

BRADLEY T. REARDEN, Ph.D.

Oak Ridge National Laboratory
P.O. Box 2008, Bldg. 5700
Oak Ridge, TN 37831-6370
reardenb@ornl.gov

EDUCATION: 1989-1999

Texas A&M University, College Station, TX
Doctor of Philosophy in Nuclear Engineering, December 1999
Dissertation title: "Development of SAMS: A Sensitivity Analysis Module for the SCALE Code System Using KENO V.a in the CSAS25 Sequence"

Master of Science in Nuclear Engineering, August 1995
Thesis title: "Engineering Analysis of a Power Upgrade for the Texas A&M Nuclear Science Center Reactor"

Bachelor of Science in Nuclear Engineering, May 1993

EXPERIENCE:

12/99-present

Oak Ridge National Laboratory – Nuclear Science and Technology Division – Criticality and Shielding Methods and Applications Group

Research and Development Staff

Developing state-of-the-art software for nuclear safety analysis.

- Primary developer and code manager of TSUNAMI sensitivity and uncertainty analysis software within SCALE.
 - Developed automated computational sequences (TSUNAMI-1D and TSUNAMI-3D) to perform eigenvalue sensitivity and uncertainty analysis.
 - Developed flux moment, angular flux and mesh flux accumulation techniques for the KENO V.a Monte Carlo code.
 - Developed sensitivity analysis versions of resonance self-shielding codes in SCALE (BONAMIST, NITAWLST and SENLIB).
 - Developed sensitivity analysis module for SCALE (SAMS) to compute sensitivity and uncertainty data.
 - Completed development of TSUNAMI-IP code that computes integral indices and other parameters that assess the applicability of benchmark experiments for code validation studies based on sensitivity and uncertainty data.
 - Developed methodology to quantify additional margin to subcriticality where benchmark coverage is lacking in criticality code validation studies.
- TSUNAMI training courses
 - Instructor of multi-day training courses in theory and application of TSUNAMI techniques.
- Performing studies using sensitivity and uncertainty analysis techniques.
 - Collaborating with other institutions on US DOE Nuclear Energy Research Initiative (NERI) project to design, assemble and analyze benchmark experiments for UO₂ fuel with enrichments ≥ 5 wt-% ²³⁵U.
 - Identification of applicable experiments for the Mixed-Oxide Fuel Fabrication Facility criticality code validation studies.
 - Assessment of available benchmark experiments and analysis of proposed experiment designs for Idaho National Engineering and Environmental Laboratory.
- Developer of Javapeno plotting package for displaying data from several SCALE codes.
- Leading development of HTML-formatted output for SCALE codes.

1/98 – 12/99

Oak Ridge National Laboratory – Computational Physics and Engineering Division – Nuclear Engineering Applications Section – Reactor and Fuel Cycle Analysis Group

Postgraduate Research Associate – Oak Ridge Institute for Science and Education

Developed a three-dimensional sensitivity analysis package that includes enhanced versions of the KENO V.a Monte Carlo code and the CSAS25 SCALE sequence. Performed sensitivity analyses for criticality safety applications using state-of-the-art evaluation tools recently developed for the SCALE code system.

8/95 – 1/98

Texas A&M University - Department of Nuclear Engineering

Graduate Research Assistant

Performed engineering analyses in conjunction with DOE's Amarillo National Resource Center for Plutonium. Projects included the design of a mixed oxide fuel experiment and analysis of mixed oxide fuel assemblies.

- 4/94 - 8/95 Texas A&M University - Nuclear Science Center
Graduate Research Assistant
Performed safety analysis calculations to support the conversion of research reactor from HEU to LEU fuel and to increase the maximum steady state power level from 1.0 to 1.5 MW.
- 6/93 - 8/93 Savannah River Site - Scientific Computations Division - Radiation Shielding Group
Graduate Researcher – Oak Ridge Institute for Science and Education
Contributed to the development of an input processor for a multi-dimensional neutron transport code.
- 6/91 - 8/91,
6/92 - 8/92 Texas Utilities - Reactor Engineering - Reactor Physics
Summer Internship (two consecutive summers)
Various projects included the generation of core following reports and the development of a one-dimensional neutron diffusion model to predict axial power profiles of the Comanche Peak Steam Electric Station.

CITIZENSHIP & SECURITY CLEARANCE:

US Citizen
Department of Energy Q-level security clearance

HONORS & ACTIVITIES:

Oak Ridge/Knoxville Section of American Nuclear Society – Vice Chair/Chair Elect, 2005-2006 – Arrangements Committee Chair, 2004-2005

U.S. Department of Energy – Office of Science – Undergraduate Research Programs – Outstanding Mentor, 2004.

