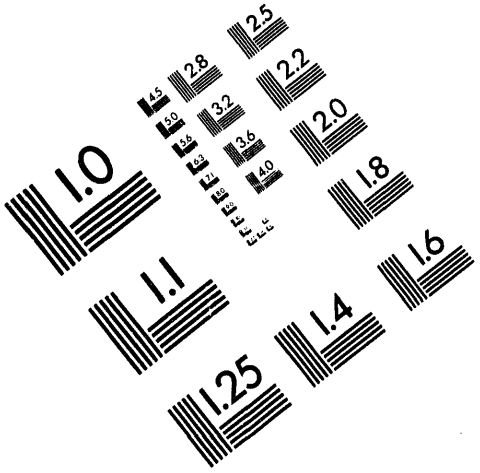
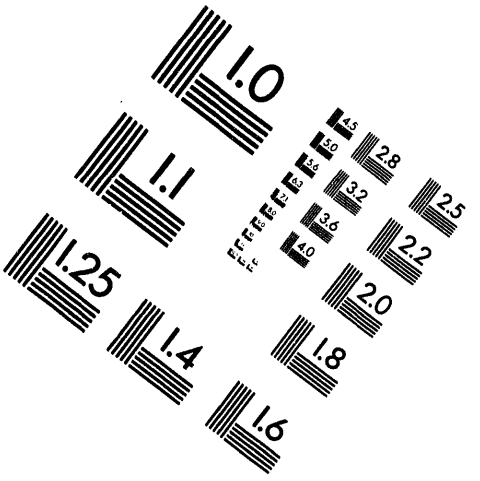
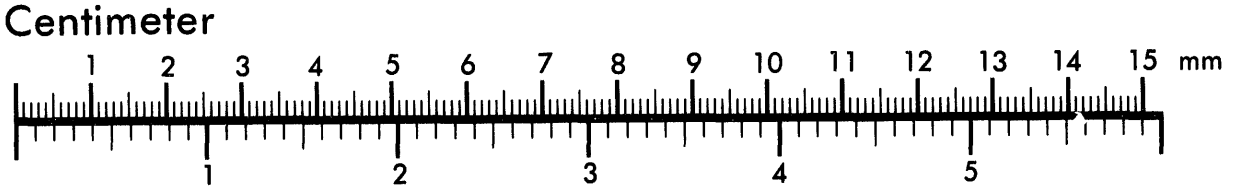
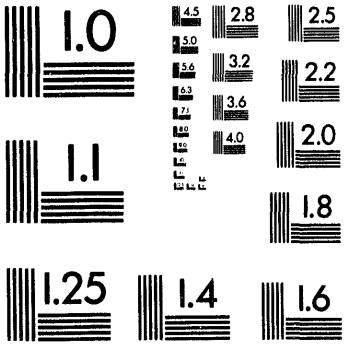
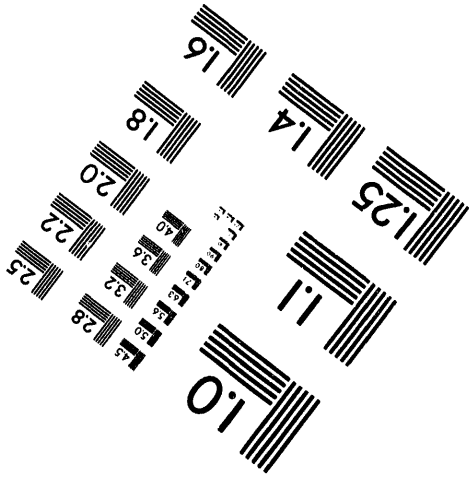


Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

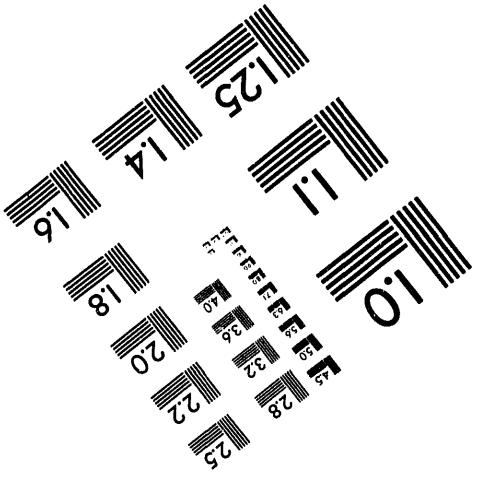








MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.



