International Atomic Energy Agency

INDC(NDS)-273
Distrib.: G

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Summary Report

of the First IAEA Research Co-ordination Meeting

on

"IMPROVEMENT OF MEASUREMENTS, THEORETICAL COMPUTATIONS AND EVALUATIONS OF NEUTRON INDUCED HELIUM PRODUCTION CROSS SECTIONS"

hosted by the Institute of Experimental Physics
of Kossuth Lajos University
at Debrecen, Hungary,
17-19 November 1992

Prepared
by

A.B. Pashchenko
IAEA Nuclear Data Section
Vienna, Austria

March 1993

Reproduced by the IAEA in Austria
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Abstract

The present Report contains the Summary of the First IAEA Research Co-ordination Meeting on "Improvement of Measurements, Theoretical Computations and Evaluations of Neutron Induced Helium Production Cross Sections", which was hosted by the Institute of Experimental Physics of Kossuth Lajos University (IEP) at Debrecen, Hungary and held from 17-19 November 1992. This RCM was organized by the IAEA Nuclear Data Section (NDS), with the cooperation and assistance of local organizers at the IEP. The papers which the participants prepared for and presented at the meeting will be published as an INDC report.

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Appendices

(1) Introduction

Fusion research programmes worldwide have made steady progress during the last decade. With the continuous progress toward break even deuterium-tritium (D-T) fusion facilities, more thoughts have recently been given to the materials, that can be used in future power-producing reactors, and related nuclear data needs. Presently, there are two major goals in fusion materials development that should be achieved simultaneously:

(1) The development of materials with maximum resistance to large fluences of fast neutrons with energies $\leqq$ 15 MeV.

(2) The development of so-called "low-activation" materials (LAMs) in which the neutron-induced activity is as low as possible.

Radiation damage of structural materials by fast ($\leqq$ 15 MeV) neutron interactions is expected to be a severe problem in future (D-T)-based fusion reactors. One of the main types of radiation damage is blistering and embrittlement of structural materials due to neutron-induced He gas production reactions and He pressure build-up in these materials; these reactions also lead to transmutations of the original structural material elements to different elements. Tests of the available He-gas production cross section measurements in neutron spectra typical for fusion reactors show large discrepancies for some of the structural materials considered for fusion reactors. Many of the available required He production cross sections used in transmutation computations are based on rough and simplified nuclear model calculations, and there is a general lack of reliable experimental data to test the reliability of these theoretical cross section data.

The Agency's Specialists Meeting on the Fusion Evaluated Nuclear Data Library (FENDL) held in Vienna in May 1989 recommended the incorporation into FENDL Version 1 cross-section data of 256 neutron nuclear reactions most important for fusion material activation. This list includes 52 He production cross sections. For 33 of them there are no experimental data available at all; for the other 19 reactions data of various authors differ from each other by more than the experimental errors.

The third and last Research Co-ordination Meeting (RCM) of the IAEA Co-ordinated Research Programme (CRP) on "Methods of Calculation of Fast Neutron Nuclear Data for Structural Materials of Fast and Fusion Reactors", held in Vienna in June 1990, concluded that the calculation of neutron reactions with complex particle emission such as (n, He production) reactions is still a serious problem, requiring further theoretical developments and testing and comparison with more accurate experimental data than presently available.

In the meantime, new experimental and theoretical efforts have been started or are planned in several countries, and the co-ordination of these efforts by the Agency appears to be very timely and desirable.

At its 18th Meeting in October 1990, the International Nuclar Data Committee (INDC) reviewed the need and status of the neutron-induced He production data for fusion reactor technology and endorsed the proposal of the Nuclear Data Section to start this new CRP on "Improvement of Measurements, Theoretical Computations and Evaluations of Neutron Induced Helium Production Cross-Sections" "to meet the increasing needs for the ITER team and other national and regional projects for fusion material studies with respect to radiation effects on components in fusion facilities and future reactors".

