are currently making measurements on the β-energy release from samples of U-235 and Pu-239 which were irradiated for 10^5 secs in Zebra about 3 months ago and they intend to continue their measurements for at least another 3 months. The analysis of the results has not yet started but they hope to make the results available in due course. They have not attempted to measure γ-ray energy release.

Membership of Ad-hoc Subcommittee on International Nuclear Data Conference

Rose Chairman

Cierjacks

Liskien

Mehta

Schmidt

Smith

Usachev

Membership of the Four Standing Subcommittee of INDC

(8th INDC Meeting, Vienna, 6-10 October 1975)

1. Subcommittee on Nuclear Standard Reference Data

Liskien, BCMN, Geel, Chairman

Legrand, France (for Le Gallic)

Lemley, IAEA/NDS (ex. off.)

Lemmel, IAEA/NDS (ex. off.)

Rose, UK

Schmitt, France

Seidel, German Dem. Rep.

Smith, USA

Wapstra, Holland

Yankov, USSR

2. Subcommittee on Discrepancies in Important Nuclear Data and Evaluations

Joly, France Chairman

Amiel, Israel (ad hoc)

Cierjacks, FRG

Condé, Sweden

Fuketa, Japan

Konshin, USSR (corresponding)

Lammer, IAEA/NDS (ex. off.)

Lemley, IAEA/NDS (ex. off.)

Lemmel, IAEA/NDS (ex. off.)

Michaudon, France

Motz, USA

Rowlands, UK

Smith, USA

Usachev, USSR

Vasiliu, Romania (ad hoc)

Vlasov, IAEA/NDS (ex. off.)

3. Subcommittee on Energy Application on Nuclear Data

Motz, USA Chairman

Amiel, Israel (ad hoc)

Benzi, Italy

Cierjacks, FRG

Condé, Sweden

Fuketa, Japan

Gemmell, Australia

Mehta, India

Michaudon, France

Rapeanu, Romania (ad hoc)

Rowlands, UK

Schmidt, IAEA/NDS

Vlasov, IAEA/NDS (ex. off.)

Yankov, USSR

4. Subcommittee on Non-energy Application of Nuclear Data

Berenyi, Hungary Chairman

Cierjacks, FRG

Cross, Canada

Legrand, France (for Le Gallic)

Lorenz, IAEA/NDS (ex. off.)

Mehta, India

Rose, UK

Smith, USA

Usachev, USSR

Wapstra, Holland

Zelenkov, USSR (corresponding)

3 October 1975

AGENDAE

OF THE

FOUR STANDING SUBCOMMITTEES

(Agenda item II B)

CBNM GEEL

HL/nr

Geel, September 10th, 1975
VdG - 257/75

DRAFT AGENDA

Meeting of the INDC Subcommittee on Standard Reference Data
Monday, 6/10/75 afternoon

		(relevant material)
1.	Modification/adoption of draft agenda	draft agenda
2.	Further harmonization between INDC and NEANDC subcommittee activities	
3.	Short discussion of the NEANDC entries to the joint status file	Letter of Liskien 9/9/75
4.	Discussion and updating of the present INDC entries to the joint status file	draft report * of INDC Subcommittee
5.	Updating of information from the ad-hoc group on "Neutron Energy Calibration"	
6.	Discussion on "High Energy γ-Ray Standards"	Letters of Liskien 15/4/75 and 30/4/75
7.	Programme proposals for 3rd IAEA Standard Panel	Contents of 2nd Panel

* deadline for the different entries was 15/8/75.

Nevertheless only some of them are today available. The full collection will be distributed to all INDC participants as soon as possible.

APPENDIX III

Proposed Agenda of the INDC Subcommittee on Discrepancies for the VIIIth INDC meeting(october75)

1- Fission cross sections of ^{239}Pu (above 100 eV) and ^{238}U, including ratios to ^{235}U fission cross section .

Reviewer : Rowlands.

2- Capture cross section of ^{238}U above about 100 eV and the ratio to ^{235}U fission.

Reviewer : Cierjacks (in cooperation with Rowlands[1]).

3- Alpha values for ^{235}U and ^{239}Pu above about 100 eV.

Reviewer : Sukhoruchkin.

4- Resonance parameters data of ^{235}U, ^{238}U and ^{239}Pu.

Reviewer : Joly.

5- Values of $\bar{\nu}$ (E) for ^{238}U, ^{239}Pu and ^{238}U.

Reviewer : Fuketa (in cooperation with Tsukada [1]).

6- Inelastic scattering data of ^{238}U.

Reviewer : Motz (in cooperation with Smith [1]).

7- Capture cross sections of Cr, Fe and Ni above about 100 eV.

Reviewer : Cierjacks (in cooperation with Fröhner [1]).

8- Sodium capture and total cross sections in the 3 KeV resonance.

Reviewer : Rowlands (in cooperation with Jackson).

9 Fission neutron spectra of ^{235}U, ^{239}Pu, ^{238}U.

Reviewer : Schmidt/Lemley

10 Fission product nuclear data. Conclusions and recommendations of the Bologna F.N.D.P. panel.

Reviewer : Schmidt/Lammer

11- Transactinium nuclear data (if informations from TND' panel available)

Reviewer : Schmidt/Lorenz

12 - Reactor dosimetry cross sections.

Reviewer : Schmidt/ Vlasov (in cooperation with Batchelor/Liskien[2]).

13- Discrepancies and gaps in major CPND for fusion (D, T), (T, T), etc...

Reviewer : Motz.

14 - Delayed neutron emitters.

Reviewer : Smith [3].

(1) Names of the reviewer for the same (or approximately the same) topic in the NEANDC Subcommittee on discrepancies).

(2) There is no member of the CBNM in the INDC Subcommittee; it is however expected that the CBNM, which has settled a European reactor dosimetry group, could be a good " consultant " for this topic.

(3) A. B. Smith is not an " official " member of the INDC Subcommittee (Appendix V of the sixth INDC meeting); it is however hoped he will be able to devote a part of his time for helping this Subcommittee on a problem he knows certainly better than any other INDC participant.

ENERGY APPLICATIONS OF NUCLEAR DATA

Subcommittee Agenda Items

8th INDC Meeting

A. Fission Product Nuclear Data (FPND)

B. Reactor Dosimetry Data

C. Nuclear Data for Fusion

D. Atomic and Molecular Data (A+M) for Fusion

E. Safeguards Data

F. Transactinium Nuclear Data

G. Charged Particle and Photonuclear Data

H. Nuclear Structure Data

30 September 1975

Subcommittee on Non-Energy Applications

Tentative Agenda

Meeting Monday afternoon, 6 October 1975

1. Recommendations of last INDC Meeting (Official Minutes, INDC-18/L, p. 173-175).

2. Recommendations from 1974 non-neutron nuclear data meetings.

3. Working papers

   a. Rose: Washington Conference

   b. Wapstra: Paris Conference on Atomic Masses

   c. Rose: Compilation of Cross Sections for Ion Beam Analysis of Materials

   d. Other working papers.

4. Report on the Non-Neutron Nuclear Data Working Group of the ICRM (= International Committee on Radiation Measurements) (Legrand).

5. Distribution of responsibilities for review of non-neutron nuclear data needs.

6. Other suggestions and additional information.

Distribution:

A.B. Smith
D. Berenyi
W.G. Cross
J. Legrand
A. Lorenz
M.K. Mehta

B. Rose
L.N. Usachev
A.H. Wapstra
W. Gemmell
J.J. Schmidt

APPENDIX V

MEMORANDUM

To: INDC Participants 1 August 1975

From: J.J. Schmidt
Scientific Secretary of INDC

Sunbject: Future CINDA publication work

Please find enclosed a working paper by H.D. Lemmel from the Nuclear Data Section on a proposed change in the future CINDA publication cycle for consideration at the forthcoming INDC Meeting.

Working Paper on the

CINDA publication schedule

H.D. Lemmel 1975-08-01

Attached are:

1. An extract from Memo 4C-3/115 in which NDS proposed a two-years publication cycle for CINDA.

2. An extract from the Minutes of the March 1975 Four-Centres Meeting, in which a two-years publication cycle was agreed to start with CINDA 76/77.

3. An extract from Memo 4C-2/63 reporting a counter proposal by the CCDN Committee to split CINDA into "early" and "late" volumes.

4. The Memo 4C-3/124 showing that the two-years publication cycle may be favourable compared to the proposal of the CCDN Committee. - NNCSC expressed its preference for the two-years publication cycle.

NDS suggest's that INDC considers favourably the proposed two-years publication cycle of CINDA for CINDA 76/77.

A preliminary price estimate for CINDA 76/77 is 106 $ per 2 years compared to 58 $ for CINDA 75 (one year). Conventional publication cycle may cost about 65 $ for CINDA 76 plus 75 $ for CINDA 77 = about 140 $ per 2 years.

Memo 4C-3/115

(Extract)

To: Distribution 6 January 1975

From: H.D. Lemmel + J.J. Schmidt

Subject: CINDA

A. Postponement of CINDA75 to improve its completeness?
→ B. Two-years publication cycle of Cinda?
C. Proposals re Cinda for 4C-Meeting

B. Two-years publication cycle of Cinda?

We were informed by the IAEA Division of Publications that the paper prices have drastically increased. For the Cinda books, the paper-costs contribute significantly to the sales price. It seems therefore advisable to reduce the paper costs by changing over to a two-years publication cycle for Cinda, as for example:

CINDA75/76	cumulative issue: summer 1975, ca. 2 000 pages
CINDA75/76	first supplement: winter 1975/76, ca. 200 pages
CINDA75/76	second supplement, cumulative, including the first supplement: summer 1976, ca. 400 pages
CINDA75/76	third supplement, cumulative, including the second supplement: winter 1976/77, ca. 600 pages
CINDA77/78	cumulative issue: summer 1972, and so on.

The principle, that complete information could be obtained by consulting not more than two issues, would be retained. For more continuous cost distribution, the Agency could charge the bulk subscribers such that they could pay for the cumulative issue in 1975, and for all three supplements together in 1976, if so requested.

We suggest to start this two-years cycle already with the next issue. For timely information of our Publications Division, a decision must be made at latest at the March 75 4C-Meeting.

Would you please check, in particular at NEA and USAEC, whether such a change would create insuperable difficulties, for example for budgetary reasons? Alternatively, CINDA75 could be the last one to be issued in a one year cycle, and the two years cycle could be postponed to start with CINDA76/77.

Extract from the Minutes of the
March 1975 Four-Centres Meeting

X. Future Publication of CINDA

1. Publication Cycle and Costs

The CINDA book is increasing in cost by a factor of two due to increased production cost (mainly paper cost increases) and the change in the exchange rate of the dollar. To reduce the cost, CINDA will go to a two year cycle in 1976/77 with three cumulative supplements. The size of the supplements will be monitored and a possible extension to a three year cycle will be discussed at future meetings. It was agreed to make use of "cosmetic" codes* to keep the supplements free of old data.

*(This CINDA slang means a mechanism by which important revisions to old CINDA entries will be included in the Supplement books, but less important (so-called "cosmetic") revisions will be excluded. - HDL)

MEMO 4C-2/63
(Extract)

To : See distribution below

Date : 28th May, 1975

From : Nigel Tubbs N.A.T.

Subject : CINDA publication scheme.

At last week's meeting of the CCDN Committee, the questions of CINDA literature coverage and publication frequency were discussed. The Committee made the following recommendation :

"The Committee discussed ways of reducing CINDA publication costs. They recommended, for consideration by the four centres, an alternative to their proposal for a two-year publication cycle. The Committee would prefer to split the book into 'early' and 'late' volumes, containing publications before and after January, 1970. The cumulation of more recent references would be published annually with a single supplement, while the volume containing pre-1970 publications should stand for several years."

Memo 4C-3/124

To: Distribution 16 June 1975

From: H.D. Lemmel

Subject: Cinda publication schedule

Reference: 4C-2/63 of 75-5-28

The NDCC Committee recommended for consideration a publication mode of Cinda, whereby the book would be split into an 'early' and a 'late' volume, containing the references published before or after 1 Jan 1970, respectively. The early volume would have a life-time of 3 to 5 years, and the late volume would appear annually as a cumulative issue plus a supplement.

This proposal seems well worth to be examined. The following considerations show, however, that the NDCC proposal brings no savings compared to the two-years publication cycle, and that there are other disadvantages. We would therefore prefer the two-years publication cycle.

May we ask NDCC to present these considerations to the NDCC Committee and to inform us of its reaction. Please note that we must submit the matter in August at latest to the INDC.

Clearance: J.J. Schmidt

Distribution:

L. Lesca, NDCC (5)
S. Pearlstein, NNCSC (5)
V. Manokhin, CJD (5)

NDS: P.M. Attree
A. Calamand
H.D. Lemmel
A. Lorenz
K. Okamoto
J.J. Schmidt
G. Lammer
file

Prof. H. Goldstein

1. Calculation of page-numbers:

The page number increment was rather constant in the past years with 250 pages for a half-year supplement and with 200 pages increment per year for the cumulative issue. The reason for the relatively large volume of the supplement is threefold:
1. it includes revisions of earlier entries,
2. it includes progress-reports which are important when they are new but which are lateron deleted from the book (so-called "no-book flag" operation),
3. it has more space-consuming headlines per page.

The following estimates are based
in col.1 on 250 pages per half-year supplement,
in col.2 on 200 pages per half-year supplement assuming more restrictive criteria for the inclusion of revisions of earlier entries.

a. Two-years publication cycle:

		col.1	col.2
Spring 1976:	Cinda 76/77: in 3 volumes split by Z	2300 pages	2300
Fall 1976:	Suppl. 1:	250	200
Spring 1977:	Suppl. 2 (incl.Suppl.1):	500	400
Fall 1977:	Suppl. 3 (incl.Suppl.2):	750	600
Spring 1978:	Cinda 78/79: in 3 volumes	2700	2700
Fall 1978:	Suppl. 1:	250	200
Spring 1979:	Suppl. 2 (incl.Suppl.1):	500	400
Fall 1979:	Suppl. 3 (incl.Suppl.2):	750	600
Total in 4 years:	12 volumes	8000 pages	7400

b. NDCC proposal:

		col.1	col.2
Spring 1976:	Cinda old (ref-date ≤ 1969) in 2 volumes split by Z	1200** pages	1200
	Cinda 76 new (ref-date ≥ (1970) in 2 volumes split by Z	1100**	1100
Fall 1976:	Suppl.:	250	200
Spring 1977:	Cinda 77 new in 2 volumes	1300	1300
Fall 1977:	Suppl.:	250	200
Spring 1978:	Cinda 78 new in 2 volumes	1500	1500
Fall 1978:	Suppl.:	250	200
Spring 1979:	Cinda 79 new in 2 volumes	1700	1700
Fall 1979:	Suppl.:	250	200
Total in 4 years:	14 volumes	7800 pages	7600

**The split of Cinda in the "old" and "new" parts was done according to Nigel's estimate (4C-2/63, para 1.) that the volume ≥ 1970 would be slightly smaller than the volume ≤ 1969.

Conclusion:

Within the limits of accuracy of this estimate both publication proposals will require an equal amount of paper, that is about 7700 ± 300 pages in 4 years. If the amount of revisions to be included in the supplements decreases even further, then the two years publication cycle will require noticeably less paper than the NDCC proposal.

2. Other considerations

a. Full information on a given reaction can be obtained
   - by consulting 1 or 2 books (= main issue + one supplement) in the case of the 2-years publication cycle,
   - by consulting 2 or 3 books (= main issue old + main issue new + one supplement) in the case of the NDCC proposal.

   This consideration favors the 2 years publication cycle.

b. The separation between "old" and "new" will not be clear.

   (1) A blocked entry with 3 references in the years < 1969 and one reference of > 1970 will probably be included in the "new" part.

   (2) A blocked entry with all references in the years < 1969 and an Exfor index line of > 1970 will probably be included in the "old" part.

   (3) Unblocked references of an experiment made in the years around 1970 would appear partly in the "old" part, partly in the "new" part.

   (4) Important supplements and corrections to the "old" part would have to be included in the later issues of the "new" part.

   These are not insuperable difficulties, but they would require some programming efforts. The two-years publication cycle would avoid them.

c. The desire expressed in the NDCC proposal of separating "old" and "new" references, is fulfilled, in a modified way, also in the two-years publication scheme, where the supplements issued over a two-years period will include mostly "new" literature. Of the "old" literature, the supplements will include only important supplements and corrections, exactly as in case b.(4) above.

Conclusion:

It appears that the 2-years publication cycle has some advantages to the users of Cinda and also to the Centers producing Cinda, although the differences to the NDCC proposal are actually small.

Session III.C

Working paper on the CINDA publication schedule

B. Rose, A.E.R.E., Harwell, U.K.

Proposals for altering the present publication cycle of CINDA have been set out in a working paper by Dr. Lemmel. The main, indeed the only reason for a revision is to save on the cost of production by reducing the amount of paper used. Dr. Lemmel's paper examines two schemes, these being a two-year publication cycle (scheme 1) and a splitting of the book into 'old' and 'new' volumes (scheme 2). Estimates of the number of pages required over a period of 4 years indicated little to choose between the two and because it was felt that the two-year cycle had some other advantages, it was recommended for implementation.

The reason why the two schemes consume similar amounts of paper lies in the choice of the end of 1969 as the date dividing CINDA 'old' and CINDA 'new' in scheme 2. With such a division, CINDA 'old' is only slightly larger than the first edition of CINDA 'new' (1200 and 1100 pages respectively) and republishing approximately half of the total volume each year amounts to essentially the same as issuing the whole of CINDA every 2 years. The advantage of having 'old' and 'new' volumes becomes much more significant as the size of the 'old' volume is increased relative to the 'new'. This can be achieved by bringing the CINDA 'old' cut-off date nearer to the present time.

Before proceeding to examine the implications of the suggestions outlined above, we put forward another proposal for a CINDA publication scheme (scheme 3). In this scheme, which uses elements drawn from schemes 1 and 2, a CINDA 'old' would be published (but with cut-off date later than the end of 1969) and CINDA 'new' would appear only every 2 years, with three intervening cumulative supplements.

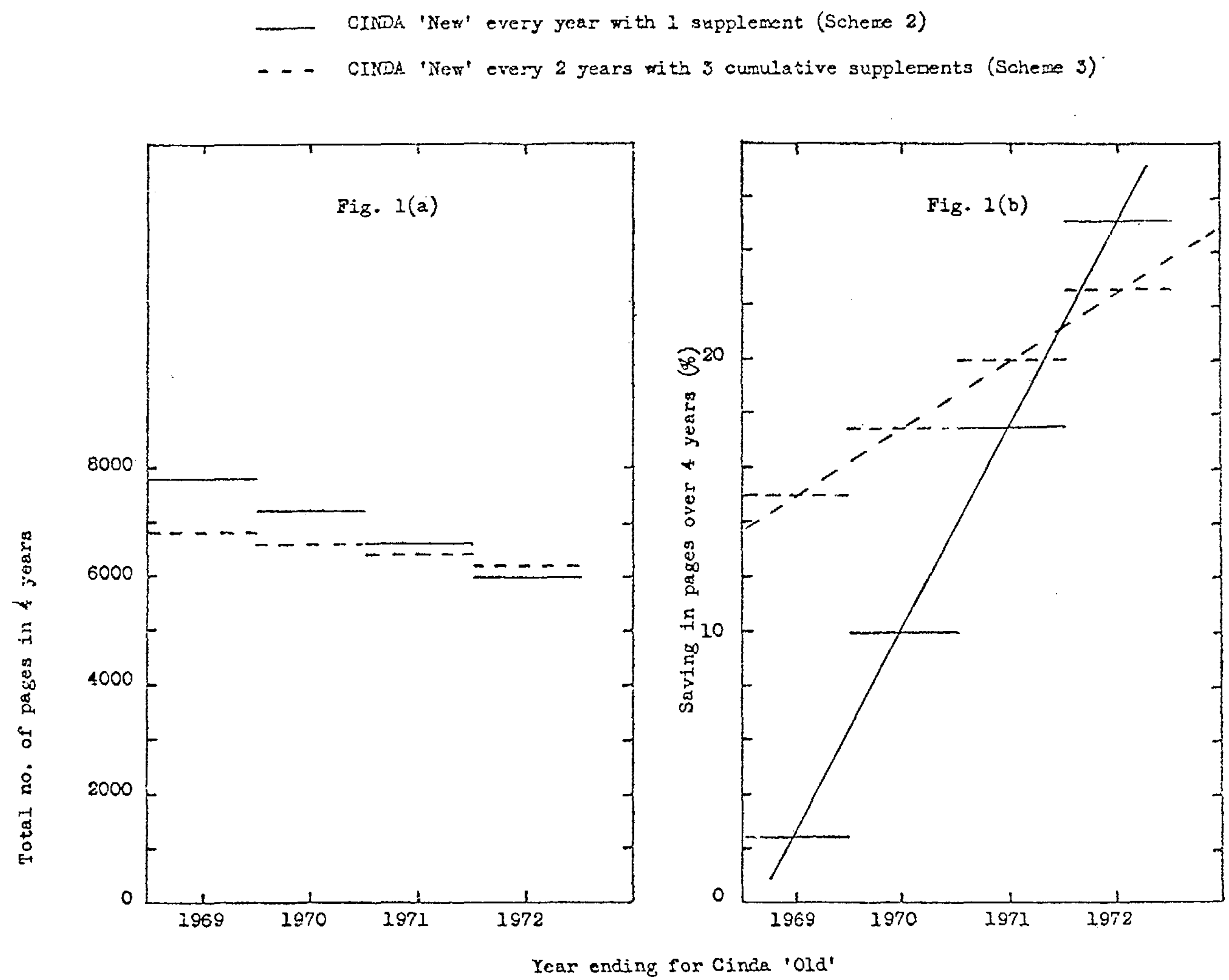
We have made estimates of the number of pages required by each of the three schemes over a 4-year period using cut-off dates varying from the end of 1969 to 1972, where appropriate. The results for schemes 2 and 3 are shown in Fig. 1(a) and these are to be compared with the 8000 pages used by scheme 1. The calculations are based on the assumption that for each year beyond 1969, the 'old' volume would increase in size by 200 pages, with a corresponding decrease in the first issue of the 'new' volume. Also, the col. 1 criteria of Lemmel's paper have been used (i.e. 250 pages per half-year supplement) and it is assumed that the schemes begin operating in the spring of 1976. Fig. 1(b) shows the percentage saving of pages for schemes 2 and 3 relative to the number required by scheme 1. It is immediately obvious that scheme 3 offers the greatest savings for CINDA 'old' cut-off times up to mid-1972. Taking the end of 1970 or 1971 as the dividing period between the two volumes, saving ~20% can be achieved with scheme 3. Some of the savings in schemes 2 and 3 will be lost because of the stockpile of CINDA 'old' volumes which will have to be kept to satisfy the demands of new users. However, this should be more than compensated by the savings in money terms. As time goes on, the cost per page of publication is likely to increase so that a 20% saving in a few years time could be worth considerably more than the necessary additional expenditure at the present time.

