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**INTERNATIONAL NUCLEAR DATA COMMITTEE**

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**ESTABLISHMENT OF AN INTERNATIONAL REFERENCE  
DATA LIBRARY OF NUCLEAR ACTIVATION CROSS SECTIONS**

Summary Report of the First Research Co-ordination Meeting organized  
by the International Atomic Energy Agency in co-operation with the  
Institute of Experimental Physics and held in Debrecen, Hungary,  
from 4 to 7 October 1994

Prepared by  
A.B. Pashchenko  
IAEA Nuclear Data Section

February 1995

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



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## **ABSTRACT**

The report contains the Summary of the First IAEA Research Co-ordination Meeting (RCM) of the new Co-ordinated Research Programme (CRP) on "Establishment of an International Reference Data Library of Nuclear Activation Cross Sections". The meeting was organized by the IAEA Nuclear Data Section with co-operation and assistance of local organizers from the Institute of Experimental Physics and held in Debrecen, Hungary, from 4 to 7 October 1994.

The purpose of the RCM was to discuss the scope and goals of the CRP, to report and evaluate the first results of the research carried out by each participating laboratory, to review the current tasks, identify further actions of participants and agree on the coordination of work under this CRP.

The detailed agenda, the list of participants, conclusions and recommendations of the meeting are presented in the summary report.



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1<sup>st</sup> Research Co-ordination Meeting of the Agency's CRP on

**"Establishment of an International Reference Data Library of  
Nuclear Activation Cross Sections"  
Debrecen, 4 to 7 October 1994**

**(1) Introduction**

In accordance with the proposal from the IAEA Nuclear Data Section and with endorsement by the International Nuclear Data Committee (INDC), an advisory body for the nuclear data programme of the IAEA, the Agency initiated a new Co-ordinated Research Programme (CRP) on "Establishment of an International Reference Data Library of Nuclear Activation Cross Sections". It was agreed that the goal of the CRP is to provide a universal database of neutron and charged particle activation cross sections and related decay data for nuclear and fusion technology and for environmental protection and the estimate of potential radiation hazards connected with any kind of nuclear installation and technique. More details are given in the attached information sheet. The need for such a reference library was noted in the Medium Term Plan for the Nuclear Data Section activity after 1992 [A.J. Deruytter, Minutes of the 18th INDC Meeting, Vienna, 15-19 October 1990, document INDC/P(91)-1, p. 77].

**(2) Objectives of the Meeting**

The purpose of the Research Co-ordination Meeting (RCM) was to discuss the scope and goals of the CRP, to report and evaluate the first results of the research carried out by each participating laboratory, to review the current tasks, identify further actions of participants and agree on the coordination of work under this CRP.

**(3) Organization of the Meeting**

The first Research Co-ordination Meeting of the CRP was organized by the IAEA Nuclear Data Section with the co-operation and assistance of local organizers from the Institute of Experimental Physics of the Kossuth Lajos University and held in Debrecen, Hungary, from 4 to 7 October 1994.

The RCM was attended by eight chief scientific investigators involved and by four observers. The CRP members were: Yu Baosheng (China), J. Csikai (Hungary), J. Kopecky (Netherlands), Y. Ikeda (Japan), A.V. Ignatyuk, O.T. Grudzevich (both from Russia), J.M. Perlado (Spain) and R.A. Forrest (UK). S. Qaim (Germany), F. Tárkányi (Hungary), V. Avrigeanu (Romania) and K.I. Zolotarev (Russia) participated as observers. The complete list of participants and their affiliations are given in Attachment 3.

#### (4) Meeting Proceedings and Results

The meeting was opened by J. Csikai, Director of the Institute of Experimental Physics, Debrecen. After the welcome by A.B. Pashchenko on behalf of the Agency, R.A. Forrest from UKAEA Fusion, Culham, UK, was selected to be the Chairman of the meeting.

The agenda of the RCM included scientific and technical presentations of participants, discussion and revision of the CRP scope, and discussion on the future tasks and coordinated actions of participating laboratories.

The discussions were guided by the following order:

- opening session
- participants' reports
- activation data libraries
- review of theoretical models, evaluations and measurements
- validation of data libraries
- general discussion on the future scope of the CRP
- conclusions and recommendations
- final considerations.