1 of 1

LA-UR 94-2520

Conf-941102--14

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

TITLE: MCNP ENDF/B-VI IRON BENCHMARK CALCULATIONS

AUTHOR(S): J. David Court
John S. Hendricks

SUBMITTED TO: ANS 1994 Winter Meeting, Washington, D.C.
November 13-17, 1994

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes.

The Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

MASTER

FORM NO 836 R4
ST NO 2629 5/81

MCNP™ ENDF/B-VI IRON BENCHMARK CALCULATIONS

J. David Court and John S. Hendricks

Los Alamos National Laboratory

Four iron shielding benchmarks have been calculated for, we believe the first time, with MCNP4A[1] and its new ENDF/B-VI library.[2] These calculations are part of the Hiroshima/Nagasaki dose re-evaluation for the National Academy of Sciences and the Defense Nuclear Agency. We believe these calculations are significant because they validate MCNP and the new ENDF/B-VI libraries. These calculations are compared to ENDF/B-V, experiment, and in some cases the recommended MCNP data library (a T-2 evaluation) and ENDF/IV.

The first iron shielding benchmarks are the Livermore pulsed sphere experiments[3,4] from the 1960's. These consist of a 14-MeV pulsed D-T neutron source in spheres of different materials and thicknesses and measured with time-of-flight detectors. The iron experiments were for iron spheres of 0.9 and 4.8 mean free paths. In addition to comparing the detailed energy spectrum from 2-MeV to 16 MeV, the integrals of emerging neutrons are tabulated in two bins: 2 - 16 MeV and 12 - 16 MeV. These data are presented in Table 1.

The second benchmark experiment is the Oak Ridge fusion shielding benchmark devised by Santoro in the early 80's.[4,5] The experiment consists of a monodirectional 14-MeV D-T neutron source impinging upon three configurations of steel shielding. Concrete and borated polyethylene are also important shielding

MCNP™ is a trademark of the Regents of the University of California, Los Alamos National Laboratory.

materials in the problem. Detectors are located both on and off-axis from the incident beam. The different data libraries used in the calculation and the different shielding configurations and detector locations provide a large number of spectra to compare. The spectra for ENDF/B-VI, configuration 1, and the on-axis detector is shown in Fig. 1, coplotted against experimental upper and lower energy. The agreement between all data versions and the experiment are within 50% which is excellent for deep penetration problems. Note that agreement is always bad in the 7.5 to 9.5 MeV energy range where the computational unfolding routines that were used to process the experimental data produce a nonphysical dip in the neutron spectra.

The third shielding benchmark experiment is a 76-cm diameter iron sphere with a Cf-252 fission source in the 15.3 cm diameter cavity in the center.[6] These results are consistent with the Livermore Pulsed Spheres.

The fourth and final shielding benchmark experiment is the Oak Ridge iron benchmark with a fission source.[7] A reactor beam port emits neutrons in the range thermal - 10 MeV which impinge on iron thicknesses up to 92 cm (13 mean free paths) thick. Detectors are placed about a meter behind the iron slabs at various angles relative to the incident neutron beam. For the most part the calculations are within the quoted 15% experimental uncertainty.

REFERENCES

1. Judith F. Briesmeister, Ed., "MCNP4A - A General Monte Carlo N-Particle Transport Code," LA-12625-M, Los Alamos National Laboratory Report, November 1993.

2. John S. Hendricks , Stephanie C. Frankle, and John D. Court, "New Data for MCNP," submitted to the *ANS 1994 Winter Meeting*, November 13-17, 1994, Washington, D.C.

3. C. Wong, J. D. Anderson, P. Brown, L. F. Hansen, J. L. Kammerdiener, C. Logan, and B. Pohl, "Livermore Pulsed Sphere Program: Program Summary Through July 1971," Lawrence Livermore National Laboratory report UCRL-51144 Rev. 1 (1972).

4. D. J. Whalen, D. A. Cardon, J. L. Uhle, and J. S. Hendricks, "MCNP: Neutron Benchmark Problems," Los Alamos National Laboratory report LA-12212 (1991).