We feel that the principle of obtaining complete information from not more than two issues is not sufficiently important to override the very significant savings which can be achieved by relaxing this requirement. Of the other general points which Dr. Lemmel raises in his paper as difficulties which will result by using scheme 2 (and also, therefore, scheme 3), none would seem to cause a real problem. Blocks with entries before and after the dividing date between 'old' and 'new' parts should appear in the 'new' part as, generally speaking, the most recent reference is the most important and should determine the place of the block. This criterion for positioning blocks is current practice in CINDA and has the advantage that new references can be added to the block without causing difficulties. The problem of a block consisting of a number of entries dated before the cut-off date but with an EXFOR index line after that time is surely easily dealt with a small amount of programming and, in any case, it would be perfectly reasonable to have such blocks included in the 'old' volume. It is true that unblocked references spanning the cut-off date would appear partly in the 'old' and partly in the 'new' parts. By definition these references will not be on consecutive lines in a two-year cycle CINDA (except by a very unlikely accident) and they may even be on separate pages. If therefore they appear in separate volumes, will this be so much worse? Corrections to the 'old' part would naturally be included in the 'new' part but the mistakes can be corrected properly when it is thought necessary to 'begin again' with a revised 'old' volume.

The choice of cut-off date for CINDA 'old' is clearly a critical issue as far as savings are concerned. A rough examination of CINDA 75 seems to indicate that of all the entries, at most ~1% are blocks spanning more than 5 years and this suggests that a cut-off date of the end of 1970 or 1971 should not create many difficulties. The exact choice would probably have to await a detailed analysis of the complete CINDA file, and would not necessarily have to be the end of a calendar year.

As a result of the above considerations, I propose that CINDA be divided into 'old' and 'new' parts, with the dividing line being drawn somewhere in the period 1970 to 1972 and with the 'new' part being issued every 2 years with 3 intervening cumulative supplements.

September 1975


CINDA 'New' every year with 1 supplement (Scheme 2)
CINDA 'New' every 2 years with 3 cumulative supplements (Scheme 3)
Fig. 1(a)
Total no. of pages in 4 years
8000
6000
4000
2000
0
1969
1970
1971
1972
Fig. 1(b)
Saving in pages over 4 years (%)
20
10
0
1969
1970
1971
1972
Year ending for Cinda 'Old'

Report to the INDC on U.S. Data Study

The Division of Physical Research of the US Energy Research and Development Administration (ERDA) has requested the Brookhaven National Laboratory to review the compilation and evaluation of nuclear structure and charged particle reaction data. Lead author in the study is Dr. Sol Pearlstein. The main objectives of the study are recommendations that if implemented should provide the research community with data compilations and evaluations that are updated at a reasonable frequency and with specialized data services that are required.

As part of the study the authors interviewed evaluators from many countries in order to obtain realistic estimates of the manpower required. Basic and applied research scientists the world over were surveyed by mail for the special insight they might provide. Before making their recommendations the authors combined these results with those of previous studies. At present, only the draft recommendations have been completed with the final report due to ERDA 15 October 1975.

The authors recommend that the U.S. effort in the evaluation and compilation should be a coordinated effort of several national laboratories and research groups. Significant participation by evaluators outside the U.S. is expected. Help in the coordination of these activities will be given by the IAEA's Nuclear Data Section. The U.S. activities would be consistent with the cooperation implemented for charged particle reaction data at the meeting held in Vienna September 1975.

The proposed evaluation network would contribute to three data files maintained in the US.

1) a complete bibliographic file,

2) a file of selected experimental data, and

3) a file of recommended data.

These files would be the source for several publications. The use of a centralized master data file would ensure consistency in values appearing in overlapping publications.

To accomplish the objectives of the study in a cost effective manner the report recommends that:

1) an evaluator network be established
2) unnecessary duplication of evaluation effort be eliminated
3) supporting services be centralized
4) international cooperation be used to share evaluation tasks
5) current efforts not be disrupted with smooth transitions made in new directions.

A working paper for the INDC Subcommittee on Non-energy Applications

B. Rose, AERE, Harwell, UK

COMPILATION OF CROSS-SECTIONS FOR ION BEAM ANALYSIS OF MATERIALS

Abstract

Rutherford back-scattering and nuclear reaction analysis using ion beams are increasingly being applied by materials scientists for the quantitative analysis of solid surfaces. However, information regarding the appropriate scattering or reaction cross-sections, and thus the most suitable reaction to use, is difficult to obtain, being distributed throughout the literature of nuclear physics.

The group under Dr. G. Dearnaley at AERE proposes to compile a handbook of all the charged-particle scattering and reaction cross-sections measured to date, in a form suited to the needs of materials scientists, and to draw up a list of important cross-sections which are either unmeasured or insufficiently accurate, for the attention of nuclear physicists.

Historical background

The first application of Rutherford scattering of energetic ions to surface analysis was made in 1954 by Sylvan Rubin[1] working at the Stanford Research Institute, who measured the composition of deposits on the inner wall of gun barrels for the US Army.

A much more widely-publicized application took place in 1967, when alpha particles from a radioactive source carried by Surveyor 5 were scattered from the lunar surface to obtain an analysis of its composition.[2] The results, for example the unexpectedly high titanium concentration, were well confirmed by analysis of lunar material collected during Apollo missions.[3]

More recently, both ion back-scattering and nuclear reaction analysis have been applied to the determination of near-surface composition of semi-conductor devices[4][5], alloys[6] and corrosion films.[7] Specially-equipped laboratories have been installed at IBM Thomas J. Watson Research Laboratory, at Bell Laboratories, and at the Naval Research Laboratory, Washington. To quote from a recent and valuable report[8] by Dr. E.A. Wolicki of Nuclear Science Division, N.R.L.:

"In the past few years the field of surface analysis has seen the development of a surprising number of promising new physical methods based on the use of high-energy ion beams. Improvements and advances continue to be reported at a rapid pace at the time of this writing (December 1972) and the field can well be said to be scientifically most interesting and exciting".

The technique consists of irradiating a material sample with a beam of ions, such as protons, deuterons, ^3He or ^4He, and others, in the energy range from about 500 keV up to 5 MeV. These irradiations are performed in vacuum, and the ion species, usually from a Van de Graaff accelerator, is magnetically analysed so as to have a well-defined energy. Scattered particles or reaction products emitted from the target samples are detected, commonly with silicon surface-barrier detectors (9) and their energy spectrum is displayed with a multichannel pulse-height analyzer.

The energy spectrum so produced will be determined by the atomic species present in the surface of the target: in Rutherford scattering there is a simple relationship between the mass of the target atom and the scattered energy, while the energy loss suffered by ions that penetrate below the surface can be employed to measure the depth variation of composition. Depth resolutions of about 200 A have been achieved. (4) If nuclear reactions are employed, the emission can be highly specific to a chosen nuclear species, and isotopic tracers have been widely used to study, for example, oxidation processes in an environment enriched in ^{18}O. Nuclear resonances in the $^{18}O(p,\alpha)$ reaction at well-defined energies allow the corrosion film to be analysed as a function of depth. (10)

Although the methods described make use of sophisticated accelerator equipment, there is no lack of such facilities throughout the world, for over 300 Van de Graaff laboratories were established for nuclear research. The greatest concentration exists in the USA, where already university accelerator facilities are being applied to industrial analysis problems (e.g. California Institute of Technology, Kansas State University, etc.). In Britain, good use is being made of the accelerators at Harwell, which offer a wide range of ion energies together with a unique ion microbeam facility. (11) In Holland, the Philips organization is shortly to install a new Van de Graaff laboratory specifically for surface analysis, while in the USA Bell Laboratories is engaged in extending the energy range of its present facility to over 5 MeV, for the same purpose.

Proposed approach

A knowledge of the scattering or reaction cross-sections pertaining to the ion-target combination studied is essential in obtaining a quantitative materials analysis by the techniques described above. At sufficiently low energies it has usually been assumed that the Rutherford scattering law

$$\sigma_R \propto \frac{Z_1^2 Z_2^2}{E_o^2}$$

applies, where

σ_R = Rutherford scattering cross-section

Z_1 = ion atomic number

Z_2 = target atomic number

E_o = incident ion energy

For the commonly-encountered $^{16}O(\alpha,\alpha)$ alpha scattering process, however, there are significant (30%) departures from Rutherford scattering due to nuclear resonances at around 3 MeV. Such resonances, leading to large increases in cross-section at certain energies and angles of observation, have been utilised by Dearnaley et al. (12) to study corrosion films. In nuclear reaction analysis it is necessary to know not only the cross-sections for the specific reaction chosen for analysis, but those of possible competing reactions due to other constituents in the sample. A careful selection of ion energy and angle of observation may then be required.

The information needed for such work is spread very widely throughout a large body of literature extending over many years of research into low energy nuclear physics. There is no single compilation available, although several incomplete sources exist. The most valuable reference work consists of the series of compilations (13) under the title "Energy levels of Light Nuclei", pioneered by F. Ajzenberg-Selove and T. Lauritsen. However, this work lists principally the original papers that contain the sought-after cross-sections, and the discussion of the data is intended for nuclear physicists.

Such information is nowhere to be found in a form that is readily accessible to the materials scientist who now needs to be able to apply ion beam techniques to the analysis of his specimens. Likewise, most nuclear physicists are unaware of the subtleties of semiconductor device fabrication, or of corrosion, in order to be able to cope with the unexpected analytical problem.

There is thus a need for a compilation of data, aimed specifically at the materials investigator, which will enable him both to choose an appropriate reaction or scattering method, and to analyse the resulting spectra. We propose to employ a small multi-disciplinary team to compile this data, together with references to the use of various reactions, etc. in materials analysis, and relevant observations, pitfalls, precautions, etc. drawn from our experience and that of others. For example, in a number of published analyses the difference between cross-section ratios measured in the centre-of-mass and laboratory systems of co-ordinates was overlooked, introducing a systematic 8% error in oxygen determination by (α,α) scattering.

The Handbook would thus include an introductory section dealing with the principles of the method, and experimental technique. Factors such as the choice and preparation of suitable standard targets for intercomparison purposes have so far proved more pressing than the need for further data, although we anticipate that we shall discover a lack of specific data during the course of our compilation. Equally important to disseminate are the techniques of particle discrimination, pulse pile-up rejection and other methods well-known in the nuclear field, together with an awareness of the consequences of ion channelling in crystalline targets.

Figure 1 illustrates the kind of nuclear cross-section data which would follow, covering a range of ion energies up to about 5 MeV and appropriate detection angles. Ion species are to include protons, deuterons, ^{3}He and ^{4}He, and occasionally tritons (where their advantage outweighs the difficulties of handling ^{3}H). Some heavy-ion reactions induced by beams such as ^{7}Li, ^{11}B and ^{19}F in hydrogen analysis will also be included. Target nuclei will extend from the lightest (hydrogen) up to medium-weight species (titanium) with emphasis on those materials of greatest technological importance, including silicon, oxygen, carbon, hydrogen and nitrogen.

Experience in nuclear cross-section determination is essential in discriminating between conflicting data, and arriving at the most reliable information.

Finally, where data is found to be lacking, recommendations will be prepared in the form of a list of outstanding data requirements. By this means, the proper representations could subsequently be made to the data-gathering organizations (e.g. the IAEA International Nuclear Data Committee, Subcommittee on Non-energy Applications) so that the deficiences could be widely published. The measurement of some of these required cross-sections could be the subject of a follow-up program.

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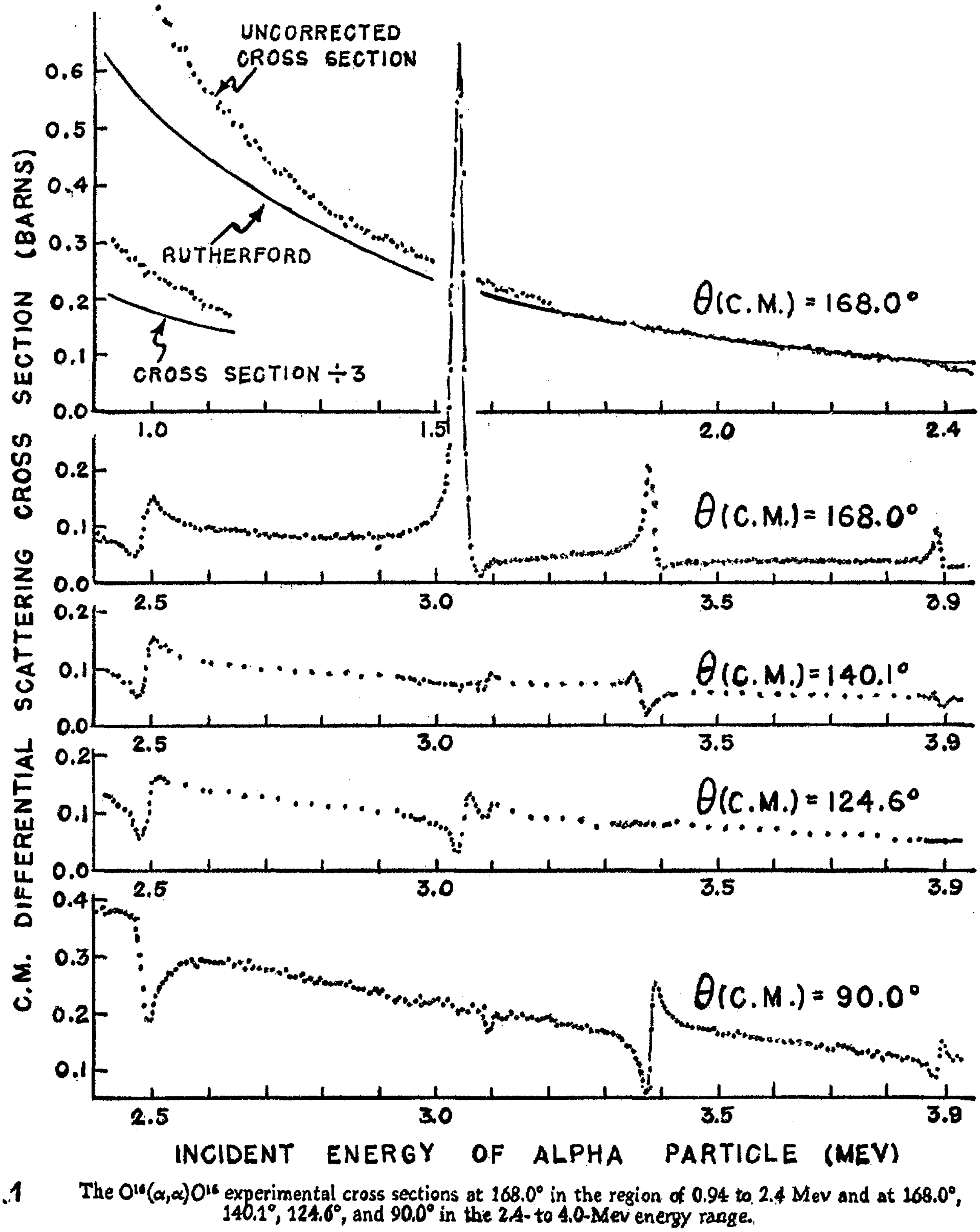

Fig. 1 The $O^{16}(\alpha,\alpha)O^{16}$ experimental cross sections at 168.0° in the region of 0.94 to 2.4 Mev and at 168.0°, 140.1°, 124.6°, and 90.0° in the 2.4- to 4.0-Mev energy range.

MEMORANDUM

To: INDC Members and Participants 24 March 1975

From: A. Lorenz

Subject: Recommendations from non-neutron nuclear data meetings held in 1974

As requested by the subcommittee on non-energy data at the 7th INDC Meeting (October 1974), please find attached the summaries of the Recommendations from the Consultants' Meeting on Charged Particle and Photonuclear Reactions (24-26 April 1974), Meeting I, and the Specialists' Meeting on Nuclear Data for Applications (29 April-3 May 1974), Meeting II.

The recommendations from both meetings are regrouped according to the bodies or organizations they are addressed to. Each recommendation is referenced to one of the two meetings (Mtg I and Mtg II) and to the numeration of the recommendations used in the original reports (e.g. A.1, C.3, etc.).

In order to adequately reflect the views you expressed at the last INDC meeting, or the opinion you have formulated since then, in our future deliberations, we would appreciate your comment on the feasibility of implementing the appropriate recommendations in your country, and on the overall aspect of the proposed establishment of international cooperation in the field of non-neutron nuclear data.

RECOMMENDATIONS TO THE INDC

1. Ascertain the needs for the compilation and evaluation of selected nuclear data. (Mtg II, Rec. C.3)

2. Recirculate the (Guide to authors) recommendations to editors of nuclear physics journals. (Mtg II, Rec. E.7)

3. Investigate the need for angular and energy distribution data compilation in the scope of an international effort to compile charged particle and photonuclear reaction data. (Mtg I, Rec. B.5)

RECOMMENDATIONS TO NATIONAL AUTHORITIES AND INTERNATIONAL ORGANIZATIONS CONCERNED

1. Support mass-chain compilation and evaluation activities. (Mtg II, Rec. B.1)

2. Support the compilation and evaluation of selected nuclear data (Mtg II, Rec. C.1)

3. Guarantee the free exchange of all experimental nuclear structure and decay data between all groups and individuals concerned. (Mtg II, Rec. D.4)

RECOMMENDATIONS TO THE IAEA

1. Consider including training of nuclear data compilers and convening training courses in compilation and evaluation of nuclear data as part of the IAEA fellowship programme. (Mtg II, Rec. B.4)

2. Establish a Central Information Office within the Nuclear Data Section to serve as a Referral Centre for nuclear structure and decay data information. (Mtg II, Rec. E.1, E.2, and E.5)

3. Continue publishing compilations and evaluations of selected nuclear data in IAEA publications (Mtg II, Rec. E.6)

4. That the Director General take the necessary steps to implement the recommendations set forth in INDC(NDS)-59 and INDC(NDS)-60, and bring them to the attention of national and pertinent international authorities. (Mtg I, Rec. C.1 and Mtg II, Rec. F.1)

5. That the Director General bring the conclusions and recommendations of this meeting to the attention of national and international organizations. (Mtg II, Rec. F.2)

RECOMMENDATIONS TO IAEA NUCLEAR DATA SECTION

1. Assist in coordinating the working programmes of existing and new compilation centres and groups. (Mtg II, Rec. B.3)

2. Promote and coordinate required nuclear data compilations and evaluations in smaller countries. (Mtg II, Rec. C.3)

3. Promote the establishment of an international evaluated nuclear data file

   - containing single values with uncertainties
   - whose scope is based on INDC determined needs
   - whose format is based on one of the existing formats. (Mtg II, Rec. D.1)

4. Ascertain that the content of the International File of Evaluated Data be disseminated to all interested parties. (Mtg II, Rec. D.5)

5. Advertise the services provided by the Central Information Office through all available channels. (Mtg II, Rec. E.3)

6. Conditional upon a positive response from IAEA Member States, convene future meetings on nuclear structure and decay data to implement the proposed system of international cooperation. (Mtg II, Rec. F.3)

RECOMMENDATIONS TO ALL CENTRES AND GROUPS COOPERATING IN THE COMPILATION OF NUCLEAR STRUCTURE AND DECAY DATA

1. Adopt the Oak Ridge Nuclear Data Project bibliographic keywords and reference system. (Mtg. II, Rec. A.1)

2. Existing and new centres and groups should coordinate their efforts, communicate with each other, profit from each other's experience, and be closely associated with experimental nuclear physic laboratories. (Mtg II, Rec. B.2 and C.2)

3. Publish mass-chain compilations and evaluations more often. (Mtg II, Rec. B.5)

4. Coordinate their effort in order to insure a continuous up-dating of the proposed international file of evaluated data. (Mtg II, Rec. D.3)

5. Keep the proposed Central Information Office (for nuclear data information) informed of all developments. (Mtg II, Rec. E.4)

6. The Oak Ridge Nuclear Data Project should provide copy of the references Master file to nuclear data centres, and to neutron data centres upon request. (Mtg I, Rec. A.1)

RECOMMENDATIONS TO ALL CENTRES AND GROUPS COOPERATING IN THE COMPILATION OF CHARGED PARTICLE AND PHOTONUCLEAR REACTION DATA

1. Adopt the Oak Ridge Nuclear Data Project bibliographic key-words and reference system. (Mtg I, Rec. A.1)

2. Continue building up and maintaining charged particle and photonuclear reaction data files. (Mtg I, Rec. B.1)

3. New centres and groups should consult with the two existing charged particle and Photonuclear Reaction Data Centres. (Mtg I, Rec. B.2)

4. Existing centres should supply copies of their masterfiles, upon request, to the existing neutron data centres for dissemination to the user community. (Mtg I, Rec. B.3)

5. Consider the use of existing computer formats for the exchange of charged particle and photonuclear reaction data. (Mtg I, Rec. B.4)

APPENDIX X

MEMORANDUM

To: INDC Participants 2 October 1975

From: A. Lorenz
Nuclear Data Section

Subject: Atomic and Molecular Data for Fusion
(Agenda item V A)

Please find attached the "Fact Sheet" on the development of the A&M Data for Fusion Programme Proposal.

