607

UNCLASSIFIED

UKNDC(73)M.9T

EANDC(UK)-152'A'

INDC(UK)-21/G

TECHNICAL MINUTES OF THE 9th MEETING OF THE UNITED KINGDOM NUCLEAR DATA COMMITTEE

HELD AT

A.E.R.E., HARWELL ON 22nd JUNE, 1973

B. H. Patrick, Secretary, UKNDC.

Nuclear Physics Division,
A.E.R.E., Harwell,
Didcot, Berks.

CONTENTS

INTRODUCTION

At the 9th meeting of the United Kingdom Nuclear Data Committee (UKNDC), it was agreed that an edited version of the minutes should be produced and distributed to the EANDC ('A' distribution) and this has since been extended to include the INDC members. This document is therefore the first set of technical minutes to be made available. The Committee is currently undergoing changes in structure, as discussed in Agenda Item 10, and its role should become apparent as these changes are implemented.

Technical Minutes of the 9th Meeting of the United Kingdom Nuclear Data Committee held at A.E.R.E., Harwell on 22nd June 1973

Present:	Dr. B. Rose	AERE (Chairman)
	Mr. E. J. Axton	NPL
	Dr. S. Blow	CEGB
	Mr. G. Constantine	AERE
	Mr. E.A.C. Crouch	AERE
	Mr. J. G. Cuninghame	AERE
	Dr. C. G. Campbell	AEEW
	Dr. A.T.G. Ferguson	AERE
	Dr. D. Gibbons	AERE
	Dr. J. E. Lynn	AERE
	Mr. E. D. Pendlebury	AWRE
	Dr. B. H. Patrick	AERE (Secretary)
	Dr. M. G. Sowerby	AERE
	Mr. J. L. Rowlands	AEEW
	Mr. J. S. Story	AEEW

ACTIONS

Agenda Item 1 - Minutes of previous meeting

The minutes of the previous meeting (UKNDC(72)M.8) were accepted as a true record subject to the following amendment.

Paragraph 43. End the first sentence at "... now near completion" by removing the words "and he asked for advice on what they should now do." Then insert the following sentence: "It is unlikely that there will be effort available to undertake another long term measurement but nevertheless he asked for the committee's opinion on what measurements were most needed, should the resources be available."

Agenda Item 2 - Matters arising

Action 1 (Programmes for NEA Computer Programme Library). There had been some confusion over the exact requirements of the CPL but it had become clear that the Library wanted programme suggestions and the list of codes given in paper UKNDC(72)P.46 had been sent. It was expected that the CPL would select a number of codes from all the suggestions received and that EANDC members would be asked to review this list and in this way the final choice would be made.

Action 2 (Report to CPL of U.K. experience with codes). This action had been covered, for this year, by the work carried out under action 1.

Action 4 (Shielding Group interest in (α,n) reactions). Mr. Rowlands had discussed this topic with Avery who had an interest in such data and he had said that there is a need for an assessment of them. This view had also been put forward in a paper by Baker (Risley) presented to DIDWP in which, among other requests, he had asked for recommendations of α-particle decay energies for use in calculations of neutron activity due to (α,n) reactions. It is likely that DIDWP will be asked to put some of these requests on the U.K. request list at its next meeting.

Action 5 (CTR request list to be sent to the INDC). The Chairman had sent the U.K. list of controlled thermonuclear research (CTR) requests, as given in paper UKNDC(72)P.43, to the International Nuclear Data Committee (INDC). Since then, there have been some misgivings as the list no longer reflects the current

thinking on CTR in the U.K. There had been a move towards considering structures built with conventional materials rather than the more exotic ones previously envisaged and only when these have been proved to be inadequate will there be a need to turn to the unconventional materials. There seemed to be no point in trying to modify the list once it had been sent to the INDC as, in any case, it will be revised in a year or so.