(2) Scope and Goals of the CRP

The International Atomic Energy Agency has established the Co-ordinated Research Programme on "Improvement of Measurements, Theoretical Computations and Evaluations of Neutron Induced Helium Production Cross Sections" with the goal to provide an improved base of neutron-induced He-production data to the International Thermonuclear Experimental Reactor (ITER) Project and other national and regional fusion reactor projects as required for the development of radiation-resitant and low-activation structural materials for fusion reactor technology (stainless steel constituents, Ti, V, Mn, Cu, Mo, Nb and others). To reach this goal will require the following three types of research activities:

(i) improvement of the theoretical models and their parameterization for the computation of (n,Xα) data;

(ii) extension of the base of experimental (n,Xα) data by precise measurements between reaction threshold (several MeV) and 15 MeV neutron energy; and

(iii) improvement of existing and production of new (n,Xα) data evaluations.

The major activities of the CRP will be performed by individual participants at their home institutes. Periodically (approximately every 18 months) the IAEA will convene CRP meetings, bringing together all participants to review the status of the activities of the CRP. Between meetings participants are encouraged to inform the IAEA of all relevant work on the subject and to send copies of all papers, progress reports, etc. to the IAEA which will be distributed to all participants. At least once a year each participant must submit a progress report to the IAEA.

The list of the CRP participants is given below as Appendix 1.

(3) Organization of the Meeting

The first Research Co-ordination Meeting of the CRP was organized by the IAEA Nuclear Data Section (NDS) with co-operation and assistance of local organizers from the Institute of Experimental Physics of the Kossuth Lajos University and held at the Institute of Nuclear Research of the Hungarian Academy of Science (ATOMKI) in Debrecen, Hungary, from 17 to 19 November 1992. The meeting agenda is given below as Appendix 2. The meeting was attended by 25 scientists (eight IAEA principal scientific investigators) from 10 Member States. Scientists working in the field from the Institute of Experimental Physics and ATOMKI as well as the IAEA fellows were also invited to participate in the meeting. A list of these attendees is given in Appendix 3.

(4) Meeting Proceedings

The Meeting was opened by Professor Dr. J. Csikai, Director of the Institute of Experimental Physics, and Dr. G. Bazsa, Deputy Rector of the Lajos Kossuth University. Then the IAEA Scientific Secretary for the meeting, after welcome address, briefly emphasized the scope and goals of the CRP and the objectives of the meeting.

The objectives of this first meeting were

- to review the theoretical models and their parameterization for the computation of (n,xα) data;
- to discuss the results of measurements obtained so far by participating institutes;
- to review the status and remaining gaps in the required data and, if necessary, identify further measurements and calculations needed to fill these gaps; and
- to develop a detailed work-plan for the Co-ordinated Research Programme.

Professor Dr. Julius Csikai was elected as Meeting Chairman.

At the first session of the Meeting (Participants' reports) each research agreement/contract holder presented an oral report on the research planned to be carried out under the framework and auspices of the CRP. At the next two sessions (Session 2. Review on theoretical models and Session 3. Review on (n,α) measurements and theoretical interpretations) the meeting participants and observers made presentations on their work currently being carried out under the CRP. Each presentation was followed by extensive and occasionally rather intensive discussions.

After these presentations and accompanying discussions, the Meeting participants split in two Working Groups for more detailed discussions and for the preparation of extended summary reports. The following Working Groups were formed:

I. Working Group on Computations and Evaluations (Chairman: Dr. C.Y. Fu).

II. Working Group on Experimental Measurements of (n,α) cross sections, energy and angular distributions. (Chairman: Dr. H. Vonach).

(5) Conclusions and Recommendations

The main objectives of the first CRP Meeting have been achieved to a large extent and as a result of the discussions, the next steps in the work programme under the CRP have been worked out.

The detailed conclusions and recommendations of the two working groups that were formed during the Meeting are presented in Appendices 4 and 5.

The Scientific Secretary of the meeting wishes to express his appreciation to Professor Dr. J. Csikai for acting as Chairman and to Professor Dr. H. Vonach and Dr. C.Y. Fu for drafting the summary of the conclusions and recommendations of the meeting.

(6) Future Meetings

The meeting participants recommended that to maximize the interactions between the data developers and users, the Second CRP Meeting be held from 3 to 6 May 1994 at Oak Ridge, Tennessee, U.S.A., in conjunction with the International Conference on Nuclear Data for Science and Technology. Dr. C.Y. Fu from the Oak Ridge National Laboratory, as the proposed host, has kindly agreed to assist the Agency in organizing the Second CRP Meeting.