Fact Sheet on the Development of the A&M Data for Fusion Programme Proposal

22 October 1974

Draft paper by R.S. Pease on "Data on Atomic and Molecular Cross Sections for Fusion Research" submitted to the 5th Meeting of the International Fusion Research Council recommending that the IAEA be invited to table a proposal for establishing an international information service.

16 November 1974

At its 5th Meeting, the International Fusion Council (IFRC) recommends that a survey of existing atomic banks be performed by IAEA.

14 February 1975

"Atomic and Molecular Data for Fusion", proposal for a new programme component to be incorporated into the scope of the IAEA Nuclear Data Section (Interoffice Memorandum, from J.J. Schmidt, dated 14 February 1975) submitted to the IAEA Director General.

18 February 1975

At the Director General's Meeting (DGM-8/75), the Director General suggested that

- a small meeting of A&M experts be called to obtain their recommendations,
- the survey on A&M data be submitted to IFRC, the new A&M programme description be submitted to the Agency's Scientific Advisory Committee (SAC), and
- conditional upon SAC's positive reaction, the new A&M programme be incorporated into the Programme and Budget for 1977.

4 March 1975

- In a letter dated 4 March 1975 Professor Glubrecht (Deputy Director General for the Department of Research and Isotopes) officially informed Dr. C.M. Braams (Chairman of IFRC) of the decision taken by IAEA and about the steps taken by the Secretariat.

- At the DGM of 4 March 1975 (DGM 10/75) progress of the A&M data review and programme planning was reviewed, and the decision taken that "Letters of invitation would be sent as soon as possible to the US and USSR inviting their experts to Vienna for consultation in early May 1975."

March 1975

- INDC informed by IAEA/NDS (Memorandum from J.J. Schmidt dated 20 March 1975) that NDS, at the request of the Director General, is performing a survey on A&M data for fusion, and asked for its support in gathering the necessary information.

- In another memorandum to INDC (dated 24 March 1975) J.J. Schmidt informed INDC of the proposed extension of NDS data scope to include A&M data for fusion.

30 June - 1 July 1975

First part of consultants meeting on A&M data for fusion, with Dr. C.F. Barnett (USA), held prior to scheduled meeting time of 21-22 July.

21-22 July 1975

Second part of Consultants Meeting on A&M data for fusion, 21-22 July, attended by Yu.V. Martynenko (Kurchatov Inst., USSR), M.F.A. Harrison (Culham, UK) and H.W. Drawin (Fontenay-aux-Roses, France).

5 August 1975

Consultants Recommendations concerning the future IAEA programme on A&M data for fusion, sent out to INDC participants and Members of IFRC.

14 August 1975

Survey report on A&M data requirements for fusion and on the status of A&M data compilation sent to INDC participants and IFRC Members.

25 August 1975

Final report including the Consultants Recommendation and survey report submitted to the Director General (copies also sent to INDC and IFRC).

24 September 1975

Memorandum from J.J. Schmidt sent to INDC participants, including the assessment of additional staff requirements to implement a programme on A&M data for fusion by IAEA/NDS.

MEMORANDUM

To: INDC Participants 24 September 1975

From: J.J. Schmidt
Scientific Secretary of INDC

Subject: Additional staff requirements for the Nuclear Data Section in 1976 and 1977 (re Tentative Agenda items VB and VIIB)

Please find enclosed the assessment of the additional staff requirements for the Nuclear Data Section in the years 1976 and 1977.

Summary

1. Atomic and molecular (A+M) data for fusion (new programme)

In 1977 the minimum staff required for a functioning new unit for A+M data for fusion are found to be as follows:

1 atomic physicist, P-4 (identified below as post X)
1 atomic physicist, P-3 (identified below as post Y)
1 programmer, P-2/P-3 (identified below as post Z)
1 data preparation clerk, G-4/G-5
1 secretary, G-4/G-5

Concerning the P-staff, this is one professional post more than requested in the mentioned IOM by Prof. Glubrecht, but one professional post less than recommended by the Consultants Meeting on A+M data for fusion in June-July 1975 (henceforth referred to as the Consultants) convened at the request of the Director General and supported by the International Fusion Research Council (IFRC) at its meeting in Lausanne on 30 and 31 August 1975.

In 1976, the same minimum professional staff as specified above for 1977 are found to be needed in agreement with the 1976 professional manpower figures recommended by the Consultants and by IFRC. The absolute minimum staff required to start the new programme in 1976 is the addition of

1 atomic physicist, P-4 and
1 secretary, G-4/G-5.

2. Nuclear data programme

The section's nuclear data programme is expanding to the extent that the new A+M data programme cannot be undertaken without the addition of the above mentioned staff, and, that as a minimum, the addition to the nuclear data programme of

1 nuclear physicist, P-2/P-3

is required as soon as possible, and certainly by 1977.

Detail

1. A+M data for fusion (new programme)

The minimum staff requirements listed in the summary are the result of a careful assessment of the manpower needed to implement the short-range (1976 and 1977) objectives and to start work on the long-range objectives (≥1977) of the A+M data programme as recommended by the Consultants and by the IFRC.

The recommendations of the Consultants (given in Attachment A) are partially based on the results of an initial survey performed by the Agency's Nuclear Data and Physics Sections on the needs and current compilation activities in the field of A+M data for fusion (available upon request). The conclusions and recommendations of the IFRC are summarized in Attachment B.

In the outline of the new A+M data programme below, the individual tasks, as well as the level of the P-staff required to perform these tasks are specified. In the initial phase of the new programme at least one larger specialists' meeting of the advisory group type and one or more consultants meetings will be required per year. These will have to be prepared and conducted, and their recommendations and actions be implemented by the professional staff listed below.

A. Coordination of existing activities	Level
1. Extend survey on compilations and publications, emphasizing those subject areas specified by IFRC.	P-3 physicist (post Y)
2. Assess current experimental and theoretical research activities in A+M data.	P-4 physicist (post X)
3. Formulate a storage and retrieval system to compile information collected under activities 1 and 2 above.	P-2/P-3 programmer (post Z)
4. Develop newsletter to currently inform the pertinent community (~1800 people) on completed, on-going, and planned compilation, evaluation, experimental and theoretical activities.	P-3 physicist (post Y)

B. Assessment of Requirements

1.	Extend survey of data needs and identify the most critical needs in cooperation with existing compilation and research groups.	P-4 physicist (post X)
2.	Assess status and availability of needed data and of over-all size of compilation and coordination effort.	P-4 physicist (post X)

C. Initial Publication Effort

1.	Publish immediately C.F. Barnett's cumulative bibliographic data base of Atomic and Molecular Processes (1950-1975):	
1a.	adopt and develop necessary computer programmes	P-2/P-3 programmer (post Z)
1b.	expand data base to include non-US input (particularly unpublished literature, e.g. reports)	P-3 physicist (post Y)
1c.	produce cumulative bibliography as publication for sale	P-3 physicist (post Y)
2.	Publish a compendium of numerical data on surface effects	P-3 physicist (post Y)

D. Compilation and Dissemination of Bibliographic and Numerical Data

1.	Consolidate the communication with existing compilation centers and individuals, and coordinate the compilation of the needed data determined by assessment performed under B.	P-4 physicist (post X)
2.	Establish (design and programme) a standardized input/output format for the computerized storage and retrieval of bibliographic and numerical A+M data.	P-4 physicist (post X) P-3 physicist (post Y) P-2/P-3 programmer (post Z)
3.	Establish an international system of data dissemination in cooperation with existing centres and research groups.	P-4 physicist (post X)
4.	Compile systematically numerical and bibliographic data, and disseminate requested data.	additional physicists

Components A, B, C, and D 1-3 correspond to the short-range objectives as specified by the Consultants and by IFRC. A, B, C and D 2 are continuing tasks which have to be started immediately, i.e. in 1976, while D 1 and D 3 will have to be phased in in the second year of operation, i.e. 1977, after some results have been obtained on A and B.

Careful estimates of the level and size of the professional effort required for these tasks were performed on the basis of the section's experience with its nuclear data programme. The result is outlined in the table below.

Year	Components	Minimum professional staff required
1976	A, B, C and D 2	1 physicist, P-4 (post X) 1 physicist, P-3 (post Y) 1 programmer, P-2/P-3 (post Z)
1977	A, B, C continued with less workload D 2 continued at same level D 1, D 3 started	same as in 1976

For 1976, the staff required equals that recommended by the Consultants and IFRC; for 1977, it was found that the recommended activities could be performed by one professional staff less than recommended.

The absolute minimum staff which is required for 1976 in order to start the new programme at all is one atomic physicist of P-4 level who would perform a full-time job on the A 2, B 1, and B 2 tasks. The other tasks specified under A and the urgently recommended publications (C) as well as the needed programming would have to be delayed beyond 1976, in disaccord with the recommendations of the Consultants and of the IFRC.

For the preparation of proposals, surveys and meetings for the A+M data programme several P-5, P-4 and P-3 man-months of the current nuclear data staff had to be committed in 1975. This had the consequence that a few important nuclear data activities requested and recommended by the Agency's International Nuclear Data Committee, such as a world-wide questionnaire survey on nuclear data needs, and the systematic collection of information on existing data compilations and publications, had to be delayed until 1976.

Considering the simultaneous expansion of the section's nuclear data activities, (see section 2), it must be stressed that the use of nuclear data staff for the A+M data programme cannot be continued, so that without the addition of at least one P-4 atomic physicist the start of the A+M data programme would have to be delayed. It is also noted that the successful start of the A+M data programme in 1976 depends upon the availability of atomic physicists with technical experience in atomic and/or fusion physics research, an expertise which cannot be drawn from the present staff of the section.

The start of component D 4 presupposes that the short range tasks outlined above have been initiated. For that reason it cannot be started before 1978, and would need several additional atomic physicist/compilers staff.

2. Nuclear data programme

As pointed out in the IOM of 1975-08-14 by Mrs. Attree to Professor Glubrecht, the data-centre activities of the NDS have considerably expanded during the last year. The amount of experimental data compiled, the volume and variety of evaluated data received and the number of requests for all types of nuclear data have increased. Also, the scope of the section's nuclear data activities is currently expanding from neutron data to the full complement of nuclear data, including nuclear structure and decay as well as charged particle nuclear reaction data with the consequence of an increasing number and scope of meetings organized by the section. The need for more than one year of "temporary" assistance in 1974/75 illustrates the understaffing of the section and the difficulty to maintain a satisfactory mode of the data centre operations without the addition of more staff on the P- and G-grade level. As a minimum on the professional level, the nuclear data programme of the section would need the addition of

1 nuclear physicist, P-2/P-3

as soon as possible, but not later than 1977. An additional junior physicist/compiler post will be required at a higher G-level.

Consultants' Meetings

on

Atomic and Molecular Data for Fusion

Vienna, 30 June - 1 July and 21 - 22 July 1975

Recommendations to the IAEA

1. The Consultants unanimously stressed the immediate and expanding needs for A and M data for fusion. The present national activities do not adequately meet the demand.

Current fusion research is particularly lacking in A and M data relevant to particle injection, plasma heating and cooling, impurity effects, plasma modelling and plasma diagnostics; whereas in the longer term, the emphasis will move towards reactor related problems, such as the first wall and fueling. Existing data are spread widely throughout the international literature (e.g. journals, internal laboratory reports and proceedings of conferences) and should be compiled for efficient use. Also important deficiencies in the data will be identified and significant duplication of research efforts will be avoided.

2. The Consultants consider that the IAEA is a particularly suitable organisation to provide a central and international service for the co-ordination, compilation and evaluation of A and M data for fusion.

The Agency already provides an international service in the the nuclear data field and is outstandingly well equipped to extend its activities to include A and M data for fusion.

3. The Consultants therefore recommend that the IAEA immediately establish an international programme for A + M data for fusion.

This programme should be implemented in the following way.

A. Short-range objectives

1) Identify the most critical needs for A + M data for fusion in cooperation with existing compilation and research groups.

2) Coordinate future data compilation work to avoid duplication of effort.

3) As a matter of urgency, establish a standardized computer input and output format for the storage and retrieval of bibliographical and numerical data.

4) Establish an international system of data dissemination in cooperation with existing centres and research groups.

5) Develop guidelines for the publication of A and M data.

B. Long-range objectives

1) Act as a central library for bibliographical and numerical data collected from data centres and other establishments specialized in atomic and molecular structure and collisions, surface and vacuum physics.

2) Develop universal criteria for evaluating A + M data.

3) Assume coverage of the world's report and conference literature and make available bibliographical and numerical data to specialized data centers.

4) Initiate and support critical reviews by contracting to specialists throughout the world and by bringing to the IAEA for a period of 1-2 years specialized scientists to write reviews.

5) Support and provide funds to scientists in developing countries to perform CTR related work in atomic collisions and particle interaction with surfaces.

C. Implementation

1) The Nuclear Data Section should initiate immediately work on the short range objectives with the present staff.

2) The minimum staff required to implement this programme is listed by year in the table below.

1976	1977	1978
2 physicists 1 programmer 1 secretary	3 physicists 1 programmer 2 keypunch 1 secretary	6 physicists 1 programmer 2 keypunch 1 secretary 1 data specialist 3 temporary experts (critical reviewers)
4 people	7 people	14 people

3) Starting with the first year adequate travel funds should be provided to allow staff members of the IAEA A and M data unit for fusion to visit existing centers and coordinate activities.

4. Immediate Action

The Consultants strongly recommend the immediate publication by the IAEA of Dr. Barnett's comprehensive Bibliography of Atomic and Molecular Processes (1950 to 1975) compiled by the Controlled Fusion Data Center in Oak Ridge.

Although this is a US compilation its scope is truly international and its publication by the Agency would be of immediate and world-wide benefit to the fusion community. A conservative estimate of the demand is 1000 copies.

Attachment B

Conclusions and Recommendations

of the

International Fusion Research Council (IFRC)
at its Sixth Meeting, Lausanne, 30-31 August 1975
concerning the proposed new IAEA programme on
atomic and molecular (A+M) data for fusion.

General

IFRC fully supports the recommendations of the consultants convened by the IAEA on 30 June and 1 July and 21/22 July 1975 concerning objectives, proposed implementation, and needed manpower of the proposed new IAEA programme on A+M data for fusion for the years 1976 and 1977. At its next meeting in 1976 it wishes to review the status of the programme and the need for further manpower for 1978 and onwards.

Detail

Location

IFRC considers the IAEA as the right truly international body to undertake a programme in A+M data for fusion which comprizes all countries working on fusion research and technology.

Scope

IFRC stresses that the volume of A+M data important for fusion compares with the volume of neutron data for fission reactors. It recommends that the Agency's A+M data programme include all atomic reaction and structure data for all atomic species occurring in fusion, a selection of very important molecular data, and all data on plasma-wall interactions.

Objectives

IFRC approves unanimously of the short- and long-range objectives as recommended by the consultants, with only a few minor modifications. It stresses the consultants observation, that adequate staff would be needed for A+M data evaluation and that this task be better reserved to laboratories in Member States.

Publications

IFRC approves of the Consultants' recommendation for immediate publication by the IAEA of Dr. Barnett's comprehensive Bibliography of A+M Processes (1950-1975) in the Nuclear Fusion Series.

Manpower

IFRC approves of the manpower recommended by the consultants for 1976 and 1977 with a concern that no manpower for A+M data is so far foreseen in the Agency's budget for 1976. Before considering the additional manpower recommended for 1978 it wishes to review the start of the A+M data programme at its next meeting in 1976.

Meetings

IFRC recommends to the IAEA to hold an Advisory Group Meeting of fusion and atomic data specialists in 1976. This meeting should review in detail the important A+M data needs for fusion and the status of these data and start the technical cooperation between the IAEA and A+M data centres in Member States.

INTERNATIONAL FUSION RESEARCH COUNCIL

List of participants

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9 October 1975

Statement from INDC on A+M data for fusion

1. The INDC took note of the recommendations of the IFRC concerning the proposed new IAEA programme on atomic and molecular data for fusion and of the survey report written by the IAEA Nuclear Data and Physics Sections on A+M needs for fusion data and compilation.

General Conclusions

2. The INDC endorses the view that compilation and exchange of bibliographic material and of a great deal of basic scientific data will have a proper role to play in the development of fusion reactor systems. The INDC has valuable experience to offer in this aspect of the work and also in the coordination of measurement programmes and would be willing to contribute to an international A+M programme for fusion.

3. However, the INDC as at present constituted does not have the technical expertise to assess the importance of these needs, and it notes that some of the data included, such as information on radiation damage, is of a type with which it has not dealt in the past.

4. INDC recognizes that the initial effort to document data needs has come from the fusion community and considers that future efforts of justifying data needs and judging the adequacy or otherwise of existing data and compilations also must come from the fusion community.

More detailed considerations

5. Accepting the premise that large quantities of atomic and molecular data are required for fusion research as indicated by the initial survey provided by the fusion community, then INDC recognizes from its experience with nuclear data the value of international exchange of data and other forms of international cooperation. INDC further recognizes that NDS, because of its extensive experience in the handling of international cooperation in the nuclear data field, is uniquely qualified to initiate an international trial effort in the atomic and molecular data field.

6. With certain provisos, INDC would support the addition to NDS of two physicists and a programmer, with appropriate assistance, for 1976 and 1977 to assist in working on certain short range objectives such as, for example, those listed in section A of the recommendations of the Consultants Meetings of 30 June - 1 July and 21-22 July 1975).

7. The provisos mentioned in § 6 are as follows:

(i) The effort devoted by the NDS to fusion A+M data, which should mainly be carried out by the additional staff listed in § 6, should not be at the expense of its effort on nuclear data, where a continuing programme at at least the present size is seen for several years.

(ii) The working and size of the new programme should be reviewed jointly by IFRC and INDC within two years.

(iii) It is too early to judge the manpower needs for 1978 as envisaged in the consultants report.

(iv) The communication links between NDS and the national fusion programmes should be determined by IFRC and NDS would continue to report to INDC on such matters.

8. The committee noted from the discussion that the consultants consider that, in toto, these A+M data will be comparable in magnitude to the neutron data compiled for fission reactor systems. If this proves to be the case, its present view is that the total of such data will need to be handled by a network of national or regional centres. The proper role of a centre in Vienna could be twofold

(i) the centre which correlates work of all centres, and

(ii) a data centre in its own right for some well-defined region.

9. The INDC consequently believes that the fusion community should consider whether the existing nuclear data centres, which have great experience in compiling and exchanging nuclear data and references, may have an important role to play with regard to A+M data for fusion. Any consequent increase in these centres of course must clearly be justified by, and/or paid for by, the fusion community itself.

10. If, in the longer term, the IAEA and the fusion community consider that a large programme of work is necessary in Vienna, it is by no means clear that the overall management of such a programme could readily be supervised by even a modified INDC without adversely affecting the nuclear data programme.

Session VI.D Working Paper on WRENDA - B. Rose (UK)

WRENDA - contribution to a discussion

1. The future of WRENDA is a regular major topic at INDC meetings - this will be the third in a row at which its value has been questioned. It clearly has taken a lot of INDC time to discuss it, it is taking the time of more INDC members to prepare documents such as this one, it has taken a considerable amount of the time of NDS staff in deciding on format and in programming, time of all data centre staff in compiling and it is of course an additional expense in its production and distribution.

One is entitled to ask therefore

(i) Who wants it, and of what value is it to him who does?

(ii) If the information already exists in some other document or documents, why is this particular document so important? Is the benefit so identified worth the total cost in time and effort of producing it?

2. Before turning to these questions, it is as well to remember that the original concept of a request list in the UK was as an administrative document, namely to provide a set of topics at meetings in which progress in fulfilling the needs of the reactor programme was monitored. The columns relating to energy range, accuracy, etc., were merely indications of approximate requirements, the detailed requirements and allocation of priority being arrived at by agreement between the reactor and data physicists present. Frequently it would at times be accepted that a request had been satisfied even when the new experiments did not formally satisfy the request as listed.

