

LA-UR-04-8965

Approved for public release;
distribution is unlimited.

Title: Bibliography of MCNP™ Verification and Validation: 2004

Author(s): Russell D. Mosteller

Submitted to:



Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the U.S. Department of Energy under contract W-7405-ENG-36. 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. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Form 836 (8/00)



Bibliography of MCNP™ Verification and Validation: 2004

A list of publications during the year 2004 has been compiled on the subject of verification and validation of the MCNP Monte Carlo code. This compilation supplements a previous one that listed publications from 1990 through 2003. The list includes journal articles, papers presented at scientific and technical conferences, Los Alamos National Laboratory reports, and evaluations from the International Handbook of Evaluated Criticality Safety Benchmark Experiments.

1 OVERVIEW

The MCNP Monte Carlo code¹ has a wide range of applications, including radiation protection and dosimetry, radiation shielding, criticality, medical physics, and oil well logging, to mention only a few. In order to better document the verification and validation of the code for these and other purposes, lists of publications on that topic that appeared during 2004 are presented herein. A previous compilation² covers the time span from 1990 through 2003. The lists include journal articles, papers presented at scientific and technical conferences, Los Alamos National Laboratory (LANL) reports, and evaluations from the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*.³

Three general criteria were applied to determine whether a paper or report should be cited herein. First, it must contain a comparison between MCNP results and results from another source, such as measurements, calculations with other codes, or analytic solutions. Second, a LANL staff member had to make a substantive contribution to the study. Third, the paper or report must contain a reasonably detailed description of the comparisons being made and the basis for those comparisons. Accordingly, abstracts and short summaries, such as those contained in the *Transactions of the American Nuclear Society*, are not cited herein.

2 ARTICLES IN SCIENTIFIC AND TECHNICAL JOURNALS

Table 1 presents a list of articles published in scientific and technical journals in 2004.

3 PAPERS PRESENTED AT CONFERENCES AND TOPICAL MEETINGS

Table 2 presents a list of papers presented at conferences and topical meetings during 2004, most of them sponsored by the American Nuclear Society.

4 LOS ALAMOS NATIONAL LABORATORY REPORTS

LANL publishes reports in a variety of formats, including formal research reports and less formal reports with more limited scope. Informal LANL reports involving verification or validation of MCNP are listed in Table 3, in descending chronological order. These reports typically fall within one of three categories: (1) papers that have been submitted for publication but not yet published, (2) papers presented at meetings for which no formal proceedings were published, and (3) papers with such a narrow scope that they are not appropriate for research reports.

5 EVALUATIONS IN THE *INTERNATIONAL HANDBOOK OF EVALUATED CRITICALITY SAFETY BENCHMARK EXPERIMENTS*

The 2004 edition of the *Handbook* contains benchmark specifications for 3,331 different critical experiments. Those specifications were prepared by participants from 13 different countries and appear in 379 separate evaluations.

The evaluations in the *Handbook* have undergone three separate levels of review. First, the evaluation is reviewed for completeness and consistency by an “internal reviewer,” who belongs to the same organization as the evaluator(s). Second, it is reviewed in detail by an “external reviewer,” who belongs to a different organization than the evaluator(s). Finally, it is reviewed by the members of the International Criticality Safety Benchmark Evaluation Project and discussed at one or more of their annual meetings. After each level of the review, a list of comments, suggestions, and/or corrections is given to the evaluator(s), who must then respond to them. After a consensus is reached, the revised evaluation moves along to the next review level. Consequently, the evaluation has received extensive scrutiny before it is incorporated into the *Handbook*. Each evaluation includes sample results from two or more combinations of codes and nuclear data libraries. With very few exceptions, one of those codes is MCNP.

A list of evaluations written and reviewed by LANL staff members is given in Table 4, in the order in which they appear in the *Handbook*. Each evaluation includes results from an MCNP calculation for each benchmark within it, based on input that was prepared by a LANL staff member. Comparisons between the benchmark values for k_{eff} and the corresponding value calculated with MCNP appear in a table in Section 4 of each evaluation.

6 REFERENCES

1. X-5 Monte Carlo Team, "MCNP — A General Monte Carlo N-Particle Transport Code, Version 5, Volume I: Overview and Theory," Los Alamos National Laboratory report LA-UR-03-1987 (2003).
2. Russell D. Mosteller, "Bibliography of MCNP Verification and Validation: 1990 - 2003," Los Alamos National Laboratory report LA-UR-03-9032 (2003).
3. *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, OECD Nuclear Energy Agency report NEA/NSC/DOC(95)03 (rev., 2004).

Table 1. Articles in Scientific and Technical Journals

1. Rene Sanchez, David J. Loaiza, Glenn Brunson, and Robert Kimpland, "Critical Experiments Mixed with Highly Enriched Uranium and Matrix Elements (Si, Mg, Al, Gd, and Fe)," *Nucl. Sci. Eng.*, **147**, pp. 307-318 (July 2004).
2. F. B. Brown and W. R. Martin, "Stochastic Geometry Capability in MCNP5 for the Analysis of Particle Fuel," *Ann. Nucl. Energy*, **31**, pp. 2039-2047 (November 2004).
3. Taro Ueki, Forrest B. Brown, D. Kent Parsons, and James S. Warsa, "Time Series Analysis of Monte Carlo Fission Sources — I: Dominance Ratio Computation," *Nucl. Sci. Eng.*, **148**, pp. 374-390 (November 2004).
4. Thomas E. Booth, "Ex Post Facto Monte Carlo Variance Reduction," *Nucl. Sci. Eng.*, **148**, pp. 391-402 (November 2004).

