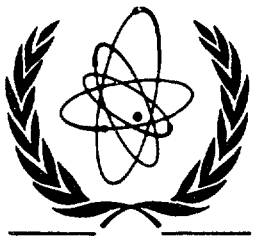
INDC(NDS)-201/GF



International Atomic Energy Agency

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

# IAEA SPECIALISTS' MEETING ON THE FUSION EVALUATED NUCLEAR DATA LIBRARY RELATED TO THE ITER ACTIVITY

IAEA HEADQUARTERS, VIENNA, AUSTRIA

16-18 NOVEMBER 1987

Summary Report

Prepared by V. Goulo and A. Lorenz

January 1988

# IAEA SPECIALISTS' MEETING ON THE FUSION EVALUATED NUCLEAR DATA LIBRARY RELATED TO THE ITER ACTIVITY

IAEA HEADQUARTERS, VIENNA, AUSTRIA

16-18 NOVEMBER 1987

Summary Report

Prepared by V. Goulo and A. Lorenz

January 1988

## Abstract

This is the summary report of an IAEA Specialists' Meeting on the Fusion Evaluated Nuclear Data Library Related to the ITER Activity, convened by the IAEA Nuclear Data Section in Vienna from 16 to 18 November 1987. The objective of the meeting was to formulate a detailed programme and time schedule for the development of the Fusion Evaluated Nuclear Data Library (FENDL) to meet the future needs of the ITER activity.



Printed by the IAEA in Austria
February 1988

88-00574

## MEETING SUMMARY

### INTRODUCTION

In response to views expressed by members of the International Fusion Research Council (IFRC) with regard to the need for a nuclear as well as an atomic data base for the development of the International Thermonuclear Experimental Reactor (ITER) project, and taking into consideration the existence of the required infrastructure and expertise within the IAEA Nuclear Data Section, the Agency has taken the initiative to establish the framework and strategy for the development of a computer-based evaluated nuclear data base dedicated to the design of the ITER fusion reactor.

On 16-18 November 1987, the IAEA Nuclear Data Section convened a group of specialists to formulate a detailed programme and time schedule for the development of a specific Fusion Evaluated Nuclear Data Library (FENDL) to meet the future needs of the ITER activities. This initiative was stimulated by recommendations of an earlier IAEA Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology held in December 1986 in Gaussig, German Democratic Republic. The Agenda of the meeting and the list of participants are given in Appendix A and Appendix B respectively.

### CONCLUSIONS AND RECOMMENDATIONS

During meeting discussions the participants suggested that the title of the meeting be corrected to "Fusion Evaluated Nuclear Data Library related to the ITER activity".

The meeting participants arrived at the following general conclusions:

1. The FENDL library will be based on five major national and regional evaluated nuclear data libraries; the contributions from each of these libraries, selected according to the criteria of quality and availability, are listed in the "Pre-selection List of Evaluations for FENDL", which was agreed upon at the meeting, and is given in Appendix C. The five libraries are:

   - the ENDF/B-IV,-V and -VI libraries maintained by the National Nuclear Data Center at the Brookhaven National Laboratory;

   - the BROND library maintained by the USSR Nuclear Data Center at FEI Obninsk;

   - the JENDL-2 and -3 Japanese libraries maintained by the JAERI Nuclear Data Centre;

   - the EFF-1 and -2 European Fusion Files, and

   - the ENDL-84 library maintained by the Lawrence Livermore National Laboratory in the US.

2. Detailed specifications and procedures for the assembly of the FENDL library, and for its testing through benchmark calculations, which were recommended at the meeting, are outlined in Appendix D and Appendix E respectively. It was also agreed that the FENDL library should be in the ENDF/B-VI format.

3. The target date for the completion of the first version of the FENDL library is February 1989. The agreed upon time schedule is given in Appendix F.

## FUTURE MEETINGS

In order to implement the proposed schedule and confirm the data requirements for the ITER design with the ITER design team, the Agency plans to convene a Specialist's Meeting in July 1988 at the Max Planck Institute at Garching, Federal Republic of Germany. A meeting to review and to assess the status of the first version of the FENDL library is planned for February 1989.