3. The concept of the request list was extended when RENDA and WRENDA were produced. It is clear that these documents are not suited for the original purpose, but the intended use of these documents was not clear cut. Since then we have had data for safeguards and for fusion added and there is talk of non-neutron data, of data for non-energy purposes being added, and now we have proposals concerning the compilation of atomic and molecular data for fusion and if for fusion why not for biomedical purposes. It is clearly time for a critical review of the purposes to which a WRENDA-like document could be put.

4. There were (and are) a number of possibilities - dealing initially only with the data for reactors

(i) The convenience of having all lists together in a single document to facilitate comparison between request lists and so expose differences in the philosophy of their compilation. This is a technical purpose and would primarily be of interest to those countries with a large nuclear data programme of their own. However, a comparison of this nature cannot be made using request lists alone - it calls for detailed discussion in depth. The comparison of national lists is only the beginning and could be just as well done by comparison of national documents.

(ii) To demonstrate that there is a 'world view' of the nuclear data of importance to the reactor field (but to whom is this demonstration addressed?), to summarize the status of work on a particular request and to provide a convenient source book from which an experimental programme may be selected. However, this is only one element in the formation of an experimental programme and unlikely to be the dominant one. In any case a list of this kind is inevitably out of date to some extent and in no cases should new work be undertaken without ascertaining the status of other work that may be in progress on the same topic. Furthermore, the exact definition of a request cannot be adequately summarized in a short space, as mentioned in §2.

(iii) To be used in a political way to demonstrate that nuclear physics is a subject with important practical consequences and therefore deserves support. Its value for this purpose is zero in the major countries, the size of whose programmes are determined almost entirely by domestic considerations. Is there any evidence that it has been of any value in this regard in the developing countries?

5. None of the above purposes seem to be greatly facilitated by the existence of a single document, either for the major or developing countries. The existing document, reflecting as it must the national compilations, is highly non-uniform in its approach and yet, simply by existing, it suggests a uniformity of content which is quite spurious. Any administrator who cares to look at it seriously will find that a very large fraction of the requests are withdrawn without being fulfilled and this is simply providing free ammunition to those who consider nuclear physicists as essentially frivolous people. Additionally, we expect over the next few years to generate some national request lists for other topics, each of which will necessarily have quite different criteria for inclusion and priority (if indeed priority is a concept that will apply to them). Are these also to be included in WRENDA?

6. I propose therefore that, instead of continuing with WRENDA, national request lists for reactor, safeguard and fusion data be circulated more widely through IAEA channels. These will be updated as seems appropriate to the country concerned, but not necessarily on an annual schedule. New lists which will appear from time to time, such as for fission product data, charged particle data, will be circulated in the same way and the basis and criteria for each will appear in each document and may of course be quite different from those suited to the reactor programme. I do not believe that any loss in real cooperation between countries in the nuclear data programme will result from ceasing to produce WRENDA, provided that the national lists are circulated as suggested. The time and effort previously devoted to discussion and production of WRENDA will then be more profitably spent on other aspects of the data programme.

4 September 1975

25 September 1975

Session V.A.

Working Paper on NDS Experience with the Operation of the WRENDA System

J. R. Lemley

Nuclear Data Section

Abstract

The objectives of a nuclear data request list are reviewed briefly. Information about the use of WRENDA which has come to the attention of the NDS is presented along with observations which suggest that in some respects WRENDA is not achieving its maximum effectiveness. The role of the NDS in the cooperative production of WRENDA by the Four Neutron Data Centers is briefly outlined, and desirable, but non fundamental, improvements are suggested. Several alternatives for the information content of the status file, potential sources of status information, and allocation of responsibility for preparation of status comments are discussed. In a final section tentative recommendations for discussion by INDC are presented.

I. Purpose of a data request list

A "data request list" should define as quantitatively and specifically as possible the basic data requirements associated with a developing technology for which available data are inadequate. A primary objective of a request list is to facilitate communication of data needs between the users and the producers of the data in order to ensure the availability of data when it is needed.

Ultimately a request list should be useful to data measurers and evaluators in planning and in obtaining support for measurement and evaluation programs. A request list should also be useful to funding agencies in selecting for support research proposals which are of importance for particular applied programs.

If a request list is to be useful in guiding research programs, it must be reliable. The requests must be screened to ensure that they accurately represent the requirements of a given application. Requests must be reviewed along with newly available data in order to determine whether available data continue to be unsatisfactory. If there are many data requirements for a particular application, priorities must be assigned to the various data requirements to reflect the degree of their urgency within the context of all objectives of the applied program.

Since applied research and development programs are usually, but not exclusively, organized around national objectives, request lists therefore usually have a national origin and summarize the nation's data needs for its own developing technologies. Request lists of this kind are known so far only in the nuclear energy field. Because of their relation to applied programs, useful screening and reviewing of requests can be accomplished only through close cooperation among the requestors, measurers, evaluators, data committees and funding agencies which are responsible for the applied programs and cannot be provided by an external organization such as the NDS.

II. Use and Usefulness of WRENDA

Data request lists compiled on both a national and international basis have been powerful techniques in promotion and organization of neutron data measurement programs which have led to increasingly detailed and accurate knowledge of neutron data required for reactor design. Since information concerning the internal use of national data request lists is more appropriately obtained from representatives of Member States, which maintain such lists, the following discussion is concerned primarily with use of international request lists and, in particular, with use of the WRENDA request lists.

The EANDC was very successful in promoting international cooperation to fulfill data requests in the most economical way. Their RENDA request list was useful in grouping together requests for the same data type and energy range and in allocating measurements to appropriate facilities within the member countries. For example, EANDC promoted and stimulated comprehensive programs on elastic and inelastic neutron scattering at Argonne, fast neutron capture at Karlsruhe, resonance fission at Saclay and CBNM Geel. The INDC can play a similar role particularly with regard to East-West cooperation and to cooperation between developing and developed countries, and the WRENDA system should continue to evolve in ways which will facilitate such international cooperation.

Excluding Member States which maintain their own data request lists, the following typical examples of use of the WRENDA publication to plan research activities have come to the attention of the NDS through either formal or private communications:

- Studsvik, Sweden: measurement of angular distributions of elastically and inelastically scattered neutrons for fission-reactor and fusion applications,

- Technical University of Dresden, GDR: double differential neutron emission cross-section measurements at 14 MeV;

- Korea - Japan: plans for joint measurements and evaluations of fission product cross-sections and of data required for fusion.

- Bangladesh - India: plans for cooperative work on data related to the thorium fuel cycle,

- Israel: Evaluation of data for Pu-238, Am-241 and Cm-244,

- Bariloche, Argentina, and CBNM Geel: plans for measurement of thermal data for reactor development.

- Measurements of the $^{103}Rh(n,n')^{103}Rh^{m}$ cross section in South Africa, Brazil and at CBNM Geel.

Although the WRENDA publication receives wide distribution (INDC/U+R+F+S, over 700 copies for WRENDA 75), the NDS receives requests specifically for the document as well as for information which can be obtained conveniently either from the document or selectively from the master file. Approximately 40 additional copies of WRENDA 74, which received a 'U' distribution, were specifically requested or were distributed in response to inquiries about data requirements related to fission reactors.

The capability for selective retrieval from the WRENDA master file was publicized for the first time in WRENDA 74 and again in WRENDA 75. Actual examples of requests for such selective information include an inquiry about all requests for data at incident neutron energies in the 14 MeV range, an inquiry about all requests relating to molybdenum and its isotopes,and several inquiries concerning the most recent data request list for fusion,since the previous publication of the fusion list had been in December 1973.

Administratively WRENDA has been useful to the NDS in reviewing requests for support of research involving nuclear data measurements, in providing targets and samples for nuclear data measurements, and in advising developing laboratories about useful data-measurement programs which they could undertake with available facilities. In planning international meetings on nuclear data, the NDS finds an international request list like WRENDA especially useful and convenient because it is necessary to select topics which are truly of international interest.

In the introduction to WRENDA 75 and previous editions it has been requested that when measurers and evaluators undertake work on data requested in WRENDA, they should inform the requestor. It was further requested that the same information be provided to the NDS or to a regional data center so that the status comments could be updated. So far the NDS has received such correspondence in only one instance - three letters with preliminary data dated 30 July 1975 from R.L. Macklin, Holifield National Laboratory, to W. Benzi, J.Y. Barré and C.G. Campbell respectively. Hopefully this type of direct correspondence occurs more frequently that we are aware between measurers and requestors and through national data committees or the other data centers.

NDS also wishes to bring to the attention of INDC some general considerations which it believes would lead to improvement in the effectiveness and usefulness of WRENDA. Specific changes which NDS wishes to see implemented are included in the next section.

If the purpose of WRENDA is to define as quantitatively as possible the data needs of applied programs, then its usefulness is seriously challenged when the relationship of a request to an application is obsure or the importance weakly justified. For example data requests related to development of fission reactors should be based as much as possible upon detailed sensitivity studies which are possible at the present advanced state of development of that technology.

The usefulness of WRENDA appears questionable when requests are infrequently reviewed or modified. WRENDA contains some requests which apparently have not been reviewed even though they may be partially satisfied by recently available data. **WRENDA** also contains some requests which are so general or so comprehensive, considering the state of development of the application and the quality of available data, that they should have been formulated more exactly before entry in WRENDA.

Considering the fundamental connection of a data request list with an applied program or developing technology, a requestor should in general be a data user rather than exclusively a data producer so that the data request list serves applied objectives rather than independently perpetuates a data measurement or evaluation program.

III. Responsibilities of the NDS in the Four-Center Production of WRENDA

The production of WRENDA is presently a joint responsibility of the Four Neutron Data Centers, who cooperate closely with the nuclear data communities within their respective service areas. In this section the responsibilities of NDS and the other Centers are outlined briefly, and comments and recommendations based on the NDS experience in carrying out its responsibilities are presented.

As part of the Four-Center cooperative agreement, the NDS maintains the WRENDA master file, publishes and distributes the WRENDA request lists annually, provides country retrievals to each of the other Centers for use in reviewing and updating the requests, and provides special retrievals from the master file on request. Except for occassional improvements in programs for file maintenance, error detection and book production, the computer system is complete. Peter Smith of NDS has been responsible for the programming. The programs are available to any other centers which might wish to use them.

It is the responsibility of each of the Four Neutron Data Centers to collect new requests and to submit requests in a convenient form for review, in cooperation with the national data communities and requestors within their service areas. New requests, revisions and deletions are coded at each Center and submitted in an agreed format according to an agreed schedule to the NDS for updating of the master file. Although WRENDA requests from all the other Centers have in the past not been received in ready-to-process form, the additional work required at NDS to process the incoming requests is becoming generally less time consuming and is expected to decrease further through improved Four-Center cooperation.

A significant difference in format of published request lists produced from the new WRENDA system in comparison to those produced from the old RENDA system, developed and maintained at CCDN Saclay, is that all requests which refer to the same nuclide and physical quantity are blocked together. Each block of requests may be followed by a block of status comments which contain information relevant to one or more of the requests. Repetition of status information was thus eliminated. Apparently the blocking of requests has been favorably received.

Also during the conversion from the old RENDA system to the new WRENDA system, the editorial decision was made to consolidate similar requests from the same country for the same application in order to reduce the number of requests and to make the publication shorter and more easily readable. Any number of requestor's names could be associated with a combined request. In view of the mentioned advantages NDS strongly urges national data committees to continue and extend this policy of combining requests so that there can be a minimum number of requests in each request block.

It is recognized that certain problems arise from the policy of combining similar requests. Requestors might protest if their requests were modified in any way by national data committees or local data centers. Hopefully small differences would be resolved in the nearest local equivalent of the "Heurige".

Another problem which has been unprofitably time consuming for NDS is tracing the evolution and history of request numbers when requests are combined and subsequently modified in different ways by the various requestors. In the future this problem will be resolved between the requestors' national data committees and the responsible data center. NDS will simply enter the requests in the master file exactly as they are received.

A related problem concerns distinguishing satisfied requests from requests which are withdrawn because they are no longer of interest. Less than 10 requests from WRENDA 74 were specifically marked "satisfied" during the year following its publications while 258 requests were withdrawn. Therefore no separate list of satisfied requests was published with the data request list for fission reactor development in WRENDA 75. The NDS cannot assume responsibility for contacting requestors individually concerning this point and suspect that the other data centers would also find this task a very low-priority use of manpower. It is the individual requestor in cooperation with national data committees who must review and modify their own requests or indicate the reason for withdrawal. The INDC might adopt a recommendation to this effect or, alternatively, recommend that a list of satisfied requests no longer be maintained.

IV. The Status File

A. Purpose and content

Even more than in the case of the request file, there seems to be disagreement over the purpose, content and usefulness of the status file. Before further effort, either at the NDS or in the Member States, is devoted to the status file, a consensus concerning its content and purpose must be reached.

The status blocks in WRENDA 75 illustrate at least three possibilities concerning content and organization of status information. A few status blocks (e.g. $^{235}U(n,f)$) provide concise, up-to-date "mini" evaluations which specify the accuracy or uncertainty of available data over the energy ranges mentioned in the request blocks. It has been possible to provide this kind of status information only in the few cases where there were readily available recent published evaluations from which the desired information could be conveniently extracted. Additional references to recent data not considered in the evaluations have also been included. No organization has been able to assume continuing responsibility for preparartion of this kind of status information for all requests.

As a second example, some status blocks contain only references to recently completed work and to work in progress although CINDA serves a similar function. If it were agreed that CINDA-like comments were useful in the WRENDA status file, it should be possible to extract from the CINDA master file, for example, all references for a particular quantity which had not been included in the last CINDA publication.

A third and intermediate possibility is illustrated by status blocks which cite a recent review or evaluation and provide additional references to work completed or in progress after the effective date of the evaluation.

B. Sources of Status Information and Responsibility for Status Reviews

Presently status information is obtained rather unsystematically from many sources - status files associated with national request lists, requestors, national data committees, INDC and NEANDC technical committees, NDS data-review activities, and individual experts who have reviewed requests about which they have current knowledge. For some requests no status comments are included.

Perhaps the most thorough way to perform status reviews would be to assign systematically the responsibility for each quantity to specific individuals or organizations. However there exist sources from which some status information might be obtained with small additional effort.

1. In the near future some evaluated data files will contain information on the uncertainty of the data. This information could be summarized, as a function of energy if appropriate, and included in the status file along with references to the complete evaluation report and other more recent data or work in progress.

2. Subcommittees of both INDC and NEANDC regularly review certain important data (standards, properties of important fissile and fertile isotopes, certain "discrepant" data) and could prepare reports for the WRENDA status file as part of their normal responsibilities. Since no organization presently is able to assume complete responsibility for status reviews of all requests, perhaps only comments prepared by specially qualified groups such as these should be included in the status file.

Considering the lack of consensus about the usefulness, purpose and content of the status file, the NDS considers any commitment to prepare reviews for WRENDA other than as part of its own data-review activities to be of very low priority compared to other parts or proposed redirections of its program.

V. Tentative Recommendations

The following tentative recommendations have been prepared to stimulate and concentrate discussion by INDC. In several cases mutually contradictory resolutions have been drafted in order to emphasize dictrotomies which require resolution and to introduce possible solutions of opposed natures.

A. Recommendations concerning the request file

1. Considering the controversy over WRENDA which has developed within INDC and within the scientific community, the INDC should present a consensus about whether the Four-Centers should continue to maintain the master file and to produce the publication in their present forms.

2. WRENDA should be renamed "World Request List for Nuclear Data". The word "Measurements" should be dropped since WRENDA 75 contains requests for evaluations and simply for information.

3. In progress reports on nuclear data WRENDA request numbers should be included with descriptions of work which is related to requests in WRENDA. (Continuation of Action 9 from the 7th INDC Meeting, which has been only partially fulfilled even in reports to INDC.)

4.A. INDC Members should encourage the requestors and data committees in their countries to distinguish satisfied requests from requests which are withdrawn for other reasons when their requests are reviewed.

4.B. Lists of satisfied and/or withdrawn requests should no longer be included in WRENDA publications.

B. Recommendation concerning the status file

5.A. The INDC should present a consensus on the desired purpose, content and form of the status file.

5.B. Status comments should no longer be included in WRENDA publications since other satisfactory sources of status information already exist.

6. The INDC should advise on how responsibility for preparation of status comments of the recommended form might be incorporated within the present Four-Center cooperation.

7. The technical subcommittees of INDC and NEANDC should prepare status reviews for all WRENDA requests related to their areas of responsibility. In lieu of systematic assignment of responsibility for preparation of status comments, the WRENDA status file should be limited in practice to reviews prepared by these and other qualified groups.

8. Information about the accuracy or uncertainty of data, which is presently being incorporated in various evaluated data libraries, should be summarized and included in relevant status blocks in the WRENDA along with a reference to the evaluation report and references to more recent work and work in progress.

APPENDIX XVI

Agenda Item VI D

6 October 1975

Proposal on WRENDA

J.J. Schmidt

1. Purpose

WRENDA fulfils a multiple purpose. The merge of numerous individual request lists into one document enables a convenient comprehensive overview of the world's nuclear data requirements for energy purposes. As it is the responsibility of INDC to review the world's requirements for nuclear data and to promote and co-ordinate nuclear data research programmes the WRENDA document provides necessary background in convenient form. WRENDA will also continue to be of help in determining emphasis and scope of some of the Agency's nuclear data meetings.

Cumulation and priorities of requests are a measure of their importance and can guide the technical sub-committees on the data which deserve review. WRENDA and the review work of the sub-committees should therefore be linked together more closely. Note that the important requests in WRENDA 75 and the items reviewed by the technical subcommittees are almost identical. I consider WRENDA therefore to be one of the basic documents of use for the committee, closely linked to its basic purpose. It should therefore continued to be distributed (at least) to the Committee itself.

Furthermore, from written and oral communication and from advisory missions to countries in its service area NDS has firm indications that the WRENDA list fulfils a useful purpose in steering measurement programmes of smaller and developing countries. Again for these countries it is much easier to draw the information from one instead of many documents. I therefore suggest that the dissemination of WRENDA continue to include smaller and developing countries.

INDC should decide and advise NDS whether the several large countries with many data requests should continue in future to receive the WRENDA list.

2. Status comments

I suggest that the status comments as contained in WRENDA 75 and the status file be removed and replaced by very short excerpts from the reports of the technical subcommittees. At most one manmonth effort will be needed for this exercise, and NDS offers to do this on a trial basis for the 1976 WRENDA edition. This way the important requests will receive adequate status comments and the remaining less important requests will remain unreviewed.

I also suggest to issue the review reports of the technical subcommittees as INDC reports and send them to the requestors and measurers (R and U distribution) including, where existant, national nuclear data committees. If the finalized reports could be sent to requestors etc. latest by 15 November 75, i.e. about one month after this INDC meeting, this will give requestors the chance to review the validity of their requests before WRENDA 1976 is issued.

There are several advantages to these suggestions. The request review activities national or international, can be confined to the participants of the INDC (and NEANDC, see 3) technical subcommittees. This is already their task and there will be no need for additional review. NDS, by excerpting review reports, keeps itself informed about the progress in important data. There will be a direct link, so far missing between reviewers, requestors and measurers.

3. NEANDC

If these suggestions are accepted, I propose that NEANDC be informed and asked for their agreement to make its review reports in future available to the same distribution of WRENDA requestors and measurers including national data committees. It is not suggested to link the time scales of the INDC and NEANDC reviews and the annual WRENDA editions, but only that the review reports be distributed as soon as they become available. NDS will volunteer to distribute the NEANDC review reports as well.

4. Extensions?

I suggest to keep WRENDA confined to its present scope (fission, fusion and safeguards) unless it will be clearly proven in the future, that the data requirements of other fields are most conveniently expressed in WRENDA-like format.

September 29, 1975

Working paper submitted to the INDC meeting

Japanese Nuclear Data Committee
Subcommittee on Nuclear Data for
Safeguards Techniques

The Second Request List of Japan for Safeguards Techniques will be submitted to CCDN in October, 1975. The original requests were collected from the Japanese users and researchers in October, 1973. A total number of the collected requests were 95. These requests have been examined and screened by Subcommittee on Safeguards Techniques in Japanese Nuclear Data Committee. A total number of screened requests were 49. These requests contain the following quantities:

Quantity		Number of requests Original	Final
(1)	Total gamma ray yield	15	12
(2)	Half life	17	1
(3)	Fission half life	10	4
(4)	Decay heat	7	5
(5)	Capture cross section	12	8
(6)	Fission cross section	11	2
(7)	Photofission yield	7	7
(8)	Charged particle cross section	1	1
(9)	Fission product mass yield spectrum	8	4
(10)	Delayed neutrons emitted per fission	7	5
	Total	95	49

These requests are needed for:

(1) assay of Pu isotopes by gamma ray spectroscopy or by calorimetry or by neutron coincidence method, (2) active assay of mixed fuel and irradiated fuel, (3) non destructive assay of nuclear fuel by gamma ray spectroscopy of photofission products and (4) detection of failed fuel by gamma ray spectroscopy of fission products.

The criteria for priority are the same as those of INDC(NDS)-50/U+S. First priority-(1) is given 10 requests, Second priority-(2) to 10 requests and finally, Third priority-(3) to 29 requests.

For the 8th INDC Meeting

WORKING PAPER : SESSION V. A.

