# BRADEN GODDARD

Virginia Commonwealth University
Department of Mechanical and Nuclear Engineering
P.O. Box 843015, Richmond, Virginia 23284-3015

Office: +1 804-827-7029
Email: bgoddard@vcu.edu

## Research Interests

- Nuclear Security and Counter Terrorism
- Nonproliferation and International Safeguards
- Radiation Detection and Measurements
- Environmental Measurements and Assay

## Education

- *Texas A&M University, College Station, TX, USA*
  - **Ph.D. Nuclear Engineering**, May 2013 (GPA: 3.82)
    - Doctorate Dissertation: "*Quantitative NDA Measurements of Advanced Reprocessing Product Materials Containing U, Np, Pu, and Am*"
  - **M.S. Nuclear Engineering**, Dec. 2009 (GPA: 3.82)
    - Masters Thesis: "*Development of a Real-Time Detection Strategy for Material Accountancy and Process Monitoring during Nuclear Fuel Reprocessing using the UREX+3a Method*"
  - **B.S. Nuclear Engineering**, Minor: Mathematics, May 2007 (GPA: 3.96)

## Work Experience

*Assistant Professor*

Sept. 2016 – Present, Department of Mechanical and Nuclear Engineering, Virginia Commonwealth University, Richmond, VA, USA

- Teach graduate and undergraduate nuclear engineering classes
- Conduct experimental and computational research on a variety of nuclear security and nonproliferation topics

*Senior Reachback Scientist*

Feb. 2015 – June 2016, Department of Nuclear Engineering, Khalifa University, Abu Dhabi, UAE

- Created the radiation emergency response reachback program in the United Arab Emirates
- Provide 24/7 reachback technical support and spectral analysis of HPGe Micro-Detectives

*Post-Doctoral Research Fellow*

Aug. 2014 – June 2016, Department of Nuclear Engineering, Khalifa University, Abu Dhabi, UAE

- Created the Radiation Metrology Laboratory and perform high-fidelity measurements on radioactive materials using GM, NaI, and liquid scintillation detectors to determine time variations in the count rates
- Teach graduate and undergraduate nuclear engineering classes
- Conduct research on a variety of nonproliferation and radiological environmental measurement topics

*Senior Scientist*

July 2013 – July 2014, Remote Sensing Laboratory, Nevada National Security Site, Las Vegas, NV, USA

- Was responsible for covertly detecting radiological weapons at large national and international events
- Analyzed gamma-ray spectra and neutron count rates from a variety of detector systems to evaluate and improve radiological search and emergency response capabilities

*Guest Student*
Sept. 2011 – Nov. 2011, Nuclear Nonproliferation Division, Los Alamos National Laboratory, Los Alamos, NM, USA
- Benchmarked the ENMC MCNPX model with passive and active measurements of both plutonium and uranium
- Created a method to passively assay bulk uranium masses using time correlated neutron detection

*NESLS Intern*
June 2009 – Aug. 2009 and May 2008 – Aug. 2008, Nuclear Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, TN, USA
- Created an AWCC MCNPX model
- Performed active interrogation list mode neutron measurements on uranium standards
- Developed a methodology to measure the isotopic mass of mixed actinide oxide powders

*Student Intern*
May 2007 – Aug. 2007, Nuclear Simulations Department, Comanche Peak Steam Electric Station, Glen Rose, TX, USA
- Updated the core simulator model from cycle 11 to cycle 13
- Implemented quadrant dependent $^{16}N$ detectors in the simulator model

*Laboratory Assistant*
Sept. 2006 – May 2007, Department of Nuclear Engineering, Texas A&M University, College Station, TX, USA
- Maintained existing laboratory equipment
- Helped installed a 10-port positive-pressure glovebox

*Student Intern*
June 2005 – Aug. 2005, Department of Nuclear Engineering and Management, University of Tokyo, Tokyo, Japan
- Assisted with experiments on two-phase water vapor flow and analyzed the void fraction using high speed cameras
- Assisted with experiments on particle image velocimetry measurements using tracer seeds, high speed cameras and lasers

*Mathematics Tutor*
Jan. 2002 – June 2004, Department of Mathematics, Palomar College, San Marcos, CA, USA
- Tutored over 200 students each semester
- Graded exams for the Pre-Algebra, Beginning Algebra and Intermediate Algebra Self-Taught courses