APPENDIX 1

334-F4-RC-498

INTERNATIONAL ATOMIC ENERGY AGENCY

The First Research Co-ordination Meeting

on

"IMPROVEMENT OF MEASUREMENTS, THEORETICAL COMPUTATIONS AND EVALUATIONS OF NEUTRON INDUCED HELIUM PRODUCTION CROSS SECTIONS"

Institute of Experimental Physics, Kossuth Lajos University
Debrecen, Hungary

17 to 19 November 1992

LIST OF THE CRP PARTICIPANTS

1. Prof. Dr. H.K. Vonach
   Institut für Radiumforschung
   und Kernphysik
   Boltzmanngasse 3
   A-1090 Vienna
   AUSTRIA

   Fax: 346650-482

   Research Agreement No. 6876/CF
   "Measurement of (n,alpha) and total He-production Cross-sections".

2. Dr. ZHANG Jingshang
   Chinese Nuclear Data Center
   Institute of Atomic Energy
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   Research Contract No. 7048/RB
   "Improvement of Measurement, Theoretical Computations and Evaluations of Neutron-induced Helium Production Cross-sections".

ABPashchenko/mw x1708
#5998N,p.88-90

3. Dr. R. Capote Noy
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Research Contract No. 7049/RB
"Calculations of Neutron-induced Helium Production Cross Sections and Emission Spectra using Preequilibrium and Direct Reaction Model".

4. Dr. Cs.M. Buczkó
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HUNGARY

Fax: 0036-52-16181 or: 0036-52-14050

Research Contract No. 6971/RB
"Measurements and Computations of (n,xalpha) Cross-sections".

5. Dr. S. Chiba
Nuclear Data Center
Japan Atomic Energy
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Tokai-mura, Naka-gun
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Fax: 335806107

Research Agreement No. 7050/CF
"Measurement of Double-differential (n,xalpha) Reaction Cross Sections of Structural Materials in the Energy Region of 8 to 13 MeV".

6. Dr. N.V. Kornilov
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Ploschad Bondarenko
249 020 Obninsk, Kaluga Region
THE RUSSIAN FEDERATION

Fax: 095-2302326

Research Agreement No. 6877/CF
"Investigation of the Mechanism of (n,alpha) Emission by Exited Nuclei".

7. Dr. A.V. Zelenetskij
Head of Scientific Group
Institute of Atomic Energetics
249 020 Obninsk, Kaluga Region
THE RUSSIAN FEDERATION

Fax: 095-255-2225

Research Agreement No. 7128/CF
"Theoretical Computations and Evaluations of Neutron Induced Helium Production Cross-sections".

8. Dr. Chia-Yao FU
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37830
U.S.A.

Fax: 6155767926

Research Agreement No. 7051/CF
"Resolving the Calculational Differences among the ENDF/B-VI, EFF-2, and JENDL-3 Evaluations for the (n,alpha) Cross Sections of Cr, Fe, and Ni Isotopes".

APPENDIX 2

PROPOSED AGENDA

Tuesday, 17 November

09.30	Opening of the RCM Host
	Opening Remarks Scope and Objectives of the CRP A.B. Pashchenko (IAEA)
	Election of the Chairman Adoption of the Agenda
10.00	Session 1 Participants' reports (Each research agreement/contract holder shall present an oral report on the research currently being carried out under the framework and auspices of the CRP.)
11.00	Coffee break
11.20	Session 1. (cont.)
12.30	Lunch break
14.00	Session 2. Review on the theoretical models
	Presentation by Dr. Chia-Yao FU, "Resolving the Calculational Differences among the ENDF/B-VI, EFF-2, and JENDL-3 Evaluations for the (n,α) Cross Sections of Cr, Fe, and Ni Isotopes"
	Presentation by Dr. Zhang Jingshang, "A theoretical Method for Calculating Double Differential Cross Sections of Alpha Particle Emission"
	Presentation by Dr. V. Avrigeanu: "Calculations of excitation functions of (n,α) reactions"
15.40	Coffee break

16.00 Session 2 (cont.)

Presentation by Dr. A. V. Zelenetskij:
"Systematical analysis of (n,α) reaction cross sections for 14 MeV neutrons.