The agenda is given as Attachment 2, the complete list of documents distributed at the meeting as Appendix 4.

The above topics were discussed to some extent during the meeting and the full text of the meetings' conclusions and recommendations is given as Attachment 1. The related actions of the participants are included in the recommendations. The following main comments are drawn from notes and the discussion more or less in order in which they arose:

- (a) Following discussions on the revised scope of the CRP, it was agreed that the primary objective of the CRP is the production of an activation library for **selected** neutron and charged particle induced reactions that is tested and validated. **The library should be suitable for a range of applications and should not be restricted to fusion applications** as is the case with the FENDL activation library. **The reference library should not cover all possible reactions but rather concentrate on a limited number (to be decided) of very important reactions.** Initially the energy range should be restricted to 20 MeV.
- (b) As a result of the preliminary discussion it was noted that the CRP should also address how new experimental measurements could improve the reference activation library.

- (c) It was agreed that the range of applications that should be covered by the reference library include:
- Magnetic and inertial fusion with emphasis on safety, environmental and material applications and also for plasma diagnostics
  - Fission reactors, especially for decommissioning applications
  - Isotope production by accelerators for medical applications
  - Neutron dosimetry
  - Geophysical and astrophysical applications.
- (d) The procedure for the production of the starter file of **neutron induced** reaction data was agreed.
- (e) The procedure for the production of the starter file of **charged particle induced** reaction data was agreed.
- (f) The procedure for validation and testing of the starter files was discussed and agreed.

After the reports of participants were presented and discussed, the Chairman, R.A. Forrest, organized three working groups to discuss assigned issues and prepare draft conclusions and recommendations and planned actions. The groups with their chairmen were as follows:

- Activation Libraries (Chairman: A.V. Ignatyuk)
- Experimental Measurements (Chairman: J. Csikai)
- Validation and Testing (Chairman: Y. Ikeda)

All participants were asked to carry on sequential discussions for the following 1½ days with one summary report of conclusions and recommendations to the entire meeting before a draft document was presented for final consideration.

## (5) Future Meetings

In conclusion, the meeting participants unanimously approved to consider the results of the CRP at the second RCM which is recommended to be held in the Instituto de Fusion Nuclear, Universidad Politecnica de Madrid, Madrid, Spain, in May 1996.

## (6) Acknowledgements

The RCM had full and efficient support of the local organizers. The meeting participants wish to thank the Institute of Experimental Physics for the warm hospitality and Professor Csikai for the efficient organization of the meeting.



## CONCLUSIONS AND RECOMMENDATIONS

### **RCM on Establishment of an International Reference Data Library of Nuclear Activation Cross Sections**

Chairman: R.A. Forrest

#### **(1) Revised scope of CRP**

The primary objective of the CRP is the production of an activation library for selected neutron and charged particle induced reactions that is tested and validated.

The need for such a reference library was noted in the Medium Term programme for the Nuclear Data Section activity for 1992-1996 [see document INDC/P(91)-1]. The library should be suitable for a range of applications and should not be restricted to fusion applications as is the case with the FENDL activation library. The reference data library should not cover all possible reactions but rather concentrate on a limited number (to be decided) of very important reactions. Initially the energy range should be restricted to 20 MeV. At this stage there is no need for a new decay data library; the existing libraries from the general purpose files or the FENDL decay data library should be used in activation applications. It is noted however that the existing decay data libraries that are used in conjunction with the regional activation libraries contain many differences and discrepancies, and that more work is required to identify and correct these discrepancies.

As a result of preliminary discussions it was noted that the CPR should also address how new experimental measurements could improve the reference activation library.

The range of applications that should be covered by the reference library include:

- Magnetic and inertial fusion with emphasis on safety, environmental and material applications and also for plasma diagnostics
- Fission reactors, especially for decommissioning applications
- Isotope production by accelerators for medical applications
- Neutron dosimetry
- Geophysical and astrophysical applications

The **neutron induced** reaction data library will be produced by the following procedures:

(a) Compile a master list of important reactions based on:

- The list of reactions important for magnetic fusion [EAF-Doc-004 and Perlado]
- The list of reactions important for diagnostics in fusion plasmas (14-20 MeV) [Forrest and Perlado]
- The list of reactions important for inertial fusion [Perlado]
- The list of reactions important for fission reactors [JAERI report and Ignatyuk]
- The list of reactions important for neutron dosimetry [IRDF] and D-D diagnostics (0-6 MeV) [Csikai]
- The list of reactions important for geophysical applications [IAEA TEC-DOC-357 and Csikai]
- The list of reactions for astrophysics applications [Qaim]

The various lists will be supplied to the NDS by the end of November 1994 by the named people and these will be passed to Forrest who will compile the master list by the end of December 1994. NDS will distribute this list to all participants who will indicate which reactions should be included in the reference library and reply to NDS by the end of March 1995. NDS will collate the replies, choose the reactions required and produce plots of experimental data, available evaluations and calculations and distribute to the participants by the end of June 1995. Such work will be performed by Baguer Perez and Grudzevich under the supervision of Pashchenko. **N.B.** all supplied data should be in the pointwise format used for the FENDL activation file.

(b) Make a selection of evaluations that should be included in the reference library using the following procedure:

- Participants will send choice of evaluations and candidates for new measurements and calculations to NDS by end of September 1995. Based on these choices participants will plan their work programmes and make whatever contributions are possible.
- The IAEA NDS would welcome any other contributions from groups outside the CRP. Any such additional data could be included in the reference library if it were suitable.

- (c) It was agreed that a full covariance description of uncertainty data is needed only for a small number of (dosimetry) reactions. Any uncertainty data supplied by the candidate evaluations will be used in the starter file, but this may be improved as a result of work in the CRP.

The **charged particle induced** reaction data library will be produced by the following procedure:

- (a) The range of charged particle data is very large and this CRP should not consider high energy transmutation or complete data libraries. It should deal with a very restricted set of reactions induced by protons, deuterons,  $^3\text{He}$  and  $\alpha$ -particles of energy up to 40 MeV, of the most commonly used medical radioisotopes (e.g.  $^{11}\text{C}$ ,  $^{18}\text{F}$ ,  $^{123}\text{I}$ ,  $^{201}\text{Tl}$  etc.) and for the monitoring of charged particle beams. To cover this area of work it will be necessary to enlarge the membership of the CRP. It was agreed to ask Dr. Tárkányi (ATOMKI Debrecen) to submit a proposal to the IAEA.
- (b) The list of relevant charged particle induced reactions will be produced by Tárkányi and Qaim, and plots of available experimental data for the various reactions will be produced by the end of June 1995.

### **Validation and testing of the starter file**

The starter library will require testing and validation. The following procedure will be used:

- Identify existing benchmarks for both fusion and fission that are available [Ikeda will supply information on existing fission studies]
- Consider the setting up of new benchmark studies *e.g.* at Jülich/Debrecen, for both neutrons and charged particles
- Encourage the possibility of using the new high intensity 14 MeV neutron sources for fusion benchmarks.

For all suitable and available benchmarks initiate comparison studies with the reference library and suggest changes to the starter file. Such feedback will be used to construct the next version of the reference library.

## **Recommendations of Working Group I - Activation Libraries**

Chairman: A.V. Ignatyuk

The latest versions of the national activation data libraries: ADL-3, JENDL/A and EAF-4 can be considered as a good basis for the preparation of the starter file of the reference activation data library.

### Recommendations:

- (1) Three libraries mentioned above with the latest corrections should be included into the intercomparison documentation that will be produced by Baguer Perez;
- (2) NDS will ask the Chinese Nuclear Data Center and the Los Alamos Laboratory about their possible contributions to the intercomparison of recommended cross section libraries;
- (3) The participation of any new evaluation prepared in accordance with the goals and schedule of the CRP is to be encouraged;
- (4) The reference activation data library will be assembled at the NDS under the supervision of Pashchenko in the FENDL/A pointwise format;
- (5) A format for the uncertainty file will be developed on the basis of the existing EAF uncertainty file. The details will be discussed at the next CRP Meeting.

## **Recommendations of Working Group II - Experimental Measurements**

Chairman: G.J. Csikai

Conclusions and recommendations are given below regarding the measurements of cross sections of neutron and charged particle induced reactions up to about 20 and 40 MeV incident energies respectively.

- (1) Lists of reactions measured at JAERI-FNS, KRI (St. Petersburg) and IEP (Debrecen) [see INDC(NDS)-301, 1994] will be completed for those reactions for which the data at present are unsatisfactory, to determine reliable and recommended standard reference data for the excitation functions.