## Software Proficiencies

- MCNP6, MCNPX, MCNPX-PoliMi
- ORIGEN 2.2, ORIGEN-ARP
- SOURCES4C
- Genie-2000, PC/FRAM 4.4
- PeakEasy 4.53
- INCC 5
- AVID 1.6
- RadDetect 1.1
- MS Visual Basic
- C programming

## Awards

- World Nuclear University Radiation Technologies School scholarship 2014 – 2014
- Nuclear Nonproliferation International Safeguards Fellowship 2010 – 2013
- Innovations in Fuel Cycle Research award 2010 – 2011
- Roy G. Post Foundation scholarship 2010 – 2011
- Institute of Nuclear Materials Management – J. D. Williams 2009 – 2010
- American Nuclear Society – DiSalvo 2006 – 2007
- Texas A&M Nuclear Engineering – Stinson 2006 – 2007
- U.S. Department of Energy scholarship 2005 – 2007
- National Academy for Nuclear Training scholarship 2005 – 2007

## Personal Achievements

- Created the Nuclear Security and Nonproliferation Laboratory at VCU
- Created the Radiation Metrology Laboratory at Khalifa University
- Created the radiation emergency response reachback program in the United Arab Emirates
- Took over stewardship of the Radiation Teaching Laboratory at Khalifa University
- Took over stewardship of the Radiation Measurement Laboratory at VCU
- Strong involvement in professional nuclear societies (ANS, INMM, and WINS)
- Broad experience in the nuclear field (industry, national laboratories, and academia)
- International work experience (United States, United Arab Emirates, and Japan)

## Courses Taught

- Nuclear Safeguards Measurements and Simulation (EGMN 591), VCU
    - Spring 2017
- Radiation Science and Health Physics (NUCE 301), Khalifa University
    - Spring 2015, Fall 2015
- Radiation Measurement and Applications Laboratory (NUCE 605), Khalifa University
    - Spring 2015
- Radiation Measurement and Applications (NUCE 606), Khalifa University
    - Spring 2016

## Professional Involvement

- **American Nuclear Society**
    - Nuclear Nonproliferation Technical Group Member 2013 – Present
    - National Member 2004 – Present
    - Young Members Group Member 2004 – Present
    - Texas A&M University Student Chapter Member 2004 – 2005

- **Institute of Nuclear Materials Management**
    - Strategic Planning Committee Member 2014 – Present
    - National Member 2008 – Present
    - NDA Users Group Member 2008 – Present
    - Texas A&M University Student Chapter Member 2009 – 2013

- **World Institute for Nuclear Security**
    - Certified Nuclear Security Professional 2016 – Present
    - National Member 2014 – Present

- **Journal Reviewer**
  - Nuclear Science and Techniques 2016
  - Nuclear Technology 2015
  - Separation and Purification Technology 2014

## Journal Publications

1. **B. Goddard**, A.A. Solodov, and P. Simmons "Khalifa University Reachback Program Supporting Prevention of Illicit Nuclear and Radiological Material Smuggling in the United Arab Emirates," International Journal of Nuclear Security, Vol. 2, No. 1, Article 14, 2016
2. **B. Goddard**, S. Croft, A. Lousteau and P. Peerani, "Evaluation of Am-Li Neutron Spectra Data for Active Well Type Neutron Multiplicity Measurements of Uranium," Nuclear Instruments and Methods in Physics Research A, 830, pp. 256-264, 2016
3. S. Croft, A. Favalli, M.T. Swinhoe, **B. Goddard**, and S. Stewart, "The Effect of Deadtime and Electronic Transients on the Predelay Bias in Neutron Coincidence Counting," Nuclear instruments and methods in physics research A, 814, pp. 96-103, 2016
4. **B. Goddard**, G.W. Hitt, A.A. Solodov, D. Bridi, A.F. Isakovic, R. El-Khazali, and A. Abulail, "Experimental Setup and Commissioning Baseline Study in Search of Time-Variations in Beta-Decay Half-Lives," Nuclear Instruments and Methods in Physics Research A, 812, pp. 60-67, 2016
5. **B. Goddard**, W.S. Charlton, and P. Peerani, "Quantitative NDA Measurements of Multi-Actinide Oxide Fuels," Nuclear Technology, Vol. 186, No. 3, pp. 403-414, June 2014
6. C.M. Ryan, C.M. Marianno, W.S. Charlton, A.A. Solodov, R.J. Livesay, and **B. Goddard**, "Predicting Concrete Roadway Contribution to Gamma-ray Background in Radiation Portal Monitor Systems," Nuclear Technology, Vol. 186, No. 3, pp. 415-426, June 2014
7. **B. Goddard**, W.S. Charlton, and P. Peerani, "First Principle Active Neutron Coincidence Counting Measurements of Uranium Oxide," Nuclear Instruments and Methods in Physics Research A, 739, pp. 1-5, 2014
8. **B. Goddard**, W.S. Charlton, and P. Peerani, "Expanding the Capabilities of Neutron Multiplicity Measurements: Conclusions from a Four Year Project," ESARDA Bulletin, issue 50, pp. 18-26, ISSN 0392-3029, December, 2013
9. **B. Goddard** and S. Croft, "High Fidelity Passive Neutron Multiplicity Measurements and Simulation of Uranium Oxide," Nuclear Instruments and Methods in Physics Research A, 712, pp. 147-156, 2013
10. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Development of a Real-Time Detection Strategy for Process Monitoring during Nuclear Fuel Reprocessing using the UREX+3a Method," Nuclear Engineering and Design, 240 (11) pp. 3904-3909, 2010
11. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Real-Time Detection of UREX+3a Extraction Streams for Materials Accountancy," Journal of Nuclear Materials Management, 38 (1), pp. 34-39, 2009