Table 2. Papers Presented at Conferences and Topical Meetings

1. W. S. Kiger, III, A. G. Hochberg, J. R. Albritton, and Tim Goorley, "Performance Enhancements of MCNP4B, MCNP5, and MCNPX for Monte Carlo Radiotherapy Planning Calculations in Lattice Geometries," *Proceedings of the 11th International Symposia on Neutron Capture Therapy*, Boston, MA, USA (October 2004).
2. Russell D. Mosteller, "Comparison of Results from the MCNP Criticality Validation Suite Using ENDF/B-VI and Preliminary ENDF/B-VII Nuclear Data," *International Conference on Nuclear Data for Science and Technology (ND2004)*, Santa Fe, New Mexico (September 2004).
3. J. S. Bull, H. G. Hughes, P. L. Walstrom, J. D. Zumbro, and N. V. Mokhov, "Magnetic Field Tracking With MCNP5," *Proceedings of the 10th International Conference on Radiation Shielding*, Madeira, Funchal, Portugal (May 2004).
4. John D. Zumbro, Angela Acuff, Jeffrey S. Bull, H. Grady Hughes, Richard E. Prael, and Elizabeth C. Selcow, "Proton Radiography Applications with MCNP5," *Proceedings of the 10th International Conference on Radiation Shielding*, Madeira, Funchal, Portugal (May 2004).
5. Forrest B. Brown, Jeremy E. Sweezy, and Robert Hayes, "Monte Carlo Parameter Studies and Uncertainty Analyses with MCNP5," *Proceedings of PHYSOR 2004, The Physics of Fuel Cycles and Advanced Nuclear Systems: Global Developments*, Chicago, Illinois (April 2004).
6. Russell D. Mosteller, "ENDF/B-V and ENDF/B-VI Calculations for the LWBR SB Core Benchmarks with MCNP5," *Proceedings of PHYSOR 2004, The Physics of Fuel Cycles and Advanced Nuclear Systems: Global Developments*, Chicago, Illinois (April 2004).
7. Russell D. Mosteller, "An Assessment of ENDF/B-VI Releases Using the MCNP Criticality Validation Suite," *Proceedings of PHYSOR 2004, The Physics of Fuel Cycles and Advanced Nuclear Systems: Global Developments*, Chicago, Illinois (April 2004).
8. Russell D. Mosteller, David J. Loaiza, and Rene G. Sanchez, "Creation of a Simplified Benchmark Model for the Neptunium Sphere Experiment," *Proceedings of PHYSOR 2004, The Physics of Fuel Cycles and Advanced Nuclear Systems: Global Developments*, Chicago, Illinois (April 2004).

Table 3. Los Alamos National Laboratory Informal Reports

1. F.B. Brown, W.R. Martin, W. Ji, J.L. Conlin, and J.C. Lee, "Stochastic Geometry and HTGR Modeling for MCNP5," LA-UR-04-8668 (2004).
2. Russell D. Mosteller, Peter J. Jaegers, and Roger W. Brewer, "Analysis of the Fourth Zeus Critical Experiment with MCNP5™," LA-UR-04-8453 (2004).
3. Russell D. Mosteller and Robert C. Little, "ENDF/B-VI and Preliminary ENDF/B-VII Results for the MCNP Criticality Validation Suite," LA-UR-04-7356 (2004).
4. F.B. Brown and R.D. Mosteller, "MCNP5 Workshop – PHYSOR-2004," LA-UR-04-2647 (2004).

Table 4. Evaluations in the International Handbook of Evaluated Criticality Safety Benchmark Experiments: LANL Evaluations

1. R. W. Brewer, "Benchmark Experiments Using HEU Plates Reflected by Lithium Deuteride," HEU-MET-FAST-063 (R. D. Mosteller, internal reviewer).
2. David K. Hayes, "Zeus: Fast-Spectrum Critical Assemblies with an Iron-HEU Core Surrounded by a Copper Reflector," HEU-MET-FAST-072 (Rene Sanchez, internal reviewer).
3. Russell D. Mosteller, Roger W. Brewer, and Joseph Sapir, "The First Set of Zeus Experiments: Intermediate-Spectrum Critical Assemblies with a Graphite-HEU Core Surrounded by a Copper Reflector," HEU-MET-INTER-006 (Roger W. Brewer and David Loaiza, internal reviewers).
4. David Loaiza, "2 x 2 x 26 Array of Highly Enriched Uranium with Aluminum, Moderated and Reflected by Polyethylene," HEU-MET-THERM-012 (Rene Sanchez, internal reviewer).
5. Rene Sanchez and David Loaiza, "Polyethylene Reflected and Moderated Highly Enriched Uranium System with Concrete," HEU-MET-THERM-018 (David Loaiza, internal reviewer).
6. David Loaiza, "Neptunium-237 Sphere Surrounded by Highly Enriched Uranium and Reflected by Low-Carbon Steel," SPEC-MET-FAST-014 (Rene Sanchez, internal reviewer).