Nuclear Data Requests for Fusion Reactor Development from Japan

WORKING GROUP on Nuclear Data for Fusion Reactors, JNDC

Three researchers individually submitted the nuclear data requests for fusion reactor development at the suggestion of the Research Committee on Nuclear Fusion Reactor and the Japanese Nuclear Data Committee of the Atomic Energy Society of Japan. The requests are now under a screening procedure in the Working Group on Nuclear Data for Fusion Reactors, JNDC, which will be finished in November 1975, and the requests will be sent to CCDN in accordance with the WRENDA procedure.

In the following table, the items of the above requests are simply listed for reference.

Some gross requests from viewpoints of the blanket chemistry and metallurgy have also been submitted to the Committees, but these are to be refined and are not included in Table 1.

Table 1 Provisional Simplified List of Items of the Nuclear Data Requests for Fusion Reactor Development from Japan

(The following requests are all for neutron incident reactions)

[TARGET]	[QUANTITY]	[ENERGY RANGE]
3 Li 6	Elastic & Differential Elastic	1.0+6 - 1.5+7 eV
	Total Photon Production & Gamma Spect.	threshold*- "
	N,ND	threshold - "
	N,T	3.0+6 - "
3 Li 7	Elastic & Differential Elastic	1.0+6 - "
	Inelastic & Energy Differential	threshold - "
	Total Photon Production & Gamma Spect.	" - "
	N,2N , Neutron Spectra & Angular Dist.	" - "
	N,NT & Neutron Spectra	
4 Be	Total Photon Production	" - "
	N,2N	" - "
	N,T	" - "
4 Be 9	Inelastic	" - "
	Total Photon Production & Gamma Spect.	" - "
	N,2N , Neutron Spectra & Angular Dist.	" - "
	N,ALPHA	" - "
6 C 12	Inelastic & Energy Differential	5.0+6 - "
	N,N3ALPHA	threshold - "
8 O 16	N,P	" - "
	N,ALPHA	8.0+6 - "
	N,NALPHA	threshold - "
9 F 19	Inelastic	1.0+6 - "
	Absorption	thermal - "
13 Al 27	Inelastic	threshold - "
	Capture & Gamma Spectra	thermal - "
	Total Photon Production	threshold - "
	N,2N	" - "

* Threshold for particle emission in case of "Total Photon Production".

APPENDIX XVIII

(Table 1 Continued)

[TARGET]	[QUANTITY]	[ENERGY RANGE]
13 Al 27	N,P	threshold - 1.5+7 eV
	N,D	" - "
	N,T	" - "
	N,ALPHA	" - "
20 Ca	Elastic & Differential Elastic	1.0+6 - "
	Capture & Gamma Spectra	thermal - "
	Total Photon Production & Gamma Spect.	5.0+5 - "
22 Ti	Inelastic	threshold - "
	Total Photon Production	" *- "
	N,2N	" - "
	N,P	" - "
	N,ALPHA	" - "
23 V	Inelastic	" - "
	Capture & Gamma Spectra	thermal - "
	Total Photon Production	threshold - "
	N,2N	" - "
	N,P	" - "
	N,ALPHA	" - "
23 V 50	N,2N	" - "
	N,ALPHA	" - "
23 V 51	N,P	" - "
	N,ALPHA	" - "
	N,NALPHA	" - "
24 Cr	Inelastic & Gamma Spectra	" - "
	Capture & Gamma Spectra	thermal - "
	N,2N	threshold - "
	N,P	" - "
	N,ALPHA	" - "
24 Cr 52	N,2N	" - "

(Table 1 Continued)

[TARGET]	[QUANTITY]	[ENERGY RANGE]
26 Fe	Inelastic & Gamma Spectra	threshold - 1.5+7 eV
	Capture & Gamma Spectra	thermal - "
	Total Photon Production	threshold*- "
	N,2N	" - "
	N,P	" - "
	N,ALPHA	" - "
28 Ni	Inelastic & Gamma Spectra	" - "
	Capture & Gamma Spectra	thermal - "
	Total Photon Production	threshold - "
	N,2N	" - "
	N,P	" - "
	N,T	" - "
	N,ALPHA	" - "
29 Cu	Inelastic & Gamma Spectra	" - "
	Capture & Gamma Spectra	thermal - "
	Total Photon Production & Gamma Spect.	threshold - "
41 Nb	Capture & Gamma Spectra	thermal - "
41 Nb 92	N,ALPHA	threshold - "
41 Nb 93	Inelastic	" - "
	Inelastic ^{93m}Nb	" - "
	Capture & Gamma Spectra	thermal - "
	Capture ^{94m}Nb	" - "
	Total Photon Production & Gamma Spect.	threshold - "
	N,2N	" - "
	N,P	" - "
	N,ALPHA	" - "
	N,NALPHA	" - "
41 Nb 94	Capture	thermal - "

* Threshold for particle emission in case of "Total Photon Production".

(Table 1 Continued)

[TARGET]	[QUANTITY]	[ENERGY RANGE]
42 Mo	Elastic & Differential Elastic	1.0+6 - 1.5+7 eV
	Inelastic, Energy Dif. & Gamma Spect.	threshold - "
	Capture & Gamma Spect.	thermal - "
	Total Photon Production & Gamma Spect.	threshold*- "
	N,2N	" - "
	N,P	" - "
	N,ALPHA	" - "
	Above cross sections for the isotopes are also requested	
42 Mo 92	Capture	thermal - "
42 Mo 94	N,2N	threshold - "
82 Pb	Total Photon Production & Gamma Spect.	" - "
93 Np 237	Fission Cross Section	" - "

* Threshold for particle emission in case of "Total Photon Production".

WORKING PAPER: SESSION VI E

Co-operation between JAERI (Japan) and KAERI (Korea) in Nuclear Data Measurements and Evaluations (T. Fuketa, JAERI, Japan)

In case of receiving researchers from KAERI to JAERI, the measurement and/or evaluation of nuclear data is assigned to one of the high priority items in JAERI. Funds for the sending researchers are left to KAERI's choice, probably by JICA or Colombo funds, and the possibility seems to depend upon the order of priority of the application in Korea.

Proposed themes (as of December 1974*) for the nuclear data measurement and evaluation which Korean physicists may join at JAERI are as follows:

1) Nuclear Data Measurements

	[Samples]	[Reaction Types]	[Neutron Energy]	[Remarks]
(1-1)	Nb	Elastic & Inelastic Scatt. Cross Sections	around 20 MeV	5.5 MV V.d.G. TOF October 1975#
(1-2)	$^{90,92,94}Zr$	Same as the above	4 - 8 MeV	5.5 MV V.d.G. TOF April 1975#
(1-3)	^{71}Ga and $^{155,157}Gd$	Total & Capture Cross Sections	1 eV - 100 keV	Linac TOF April 1975#
(1-4)	$^{143,145,146,148}Nd$ and ^{183}W	Same as the above	1 eV - 100 keV	Linac TOF March 1976#

2) Nuclear Data Evaluations

2.1 Evaluation work related to the fission product nuclear data.

A more specific theme would be an evaluation work related to the decay heat by the transplutonic fission products for example.

A JNDC group work on the evaluation of the neutron cross sections of the fission product nuclides is now entering into the last stage. Therefore, for the JAERI-KAERI program in very near future, an evaluation work on the neutron cross section of a few FP nuclides might not fit too well at JAERI.

Earliest date to start.

All measurements in the above are related to the requests in WRENDA 74.

* M. Cho from KAERI and S. Tanaka, A. Asami and T. Fuketa from JAERI met at JAERI on 2nd December 1974, and made a brief preliminary discussion on the matter.

Convenient time to start this work: any time by the end of 1976.

2.2 Evaluation of the neutron inelastic scattering data of ^{238}U.

The main part of the work would be the theoretical calculation by using computer codes ELIESE-III, CASTHY, JUPITOR, Etc.

Convenient time to start this work: any time by the end of 1975.

2.3. Systematic studies on the neutron resonance parameters including the compilation and data processing by computer.

For example:

a) Review and/or evaluation of the resonance parameters of specific nuclides (FP, fissile, etc.),

b) Review and/or evaluation of the strength functions,

c) Compilation of the resonance parameters by using COMFORD (a computer file).

Convenient time to start this work: any time by the end of 1976.

In the above cooperation, KAERI planned to ask financial support for samples from the IAEA, but it is rather difficult to make a specific coincidence of a visiting period of researcher, a machine availability and a sample availability beforehand. Therefore, we propose that a KAERI physicist joins one of the above JAERI's programmes to start with.

KAERI is also planning to make the measurements at the neutron energies of 14 MeV and thermal.

MEMORANDUM

To: INDC Participants 7 July 1975

From: J.J. Schmidt
Scientific Secretary
of INDC

Subject: Report on a duty travel to several East Asian countries, 14 October - 7 November 1974

Partially in fulfilment of action 33 from the Lucas Heights INDC Meeting, please find enclosed a report on my duty travel, which I performed to laboratories in several East Asian countries after the Lucas Heights INDC Meeting. This report should also serve as a short background document to the discussion of nuclear data measurements in developing countries at the INDC Meeting in October 1975. Supplementary information on discussions and developments after my trip you will find in the fothcoming annual report of NDS to INDC.

Report on a duty travel to several East Asian countries

14 October - 7 November 1975

by

J.J. Schmidt

1. Time table

JAERI, Tokai-Mura, Japan	14-15 October
Tokyo Institute of Technology, Tokyo, Japan	16 October
Kumatori Research Reactor Institute Kumatori/Osaka, Japan	17-18 October
KAERI Korean Atomic Energy Bureau Seoul National University	Seoul, South Korea 21-22 October
Atomic Energy Centre, Dacca, Bangladesh	24-26 October
BARC Variable Energy Cyclotron Project Saha Institute of Nuclear Physics	Calcutta, India 28-29 October
BARC Trombay, Bombay, India	30-31 October
Delhi University IARI Nuclear Research Laboratory	Delhi, India 1-2 November
PINSTECH, Rawalpindi, Pakistan	4-6 November
Tehran University, Nuclear Centre, Tehran, Iran	7 November

A check list for abbreviations used in the report is included as an attachment.

2. Report

In the following the major results of the visits and discussions during this travel are summarized including lists of the main contact persons. I gave lectures on the Agency's nuclear data programme at Lucas Heights, JAERI, Kumatori, Dacca, Calcutta, BARC and PINSTECH. Numerous actions resulted from this trip to improve the information transfer and to send nuclear data and documents to a variety of customers, and to assist laboratories by technical advice and financial aid in their nuclear data programme.

JAERI

Persons contacted:

Dr. K. Tsukada, Head Nuclear Physics Division;

Dr. T. Fuketa, Japanese INDC Member, Head Nuclear Data Laboratory;

Dr. K. Nishimura, Principal Scientist of the Nuclear Data Laboratory;

Dr. H. Takekoshi, Head Linear Accelerator Laboratory;

Dr. K. Harada, Head Van de Graaff Accelerator Laboratory;

Dr. M. Cho, Korean INDC Liaison Officer, on leave from KAERI;

and several members of the Japanese Nuclear Data Committee.

JAERI will develop a national nuclear data centre for energy applications, which is supposed to serve as a link between NEA/NDCC and IAEA/NDS, as applicable, and Japanese and regional nuclear data customers.

First plans were established during my visit regarding bilateral cooperation, in the framework of the Agency's RCA, between JAERI and KAERI in the measurement and evaluation of fission product nuclear data needed for nuclear safety, fuel management and environmental protection.

JAERI's new 20 MeV Emperor Tandem Accelerator (meanwhile approved) will partly be used for nuclear data measurements needed for fusion.

The Japanese are interested in a stronger Japanese participation in future nuclear data meetings of the Agency; details of such participation were discussed.

I was informed about the extensive activities and technical work of the Japanese Nuclear Data Committee.

I visited particularly the two TOKAMAK installations and the linear accelerator laboratory.

Tokyo Institute of Technology

Persons contacted:

Dr. H. Ohnuma, Associate Professor, Dept. of Physics

Professor Ohnuma participates in a Japanese study group on charged particle nuclear data (CPND) processing which is headed by Professor Hajime Tanaka from Hokkaido University and funded by the Japan National Ministry of Education. This study group is currently developing a system for the compilation of charged particle nuclear reaction data, whose structure incidentally bears a close resemblance to the EXFOR system developed by the four neutron data centres. It was therefore agreed, that in future this group should participate in the cooperation of the CPND centres and groups promoted by IAEA/NDS and in the development of an EXFOR-based exchange system for CPND.

Kumatori-Laboratory

Person contacted:

Dr. I. Kimura, Assistant Professor, Reactor Division

Professor Kimura is expert in neutron cross sections for reactor dosimetry. Participation in the Agency's programme in this field was discussed, particularly in the inter-laboratory comparison of foil activities. Kimura is strongly interested to become a member of the Agency's IWGRRM.

I visited the laboratory's three critical assemblies under construction.

KAERI and Korean Atomic Energy Bureau (KAEB)

Persons contacted:

Dr. Byoung Whie Lee, Director of KAEB;

Dr. Young Ku Yoon, President KAERI;

Dr. Dong Hoon Kim, Head Reactor Physics Laboratory;

Dr. Moon Kyn Chung, Head Neutron Physics Laboratory;

Dr. Jung Do Kim, Member of Reactor Physics Laboratory,
acting Korean INDC Liaison Officer (in the absence of Dr. M. Cho).

The discussions at JAERI on the cooperation between KAERI and JAERI in nuclear data measurement and evaluation were continued with the conclusion that the area of fission product nuclear data would be most appropriate for such cooperation. This cooperation, once successfully implemented, could later on be extended to other data such as nuclear data for fusion.

In addition to such cooperation which would involve sending KAERI scientists to Japan to work on JAERI's accelerators, KAERI would be in a position to make an independent, complementary contribution by measuring requested thermal and 14 MeV neutron cross sections with existing facilities (thermal reactor and 14 MeV neutron generator).

KAERI and JAERI promised to work out a detailed cooperative programme and send it to IAEA/NDS for further discussion at IAEA and by INDC.

In addition I received an intensive introduction into the current programme of KAERI and ambitious future nuclear science and power plans.

Seoul National University

Persons contacted:

Dr. Hae-Ill Bak, Associate Professor, former staff member of IAEA/NDS, Dept. of Nuclear Engineering

and several Professors of this Dept.

The Department has a very poor laboratory equipment and aims at better cooperation with KAERI also in using KAERI's facilities. Subject to Japanese funds, Prof. Bak plans the set-up in 1975 of a nuclear spectroscopy group in cooperation with KAERI, and with technical advice from IAEA/NDS;

Atomic Energy Centre, Dacca

Persons contacted:

Dr. M. Islam, Head Van de Graaff Accelerator Laboratory, Bangladesh, INDC Liaison Officer;

Dr. M.H. Miah, Head Computer Division, NEA/CPL Liaison Officer for Bangladesh;

Dr. M. Rahman, Head Theoretical Physics Division, associate member of ICTP Trieste;

Dr. M.A.W. Miah, Director International Affairs, Bangladesh AEC;

and many other scientists from the Centre, the Atomic Energy Commission and Dacca University.

The Van de Graaff accelerator group responded positively to my suggestion to use their expertise to set up a fission physics and cross section programme. As part of the existing bilateral agreement between BAEC and BARC they intend to cooperate with the BARC Nuclear Division on this subject. British and EURATOM/CBNM/Geel physicists, partly under IAEA technical assistance, will render expert advice to the programme, Harwell will make available equipment to the extent needed, as possible.

The Dacca Centre also participates in the programme committee for the Variable Energy Cyclotron Project at Calcutta, and will cooperate with this project once it is completed.

The discussions frequently digressed to the severe problems caused to the country by the heavy floods in 1974 and the Centre's share in dealing with those problems.

Variable Energy Cyclotron Project, Calcutta

Persons contacted:

Dr. A.S. Divatia, Technical Project Manager, former Indian INDC Member; and

Dr. S. Chatterjee, Administrative Project Officer.

The VECP is based on the Berkeley cyclotron design, but is wholly constructed by Indian firms. Its completion is suffering from irregular electricity supply in the Calcutta district, but the magnets are installed, the external beam is scheduled to be available by the end of 1974 and the internal beam by July 75 when start of the operation is planned. Once in operation, it will be the largest nuclear physics facility in Eastern Asia, except the Japanese Synchrocyclotrons, and will serve as a multidisciplinary national science institution for all Indian and other regional (e.g. Dacca) laboratories and universities. Its programme will cover nuclear physics and data measurements, isotope production, material testing and radiation damage, nuclear chemistry, biomedical research and, in a second stage, heavy ion research. The VECP was visited and its future programme discussed in very detail.

Saha Institute, Calcutta

Persons contacted:

Prof. S.K. Mukherjee, Head Division of Electrostatic Accelerators;

Prof. B.B. Baliga, Head Cyclotron Laboratory.

The institute's 14 MeV Cockroft-Walton (CW) neutron generator (sub-nanosecond pulsing under preparation) and the 30 years old cyclotron (modelled after the original Lawrence Cyclotron) were visited and possibilities suggested and discussed for an informal technical cooperation between the CW accelerator groups at the Saha Institute and at the Chittagong and Rajshahi Universities in Bangladesh in 14 MeV neutron research on the basis of the Agency's WRENDA request lists for nuclear data measurements.

BARC Trombay, Bombay

Persons contacted:

Dr. R. Ramanna, Director BARC;

Dr. M.K. Mehta, Head Nuclear Physics Division, Indian INDC Member;

Dr. B.P. Rastogi, Head Theoretical Reactor Physics Section;

Dr. V.C. Deniz, Head Experimental Reactor Physics Section;

Dr. M. Balakrishnan, Member Nuclear Physics Division, Indian CINDA reader;

and many other scientists from BARC and from the Reactor Research Centre Kalpakkam near Madras.

Drs. Ramanna and Mehta agreed to my proposal to use the available Van de Graaff accelerator and projected (VECP) facilities and scientific expertise to set up a long-term measurement and evaluation programme for nuclear data needed for the future Indian Th-232/U-233 fission reactor and fuel cycle programme. The convincing argument is that almost every other country active in the nuclear data field will expect this contribution from India as being scientifically very well qualified and with its nuclear power programme genuinely oriented towards the use of its large monazite resources. Cooperation of the Dacca Van de Graaff group in the fission part of this programme will be searched for. I reminded of the special assistance IAEA/NDS could render by providing sample material.

Preliminary discussions were devoted to the set-up of a small regional nuclear data centre at BARC, similar to that contemplated for JAERI, in view of the many Indian nuclear data customers of IAEA/NDS. More definite plans will depend upon a more detailed assessment of the information transfer between IAEA/NDS and its Indian customers.

Following the recommendation by INDC, BARC will set up an interdisciplinary group to study the future Indian nuclear data requirements. They are particularly concerned with assessing the charged particle nuclear data requirements for medical diagnostics and therapy, meteorological and forensic application's oil and natural gas exploration, steel composition analysis, distribution of protein in rice and soil investigation.

Delhi University

Person contacted:

Dr. S. Pancholi, Associate Professor, Nuclear Physics Department.

Apart from experimental nuclear decay scheme studies Prof. Pancholi is working on mass chain nuclear structure data compilations, partially in cooperation with the Oak Ridge Nuclear Data Project. Pancholi promised to review the need for an updating of nuclear structure data of nuclides belonging to the Th-232/U-233 fuel cycle and to inform BARC and IAEA/NDS about the result of his review.

IARI, Delhi

Person contacted:

Dr. P.N. Tiwari, Nuclear Research Laboratory.

I discussed with Dr. Tiwari the nuclear activation analysis methods they employ in their agricultural research including the sources and use of the nuclear data related to it and examined their γ-ray and nuclear magnetic resonance spectrometers.

Dr. Tiwari is interested to join the Indian study group on nuclear data requirements.

PINSTECH, Rawalpindi

Persons contacted:

Dr. M.A. Khan, Chairman Pakistan Atomic Energy Commission;

Dr. J. Ahmad, Director PINSTECH;

Dr. A.M. Khan, Head Nuclear Physics Division, Pakistan INDC Liaison Officer;

Dr. G.D. Alam, Head Fission Group;

Dr. I.H. Qureshi, Head Nuclear Chemistry Division;

Dr. M.N. Qazi, Head Reactor Physics Group.

The feasibility was discussed of implementing an INDC proposal relating to the use of prompt decay γ-rays from thermal neutron capture for material composition analysis as an alternative prompt method compared to the "classical" delayed neutron activation and fluorescence analysis methods. It was concluded that this method would only yield results of a comparable accuracy if the intensities of the prompt decay gammas were much more accurately known. It was concluded that the presently existing data should first be more closely examined before eventually an interlaboratory approach to the measurement of the needed data, their compilation in a prompt decay γ-ray atlas and the use of the said method based on improved data could be initiated by IAEA, with the assistance by a leading laboratory in the field such as the Idaho nuclear laboratory in the US (R. Heath and coworkers).

I visited several divisions, the swimming pool reactor which is used for thermal neutron scattering and fission studies, neutron capture γ-ray spectroscopy, activation analysis and radioisotope production and the 14 MeV neutron generator which is used for neutron cross section work.

Tehran University Nuclear Centre

Persons contacted:

Prof. H. Parnianpour, new Director, Nuclear Centre;

Dr. M.A. Etemad, nuclear physicist, new Iran INDC Liaison Officer

and several reactor and nuclear physicists.

The nuclear data activity in Iran is so far very small, but is expected to grow in future, with the development of the Iranian nuclear power programme. The greatest problem is the build-up of a nuclear ifrastructure and the most adequate use of the large financial resources now available. Only very minimal use was made so far of the Centre's research reactor and Van de Graaff accelerator.

