

ROBERT ANGELO BORRELLI

ASSISTANT PROFESSOR · UNIVERSITY OF IDAHO · IDAHO FALLS CENTER FOR HIGHER EDUCATION
NUCLEAR ENGINEERING AND INDUSTRIAL MANAGEMENT DEPARTMENT
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EDUCATION**University of California-Berkeley****Doctor of Philosophy · Nuclear Engineering***December 2006**Dissertation: Radionuclide transport modeling with bentonite extrusion*

Examination fields: Mathematical modeling, Subsurface nuclear technology

Committee: Joonhong Ahn (Chair), William E. Kastenberg, Tarek I. Zohdi

Worcester Polytechnic Institute**Master of Science · Civil/Environmental Engineering***May 1999**Thesis: Characterization of background radiation in the environment*

Advisor: James C. OShaughnessy

Worcester Polytechnic Institute**Bachelor of Science · Mechanical/Nuclear Engineering with high distinction***May 1996**Capstone: Real time PLC-based reactivity modeling by inverse point kinetics*

Advisor: Leo M. Bobek

RESEARCH EXPERIENCE**University of Idaho · Idaho Falls Center for Higher Education****Nuclear Engineering and Industrial Management Department****Assistant Professor***July 2015 -*

Advanced fuel cycle analysis; risk assessment; neutronics; nonproliferation; scientific computing

Coordinator - NPP Decommissioning and Used Fuel Management Certificate

August 2019 -

Affiliate - Boise State University Energy Policy Institute

August 2019 -

State of Idaho Professional Engineer, Faculty Restricted

*October 2019 -***University of California-Berkeley · Department of Nuclear Engineering****Postdoctorate Researcher***February 2009 - July 2012*

A safeguards methodology was developed for remotely-handled nuclear materials facilities that proposes functional design components and a risk-informed framework in an effort to integrate safeguards with safety and security into facility design.

The University of Tokyo · Department of Nuclear Engineering/Management**Research Associate***August 2007 - January 2009*

Mathematical models for mass transport in the engineered barrier system of a high-level nuclear waste repository are established for bentonite extrusion and radionuclide transport under different environmental conditions to assess potential impacts on performance assessment.

University of California-Berkeley · Department of Nuclear Engineering**Postdoctorate Researcher***February 2007 - April 2007*

Mathematical modeling of mass transport in the engineered barrier system of a high-level nuclear waste repository continued, to assess the potential of extruding bentonite to confine radionuclides.

University of California-Berkeley · Department of Nuclear Engineering**Doctoral Candidate***August 2005 - December 2006*

The dissertation thesis focused on the mathematical modeling of mass transport in the engineered barrier system of a

high-level nuclear waste repository. A mass transport model was established for radionuclides in a porous medium, bentonite extrusion model in a planar fracture to assess the potential to confine radionuclides.

RELATED RESEARCH EXPERIENCE

Earth Sciences Division · Lawrence Berkeley National Laboratory

Intern

July 2001 - February 2002

Conducted data analysis for chaotic modeling of water flow in the unsaturated zone.

Leslie C. Wilbur Nuclear Reactor Facility · Worcester Polytechnic Institute

Major Qualifying Project

August 1995 - May 1996

The Major Qualifying Project synthesizes previous undergraduate studies to solve problems or perform tasks in the major field and communicate results effectively. For this project, a logic algorithm was developed for reactivity derived from point kinetics equations and a programmable logic controller was modified for real time collection of data during nuclear reactor operation for use with experimental coursework and maintenance procedures.

RELATED PROFESSIONAL EXPERIENCE

Leslie C. Wilbur Nuclear Reactor Facility · Worcester Polytechnic Institute

Assistant Radiation Safety Officer

October 1996 - August 1999

- Responded to emergencies concerning incidents involving radioactive material
- Maintained records of radiation exposures and dosimetry to campus personnel
- Maintained the full and current inventory of radioisotopes
- Performed calibrations for radiation detectors
- Instructed all radiological and nuclear reactor laboratory safety training
- Performed secretarial duties for Radiation, Health, and Safety Committee

Leslie C. Wilbur Nuclear Reactor Facility · Worcester Polytechnic Institute

Senior Nuclear Reactor Operator #70145

August 1994 - August 1999

- Operated the university nuclear reactor for experimental research projects
- Trained reactor operator license candidates
- Performed corrective and preventative maintenance of reactor systems
- Modified operator training program to a computer based system

AWARDED PROJECTS

- (1) Athi Varuttamaseni (PI), Shinjae Yoo (co-PI) - Brookhaven National Laboratory, R. A. Borrelli (co-PI) - University of Idaho. Adaptive control and monitoring platform for autonomous operation of advanced reactors. NEUP 20-19280. **\$1,000,000.** 2020.10.01 - 2023.09.30.
- (2) Lee Ostrom (PI), Richard N. Christensen, R. A. Borrelli, Haiyan Zhao (co-PIs) - University of Idaho. ORED Fall 2019 EIS: Portable XFR for use in supporting material research. ORED Equipment and Infrastructure Support. **\$40,000.** 2019.12.01 - 2020.11.30
- (3) R. A. Borrelli (PI) - University of Idaho, Mark. D. DeHart (co-PI) - Idaho National Laboratory. Application and enhancement of MAMMOTH depletion capabilities. **\$33,521.** 2020.01.13 - 2020.12.31
- (4) Richard N. Christensen (PI), R. A. Borrelli, Michael G. McKellar, Michael Haney, David Arcilesi (co-PIs) - University of Idaho, Richard Jacobson (co-PI) Idaho State University. NuScale Simulator at the Center for Advanced Energy Studies. Department of Energy Scientific Infrastructure Support for Consolidated Innovative Nuclear Research. **\$285,763.** 2019.10.01 - 2020.09.30
- (5) R. A. Borrelli (PI) - University of Idaho, Dennis D. Keiser, Jr., (co-PI) - Idaho National Laboratory. Graduate Research Assistantship: Connecting U-Mo Fuel Processing, Microstructure, and Irradiation Performance. **\$91,835.** 2018.10.01-2021.05.30
- (6) R. A. Borrelli (PI), Richard N. Christensen (co-PI) - University of Idaho, Brian J. Jaques (co-PI) - Boise State University, Piyush Sabharwall (co-PI) - Idaho National Laboratory, Mark Delligatti (co-PI) - Table Rock, LLC,

Sakae Casting USA, LLC (co-PI). Modeling and design of borated aluminium cask for used fuel cooling. Idaho Global Entrepreneurial Mission (IGEM) - Idaho Commerce, **\$237,898**. 2018.01.01-2019.05.31

- (7) R. A. Borrelli (PI) - University of Idaho, Dennis D. Keiser, Jr., (co-PI) - Idaho National Laboratory. Graduate Research Assistantship: Connecting U-Mo Fuel Processing, Microstructure, and Irradiation Performance. **\$36,180**. 2017.11.01-2018.05.31
- (8) R. A. Borrelli (PI), Lee Ostrom (Senior Advisor) - University of Idaho, Stephen G. Johnson (Senior Advisor) - Idaho National Laboratory. Performance assessment of americium as fuel in radioisotope thermoelectric generators for deep space exploration. Idaho NASA EPSCoR Research Initiation Grant. **\$55,000**. 2017.08.01-2018.04.30
- (9) Kelley M. Verner (PI), R. A. Borrelli, Marc T. Skinner, Emma K. Redfoot, Jieun Lee, Seth Dustin, John Peterson (co-PIs) - University of Idaho. Increasing the Go-on Rate in Southeast Idaho Through the Nexus of Food, Energy, and Water. University of Idaho Vandals Big Ideas Project. **\$23,984**. 2017.07.01-2018.06.30
- (10) R. A. Borrelli (PI) - University of Idaho, Jason Hales (co-PI) - Idaho National Laboratory. Graduate Research Assistantship: Idaho National Laboratory Code Documentation. **\$35,435**. 2016.10.01-2017.06.30
- (11) Vivek Utgikar (PI), Fatih Aydogan, Krishnan Raja, Raghunath Kanakala, R. A. Borrelli, Haiyan Zhao, Matthew Swenson (co-PIs) - University of Idaho. University of Idaho Nuclear Engineering Faculty Development Program. United States Regulatory Commission Faculty Development Grant. **\$434,048**. 2015.09.29 - 2019.09.30

EQUIPMENT ACQUISITIONS

University of Idaho, Idaho State University, Idaho National Laboratory. Western Services Corporation Pressurized Water Nuclear Reactor Simulator.

