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TITLE: **Testing of the ENDF/B-VI Neutron Data Library ENDF60 for use with MCNP™**

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Testing of the ENDF/B-VI Neutron Data Library ENDF60 for use with MCNP™

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The continuous-energy neutron data library ENDF60, for use with the Monte Carlo N-Particle radiation transport code MCNP4A, was released in the fall of 1994.[1] The ENDF60 library is comprised of 124 nuclide data files based on the ENDF/B-VI evaluations through Release 2. Fifty-two percent of the ENDF/B-VI evaluations are translations from ENDF/B-V. The remaining forty-eight percent are new evaluations which have sometimes changed significantly. MCNP4A has added three new ENDF/B-VI scattering laws to fully utilize the ENDF/B-VI evaluations. This includes new data formats and processing, transport physics, and next-event estimator (point detector) sampling schemes. These three laws are the Kalbach-87 formalism (ENDF/B-VI file 6 LAW=1, LANG=2), correlated angle-energy scattering (ENDF/B-VI file 6 LAW=7), and the phase-space law (ENDF/B-VI file 6 LAW=6). Extensive tests were carried out to ensure that the new scattering laws were properly implemented in MCNP4A and that both transport and next-event estimator solutions agreed.

A number of new quality assurance tests for the ENDF60 library were implemented by the Nuclear Theory and Applications group, T-2, and the Radiation Transport group, X-6. Among these tests were a number of benchmark and comparison simulations that were performed by X-6. In particular, the ENDF60 data library was compared with previously available data libraries for a set of infinite medium simulations and photon-production simulations.[2] The library was also compared with experimental benchmarks using the Lawrence Livermore Pulsed Sphere experiments and a set of four iron benchmark experiments.[3-4] Additionally, results from the ENDF60 library and ENDF/B-V data libraries were compared for a set of nine benchmark critical assemblies, some of which have been simplified, and for a set of twenty-five benchmark problems for the KENO code.[5-6] Some of the KENO code benchmark problems are repeats of one another and some are fictitious such as an infinite cylinder. Tables 1 and 2 show the results from both sets of criticality

benchmarks using the ENDF/B-V based data libraries and the ENDF60 data library. The combined results from all of the quality assurance tests indicate that the ENDF60 data library gives similar results to previous data libraries for criticality simulations, while making substantial improvements for some specific nuclides. Additionally, a number of ENDF/B-VI evaluations have been revised for Release 3 anticipated in the spring of 1995. Results from these newly revised evaluations for the criticality benchmarks will also be discussed.

The Radiation Shielding Information Center's (RSIC) release package contains the ENDF60 neutron library, a new photon library MCPLIB02, the electron library EL1, and an updated XSDIR file. The new photon library MCPLIB02 extends the photon interaction data from 100 MeV to 100 GeV, based upon the Lawrence Livermore National Laboratory (LLNL) Evaluated Photon Data Library (EPDL).

1 "ENDF/B-VI Data for MCNP", J. Hendricks, S. Frankle, and J. Court, Los Alamos National Laboratory Report, LA-12891.

2 "MCNP ENDF/B-VI Validation: Infinite Media Comparisons of ENDF/B-VI and ENDF/B-V", J. Court, J. Hendricks, and S. Frankle, Los Alamos National Laboratory Report, LA-12887.

3 "Lawerence Livermore Pulsed Sphere Benchmark Analysis of MCNP ENDF/B-VI", J. Court, R. Brockhoff, and J. Hendricks, Los Alamos National Laboratory Report, LA-12885.

4 "Benchmark Analysis of MCNP ENDF/B-VI Iron", J. Court and J. Hendricks, Los Alamos National Laboratory Report, LA-12884.

5 "MCNP: Neutorn Benchmark Problems", D. Whalen et al, Los Alamos National Laboratory Report, LA-12212.

6 "MCNP: Criticality Safety Benchmark Problems", J. Wagner, J. Sisolak, and G. McKinney, Los Alamos National Laboratory Report, LA-12415.

Table 1: Critical Assembly Benchmarks

	T-2	ENDF/B-V	ENDF/B-VI
Godiva 93.71% Enriched Bare Sphere	*	1.00008±0.00104	0.99525±0.00108
Jezebel - 95.5% Enriched ^{239}Pu	0.99857±0.00212	1.01510±0.00223	1.00226±0.00217
Jezebel - 80% Enriched ^{239}Pu	1.00799±0.00121	1.01595±0.00120	1.00970±0.00116
Uranium Cylinder 10.9% Enriched ^{235}U	*	1.00095±0.00056	0.99980±0.00049
Uranium Cylinder 14.11% Enriched ^{235}U	*	1.00087±0.00056	0.99715±0.00047
Graphite-Tamped Uranium Sphere	0.98850±0.00110	0.98690±0.00102	0.98998±0.00105
Water-Reflected Uranium Sphere	*	0.99667±0.00190	0.99606±0.00191
Three Cylinders of Uranium Solution	*	1.00153±0.00126	0.99611±0.00136
3x3 Array of Pu Fuel Rods	1.00082±0.00174	1.00757±0.00169	0.99916±0.00154

Table 2: KENO Benchmarks

	ENDF/B-V	ENDF/B-VI
Keno 1	0.99987±0.00093	0.99365±0.00087
Keno 2	0.99987±0.00093	0.99365±0.00087
Keno 3	0.99933±0.00112	1.00015±0.00109
Keno 4	1.00084±0.00282	0.99983±0.00258
Keno 5	1.00042±0.00281	1.00441±0.00293
Keno 6	0.74606±0.00074	0.74257±0.00071
Keno 7	1.00022±0.00083	0.99536±0.00079
Keno 8	0.94036±0.00085	0.93807±0.00070
Keno 9	2.29097±0.00100	2.25973±0.00093
Keno 10	0.99987±0.00093	0.99365±0.00087
Keno 11	0.99987±0.00093	0.99365±0.00087
Keno 12	0.99869±0.00121	0.99940±0.00127
Keno 13	0.99489±0.00084	0.99141±0.00081
Keno 14	0.99849±0.00084	0.99686±0.00082
Keno 15	1.00155±0.00097	1.00027±0.00109
Keno 16	0.99066±0.00093	0.99235±0.00089
Keno 17	1.00290±0.00143	0.99862±0.00152
Keno 18	1.02802±0.00123	1.03085±0.00128
Keno 19	0.99869±0.00121	0.99940±0.00127
Keno 20	0.99707±0.00133	0.99809±0.00147
Keno 21	0.99510±0.00082	0.99292±0.00089
Keno 22	0.99775±0.00082	0.99551±0.00082
Keno 23	0.99987±0.00093	0.99365±0.00087
Keno 24	0.99819±0.00081	0.99440±0.00085
Keno 25	1.00115±0.00090	0.99516±0.00088