ATTACHMENT

List of abbreviations used in the report

BAEC	=	Bangladesh Atomic Energy Commission
BARC	=	Bhabha Atomic Research Centre (Trombay)
CBNM	=	Central Bureau for Nuclear Measurements
CPND	=	Charged Particle Nuclear Data
IAEA/NDS	=	IAEA Nuclear Data Section
IARI	=	Indian Agricultural Research Institute (Delhi)
ICTP	=	International Centre for Theoretical Physics (Trieste)
INDC	=	International Nuclear Data Committee
IWGRRM	=	International Working Group for Reactor Radiation Measurements
JAERI	=	Japan Atomic Energy Research Institute
KAERI	=	Korean Atomic Energy Research Institute
NEA/CPL	=	NEA Computer Programme Library (Ispra)
NEANDC	=	NEA Nuclear Data Committee
NEA/NDCC	=	NEA Neutron Data Compilation Centre
RCA	=	Regional Cooperative Agreement (IAEA)
VECP	=	Variable Energy Cyclotron Project (Calcutta)

INDC Meeting - Session VI E

Working paper on Co-ordination of Nuclear Data Activities

Nuclear Data Measurements in Developing Countries

Prompted by the INDC initiative to stimulate nuclear data measurements in laboratories in developing countries the Nuclear Physics Division at Harwell has investigated how best to encourage and support such work at Dacca, Bangladesh. The nuclear physics laboratory there is within the Atomic Energy Centre and work is done by staff of the centre together with staff and students of the University of Dacca. The laboratory was visited in November 1974 by Dr. A.T.G. Ferguson who attended the Bose Memorial Symposium. Dr. M.K. Mehta of the Bhabha Atomic Research Centre, Bombay, India was also present. It was recognised that one of the dangers to be avoided was uncoordinated attempts to steer Dacca in two diverse directions. The difficulties of serious collaboration over long distances was obvious and hence collaboration with their nearest scientific neighbours seems most profitable. It was agreed that to give some unity to the programme they would join with BARC in a programme of data measurements relevant to the Thorium Cycle. It was agreed that Dacca would propose a programme in this field to be agreed with BARC. On the basis of this agreed programme Harwell would place a modest research contract with Dacca. This would provide funds against which it was envisaged Dacca could draw small essential items - targets, electronic components etc. from Harwell stores and other sources. Summer visits to Harwell aimed for example at calibrating counters against local standards would also be supported. So far the proposals from Dacca are still awaited.

A.T.G. Ferguson
Nuclear Physics Division
Hangar 8

18 September 1975

INDC Meeting - Session VI E

Working paper on Co-ordination of Nuclear Data Activities

Information about the International Seminars in Physics and Chemistry, Uppsala, Sweden

The University of Uppsala arranges international seminars in physics and chemistry for research training in Swedish laboratories sponsored by the Swedish International Development Authority (SIDA), IAEA and UNESCO. The aim of the Seminars is to initiate the creation of research groups at universities or national laboratories in developing countries. This assistance is given in order to improve the conditions and prospects for local research work.

The major part of the time is spent on research work, each participant entering as a member of a small team of scientists at a suitable laboratory mostly belonging to the University. Besides the research work there are complementary programmes and courses offered.

Training courses can also include topics closely related to nuclear data measurements.

As an example, the Seminars have assisted the Atomic Energy Centre in Dacca to set up research groups in X-ray fluorescence, gamma ray spectroscopy and ion-solid interactions. Scientists from the Centre have joined groups at the Neutron Physics Laboratory, Studsvik and the Tandem Accelerator Laboratory, Uppsala, where they have made neutron scattering and neutron capture gamma-ray spectroscopy measurements.

H. Condé

MEMORANDUM

To: INDC Participants 11 September 1975

From: J.J. Schmidt and A. Lorenz

Subject: Professional Responsibility Distribution in the IAEA Nuclear Data Section for 1974-1975

The attached information is distributed in response to Action 17 from the 7th INDC meeting, requesting the IAEA/NDS to provide information to the committee about the composition and responsibilities of NDS staff.

The information is presented in three parts:

1. Composition of the IAEA Nuclear Data Section during the 1974-1975 time period.

2. Identification and definitions of the IAEA/NDS programme components.

3. Chart showing the professional responsibility distribution in the IAEA/NDS during the 1974-1975 time period.

Please note that the responsibility chart is representative of the 1974-1975 "work-year" (i.e. September 1974 - August 1975) and does not represent an average over the last few years or a prognostication of the year to come. Also, in order to account for their responsibilities more adequately, the two compilation clerks and the G-grade programmer have been incorporated in the P-1 category of the chart.

The numbers given in the chart are percentages of time spent on any given programme component. Divided by 100, these figures give the man-years devoted to each programme component during the 1974-1975 time period.

1. COMPOSITION OF THE IAEA NUCLEAR DATA SECTION

(during the September 1974 - August 1975 time period)

A. Administrative Unit

J.J. Schmidt	(P-5)	Section Head
A. Lorenz	(P-4)	Deputy Section Head
H. Feiler	(G-4)	Section Secretary
U. Leidolf	(G-4)	Secretary/Librarian

B. Physics/Compilation Unit

H. Lemmel	(P-4)	Unit Head
L. Kral	(G-5)	Unit Secretary
M. Vlasov	(P-4)	Physicist
J. Lemley	(P-3)	Physicist
K. Okamoto	(P-3)	Physicist/Compiler
M. Khalil	(P-3)	Physicist/Compiler
A. Calamand	(P-2)	Physicist/Compiler
R. Yaghubian	(G-5) (50%)	Compilation Clerk
G. Lammer	(G-6)	Compilation Clerk

C. Programming Unit

P. Attree	(P-4)	Unit Head
E. Rogauz	(G-5)	Unit Secretary
P. Smith	(P-2)	Programmer
F. Hirschbichler	(P-1)	Programmer
K. McLaughlin	(G-7)	Programmer
E. Barge	(G-4)	Data Processing Clerk
C. Manica	(G-4)	Data Processing Clerk

2. IDENTIFICATION AND DEFINITIONS OF IAEA/NDS PROGRAMME COMPONENTS

A. NDS Administration

A1. Programme and Budget

Administration of the Nuclear Data Section, programme, budget, personnel.

A2. Internal and External Liaison

Contact with other IAEA sections and divisions including the IAEA Computer Section and ICTP Trieste, staff council work. Liaison and contacts with external organizations e.g. NEA, CEC, CODATA, UNESCO.

A3. Publicity

Advertising, public relations, formulation and production of brochures, exhibits, etc.

B. INDC Secretariat

B1. INDC meetings

Preparation, attendance and follow-up of INDC meeting. Participation in INDC Subcommittee work.

B2. Administration

INDC lists of documents and correspondents: upkeep of these files and associated programming and data processing effort. Correspondence related to the committee. INDC Liaison Officers, their appointment, and associated correspondence. INDC report translation, handling and dissemination.

B3. Special Compilations

Collection and collation of information for the production of special compilations (e.g. Facilities List, National Nuclear Data Committees, etc.). Programming and data processing related to this effort.

C. Data Status and Needs Assessment

Surveying, reviewing and assessing the status and needs of specific categories of data. Organization and convening of meetings, and follow-up of actions and recommendations from these meetings. Coordination with other data centres and other organizations. Coordination of data measurers and users.

D. Coordination Activities

D1. Nuclear Data Requirements

Development of the WRENDA (World Request List for Nuclear Data) programme and coordination of the input to and maintenance of the WRENDA computer file; updating of the file and annual publication and distribution of the WRENDA list.

D2. Targets and Samples programme

Management of the T&S programme to furnish target material to developing countries on request for nuclear data measurements. Negotiate purchase or loan agreements with existing suppliers (Geel, Oak Ridge etc.)

D3. Nuclear Data Measurements in Developing Countries

Encouragement and coordination of cooperative research programmes between developing countries.

E. Data Centre Activities

All physics and programming activities related to the operation of the data center, including the collection, collation, input (storage), retrieval and dissemination of bibliographic and numerical data. Development maintenance and updating of the necessary computer programmes. Organize and convene periodic technical meetings with other centres, including Four Centre Meetings. Establish and maintain contacts with the community of users in the NDS service area.

E1. Bibliographic Data (CINDA)

Compilation and entry of bibliographic reference information into CINDA and other data index systems. Development of CINDA system and Manual, production and distribution of annual CINDA publication. Coordination of CINDA with other centers.

E2. Numerical Experimental Data (EXFOR)

Compilation and processing of neutron nuclear data from NDS service area and of data received via inter-centre exchange of EXFOR tapes. Developing and maintaining contacts with experimental physicists and groups in NDS service area. Coordination of EXFOR system and its development with other centres; production and distribution of the EXFOR dictionaries, and maintenance of dictionaries master file; assistance in the production of the EXFOR manual.

E3. Numerical Evaluated Data

Processing, maintaining up-todate and disseminating upon request evaluated data files received from other centres. Collection of evaluated data files from NDS service area and transmission of these files to other centres. Maintaining an up-to-date index of the evaluated data files stored at NDS.

E4. Data reviews and evaluations

Performance and publication of specific data reviews and/or evaluations, independently or in cooperation with outside physicists. The on-going review and evaluation being performed by NDS are:

- Third IAEA evaluation of thermal fission data
- Review of reactor dosimetry cross section.

E5. Data Centre Services

Answer requests for bibliographic data (CINDA retrievals), experimental numerical data (EXFOR retrievals), evaluated numerical data, and for reports and documents. Maintaining information request and dissemination logs and statistics. Perform physics analysis of requests when necessary.

1974-1975 PROFESSIONAL RESPONSIBILITY DISTRIBUTION IN THE NUCLEAR DATA SECTION (given in percentage of time spent on each item)	TOTAL STAFF %	PHYSICS STAFF						PROGRAMMING STAFF				
		TOTALS	P-5	P-4	P-3	P-2	(P-1)	TOTALS	P-4	P-3	P-2	(P-1)
A. NDS Administration	100	62	35	25	2	0	0	38	23	-	5	10
A1. Programme and Budget	39	34	20	12	2	0	0	5	5		0	0
A2. Internal and External Liaison	50	17	10	7	0	0	0	33	18		5	10
A3. Publicity	11	11	5	6	0	0	0	0	0		0	0
B. INDC Secretariat	100	57	13	36	6	2	0	43	2	-	0	41
B1. INDC Meeting	33	31	10	15	4	2	0	2	2		0	0
B2. Administration	53	18	3	15	0	0	0	35	0		0	35
B3. Special Compilations	14	8	0	6	2	0	0	6	0		0	6
C. Data Status and Needs Assessment	172	169	25	78	17	34	15	3	0	-	0	3
C1. Standard Reference Data (SRND)	4	4	2	0	2	0	0	0	0		0	0
C2. Reactor Dosimetry Data (RDND)	44	41	3	33	5	0	0	3	0		0	3
C3. Fission Product Data (FPND)	21	21	4	2	0	0	15	0	0		0	0
C4. Transactinium Isotope Data (TND)	14	14	3	11	0	0	0	0	0		0	0
C5. Nuclear Structure and Decay Data (NSDD)	15	15	5	10	0	0	0	0	0		0	0
C6. Atomic and Molecular Data (A+MD)	25	25	5	15	5	0	0	0	0		0	0
C7. Charged Particle Nuclear Data (CPND)	49	49	3	7	5	34	0	0	0		0	0
D. Coordination Activities	98	63	11	3	49	0	0	35	5		30	0
D1. Nuclear Data Requirements (WRENDA)	63	28	5	1	22	0	0	35	5		30	0
D2. Targets and Samples Programme	24	24	2	0	22	0	0	0	0		0	0
D3. N.D. Measurements in Developing countries	11	11	4	2	5	0	0	0	0		0	0
E. Data Centre Activities	880	599	16	158	226	64	135	281	70	-	65	146
E1. Bibliographic Data (CINDA)	179	146	4	29	16	12	85	33	10		5	18
E2. Numerical Experimental Data (EXFOR)	333	166	3	29	50	34	50	167	55		43	69
E3. Numerical Evaluated Data	116	94	1	13	80	0	0	22	5		5	12
E4. Data Reviews and Evaluations	75	72	4	68	0	0	0	3	0		0	3
E5. Data Centre Services	177	121	4	19	80	18	0	56	0		12	44
TOTALS	1350	950	100	300	300	100	150	400	100	-	100	200

INDC STATEMENT TO THE DIRECTOR GENERAL

INDC reviewed in details the activities and staff structure of NDS. It supports the addition of one professional staff employee to the Nuclear Data Section with the understanding that this individual will be almost fully devoted to a well defined, high priority task in the nuclear data area related to neutron energy (e.g. neutron data compilation services) in such a manner that major improvement can be expected in a two year engagement.

10/10/75

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76-10200
Translated from Russian

THE ADJUSTMENT OF GROUP CONSTANTS ON THE BASIS OF EVALUATED INTEGRAL EXPERIMENTS AND THE LATEST EVALUATED MICROSCOPIC NUCLEAR DATA

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ABSTRACT

The adjustment of constants on the basis of the results of 48 integral experiments and a set of evaluated microscopic data from the United Kingdom Nuclear Data Library (UKNDL) and the BNAB-70 26-group system is reported.

The conditions for methodical and mathematically formalized use of integral experiments in obtaining nuclear data for reactors were established with the publication of a generalized perturbation theory [1] and the first application of the least-squares method to this problem [2]. Two other ways of using the least-squares method were described in Refs [3] and [4]. Two of the authors of this paper used the least-squares method described in Ref. [4] in a paper presented at the first Kiev Conference [5], and then introduced their own model of error correlations [6] and used an algorithm taken from "the systematic planning of experiments" (see Ref. [7]). In this algorithm there is no matrix conversion operation, so that the number of adjustable parameters is greatly increased compared with Ref. [5].

The essential aspects of using integral experiments in nuclear data work are dealt with briefly below.

A fundamental point in using integral measurements is that the theoretical model must be consistent with the experimental conditions. All the experiments used in this paper are evaluated to some extent and the authors are confident that any possible inconsistencies between experiment and theory are within the assigned errors. Data from 48 integral experiments were used in this work, the bulk of them being experiments on BFS assemblies [8] (29 experiments, 12 of which are experiments on reactivity ratios and 17 on cross-section ratios). In addition data on k_{eff} for ZPR assemblies, cross-section ratios for ZPR-III (48) and ZPR-VI (7), as well as certain other data were employed.

In the evaluation of the integral experiments the following effects were taken into account:

1. Finiteness of the dimensions of the samples used in the measurements of reactivity coefficients and certain cross-section ratios [9];
2. The effect of the heterogeneous structure of the critical assemblies;
3. The effect of the group approximation used in the 26-group calculation on the values of the functionals.

It should be noted that the theoretical methods of introducing corrections and the values of these corrections were checked by means of additional experiments (measurements with samples of different dimensions, variation of the degree of heterogeneity of the critical assemblies, etc.) [10].

Table 1 shows the characteristic values of the corrections made for a number of functionals measured on the BFS-30 critical assembly. Column 0 of this table shows the value of the functional measured directly in the experiment and the experimental error. Columns 1-3 show the value modified by appropriate corrections. Column 3 also shows the final error in the evaluated experimental value. Column 4 shows the theoretical value of the functional based on the initial system of constants and column 5 shows the adjusted theoretical value.

In making the adjustment it was assumed that there was no correlation between the errors of the different integral experiments, i.e. the covariation matrix of the integral experiments is diagonal. All the 48 functionals used were calculated on the basis of the 26-group system of constants, in which σ_c and σ_f of ^{235}U, ^{238}U and ^{239}Pu and $\sigma_{absor.}$ of ^{10}B are data from UKNDL [11], and the ^{56}Fe capture cross-section corresponds to the latest evaluation performed in the Nuclear Data Centre in 1975 and reported at this Conference. The remaining cross-sections in the calculation were the same as those in BNAB-70. We shall refer to such a system of constants as mixed.

The description of the set of integral experiments before and after adjustment can be characterized by the parameter

$$M_\ell^2 = [\sum_{i+1}^{N} \{(E_i - C_i^\ell)/ C_i\}^2/\Delta_i^2]/N$$

where E_i is the evaluated experimental value of the i^{th} functional, C_i^{ℓ} is the calculated value of this functional based on the "ℓ" system of constants and */ is the error in the experimental value. We find that $M^2_{BNAB-70} = 14$, $M^2_{mixed} = 10$ and $M^2_{adj.} = 0.7$.

The changes in the values of the constants with adjustment are given in Table 2, column 0. Only the principal data are given. Column 1 shows the changes in the values of the constants when the experiments on k_{eff} of the ZPR-III assemblies are omitted from the total set and adjustment is performed on the basis of the remaining set, column 2 shows the changes when k_{eff} of the ZPR-III and k_{eff} of the BN-350 and SNEAK reactors are omitted, and column 3 the changes when all the experiments on reactivity ratios are omitted. As can be seen from Table 2, the change in the values of the constants behaves quite conservatively with respect to the omission of the different types of experiments.

The system of constants obtained through adjustment was included in the catalogue of the M-26 reactor programme and the results of the adjustment were checked by direct calculations. The results of these are in good agreement with calculations based on perturbation theory. The adjusted system of constants describes the spectra of the BFS assemblies much better than the BNAB-70 system.

Using the above set of microconstants and integral experiments, it is possible to calculate the conversion ratio of plutonium breeders to within 3%.

The changes in the values of the microconstants shown in Table 2 largely correspond to the trends in the results of the latest microscopic measurements. This applies to σ_{cap} of ^{238}U, the latest evaluation of which is being presented by V.A. Tolstikov at this Conference, and to σ_{fis} of ^{239}Pu, particularly in the range below 200 keV. The fission cross-section of ^{238}U increases somewhat more than would be expected from the micro-experiment. It is important to note that a number of quantities vary by less than the assigned error; these include ν_F of ^{239}Pu, α of ^{239}Pu, σ_c of ^{238}U and σ_c of ^{56}Fe.

It is characteristic that the variation of the above quantities became small only after the latest, most reliable evaluations were used for the cross-sections in relation to which the adjustment was carried out. For example,

*/ Translator's note. Gap in original.

α of ^{239}Pu increased by 30% when adjusted on the basis of BNAB-69, by 11% when adjusted on the basis of BNAB-70 and by only 4% when adjusted on the basis of UKNDL data. A similar situation also applies for σ_c of ^{56}Fe.

In conclusion we would stress that work on making data more precise may be considered complete when microscopic data cease to vary during the adjustment process.

Table 1

No. of experiment	0	I	2	3	4	5
P5/F5+	I.78±.018	1.6 +	+	– +	I.52	I.7
P10/P5+	.97±.006	1.05+	1.02+	1.0I±.04+	0.858	I.02
P8/F5+	.040I±.0³8	.040I	.04I5	.0420±.0²15	.0432	.0430
P9/F8+	I.I ±.02	I.I0	I.I02	I.II±.02	I.06	I.II

Table 2

Type of cross-section	Energy, MeV	0	I	2	3	4 */
CAP PU -239	0.8<E<I0.5	0.7	-0.2	-0.2	2.9	50
CAP PU -239	0.I<E<0.8	-0.5	-0.6	-0.7	0.9	I5
CAP PU -239	0<E<0.I	8.6	7.6	+6.2	I0.8	I0
CAP U -238	0.8<E<I0.5	-7.9	5.5	-3.7	-5.5	20
CAP U -238	0.I<E<0.8	-9.7	-7.7	-8.0	-8.8	I0
CAP U -238	0<E<0.I	-7.0	-I0.7	-I0.7	-2.7	I5
FIS PU -239	0.8<E<I0.5	4.5	3.0	4.0	3.7	6
FIS PU -239	0.I<E<0.8	-0.I	0.2	0.5	0.5	3
FIS PU -239	+0<E<0.I	4.3	3.I	2.9	5.7	3
FIS U -235	0.8<E<I0.5	-4.0	-5.2	-4.6	-0.7	4
FIS U -235	0.I<E<0.8	-2.77	-2.2	-I.9	-I.5	3
FIS U -235	0<E<0.I	-I.5	-2.5	-2.5	-0.3	3
FIS U -238	0.8<E<I0.5	8.5	8.0	8.6	8.4	5
NUF U -238	0.8<E<I0.5	-I.7	-2.4	-I.78	-0.7	3
CAP U -235	0.8<E<I0.5	37	36	37	22	50
CAP U -235	0.1<E<0.8	20	15.9	I4	I5	I5
CAP U -235	0<E<0.1	-3.7	-2.7	-3.8	2.8	I0
NUF PU -239	0.8<E<10.5	-0.I	-0.13	0.I	-0.33	3
NUF PU -239	0.I<E<0.8	-0.4	-0.35	-0.2	-0.37	I
NUF PU -239	0.I>E>0	-0.7	-0.57	-0.4	-0.66	2
NUF U -235	0.8<E<I0.5	-I.0	-I.I	-I.0	-0.63	3
NUF U -235	0.I<E<0.8	-I.7	-I.7	-I.4	-I.3	I
NUF U -235	0.I>E>0	-0.7	-I.5	-I.I	-0.8	2

*/ Column 4 shows the accuracies of the microçonstants.

+ original figures hardly readable.

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9 October 1975

Subcommittee Report - Nuclear Data for Energy Applications

The subcommittee reviewed tha areas of Fission Product Nuclear Data, Reactor Dosimetry and Nuclear Data for Fusion to the extent possible in the short meeting period.