Action 6 (The effect of the (n,Y n') reaction on reactor spectra). Mr. Pendlebury said he had circulated some copies of his calculations of the effect of the (n,Y n') reaction on the spectra in Vera and Zebra assemblies at DIDWP but no further work had been done on this topic. The importance of knowing the neutron spectrum in a fast reactor was stressed, particularly the relative spectrum at, for example, 1 keV and 100 keV. Studies in the U.S. were reported to have shown that there is an increase of about 3% in the Doppler effect calculated for the Fast Test Reactor with sodium voided from the core when this reaction is taken into account for U-238 only. This is probably the most important material from the point of view of the effect of this reaction since, in a typical fast reactor, the quantity of plutonium is only ~20% of the U-238 content and the cross-section is probably negligible for other materials like sodium and iron due to the strong gamma-ray transitions to states below the neutron separation energy. The cross-section in U-238 may be somewhat larger than that originally estimated by Moldauer (the U.S. calculations assumed a cross-section 50% greater) and there is clearly a need for a fresh look and an up-to-date estimate of the magnitude. Dr. Lynn agreed to look at the problem from the theoretical stand-point, and Dr. Ferguson will consider the possibility of making direct experimental measurements, while investigating a statement reported to have been made by A. B. Smith (Argonne) to the effect that the U.S. would not attempt a measurement because it would be too difficult. Once Dr. Lynn has estimated the cross-section, the effect in reactors will be reappraised.

LYNN
FERGUSON

Action 7 (Np-237 and U-238 data requests). The situation regarding requests for data on Np-237 and U-238 has been clarified and the request list now contains a category 2 request for an evaluation of the Np-237 fission cross-section and a category 1 request for a measurement of the fission cross-section of U-238 relative to that of U-235 to an accuracy of 3%. At this point, the recent observation by Block et al (RPI) of resonances indicating sub-threshold fission in U-238 was mentioned and Dr. Lynn stated that the magnitude of the observed cross-section on the peaks was about equal to the upper limit placed on the cross-section in an experiment performed several years ago on the linac. The observed cross-section may be significant when using the fission of U-238 as a detector in a reactor assembly and it may imply a cross-section at higher energies which is not negligible.

Action 8 (Spectrum shape for one group average cross-sections of Am and Cm). Mr. Rowlands had sent a spectrum shape to Sowerby who had computed the one group average cross-sections.

Action 9 (Status of Li-6 as a spectrum detector). The use of Li-6 as a spectrum detector is currently being reappraised at Winfrith and at the moment there is a tendency to move away from this technique. However, the Reactor Group still maintain an interest in the cross-sections of Li-6 and the appropriate items remain in the request list.

Action 10 (Widening of circulation of NNDEN newsletter). The Chairman had written to Rosen about the possibility of widening the circulation of the NNDEN newsletter.

Action 11 (Safeguards requests). The question of requests for nuclear data

relating to safeguards had been discussed with Anderson and Terrey and although they still believed that a separate request list for safeguards was unnecessary, as data measured for other purposes are generally sufficient, they have reviewed the situation in detail. At present measurements are often made against standards but a need for data may arise to enable the standards to be more accurately assessed. Mr. Terrey had written to Butland (AEEW) indicating that certain items in the latest physics and chemical nuclear data request lists (AEEW- M 1144 and CNDC(73)P.1 respectively) could be labelled as being of safeguards interest. The items relate to the following requests:- delayed neutron energy spectra of U-238 (item 56 in table 1 of AEEW - M 1144), U-233, U-235, Pu-239 and Pu-241 (items 401, 402, 406 and 412 of CNDC(73)P.1), the gamma-ray spectra of Pu-240, Pu-241 and Am-241 (items 26, 29 and 33 of CNDC(73)P.1) and the evaluation of delayed neutrons from all materials (item 604 in CNDC(73)P.1).

Action 12 (Compilation of fission product yield data by CCDN). It had been agreed by those concerned that the fission product yield data collected by Crouch could be sent to the CCDN and London Office had no objections to the Centre's involvement in these kinds of data.

Action 13 (List of evaluations sent to CCDN). Mr. Story had sent the Chairman a list of the evaluations which had been requested by the IAEA via the CCDN and those whose transmission to the IAEA had been agreed by the U.K.

Action 14 (Proposal regarding membership of EANDC). This action had been done and Rose and Campbell had discussed the proposal with Dr. Williams.

Action 15 (Circulate proposal for future scope, structure and outlook of EANDC). This had been done and was discussed further under item 9.