THESIS COMMITTEES

MAJOR PROFESSOR

Current

Kelley M. Verner, Ph.D. Candidate - Materials science and nuclear fuels analysis
 Joseph Christensen, Ph.D. - Criticality safety modeling
 Olin Calvin, Ph.D. - Enhancement of MAMMOTH depletion capabilities
 Teyen Widdicombe, Ph.D. - RTG satellite design

Graduates

John Peterson, MS - Molten salt reactor neutronics design
 Emma K. Redfoot, MS - Allocating heat and electricity in a nuclear renewable hybrid energy system coupled with a water purification system
 Jieun Lee, MS - Risk-informed safeguards of pyroprocessing for advanced nuclear fuel concepts
 Trevor MacLean, MEng - Cybersecurity modeling of non-critical nuclear power plant instrumentation
 Malachi Tolman, MEng - INL BISON code documentation

MEMBER

Graduates

University of Idaho

Jacob Benjamin, Ph.D. - Bounding cyber in design basis threat
 J. Seth Dustin, MS - High level examination of Am-241 as an alternative Fuel Source in radioisotope thermoelectric generators
 D. Devin Imholte, MS - Conceptual design of the Advanced Test Reactor non-destructive examination system
 Winfred Sowah, MS - Thermal behavior of cold plated storage cask for light water reactor nuclear fuels
 John Bell, MS - Hierarchical inference and spoofing alarm in HVDC control systems
 John Biersdorf, MEng - Precipitation changes to Idaho National Laboratory over time

Idaho State University

Pedro Mena, MS - Reactor transient classification using machine learning

REFEREED JOURNAL PUBLICATIONS

- (1) Borrelli, R. A., Delligatti, Mark S., Heidrich, Brenden J., 2020. Borated aluminum cask design for onsite intermediate storage - neutronics design and certification analysis. *Nuclear Engineering and Design* 363, doi:10.1016/j.nucengdes.2020.110666.
- (2) Carter, John P., Borrelli, R. A., 2020. Neutron physics study of an integral molten salt reactor using Monte Carlo N-Particle code. *Nuclear Engineering and Design* 365, doi.org/10.1016/j.nucengdes.2020.110718.
- (3) Christensen, Joseph, Borrelli, R. A., 2020. Nuclear criticality safety aspects for the future of HALEU: Evaluating heterogeneity in intermediate-enrichment uranium using critical benchmark experiments. *Nuclear Science and Engineering*, doi.org/10.1080/00295639.2020.1819143.
- (4) Carter, John P., Borrelli, R. A., 2020. Integral molten salt reactor temperature sensitivities using Serpent target motion sampling. *Nuclear Engineering and Design* 369, doi.org/10.1016/j.nucengdes.2020.110863.
- (5) Widdicombe, Teyen, Borrelli, R. A., 2020. MCNP modelling of radiation effects of the Dragonfly missions RTG on Titan. *AIAA Journal of Spacecraft and Rockets*, [in revision].
- (6) Novich, Kaelee A., Pedersen, Samuel V., Borrelli, R. A., Christensen, Richard N., Jaques, Brian J., 2020. Synthesis of boron carbide reinforced aluminum castings through mechanical stir casting. *Journal of Composite Materials*, [under review].
- (7) Mena, Pedro, Borrelli, R. A., Kerby, Leslie, 2020. Nuclear reactor transient diagnostics using classification and AutoML. *Nuclear Technology*, [under review].
- (8) Christensen, Joseph, Borrelli, R. A., 2020. Modeling heterogeneity in low-enriched systems using evaluated critical benchmark experiments. *Nuclear Science and Engineering*, [under review].
- (9) Tacke, Jonathan, Borrelli, R. A., Roberson, Dakota, 2020. Advanced frequency-domain compensator design for subsystems within a nuclear generating station. *Nuclear Engineering and Design*, [under review].
- (10) Lasley, Trevin, Christensen, Joseph, Borrelli, R. A., 2020. Nuclear criticality safety analysis: Fuel recovery criticality experiments from the fuel elements of the experimental beryllium oxide reactor. *Nuclear Science and Engineering*, [under review].
- (11) Peterson, John, Haney, Michael, Borrelli, R. A., 2019. An overview of methodologies for cyber security vulnerability assessments conducted in nuclear power plants. *Nuclear Engineering and Design* 346, 75.
- (12) Lee, Jieun, Borrelli, R. A., 2019. Sensitivity analysis and application of advanced nuclear accounting methodologies on the high reliability safeguards model: Use of discrete event simulation for material throughput in fuel fabrication. *Nuclear Engineering and Design* 345, 183.
- (13) Lee, Jieun, Shigrekar, Amey, Borrelli, R. A., 2019. Hazard and operability analysis of a pyroprocessing facility. *Nuclear Engineering and Design* 348, 131.
- (14) Redfoot, Emma K., Borrelli, R. A., 2018. Analysis of nuclear renewable hybrid energy systems modeling and nuclear fuel cycle simulators. *Nuclear Technology* 204, 249.
- (15) Lee, Jieun, Tolman, Malachi, Borrelli, R. A., 2017. High reliability safeguards approach to remotely handled nuclear processing facilities: Use of discrete event simulation for material throughput for fuel fabrication. *Nuclear Engineering and Design* 324, 54.
- (16) Borrelli, R. A., Ahn, Joonhong, Hwang, Yongsoo, 2017. Approaches to a practical systems assessment for safeguardability of the advanced nuclear fuel cycle. *Nuclear Technology* 197, 248.
- (17) Borrelli, R. A., 2016. Functional components for a design strategy: Hot cell shielding in the high reliability safeguards methodology. *Nuclear Engineering and Design* 305, 18.
- (18) Borrelli, R. A., 2014. A high reliability safeguards approach for safeguardability of remotely-handled nuclear facilities: 1. Functional components to system design. *Journal of Nuclear Materials Management* XLII, 4.
- (19) Borrelli, R. A., 2014. A high reliability safeguards approach for safeguardability of remotely-handled nuclear facilities: 2. A risk-informed approach for safeguards. *Journal of Nuclear Materials Management* XLII, 27.

- (20) Borrelli, R. A., 2014. Use of curium neutron flux from head-end pyroprocessing subsystems for the high reliability safeguards methodology. *Nuclear Engineering Design* 277, 166.
- (21) Borrelli, R. A., 2013. Use of curium spontaneous fission neutrons for safeguardability of remotely-handled nuclear facilities: Fuel fabrication in pyroprocessing. *Nuclear Engineering and Design* 260, 64.
- (22) Borrelli, R. A., Thivent, Olivier, Ahn, Joonhong, 2013. Parametric studies on confinement of radionuclides in the excavated damaged zone due to bentonite type and temperature change. *Physics and Chemistry of the Earth* 65, 32.
- (23) Borrelli, R. A., Thivent, Olivier, Ahn, Joonhong, 2011. Impacts of elevated temperatures on bentonite extrusion and radionuclide transport in the excavated damaged zone. *Nuclear Technology* 174, 94.
- (24) Borrelli, R. A., Ahn, Joonhong, 2008. Radionuclide transport in a water-saturated planar fracture with bentonite extrusion. *Nuclear Technology* 164, 442.
- (25) Borrelli, R. A., Ahn, Joonhong, 2008. Numerical modeling of bentonite extrusion and radionuclide migration in a saturated planar fracture. *Physics and Chemistry of the Earth* 33, S131.

BOOK CONTRIBUTION

- (1) MacLean, Trevor, Borrelli, R. A., Haney, Michael A., 2019. 'Cybersecurity modeling of non-critical nuclear power plant digital instrumentation.' *Critical Infrastructure Protection XIII*. Jason Staggs, Sujeet Sheno, eds. in: Chapter 5, 277.
- (2) Borrelli, R. A., 2015. 'Reflections on developing an identity for the third generation nuclear engineer in the post-Fukushima society,' *Reflections on the Fukushima Daiichi nuclear accident: Toward social-scientific literacy and engineering resilience*. ISBN 978-3-319-12090-4.

REFEREED CONFERENCE PROCEEDINGS

- (1) Richards, James, Borrelli, R. A., 16-19 November 2020. Development of a tool for evaluating nuclear integrated energy systems profitability for existing reactors. *Proc., American Nuclear Society Virtual Winter Meeting*.
- (2) Peterson, John, Haney, Michael, Borrelli, R. A., 17-21 November 2019. An overview of methodologies for cybersecurity vulnerability assessments conducted at nuclear power plants. Washington, D. C.: *Proc., American Nuclear Society Winter Meeting*.
- (3) Kolias, Constantinos, Borrelli, R. A., Barbara, Daniel, Stavrou, Angelos, 17-21 November 2019. Malware detection in critical infrastructures by using the electromagnetic emissions of ples. Washington, D. C.: *Proc., American Nuclear Society Winter Meeting*.
- (4) Christensen, Joseph, Borrelli, R. A., Henkel, Charles S., Matthews, Brian, 09-13 June 2019. Minimum accident of concern for uranyl sulfate solutions. Minneapolis, Minnesota: *Proc., American Nuclear Society Annual Meeting*.
- (5) Borrelli, R. A., 09-13 June 2019. Updates on borated aluminum cask design for onsite used fuel storage. Minneapolis, Minnesota: *Proc., American Nuclear Society Annual Meeting*.
- (6) MacLean, Trevor, Haney, Michael, Borrelli, R. A., 11-13 March 2019. Cybersecurity modeling of non-critical nuclear power plant instrumentation. Arlington, Virginia: *Proc., Thirteenth Annual IFIP WG 11.10 International Conference on Critical Infrastructure Protection*.
- (7) Lee, Jieun, Borrelli, R. A., 17-21 June 2018. Upgrades on high reliability safeguards model for material throughput in fuel fabrication. Philadelphia, Pennsylvania: *Proc., American Nuclear Society Annual Meeting*.
- (8) Borrelli, R. A., Dustin, J. Seth, Pedersen, Samuel V., Jaques, Brian J., 17-21 June 2018. Design of a borated aluminum cask design for onsite used fuel storage. Philadelphia, Pennsylvania: *Proc., American Nuclear Society Annual Meeting*.
- (9) Borrelli, R. A., Delligatti, Mark S., 17-21 June 2018. Regulatory licensing pathway for a borated aluminum cask design for onsite used fuel storage. Philadelphia, Pennsylvania: *Proc., American Nuclear Society Annual Meeting*.