A. FPND As proposed previously, the NDS is planning to issue a Newsletter on FPND starting next month. A proposed format was distributed by M. Lammer and submissions from some 250 individuals have been requested during the past few months, a number of which have now been received. This effort by NDS was endorsed by the subommittee with the following comments and observations:

1. The format might be altered from experience gained in this initial cycle.

2. The list of contributors may well increase after this initial issue. Limits to contributions may have to be imposed, perhaps by page limits and by the number of separate contributions.

3. Possible misuse of this service could occur if individuals try to quote it as initial publication.

Since the NDS will only photocopy individual submissions, it is not their responsibility about just what is contained in any contribution. The subcommittee felt the potential for misuse was probably no greater than for the usual progress reports.

The NDS plans to hold an Advisory Group Meeting in early 1977 and Schmidt asked for consideration of the priority of various topics. A balance between integral and microscopic information is desired and it is expected that results from a number of new experiments, calculations and evaluations will be available. Amiel made the following recommendation:

> Ask interested labs to remeasure chain yields, discrepancies exceed 5%. We should also ask the people who presented at the FPND panel at Bologna reviews on chain yield in thermal and fast fission of ^{232}Th, $^{233,235,238}U$ and ^{239}Pu to update their compilations and evaluations and circulate through the NDS their revised lists together with the indicated discrepancies.

The subcommittee noted the UK response to the Lott proposal on fission product energy release information. The point is well made that available data must be able to permit accurate estimates of decay heat for irradiation periods far in excess of 10^5 seconds. The UK experiment at Zebra to verify decay heat after a 6 months decay period may well be important. It is, however, expected that already available information on the long-lived activities are in a much better state for this purpose than are the data for much shorter half-lives. These short periods should, therefore, be emphasized as of higher priority at the present time.

The subcommittee endorsed Schmidt's letter of July 3, 1975, which requested that Lott prepare a summary of afterheat experimental and calculation results for the 1977 Meeting on FPND.

Motz informed the committee that an extensive survey of selected fission product yields in ten or so fast assemblies was being published by the Los Alamos Nuclear Chemistry Group. Detailed information will be available in December 1975.

B. <u>Reactor Dosimetry</u>. M. Vlasov of the NDS reviewed his draft Status of Neutron Cross Section Data for Reactor Radiation Measurements document, INDC(NDS)-47/L, which was distributed. He hopes to have the completed document ready soon now that the ENDF/B-IV evaluated files are available for comparison. This review is a very comprehensive undertaking with an intent to arrive at a recommended cross section set during the next two years. Vlasov also distributed a "Survey of Benchmark Neutron Fields for Data Testing and Calibration for Reactor Fuels and Materials Dosimetry". Requests to laboratories are being made to obtain information for this survey.

The subcommittee was of the opinion that this was quite useful work in a field which is growing in importance. The evaluation of data and benchmark experiments, while very important, can be extremely demanding and limited or individual efforts such as those at NDS must focus on specific areas and avoid duplication of other programs.

Gemmell attended some of the Euratom Petten Dosimetry Meeting in September. He noted that very few users seemed to be present, but considerable exchange between the measuring experts was apparent. Although improvement in the agreement of direct integral measurements with calculated activities from microscopic cross sections was noted, discrepancies of 7 to 8% are still prevalent.

C. Nuclear Data for Fusion. Schmidt requested consideration of his proposal to hold an Advisory Group Meeting in 1978 on this subject. The subcommittee regarded this as a most appropriate and important subject and felt that the timing should be excellent. Several integral experiments are being completed on lithium assemblies, sensitivity calculations are being performed and a considerable amount of microscopic cross section measurements are underway or planned. Since, however, a difficult and extensive neutron energy regime, generally 5 to 15 MeV, is involved, it is expected that much more data will be required. Thus a status in the 1977/78 time frame should be very useful in appraising the status of this field.

Motz agreed to prepare a summary of data problems and current references in fusion for use by the NDS.

HTM

8/10/75

To: INDC Members

From: S. Amiel

Proposed Recommendation:

Ask interested labs to remeasure chain yields, where discrepancies exceed 5%. We should also ask the people who presented at the FPND panel at Bologna reviews on chain yield in thermal and fast fission of ^{232}Th, $^{233,235,238}U$ and ^{239}Pu to update their compilations and evaluations and circulate through the NDS their revised lists together with the indicated discrepancies.

This, I believe, will encourage people to renormalize and experimentally update their values of independent, fractional and cumulative fission product yields as well as delayed neutron data; - these can then be presented and discussed on the 2nd IAEA FPND panel.

NUCLEAR DATA FOR ENERGY APPLICATIONS

SUBCOMMITTEE ASSIGNMENTS

DOSIMETRY	-	Cierjacks
FPND	-	Rowlands Amiel
SAFEGUARDS	-	Fuketa
TND	-	Michaudon
FUSION	-	Motz

Berenyi 9/10/75

Report on the Non-Energy Applications Sub-Committee to the INDC

I. In the field of non-energy applications the main problem is to clarify and quantify the needs for nuclear and related atomic data. Therefore, the members of the sub-committee reported first on the results in connection with this task. The forms to fulfil the tasks are different ones in the different countries. In some countries there are formal or ad hoc committees (study groups) to deal with the question (e.g. UK, USA, India, France), in others the task to be solved by personal contacts and interviews (e.g. FRG, Holland, Canada, Hungary). In USSR nuclear data needs in geological survey emerged e.g. during the last Kiev Conference.

II. Several working papers were discussed in the sub-committee, namely Rose's report on the Washington Conference, Wapstra's report on th Paris Conference on Atomic Masses, Cross' paper on nuclear data needs for biomedical purposes and that of Rose on cross-section needs for ion beam analysis (all these papers have been distributed for every member of INDC).

On the basis of these reports and the discussion some sub-fields of non-energy applications where needs may arise have been fairly defined. These are as follows:

(i) Fast neutron therapy: neutron cross sections (elastic, inelastic and interaction) at neutron energies higher than 15 MeV for the major constituents of the human body (H, O, C, N, Ca, P) as well as cross sections and neutron spectra for the Be(α,n) reaction by which fast neutrons are produced.

(ii) Medical isotope production: measurements or/and a proper compilation for charged particle excitation functions for certain isotopes; the accuracy needed here might be usually not better than 25%.

(iii) Radiation protection: among others the W-values (energy loss per ion pair) in various counter gases and tissue constituents are interesting in this sub-field.

(iv) Ion beam analysis of materials: the needs appear to be established and compilation effort has already begun which will more clearly define those areas of ignorance where gaps exist in the data.

(v) Industrial gauging: differential electron multiple scattering data in the energy range up to 4 MeV were claimed take of importance in the inferred design of industrial scattering gauges.

III. In the course of the discussion in the subcommittee it became clear that one should not deal with non-energy applications in general by forming study groups, committees or perhaps sending out questionnaires covering the very broad field of non-energy applications of nuclear data. The more efficient way seems to be to focus the efforts in national and international respect to one or at most several subfields of the non-energy applications during a certain period.

That is why the following actions are recommended.

(i) Concerning the biomedical applications the situation seems to be mature to make a more or less complete summary on the needs in this particular field during the next 18 months. This report would include the areas of nuclear medicine, biomedical research using tracers, neutron radiotherapy and radiation protection (paragraphs i-iii in the earlier section). Dr. Cross is asked to make this report for the next INDC meeting after having further information from Drs. Rose, Mehta, Smith, Usachev, Legrand and others. NDS might also organize an official consultants meeting in this field. (Cross, members concerned, NDS).

(ii) It is also recommended to collect the needs to undertake the necessary preparatory work to a report similar to that in the biomedical field (cf. III.i) in one or two of the following topics: geological surveying, ion beam analysis, industrial gauging etc. during the next period. Such work might also be carried out in the form of official consultants meeting at IAEA and in the frame of the Non-Neutron Nuclear Data Working Groups of the International Committee on Radionuclide Metrology in Paris. (Members concerned, Legrand, NDS).

(iii) The questionnaires from NDS to non-energy users of nuclear data should also be distributed. However, one must not expect much from them on the basis of rather negative experiences of numerous questionnaires. Anyway, members of the sub-committee are asked that they try to help the success of this questionnaire with personal interviews and forming local meeting according to the recommendations of the earlier INDC meeting. (NDS, members of the subcommittee).

WORKING PAPER FOR NON-ENERGY APPLICATIONS SUBCOMMITTEE

NUCLEAR DATA NEEDS FOR BIOMEDICAL PURPOSES

W.G. Cross

The major areas of biomedical applications of nuclear data are:

- Nuclear medicine (diagnostic and therapeutic radioisotopes)
- Radiotherapy (gamma rays, neutrons, pions and heavy ions)
- Biochemical and physiological research, using tracers
- Radiation protection
- Biological aspects of environmental problems.

The following discusses data needs in some of these areas - nuclear medicine, biochemical research and radiotherapy using neutrons.

Nuclear Data Needs for Nuclear Medicine and Biochemical Research

The commonest diagnostic use of radioactivity involves inserting a radioactive isotope into a patient and measuring its subsequent distribution in the body (by emitted gamma radiation) and the change of this distribution with time. The amount inserted is the minimum that has been found empirically to give the required spatial and time resolution with the detection equipment available. Doses to various parts of the patient are calculated and these influence the choice of isotope. This requires data on half lives, average beta energies, intensities and energies of the main gamma rays, X-rays, conversion and Auger electrons. However, since a low dose to the patient is only one of several factors affecting the choice of an isotope, high accuracy of dose calculations is unnecessary. Most isotopes used are chosen to have a relatively simple gamma spectrum, having one predominant line that can be easily isolated from others by a NaI spectrometer. Energy accuracy of 1 keV is more than adequate. Gamma doses are usually dominated by one or a few intense lines and the intensities of weaker lines are relatively unimportant.

The most demanding requirements for absolute intensities are for calibration sources (which are much the same as used in other scientific fields) and for the standardization of isotope strength by pharmaceutical manufacturers. For the latter, accuracies of a few percent are adequate but lower accuracy would not seriously hinder diagnostic usage.

At present about 120 isotopes, listed in Table I, are used in medical diagnostics. While this number had grown rapidly over the last 10 years, experts consulted believe that the number will decrease in future, as the less successful isotopes are eliminated. The ideal isotope decays by electron capture or low energy positrons, emits a single gamma line of 100 to 500 keV, has a half life of 30 minutes to a few hours, can be produced cheaply and free from undesirable radioactive contaminants, and can be attached to a wide variety of chemical compounds. While a few isotopes far off the beta stability line, whose decay schemes are not yet well known, may prove useful in the future the number is not expected to be large.

A second diagnostic technique uses activation analysis, either in vivo or in vitro, to determine the amounts of elements naturally present in the body. Half lives down to a few minutes can be used. Biological variations from one person to another make high accuracy of measurement unimportant. Measurements are normally made relative to a sample containing a known mass of the element.

In biochemical research using radioactive tracers there are fewer restrictions on the properties of nuclides than in diagnostic uses. Nevertheless, because measurement requirements are easier (e.g.; pure beta emitters can be used since absorption is not important) the number of widely used isotopes is considerably smaller than in clinical diagnosis. Of the tagged compounds commercially available, about 98% are tagged with ^{3}H or ^{14}C and the remainder with isotopes having a half life of a week or more. Intensity measurements are usually made relative to a sample of stock material.

Radioactive isotopes are also used in therapy, both for cancer and for other conditions. In calculating doses, high accuracy is again not very important because of variability in the movement of the radioisotope in the body. The isotopes used are among those in Table I, although the desirable properties of an isotope are quite different from those for diagnostic use.

Decay schemes for all but about 16 of the isotopes listed in Table I have been revised in Nuclear Data Sheets since the beginning of 1970. Of the remainder, 7 were revised in 1968 and 9 in 1966 (either for Nuclear Data Sheets or the 1968 edition of Lederer et al's Table of Isotopes) and all those except ^{11}C are under revision at present. With the possible exception of a few half lives there does not appear to be an urgent need, in nuclear medicine, for new decay data or for more mass chain compilation work than is already underway.

A need for repackaged decay data, in a form suitable for medical dose calculations should be largely met by the new compilation of Dillman for the MIRD committee. This includes most of the isotopes of Table I and should be published in the fall of 1975. A sample format is shown. The input data are taken from current Nuclear Data Sheets tapes. Dillman is now working on a similar 500-isotope compilation.

Isotope Production for Nuclear Medicine

Because electron-capture and positron-emitting isotopes are preferred for diagnostic medicine, many isotopes must be made by charged particle or gamma-n reactions. It is generally agreed that many required charged particle excitation functions are not available. They are needed both for the desired production reactions and also for the coincident production of unwanted nuclides, in order to choose the best reaction mode and bombarding energy. Accuracies of 25% will usually be adequate for making this choice. The charged particle reactions compilation of the Karlsruhe group (published by Landolt-Börnstein) contains not only measured excitation functions but also their systematics, so that unmeasured cross sections can be estimated, often to sufficient accuracy. The very high price of these 3 volumes is probably a deterrent to widespread use. While updating the compilation of charged particle experimental results is valuable for many applications, it appears to me that more calculations, based on established systematics, would be the most efficient way of satisfying the data needs of medical isotope producers.

Nuclear Data Needs for Neutron Therapy

If reliable, cheap D-T generators were available, with outputs of 4×10^{13} n/sec (about 100 rad/min at 1 m) and target half lives of 100 h or more, D-T neutrons would probably be used almost exclusively. Enough nuclear data exists to go ahead with 15-MeV neutron therapy, although one would like to have more data on the spectra of alpha particles from O and C. Some improved data for shielding calculations are also needed but these will presumably be obtained in connection with fusion programmes. Existing D-T generators for therapy have outputs about 10 times lower than desired and are useful for therapy only on an experimental basis.

The most promising alternative source is the ^{9}Be(d,n) reactions, using 35-50 MeV deuterons from cyclotrons. For 50 MeV deuterons the neutron spectrum peaks at 21 MeV and extends to about 50 MeV. High mean energy is needed to reduce attenuation in the body, although cyclotron neutrons of lower energies have been used for tumors close to the surface. Several cyclotrons are now used on an experimental clinical basis. The beam intensity is adequate and target deterioration is not important.

The main new data requirements for therapy with cyclotrons are:

(a) The cross section of the ^{9}Be(d,n) reaction and more accurate neutron spectra at a variety of deuteron energies and target thicknesses.

(b) Cross sections for 15 - 50 MeV neutrons in major body elements (H,O,C,N,Ca,P), needed to calculate dose distributions in the body. Prime needs are cross sections and angular distributions for elastic scattering and inelastic scattering to the first excited state of ^{12}C, inelastic scattering cross sections and secondary neutron spectra for the other levels and elements, (n,p) and (n,α) cross sections and spectra of the protons and alpha particles. The required accuracy varies a great deal with the data but decreases with neutron energy above the peak of the spectrum. There are few data available above 20 MeV. Considerable use might be made of cross sections for proton scattering which are easier to obtain and some of which exist, along with enough comparisons between proton and neutron data to check the extrapolation to neutrons.

(c) Cross sections for calculating transmission of 15 - 50 MeV neutrons through beam collimators and shielding. The elements involved are Fe, Pb, possibly W and the elements in concrete. Secondary gamma spectra and activation cross sections are also required.

(d) Some atomic data, in particular the number of eV/ion pair (W) for protons in tissue and in detector gases.

Other neutron source reactions - e.g.; D-D, D-T, ^{9}Be-^{3}He, ^{9}Be-p or ^{7}Li-p, all using high energy bombarding particles, may turn out to have advantages over ^{9}Be-d. Enough cross section and neutron spectral data are required to assess the relative merits of these reactions. For this purpose high accuracy is not required. Measurement of neutron and gamma doses and neutron spectra will probably be done with a combination of ion chambers, scintillators and a variety of activation and damage track detectors of different thresholds. Cross sections for these reactions will be required. Therapy with neutrons from ^{252}Cf is expected to increase. The data required for measuring doses and spectra are the same as are required for reactors.

The rate of development of neutron therapy will depend on the results of experiments and clinical experience with existing installations, on the availability of cheaper neutron sources and on the confidence with which dose distributions can be calculated and measured. Better data can contribute significantly to the latter.

Table I: Radioactive Isotopes used in Medicine

H3	Ga66	I126
Be7	Ga67	I129
C11	Ga72	I130
C14	Ge68-Ga68	I131
N13	As72	I132
O15	As73	I133
F18	As74	Xe127
Na22	Se73	Xe133
Na24	Se75	Cs127
Mg28-Al28	Br77-Se77m	Cs129
P30	Br82	Cs131
P32	Kr81	Cs137-Ba137m
S35	Kr83m	Cs134
Ar37	Kr85	Ba128-Cs128
K38	Kr85m	Ba133
K40	Rb81-Kr81m	Ba135m
K42	Rb84	Ce139
K43	Rb86	Dy157
Ca45	Sr82-Rb82	Tm167
Ca47-Sc47	Sr85	Er171
Ca49-Sc49	Sr90-Y90	Yb169
Cr51	Y87-Sr87m	W188-Re188m
Mn52	Mo99-Tc99m	Ir190m-Os190m
Mn54	Ru97	Os191/m-Ir191m
Fe52-Mn52m	Ru103	Pt195m
Fe53	Pd103	Au195
Fe55	Cd109-Ag109m	Au198
Fe59	In111	Au199
Co57	In115m	Hg197
Co58	Sb117	Hg203
Co60	Sn113-In113m	Tl201
Cu64	Sn117m	Pb203
Cu67	I123	Bi204
Zn62	I124	Bi206
Zn65	I125	Ra224
		Pu237
		Am241

133 Xe

INPUT DATA

54 XENON 133 HALF LIFE = 5.31 DAYS

DECAY MODE- BETA MINUS

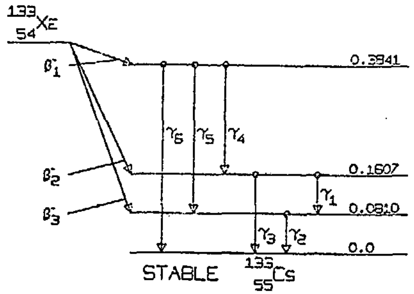
TRANSITION		MEAN NUMBER/ DISINTE- GRATION	TRAN- SITION ENERGY (MEV)	OTHER NUCLEAR DATA
BETA MINUS	1	0.0002	0.0429*	ALLOWED
BETA MINUS	2	0.0163	0.2660*	ALLOWED
BETA MINUS	3	0.9830	0.3460*	ALLOWED
GAMMA	1	0.0162	0.0796	M1, AK= 1.36 AL(T) = 0.200
GAMMA	2	0.9997	0.0809	M1, AK= 1.46 K/(L+M)= 4.65
GAMMA	3	0.0000	0.1606	M1, AK= 0.210 K/(L+M)= 3.75
GAMMA	4	0.0000	0.2230	M1, AK(T) = 0.0839 AL(T) = 0.0112
GAMMA	5	0.0000	0.3028	M1, AK= 0.0390 AL(T) = 0.00494
GAMMA	6	0.0002	0.3839	E2, AK= 0.0170 AL(T) = 0.00270

*ENDPOINT ENERGY (MEV).

REF.- ALEXANDER, P. AND LAU, J.P., NUCL. PHYS. A121, 612 (1968).

XENON-133

BETA-MINUS DECAY



OUTPUT DATA

54 XENON 133 HALF LIFE = 5.31 DAYS

DECAY MODE- BETA MINUS

RADIATION		MEAN NUMBER/ DISINTE- GRATION $\bar{n}_i$	MEAN ENERGY/ PAR- TICLE $\bar{E}_i$ (MeV)	EQUI- LIBRIUM DOSE CONSTANT Δ_i (g-rad/ µCi-h)
BETA MINUS	2	0.0163	0.0750	0.0026
BETA MINUS	3	0.9830	0.1006	0.2106
GAMMA	1	0.0061	0.0796	0.0010
K INT CON ELECT		0.0084	0.0436	0.0007
L INT CON ELECT		0.0012	0.0742	0.0001
GAMMA	2	0.3603	0.0809	0.0621
K INT CON ELECT		0.5261	0.0450	0.0504
L INT CON ELECT		0.0848	0.0756	0.0136
M INT CON ELECT		0.0282	0.0799	0.0048
GAMMA	3	0.0000	0.1606	0.0000
GAMMA	4	0.0000	0.2230	0.0000
GAMMA	5	0.0000	0.3028	0.0000
GAMMA	6	0.0002	0.3839	0.0001
K ALPHA-1 X-RAY		0.2552	0.0309	0.0168
K ALPHA-2 X-RAY		0.1321	0.0306	0.0086
K BETA-1 X-RAY		0.0712	0.0349	0.0053
K BETA-2 X-RAY		0.0150	0.0359	0.0011
L X-RAYS		0.0823	0.0043	0.0007
KLL AUGER ELECT		0.0402	0.0253	0.0021
KLX AUGER ELECT		0.0177	0.0296	0.0011
KXY AUGER ELECT		0.0029	0.0339	0.0002
LMM AUGER ELECT		0.4894	0.0033	0.0034
MXY AUGER ELECT		1.1847	0.0009	0.0025

8/10/75

The Status of Nuclear Mass Determinations

A.H. Wapstra

A fuller status report, constituting part of the closing address to the Fifth International Conference on Atomic Masses and Fundamental Constants, will be sent to the members of the Subcommittee on Non-energy applications. The following is a short summary.