- (2) A preliminary list of possible new measurements was discussed by the CRP participants, but it was agreed to defer identification of a final list until the next meeting. Csikai agreed to be responsible for compiling the list of reactions. Any contributions from outside of the CRP would also be welcomed.
- (3) In addition, needs for new measurements are also indicated in some recent reports [EAF-Doc-004 (1994); INDC(NDS)-302 (1994); RCM/DEBR 94/P-4 (1994)].
- (4) The improved D-D gas cell neutron sources including the precise determination of neutron spectra (energy of primary charged particle beam, activation unfolding method and direct detection of neutrons) makes it possible to complete the cross sections in the energy range between 9-13 MeV which can ensure a more reliable experimental data base for testing the model calculations and the evaluated data. Energy and fluence monitors for D-D plasma dosimetry are also required.
- (5) To complete the data base for monitoring the beam performance of charged particle beams and to solve the discrepancies in the existing data both for monitor and for production reactions it is necessary to perform some experimental work immediately.
- (6) It is recommended to organise information exchange with the NEANSC Working Group on the interlaboratory collaboration on activation cross section measurements. Pashchenko will be responsible for this action.

### **Recommendations of Working Group III - Validation and Testing**

Chairman: Y. Ikeda

In order to create a high quality library, data validation is essential. According to the results of the Working Group discussion, the following validation procedures are recommended:

- (1) The cross section data of all submitted libraries should be intercompared graphically with available experimental data at the beginning of the study.
- (2) The available experimental data should be identified for the benchmarks. The experimental benchmark data need to be compiled for the validation. (USDOE/JAERI data are identified as the starting benchmark for fusion reactor applications.)
- (3) The CRP participants should take responsibility for providing the benchmark calculations with the different libraries. If there are any serious discrepancies between the experiments and evaluations then the sources should be investigated. Criteria for judging between candidates need to be discussed in the future.

- (4) Efforts to produce new benchmark experimental data are recommended to fill the weaknesses of the existing data. The Working Group strongly recommends the validation for  $(n, \gamma)$  reactions with low energy neutron spectra, *e.g.* fission reactor and  $^{252}\text{Cf}$  spectra. New benchmark studies are planned at Jülich/Debrecen based on D+Be and D-D reactions (up to  $E_d = 13$  MeV) for neutrons and integral yield measurements up to 40 MeV for production of medical isotopes using p, d,  $\alpha$ ,  $^3\text{He}$  beams. Beside the existing USDOE/JAERI data it is recommended to pursue new integral experiments with high intense D-T neutron generators for reactions which produce long-lived radioactivity.
- (5) It was agreed that the benchmarks require the following information:
  - (i) Neutron spectrum,
  - (ii) Absolute flux,
  - (iii) Material specification with impurity compositions,
  - (iv) Irradiation time, cooling time and counting time,
  - (v) Irradiation history,
  - (vi) Radioactivity at defined times in a defined unit (*e.g.* Bq/kg),
  - (vii) Gamma-ray spectrum.
- (6) A library of validation benchmarks suitable for activation libraries should be assembled. Ikeda will coordinate the collection of such benchmarks which will be made available through the NDS.

IAEA Research Co-ordination Meeting on

**"Establishment of an International Reference Data Library of  
Nuclear Activation Cross Sections"**

Debrecen, 4 to 7 October 1994

**Agenda**

Tuesday, 4 October

09:30 hrs

**Opening Session**

- Opening of the meeting

Host: Prof. Dr. J. Csikai  
IAEA: A.B. Pashchenko

- Election of Chairman
- Adoption of Agenda and Time Schedule
- Announcement of Organizational Matters
- Discussion of Scope and Objectives of the CRP

10:15 hrs

**Session I: 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 hrs

**Coffee Break**

11:15 hrs

**Session I (cont'd)**

- Discussions

12:30 hrs

**Lunch Break**

14:00 hrs            **Session II: Activation Data Libraries**

Presentation by J. Kopecky:  
*"Development of EAF Libraries at ECN, Petten"*

Presentation by Yu. Ikeda  
*"Status of the JENDL Activation File"*

15:30 hrs            **Coffee Break**

16:00 hrs            **Session II (cont'd)**

Presentation by A. Ignatyuk  
*"The ADL Project at IPPE, Obninsk"*

Presentation by Yu Baosheng  
*"Status of the CNDC Activation File"*

17:30 hrs            - Discussions

Wednesday, 5 October

09:00 hrs            **Session III - Review of the Theoretical Models, Evaluations  
and Measurements**

