

JOHN C. WAGNER

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ACADEMIC SUMMARY

Pennsylvania State University

Doctor of Philosophy in Nuclear Engineering, December 1997

Thesis title: *Acceleration of Monte Carlo Shielding Calculations with an Automated Variance Reduction Technique and Parallel Processing*

Pennsylvania State University

Master of Science in Nuclear Engineering, December 1994

Thesis title: *Monte Carlo Transport Calculations and Analysis for Reactor Pressure Vessel Neutron Fluence*

University of Missouri-Rolla

Bachelor of Science in Nuclear Engineering, May 1992

WORK EXPERIENCE

Oak Ridge National Laboratory, Research & Development Staff

Nuclear Analysis Methods and Applications Group, Nuclear Science and Technology Division

Supervisor: Dr. Cecil V. Parks

6/99-Present Performing various tasks related to the development and applications of methods for criticality safety, radiation shielding and spent fuel characterization, with emphasis in the areas of Burnup Credit for spent fuel storage, transport, and long-term disposal and variance reduction for Monte Carlo shielding calculations. Completed and on-going projects include:

- Performed numerous studies related to the reactivity of commercial spent nuclear fuel to support existing USNRC regulatory guidance on burnup credit for storage and transport, and to provide technical justifications and recommendations for future expansion of burnup credit. Efforts included (1) development of a computational benchmark for the assessment of reactivity margins in a burnup credit cask; (2) studies of reactivity margins associated with fission products, depletion conditions, cooling time, spatial burnup distributions, burnable poison rods, integral burnable absorbers, control rods, and axial power shaping rods; and (3) support of USNRC Phenomenon Identification and Ranking Table (PIRT) process for burnup credit.
- Automated variance reduction for Monte Carlo fixed source calculations based on discrete ordinates adjoint functions. Currently developing a code for automated generation of deterministic importance functions based on 3-D adjoint discrete ordinates calculations and subsequent calculation of variance reduction parameters.

Holtec International, Principal Engineer

Supervisor: Mr. Michael McNamara

7/97-6/99 Accomplishments and responsibilities included:

- Criticality safety analyses for dry spent fuel storage
 - Performed criticality safety analyses, using MCNP and KENO, for HI-STAR 100 spent fuel storage/transport system and HI-STORM 100 storage system, in accordance with 10CFR71 and 10CFR72.
 - Lead author of criticality chapters for the HI-STAR 100 TSAR and SAR and HI-STORM 100 TSAR.
 - Experience interacting with the USNRC reviewers, culminating in the resolution of all criticality related questions and their issuance of draft Safety Evaluation Reports (SERs) and Certifications of Compliance (CoCs) for the HI-STAR 100 storage and transport system.
 - Assisted in the preparation of proposals, including development of new basket design(s).

WORK EXPERIENCE (continued)

- Criticality safety analyses for wet spent fuel storage
 - Performed criticality safety analyses, using MCNP, KENO, and CASMO, to support re-racking spent fuel pools for maximum capacity, in accordance with 10CFR50. In addition to the analyses themselves, the responsibilities included: preparation of the criticality safety related chapter (Chapter 4) of the License Amendment Reports, resolution of comments and questions by the utilities, and finally, where necessary, resolution of questions by the USNRC reviewers.
 - Performed criticality safety analyses for a number of specific purposes other than re-racking, including: expansion of storage capacity, qualification of new fuel types for storage in existing racks, and analysis/qualification of damaged fuel for storage.
 - Assisted in the preparation of proposals, including development of proposed rack design(s).
- Shielding analyses for dry spent fuel storage
 - Consultant and technical reviewer for shielding analyses, using SAS2H, ORIGEN-S, and MCNP, for HI-STAR 100 spent fuel storage/transport system and HI-STORM 100 storage system, in accordance with 10CFR71 and 10CFR72.
 - Development of more efficient methods for Monte Carlo radiation shielding calculations.

