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THE INTERNATIONAL REACTOR DOSIMETRY FILE

(IRDF-90 Version 2)

Assembled by

N.P. Kocherov, and P.K. McLaughlin

Abstract: This document describes the contents of the new version of the International Reactor Dosimetry File IRDF-90 Version 2 of 1993 which contains recommended neutron cross-section data to be used for reactor neutron dosimetry by foil activation. It also contains selected recommended values for radiation damage cross-sections and benchmark neutron spectra. This library supersedes all earlier versions of IRDF. It is available on magnetic tape or on a set of PC diskettes from the IAEA Nuclear Data Section, cost free, upon request.

Revised by P.K. McLaughlin IAEA/NDS Jan. 2005

The file was revised to conform with ENDF/B format standards.. The merged file was corrected for format errors and processed through the code CHECKR to ensure, as far as possible, format compatibility.

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N.P. Kocherov, "International Reactor Dosimetry File IRDF-90, Status and Testing", 7th ASTM-Euratom Symposium on Reactor Dosimetry, 27-31 Aug. 1990, Proceedings by Kluwer Academic Press (1992), p. 357-361. Database IRDF-90 version 2 obtained from the IAEA Nuclear Data Section, (date).

The International Reactor Dosimetry File (IRDF-90) Version 2 of 1993

Assembled by N.P. Kocherov, and P.K. McLaughlin

1. Introduction

Since the first release of version 1 of the IRDF-90 file in summer 1990 we have received many comments from its users. The main problems were identified in the covariance information (Files 33). Since then also some new evaluations appeared which were not available at the time of the release of version 1. Six new covariance files were added to the file. They were also not available before. In its present form the file contains 58 cross-

sections of dosimetry reactions, all with complete covarianceinformation. 9 new dosimetry reactions were added compared to version 1. The IRDF- 90 version 2 contains 39 neutron dosimetry reaction cross-sections from the latest revisions of the ENDF/B-6 [1], 14 evaluations made by Prof. H Vonach and his coworkers at the IRK in Vienna [2] and 5 evaluations by the specialists from the Chinese Nuclear Data Center in Beijing, prepared specially for this file under contract with the IAEA [3]. The data in the original ENDF-6 format were processed to **640 group extended SANDII format** in the Nuclear Data Section of the IAEA using the processing codes LINEAR, RECENT and GROUPIE by D.E. Cullen [4]. The covariance information is not processed by these codes and it is contained in IRDF-90 in the original ENDF-6 format. The initial version of this file was described in [5]. This file with some further format modifications (IRDF-90/NMF-G file, see modifications in [9]) is also distributed with the Neutron Metrology File NMF-90 described in [6].

2. Contents of the IRDF-90

The list of reactions and the origins of evaluations are given in Table 1. As we did not have any new sets of standard damage cross-sections or of standard and reference neutron spectra the ones from IRDF-85 were kept here with the same special notations. The damage cross-sections and neutron spectra are in the ENDF-5 format.

Data Content:

File 1 Cross section data in ENDF/B-VI format (640 groups) 25211 records for 58 reactions

File 2 Damage cross sections in ENDF/B-V format (640 groups) 754 records for 4 materials

File 3 Spectra data files in ENDF/B-V format (640 groups) 1598 records for 10 benchmark neutron fields

In File 3 neutron spectra for the following benchmark neutron fields are given

spontaneous fission - NBS Evaluation

Cf-252

U-235	thermal fission - NBS evaluation
U-235	thermal fission - ENDF/B-V evaluation
ISNF	Intermediate-energy standard neutron field
CFRMF	Coupled fast reactivity measurement facility
BIG-TEN (LANL)	10% enriched uranium cylindrical critical assembly
SIGMA-SIGMA	Coupled thermal/fast uranium and boron carbide spherical assembly (MOL)
ORR	Reactor in Oak Ridge National Laboratory
YAYOI	Spectrum (JAERI)
NEACRP BENCHMARK KARLSRUHE	Central zone neutron flux

All improvements in the file became possible only through efficient cooperation between Drs. H. Nolthenius, E. Zsolnay, and E. Szondi who were testing the file [7,8] and Drs. H. Vonach, S. Tagesen and D. Hetrick who made the necessary improvements in the covariance data files. Their contribution is gratefully acknowledged.