Presentation by J. Csikai  
*"Measured, Calculated and Evaluated Excitation Functions of  
 $^{58}\text{Ni}(n,p)^{58\text{m,g}}\text{Co}$  Reaction from 2 to 15 MeV"*

Presentation by O. Grudzevich  
*"Method of Excitation Function Calculations for Reactions with  
Isomer States"*

Presentation by V. Avrigeanu  
*"Calculation of Excitation Functions of Neutron Induced  
Reactions"*

Presentation by K. Zolotarev  
*"New Evaluations of Excitation Functions for some Important  
Reactions used for Fusion and Fission Reactor Dosimetry"*

- 11:00 hrs            **Coffee Break**
- 11:30 hrs            **Session IV - Validation of Data Libraries**
- Presentation by R. Forrest  
                          "*Comparison of USDOE/JAERI Experimental Data with Calculations using EASY 2*"
- Presentation by J.M. Perlado  
                          "*Blanket and Chamber Wall Activation Analysis in Internal Fusion Reactor KOYO*"
- 12:30 hrs            **Lunch Break**
- 14:00 hrs            **Session IV (cont'd)**
- Presentation by A. Ignatyuk  
                          "*Benchmark Validation of Activation Data Libraries*"
- Presentation by R. Forrest  
                          "*Development of EASY*"
- 15:30 hrs            **Coffee Break**
- 16:00 hrs            **Session V: General Discussion on the Future Scope of the CRP**
- Overview of current tasks
  - Coordination of work

Thursday, 6 October

- 09:00 hrs            **Session V (cont'd)**
- Actions and deadlines
  - Formation of Working Group to draft the conclusions and recommendations of the meeting

12:30 hrs            **Lunch Break**

14:00 hrs            **Session VI: Conclusions and Recommendations**

- Drafting of meeting conclusions and recommendations

Friday, 7 October

09:00 hrs            **Session VI (cont'd)**

- Completion of Working Group Report
- Visit to the laboratories and facilities of the Institute of Experimental Physics and the Institute of Nuclear Research

12:30 hrs            **Lunch Break**

14:00 hrs            **Session VII: Final Considerations**

- Discussion of Conclusions and Recommendations
- Corrections and Adoption of Final Reports
- Adoption of the schedule of Work and Future Meetings
- Closing of the RCM

1<sup>st</sup> Research Co-ordination Meeting of the Agency's CRP on  
**"Establishment of an International Reference Data Library of  
Nuclear Activation Cross Sections"**  
**Debrecen, 4 to 7 October 1994**

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Dr. A.B. Pashchenko  
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IAEA Research Co-ordination Meeting on  
**"Establishment of an International Reference Data Library of  
Nuclear Activation Cross Sections"**

Debrecen, 4 to 7 October 1994

**LIST OF DOCUMENTS DISTRIBUTED AT THE MEETING**

RCM/DEBR94/P-1	Tentative Agenda and List of Presentations
RCM/DEBR94/P-2	List of Participants
RCM/DEBR94/P-3	Information Sheet
RCM/DEBR94/P-4	"A Survey of Selected Neutron-Activation Reactions with Short-Lived Products of Importance to Fusion Reactor Technology" by Robert C. Ward, Itacil C. Gomes and Donald L. Smith
RCM/DEBR94/P-5	"Status of Neutron Activation Cross Section Data for Production of Long-Lived Radionuclides important for Waste Disposal" by N. Baguer Perez, E.T. Cheng, A.B. Pashchenko and H.K. Vonach
RCM/DEBR94/P-6	"List of Neutron Activation Reactions Important for Fusion Power Plant Technology with their Priorities and Experimental Status" by E.T. Cheng, R.A. Forrest, J. Kopecky and F.M. Mann (see attachment of report INDC(NDS)-301)
RCM/DEBR94/P-7	Page 77 of Minutes of the 18th INDC Meeting, Vienna, 15-19 October 1990 by A.J. Deruytter
RCM/DEBR94/P-8	Conclusions and Recommendations of the IAEA SPM on "Comparison of Activation Cross Section Measurements and Experimental Techniques for Fusion Reactor Technology", St. Petersburg, Russia, 7-9 September 1994