UT-Battelle Awards Night – Outstanding Accomplishment in Science and Technology – Early Career Award for Engineering Accomplishment – Finalist 2003

American Nuclear Society – Member since 1989, Texas A&M Student Branch - Vice President, 1991-1992

Technical Program Committee Member – MC 2005, 2005 NCS D Topical Meeting, IYNC 2000

American Nuclear Society Nuclear Criticality Safety Division – Program Committee Member 2001-2004

American Nuclear Society Central Regional Student Conference – Co-chairman, 1992

International Forum - Youth and the Plutonium Challenge - Obninsk, Russia, Co-Chairman, July, 1998

Alpha Nu Sigma – Member Since 1992, Texas A&M Student Branch - Vice President, President 1992-1994

Tau Beta Pi – Member Since 1993, Texas A&M Student Branch - Treasurer 1993-1994

Institute for Nuclear Power Operations - Graduate Fellowship Recipient - 1993-1994

Society for Technical Communications – South Carolina STC 2002 Technical Publications Competition – Merit

Reviewer – *Journal of Heat Transfer*, ANS Nuclear Criticality Safety Division

PUBLICATIONS:

Refereed Journal Articles

- B. T. Rearden, W. J. Anderson, and G. A. Harms, "Use of Sensitivity and Uncertainty Analysis in the Design of Reactor Physics and Criticality Benchmark Experiments for Advanced Nuclear Fuel," *Nucl. Tech.*, **151**, 133-158 (2005).
- B. L. Broadhead, B. T. Rearden, C. M. Hopper, J. J. Wagschal, and C. V. Parks, "Sensitivity- and Uncertainty-Based Criticality Safety Validation Techniques," *Nucl. Sci. Eng.* **146**, 340-366 (2004).
- B. T. Rearden, "Perturbation Theory Eigenvalue Sensitivity Analysis with Monte Carlo Techniques," *Nucl. Sci. Eng.* **146**, 367-382 (2004).
- K. R. Elam and B. T. Rearden, "Use of Sensitivity and Uncertainty Analysis to Select Benchmark Experiments for the Validation of Computer Codes and Data," *Nucl. Sci. Eng.* **145**, 196-212 (2003).

Technical Reports

S. Goluoglu, K. R. Elam, B. T. Rearden, B. L. Broadhead, and C. M. Hopper, *Sensitivity Analysis Applied to the Validation of the 10B Capture Reaction in Nuclear Fuel Casks*, NUREG/CR-6845 (ORNL/TM-2004/48), UT-Battelle, LLC, Oak Ridge National Laboratory, August 2004.

B. T. Rearden and K. R. Elam, *Investigations and Recommendations on the Use of Existing Experiments in Criticality Safety Analysis of Nuclear Fuel Cycle Facilities for Weapons-Grade Plutonium*, ORNL/TM-2001/262, UT-Battelle, LLC, Oak Ridge National Laboratory, June 2002.

C. V. Parks, B. T. Rearden, M. D. DeHart, B. L. Broadhead, and L. M. Petrie, Jr., *Final EMSP Report U.S. Department of Energy – Development of Nuclear Analysis Capabilities for DOE Waste Management Activities*, April 2001.

C. V. Parks, B. T. Rearden, M. D. DeHart, B. L. Broadhead, C. M. Hopper, and L. M. Petrie, *Annual Environmental Management Science Program (EMSP) Project Summary. Project Title: Development of Nuclear Analysis Capabilities for DOE Waste Management Activities*, ORNL/TM-2000/65, February 2000.

C. V. Parks, B. T. Rearden, M. D. DeHart, B. L. Broadhead, C. M. Hopper, and L. M. Petrie, *Annual Environmental Management Science Program (EMSP) Summary Progress Report. Project Title Development of Nuclear Analysis Capabilities for DOE Waste Management Activities*, ORNL/TM-1999/101, June 1999.

B. L. Broadhead and B. T. Rearden, "Exploratory Studies for Three-Dimensional Sensitivity Methods," ORNL/M-6583, August 1998.

B. T. Rearden, S. O’Kelly, and T. A. Parish, *Potential Capability of the Texas A&M University Nuclear Science Center Reactor for Mixed-Oxide Fuel Rodlet Irradiations*, ANRCP-NG-ITWD-96-06, October 1996.