Action 16 (Location of next Nuclear Data Forum). The Chairman was pleased to report that Imperial College had agreed that the next Nuclear Data Forum could be held at the University of London Reactor Centre at Silwood Park. Further discussions are to be found under item 6.

Action 17 (Story to seek Askew's view on changes to U-235 eta value as preliminarily suggested by the IAEA 2200 m/s data evaluation panel). Mr. Story had discussed the possible reduction of the U-235 eta value with Askew who had done some calculations on large liquid fissile criticals at Oak Ridge using the WIMS code and which indicated that more activity rather than less was required suggesting that eta should be raised. Mr. Axton reported that Boldeman (Lucas Heights) had pointed out that recent measurements of the mean energy of the U-235 fission neutron spectrum seem to be giving a higher value than previously measured, moving towards the value for the Cf spectrum. This will help to resolve the discrepancy. There was some discussion on whether or not the panel should take the reactor measurements into account in the review. U.K. policy in the fast reactor field is to treat the differential data without reference to integral experiments but since no adjustments are made to thermal data perhaps a less rigid approach is required. The panel were worried that they would be discredited if the final 2200 m/s values lay outside the range acceptable to the reactor physicists and there was already a move in the U.S. to produce their own set. It was stressed that the panel would have to satisfy themselves that they could critically examine the reactor data before they could take it into account. Mainly because of this problem with eta, the review is unlikely to be completed before the end of the year.

Agenda Item 3 - Progress reports on nuclear data measurements and evaluations

A collection of progress reports from Harwell, Winfrith, Aldermaston and the

University of Birmingham was presented as paper UKNDC(73)P.49 and a summary of the work done at N.P.L. was distributed at the meeting. Dr. Lynn began the Nuclear Physics Division report by describing activities at the Linear Accelerator. Total cross-section measurements on a number of elements and compounds have reduced the associated uncertainties by up to a factor 10 in the energy range 2 to 3 eV. However, Story observed that the value 3.836±0.044 barns obtained for oxygen was disturbingly larger than the 3.747±0.014 barns measured by Koester. Dr. Lynn continued with a report on the Li-6(n,α) cross-section and stated that the reason for the discrepancy between the measured cross-section over the $5/2^-$ level at 0.25 MeV and that calculated from total cross-section measurements lies in the fact that a single level description is inadequate. Uttley has shown that the (n,α) and total cross-sections can be calculated from the same set of parameters to give good agreement with the measured values using a two level - two channel analysis. Since the Li-6(n,α) cross-section file in the UKNDL is

LYNN

now known to be wrong, Lynn was asked to make arrangements for producing a new file. The evaluation and calculation of the cross-sections of Am and Cm isotopes has been completed but the discrepancy between the integral cross-section for the production of Cm-242 from Am-241 in the Zebra MZB core and that calculated from the differential data still remains. Arrangements are being made to obtain a suitable Am-241 sample for measurements of the capture and fission cross-sections.

The discussion then moved on to work done on the synchrocyclotron. Measurements of the total cross-section of iron were presented as paper UKNDC(73)P.47. It is intended to modify the Moxon analysis programme so that it can be used on the PDP-11 to analyse these total cross-section data to enable the necessary corrections to be applied to the capture measurements which are planned on the linac. The preliminary results of a measurement of the ratio of the U-238 to U-235 fission cross-sections show very good agreement with the latest evaluation by Sowerby et al from 1.4 MeV to 20 MeV. The Chairman noted that James, who is at present on leave of absence at Oak Ridge, had supplied some figures comparing the counting rates for the same experiment on ORELA and the Harwell synchrocyclotron. For the same flight path length and energy resolution, and using the same sample mass, the figures seem to imply that the neutron yield from the synchrocyclotron is twice that from ORELA at 325 keV, but great care must be exercised in drawing any conclusion from such data.

Dr. Lynn completed this section by reporting on work which had been done since March when the progress report was written. All the data relating to the capture cross-section of separated isotopes of Eu-151 and Eu-153 have been measured and cross-sections will be produced up to 100 keV. Work concerned with the Doppler effect in U-238 has proceeded along two fronts, namely experimental and calculation. In the first, suitable furnaces are being investigated and current thinking favours using a 25 kV electron gun with a current of several amps. In the second, Sowerby has got a Lynn programme working which will calculate the average transmission from resonance parameter data produced by GENEX.