We would appreciate receiving any suggestions concerning further improvement of the quality of this file. Please send comments to:

Dr. V.G. Pronyaev International Atomic Energy Agency Wagramerstrasse 5, P.O. Box 100 A-1400 Vienna, Austria

Note: The present version 4 of this report includes corrections and gives some additional references; the database is still unchanged since version 2 of this IAEA-NDS-report dated Oct. 1993.

References

- 1. U.S. National Nuclear Data Center, Evaluated Nuclear Data File, ENDF/B-6, BNL, Upton, N.Y. (1990) and later revisions.
- M. Wagner, H. Vonach. A. Pavlik, B. Strohmaier, S. Tagesen, J. Martinez-Rico, "Evaluation of Cross-Sections for 14 Important Neutron Dosimetry Reactions," Physics Data, 13-5, Karlsruhe, 1990.
- 3. C. Dunjiu, "Evaluations of Cross-Sections for Dosimetry Reactions," Final Report on Contract 5516, INDC(CPR)-024, 1991, Vienna.
- 4. D.E. Cullen, "The 1992 ENDF/B Preprocessing Codes", Report IAEA-NDS-39 Rev. 7, 1992.
- 5. N.P. Kocherov, "International Reactor Dosimetry File IRDF-90, Status and Testing", 7th ASTM-Euratom Symposium on Reactor Dosimetry, 27-31 Aug. 1990, Proceedings by Kluwer Academic Press (1992) p. 357-361.
- 6. E.M. Zsolnay, E.J. Szondi, H.J. Nolthenius, "The Neutron Metrology File NMF-90", Report IAEA-NDS-171, Rev. 1, 1999.
- 7. E.M. Zsolnay, H. Nolthenius, "On the Quality of the Uncertainty Information in the International Dosimetry File IRDF-90," Report ECN-1-93-019, ECN, Petten, 1993.
- H. Nolthenius, E.M. Zsolnay, E.J. Szondi, "Testing of the IRDF-90 Cross-Section Library in Benchmark Neutron Spectra," <u>Reactor Dosimetry ASTM 1228</u>, Harry Farrar IV, E. Parvin Lippincott, and John G. Williams, Eds., American Society for Testing and Materials, Philadelphia, to be published in 1994.
- 9. E.J. Szondi, "The Group Version of the International Reactor Dosimetry File IRDF-90 for Use in the Neutron Metrology File NMF-90 (IRDF-90/NMF-G)", Report INDC(HUN)-34, Vienna, 1999.

Table 1. Contents of the IRDF-90

E-6 = data taken over from ENDF/B-VI Original = data evaluated for IRDF-90 Priv. Comm. = Private Communication New evaluations introduced into the file are shown in bold.

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Date	Library of Origin
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9-F-199253 16; 33 16M. Wagner et al., IRK111-Na-2311233 102; 33 102Yu Hanrong, CNDC1212-Mg-2412253 103; 33 103M. Wagner et al., IRK1713-Al-2713253 103; 33 103D. Hetrick, C.Y. Fu, ORNL1715-P-3115253 103; 33 103D. Hetrick, C.Y. Fu, ORNL1716-S-3216253 103; 33 103D. Hetrick, C.Y. Fu, ORNL1721-Sc-4521262 151; 32 151;Z. Zhao, CNDC1722-Ti-4622253 103; 33 103D. Hetrick, C.Y. Fu, ORNL1722-Ti-4722283 28; 33 28;C. Y. Fu, ORNL1722-Ti-4822313 28; 33 28;C.Y. Fu, ORNL1722-Ti-4822313 103; 33 103D. Hetrick, C.Y. Fu, ORNL1723-V-023003 107; 33 107A. Smith, D. Smith, ANL1724-Cr-5224313 16; 33 16;M. Wagner et al., IRK1725-Fe-5426253 103; 33 103D. Hetrick, C.Y. Fu, ORNL1726-Fe-5426253 103; 33 103D. Hetrick, et al., ORNL1727-Co-5927253 16; 33 16M. Wagner et al., IRK1728-Ni-5828253 103; 33 103N. Larson et al., ORNL1729-Cu-6329313 16; 33 16M. Wagner et al., IRK1729-Cu-6529313 16; 33 16M. Wagner et al., IRK1730-7; 33 107C. Fu et al., ORNL171729-Cu-652931 <t< td=""><td>1989</td><td>E-6***</td></t<>	1989	E-6***
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8	1991	E-6
(translated from UK)		