Full-Length Topical Papers

D. E. Mueller and B. T. Rearden, "Sensitivity Coefficient Generation for a Burnup Credit Cask Model using TSUNAMI-3D," in *Proc. of the 2005 NCS D Topical Meeting*, Knoxville, TN, September 19-22, 2005.

S. M. Bowman, B. T. Rearden, and J. E. Horwedel, "Complete User Visualization Interface for KENO," in *Proc. of the 2005 NCS D Topical Meeting*, Knoxville, TN, September 19-22, 2005.

B. T. Rearden, "Improvements in KENO V.a to Support TSUNAMI-3D Sensitivity Calculations," in *The Monte Carlo Method: Versatility Unbounded in a Dynamic Computing World*, Chattanooga, Tennessee, April 17-21, 2005 .

S. M. Bowman, B. T. Rearden, and J. E. Horwedel, "Integrated Interactive Visualization for KENO," in *The Monte Carlo Method: Versatility Unbounded in a Dynamic Computing World*, Chattanooga, Tennessee, April 17-21, 2005 .

B. T. Rearden, C. M. Hopper, and K. R. Elam, "TSUNAMI Analysis of the Applicability of Proposed Experiments to Reactor-Grade and Weapons-Grade Mixed Oxide Systems," pp. 125–132 in *Proc. of the International Symposium NUCEF2005*, Tokai, Japan, February 9-10, 2005.

B. T. Rearden, C. M. Hopper, K. R. Elam, S. Goluoglu, and C. V. Parks, "Applications of the TSUNAMI Sensitivity and Uncertainty Analysis Methodology," pp. 61-66 in *Proc. of The 7th International Conference on Nuclear Criticality Safety (ICNC2003)*", October 20-24, 2003, Tokai-mura, Japan.

S. M. Bowman, D. F. Hollenbach, M. D. DeHart, B. T. Rearden, I. C. Gauld, and S. Goluoglu, "SCALE 5: Powerful New Criticality Safety Analysis Tools," pp. 447-453 in *Proc. of The 7th International Conference on Nuclear Criticality Safety (ICNC2003)*", October 20-24, 2003, Tokai-mura, Japan.

W. J. Anderson, M. Saglam, B. T. Rearden, and R. Smith, "Reactor Physics and Criticality Benchmark Evaluations for Advanced Nuclear Fuel: Experiment Analysis Comparison Report," 09-03.pdf in *Proc. of American Nuclear Society, Advances in Nuclear Society, Advances in Nuclear Fuel Management III*, October 5-8, 2003, Hilton Head, South Carolina.

M. E. Dunn and B. T. Rearden, "Application of Sensitivity and Uncertainty Analysis Methods to a Validation Study for Weapons-Grade Mixed-Oxide Fuel," 35666.pdf in *Proc. of 2001 ANS Embedded Topical Meeting on*

Practical Implementation of Nuclear Criticality Safety, November 11-15, 2001, Reno, NV [ANS Order No.: 700284; ISBN: 0-89448-659-4.]

B. T. Rearden, "Sensitivity and Uncertainty Analysis for Nuclear Criticality Safety Using KENO in the SCALE Code System," in *Proceedings of Monte Carlo Radiation Physics, Particle Transport Simulation Applications*, Lisbon, Portugal, October 23-26, 2000.

B. T. Rearden, "SAMS: A Sensitivity Analysis Module for Criticality Safety Analysis Using Monte Carlo Techniques," 122.pdf (2102) in *Proceedings of the PHYSOR 2000, ANS International Topical Meeting on Advances in Reactor Physics and Mathematics and Computation into the Next Millennium*, May 7-12, 2000, Westin William Penn Hotel, Pittsburgh, Pennsylvania, USA. [ISBN0-89448-655-1; ANS Order No. 2700281 (May 2000).

B. L. Broadhead, R. L. Childs, and B. T. Rearden, "Computational Methods for Sensitivity and Uncertainty Analysis in Criticality Safety," pp. 57-65 in *Proceedings of ICNC'99, Sixth International Conference on Nuclear Criticality Safety*, Vol. I, Palais des Congrès, Versailles, FRANCE, September 20-24, 1999.

B. T. Rearden, S. O'Kelly, and T. A. Parish, "Potential Capability of the Texas A&M Nuclear Science Center Reactor for Mixed-Oxide Fuel Rodlet Irradiations," *Proceedings of the American Nuclear Society Topical Meeting - Advances in Nuclear Fuel Management II*, Myrtle Beach, SC, March 23-26, 1997, TR-107728-V1, EPRI, Pleasant Hill, CA (1997).