The progress reports were continued by Ferguson who discussed first the measurements of fission neutron spectra. In these experiments, the detector efficiency was measured up to 12 MeV and calculated above that energy. The contribution of the C-12(n,n')3α reaction was not included in these calculations and this aspect is now being considered. However, this omission would not explain the gross departure of the measured spectra from the Maxwellian form above 5 MeV. A joint Anglo-Swedish experiment on U-235 is planned at Harwell in the autumn and it is hoped that this will resolve the discrepancy between the spectrum shapes measured in the two countries. Work is continuing on measurements of the inelastic scattering cross-section of U-238 and preliminary results were presented for the region between 1 and 2.5 MeV. The question of the degree of

departure from isotropy of the scattered neutrons is now being examined. The cross-section in the energy region near 100 keV is also important from the Doppler effect viewpoint.

Mr. Cuninghame presented the report of the A.E.R.E. Chemistry Division and said that the measurement of the U-235 fission yields at several incident neutron energies in the range 130 keV to 1.3 MeV were now complete and indicated that there is no change in the yields of the high yield species Mo-99, Ba-140 and Nd-147 to within a standard deviation of 3.5%, 3.3% and 4.7% respectively. The yields of the wing nuclide Sm-153 and the valley nuclide Ag-111 rise with increasing energy. Because of difficulties in using long counters to determine neutron fluxes very close to the neutron target, the flux measurements in these experiments had been made using fission track detectors placed close to the U-235 sample and this arrangement had proved very reliable in use. Similar yield measurements for Pu-239 will now be done. In connection with evaluation work, the thermal and fast yield evaluations by Crouch have been published as reports AERE - R 7209 and AERE - R 7394 respectively. Tomlinson is currently revising his delayed neutron evaluation. There was a report that the U.S. find his earlier evaluation does not correctly predict certain integral properties but the experience at Winfrith is such that their integral experiments confirm the evaluation.

The latest value of the Pu-241 half-life deduced from the measurements on old material being carried out by Wilkins of the Analytical Sciences Division is 15.10 ± 0.14 years, this being in good agreement with the 14.91 ± 0.15 years obtained by Whitehead et al using the Am-241 growth rate method on 'new' Pu-241. There is still a discrepancy between these values and that obtained by Crouch of 14.2 ± 0.2 years for new material.

The progress report from the Fast Reactor Physics Division at Winfrith was given by Story. There were no comments on this work.

It was suggested that the response of the neutron spectrometer described in the report from the University of Birmingham could be checked using, for example, the Be(d,n) reaction together with time-of-flight and Campbell said he would bring this to the attention of the Birmingham group.

The N.P.L. progress report was summarised by Axton and there was no significant discussion.

Agenda Item 4 - Progress report on nuclear data for fusion reactors

The progress report on nuclear data for fusion reactors was presented as paper UKNDC(73)P.52 by Ferguson. Work done in the past had been mainly concerned with charged particle reactions but the emphasis had now switched to fast neutron reactions and facilities for making measurements are being set up.

Agenda Item 5 - Report of the Chemical Nuclear Data Committee

This report, by Cuninghame, dealt with events leading up to and stemming from a meeting of the Chemical Nuclear Data Committee on 2nd May. The continual fall in the numbers of those working on chemical nuclear data was causing considerable anxiety in the CNDC but there appeared to be some signs that those who required the data were becoming aware of the problem.

Contact has been established between various members of the CNDC and the people responsible for the bulk of the chemical nuclear data work in Europe. By keeping in close contact, results should become available more quickly and eventually this might lead to some co-ordination of the work. Mr. Story suggested that this was a case where a newsletter might be useful.

Agenda Item 6 - The Nuclear Data Forum

LYNN

The location of the Forum having been settled (see page 3), Lynn was asked to contact Goddard at Imperial College to fix the date (suggested for 6th December) and to arrange the programme. Among the suggested topics were spectrum measurements, integral techniques, the uses of track detectors, a report on the IAEA panel meeting on fission product nuclear data to be held in Bologna and resonance parameter data for U-235 and Pu-239. This last item would be suitable for any material which was being prepared for an EACRP sponsored meeting on this topic in late 1973.