Nuclide	IRDF MAT No.	Reactions and* Uncertainties	Author & Lab **	Date	Library of Origin
49-In-115	4931	3 16; 33 16	C. Dunjiu, CCNDC	1991	Priv. Comm.
		3 51; 33 51	S. Chiba, D.L. Smith, ANL	1990	E-6
		2 151	E.Schmittroth, HEDL	1990	
		3 102; 33 102	E.Schmittroth, HEDL	1990	E-6=E-5
53-I-127	5325	3 16; 33 16	Z. Wenrong et al., CNDC	1991	Priv. Comm.
64-Gd-0	6400	3 1; 3 102	Mixed from E-6 isotope data by N. Kocherov, IAEA	1990	Original
79-Au-197	7925	2 151; 3 102 33 102	P. Young et al., LANL	1989	E-6***
		3 16; 33 16	M. Wagner et al., IRK	1991	Original
90-Th-232	9040	2 151 3 18; 33 18 2 102 22 102	M. Bhat et al., BNL, ANL	1990	E-6
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92-U-235	9228	2 151 3 18; 33 18	L. Weston et al., ORNL, LANL	1989	E-6***
92-U-238	9237	2 151 3 18; 33 18 3 102; 33 102	L. Weston et al., ORNL, LANL	1989	E-6***
93-Np-237	9337	2 151 3 18; 33 18	F. Mann et al., HEDL, SRL	1978	E-4
94-Pu-239	9437	2 151 3 18; 33 18	P. Young et al., LANL	1989	E-6***
26-Fe-00	8000	ASTM Damage	Priv. Comm. W. Zijp Cross Sections	1979	Priv. Comm.
26-Fe-00	8001	Eur. Damage Cross Sections	Priv. Comm. W. Zijp	1979	Priv. Comm.
24-Cr-00	8002	Eur. Damage Cross Sections	W. Zijp, Petten	1985	Priv. Comm.
28-Ni-00	8003	Eur. Damage Cross Sections	W. Zijp, Petten	1985	Priv. Comm.

Note: * The following ENDF notations for reactions are used 1-total, 16-n,2n, 18-fission, 28-n,np, 102-n(, 103-np, 107-na, 2 151 - resonance parameters. 51 means total population of the 1^{st} level from all channels (not an ENDF notation); 3 - cross-section data file; 33 – covariance data file.

** The lab codes given under "Author & Lab" are as follows:

ANL	-	Argonne National Laboratory, Argonne Illinois
BNL	-	Brookhaven National Laboratory, Upton, N.Y.
CNDC	-	Chinese Nuclear Data Center
IAEA	-	International Atomic Energy Agency, Vienna
IRK	-	Inst. fhr Radiumforschung und Kernphysik, Vienna
LAEDI		Lange and Adams's Engineers Descended Land Tales'

LANL	-	Los Alamos National Laboratory, New Mexico
LLNL	-	Lawrence Livermore National Laborarory, California
ORNL	-	Oak Ridge National Laboratory, Tennessee
Petten	-	Netherland's Energy Research Foundation, Petten
SRL	-	Savannah River Laboratory, South Carolina
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*** The cross sections and covariance matrices for 6Li(n, a), 10B(n, a0), 10B(n, a1), 197Au(n, g), 235U(n, f) and 239Pu(n, f) are taken from unreleased version of ENDF/B-VI evaluation prepared by A. Carlson, G. Hale W.P. Poenitz and R. Peelle as combined R-matrix and least squarefitting of correlated data sets for these reactions.