Conference Summaries

B. T. Rearden, M. L. Williams and J. E. Horwedel, "Advances in the TSUNAMI Sensitivity and Uncertainty Analysis Codes Beyond SCALE 5," *Trans. Am. Nucl. Soc.* 92, 760-762 (2005).

S. Goluoglu, K. R. Elam, B. T. Rearden, B. L. Broadhead, C. M. Hopper, and C.V. Parks, "Validation of the 10B Capture Reaction in Nuclear Fuel Casks with Sensitivity Analysis," in *Proc. of American Nuclear Society: International ANS/ENS 2003 Winter Meeting with cooperation from Nuclear Energy Institute on "Nuclear Technology: Achieving Global Economic Growth While Safeguarding the Environment,"* November 16-20, 2003, New Orleans, Louisiana. *Trans. Am. Nucl. Soc.* 89, 134-135 (2003).

S. Goluoglu, C. M. Hopper, and B. T. Rearden, "Extended Interpretation of Sensitivity Data for Benchmark Areas of Applicability," in *Proc. of ANS 2003 Annual Meeting "The Nuclear Technology Expansion: Unlimited Opportunities"*, June 1-5, 2003, San Diego, CA. *Trans. Am. Nucl. Soc.* 88, 77-79 (June 2003).

S. M. Bowman, D. F. Hollenbach, M. D. DeHart, B. T. Rearden, I. C. Gauld and S. Goluoglu, "An Overview of What's New in SCALE 5," in *Proc. of American Nuclear Society 2002 Winter Meeting "Building the World Nuclear Community -- Strategies for the Deployment of New Nuclear Technologies"*, November 17-21, 2002, Washington, DC. *Trans. Am. Nucl. Soc.* 87, 265-268 (2002).

D. F. Hollenbach, L. M. Petrie, B. T. Rearden, and S. M. Bowman, "KENO Postprocessor Analysis and Plotting Capabilities," in *Proc. of American Nuclear Society 2002 Winter Meeting "Building the World Nuclear Community -- Strategies for the Deployment of New Nuclear Technologies"*, November 17-21, 2002, Washington, DC. *Trans. Am. Nucl. Soc.* 87, 270-272 (2002).

B. T. Rearden and D. E. Peplow, "Comparison of Sensitivity Analysis Techniques in Monte Carlo Codes for Multi-Region Criticality Calculations," in *Proc. of American Nuclear Society 2001 Winter Meeting, "Nuclear Research and Development,"* November 11-15, 2001, Reno, NV. *Trans. Am. Nucl. Soc.* 85, 163-165 (2001).

B. L. Broadhead and B. T. Rearden, "Foundations for Sensitivity Based Criticality Validation Techniques," *Proc. of ANS/ENS 2000 International Winter Meeting and Embedded Topical Meetings*, November 12-16, 2000, Washington, D.C. *Trans. Am. Nucl. Soc.* 83, 93-95, 2000.

B. T. Rearden and R. L. Childs, "Prototypical Sensitivity and Uncertainty Analysis Codes for Criticality Safety with the SCALE Code System," *ANS/ENS 2000 International Winter Meeting and Embedded Topical Meetings*, November 12-16, 2000, Washington, D.C. *Trans. Am. Nucl. Soc.* 83, 98-100, 2000.

B. T. Rearden, C. M. Hopper, K. R. Elam, B. L. Broadhead, and P. B. Fox, "Prototypic Applications of Sensitivity and Uncertainty Analysis for Experiment Needs," *Proc. of ANS/ENS 2000 International Winter Meeting and Embedded Topical Meetings*, November 12-16, 2000, Washington, D.C. *Trans. Am. Nucl. Soc.* 83, 103-107, 2000.

B. L. Broadhead, C. M. Hopper, K. R. Elam, B. T. Rearden, and R. L. Childs, "Criticality Safety Applications of S/U Validation Methods," *Proc. of ANS/ENS 2000 International Winter Meeting and Embedded Topical Meetings*, November 12-16, 2000, Washington, D.C. *Trans. Am. Nucl. Soc.* **83**, 107-113, 2000.

Rearden, B.T., Parish, T.A. and Charlton, W.S., "Generation of Two-Group Cross Sections for WG-MOX Fuel Using MCNP," *Trans. Am. Nuc. Soc.*, **77**, 323 (1997).

Rearden, B.T., "An Engineering Analysis of a Power Upgrade for the Texas A&M Nuclear Science Center Reactor," *Trans. Am. Nuc. Soc.*, **73**, 411 (1995).