Data Bank

OECD

The JEF-2.2 Nuclear Data Library

JEFF Report 17

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of 27 OECD Member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

FOREWORD

The Joint Evaluated File (JEF) project was started in 1982 as a collaborative project between the NEA Data Bank Member countries. The main objective is to provide participating countries with a common and unique source of nuclear data for the calculation and prediction of different nuclear applications. The first version of the JEF file was issued in 1985, and was followed in spring 1993 by an improved second version (JEF-2.2).

The JEF project is managed by a Scientific Co-ordination Group (SCG). The technical work is performed within specific working groups, comprising experts working on different nuclear data related activities, such as measurements, evaluations, processing and validation.

An extensive programme of benchmark testing of the JEF-2.2 data has been undertaken and is reported in this publication. The JEF file has been validated both for thermal and fast reactor applications, as well as for many other special applications, such as criticality, decay heat and radiation shielding, including a special emphasis on the major structural materials. A large number of laboratories throughout Western Europe have been engaged in this data processing and validation phase. The main contributors were: CEA, France; IKE, Germany; IRI and ECN, Holland; ENEA, Italy; PSI, Switzerland; Studsvik, Sweden; and AEAT, UK with financial support from national industries (BNFL, EDF, COGEMA…).

The collective work for the JEF project, mainly presented at the biannual JEF meetings, has been documented in a series of unofficial publications called JEF/DOC. These documents have been extensively consulted in the production of the present summary report of the JEF-2.2 data library. The CD-ROM version of this summary report contains direct hyper-links to the referenced JEF/DOCs, included on the CD-ROM. The list of authors, who were directly involved in writing this report, is given on the next page.

The chairpersons who led the JEF Scientific Co-ordination Group over the years were: C.G. Campbell, UKAEA (1982-1986), M. Salvatores, CEA Cadarache (1986-1994), P.J. Finck, CEA Cadarache (1994-1997), H. Gruppelaar, ECN Petten (1997-1999). The present chairman is R. Jacqmin, CEA Cadarache. The secretariat of the meetings, as well as the assembly and the maintenance of the JEF file, has been the responsibility of NEA Data Bank (C. Nordborg, M. Konieczny, M. Kellett and A. Nouri).

Special thanks to J. Rowlands, who edited the report, and to H. Tellier, who reviewed the whole document and made valuable comments regarding the overall homogeneity of the text.

This summary report is dedicated to the former JEF chairman, Harm Gruppelaar, who was strongly devoted both to the JEF and the EFF (European Fusion File) projects. Following his initiative, these two projects are now co-operating very closely on the development of a joint new evaluated data library called JEFF-3. Harm Gruppelaar passed away on 14 November 1999.

CONTRIBUTIONS TO THE DIFFERENT CHAPTERS

CHAPTER 1: NEA Data Bank

CHAPTER 2: Summary by J. Rowlands based on the paper by J. Blachot, and C. Nordborg with additions from the paper by A. Tobias, and contributions by A.L. Nichols, and F. Storrer.

CHAPTER 3: R.W Mills, D.R. Weaver and M.F. James.

CHAPTER 4: Summary by J. Rowlands based on JEF Report by M. Mathes *et al.*

CHAPTER 5: Summary of different JEF/DOCs (see list at the end of this chapter) by J. Rowlands.

CHAPTER 6: Summary by J. Rowlands based on work done mainly at CEA/Cadarache by E. Fort, G. Rimplaut (see reference section of this chapter).

CHAPTER 7: A. Nouri, N. Smith, B. Roque and I. Guimier.

CHAPTER 8: Update by J. Rowlands of the paper by A.F. Avery with additions from S.H. Zheng.

CHAPTER 9: Summary by J. Rowlands based on different studies by F. Storrer, B. Nimal, J. Blachot, J.C Nimal and C.M Diop, P. de Leege, J. Hoogenboom and J. Kloosterman.

CHAPTER 10: Summary by J. Rowlands of a more detailed study by E. Fort, V. Zammit *et al*.

CHAPTER 11: R.W Mills.

CHAPTER 12: E Fort, W. Assal, A. Avery, P. Blaise, J-C. Bosq, S. Cathalau, C. Dean, G. Rimpault, J. Rowlands, P. Smith, R. Soule, V. Zammit, M. Salvatores, P.J. Finck.

CHAPTER 13: Compiled by NEA/Data Bank.

CHAPTER 14: A.L Nichols, C.J Dean.

CHAPTER 15: Summary by J. Rowlands of different papers (see reference list of this chapter).

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EXECUTIVE SUMMARY

The present report is a summary documentation of the second version of the Joint Evaluated File (JEF-2.2). The information contained in the file comprises neutron reaction data, radioactive decay data, fission yield data and thermal scattering law data. The data library has been assembled and tested as a joint undertaking between experts in NEA Data Bank Member countries. The Data Bank secretariat acted as co-ordinator of the project and maintains the master version of the file.

The report has been divided up in the following four parts:

Part one provides information on the origin of the data. It also describes modifications and improvements that were made to the data before adopting them in the JEF-2.2 library.

Part two summarises the validation and testing of the JEF-2.2 library for different nuclear applications. All validation has been performed with non-adjusted data, i.e. the performances are those derived directly from the original data without taking into account feedback from specific integral experiments. In addition, the JEF-2.2 data-testing programme gave special attention to the use of the most sophisticated models, to carrying out systematic computer code comparisons and to selecting clean and well-documented integral benchmarks.

The overall conclusion from this data validation programme is that the unadjusted JEF-2.2 file generally performs well, at least as well as former adjusted data libraries. However, there are still areas where improvements are needed.

Part three gives an overview of the validation of the JEF-2.2 data by means of cross-section adjustment studies. This part provides a short description of the methodologies used, and it derives quantitative information on data changes needed to achieve a very good accuracy in the calculation of different reactor applications.

Part four proposes improvements to the JEF-2.2 file to meet the new challenges, both for advanced reactor concepts and new fuel cycle options. This feedback is being taken into account in the preparation of the new version of the evaluated file JEFF-3.