Pennsylvania State University, Graduate Research Assistant

Advisor: Prof. Alireza Haghighat, Nuclear Engineering Department

8/92 - 7/97 Completed projects include:

- Code development for automatic variance reduction of Monte Carlo (MCNP) calculations using three-dimensional discrete ordinate adjoint functions, resulting in a new code, A³MCNP, which is capable of (1) automatic generation of input files for 3-D S_N TORT calculations, including mesh generation and cross section processing and (2) automatic and effective calculation and utilization of variance reduction parameters (coupled source biasing parameters and cell independent weight windows) from S_N adjoint functions to accelerate Monte Carlo calculations;
- Adaptation of MCNP for parallel processing with the Message Passing Interface (MPI);
- Monte Carlo calculations and analyses of reactor pressure vessel neutron fluence for Three Mile Island Unit 1 (TMI-1), including detailed comparisons to measured data and deterministic (DORT) results;
- Co-organizer and co-instructor of the International Workshop/Training Course on Transport Methodologies and Uncertainty Estimation for PWR Pressure Vessel Fluence and BWR Shield/Shroud Dose Calculations (June 19-23, 1995), the Second International Training Course/Workshop on Methodologies for Particle Transport Simulation and Their Application to Reactor Dosimetry/Shielding (June 2-7, 1996), and the Third International Training Course/Workshop on Methodologies for Particle Transport Simulation and Their Application to Reactor Dosimetry/Shielding (May 19-23, 1997);
- Monte Carlo design/optimization studies for the Penn State Breazeale Reactor's (PSBR) D₂O tank and collimator to improve the imaging capabilities at the PSBR; and
- Characterization of the neutron and gamma radiation environments at the Army Pulse Radiation Facility (APRF) with the Monte Carlo method, including comparisons to measured data.

Holtec International, Consultant

Contacts: Dr. Stanley E. Turner and Everett L. Redmond II

9/96 - 3/97 Performed technical review of criticality (MCNP & KENO) and shielding (SAS2H, ORIGEN-S & MCNP) calculations associated with the NRC license submittal for the HI-STAR 100 and HI-STORM 100 spent fuel storage/transport systems and shielding analysis for the Private Fuel Storage Facility.

Los Alamos National Laboratory, Graduate Research Assistant

Radiation Transport Group (X-6/XTM), Applied Theoretical Physics Division

Supervisor: Dr. John S. Hendricks

5/94 - 7/94 Improved and enhanced the CRSRD computer code, which translates multigroup cross sections into a format suitable to MCNP. Assumed the major portion of the responsibility for coordinating and teaching the MCNP Multigroup/Adjoint Course (LANL, June 6-7, 1994).

Supervisor: Dr. John S. Hendricks

5/93 - 8/93 Investigated the usage and validity of the general purpose Monte Carlo transport code MCNP for multigroup/adjoint calculations. Published as LA-12704, "MCNP: Multigroup/Adjoint Capabilities."

WORK EXPERIENCE (continued)

Supervisor: Dr. Gregg W. McKinney

- 6/92 - 8/92 Investigated the suitability of the general purpose Monte Carlo transport code MCNP for criticality safety calculations. Compared MCNP and KENO results for benchmarking purposes. Published as LA-12415, "MCNP: Criticality Safety Benchmark Problems."

Oak Ridge National Laboratory, Summer Research Participant

Research Reactors Division

Supervisors: Dr. David H. Cook and B. Lamar Lepard

- 6/91 - 8/91 Two major projects included: (1) safety evaluation of the proposed High Flux Isotope Reactor (HFIR) fire protection system and (2) determination of hydrogen accumulation in pony motor battery rooms.

CITIZENSHIP / SECURITY CLEARANCE

US Citizen

- 6/93-4/97 Active Department of Energy (DOE) Q-level security clearance
2/99-Present Active Department of Energy (DOE) L-level security clearance

HONORS & ACTIVITIES

- Best Benchmarking Paper Award from the Math & Computations Division of the ANS (M&C Meeting, Portland, OR, May 1995)
- Best Paper Award in Reactor Physics at 1993 ANS Student Conference (Rensselaer Polytechnic Institute)
- INPO Fellowship 1992-1993
- Power Engineering Scholarship, 1991
- Reviewer for *Nuclear Technology* and *Nuclear Science & Engineering*, 1999 to present
- Reviewer for the ANS/ASTM 9th Intl. Symposium on Reactor Dosimetry, Sept. 1996
- Member of the American Nuclear Society (ANS)
- Elected to Executive Committee, Mathematics & Computation Division, ANS, 2001-2004
- Elected to Board, ANS Oak Ridge/Knoxville Local Section, 2001-2004
- Member of the Alpha Nu Sigma - Nuclear Engineering Honor Society
- Member of ANS Standards Committee 19.10, "Fast Neutron Fluence in Light Water Reactor Pressure Vessels."