- (10) Dustin, J. Seth, Borrelli, R. A., 26 February-01 March 2018. Preliminary performance assessment of americium-241 as fuel in radioisotope thermoelectric generators for deep space exploration. Las Vegas, Nevada: Proc., ANS NETS 2018 - Nuclear and Emerging Technologies for Space.
- (11) Lee, Jieun, Borrelli, R. A., 29 October-02 November 2017. Hazard and operability analysis of a pyroprocessing facility. Washington, D. C.: Proc., American Nuclear Society Winter Meeting.
- (12) Redfoot, Emma K., Verner, Kelley M., Borrelli, R. A., 29 October-02 November 2017. Applying preliminary hazard analysis and analytic hierarchy process to a nuclear renewable hybrid energy system. Washington, D. C.: Proc., American Nuclear Society Winter Meeting.
- (13) Borrelli, R. A., Tolman, Malachi, Lee, Jieun, 11-15 June 2017. Preliminary analysis of facility design for pyroprocessing safeguardability. San Francisco, California: Proc., American Nuclear Society Annual Meeting.
- (14) Redfoot, Emma K., Borrelli, R. A., 11-15 June 2017. Nuclear fuel cycle simulator as a means to model a nuclear hybrid energy system. San Francisco, California: Proc., American Nuclear Society Annual Meeting.
- (15) Peterson, John, Haney, Michael A., Borrelli, R. A., 11-15 June 2017. Cybersecurity vulnerability assessment methodologies for nuclear power plants. San Francisco, California: Proc., American Nuclear Society Annual Meeting.
- (16) Borrelli, R. A., Tolman, Malachi, 06-10 November 2016. Development of a discrete event simulation model for pyroprocessing safeguardability. Las Vegas, Nevada: Proc., American Nuclear Society Winter Meeting.
- (17) Borrelli, R. A., 10-14 November 2013. Summary of modeling studies in the high reliability safeguards approach. Washington, D. C.: Proc., American Nuclear Society Winter Meeting.
- (18) Borrelli, R. A., 29 September-03 October 2013. Applying curium spontaneous fission neutrons in the high reliability safeguards approach for remotely-handled nuclear facilities. Salt Lake City, Utah: Proc., Global 2013 - International Nuclear Fuel Cycle Conference.
- (19) Borrelli, R. A., 23-27 September 2012. Applying curium spontaneous fission neutrons in the high reliability safeguards approach for remotely-handled nuclear facilities. Savannah, Georgia: Proc., 9th International Conference on Facility Operations-Safeguards Interface.
- (20) Borrelli, R. A., 10-14 April 2011. Role of neutron detection in the high reliability safeguards approach. Albuquerque, New Mexico: Proc., International Conf., High-Level Radioactive Waste Management.
- (21) Borrelli, R. A., Kim, Lance, Blandford, Edward D., Hwang, Yongsoo, Kim, Eung Ho, Peterson, Per F., 13-17 June 2010. High reliability safeguards for remote-handled nuclear materials. San Diego, California: Proc., 2010 International Congress on Advances in Nuclear Power Plants (ICAPP '2010).
- (22) Borrelli, R. A., Ahn, Joonhong, 29 March-01 April 2010. Parametric studies on confinement of radionuclides in the excavated damaged zone due to bentonite type and temperature change. Nantes, France: Proc., Clays in Natural & Engineered Barriers for Radioactive Waste Confinement, 4th International Meeting.
- (23) Borrelli, R. A., Thivent, Olivier, Ahn, Joonhong, 29 September-01 October 2009. Effect of temperature change on bentonite extrusion and radionuclide migration in the excavated damaged zone. Luxembourg: Proc., Impact of Thermo-Hydro-Mechanical-Chemical Processes on the Safety of Underground Repositories Conference.
- (24) Borrelli, R. A., Thivent, Olivier, Ahn, Joonhong, 20-25 September, 2009. Parametric studies for temperature changes of bentonite extrusion and impacts on radionuclide migration in the excavated damaged zone. Kennewick, Washington: Proc., 12th International Conference on the Chemistry and Migration Behaviour of Actinides and Fission Products in the Geosphere.
- (25) Borrelli, R. A., Ahn, Joonhong, 26-28 March 2008. Impact of bentonite extrusion on radionuclide migration in a saturated planar fracture. Osaka, Japan: Proc., 2008 Annual Meeting of the Atomic Energy Society of Japan.
- (26) Borrelli, R. A., Ahn, Joonhong, 17-20 September 2007. Impact of bentonite extrusion on radionuclide in a saturated planar fracture. Lille, France: Proc., Clays in Natural & Engineered Barriers for Radioactive Waste Confinement, 3rd International Meeting.

- (27) Borrelli, R. A., Ahn, Joonhong, 2007. Radionuclide transport in a water-saturated planar fracture with bentonite extrusion. J. Grunlan, D. Bhattacharyya, E. Marand, O. Regev, A. Balazs (eds.), 1006E. San Francisco, California: Proc., Transport Behavior in Heterogeneous Polymeric Materials and Composites, Mater. Res. Soc. Symp.
- (28) Borrelli, R. A., Ahn, Joonhong, 30 April - 04 May, 2006. Bentonite extrusion in planar fracture based on net water flow. Las Vegas, Nevada: Proc., International Conf., High-Level Radioactive Waste Management.
- (29) Bobek, Leo M., Borrelli, R. A., 16-20 June, 1996. Plc-based reactivity measurements using inverse point kinetics. Reno, Nevada: Proc., American Nuclear Society Annual Meeting.

NON-REFEREED TECHNICAL REPORTS

- (1) Dustin, J. Seth, Borrelli, R. A., 2020. High level examination of Am-241 as an alternative fuel source in radioisotope thermoelectric generators. LA-UR-20-20574.
- (2) Borrelli, R. A., Christensen, Richard N., Jaques, Brian J., Pedersen, Samuel V., Sowah, Winfred, 2019. Modeling and design of borated aluminum cask for used fuel cooling. Final report. APP-002714.
- (3) Borrelli, R. A., Christensen, Richard N., Jaques, Brian J., Pedersen, Samuel V., Sowah, Winfred, 2019. Modeling and design of borated aluminum cask for used fuel cooling. Progress report. APP-002714.
- (4) Ahn, Joonhong, Borrelli, R. A., Orucoglu, Esra, van den Akker, Bret P., Woo, Seung Min, Yoon, Jihae, 2015. Systems assessment for advanced nuclear fuel cycle: Final report for UCBNE-KAERI collaboration. UCBNE-5150.
- (5) Ahn, Joonhong, Borrelli, R. A., Yoon, Jihae, 2012. Systems assessment for advanced nuclear fuel cycle: Fourth year report for UCBNE-KAERI collaboration. UCBNE-5137.
- (6) Hecker, Siegfried S., Blandford, Edward D., Hanson, Alan S., Isaacs, Thomas, Milonopoulos, Niko, Ahn, Joonhong, Borrelli, R. A., Choi, Jorshan, Kim, Lance K., Peterson, Per F., Yoon, Jihae, 2012. Scientific and institutional aspects of advanced systems for spent nuclear fuels in emerging nuclear countries: Final report. UCBNE-5135.
- (7) Ahn, Joonhong, Borrelli, R. A., Kim, Lance K., Peterson, Per F., Yoon, Jihae, Choi, Jorshan, 2011. Systems assessment for advanced nuclear fuel cycle: Third year report for UCBNE-KAERI collaboration. UCBNE-5134.
- (8) Ahn, Joonhong, Borrelli, R. A., Kim, Lance K., Peterson, Per F., Vujic, Jasmina L., Yoon, Jihae, Choi, Jorshan, Hwang, Yongsoo, 2010. Systems assessment for advanced nuclear fuel cycle: Second year report for UCBNE-KAERI collaboration. UCBNE-5133.
- (9) Ahn, Joonhong, Peterson, Per F., Borrelli, R. A., Kim, Lance K., Yoon, Jihae, 2010. Scientific and institutional aspects of advanced systems for spent nuclear fuels in emerging nuclear countries: Interim report. UCBNE-5130.
- (10) Ahn, Joonhong, Blandford, Edward D., Borrelli, R. A., Kim, Eung Ho, Kim, Lance K., Peterson, Per F., Vujic, Jasmina L., Yoon, Jihae, Choi, Jorshan, Hwang, Yongsoo, 2009. Systems assessment for advanced nuclear fuel cycle: First year report for UCBNE-KAERI collaboration. UCBNE-5126.
- (11) Borrelli, R. A., Ahn, Joonhong, 2007. Radionuclide transport coupled with bentonite extrusion in a saturated planar fracture: TRIBEX manual. UCBNE-5111.
- (12) Borrelli, R. A., Ahn, Joonhong, 2007. Modeling and simulation of bentonite extrusion in a saturated planar fracture. UCBNE-5110.
- (13) Borrelli, R. A., Ahn, Joonhong, 2007. Modeling and simulation of radionuclide transport in a saturated planar fracture with bentonite extrusion. UCBNE-5109.
- (14) Ahn, Joonhong, Chambre, Paul L., Kawasaki, Daisuke, Borrelli, R. A., 2006. Development of integrated repository performance assessment models. UCBNE-5103.