## Government Reports

1. **B. Goddard** "Evaluation of Gamma Spectra from Medical and Industrial Radiation Sources," Remote Sensing Laboratory, Las Vegas, NV, April, 2014
2. J. Rogers, **B. Goddard**, and R. Detwiler, "Gryphon Data Archival and Analysis," Remote Sensing Laboratory, Las Vegas, NV, RSL13-CM-183J, September, 2013

3. S. Chirayath, W. Charlton, A. Stafford, C. Myers, **B. Goddard**, J. Alfred, M. Carroll, M. Sternat, E. Rauch, "Risk Informed Safeguards Approaches for Fast Reactor Fuel Cycle Utilizing MAUA based Proliferation Resistance Assessment," Nuclear Security Science and Policy Institute, College Station, TX, NSSPI-10-002, January, 2010

## Conference Proceedings

1. **B. Goddard**, G.W. Hitt, and A.A. Solodov, "Studying Environmental Effects on Radiation Detectors Response," Transactions of the American Nuclear Society Annual Winter Meeting, Washington, DC, November 8 – November 12, 2015
2. A.A. Solodov and **B. Goddard**, "Investigation of Applications of MCBEND Monte Carlo Code for Nuclear Safeguards and Security Education," Transactions of the American Nuclear Society Annual Winter Meeting, Washington, DC, November 8 – November 12, 2015
3. G.W. Hitt, **B. Goddard**, A.A. Solodov, A. Abulail, D. Bridi, R. El-Khazali and A.F. Isakovic, "Commissioning of a Replication Experiment to Investigate Claims of Beta-Decay Rate Fluctuations Correlated with Solar Proximity and Solar Activity," Annual Fall Meeting of the American Physical Society's Division of Nuclear Physics, Santa Fe, NM, October 28 – October 31, 2015
4. A.A. Solodov, A. Bosko, **B. Goddard**, and T. Guzzardo, "NaIGEM Analysis for Monte Carlo Code Generated Uranium Spectra," Proc. 56th Annual INMM Meeting, Indian Wells, CA, July 12 – July 16, 2015
5. A. Al-Ali, A.A. Solodov, and **B. Goddard**, "An Initial Radiation Baseline Study of Urban Environments in UAE," Proc. 2015 American Nuclear Society National Student Conference, College Station, TX, April 9 – April 11, 2015
6. J.C. Miller, **B. Goddard**, P. Nelson, S. Paranjape, and A. Littlefield, "Texas A&M University and India Academic Exchange Collaboration of Best Practices in Nuclear Security Education," Proc. 54th Annual INMM Meeting, Palm Desert, CA, July 14 – July 18, 2013
7. **B. Goddard**, W.S. Charlton, M. Swinhoe, and P. Peerani, "Expanding the Capabilities of Neutron Multiplicity Measurements: Conclusions from a Four Year Project," Proc. 35th ESARDA Annual Meeting, Bruges, Belgium, May 27 – May 30, 2013
8. **B. Goddard**, W.S. Charlton, and C. Marianno, "Development of a Neutron Coincidence Counting Laboratory Experiment at Texas A&M University," Proc. 2013 American Nuclear Society National Student Conference, Boston, MA, April 4 – April 6, 2013
9. **B. Goddard**, W.S. Charlton, L. Evans, and P. Peerani, "An Analysis Technique for Active Neutron Multiplicity Measurements Based on First Principles," LA-UR 12-45054, Proc. 53rd Annual INMM Meeting, Orlando, FL, July 15 – July 19, 2012
10. **B. Goddard**, S. Croft, and W.S. Charlton, "Benchmarking Uranium Oxide Passive Neutron Multiplicity Distributions," LA-UR 12-01045, Proc. 2012 American Nuclear Society National Student Conference, Las Vegas, NV, April 12 – April 15, 2012
11. **B. Goddard**, W.S. Charlton, C.A. Gariazzo, and P. Peerani, "A Concept for Quantitative NDA Measurements of Advanced Reprocessing Product Materials," Proc. Global 2011, Makuhari Messe, Chiba, Japan, December 11 – December 16, 2011
12. **B. Goddard**, W.S. Charlton, C.A. Gariazzo, and P. Peerani, "A Concept for Quantitative NDA MOX Measurements Using Only Neutron Radiation," Proc. 52nd Annual INMM Meeting, Palm Desert, CA, July 11 – July 15, 2011