5. R. T. Santoro, R. G. Alsmiller, J. M. Barnes, and G. T. Chapman, "Calculation of Neutron and Gamma-Ray Spectra for Fusion Reactor Shield Design: Comparison with Experiment, "*Nuclear Science and Engineering,* **78**, 259-272 (1981)

6. R. H. Johnson, J. J. Dorning, B. W. Wehring, "Integral tests of Neutron Cross Sections for Iron above 1 MeV," *Transactions of the American Nuclear Society,* xx, p799 (19xx)

7. ORNL-4892

TABLE 1

LIVERMORE IRON PULSED SPHERE CALCULATIONS

(DEVIATION FROM EXPERIMENT)

sphere radius (mfp)	.9	.9	4.8	4.8
energy range (MeV)	12-16	2-16	12-16	2-16
Data Set				
ENDF/B-V	-1.1%	-1.6%	-13.4%	-16.6%
T-2	.1%	.7%	- 6.6%	- 5.4%
ENDF/B-VI	-.1%	.6%	- 9.7%	- 4.8%

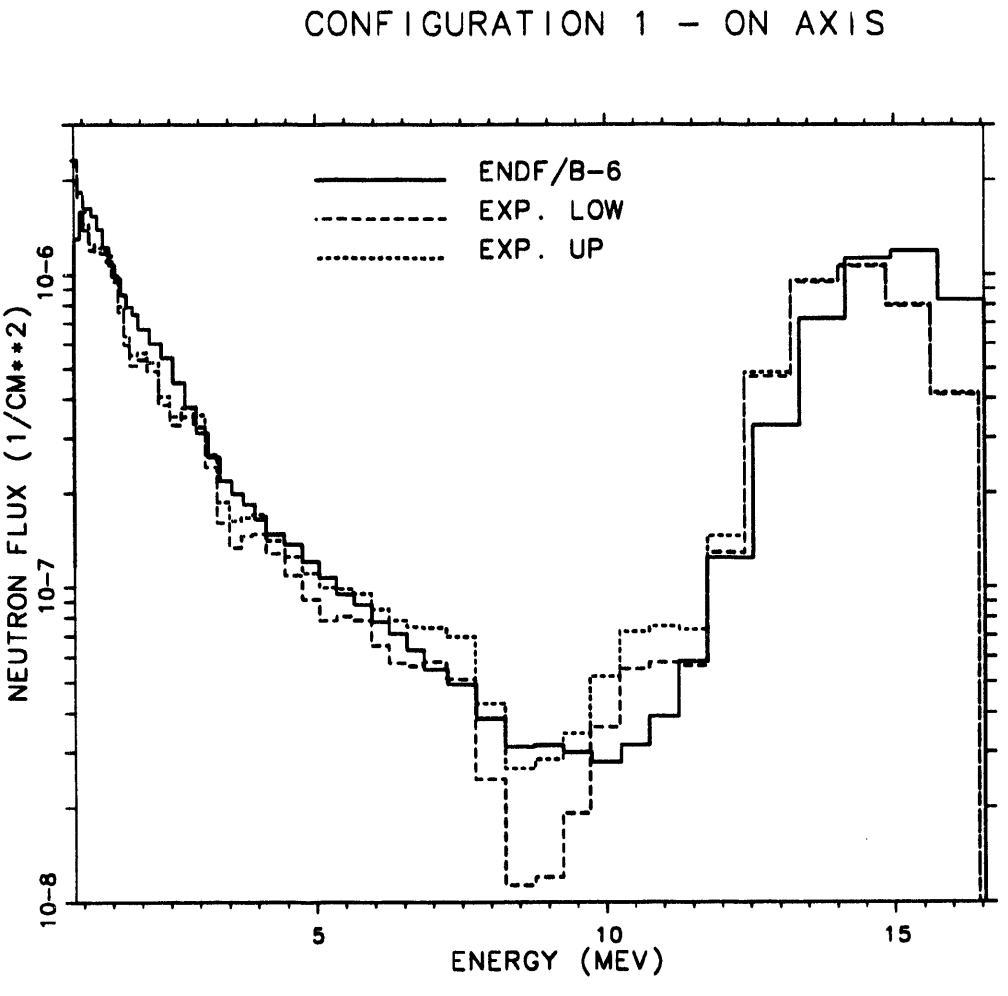


Fig. 1. Oak Ridge Fusion Shielding Benchmark for Iron results. The dashed lines show the upper and lower bounds of the experimental data and the solid line is the ENDF/B-VI results.

DATE FILMED

10/5/94

END