PUBLICATIONS

1. J.C. WAGNER, J.E. SISOLAK, and G.W. MCKINNEY, "MCNP: Criticality Safety Benchmark Problems," LA-12415, Los Alamos National Laboratory (1992).
2. J.C. WAGNER, A. HAGHIGHAT, and B.G. PETROVIC, "Investigation of Pressure Vessel Neutron Fluence Calculation with Monte Carlo," *Trans. Am. Nucl. Soc.*, **68** 446-448 (1993).
3. G.W. MCKINNEY, J.C. WAGNER, and J.E. SISOLAK, "MCNP/KENO Criticality Comparison," *Proc. of the Topical Meeting on Physics and Methods in Criticality Safety*, Nashville, TN, September 19-23, American Nuclear Society, Order 700186, 207 (1993).
4. J.C. WAGNER, E.L. REDMOND II, S.P. PALMTAG, and J.S. HENDRICKS, "MCNP: Multigroup/Adjoint Capabilities," LA-12704, Los Alamos National Laboratory (1994).
5. J.C. WAGNER, A. HAGHIGHAT, and B.G. PETROVIC, "Comparison of Monte Carlo and Synthesized 3-D Deterministic Models for Reactor Cavity Dosimetry Calculations," *Proc. of the Eighth Int. Conf. on Radiation Shielding*, Arlington, TX, 714-720 (Apr. 1994).

PUBLICATIONS (continued)

6. J.C. WAGNER, A. HAGHIGHAT, and B.G. PETROVIC, "Multigroup Versus Continuous-Energy MCNP for PWR Fluence Calculations," *Trans. Am. Nucl. Soc.*, **70** 378-380 (1994).
7. J.C. WAGNER, "Monte Carlo Transport Calculations and Analysis for Reactor Pressure Vessel Neutron Fluence," *MS Thesis*, The Pennsylvania State University, Nuclear Engineering (Dec. 1994).
8. J.C. WAGNER, A. HAGHIGHAT, B.G. PETROVIC, and H.L. HANSHAW, "Benchmarking of Synthesized 3-D Sn Transport Methods for Pressure Vessel Fluence Calculations with Monte Carlo," *Proc. Int. Conf. on Mathematics and Computations, Reactor Physics, and Environmental Analyses*, Portland, OR, 1214-1222 (May 1995). (Best benchmark paper award)
9. H.L. HANSHAW, A. HAGHIGHAT, and J.C. WAGNER, "Multigroup Cross-Section Generation with Spatial and Angular Adjoint Weighting," *Trans. Am. Nucl. Soc.*, **73** 175-177 (1995).
10. J.C. WAGNER and A. HAGHIGHAT, "Deterministic Adjoint Functions for Biasing Monte Carlo Reactor Cavity Dosimetry Calculations," *Trans. Am. Nucl. Soc.*, **73** 432-434 (1995).
11. J.C. WAGNER, A. HAGHIGHAT, and B.G. PETROVIC, "Monte Carlo Transport Calculations and Analysis for Reactor Pressure Vessel Neutron Fluence," *Nucl. Technol.*, **114** 373-398 (1996).
12. A. HAGHIGHAT, H.L. HANSHAW, and J.C. WAGNER, "Multigroup Cross Section Generation with Adjoint Weighting and its Application to PV Dosimetry," *1996 Radiation Protection & Shielding Topical Meeting*, No. Falmouth, MA, 173-180 (Apr. 1996).
13. J.C. WAGNER and A. HAGHIGHAT, "Application of the Discrete Ordinates Adjoint Function to Accelerating Monte Carlo Reactor Cavity Dosimetry Calculations," *1996 Radiation Protection & Shielding Topical Meeting*, No. Falmouth, MA, 345-352 (Apr. 1996).
14. A. HAGHIGHAT, B. PETROVIC, J.C. WAGNER, H.L. HANSHAW, and M. MAHGEREFTEH, "Uncertainties in Transport Theory Pressure Vessel Neutron Fluence Calculations," *Trans. Am. Nucl. Soc.*, **74** 140-142 (1996).
15. J.C. WAGNER, A.J. BARATTA, and J.W. GERDES, "Characterization of the Radiation Environment at the Army Pulse Radiation Facility with Monte Carlo," *Ninth Intl. Symposium on Reactor Dosimetry*, Prague, Czech Republic, 762-769, September 2-6, 1996.
16. J.C. WAGNER and A. HAGHIGHAT, "Acceleration of Monte Carlo Reactor Cavity Dosimetry Calculations with the Discrete Ordinates Adjoint Function," *Ninth Intl. Symposium on Reactor Dosimetry*, Prague, Czech Republic, 754-761, September 2-6, 1996.
17. J.C. WAGNER and A. HAGHIGHAT, "Parallel MCNP Monte Carlo Transport Calculations with MPI," *Trans. Am. Nucl. Soc.*, **75** 338-339 (1996).
18. J.C. WAGNER and A. HAGHIGHAT, "Monte Carlo PWR Cavity Dosimetry Calculations using an Automatic Variance Reduction Technique," invited, *Joint Int. Conf. on Mathematical Methods and Supercomputing for Nuclear Applications*, Saratoga Springs, 1031-1039, October 6-10, 1997.
19. J.C. WAGNER and A. HAGHIGHAT, "Automatic Variance Reduction for Monte Carlo Shielding Calculations with the Discrete Ordinates Adjoint Function," *Joint Int. Conf. on Mathematical Methods and Supercomputing for Nuclear Applications*, Saratoga Springs, 671-680, October 6-10, 1997.
20. B.G. PETROVIC, A. HAGHIGHAT and J.C. WAGNER, "Definition of a Computational 3-D Benchmark Problem for PWR Pressure Vessel Neutron Transport Calculations," *Joint Int. Conf. on Mathematical Methods and Supercomputing for Nuclear Applications*, Saratoga Springs, 292-301, October 6-10, 1997.
21. B.G. PETROVIC, J.C. WAGNER and A. HAGHIGHAT, "Verification of Improved Synthesized 3-D Sn and Monte Carlo Methods for Pressure Vessel Fast Neutron Fluence Calculations," *Joint Int. Conf. on Mathematical Methods and Supercomputing for Nuclear Applications*, Saratoga Springs, 1586-1595, October 6-10, 1997.