13. **B. Goddard**, W.S. Charlton, C.A. Gariazzo, and A.L. Lousteau, "Mass Verification Method for Actinide Mixtures Using a Multi Energy Spectrum Active Well Coincidence Counter," Proc. 51st Annual INMM Meeting, Baltimore, MD, July 11 – July 15, 2010
14. S. Chirayath, W.S. Charlton, A.A. Stafford, C.T. Myers, **B. Goddard**, J.L. Alfred, M. Carroll, M. Sternat, and E. Rauch, "Risk Informed Safeguards Integration Studies for a Fast Reactor Fuel Cycle," Proc. 51st Annual INMM Meeting, Baltimore, MD, July 11 – July 15, 2010
15. **B. Goddard**, W.S. Charlton, C.A. Gariazzo, and A.L. Thornton, "NDA Quality Control for Actinide Mixtures Using a Multi-Energy Spectrum AWCC," Proc. 2010 American Nuclear Society National Student Conference, Ypsilanti, MI, April 8 – April 11, 2010
16. **B. Goddard**, W.S. Charlton, C.A. Gariazzo, and A.L. Thornton, "Neutron Multiplicity Simulations using MCNPX 2.6," Proc. 13th Annual Student Research Week, College Station, TX, March 22 – March 26, 2010
17. **B. Goddard**, J.P. Hayward, and A.L. Thornton, "Mass Verification Method for Uranium, Plutonium, and other Actinide Containing Samples using an Active Well Coincidence Counter," Proc. 50th Annual INMM Meeting, Tucson, AZ, July 12 – July 16, 2009
18. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Real-Time Detection of UREX+3a Extraction Streams for Materials Accountancy," Proc. 50th Annual INMM Meeting, Tucson, AZ, July 12 – July 16, 2009
19. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Real-Time Detection of UREX+3a Extraction Streams for Process Monitoring Applications," Transactions of the American Nuclear Society Annual Summer Meeting, Atlanta, GA, June 14 – June 18, 100, pp. 155, 2009
20. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Real-Time Detection of UREX+3a Extraction Streams for Process Monitoring Applications," Proc. 2009 American Nuclear Society National Student Conference, Gainesville, FL, April 1 – April 5, 2009
21. **B. Goddard**, W.S. Charlton, and S.M. McDeavitt, "Real-Time Detection of UREX+3a Extraction Streams for Process Monitoring Applications," Proc. 12th Annual Student Research Week, College Station, TX, March 23 – March 27, 2009
22. **B. Goddard** and S.M. McDeavitt, "Real-Time Detection Methods to Monitor TRU Compositions in UREX+ Process Streams," Proc. 11th Annual Student Research Week, College Station, TX, March 24 – March 28, 2008
23. **B. Goddard** and S.M. McDeavitt, "Real-Time Detection Methods to Monitor TRU Compositions in UREX+ Process Streams," Proc. 2008 American Nuclear Society National Student Conference, College Station, TX, February 28 – March 1, 2008

## Invited Panel Presentations

1. **B. Goddard**, "A Nuclear Nonproliferation Graduate Student Experience," Proc. 2011 ANS Winter Meeting and Nuclear Technology Expo, Washington, DC, October 30 – November 3, 2011
2. **B. Goddard**, "World Nuclear University – Summer Institute," Proc. Waste Management 2010, Phoenix, AZ, March 7 – 11, 2010