CONFERENCE PRESENTATIONS

- (1) Richards, *James, Borrelli, R. A., 16-19 November 2020. Development of a tool for evaluating nuclear integrated energy systems profitability for existing reactors. American Nuclear Society Virtual Winter Meeting.

- (2) Cutler, *Samuel, Bateman, Allysa, Heidrich, Brenden, Borrelli, R. A., Simpson, James, Jaques, Brian J., 23-24 July, 2020. Modeling shielding designs for the safe operation of neutron generators. Boise, Idaho: Idaho Conference on Undergraduate Research [*poster*].
- (3) Peterson, *John, Haney, Michael, Borrelli, R. A., 17-21 November 2019. An overview of methodologies for cybersecurity vulnerability assessments conducted at nuclear power plants. Washington, D. C.: American Nuclear Society Winter Meeting.
- (4) Kolias, *Constantinos, Borrelli, R. A., Barbara, Daniel, Stavrou, Angelos, 17-21 November 2019. Malware detection in critical infrastructures by using the electromagnetic emissions of plcs. Washington, D. C.: American Nuclear Society Winter Meeting.
- (5) Peterson, *John, Borrelli, R. A., Roberson, Dakota, 29 September-01 October 2019. Informing electrical grid policy with a nuclear power plant simulator. Boise, Idaho: Energy Policy Research Conference [*poster*].
- (6) Christensen, *Joseph, Borrelli, R. A., Henkel, Charles S., Matthews, Brian, 09-13 June 2019. Minimum accident of concern for uranyl sulfate solutions. Minneapolis, Minnesota: American Nuclear Society Annual Meeting.
- (7) Borrelli, *R. A., 09-13 June 2019. Updates on borated aluminum cask design for onsite used fuel storage. Minneapolis, Minnesota: American Nuclear Society Annual Meeting.
- (8) MacLean, Trevor, Haney, *Michael, Borrelli, R. A., 11-13 March 2019. Cybersecurity modeling of non-critical nuclear power plant instrumentation. Arlington, Virginia: Thirteenth Annual IFIP WG 11.10 International Conference on Critical Infrastructure Protection.
- (9) Huff, *Kathryn D., Davis, Neal, Wilson, Paul, Borrelli, R. A., E., Skutnik Steven, Scopatz, Anthony, Amos, Jenny, 19 April 2018. Open-source curriculum development. Urbana, Illinois: Academy for Excellence in Engineering Education Strategic Instructional Innovation Program at the University of Illinois [*poster*].
- (10) Lee, *Jieun, Borrelli, R. A., 17-21 June 2018. Upgrades on high reliability safeguards model for material throughput in fuel fabrication. Philadelphia, Pennsylvania: American Nuclear Society Annual Meeting.
- (11) Borrelli, *R. A., Dustin, J. Seth, Pedersen, Samuel V., Jaques, Brian J., 17-21 June 2018. Design of a borated aluminum cask design for onsite used fuel storage. Philadelphia, Pennsylvania: American Nuclear Society Annual Meeting.
- (12) Borrelli, *R. A., Delligatti, Mark S., 17-21 June 2018. Regulatory licensing pathway for a borated aluminum cask design for onsite used fuel storage. Philadelphia, Pennsylvania: American Nuclear Society Annual Meeting.
- (13) Dustin, *J. Seth, Borrelli, R. A., 26 February-01 March 2018. Preliminary performance assessment of americium-241 as fuel in radioisotope thermoelectric generators for deep space exploration. Las Vegas, Nevada: ANS NETS 2018 - Nuclear and Emerging Technologies for Space.
- (14) Lee, *Jieun, Borrelli, R. A., 29 October-02 November 2017. Hazard and operability analysis of a pyroprocessing facility. Washington, D. C.: American Nuclear Society Winter Meeting.
- (15) Redfoot, *Emma K., Verner, Kelley M., Borrelli, R. A., 29 October-02 November 2017. Applying preliminary hazard analysis and analytic hierarchy process to a nuclear renewable hybrid energy system. Washington, D. C.: American Nuclear Society Winter Meeting.
- (16) Borrelli, R. A., Tolman, Malachi, Lee, *Jieun, 11-15 June 2017. Preliminary analysis of facility design for pyroprocessing safeguardability. San Francisco, California: American Nuclear Society Annual Meeting.
- (17) Redfoot, *Emma K., Borrelli, R. A., 11-15 June 2017. Nuclear fuel cycle simulator as a means to model a nuclear hybrid energy system. San Francisco, California: American Nuclear Society Annual Meeting.
- (18) Peterson, *John, Haney, Michael A., Borrelli, R. A., 11-15 June 2017. Cybersecurity vulnerability assessment methodologies for nuclear power plants. San Francisco, California: American Nuclear Society Annual Meeting.
- (19) Borrelli, R. A., Tolman, *Malachi, 06-10 November 2016. Development of a discrete event simulation model for pyroprocessing safeguardability. Las Vegas, Nevada: American Nuclear Society Winter Meeting.
- (20) Borrelli, *R. A., 10-14 November 2013. Summary of modeling studies in the high reliability safeguards approach. Washington, D. C.: American Nuclear Society Winter Meeting.

- (21) Borrelli, *R. A., 29 September-03 October 2013. Applying curium spontaneous fission neutrons in the high reliability safeguards approach for remotely-handled nuclear facilities. Salt Lake City, Utah: Global 2013 - International Nuclear Fuel Cycle Conference.
- (22) Borrelli, *R. A., 23-27 September 2012. Applying curium spontaneous fission neutrons in the high reliability safeguards approach for remotely-handled nuclear facilities. Savannah, Georgia: 9th International Conference on Facility Operations-Safeguards Interface.
- (23) Borrelli, *R. A., 10-14 April 2011. Role of neutron detection in the high reliability safeguards approach. Albuquerque, New Mexico: International Conf., High-Level Radioactive Waste Management.
- (24) Borrelli, *R. A., Kim, Lance, Blandford, Edward D., Hwang, Yongsoo, Kim, Eung Ho, Peterson, Per F., 13-17 June 2010. High reliability safeguards for remote-handled nuclear materials. San Diego, California: 2010 International Congress on Advances in Nuclear Power Plants (ICAPP '2010).
- (25) Borrelli, *R. A., Ahn, Joonhong, 29 March-01 April 2010. Parametric studies on confinement of radionuclides in the excavated damaged zone due to bentonite type and temperature change. Nantes, France: Clays in Natural & Engineered Barriers for Radioactive Waste Confinement, 4th International Meeting [*poster*].
- (26) Borrelli, R. A., Thivent, *Olivier, Ahn, Joonhong, 29 September-01 October 2009. Effect of temperature change on bentonite extrusion and radionuclide migration in the excavated damaged zone. Luxembourg: Impact of Thermo-Hydro-Mechanical-Chemical Processes on the Safety of Underground Repositories Conference.
- (27) Borrelli, *R. A., Thivent, Olivier, Ahn, Joonhong, 20-25 September, 2009. Parametric studies for temperature changes of bentonite extrusion and impacts on radionuclide migration in the excavated damaged zone. Kennewick, Washington: 12th International Conference on the Chemistry and Migration Behaviour of Actinides and Fission Products in the Geosphere [*poster*].
- (28) Borrelli, *R. A., Ahn, Joonhong, 26-28 March 2008. Impact of bentonite extrusion on radionuclide migration in a saturated planar fracture. Osaka, Japan: 2008 Annual Meeting of the Atomic Energy Society of Japan.
- (29) Borrelli, *R. A., Ahn, Joonhong, 17-20 September 2007. Impact of bentonite extrusion on radionuclide in a saturated planar fracture. Lille, France: Clays in Natural & Engineered Barriers for Radioactive Waste Confinement, 3rd International Meeting.
- (30) Borrelli, *R. A., Ahn, Joonhong, 2007. Radionuclide transport in a water-saturated planar fracture with bentonite extrusion. San Francisco, California: Transport Behavior in Heterogeneous Polymeric Materials and Composites, Mater. Res. Soc. Symp. [*poster*].
- (31) Borrelli, *R. A., Ahn, Joonhong, 30 April - 04 May, 2006. Bentonite extrusion in planar fracture based on net water flow. Las Vegas, Nevada: International Conf., High-Level Radioactive Waste Management.