PUBLICATIONS (continued)

22. J.C. WAGNER, "Acceleration of Monte Carlo Shielding Calculations with an Automated Variance Reduction Technique and Parallel Processing," *Ph.D. Thesis*, The Pennsylvania State University, Nuclear Engineering (Dec. 1997).
23. J.C. WAGNER and A. HAGHIGHAT, "Automatic Variance Reduction of Monte Carlo Shielding Calculations Using the Discrete Ordinates Adjoint Function," *Nucl. Sci. Eng.*, **128** 186-208, (1998).
24. J.C. WAGNER, J.W. GERDES, and A.J. BARATTA, "Comparison of Calculated and Measured Neutron and Gamma Radiation Environments at the Army Pulse Radiation Facility," invited, *1998 ANS Radiation Protection and Shielding Division Topical Conference*, Nashville, TN, April 19-23, 1998.
25. J.C. WAGNER and A. HAGHIGHAT, "Automatic Variance Reduction for Monte Carlo Shielding Calculations," *1998 ANS Radiation Protection and Shielding Division Topical Conference*, Nashville, TN, April 19-23, 1998.
26. A. HAGHIGHAT, H. HIRUTA, B. PETROVIC and J.C. WAGNER, "Performance of the Automated Adjoint Accelerated MCNP (A³MCNP) for Simulation of a BWR Core Shroud Problem," *Proceedings of the International Conference on Mathematics and Computation, Reactor Physics, and Environmental Analysis in Nuclear Applications*, Madrid, Spain, September 27-30, 1999.
27. C.V. PARKS, M.D. DEHART and J.C. WAGNER, *Review and Prioritization of Technical Issues Related to Burnup Credit for LWR Fuel*, NUREG/CR-6665 (ORNL/TM-1999/303), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, February 2000.
28. J.C. WAGNER and M.D. DEHART, *Review of Axial Burnup Distribution Considerations for Burnup Credit Calculations*, ORNL/TM-1999/246, Lockheed Martin Energy Research Corp., Oak Ridge National Laboratory, March 2000.
29. J.C. WAGNER, M.D. DEHART and B.L. BROADHEAD, *Investigation of Burnup Credit Modeling Issues Associated with BWR Fuel*, ORNL/TM-1999/193, Lockheed Martin Energy Research Corp., Oak Ridge National Laboratory, March 2000.
30. A. HAGHIGHAT, G.E. SJODEN, and J.C. WAGNER, "Advanced 3-D Deterministic and Monte Carlo Codes for Simulation of Real-Life Complex Nuclear Systems," *Trans. Am. Nucl. Soc.*, **82**, June 2000.
31. J.C. WAGNER and M.D. DEHART, "Investigation of BWR Depletion Calculations with SAS2H," *Trans. Am. Nucl. Soc.*, **82**, June 2000.
32. C.V. PARKS, M.D. DEHART, and J.C. WAGNER, "Phenomena and Parameters Important to Burnup Credit," *Technical Committee Meeting on the Evaluation and Review of the Implementation of Burnup Credit in Spent Fuel Management Systems*, July 10-14, 2000, Vienna, Austria.
33. C.V. PARKS and J.C. WAGNER, "Issues for Effective Implementation of Burnup Credit," *Technical Committee Meeting on the Evaluation and Review of the Implementation of Burnup Credit in Spent Fuel Management Systems*, July 10-14, 2000, Vienna, Austria.
34. J.C. WAGNER and C.V. PARKS, *Critical Review of the Practice of Equating the Reactivity of Spent Fuel to Fresh Fuel in Burnup Credit Criticality Safety Analyses for PWR Spent Fuel Pool Storage*, NUREG/CR-6683 (ORNL/TM-1999/230), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, September 2000.
35. C.V. PARKS, I.C. GAULD, J.C. WAGNER, B.L. BROADHEAD, M.D. DEHART, and D.D. EBERT, "Research Supporting Implementation of Burnup Credit in the Criticality Safety Assessment of Transport and Storage Casks," in *Proceedings of the Twenty-Eighth Water Reactor Safety Information Meeting*, Bethesda, Maryland, October 23-25, 2000.
36. A. HAGHIGHAT and J.C. WAGNER, "Application of A3MCNP to Radiation Shielding Problems," in *Proceedings of International Conference on Monte Carlo for Radiation Physics, Particle Transport Simulation and Applications*, Lisbon, Portugal, October 23-26, 2000.