Agenda Item 7 - Report on the International Symposium on Inter-communication between users, compilers and evaluators of nuclear data for applications in science and technology

A summary of the IAEA symposium on the application of nuclear data in science and technology, held in Paris in March, was given by Dr. Ferguson. The aim was to bring together compilers of nuclear data and the widest possible cross-section of users from diverse fields. The papers from users were expected to bring out the nuclear data needs in their respective fields and the shortcomings of currently available compilations.

Although there was a bias against papers from the reactor field, this still formed a major contribution. The papers from the users were grouped as follows:-

Reactor	12
Activation analysis	13
Space and advanced technology	8
Safeguards	4
Life sciences	5
Fusion	3
Miscellaneous	7

and those from evaluators were

Evaluated nuclear data files	7
Data centres	4
General compilations	4
Special user oriented compilations	5

Mr. Crouch has compiled a list of all the papers at the meeting together with some comments. It was clear from the users' presentations that the papers represented more the degree of current awareness of needs in those fields rather than a serious assessment of the relative demands of these areas.

With regard to compilations of decay schemes and level schemes, there is evidently a considerable duplication of effort which clearly leaves room for international collaboration. Several speakers pointed to the consequences which have resulted from failure to agree on international formats in the neutron data field and expressed the hope that this would be avoided in the decay scheme data field. A number of excellent specialised data compilations were described, such as those of Dillman, where nuclear data is combined with radio-biological data to give the information required by practitioners in the medical area. The charged particle compilations of Munzell were very complete although highly dependent on calculations.

The symposium was well attended and included a number of very influential

people who participated strongly in the discussions. The meeting was judged to have been a success and it was very clear that there is no single solution which will satisfy everyone. Schemes must be devised to persuade possible users to come forward with their requests and the data that already exist or could be made available should be made known. The Paris meeting should be followed up with discussions with the appropriate communities in this country so that the U.K. requirements can be established.

Following the symposium, there was a meeting between members of the INDC and the International Working Group on Nuclear Structure and Reaction Data at which it was agreed that INDC should widen its scope to include a broader spectrum of data needs. The INDC will form application oriented sub-committees, charged with the responsibility of reviewing in detail the needs for nuclear data in their application areas and to develop appropriate mechanisms for feedback of information.

The IAEA will convene a meeting of decay scheme compilation centres in early 1974 in an attempt to obtain international collaboration. The meeting will consider physical formats of nuclear structure and decay data as well as suitable international sub-divisions of evaluation work. The increasing interest of the U.S.S.R. in this field is illustrated by the fact that they have set up two new compilation centres.

Agenda Item 8 - Report on the CCDN Steering Committee meeting

A brief report of the most important discussions and decisions taken at the recent NEA Neutron Data Compilation Centre Committee meeting was presented as paper UKNDC(73)P.51 by Patrick.

Additional Items - Report on the EACRP meeting, etc.

At this point, Campbell gave a summary of the last EACRP meeting.

The IAEA Conference on nuclear data, proposed by the INDC for 1974, has been rejected by the IAEA and it is now being considered for 1975. There is a complication because the big U.S. national conference on nuclear data is due to be held in 1975 and if these were to be combined and held in the U.S.A. it would probably greatly reduce European participation, while if both meetings were held, with the IAEA meeting held in Europe, the U.S. participation would be much reduced because of two similar meetings in the same year.

Agenda Item 9 - The future scope, structure and outlook of the EANDC

Mr. Story introduced paper UKNDC(73)P.48 which arose from discussions at the last meeting of the European American Nuclear Data Committee (EANDC) and which dealt with proposals for the future scope, structure and outlook of the EANDC. That committee feels that, while there will be a continuing interest in fission reactor data, there is also a growing interest in measured and evaluated nuclear data in a wider applied context. Although these new application areas are within the committee's terms of reference, some members felt that changes to the structure may be required to meet the new needs. To begin with, there may be a need for some broadening in scope and outlook of the national and regional nuclear data committees. The committee structure in the U.S. has recently been reorganised and a new committee, the U.S. Nuclear Data Committee (USNDC) has been formed in place of the Nuclear Data Cross Section Advisory Committee (NCSAC). The USNDC consists of regular members, ex-officio members and a number of sub-committees, dealing with a wide range of nuclear data, and whose chairmen are members of the main committee. (The proposed change in the structure of the UKNDC was discussed under agenda item 10).