Presentation by Dr. R. Capote Noy:
"Calculations of Neutron-induced Helium Production Cross Sections and Emission Spectra using Preequilibrium and Direct Reaction Model"

Wednesday, 18 November

09.00 Session 3.
Review on (n,xα) measurements and theoretical interpretations

Presentation by Dr. N.V. Kornilov:
"The problems of experimental investigation and theoretical interpretation of the cross section fine structure"

Presentation by Prof. Dr. H.K. Vonach,
"Measurement of (n,α) and total He-production Cross-sections"

Presentation by Dr. A. A. Goverdovskij:
"Multidimensional measurements of alpha-particles from neutron induced reactions"

11.00 Coffee break

11.30 Presentation by Dr. Satoshi Chiba:
"Measurement of double-differential (n,xα) reaction cross sections of structural materials in the energy region of 8 to 13 MeV"

Presentation by Dr. S. Hlaváč:
"Cross Section measurements of $^{16}O(n,\alpha\gamma)$ reaction"

12.30	Lunch break
14.00	Session 3 (cont.)
	Presentation by Prof. Dr. J. Csikai: "Some results on the determinations of helium production cross sections in Debrecen"
	Presentation by Dr. F. Cserpák: "Measurements and calculations of excitation functions of (n,α) reactions on Cu isotopes"
15.20	Coffee break
15.40	Session 4. General discussion on the future scope of the CRP. Organization of working group to draft the report of the RCM. Drafting of Meeting Conclusions.

Thursday, 19 November

09.00	Completion of the RCM Working Group Report. Visit to the laboratories and facilities of the Institute of Experimental Physics and the Institute of Nuclear Research.
12.30	Lunch break
14.00	FINAL CONSIDERATIONS Discussion of Conclusions and Recommendations. Drafting of the RCM Conclusions and Recommendations. Corrections and Adoption of the Final Report. Adoption of Schedule for Work and Future Meetings. Closing of the RCM.

APPENDIX 3

IAEA Research Co-Ordination Meeting on
"Improvement of Measurements, Theoretical Computations and Evaluations of Neutron Induced Helium Production Cross Sections"

Debrecen, Hungary
17 to 19 November 1992

LIST OF ATTENDEES

AUSTRIA	Prof. Dr. H. K. Vonach
CHINA	Dr. Zhang Jingshang
CUBA	Dr. R. Capote Noy
THE CZECH AND SLOVAK FEDERAL REPUBLIC	Dr. S. Hlaváč
HUNGARY	Dr. Cs. M. Buczkó Dr. F. Cserpák Prof. Dr. J. Csikai
JAPAN	Dr. S. Chiba
ROMANIA	Dr. V. Avrigeanu
THE RUSSIAN FEDERATION	Dr. A.A. Goverdovskij Dr. N.V. Kornilov Dr. A.V. Zelenetskij
U.S.A.	Dr. Fu Chia-Yao
IAEA Staff Member	Dr. A.B. Pashchenko

Observers: Dr. S. Nagy
Dr. P. Raics
Á. Grallert
Dr. S. Szegedi
Dr. G. Pető
Dr. S. Sudár
Dr. J. Szabó
Dr. T. Sztaricskai

Mr. A.M. Abdelbagi
Ms. Gedrab Karima
Mr. S. Ibrahim
} IAEA fellows

Report of Working Group on Computations and Evaluations

Participants: A. B. Pashchenko
C.Y. Fu (Chairman)
J. Zhang
R. Capote Noy
V. Avrigeanu
A.V. Zelenetskij

A summary of the present meeting is written by A. B. Pashchenko. This working group discussed the future scope of the CRP.

Fu has resolved, to a large extent, the calculational differences among the ENDF/B-VI, EFF-2, and JENDL-3 Evaluations for the ^{58}Ni(n,α) cross sections. The major reason behind the differences is that level densities used for ^{58}Ni, ^{58}Co and ^{55}Fe are wildly different.

To see which set of level density parameters (including Avrigeanu's) is closest to be true, he plans to

1. Deduce from existing resonance parameters of ^{55}Fe the Fermi-gas parameter "a" and the spin cutoff parameter "σ^2".
2. Evaluate ^{58}Ni(n,n'), (n,p) and (n,α) cross sections from experimental data, and
3. Using ^{55}Fe "a" and "σ^2" from step 1 and evaluated cross sections from step 2, re-calculate with TNG.

The new level densities will likely be the most reliable under the present conditions. Fu will also perform similar work for ^{52}Cr and ^{56}Fe.