# IAEA Specialists' Meeting on the Fusion Evaluated Nuclear Data Library (FENDL) related to the ITER Activity

IAEA Headquarters, Vienna, Austria

16-18 NOVEMBER 1987

## AGENDA

Opening speech (Prof. M. Zifferero, DDG RI)

Introduction and information on the ITER project (J.J. Schmidt)

"Requirements of Nuclear Data for the International Thermonuclear Experimental Reactor (ITER)" (E. Cheng, GA Technologies)

---

Session I: Presentation and discussion of nuclear data files of national libraries, their status and quality

---

1. D. Larson (ORNL): Presentation of evaluated nuclear data files: ORNL (Cr-52,-53, Fe-56,-57, Ni-58,-60, Cu-63,-65, Pb, and minor isotopes), ANL (Nb, Co, V).

2. K. Shibata (JAERI): JENDL-3 status and presentation of nuclear data files.

3. R. White (LLNL, Livermore): Recent Livermore Evaluated Nuclear Data Files including Be-9.

4. H. Gruppelaar (ECN, Petten): ECN evaluations for Pb, Be-9, Li-6,-7.

5. D. Seeliger (TUD, Dresden), V. Goulo (IAEA): BROND files related to Fusion Reactor Design.

6. G. Reffo (ENEA, Bologna): ENEA evaluations for Si and Al.

7. D. Muir (LANL, Los Alamos): Los Alamos point of view on the INDL/F.

Discussion: Time and work schedule for the preparation of FENDL-1, including intercomparison, selection and review of available evaluated data files and their incorporation into FENDL-1.

---

Session II: Special Purpose Libraries and Horizontal Evaluation Problems

---

8. F. Mann (Hanford): REAC-activation data file.

9. J. Kopecky (ECN, Petten): Activation data library and isomeric ratios systematics

10. R. Forrest (AERE, Harwell): Activation data library of UK and systematics of 14.5 MeV charge particle production.

11. V. Goulo (IAEA/NDS): Status of Reactor Dosimetry Data Library IRDF-85 and its updating.

12. H. Vonach (IRK, Vienna): "Horizontal" evaluation of DDXS for structural materials.

13. D. Muir (LANL): On the covariance data of ENDF/B-VI library.

14. R. Feldbacher (TU, Graz): "Charged particle nuclear reaction data files for fusion research".

Discussion: Strategy for incorporation of special purpose libraries into FENDL-1.

---

Session III: Comparison of libraries and evaluations

---

15. E. Cheng (General Atomics, San Diego): Comparison of EFF-1 and ENDF/B-V libraries on lead blanket.

16. U. Fischer (KfK, FRG): Neutron multiplication in lead.

Discussion of future benchmark experiments and calculations including Pb, Li, Fe, selection of transport codes to be used in benchmark calculations.

---

Session IV: Format problems, maintenance of the library

---

17. H. Gruppelaar (ECN): ENDF/B-VI processing code GROUPXS.

18. C. Dunford (BNL): ENDF/B-VI utility codes and code for data conversion from ENDF/B-V into ENDF/B-VI format.

19. D. Muir (LANL): On the NJOY-87 processing code.

20. D. Larson (ORNL): "Information on the ORNL-processing system: AMPX".

Discussion: Procedure for the preparation of multigroup cross-section files.

# IAEA Specialists' Meeting on the Fusion Evaluated Nucler Data Library (FENDL) related to the ITER Activity

16-18 NOVEMBER 1987

IAEA Headquarters, Vienna, Austria

## LIST OF PARTICIPANTS


| | |
|---|---|
| CHENG, E.T. | GA Technologies Inc.<br>P.O. Box 85608<br>San Diego, CA 92138, USA |
| DUNFORD, C.L. | National Nuclear Data Center<br>Brookhaven National Laboratory<br>Upton, New York 11973, USA |
| FELDBACHER, R. | Technical University Graz<br>Peterstrasse 16<br>A-8010 Graz, Austria |
| FISCHER, U. | Institut für Neutronenphysik und Reaktortechnik<br>Kernforschungszentrum Karlsruhe<br>Postfach 3640<br>D-7500 Karlsruhe, FRG |
| FORREST, R. | Atomic Energy Research Establishment (AERE)<br>Harwell, Didcot, Oxon. OX11 ORA<br>United Kingdom |
| GRUPPELAAR, H. | Netherlands Energy Research Foundation (ECN)<br>P.O.B. 1, 3 Westerduinweg<br>NL-1755 ZG Petten<br>The Netherlands |
| KOPECKY, J. | Netherlands Energy Research Foundation (ECN)<br>P.O.B. 1, 3 Westerduinweg<br>NL-1755 ZG Petten<br>The Netherlands |
| LARSON, D.C. | Oak Ridge National Laboratory<br>P.O. Box X<br>Oak Ridge, Tennessee 37831, USA |
| MANN, F.M. | Hanford Engineering Development Laboratory<br>P.O. Box 1970<br>Richland, Washington 99352, USA |