Along the line of beta-stability, new measurements changed masses of some rare earth nuclides by about 30 keV. The reported accuracy along this line is now better than 10 keV everywhere. Many more masses are now known far from stability than only a few years ago, among them the first ones measured by mass spectroscopy (^{11}Li, $^{28-32}$Na). Even more mass differences between such nuclei are known, in cases where the absolute masses are not. It now appears that magic numbers (for which extra stability exists) far from stability are different from those near stability; this has been explained theoretically too (Hartree-Fock calculations). Thus, atomic mass formulae and extrapolation procedures (Garvey-Kelson) have to be revised.

Special cases: L.G. Smith's determinations of the H and D masses are somewhat in doubt; his instrument has been moved after his death to Delft Technological University where his measurements will be repeated. His measurements on $^{12-13-14}$C and $^{14-15}$N yield (n,γ) reaction energies that have been used to improve the calibration for γ-rays of several MeV by an order of magnitude.

The National Bureau of Standards is working on a method to measure the numbers of atoms in an enriched ^{28}Si crystal with a precision of 1 part in 10^9. This would allow to replace the weight standard (ther Paris kilogram) by an atomic weight one if the atomic weight of ^{28}Si would be known with the same accuracy. The present accuracy is 3 in 10^9; Delft will work on improvement.

The newest data indicate that Cohen and Taylor's last mass-energy conversion constant (is c^2/F) is high by about three reported standard errors.

Report on the Third All-Union Conference on Neutron Physics, Kiev, 9-13 June 1975

by

J.J. Schmidt

Purpose:

1. Participation in the Conference upon invitation;

2. Discussions on USSR participation in future meetings of the Nuclear Data Section (NDS);

3. Discussions with representatives of the three USSR nuclear data centres (at Obninsk, Moscow and Leningrad)

Summary

1. Neutron Physics Conference

The Third All-Union Conference on Neutron Physics was held at the October Palace of Culture in Kiev from 9-13 June 1975. The Conference was sponsored by the Ukrainian Academy of Sciences and the USSR State Committee on the Utilization of Atomic Energy. As in the Second Conference on Neutron Physics held in Kiev in June 1973 there was invited participation by scientists outside the USSR. Of the 350 participants - about twice as many as in 1973 - 50 were from the following countries and organizations: Australia, Bulgaria, Czechoslovakia, Egypt, France, FRG, GDR, Hungary, Netherlands, Poland, Sweden, UK, the Joint Institute for Nuclear Research Dubna, and the IAEA. Simultaneous interpretation into English was provided.

Similarly to the Nuclear Cross Sections and Technology Conference held in Washington, D.C., USA, in March 1975, the participation from developing countries outside Europe was extremely small, again probably due to lack of financial support.

In altogether 84 papers the Conference gave a broad survey of fundamental and applied aspects of neutron physics work in the USSR with a strong emphasis on neutron data needed for fast reactor development. The conference programme is reproduced in the attachment.

Regrets were expressed that neither Soviet scientists could participate in the recent Conference on Nuclear Cross Sections and Technology which took place in Washington, D.C., in March 1975 nor US scientists in the present Kiev Conference. At both conferences IAEA/NDS was asked to arrange for a suitable exchange of the proceedings of the conferences between both countries.

A little booklet was made available to the participants containing annotations of all contributions reviewed at the conference in keywords of the INIS system, however, unfortunately without abstracts.

2. USSR participation in IAEA/NDS meetings

The interest and possible participation of Soviet scientists in the following NDS meetings was discussed:

- Atomic and Molecular Data for Fusion, Vienna, 30 June - 1 July 1975;
- Transactinium Isotope Nuclear Data, Karlsruhe, 3-7 November 1975; and
- The use of Nuclear Theory in Neutron Nuclear Data Evaluation, Trieste, 8-12 December 1975.

3. Nuclear data centre discussion

I had extensive discussions with representatives of the three Soviet nuclear data centres on matters of future cooperation and exchange and related technical problems, particularly in the field of "non-neutron" nuclear references and data, and evaluated neutron data.

Detail

1. Neutron Physics Conference

In format, the Conference consisted entirely of presentations of invited papers and review summaries of individual contributions. Of the total of 84 papers, 60 were delivered by Soviet scientists and 24 by scientists outside the USSR.

The Conference was heavily oriented towards neutron data needs, measurements and evaluations for fast fission reactors and heavy nuclei with the exception of very few papers that were devoted to neutron data for thermonuclear fusion, soil investigation and astrophysics. The fact that fundamental as well as applied scientists work closely together on neutron physics and data problems for nuclear technology deserves particular mentioning.

A strong activity in the evaluation of neutron data for fission reactors is noted in which mainly groups at Minsk and Obninsk participate, in close collaboration with the Nuclear Data Centre Obninsk. Results were reported on new neutron data evaluations for U-235, Pu-240, C-12, Fe, Cr, Ni and Au covering neutron energies between 10^{-4} eV and 15 MeV. They will form part of a comprehensive evaluated neutron data library called SOKRATOR which is designed to become the basic nuclear data reference source for nuclear energy applications in the USSR and Eastern Europe. The data contained in this library will be made available to IAEA/NDS for international distribution and comparison with similar libraries in other countries.

Several reports dealt in detail with nuclear data requirements for nuclear fission and also fusion (one report) reactor technology, including needs for fission product and actinide nuclear data, in close similarity to the needs expressed at the Washington nuclear data conference. In deriving accuracy requirements for nuclear data from mathematical sensitivity studies the possibility to improve nuclear data not only by microscopic but also by integral experiments in critical facilities is explicitly taken into account. The neutron data requirements for fusion are based on given accuracy requirements for the prediction of the tritium breeding ratio in normal (D-T) fusion reactors and of both the tritium and plutonium breeding ratios in hybrid fusion reactors. The Soviet requests for fission and fusion reactor nuclear data belong to the best founded requests submitted for inclusion in the IAEA/NDS WRENDA request lists.

The scientifically most interesting part of the conference were the three sessions devoted to fission research on heavy nuclei. It was also in this area where the most vivid interaction between Soviet and other scientists took place. Much new empirical and theoretical material was presented on the double-humped fission barrier problem and the properties of the nuclear states in the so-called second well, which are responsible for the shape of actinide neutron fission cross sections needed in nuclear technology.

2. USSR participation in IAEA/NDS meetings

2.1. Atomic and molecular data for fusion

The USSR is strongly interested in the proposed new Agency programme on atomic and molecular A+M data for fusion and will send one or two experts to the Agency's forthcoming Consultants Meeting on A+M data for fusion. A delay of this meeting by three weeks to the 21 and 22 July 1975 was asked by representatives of the State Committee (meanwhile effected) in order to accommodate Soviet participation in the meeting.

2.2. Other NDS meetings

The USSR will probably send three participants to the Advisory Group Meeting on Transactinium Isotope Nuclear Data in Karlsruhe, November 1975, one of whom will review the status of alpha decay data of actinides.

Informal discussions were held with Profs. Solovev from JINR Dubna and Usachev from FEI Obninsk, Soviet Member of INDC, as well as with Drs. Malov from JINR Dubna and Ignatyuk from FEI Obninsk regarding the potential participation of the two latter scientists in the Consultants Meeting on the Use of Nuclear Theory in Neutron Nuclear Data Evaluation at ICTP Trieste, December 1975, as reviewers of the theory and systematics of nuclear level densities which will form one of the major subjects of this meeting.

3. Discussions with representatives of the USSR nuclear data centres

Detailed discussions were held with Dr. V. Manokhin, head of the Nuclear Data Centre at FEI Obninsk, Dr. L.L. Sokolovski, deputy head of the Nuclear Data Centre at the Kurchatov Institute in Moscow, and Dr. I.A.

Kondurov, head of the Data Centre at the Leningrad Nuclear Physics Institute Gatchina, with the following major results and information:

- the Obninsk and Kurchatov centres are responsible for the coordination of neutron and "non-neutron" data activities respectively in the USSR. The Kurchatov and Gatchina centres share the responsibility for the compilation of "non-neutron" nuclear references and data;

- the Kurchatov and Gatchina centres are strongly interested in a technical cooperation and exchange with data centres outside the USSR, particularly in the US, which should proceed through the IAEA Nuclear Data Section, with primary emphasis at present on charged particle nuclear data for fusion and nuclear structure and decay data of fission products;

- both centres, similarly to the Obninsk centre in the field of neutron data, compile already references on "non-neutron" nuclear data from the Soviet scientific literature and are willing (Kurchatov centre) to compile charged particle nuclear data from the USSR in exchange to data from other countries and (Gatchina centre) to share the work on A-chain nuclear data compilations with other centres;

- both centres are strongly interested in participating in all future NDS meetings on "non-neutron" nuclear data compilation and in achieving international agreements on common data exchange procedures and formats.

- the Obninsk centre will make available to NDS major new parts of its SOKRATOR library of evaluated neutron data (for U-235, Pu-240 and several reactor structural materials) and an updated version of the previous ABBN 26 group cross section library for exchange with other centres and dissemination to interested users.

The discussions were finished with more than 50 technical actions on the participants. A detailed report is available from the Nuclear Data Section as NDS Memo 294.

Attachment

Third All-Union Conference on Neutron Physics

Kiev, 9-13 June 1975

Programme

1. Nuclear data needs for fission and fusion reactors and astrophysics

2. Experimental methods of neutron physics

3. Nuclear data needs and their evaluation

4. Fundamental properties of the neutron

5. General problems of the interaction between neutrons and nuclei

6. Experimental study of the interactions of thermal and resonance neutrons with nuclei (two sessions)

7. Experimental study of the interaction of fast neutrons with nuclei

8. Cross sections and other characteristics of neutron fission of heavy nuclei (three sessions)

9. Summary of the Conference

10/10/75

Atomic Weights and Isotope Abundances

A.H. Wapstra

The Commission on Atomic Weights of the International Union of Pure and Applied Chemistry met in Madrid on September 3-6, 1975.

It was decided that, in future, the reports of this Commission will give evaluated values for (terrestrial) isotope abundances of all elements, made compatible with the adopted atomic weights.

Isotope abundances quite different from the terrestrial averages have been found in the OKLO uranium mine in Gabon. They agree with the hypothesis that, in this mine, a natural fission chain reaction has occurred, depleting ^{235}U by about one third and producing fission products. But for this case, though, newer measurements of isotope abundances indicate that fewer measurable deviations from the average abundances occur than have been reported previously.

8th INDC meeting

Working paper relevant to agenda point XI.C.6:
"1978/9 International IAEA Nuclear Data Conference"

(H. Liskien)

1. The schedule outlined in Dr. Rose's working paper neglects ICINN conferences although the 1976 Lowell conference is mentioned in brackets. It is felt that conferences of this series whose purposes are "to review past progress, survey the present status and delineate future potentialities of basic nuclear research in neutron physics from a theoretical, experimental and technological standpoint" should be included in an envisaged international conference schedule although they are more scientific and less application oriented.

2. In the past the Washington series has not strictly been a triennial series.

3. It is suggested to support a four-years sequence as given on next page.
This suggestion supports the idea of no further IAEA conferences of this kind and coincides with Dr. Rose's schedule for the years 1977 to 1979 but it includes the ICINN series. The four-years sequence also allows the easy insertion of a conference of more regional character after two years, if this is felt necessary.

	IAEA	USSR	Europe	WASH	ICINN
1965					Antwerp
1966	Paris			Washington	
1967					
1968				Washington	
1969					
1970	Helsinki				
1971		Kiev		Knoxville	
1972					Budapest
1973		Kiev			
1974					
1975		Kiev		Washington	
1976					Lowell
1977		Kiev			
1978			W - town		
1979				Washington	
1980					X - town
1981		Kiev			
1982			Y - town		
1983				Washington	
1984					Z - town

WORKING PAPER: SESSION XI.C.7

International IAEA Nuclear Data Conference?

There are at present two regular regional conferences on nuclear data, the Washington triennial series which caters largely for North America and the Kiev biennial series which caters largely for the USSR and neighbouring European countries. These are not exclusive conferences, and participation is welcomed by contributors from outside the regions.

Discussions have taken place during the past year of a proposal to institute a triennial series based on Western Europe, the first to be held in 1978. This was discussed at NEANDC in April 1975 and at JENDRPC in May 1975, and welcomed.

To be most effective, and to avoid clashes of dates, it would clearly be advantageous if the Washington series could slip by one year so that the next would be held in 1979, and if the Kiev series could be changed to a triennial sequence. The former proposal was accepted in principle by the US members at the NEANDC meeting, and the latter was put informally to several physicists in the USSR during July. It is hoped that Dr. Usachev may have a considered response to the idea at this meeting.

The proposed schedule would be as follows, compared with the present schedule

	Present schedule	Proposed schedule
1975	Washington, Kiev (past)	Washington, Kiev (past)
1976	(Lowell)	(Lowell)
1977	Kiev	Kiev
1978	Washington	W. Europe
1979	Kiev	Washington
1980	-	Kiev
1981	Washington, Kiev	W. Europe

The question arises, therefore, that if the above proposals proceed, what would be the need for an IAEA nuclear data conference in the successful sequence of Paris 1966 and Helsinki 1970. My own view is that the needs of the subject would be on the whole satisfactorily met by the three regional conferences. The local meetings every three years would allow fairly generous attendance from the individual regions and comparatively cheaply, while the fact that there was a large meeting <u>every</u> year would mean that important information could be presented without undue delay at a truly international forum.

The needs of those countries which do not fall within these regions would have to be met, as at present, by their scientists making use of one of the regional meetings.

In these circumstances, I do not consider that there is a strong case for a world-scale IAEA meeting on this topic. This would, however, make it possible for INDC to put in a strong bid for funds for smaller specialist meetings where the world-wide cover is of particular value.

B. Rose

A.E.R.E. Harwell
9 September 1975

APPENDIX XXXV

8-th INDC Meeting - List of Actions

Number	Action on	Page	Action
1	NDS/INDC Secretariat	1	Issue the "Official Minutes" of the 7th INDC Meeting. (Minor changes proposed by Usachev, Joly and Condê to be incorporated).
2	NDS/INDC Secretariat	2	Issue the final "Report of Sub-Committee on the discrepancies in important data and evaluation" as INDC"U" document.
3	All members	5	Inform NDS/INDC Secretariat before 31 December 1975 about possible reduction of L and U-documents distribution list and send revisions of correspondents list.
4	NDS/INDC Secretariat	5	Provide as soon as possible existing N-distribution lists to members concerned for review.
5	All members	5	Send to NDS/INDC Secretariat N-distribution lists before 31 December 1975.
6	Members concerned	5	Investigate about the possibility of removing library restrictions from INDC-"U" documents.
7	Chairman + Ex.Secretary	5	Investigate about the possibility of having more concise INDC Meeting minutes.
8	All members	6	Advise data centres on gaps in data centres' available files.
9	All members	6	Urge physicists in their respective countries to submit any new information on discrepancies and/or standards to the reviewers as soon as possible (Standing action).
10	Liskien + Joly	6	Submit to appropriate data centres the names of the reviewers and topics covered by their standing sub-committees.
11	Reviewers of Standing S.C. on Standards and Discrepancies	6	Ask the appropriate data centres to send them all available information (plots, data lists, etc.) on their own reviewed topic.
12	Motz	6	Update before 15 November 1975 Lemley's paper on fission spectra, taking into account the contributions presented at the 1975 Harwell Specialists Meeting.
13	Standards and Discrepancies Sub-Committee members	6	Send updated status reports to their sub-committee Chairmen before 15 November 1975 with copy to NDS.
14	NDS/INDC Secretariat	6	Send to INDC participants and NEANDC correspondents the final reports of the two technical sub-committees as soon as they are approved by the Sub-Committees' Chairmen.
15	Amiel and Seidel	10	Provide information to NDS/INDC Secretariat about groups working on compilation of non-neutron nuclear data in their countries.
16	NDS/INDC Secretariat	10	Send detailed information to Mehta on development of CPND activities.
17	NDS/INDC Secretariat	10	Invite a UK representative to attend the next CPDN Meeting.
18	Usachev	10	Inquire about the possibility of having Kurchatov and Gatchina reports on non-neutron nuclear data compilations distributed as N documents.
19	All members	10	Inform NDS/INDC Secretariat before 31 October 1975, which centres and/or group representatives should be invited by IAEA to next Advisory Group Meeting on Nuclear Structure and Decay Data (Vienna, 3-7 May 1976).

Number	Action on	Page	Action
20	Chairman	15	Send to Motz, Rose, Decker and to the Scientific Secretary a draft of the covering letter to DG on A+M data for fusion.
21	Chairman	15	Send the document "Statement from INDC on A+M data for fusion" with covering letter to DG, with a copy to the Chairman of IFRC.
22	Chairman	15	Discuss with the IFRC Chairman about the possibility of having a Joint Ad-hoc Sub-Committee of INDC and IFRC on A+M data for fusion.
23	Fuketa	15	Inform as soon as possible the Chairman and NDS on a possible Japanese delegate for the Joint INDC/IFRC Sub-Committee on A+M data for fusion.
24	NDS/INDC Secretariat	16	Send to Mehta an analysis of material provided by NDS to Indian Laboratories.
25	NDS/INDC Secretariat	17	Provide a sequential request numbering in WRENDA 1976.
26	NDS/INDC Secretariat	17	Provide new status comments for WRENDA 1976 on the basis of sub-committee reports on Standards and Discrepancies. Delete status comments as they are now.
27	NDS/INDC Secretariat	17	Send before 31 October 1975 to all members the present distribution list of WRENDA.
28	All members	17	Send before 31 December 1975 to NDS/INDC Secretariat a special distribution list for WRENDA 1976.
29	NDS/INDC Secretariat	17	Obtain through Liaison officers revised distribution lists for WRENDA.
30	Condé	18	Send information to liaison officers of Korea and Bangladesh of the technical programmes at the University of Uppsala sponsored by SIDA, IAEA and UNESCO.
31	Usachev	45	Enquire about USSR participation in the BIPM International Intercomparison on Neutron Flux Measurements (see INDC (UK)-25/U,p.75).
32	Cierjacks + Gemmell	45	Agree before 31 December 1975 on the schedule of next NEANDC and INDC meetings consistent with an 18 month average meeting cycle and inform committee participants.
33	NDS/INDC Secretariat	45	Send the distribution lists and copies of "Questionnaires" to the National Data Centres and INDC members.
34	NDS/INDC Secretariat	46	On behalf of INDC, bring Mrs Lammer's paper to the attention of FPND reviewers concerned.
35	NDS/INDC Secretariat	46	Make the point about the FPND Newsletter at the next INDC meeting.
36	All members	46	Send to NDS comments on first issue of the FPND Newsletter.
37	Chairman	46	Put the question of FPND Newsletter on the next meeting's agenda for discussion.
38	All members	46	Send to NDS/INDC Secretariat suggested topics for the 2nd FPND Panel before 31 December 1975.
39	Amiel	46	Send to INDC members a summary report on the Gatlinburg Conference on activation analysis from the point of view of non-energy applications of nuclear data.

Number	Action on	Page	Action
40	Lorenz/NDS	46	Send to all INDC members a summary of the conclusions of the TND panel and issue an INDC document with L distribution.
41	Smith	47	Send information to INDC participants on the Seminar on Nuclear Data Requirements for Shielding (ANL, 1977).
42	Rose	47	Send information to INDC participants about future meeting on Nuclear Data for shielding in the UK.
43	NDS/Secretariat	47	Send to INDC the list of planned IAEA Nuclear Data meetings and "Meetings on Atomic Energy" 90 days before energy meetings (Standing Action).
44	NDS/INDC Secretariat	47	Explore the possibility for IAEA co-sponsorship of 1979 "Washington" Conference.
45	Liskien, Smith + NDS/INDC Secretariat	47	Explore the possibility for joint IAEA/NDS panel on nuclear standard reference data in Spring 1977.
46	NDS/INDC Secretariat	48	Revise the "INDC terms of Reference" document, and send the revised version to the INDC members for comments.
47	NDS/INDC Secretariat	48	Issue the revised draft of the "INDC Method of Work" document.
48	Chairman	48	Try to solve by letter the problem of the Executive Secretary for the next period.
49	NDS/INDC Secretariat	48	Investigate about the possibility of having a 3-year attendance period for INDC members.
50	All members	48	For every action concerned, inform NDS if the action will be fulfilled or not (standing action).
51	NDS/INDC Secretariat	48	Provide the NDS memoranda related to INDC meetings with continuous numbering.
52	NDS/INDC Secretariat	48	Fix as soon as possible the date for the next INDC meeting and communicate it to INDC participants.
53	NDS/INDC Secretariat	48	Investigate about the possibility of having the 10th INDC meeting in Hungary.

Continuining actions from the 7th and former meetings and not listed above

Number	Action on	Page	Action
54	NDS/INDC Secretariat	-	Ask the Data Centres to give maximum priority to compilation and exchange of measurements and available evaluations on those data dealt with by the INDC Sub-Committees on standards and discrepancies.
55	All members	-	Keep the NDS informed of all nuclear data developments in their respective countries of interest to IAEA.
56	All INDC Participants and members of Sub-Committees.	-	Send copies of all correspondence on nuclear data to the NDS/INDC Secretariat.
57	All members	-	Enquire in their own countries about possible bilateral arrangements for helping developing countries in proposed measurements programmes. Keep NDS informed.
58	All members	-	Urge nuclear physicists in their respective countries to send experimental neutron data to the "Neutron Data Centre" in their area.