Capote, as a check to Fu's work, will calculate level densities and spin cutoff parameters for ^{58}Ni, ^{58}Co, and ^{55}Fe using combinatorial method with shell-model states. He will add angular momentum conservation to this pre-equilibrium model code PCROSS. He will work with Zelenetskij to make a review on the direct reaction contribution to ^{58}Ni(n,α).

Zelenetskij plans to calculate, using super-fluid model, the level densities of ^{57,58,59}Ni, ^{57,58}Co, and ^{54,55}Fe, the residual nuclides of 7 reactions for ^{58}Ni. He will investigate the discrepancies between theory and experiments for ^{90,94}Zr(n,α) cross sections.

The results will be compared with Gilbert-Cameron and BSFG models. He will also determine the best possible alpha-particle optical model parameters for the Cr, Fe, and Ni isotopes using carefully evaluated (n,α) data for the neighboring nuclides and a consistent set of level densities. Capote and Zelenetskij will send their calculated level densities for ^{58}Ni, ^{58}Co and ^{55}Fe to Fu for comparison.

Zhang will release his new UNF code for calculating double differential cross sections, in particular for (n,α), to public use through IAEA Nuclear Data Section. He will welcome comments from the users. He also plans to add particle-hole dependent pairing corrections and the two-gas pre-equilibrium model to UNF.

Avrigeanu, though not a member of the CRP, has been helpful to the working group and was asked to report his recent work and future plans. He has successfully applied modified McFadden-Satchler potential to the calculations of (n,α) cross sections of ^{51}V, ^{55}Mn and ^{59}Co. He plans to check the applicability of this potential and that of Nolte to the ^{48,50}Ti ^{52}Cr, ^{54,56}Fe and ^{62}Ni(n,α) cross sections, in cooperation with Prof. P.E. Hodgson. He also likes to investigate possible improvements of the pre-equilibrium model in terms of shell correction to p-h state densities, the two-gas formulation, the pre-formation factor and single-particle state density for alpha particles, as well as the Iwamoto-Harada pick-up model, in cooperation with the Debrecen group of Prof. J. Csikai.

The CRP has been informed on the present attempt within the Oxford University to construct an alpha-nucleus optical-model potential expected to reproduce the data at negative energies as well as elastic scattering over a wide energy range (18-166 MeV).

In conclusion, members of the working group discussed serious subjects pleasantly and will communicate with one another. The work plans appear well-coordinated. Each member can contribute to and benefit from this CRP.

Working Group on Experimental Measurements of (n,α) cross sections energy and angular distributions

Chairman H.Vonach

Working Group members: Cs.M. Buczkó
S. Hlaváč
F. Cserpák
S. Chiba
A.A. Goverdovskij
N.V. Kornilov
J. Csikai

Conclusions and Recommendations

1./ Results reported at this CRP meeting

A considerable part of the (n,α) data needed for applications has already been obtained by the work reported at this meeting (as either completed or in progress).

This has been possible both by the use of several new experimental setups for study of double differential charged-particle emission cross-sections and by the careful application of existing techniques such as activation measurements and study of prompt γ-radiation to the measurement of (n,α) cross-sections.

Three new setups have been reported for measuring double differential α-emission cross-sections and successfully applied to the study of the structural materials.

a) The multi-telescope system at the WNR-facility at the Los Alamos National Laboratory for study of (n,α) reactions up to 25 MeV.

b) The gridded ionisation chamber system at the JAERI tandem accelerator (JAERI/Tohoku University collaboration).

c) The gridded ionisation chamber system for high resolution studies at Obninsk accelerator.

Using these new systems important results have been obtained on the double-differential α-emission cross-sections of both ^{56}Fe, nat Fe (Los Alamos and JAERI) and natural nickel (JAERI and Obninsk). In iron existing (n,α) data non look reasonably consistent but will have to be compared in detail before they can be considered satisfactory.

In addition to the direct observation of α-particles important progress on (n,α) cross-sections was obtained by activation measurements at Debrecen and the study of the prompt γ-radiation in (n,α) reaction at Bratislava. Using the activation method the ^{65}Cu(n,α) cross-sections was determined over the whole range from threshold to 14 MeV, a number of (n,α) cross-sections for isotopes of structural materials were measured in the 14 MeV region and additional (n,α) measurement were done in the A $\approx$ 100 mass region.
The especially important cross-sections for ^{16}O(n,α_2-α_3) which is very difficult to measure by conventional methods was accurately determined by the measurement of the γ-rays of the ^{13}C levels populated in this reaction.