MUIR, D.
T-2 Nuclear Data
MS-B243
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, NM 87545, USA

PELLONI, S.
Swiss Federal Institute for
Reactor Research
5303 Wuerenlingen, Switzerland

REFFO, R.
E.N.E.A. - Centro Ricerche
Energia "E. Clementel"
Div. Fis. e Calcolo Scientifico
Via Mazzini 2
I-40138 Bologna, Italy

SEELIGER, D.
Technische Universitaet Dresden
Sektion Physik
Mommsenstrasse 13
DDR-8027 Dresden, GDR

SHATALOV, G.E.
Institut Atomnoi Energii
I.V. Kurchatova
Ploshchad I.V. Kurchatova
Moscow D-182, 123182, USSR

SHIBATA, K.
Japan Atomic Energy Research
Institute (JAERI)
Tokai-Mura, Naka-Gun
Ibaraki-Ken 319-11, Japan

VONACH, H.K.
Institut für Radiumforschung
und Kernphysik
Boltzmanngasse 3
A-1090 Vienna, Austria

WHITE, R.
Physics Department, L-405
Lawrence Livermore Laboratory
P.O. Box 808
Livermore, CA 94550, USA

GOULO, V.
IAEA Nuclear Data Section
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna, Austria

SCHMIDT, J.J.
IAEA Nuclear Data Section
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna, Austria

WANG DA HAI
IAEA Nuclear Data Section
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna, Austria

APPENDIX C

## Pre-selection list of evaluations for the Fusion Evaluated Nuclear Data Library (FENDL)

| Element Isotope | Evaluation source | Due date | Reviewer | Comments |
|---|---|---|---|---|
| H | ENDF/B-V | mid 1/88 | Evaluator | Standard V<br>Translate to ENDF-6 |
| D | BROND | 2/88 | JAERI, K. Shibata | Translate to ENDF-6** |
| | JENDL-2 | A | FEI, V. Manokhin | Translate to ENDF-6** |
| T | ENDF/B-IV | mid 1/88 | Evaluator | Translate to ENDF-6 |
| | ENDL | mid 6/88 | Evaluator | Translate to ENDF-6 |
| Li-6 | ENDF/B-V | mid 1/88 | Evaluator | Standard V |
| +Li-7 | ENDF/B-VI | 6/88 | ECN, H. Gruppelaar | Possibly joint |
| | EFF-2 | 7/88 | | submittal |
| +Be-9 | ENDF/B-VI | mid 1/88 | LANL, D. Muir | ENDF/B-VI |
| | EFF-2 | 12/88 | ECN, H. Gruppelaar | |
| B-10 | ENDF/B-V | mid 1/88 | Evaluator | Standard V |
| B-11 | ENDF/B-VI | 6/88 | FEI, V. Manokhin | ENDF/B-VI |
| C-12 | JENDL-2 | A | JAERI, K. Shibata | Translate to ENDF-6**<br>JENDL-3 desirable |
| | ENDF/B-V | mid 1/88 | Evaluator | Standard V |
| N | ENDF/B-IV | mid 1/88 | Evaluator | Translate to ENDF-6 |
| O | BROND | 2/88 | LANL, P. Young | Translate to ENDF-6** |
| F | JENDL-2 | A | Evaluator | Translate to ENDF-6** |
| Mg | JENDL-2 | A | Evaluator | Translate to ENDF-6** |
| *Al | EFF-1 | 3/88 | | Joint ENEA-LANL work |
| *Si | BROND | A | ECN, H. Gruppelaar | Translate to ENDF-6** |
| | EFF-1 | 3/88 | TUD, D. Seeliger | Translate to ENDF 6** |
| Ti | ENDF/B-IV | mid 1/88 | Evaluator | Translate to ENDF-6** |
| V | JENDL-2 | A | Evaluator | Translate to ENDF-6**<br>JENDL-3 desirable |
| *Cr | BROND | 2/88 | CRP-review | Translate to ENDF-6** |
| | ENDF/B-VI | 7/88 | CRP-review | |
| | JENDL-3 | 7/88 | | Translate to ENDF-6** |
| Mn | JENDL-3 | 7/88 | ORNL (to be confirmed) | Joint ORNL-JAERI work |