TEACHING EXPERIENCE

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Computation and modeling of nuclear systems

Fall 2020
directed study

Using published nuclear computational modeling references, this course will examine prior efforts to simplify the neutron transport and depletion calculations for advanced reactor designs, such as high-temperature pebble-bed reactors. These include efforts to model heterogeneous stochastic media, such as TRISO fuel particles dispersed in a graphite matrix. Deterministic neutron transport in stochastic media has resulted in several new methods developed in order to address the challenges associated with modeling them, however, comparison of the proposed and implemented methods has been largely absent. Other challenges facing the modeling of pebble-bed reactors include the depletion calculations for individual pebbles. Because of the flow of pebbles through the core, and the recirculation of said pebbles in most modern designs, the depletion of individual pebbles can affect the criticality of the system as well as the temperature profile of individual pebbles, which was demonstrated to have significant safety implications based on the operation of the German AVR pebble-bed system. To these ends, this course will identify relevant literature

regarding these topics and the feasibility of implementing these methods in modern nuclear modeling tools, such as the Griffin tool in development at Idaho National Laboratory.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Heterogeneity comparisons of intermediate enrichment uranium in critical systems

Fall 2020

directed study

The ICSBEP handbook contains descriptions and evaluations of critical experiments conducted in facilities throughout the world. The reach of the handbook stretches to the beginning of the history of nuclear engineering. As part of that history, a number of critical experiments have been conducted using arrays of fissile material in the intermediate enrichment range, which is defined for the purposes of this course as ten to forty percent (10%-40%). In those evaluations, a variety of methods have been discussed and described which convert a system of known or unknown degree of heterogeneity into a simplified homogeneous model, which is a traditional method for examining the critical characteristics of multiplying systems. The specific methodology for this conversion varies between evaluations and is explained in some cases, where other cases are less descriptive. It is of interest to the field of nuclear criticality safety to improve the understanding of the effect of heterogeneity on the critical characteristics of multiplying fissile systems, particularly in the range of intermediate enrichment. It is of further interest to the field that a methodology be established which can be used to evaluate these types of systems for practical nuclear criticality safety applications, especially the development of nuclear criticality safety limits.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Computation of minimum spherical critical volume for nuclear criticality safety applications

Fall 2020

directed study

The nuclear safety guide, Critical Dimensions of Systems Containing U-235, Pu-239, and U-233 contains a graph of minimum critical volumes as a function of U-235 enrichment in homogeneous and heterogeneous hydrogen-moderated systems. This graph includes a wide extrapolation between the data for ten percent enrichment and ninety-three percent enrichment. A similar graph appears in Anomalies of Nuclear Criticality without the extrapolation. This graph shows a clear transition at approximately thirty-five percent enrichment between two different types of systems. It is clear that there is a difference between the extrapolated minimum spherical critical volumes and the calculated critical volumes. As part of the development of nuclear criticality safety methodology for intermediate-enrichment uranium systems, it is necessary to more fully evaluate and explain the nature of the transition point. This work will attempt to re-create and expand on the data used to produce this graph and more fully evaluate the nature of the minimum critical volume for intermediate-enrichment systems. The secondary objective will be the proposal of nuclear criticality safety rules which could be applied to these data to ensure that fissionable material operations in this range of enrichment can be conducted safely.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Subcritical multiplication

Fall 2020

directed study

Using published fundamental nuclear data for thermal neutrons, this course will examine the relationship between processes of fission and capture and develop models for reactivity worth as a function of thermal fission and capture cross-sections and local thermal flux. This course will include evaluation of tests in zero-power reactors. The Advanced Test Reactor (ATR) physics analyses rely heavily on measurement results from the Advanced Test Reactor Critical Facility (ATRC). These results are easily delivered in terms of reactivity worth, but the results are almost never directly applicable to ATR due to differences in thermal neutron flux. Reactivity worth is not a fundamental property of a material and indeed is not a characteristic property of a given piece of reactor hardware if the hardware is to be irradiated in a new neutron environment. However, translating reactivity worth of a piece of hardware in ATRC to a pair of macroscopic cross-sections essentially characterizes the hardware with constants that will be applicable in any

subsequent location in ATR or ATRC. Therefore, reactivity worth in a new irradiation position can be predicted by calculation.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Historical examinations of heterogeneity in nuclear criticality safety

Spring 2020
directed study

Using published nuclear criticality safety references, this course will conduct an examination of the effect of heterogeneity with respect to nuclear criticality safety. As part of the history of nuclear criticality safety, a number of critical experiments have been conducted using arrays of fissile material in an attempt to quantify the effect of heterogeneity in the determination of safe handling limits. In these attempts, a number of low-enriched experiments were examined and converted in their critical dimensions to establish a useful baseline from which other limits could be extrapolated. It is of interest to the field of nuclear criticality safety to improve the understanding of the effect of heterogeneity on the critical characteristics of multiplying fissile systems, particularly in the range of intermediate enrichment. It is of further interest to the field that a methodology be established which can be used to evaluate these types of systems for practical nuclear criticality safety applications, especially the development of nuclear criticality safety limits. To that end, this course will identify relevant data in the literature used to generate historical experiments and apply MCNP to model these experiments in order to understand and evaluate assumptions and restrictions raised in the experiments.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Heterogeneity comparisons of intermediate enrichment uranium in critical systems

Spring 2020
directed study

Using the International Criticality Safety Benchmark Evaluation Project (ICSBEP) handbook of evaluated critical experiments, conduct an examination of the effect of heterogeneity in intermediate-enrichment uranium systems. The ICSBEP handbook contains descriptions and evaluations of critical experiments conducted in facilities throughout the world. The reach of the handbook stretches to the beginning of the history of nuclear engineering. In those evaluations, a variety of methods have been discussed and described which convert a system of known or unknown degree of heterogeneity into a simplified homogeneous model, which is a traditional method for examining the critical characteristics of multiplying systems. The specific methodology for this conversion varies between evaluations and is explained in some cases, where other cases are less descriptive. It is of interest to the field of nuclear criticality safety to improve the understanding of the effect of heterogeneity on the critical characteristics of multiplying fissile systems, particularly in the range of intermediate enrichment. It is of further interest to the field that a methodology be established which can be used to evaluate these types of systems for practical nuclear criticality safety applications, especially the development of nuclear criticality safety limits. This course will identify and evaluate relevant benchmark experiments for heterogeneity effects using MCNP to establish new baseline models from the benchmark handbook.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE502: Nuclear integrated energy systems

Spring 2020
directed study

Nuclear renewable hybrid energy systems enable a nuclear reactor to load follow with a renewable energy source. These must be designed to distribute energy dynamically by supplying electricity to the grid while using either thermal or electrical energy for industrial applications. This takes advantage of the flexible distribution of electricity or heat to maximize profit. The industrial process serves as a load sink for the excess heat or electricity produced by the nuclear reactor. Economic challenges to the current United States nuclear light water reactor (LWR) fleet have led to early plant closures. While LWRs primarily deliver baseload electricity, there is no reason why nuclear energy produced by these reactors cannot be used to provide energy to a range of industrial applications. This directed study course will

identify feasible systems, products, and commodities that could be produced by existing nuclear plants. As part of this, cost and potential profitability will be analyzed within the context of market structures and grid reliability.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE527: Nuclear material storage, transport, disposal

Spring 2020

There is a wide range of nuclear materials that are stored, transported and disposed of each day. The materials include medical radioisotopes, new fuel pellets, used fuel, and industrial radioisotopes. This course will cover the regulations that govern nuclear material storage, transportation and disposal, as well as the engineering requirements and practical aspects of handling these materials.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE535: Nuclear Criticality Safety I

Spring 2020

This course applies the foundation of applied nuclear physics to develop and explain the international and domestic rules and practices that are used to prevent inadvertent criticality in fuel cycle applications such as used fuel storage and processing.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE585: Nuclear Fuel Cycle Analysis

Fall 2017

This course presents the nuclear fuel cycle as an holistic system with components related in many complex ways. This course focuses on systems analysis of components that comprise the nuclear fuel cycle to understand the contemporary challenges facing nuclear energy.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

TM529: Risk Assessment

Spring 2019; 2018; 2017; 2016

This course is designed to provide students with an understanding of how to perform a comprehensive risk assessment applicable to a wide variety of engineering problems in many different disciplines. The course will focus on failure mode and effect analysis, fault tree analysis, probabilistic risk analysis, and human reliability analysis. The course will also cover fundamental probability and statistics content.

University of Idaho · Idaho Falls Center for Higher Education
Nuclear Engineering and Industrial Management Department
Assistant Professor

NE450: Principles of Nuclear Engineering

Fall 2020; 2019; 2018; 2017; 2016; 2015

In this course, an overview of fundamental nuclear engineering principles and how these are practically applied to contemporary, nuclear engineering problems will be presented. The topics covered in this course include: nuclear physics and reactions, materials science, radiation protection, energy production, fuel cycle analysis, advanced reactor design, fusion, nonproliferation, back-end management, and risk assessment and safety. Throughout the course, the ethical considerations with regards to engineering problems within these fields will also be discussed.

Diablo Valley College · Department of Architecture and Engineering
Adjunct Professor

ENG110: Introduction to Engineering

Spring 2015; 2014; 2013; Fall 2014

This course introduces students to fundamental engineering principles. Students learn how these are applied to contemporary engineering problems through laboratory exercises, homework assignments, design projects, interviews with professional engineers, and field trips to engineering companies. Topics include: materials science, risk assessment and safety, critical problem-solving, engineering analysis, engineering design processes, project development, engineering software, and presentation tools. The role of the engineer in society, professionalism, and engineering

ethics are major themes. The emphasis is on creative problem-solving, teamwork, and effective communication, both in presentation and writing.