The EANDC thought that its members would obtain a better understanding of the methods of operation of the local and regional data committees if copies of their minutes (suitably edited) were sent to the EANDC members and the U.S. has already provided reports from two of their meetings. It was agreed that
PATRICK edited minutes from UKNDC meetings would be distributed following the next few meetings, after which the EANDC will be asked to review the usefulness of such documents.

The size of the world request list WRENDA has meant that it is now too large to form the basis for general discussion by the EANDC, and that committee needs a new basis for discussion of the known data requirements. The EANDC suggested that the local data committees be asked to produce an annual list of the main outstanding discrepancies and the UKNDC agreed that this would be very useful and
ROWLANDS Rowlands would be responsible for its production.

There was some discussion on the methods by which the EANDC should expand its interests and the following consensus emerged. The EANDC is a very useful committee and it is of prime importance that none of its usefulness is lost. Considerable thought and caution should be exercised before any changes are made and any new structure should be designed to be responsive to change. The expansion should not be rushed but rather it should evolve from needs identified in new areas by local data committees. Rather than construct a committee containing experts in all new areas, specialist meetings should be sponsored thus helping to indicate the users' requirements.

Agenda Item 10 - Proposed change in the structure of UKNDC

The Chairman introduced his proposals, contained in paper UKNDC(73)P.50, for the restructuring of the UKNDC system. The general arguments for change have already been stated under agenda items 7, 8 and 9 where it is observed that the USNDC has been set up partly to foster the growing interests in nuclear data outside the fission reactor field and the INDC and EANDC are proposing to alter their structure to the same end. The Chairman felt that it would be sensible to re-organise the U.K. system so that new areas can be accommodated as they develop and he proposed a two-tier structure to meet these needs. The upper committee would exercise a co-ordinating role over the whole nuclear data programme and would be the formal communication link with international bodies in the nuclear data area. The lower committees would be sub-committees of the main committee and would be responsible for generating and stimulating the fulfilment of the data needs of each application area. It would be expected that a sub-committee dealing with the physics side of fission reactor data would be formed as well as one for the chemical nuclear data needs and it was hoped that the practice of cross-linking certain members between such committees would be retained. New areas which appear to be immediately outstanding are those concerned with fusion and biomedical aspects of nuclear data. It was pointed out that there are already existing bodies which deal with radiological data, notably the International Committee for Radiological Units and Measurements (ICRU) and the similar British committee (BCRU) and great care would need to be taken before entering the medical field. There was a suggestion that all sub-committees be chaired by users of data but the Chairman thought that as all the chairmen automatically sit on the main committee, the latter might become too diffuse a body with too little joint experience to work effectively. He felt that it would
ROSE be desirable to begin slowly and build up the structure gradually. Dr. Rose agreed to try to finalise the proposals before the next INDC meeting in October and to send the details to the EANDC.

Agenda Item 11 - Any other business

Dr. Patrick raised a point concerning the acquisition of separated isotopes

for experimental measurement purposes. He noted that only if the proposed measurement is shown to be aimed at satisfying a request in WRENDA, will the USAEC consider allowing separated isotope samples to be borrowed from Oak Ridge. A recent preprint from the photonuclear group at Saclay indicated that samples can be obtained from the USSR and Patrick asked if anyone knew about this. Mr. Cuninghame said that M. Finlan (Amersham) had details of USSR isotope
PATRICK supplies and Patrick agreed to contact him for fuller details.

Agenda Item 12 - Date of next meeting

The date of the Forum has now been fixed as Monday, 10th December, 1973 and this will be followed by the next committee meeting on Tuesday, 11th December 1973 in the Conference Room, Hangar 8, A.E.R.E., Harwell starting at 10 a.m.