| Element Isotope | Evaluation source | Due date | Reviewer | Comments |
|---|---|---|---|---|
| *Fe | BROND | 2/88 | CRP-review | Translate to ENDF-6** |
| | ENDF/B-VI | 7/88 | CRP-review | |
| | JENDL-3 | 7/88 | | Translate to ENDF-6** |
| Co | ENDF/B-VI | 6/88 | CSEWG | |
| *Ni | BROND | 2/88 | CRP-review | Translate to ENDF-6** |
| | ENDF/B-VI | 7/88 | CRP-review | |
| | JENDL-3 | 7/88 | | Translate to ENDF-6** |
| | EFF-2 | 7/88 | CRP-review | Translate to ENDF-6** |
| *Cu | ENDF/B-VI | 6/88 | JAERI, K. Shibata | |
| | JENDL-3 | 3/88 | | Desirable |
| Zr | BROND | Work is underway | CSEWG | Translate to ENDF-6** |
| | ENDF/B-VI | 1/88 | Evaluator | Backup choice |
| Nb | BROND | 2/88 | ANL (to be confirmed) | Possible revision |
| | ENDF/B-VI | 6/88 | TUD, D. Seeliger | Translate to ENDF-6** |
| *Mo | JENDL-2 | A | Evaluator | Translate to ENDF-6** |
| Sn | ENDL | 6/88 | Evaluator | Translate to ENDF-6** |
| Ba | ENDF/B-V | 1/88 | Evaluator | Fission product<br>Translate to ENDF-6** |
| *W | ENDF/B-VI | 6/88 | CSEWG | |
| +Pb | BROND | A | ORNL, P. Fu | Translate to ENDF-6** |
| | EFF-1 | A | ORNL, P. Fu | Possibly EFF-2 |
| | ENDF/B-VI | 6/88 | | |
| | JENDL-2 | A | | Possibly JENDL-3 |
| Bi | EFF-1 | 3/88 | CSEWG | Joint LLL-LANL-ANL-ENEA work |

| | |
|---|---|
| + | Highest priority |
| * | First priority |
| ** | To be translated to ENDF/B-VI format by NDS, |
| A | Evaluation is available at NDS |
| CRP-review | Planned to be reviewed at the second RCM on Methods for the Calculation of Fast Neutron Nuclear Data for Structural Materials, Vienna, 15-17 February 1988. |
| Evaluator | Evaluator of file is reviewing it himself and should communicate shortcomings to NDS. |

## Specification and Procedures for the Assembly of the FENDL Library

1. The FENDL library will be assembled in the ENDF/B-VI format by IAEA/NDS in the course of 1988; the first version of the FENDL library will be prepared in time for the February 1989 meeting.

2. ENDF/B evaluations which will be incorporated into FENDL shall be converted to ENDF/B-VI format by the NNDC at Brookhaven. All other evaluations will be converted to the ENDF/B-VI format by IAEA/NDS.

3. The FENDL library shall be composed of evaluations for each individual isotope of each composite element.

4. IAEA/NDS will prepare "review kits" for each individual isotope, composed of evaluations from all available sources, and distribute them to the assigned reviewers.

5. The final format of the FENDL library (point-wise, multi-group or in the format of probabilities) shall be determined on the basis of requirements defined by the ITER team.

6. In addition to the major source libraries of evaluated neutron induced data, the following special purpose libraries will also be prepared to be part of the "ITER fusion data package":

   - The REAC activation data library, (including the gas-production data); the update and review of this library will be performed by ECN (Petten), AERE (Harwell), and HEDL (Hanford) before the end of 1988. Format, group structure and weighting spectrum will have to be determined by the ITER design team; current codes used for activation calculations are AKFA (Jülich) and THRESH (Petten).