University of California-Berkeley · Department of Nuclear Engineering

Instructor

NE92: Issues in Nuclear Science and Engineering

Fall 2011

This course provides undergraduate students with an overview of the nuclear engineering profession, including fundamental nuclear engineering principles and how these are practically applied to nuclear engineering problems. The topics covered include nuclear physics and reactions, materials science, radiation protection, energy production, fuel cycle analysis, advanced reactor design, fusion, nonproliferation, back-end management, risk assessment, and safety. Throughout the course, the ethical considerations concerning engineering problems within these fields are also addressed through a comprehensive, student-driven course project.

University of California-Berkeley · Department of Nuclear Engineering

Instructor

NE375: Teaching Techniques in Nuclear Engineering

Fall 2011; 2010

This course acquaints graduate student instructors (GSIs) with teaching techniques for courses in the Department of Nuclear Engineering. The GSI will have several duties far beyond grading assignments and/or examinations: conducting discussion sessions, review lectures, or laboratory experiments. The GSI, therefore, needs to develop the appropriate tools to use when facing these pedagogical challenges. Three students from the 2010 course received the Outstanding Graduate Student Instructor Award given by the UC-Berkeley Graduate Student Instructor Teaching & Resource Center.

The University of Tokyo · Department of Nuclear Engineering/Management

Part time lecturer

Technical English for Scientists

Winter, Summer 2008; Winter 2007

This course provided the opportunity for non-native English speaking students to develop technical communication skills; i.e., presenting scientific and technical material to an informed audience at an international conference. In this course, the assertion evidence design concept for technical presentation of scientific topics was applied to student research interests. Transmutable skills focused on the professional communication of scientific research in various public speaking formats and a comfortable familiarity with the English language to establish a stronger foundation for technical writing.

RELATED TEACHING EXPERIENCE

University of California-Berkeley · Department of Nuclear Engineering

Graduate Student Instructor

NE375: Teaching Techniques in Nuclear Engineering

Fall 2006

- Coordinated guest lecturers from departments within the College of Engineering
- Prepared lectures for effective teaching strategies for the undergraduate classroom
- Assessed individual student technical presentations and overall course grading

EI24: Ethics and the Impact of Technology on Society

Spring 2006; 2005; 2004

- Conducted multiple discussion sections on a weekly basis and review lectures
- Supervised research projects based on current, ethical and scientific issues
- Assessed individual student presentations, projects, and overall course grading

IDS110: Introduction to Computing

Fall 2004

- Conducted multiple laboratory sessions on a weekly basis
- Supervised undergraduate research projects focused on web based education
- Assessed laboratory assignments and project grading

NE92: Issues in Nuclear Science and Engineering

Spring 2002; 2000

- Coordinated guest lecturers from Department of Nuclear Engineering
- Conducted review lectures
- Developed examinations and homework assignments

Assessed overall course grading

NE275: Principles and Methods of Risk Analysis

Fall 2001

This graduate course requires a deeper understanding of the subject matter, due to the student body. The course was one of three in the curriculum with the highest credit load. The main responsibility in this was to advise and grade semester projects and presentations based on risk assessments of engineering systems.

University of California-Berkeley · Department of Nuclear Engineering

Reader

NE150: Introduction to Nuclear Reactor Theory

Spring 2003

NE104: Radiation Detection and Nuclear Instrumentation Laboratory

Fall 2002

NE107: Introduction to Imaging

Spring 2001

NE120: Nuclear Materials

Fall 2000

Supervised laboratory sessions

Assessed examinations, homework assignments, laboratory reports, final grades

Conducted review lectures

PROFESSIONAL SERVICE

UNIVERSITY OF IDAHO

Faculty Advisor - American Nuclear Society, University of Idaho Student Section

Member - Graduate Faculty, University of Idaho

Member - NRC Student Fellowship Oversight Committee, Nuclear Engineering Program

Member - Nuclear Engineering Program Admissions Committee

Member - Idaho Falls Center for Higher Education Safety Committee

ACADEMIC SEARCH COMMITTEES

2018

Nuclear Engineering Faculty, Idaho State University, Idaho Falls Polytechnic Institute

2017

Mechanical/Nuclear Engineering Faculty, University of Idaho

PEER REVIEWER

Regular periods

American Nuclear Society Annual and Winter Meetings

IEEE Transactions on Nuclear Science

American Nuclear Society Fuel Cycle and Waste Management Division John Randall Scholarship

Nuclear Science User Facilities

Advances in Engineering Software

Nuclear Engineering and Technology

Annals of Nuclear Energy

Progress in Nuclear Energy

Energy Science & Engineering

Nuclear Engineering and Design

International Journal of Nuclear Energy

2020

American Nuclear Society Student Conference - North Carolina State University

USDOE - SBIR/STTR Phase I Release 2

2019

John Wiley & Sons, Inc.

Khalifa University of Science and Technology

American Nuclear Society Idaho Section - Idaho High School Essay Contest

American Nuclear Society Student Conference - Virginia Commonwealth University

2018

American Nuclear Society Idaho Section - Idaho High School Essay Contest

USDOE - SBIR/STTR Phase I Release 2

American Nuclear Society Student Conference - University of Florida

2017

American Nuclear Society Idaho Section - Idaho High School Essay Contest

USDOE - SBIR/STTR Phase II Release 2

USDOE - SBIR/STTR Phase II Release 1

USDOE - Office of Nuclear Energy, Consolidated Innovative Nuclear Research

American Nuclear Society Student Conference - University of Pittsburgh

2016

American Nuclear Society Idaho Section - Idaho High School Essay Contest

USDOE - SBIR/STTR Phase I Release 2

FY17 TI Portfolio, Bonneville Power Administration, Office of Technology Innovation

American Nuclear Society Student Conference - University of Wisconsin-Madison

2015

American Nuclear Society Idaho Section - Idaho High School Essay Contest

FY16 TI Portfolio, Bonneville Power Administration, Office of Technology Innovation

USDOE - Advanced Research Projects Agency-Energy Concept Papers, Open 2015 FOA

2012

USDOE - Advanced Research Projects Agency-Energy Review Panel - Arlington, Virginia

2011

International Conf., High-Level Radioactive Waste Management - Albuquerque, New Mexico

2010

Clays in Natural & Engineered Barriers for Radioactive Waste Confinement - Nantes, France

2007

Clays in Natural & Engineered Barriers for Radioactive Waste Confinement - Lille, France

CONFERENCE COMMITTEES

Co-Chair, Technical Program Committee, 2018 Advances in Nuclear Nonproliferation Technology and Policy Conference, American Nuclear Society, 11-15 November, 2018, Orlando, Florida

Technical program committee, Advances in Nuclear Nonproliferation Technology and Policy Conference: Bridging the Gaps in Nuclear Nonproliferation, 25-30 September, 2016, Santa Fe, New Mexico

Technical program paper review committee, Advances in Nuclear Nonproliferation Technology and Policy Conference: Bridging the Gaps in Nuclear Nonproliferation, 25-30 September, 2016, Santa Fe, New Mexico

TECHNICAL SESSION ORGANIZER

Cybersecurity for nuclear installations, American Nuclear Society Winter Meeting, 17-21 November, 2019, Washington, D. C. (*co-Organizer with Prof. Jamie B. Coble, University of Tennessee-Knoxville*)

TECHNICAL SESSION CHAIR

Spent fuel storage and transportation, American Nuclear Society Winter Meeting, 17-21 November, 2019, Washington, D. C.

Cybersecurity for nuclear installations, American Nuclear Society Winter Meeting, 17-21 November, 2019, Washington, D. C.