PUBLICATIONS (continued)

37. J.C. WAGNER and C.V. Parks, "Impact of Burnable Poison Rods on PWR Burnup Credit Criticality Safety Analyses," *Trans. Am. Nucl. Soc.*, **83**, 130-134, November 2000.
38. S.M. BOWMAN, I.C. GAULD, and J.C. WAGNER, *Recommendations on Standardized Technical Specifications for Spent Fuel Storage Casks*, NUREG/CR-6716 (ORNL/TM-2000/385), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, March 2001.
39. J.C. WAGNER, *Computational Benchmark for Estimation of Reactivity Margin from Fission Products and Minor Actinides in PWR Burnup Credit*, NUREG/CR-XXXX (ORNL/TM-2000/306), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, submitted for publication.
40. J.C. WAGNER and C.V. PARKS, *Parametric Study of the Effect of Burnable Poison Rods for PWR Burnup Credit*, NUREG/CR-XXXX (ORNL/TM-2000/373), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, submitted for publication.
41. C.E. SANDERS and J.C. WAGNER, *Study of the Effect of Integral Burnable Absorbers for PWR Burnup Credit*, NUREG/CR-XXXX (ORNL/TM-2000/321), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, submitted for publication
42. C.E. SANDERS and J.C. WAGNER, *Parametric Study of the Effect of Control Rods for PWR Burnup Credit*, NUREG/CR-XXXX (ORNL/TM-2001/69), U.S. Nuclear Regulatory Commission, Oak Ridge National Laboratory, submitted for publication
43. A. HAGHIGHAT and J.C. WAGNER, "Monte Carlo Variance Reduction with Deterministic Importance Functions," *Progress in Nuclear Energy*, accepted for publication.
44. J.C. WAGNER and C.V. PARKS, "Critical Review of the Practice of Equating the Reactivity of Spent Fuel to Fresh Fuel in Burnup Credit Criticality Safety Analyses for PWR Spent Fuel Pool Storage," *Nucl. Technol.*, October 2001.
45. J.C. WAGNER, "Addressing the Axial Burnup Distribution in PWR Burnup Credit Criticality Safety," accepted for *2001 ANS Embedded Topical Meeting on Practical Implementation of Nuclear Criticality Safety*, Reno, NV, November 11-15, 2001.
46. C.E. SANDERS and J.C. WAGNER, "Impact of Integral Burnable Absorbers on PWR Burnup Credit Criticality Safety Analysis," accepted for *2001 ANS Embedded Topical Meeting on Practical Implementation of Nuclear Criticality Safety*, Reno, NV, November 11-15, 2001.
47. C.E. SANDERS and J.C. WAGNER, "Parametric Study of Control Rod Exposure for PWR Burnup Credit Criticality Safety Analyses," accepted for *2001 ANS Embedded Topical Meeting on Practical Implementation of Nuclear Criticality Safety*, Reno, NV, November 11-15, 2001.
48. J.C. WAGNER and C.E. SANDERS, "Investigation of the Effect of Fixed Absorbers on the Reactivity of PWR Spent Nuclear Fuel for Burnup Credit," submitted to *Nuclear Technology*, August 2001.

REFERENCES AND TRANSCRIPTS AVAILABLE UPON REQUEST