2./ Recommendations on the future work within the CRP

In order to meet the demands of fusion reactor development and other application e.g. nuclear medicine it is recommended the future work in the following areas:

a) Structural materials: For these materials cross-sections, energy and angular distributions are needed for the main isotopes of Cr, Fe and Ni from threshold to 14-MeV and at least excitations functions for the remaining isotopes of these elements and also the elements V, Mn, and Co. In order to achieve these goals the following work is necessary.

1) Completion of the reported experiments as Fe and Ni, detailed comparison of data and further measurements if needed to clarify discrepancies. A close cooperation between JAERI, IRK and IPPE is recommended.

2) New measurements and the double-differential α emission cross-sections of ^{52}Cr from threshold to 14 MeV. All participants are asked to investigate the possibilities for obtaining suitable targets.

3) Activation measurements for (n,α) cross-sections especially for $^{55}Mn(n,\alpha)$ from threshold to 14 MeV and for $^{63}Cu(n,\alpha)$ and $^{58}Ni(n,\alpha)^{55}Fe$ in the "gap" between 9 and 14 MeV.

b) Light elements:
For a number of applications (fusion, nuclear medicine, detector efficiency calculation) further data on the $^{12}C(n,x\alpha)$ and $^{16}O(n,x\alpha)$ reactions are needed from threshold to ~ 100 MeV. Such studies should be performed both by direct observation of α-particles and extension of the (n,$\alpha\gamma$) measurements presented by S. Hlaváč.

c) Activation cross-section measurements covering a wide mass-range.
In order to check and improve our methods for calculation of (n,α) cross-sections a number of new reliable measurements of excitation function for such reactions covering the whole mass region from light nuclei to the Pb-region should be performed using enriched isotopes when necessary.

d) Production of long-lived isotopes in (n,α) reactions. A number of (n,α) reactions lead to production of very long-lived radioactive nuclides, which may be important for assessment of the radioactive waste problems in fusion reactors. Therefore these cross-sections should be measured with high priority.
Due to the low activities obtainable activation measurements will be applicable only for a few of these reaction and other methods such as

accelerator mass spectroscopy, radiochemical separation techniques and study of the prompt γ-radiation will also have to be used. Specifically the reactions

$^{13}C(n,\alpha)^{10}Be$, $^{17}O(n,\alpha)^{14}C$, $^{18}O(n,n'\alpha)^{14}C$, $^{39}K(n,\alpha)^{36}Cl$,

$^{96}Mo(n,\alpha)^{93}Zr$, $^{66}Zn(n,\alpha)^{63}Ni$ should be investigated.

e) Study of (n,α) reactions above 14 MeV

In Japan the construction of a material test facility for fusion is planned which may involve neutrons up to 50 MeV. In addition in connection with the plans for accelerators for transmutation of nuclear waste nuclear data including (n,α) reactions are needed up to very high energies (~ 1 GeV). Thus it seems appropriate to start some work on high-energy (n,α) reactions. For this purpose it is recommended to continue and extend the ongoing measuring program of the Los Alamos - IRK collaboration at WNR on the study of $(n,x\gamma)$ reactions.

3./ Recommendations concerning the reporting of results and communication within the CRP

a) In order to facilitate the comparison of results within the CRP and with the literature it is recommended that both double-differential α-emission cross-sections and angle-integrated energy-differential α-production cross-sections be reported in the C.M. system (channel energies).

In addition it is requested that the energy spread of used neutron beam and the uncertainty of the average energy be reported in addition to the nominal (average) neutron energy.

b) In order to prepare for the next meeting monitors should be determined for the most important reactions. These monitors should obtain all data about their reactions from the participants sometime before the next meeting and give a status report their reactions at the next meeting.

The following suggestion is made for this purpose:

1) ^{58}Ni and nat Ni:	S. Chiba
2) ^{56}Fe and nat Fe:	H. Vonach
3) ^{16}O	S. Hlavac
4) Activation cross sections:	J. Csikai
5) ^{52}Cr and nat Cr:	N.V. Kornilov

c) Between meetings, participants are encouraged to inform the IAEA of all relevant work on the subject and to send copies of all papers, progress reports, etc., to the IAEA, which will be distributed to all participants.

4./ The RCM has recommended to invite Dr.R.C. Haight from Los-Alamos to join the Co-ordinated Research Programme.