Data synthesis for pyroprocessing safeguards, 2018 Advances in Nuclear Nonproliferation Technology and Policy Conference (ANTPC), American Nuclear Society, 11-15 November, 2018, Orlando Florida

Special session - Prof. Joonhong Ahn Memorial, International High-Level Radioactive Waste Management Conference, 09-13 April, 2017, Charlotte, North Carolina

Nonproliferation policy, concepts, and approaches: Treaty verification regimes, state-level concepts and fuel cycle analysis, Advances in Nuclear Nonproliferation Technology and Policy Conference: Bridging the Gaps in Nuclear Nonproliferation, 25-30 September, 2016, Santa Fe, New Mexico

Security, safeguards, and non-proliferation, International Conf., High-Level Radioactive Waste Management, 10-14 April 2011, Albuquerque, New Mexico

Used Fuel recycling technologies-I, International Congress on Advances in Nuclear Power Plants (ICAPP 10) 13-17 June, 2010, San Diego, California

Engineered systems and transport processes, International Conf., High-Level Radioactive Waste Management, 07-11 September, 2008, Las Vegas, Nevada

Challenges in nuclear waste disposal: Sociological aspects and technical approaches, Global Center of Excellence, 06 December, 2007, The University of Tokyo, Tokyo Japan

SYMPOSIA ORGANIZER

Nuclear cybersecurity research initiatives annual meeting, Center for Advanced Energy Studies, 27-28 July, 2017, Idaho Falls, Idaho

Nuclear cybersecurity research focus area identification annual meeting, Center for Advanced Energy Studies, 21-22 July, 2016, Idaho Falls, Idaho

Technical implications of nuclear energy system options, Symposium on scientific and institutional aspects of advanced systems for spent nuclear fuels in emerging nuclear countries, Center for International Security and Cooperation, 29-30 September, 2011, Stanford University, Palo Alto, California

INVITED TALKS

University of Idaho • Idaho Falls Center for Higher Education

Strategies and success for ethical research • Vandal Advantage Graduate Student Orientation *August 2019; 2018*

Seminars

University of Tennessee-Knoxville Department of Nuclear Engineering *October 2019*

Lightning Talks

Idaho National Laboratory Nuclear Science & Technology Research Planning Meeting *February 2018*

Idaho National Laboratory Energy & Environment Research Planning Meeting *November 2017*

Outreach

P3/TRIO Upward Bound STEM Day *December 2015*

Lectures

Stanford University Pre-Collegiate Summer Institutes *July 2014*

COMMUNITY SERVICE

College of Eastern Idaho Machine Tool Technology Advisory Board *2018*

Idaho American Nuclear Society Smoke Detector Donation Program *2016 -*

Administration and delivery of smoke detectors to counties in need across the State of Idaho. Over the past fourteen years, we have worked with more than 70 fire departments to donate more than 5700 smoke detectors to Idaho residents. From 2016-19, we donated nearly 1800 smoke detectors to Arimo, Ashton, Bancroft, Bear Lake, Clear Creek, Declo, Downey, Grace, Hamer, Lava Hot Springs, Roberts, Shelley, and Soda Springs, across southeastern Idaho; Centerville, Clear Creek, Horseshoe Bend, Idaho City, Lowman, Placerville and Valley of the Pines in Boise County; and north to the panhandle in Coeur D'Alene, Mullan, Shoshone, North Side, and West Pend.

Idaho American Nuclear Society Highway Cleanup *2016 -*

Garbage cleanup of Miles 122-124 on Interstate 15 twice per year

OUTREACH AND RELATED PROFESSIONAL ACTIVITIES

Utah State University Graduate School Fair *September 2019*

Montana Tech Career Fair *September 2019; March 2018*

American Nuclear Society Diversity Social UI ANS Student Sponsorship *June 2018; November 2017; June 2017*

University of Idaho Moscow Campus Recruiting
 Center for Advanced Energy Studies Seminar Series
 Department of Energy consent based siting meeting
 PHYSOR University of Idaho Sponsorship
 Boise State University Nuclear Research Summit
 UI & BYU American Nuclear Society Student Social
 BYU-Idaho Career Fair

January 2020; October 2018; March 2017
October 2015-17
July 2016
April 2016
March 2016
October 2018; February 2016
October 2015

PROFESSIONAL TRAINING

Los Angeles

Participant

National Science Foundation Grant Development Conference

May 2019

Key officials representing each NSF program directorate, administrative office, Office of General Counsel, and Office of the Inspector General will participate in this two-day conference. The conference is considered a must, particularly for new faculty, researchers, educators and administrators who want to gain insight into a wide range of important and timely issues at NSF, including: the state of current funding; the proposal and award process; and current and recently updated policies and procedures.

University of Illinois Urbana-Champaign

Invited Participant

Collaborative Open Source Curriculum Development Workshop

July 2018

This workshop concluded a year of faculty interaction at six universities to develop curricula for courses common across the same disciplines at multiple universities in order to reduce the amount of time that any individual professor spends on creating what is essentially duplicate materials. The method proposed in this workshop is based on open source software development, where code is shared in online repositories, reviewed by peers, and contributed to the main project.

Generation Atomic + GAIN

Facilitator

Nuclear Advocacy and Communications Training

June 2018

Opposition groups claim nuclear power plants are unsafe. Recently, the U.S. nuclear power industry has been characterized as too expensive and dangerous when compared to other energy sources. As members of the nuclear community, we know that the success of nuclear energy has never been more important to ensuring a positive future for the world but what can we do to make a difference? This workshop will leave participants energized to tell today's nuclear power story and be well-equipped with the tools to do so. Convincing others about the benefits of nuclear involves more than just laying out the facts. Thoughtful and personal storytelling bridges gaps when speaking to those who are unfamiliar with the technology by explaining the personal and moral reasons that we work in this field. Telling our personal stories and motivations for working in nuclear creates common ground from which we can better explain nuclear's benefits: whether it's as a mother talking to a father, a surfer talking to a skier, or a cook talking to a conservationist, the human stories that nuclear makes possible are our strongest tools when speaking to the public. The most effective nuclear advocacy takes place at the interpersonal level when we strike up conversations with peers and even better, strangers. Because you can never know who it might be sitting across from you at that dinner party or next to you on the airplane, it's important to practice having open, considerate conversations with people of all backgrounds.

Pacific Northwest National Laboratory

Invited Participant

Cyber Security Course for Safeguards Practitioners

April 2018

The course is designed for early to mid-career safeguards practitioners (technical instrument developers, instrument users, policy advisors, etc.) who will benefit from a greater understanding of cyber security threats and how to reduce risks to safeguards systems and processes. This 3.5 day course is designed to teach safeguards and cybersecurity experts how to recognize and mitigate potential cybersecurity vulnerabilities in emerging safeguards instrumentation, information systems, and conduct of operations. This training features classroom style learning opportunities through hands-on exercises and provides plenty of time for questions and discussion. Participants will learn new cyber security skills, use cyber security tools, and collaborate with one another and cyber experts to resolve challenges. They will gain an understanding of cyber security principles and a better awareness of cyber risks associated with safeguards

systems. Exercises will include puzzles, exploits of attended and unattended monitoring systems, blended physical and cyber attacks on fictional nuclear facilities, and network defense.

Idaho National Laboratory Nuclear Science and Technology

Invited Participant

Collaborative Research Planning Meeting

February 2018

The Center for Advanced Energy Studies (CAES) is a catalyst for collaborative projects focused on energy research, achieved via connections between the CAES entities Idaho National Laboratory (INL), Boise State University, Idaho State University, University of Idaho, and University of Wyoming and beyond. Through a series of strategic planning meetings, CAES leadership aims to develop a set of focused research directions. The meeting is intended to establish new collaboration, along with a list of prioritized goals and actions items that will steer internal research investments with the intent of growing sustainable, externally-funded programs. The planning meeting will focus on a strategic area tied to one or more INL directorates and will bring together the appropriate INL and university leadership and researchers.

Idaho National Laboratory National and Homeland Security Sci & Tech

Invited Participant

Collaborative Research Planning Meeting

February 2018

The Center for Advanced Energy Studies (CAES) is a catalyst for collaborative projects focused on energy research, achieved via connections between the CAES entities Idaho National Laboratory (INL), Boise State University, Idaho State University, University of Idaho, and University of Wyoming and beyond. Through a series of strategic planning meetings, CAES leadership aims to develop a set of focused research directions. The meeting is intended to establish new collaboration, along with a list of prioritized goals and actions items that will steer internal research investments with the intent of growing sustainable, externally-funded programs. The planning meeting will focus on a strategic area tied to one or more INL directorates and will bring together the appropriate INL and university leadership and researchers.

Idaho National Laboratory Energy & Environment Science and Technology

Invited Participant

Collaborative Research Planning Meeting

November 2017

The Center for Advanced Energy Studies (CAES) is a catalyst for collaborative projects focused on energy research, achieved via connections between the CAES entities Idaho National Laboratory (INL), Boise State University, Idaho State University, University of Idaho, and University of Wyoming and beyond. Through a series of strategic planning meetings, CAES leadership aims to develop a set of focused research directions. The meeting is intended to establish new collaboration, along with a list of prioritized goals and actions items that will steer internal research investments with the intent of growing sustainable, externally-funded programs. The planning meeting will focus on a strategic area tied to one or more INL directorates and will bring together the appropriate INL and university leadership and researchers.

Idaho Falls Post Register

Participant

Intermountain Energy Summit

August 2017; 2016; 2015

This summit is held annually and covers energy issues unique to the intermountain region. Participants include faculty from local universities, researchers from national laboratories, energy companies, and politicians. This year, the theme is energy security with a focus on nuclear, renewable, and alternative energy sources and continued advancements in grid and cybersecurity.

Idaho National Laboratory

Project Mentor

Modeling, Experimentation, Validation (MeV) Summer School

July 2017

The MeV Summer School provides enhanced training for engineers and applied scientists involved in design, licensing, and operation of current and advanced nuclear reactor systems through a multi-faceted learning approach of lectures, tours, and hands-on activities. The school is being organized through the cooperation of national laboratories, industry, government agencies, and universities that share the goal of building a strong workforce to support global nuclear expansion. The faculty will be drawn from the top experts in academia, industry, and government. The general

organization and conduct of the school will be overseen by an international board of senior experts. A local secretariat will provide technical, logistical and administrative support to students and faculty. It is the aim of the school to foster the development of a next-generation network of scientists and engineers capable of advancing nuclear energy in the 21st century through integrated modeling and experimentation.