INTERNATIONAL ATOMIC ENERGY AGENCY

CO-ORDINATED RESEARCH PROGRAMME

on

**"Establishment of an International Reference Data Library of  
Nuclear Activation Cross Sections"**

Information Sheet

**Scientific Background**

For environmental protection and the estimate of potential radiation hazards connected with any kind of nuclear installation and technique comprehensive internationally accepted files of neutron and charged particle nuclear activation cross sections and associated decay data files are needed.

Radioactivity in fission reactors is produced not only as a result of the fission process but also as a consequence of activation of structural components. In fusion devices the D-T reaction does not directly produce radioactive products, but they are produced by the 14 MeV neutrons in the structural components of fusion devices. Activation characteristics such as radioactivity, decay heating and integrated decay energy at times after shut-down of reactors are very important factors determining their design and choice of materials. The limiting concentration levels were recently introduced for such materials as Ni and Cu and also the importance of the concentration of such impurities as Nb, Mo, Ag, Gd, Tb and Ho in structural materials was realized.

The development of new materials requires more detailed information on activation cross-sections. The major objective of current materials research programs, the optimization of suitable radiation-resistant structural materials as so-called low-activation (LA) versions, is an important source for extensive data needs<sup>[1,2]</sup>. Some additional needs come from the fields of geophysics, activation analysis and radiation damage.

The nuclear data needed for inclusion in any data library to be used for general assessments of fusion reactor structure activation (and transmutation) is very extensive. Multigroup partial (not differential) cross-sections are needed for  $(n,\gamma)$ ,  $(n,2n)$ ,  $(n,\alpha)$ ,  $(n,p)$ ,  $(n,d)$ ,  $(n,t)$ ,  $(n,n'\alpha)$ ,  $(n,^3\text{He})$  and  $(n,n')$  reactions: in this list each reaction identifies a different product nuclide and the representation  $(n,d)$  incorporates  $(n,n'p)$ ,  $(n,pn')$  and  $(n,d)$

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[1] S. Cierjacks; Nuclear data needs for low-activation fusion materials development; Fus. Engrg. Design 13, 229 (1990)

[2] S. Cierjacks, K. Ehrlich; Invited paper on "Nuclear data for fusion materials research", in Proc. Int. Conf. on Nuclear Data for Science and Technology, Jülich, FRG, May 13-17, 1991, Ed. S.M. Qaim, Springer-Verlag Berlin Heidelberg, p 259, 1992.

and so on. The (n,n') reaction is of interest only if an isomeric excited state is formed; isomeric product nuclides are treated as distinct reaction products, i.e. they are additional to the same nuclides formed in their ground states. Cross-section data are needed for all stable isotopes constituent in the structural material of interest and also for those additional stable and long-lived nuclides formed directly by the nuclear reactions considered, or resulting from subsequent radioactive decay.

In addition, as demonstrated by Cierjacks et. al.<sup>[3,4]</sup>, for materials activation in fusion reactors not only all kinematically possible neutron-induced reactions, but also so-called sequential (x,n) reactions must be considered. The treatment of such reactions required large additional nuclear data libraries not previously contained in any of the existing activation files.

There are national efforts on activation cross-section evaluations going on a large scale in a number of countries (USA, Russia, UK, Netherlands, Japan). Several data libraries were already created such as FENDL-1.1, EAF-4, ADL-91, JAERI Activation File, BOSPOR-90, SINCROACT, REAC and some others. These libraries contain 5.000 to 10.000 and even more reactions. Since the available man power in laboratories active in this field is rather limited, a collaboration in an international frame would be very beneficial and probably also the fastest to obtain results. So the co-ordination of these efforts by the Agency for the creation of the international nuclear activation data base for use in technical applications appears to be very timely and desirable.

### General information on the CRP

Where it is deemed desirable that several institutes co-operate in furthering research in a given field, Co-ordinated Research Programme (CRPs) represent an effective means to bring together researchers to collaborate in a well defined research topic. The role of the International Atomic Energy Agency (IAEA) is to define, co-ordinate and support the programme.