   - The IAEA dosimetry reaction data file (IRDF-85); to be updated in the frame of the REAL-88 project by IRK (Vienna).

   - The ECPL charged particle data library, available at IAEA/NDS.

   - The US/NBS photon interaction data library of M.J. Berger and J.H. Hubbell, available at IAEA/NDS.

## Specification and Procedures for the Benchmark Calculations of the FENDL File

In accordance with the recommendations made at the 1986 Gaussig AGM, benchmark calculations will be performed for the Dresden lead experiment. The transport codes selected for this exercise will be those available at individual laboratories including ONETRAN, ANTRA, ONEDANT and ANISN for one-dimensional calculations, and perhaps MCNP for Monte Carlo calculations. The libraries to be included in the benchmark calculations are those chosen at this meeting, namely EFF, BROND and ENDF/B-VI. The results of all calculations will be reported at the planned February 1989 meeting.

Benchmark calculations for Be and Li were also discussed at the INDC meeting in Beijing, October 1987. It was suggested that the benchmark experiments for both Be and Li be identified at the February 1989 meeting. As far as benchmark calculations for Fe, Ni and Cr are concerned, the participants suggested that calculational models, similar to those for the Dresden experiment be used for the comparison study using libraries chosen at this meeting (i.e. BROND and ENDF/B-VI). The schedule for this comparison study is also to be determined at the February 1989 meeting.

Proposed participants for this meeting are:

E. Cheng (GA Technologies, San Diego, USA)
U. Fischer (KfK Karlsruhe, FRG)
S. Pelloni (Würenlingen, Switzerland)
M. Töpfer (Dresden Technical University, GDR)
D.V. Markovskij (Kurchatov Institute of Atomic Energy, Moscow, USSR)
H. Maekawa (JAERI, Japan)
K. Sumita (Osaka, Japan)

Start Pb-benchmark calculations with the conversion of the BROND-PB file to the 175 groups VITAMIN-J scale (LANL).

## Time-Schedule for the Preparation of FENDL Starter File

1. MID JANUARY 1988. The following files are made available to NDS:

   ENDF/B-V and VI libraries:
   files in ENDF/B-VI format; H, T, Li-6, Be, B-10, C, N, Ti, Sn, Ba, Zr

   BROND:
   D, O, Si, Fe-nat, Fe-54, Fe-56, Fe-57, Fe-58, Cr-nat, Cr-50, Cr-52, Cr-53, Cr-54, Ni-nat, Ni-58, Ni-60, Ni-61, Ni-62, Ni-64, Pb

   JENDL-2:
   D, C, F, Mg, V, Mo

   EFF-1:
   Pb

2. MID FEBRUARY 1988. Organize the intercomparison of Fe, Cr, Ni-isotopic files at the IAEA RCM on Methods for the Calculation of Fast Neutron Nuclear Data of Structural Materials (15-17 February, Vienna).

3. BEGINNING OF JUNE 1988. Fix status of availability of files from pre-selection list (Appendix C) at a small ad-hoc meeting in Mito, Japan, to be held in conjunction with the International Conference on Nuclear Data.

4. MID JULY 1988. The following files are made available to NDS:

   ENDF/B-VI:
   Li-7, B-11, Cr, Fe and Ni isotopes, Co, Cu, Nb, W, Pb

   JENDL-3:
   Cr, Mn, Fe, Ni, Cu

   EFF-1,2:
   Li-7, Al, Si, Bi

   BROND:
   Nb, Zr

5. MID JULY 1988. IAEA Specialists' Meeting on FENDL with the ITER team potentially in Garching (FRG) with the objectives:
   - to report on the status of FENDL preparation;
   - to get detailed recommendations on isotopes, required reactions, and the form of data presentation for transport/shielding calculations.

6. SECOND HALF OF 1988. Preparation of FENDL in multi-group form or in the form of probabilities for Monte-Carlo codes using the NJOY-87 code.

7. FEBRUARY 1989. IAEA Specialists' Meeting on benchmark testing of fusion related nuclear data files for Be, Pb, Li, Fe calculational benchmarks as well as experimental benchmarks for Pb and Li.