University of Illinois Urbana-Champaign

Invited participant

PyNE Summit

June 2017

PyNE is a suite of tools to aid in computational nuclear science and engineering. PyNE seeks to provide native implementations of common nuclear algorithms, as well as Python bindings and I/O support for other industry standard nuclear codes.

University of Illinois Urbana-Champaign

Invited Participant

Collaborative Open Source Curriculum Development Workshop

June 2017

This workshop included faculty at six universities to develop curricula for courses common across the same disciplines at multiple universities in order to reduce the amount of time that any individual professor spends on creating what is essentially duplicate materials. The method proposed in this workshop is based on open source software development, where code is shared in online repositories, reviewed by peers, and contributed to the main project.

Pacific Northwest National Laboratory

Invited Participant

Pacific Northwest National Laboratory Safeguards Laboratory Day

May 2019; 2018; 2017

Students and faculty from the University of Idaho were invited to Pacific Northwest National Laboratory to learn about the research activities at the laboratory. The day also included hands-on safeguards and security experiments conducted at laboratory facilities, such as materials accounting and vehicle searches.

Department of Energy

Participant

Consent-Based Siting Public Meeting

July 2016

The Department of Energy is in the initial phase of developing a consent-based process for siting the facilities needed to store and dispose of the nations spent nuclear fuel and high-level radioactive waste. A consent-based approach to siting relies on understanding the views of the public, stakeholders, and governments at the local, state, and tribal levels. In this first phase, the Department is engaging with interested groups and individuals to learn about what elements are important to consider in designing an enduring approach to siting. This session is an opportunity for the public to share thoughts and perspectives through a facilitated discussion.

Global American Business Institute

Invited Participant

Trilateral Nuclear Energy Dialogue: Korea, Japan, United States

July 2016

Convene a high-level private workshop among preeminent Korean, Japanese, and American experts in nuclear energy and nuclear policy issues, with the intention of fostering relationships, confidence building, and seeking potential areas for trilateral cooperation. In keeping with the overarching theme of previous discussions the back-end fuel cycle this meeting seeks to underscore the role of advanced nuclear energy and fuel cycle technologies. Although the obstacles impeding permanent solutions to spent fuel and radioactive waste are largely political, this dialogue aims to highlight the potential of cutting-edge technologies in addressing the policy, environmental, and public acceptance challenges facing management of the nuclear fuel cycle, in addition to opportunities for international collaboration in the research, development, demonstration, and deployment of such technologies.

Pacific Northwest National Laboratory

Invited Participant

Next Generation Safeguards Initiative Summer Course

June 2016

This course, offered through the DOE/NNSA Next Generation Safeguards Initiative (NGSI), covers major international safeguards procedures currently in use in IAEA member nations. Daily lectures were supplemented with hands-on

safeguards activities conducted by IAEA safeguards inspectors and researchers at PNNL. Participants included faculty, postdoctorate researchers, and graduate students.

Boise State University

Participant

Idaho's Role in Nuclear: Clean Energy Powered by the Next Generation

March 2016

Boise State University is proud to bring globally recognized leaders in nuclear energy to address the benefits and challenges associated with nuclear energy production and its role in supplying clean energy for a growing world. The summit will also include a panel discussion with John Kotek, Assistant Director of Nuclear Energy, U.S. Department of Energy; Dr. Mark Peters, Laboratory Director for the Idaho National Laboratory; Mark Rudin, Vice President for Research at Boise State University; Mike McGough, Chief Commercial Officer at NuScale Power, and Dr. Harold Blackman, Associate Vice President for Research and Economic Development at Boise State University. The panel will address questions about the benefits of and concerns around nuclear power.

Portland State University

Participant

National Science Foundation Grant Development Conference

February 2016

Key officials representing each NSF program directorate, administrative office, Office of General Counsel, and Office of the Inspector General will participate in this two-day conference. The conference is considered a must, particularly for new faculty, researchers, educators and administrators who want to gain insight into a wide range of important and timely issues at NSF, including: the state of current funding; the proposal and award process; and current and recently updated policies and procedures.

University of California-Berkeley

Invited Participant

Proliferation Resistance and Physical Protection Working Group Workshop

November 2015

The PR&PP methodology was developed within the Generation IV International Forum (GIF) to provide a structured framework to assess the proliferation resistance and physical protection robustness of Gen IV nuclear energy systems, and to guide designers to further improve their systems. This workshop is intended to familiarize non-experts in this field with the broad aspects of the methodology and its applications. The PR&PP Working Group will present an overview of the methodology to an audience of students, academics, and members of the GIF community who wish to become more familiar with the PR&PP methodology. To illustrate the methodology, its application to a hypothetical nuclear energy system will be examined. Workshop participants will be divided into subgroups that will consider different proliferation and security threats, and will identify important design features and approaches that contribute to the systems resilience to these threats. Following these subgroup sessions, workshop participants will reconvene to review insights from the subgroups. Finally, an open discussion will be held to obtain feedback from the participants on the GIF approach to PR&PP with the objective of refining the methodology and its presentation to the wider community of academics and prospective GIF users.

State of Idaho Board of Education · Boise, Idaho

Invited participant

Open Education Resources Development

October 2015

This workshop focused on the use of open source educational materials in order to produce an online textbook as a supplement to existing commercial textbooks. An online textbook allows flexibility for faculty to augment content without requiring multiple textbooks for a course. An online textbook allows the educational content of a course to be more closely aligned with the desired learning outcomes. Two online texts have been developed: Principles of Nuclear Engineering and Risk Assessment.

University of California-Berkeley · Department of Nuclear Engineering

Discussant

Advanced Summer School of Radioactive Waste Disposal with Social-Scientific Literacy

August 2011

Reflections on the Fukushima Nuclear Accident and Beyond

This advanced summer school was established in conjunction with the Department of Nuclear Engineering/Management, the University of Tokyo and the Department of Nuclear Engineering, University of California, Berkeley to provide Ph.D. students and early-career nuclear engineers with education in social sciences and engineering. The goal was

to foster a next generation of engineers capable of understanding the public and societal needs, contributing to the societal decision making, and taking a responsible role as engineering experts in society. The discussant leads student group activities by stimulating questions from students and corroborating with the chair to develop a summary of lectures.

University of California-Berkeley · Department of Nuclear Engineering

Invited Participant

Minner Fellows Program

June 2011

The objective of this program was to develop a framework for making ethical judgments in engineering. Because engineering faculty and graduate students play a leadership role in the development of these technologies, it is essential that they become aware the ethical, legal and social ramifications of them. The course focused on context, or the embodiment of moral maturity and ethical expertise, in the same way that faculty and graduate students embody engineering and technical expertise.

Hawai'i Tokai International College

Project Mentor

Advanced Summer School of Radioactive Waste Disposal with Social-Scientific Literacy

August 2010

Special emphasis was placed on integrating nuclear science and engineering with social science. A series of lectures and student group discussions were conducted, followed by a student workshop in which projects were developed, under the theme of nuclear engineers in society, including topics such as the safety of a high level waste repository and nuclear systems for non-nuclear weapons states. Project mentors provided guidance, direction, and oversight. The school ended with a series of project presentations and submittal of project reports.

University of California-Berkeley · Department of Nuclear Engineering

Student

Advanced Summer School of Radioactive Waste Disposal with Social-Scientific Literacy

August 2009

In this summer school, The integration of nuclear science and engineering with social science was emphasized through a series of lectures, panel and group discussions. Students directed discussions based on the activities each day. The school culminated in a tour of the Waste Isolation Pilot Plant (WIPP).

University of California-Berkeley · Graduate Student Instructor Teaching & Resource Center

Participant

Summer Institute for Preparing Future Faculty

May - June 2005

This unique program is for Doctoral Candidates with an interest in an academic career. Many aspects of teaching are covered: course design, syllabus development, teaching and learning assessment, teaching and learning strategies, and the creation of a teaching portfolio. The program exposes candidates to faculty in several disciplines both within and outside the university; thus allowing for the dissemination of the full scope of teaching methods and skills, as well as broadening of perspectives with regards to the entire teaching profession.

AWARDS AND FELLOWSHIPS

University of Idaho

American Nuclear Society University of Idaho Student Section

Samuel Glasstone Award for Public Service · Second Place

2019

Certificate of Distinction

2019

University of California-Berkeley

Nuclear Engineering Department Block Grant Fellowship

2005

Outstanding Graduate Student Instructor Award

2003

Katherina S. DeSharton Fellowship

1999

Hamilton Family Memorial Fellowship

1999

United States Department of Energy · Office of Civilian Radioactive Waste Management

Civilian Radioactive Waste Management Fellowship

2000-04

Nuclear Energy Institute

National Academy for Nuclear Training Fellowship

1999

PROFESSIONAL SOCIETIES AND POSITIONS**American Nuclear Society**

Executive Committee • Nonproliferation Policy Division 2019-22

Executive Committee • Student Sections Committee 2018-21

Executive Committee • Fuel Cycle and Waste Management Division, American Nuclear Society 2018-21

Idaho Section of the American Nuclear Society

Community Service 2016 -

Board of Directors 2018-19; 2020-21

Tau Beta Pi Engineering Society