The duration of a CRP is generally 3 years, but an extension is possible, if recommended and approved by the IAEA. Research Co-ordination Meetings (RCMs) are generally convened at the beginning, in the middle and at the end of a CRP, with the purpose to define details of the programme, review the progress and formulate a final report.

In accordance with the proposal from the IAEA Nuclear Data Section and with endorsement by the International Nuclear Data Committee (INDC), an advisory body for the nuclear data programme of the IAEA, the proposed CRP on Establishment of an International Reference Data Library of Nuclear Activation Cross Sections was recommended to start in 1993.

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- [3] S. Cierjacks, O. Oblozinsky, B. Rzehorz, Nuclear data libraries for the treatment of sequential (x,n) reactions in activation calculations; Proc. IEA Workshop on Low Activation Materials, Culham, UK, April 7-12, 1991, Session 3, Contribution c), 12 pages, (1991).
- [4] S. Cierjacks, Y. Hino; The importance of sequential (x,n) reactions on element activation of fusion reactor materials; J. Nucl. Mater. 170, 134 (1990).

### **Scientific Scope and Proposed Programme Goals**

The goal of the CRP is to provide a universal data base of neutron and charged particle nuclear activation cross sections and related decay data for nuclear and fusion technology and for environmental protection and the estimate of potential radiation hazards connected with any kind of nuclear installation and technique.

The data base should satisfy the following requirements:

- (a) it should include activation cross-sections, decay half-lives, branching ratios and energy spectra of emitted radiation;
- (b) the data base should contain uncertainty estimates;
- (c) it should be extensively tested against integral activation measurements;
- (d) it should allow reliable estimation and prediction of radiation doses and health hazards from artificial radiation sources (radioactive waste, radioisotope applications, reactor decommissioning, fall-out of nuclear accidents, natural sources);
- (e) it should cover initially incident particle energies up to 20 MeV with gradual extension (1995) to the intermediate energies.

To reach this goal will require the following types of research activities:

- Investigation of methods for the fast and reliable prediction of neutron reaction cross sections that can be used with confidence when no experimental measurements exist. The methods should require minimum input so that use on a 'mass production' basis is feasible.
- Validation of data libraries (both cross section and decay data) against experimental irradiations of realistic materials in high neutron fluxes.
- Investigation of uncertainty data in the cross section libraries.
- Extension of the cross section libraries to higher energies to cover accelerator based applications, e.g. transmutation. The extension of the existing libraries above 20 MeV will require a large effort, and then these would also require comparison and validation.
- Investigation of the importance of other reactions apart from those directly induced by neutrons. The effects of sequential charged particle reactions are already recognised in certain materials, but no comprehensive library yet exists. Also photon induced reactions may in special cases be of importance.

### **Participation**

Due to budgetary limitations only a selected number of laboratories can participate in this CRP. Selection of participants will be based on the relevance of the current and projected work described in the proposals received from potential participants. As soon as the proposals have been evaluated all potential participants will be notified and only at that time will a decision be made concerning actual participation in the CRP.

### **Activities**

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.

### **Research Agreements/Contracts**

In order to participate in this CRP each participant must enter into a research agreement or contract with the IAEA. Participants from Developed Countries (as defined by the IAEA) must enter into a research agreement. Under a research agreement a participant does not receive from the IAEA any direct financial support for research. The only financial support received from the IAEA under a research agreement is transportation and per diem of the principal investigator or his representative to attend periodic CRP meetings. Participants from Developing Countries (as defined by the IAEA) can enter into a research contract. Under a research contract in addition to financial support to attend CRP meetings participants can also receive a small amount of financial support for research (up to US\$ 5,000.- per contract year). Research agreements and contracts are reviewed (based on annual reports) and, subject to approval by the Director General, renewed each year.

### **Duration of the CRP**

The CRP will run for three years (1993-1996) with the possibility of a two-year extension.

Additional information on the CRP may be obtained from Mr. A. Pashchenko, IAEA, P.O. Box 100, A-1400 Vienna, Austria, Fax: (43) 1-234564, Telex: 1-12645 atom a, Tel: 2360, Ext. 1708, E-mail: Bitnet: RNX@IAEA1.; INTERNET: PASHCHENKO@IAEAND.IAEA.OR.AT



