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THE INTERNATIONAL REACTOR DOSIMETRY FILE

(IRDF-90 Version 2)

Assembled by

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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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This data library should be cited as follows:

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).

| | |
|-------------------------------|---|
| 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:

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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.
2. 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.
8. H. Nolthenius, E.M. Zsolnay, E.J. Szondi, "Testing of the IRDF-90 Cross-Section Library in Benchmark Neutron Spectra," Reactor Dosimetry ASTM 1228, 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.

| Nuclide | IRDF MAT No. | Reactions and* Uncertainties | Author & Lab ** | Date | Library of Origin |
|------------------|-----------------|---|--|-----------------------------|------------------------------------|
| 3-Li-6 | 325 | 3 105; 33 105 | G. Hale et al., LANL | 1989 | E-6*** |
| 5-B-10 | 525 | 3 1; 3 107; 33 107 | G. Hale et al., LANL | 1989 | E-6*** |
| 9-F-19 | 925 | 3 16; 33 16 | M. Wagner et al., IRK | 1991 | Original |
| 11-Na-23 | 1123 | 3 102; 33 102 | Yu Hanrong, CNDC | 1990 | Priv. Comm. |
| 12-Mg-24 | 1225 | 3 103; 33 103 | M. Wagner et al., IRK | 1991 | Original |
| 13-Al-27 | 1325 | 3 103; 33 103 3 107; 33 107 | D. Hetrick, C.Y. Fu, ORNL M. Wagner et al., IRK | 1990 1991 | Priv. Comm. Original |
| 15-P-31 | 1525 | 3 103; 33 103 | M. Wagner et al., IRK | 1991 | Original |
| 16-S-32 | 1625 | 3 103; 33 103 | D. Hetrick, C.Y. Fu, ORNL | 1991 | Priv. Comm. |
| 21-Sc-45 | 2126 | 2 151; 32 151 ; 3 102; 33 102 | Z. Zhao, CNDC | 1991 | Priv. Comm. |
| 22-Ti-46 | 2225 | 3 103; 33 103 | D. Hetrick, C.Y. Fu, ORNL | 1989 | Priv. Comm. |
| 22-Ti-47 | 2228 | 3 28; 33 28 ; 3 103; 33 103 | C. Philis et al, ANL C.Y. Fu, ORNL | 1990 1991 | E-6 Priv. Comm. |
| 22-Ti-48 | 2231 | 3 28; 33 28 3 103; 33 103 | C.Y. Fu, ORNL D. Hetrick, C.Y. Fu, ORNL | 1977 1989 | E-6 Priv. Comm. |
| 23-V-0 | 2300 | 3 107; 33 107 | A. Smith, D. Smith, ANL | 1990 | Priv. Comm. |
| 24-Cr-52 | 2431 | 3 16; 33 16 | M. Wagner et al., IRK | 1991 | Original |
| 25-Mn-55 | 2525 | 2 151; 3 16; 33 16; 3 102; 33 102 | K. Shibata et al., JAERI, ORNL | 1988 | E-6 |
| 26-Fe-54 | 2625 | 3 103; 33 103 | D. Hetrick, et al., ORNL | 1989 | Priv. Comm. |
| 26-Fe-56 | 2631 | 3 103; 33 103 | C. Fu et al., ORNL | 1991 | E-6 |
| 26-Fe-58 | 2637 | 2 151; 3 102; 33 102 | N. Larson et al., ORNL | 1989 | E-6 |
| 27-Co-59 | 2725 | 3 16; 33 16 2 151; 3 102; 33 102 3 107; 33 107 | M. Wagner et al., IRK S. Mughabghab, BNL A. Smith et al., ANL | 1990 1977 1990 | Original E-5 E-6 |
| 28-Ni-58 | 2825 | 3 103; 33 103 3 16; 33 16 | N. Larson et al., ORNL M. Wagner et al., IRK | 1989 1990 | E-6 Original |
| 28-Ni-60 | 2831 | 3 103; 33 103 | N. Larson et al., ORNL | 1991 | E-6 |
| 29-Cu-63 | 2925 | 3 16; 33 16 2 151; 3 102; 33 102 3 107; 33 107 | M. Wagner et al., IRK C. Fu et al., ORNL C. Fu et al., ORNL | 1991 1991 1991 | Original E-6 E-6 |
| 29-Cu-65 | 2931 | 3 16; 33 16 | C. Fu et al., ORNL | 1991 | E-6 |
| 30-Zn-64 | 3025 | 3 103; 33 103 | M. Wagner et al., IRK | 1991 | Original |
| 39-Y-89 | 3925 | 3 16; 33 16 | R. Howerton, A. Smith, D. Smith, LLNL, ANL | 1991 | E-6 |
| 40-Zr-90 | 4025 | 3 16; 33 16; | M. Wagner et al., IRK | 1991 | Original |
| 41-Nb-93 | 4125 | 3 16; 33 16; 3 51; 33 51; 3 102; 33 102 | M. Wagner et al., IRK M. Wagner et al., IRK A. Smith et al., ANL, LLL | 1991 1991 1991 | Original Original E-6 |
| 45-Rh-103 | 4525 | 3 51; 33 51 | M. Wagner et al., IRK | 1991 | Original |
| 47-Ag-109 | 4731 | 3 102; 33 102 | Z. Zhao, CNDC | 1990 | Priv. Comm. |
| 48-Cd-0 | 4800 | 3 1; 3 102 | S. Pearlstein, BNL (translated from UK) | 1991 | E-6 |

| Nuclide | IRDF MAT No. | Reactions and* Uncertainties | Author & Lab ** | Date | Library of Origin |
|-----------------|-----------------|--|---|-----------------------------|--------------------------------|
| 49-In-115 | 4931 | 3 16; 33 16 3 51; 33 51 2 151 | C. Dunjiu, CCNDC S. Chiba, D.L. Smith, ANL E.Schmittroth, HEDL | 1991 1990 1990 | Priv. Comm. E-6 |
| 53-I-127 | 5325 | 3 102; 33 102 | E.Schmittroth, HEDL | 1990 | E-6=E-5 |
| 64-Gd-0 | 6400 | 3 16; 33 16 3 1; 3 102 | Z. Wenrong et al., CNDC Mixed from E-6 isotope data by N. Kocherov, IAEA | 1991 1990 | Priv. Comm. Original |
| 79-Au-197 | 7925 | 2 151; 3 102 33 102 | P. Young et al., LANL | 1989 | E-6*** |
| 90-Th-232 | 9040 | 3 16; 33 16 2 151 3 18; 33 18 3 102; 33 102 | M. Wagner et al., IRK M. Bhat et al., BNL, ANL | 1991 1990 | Original E-6 |
| 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 1st 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 |
| JAERI | - | Japanese Atomic Energy Research Inst., Tokai |

LANL - Los Alamos National Laboratory, New Mexico
LLNL - Lawrence Livermore National Laboratory, California
ORNL - Oak Ridge National Laboratory, Tennessee
Petten - Netherland's Energy Research Foundation, Petten
SRL - Savannah River Laboratory, South Carolina

*** The cross sections and covariance matrices for ${}^6\text{Li}(n, a)$, ${}^{10}\text{B}(n, a0)$, ${}^{10}\text{B}(n, a1)$, ${}^{197}\text{Au}(n, g)$, ${}^{235}\text{U}(n, f)$ and ${}^{239}\text{Pu}(n, f)$ 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.