CHAD L. POPE, PHD, PE

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EMPLOYMENT

Professor, *Idaho State University*, 2013 – present

Teach upper division and graduate courses in nuclear engineering. Direct a robust research program focusing on risk analysis and nuclear safety. Serve as the research advisor for graduate students. Jointly appointed to the Idaho National Laboratory. Selected as the Nuclear Engineering Program Director January 2016. Promoted from Associate Professor to Professor with tenure April 2018.

Consultant, *Savannah River National Laboratory*, 2018 - present

Participating in nuclear safety improvement activities including nuclear facility chemical hazards control strategy and criticality safety initiatives.

Consultant, *Argonne National Laboratory*, 2016 – 2018

Participated in safety analysis activities for the design of a commercial scale spent nuclear fuel pyro-processing facility.

Consultant, *Waste Isolation Pilot Plant*, 2016 – 2017

Provided independent nuclear safety assessment activities supporting restart of the US Department of Energy Waste Isolation Pilot Plant located in Carlsbad New Mexico.

Nuclear Safety and Criticality Safety, *Idaho National Laboratory*, 2005-2013.

Technical lead for nuclear safety at the Materials and Fuels Complex (2007-2013). Provided technical supervision for nine safety analysts covering ten nuclear facilities. Tasks included radiation and chemical dose consequence analysis, shielding analysis, depletion analysis, safety analysis and unreviewed safety question evaluations. Project leader of the Fuel Conditioning Facility Safety Analysis Report upgrade. The $2.7M upgrade project produced a DOE-STD-3009 compliant upgraded safety analysis that reclassified multiple Structures, Systems, and Components from safety class to defense-in-depth and significantly reduced the number of Technical Safety Requirements. Technical lead for criticality safety at the Materials and Fuels Complex (2005–2007). Provided nuclear criticality safety technical leadership for fissile material operations in ten nuclear facilities. Tasks included criticality safety calculations and analysis, facility inspections, and fuel handler training and qualification.

Nuclear Safety Analyst, *Argonne National Laboratory-West*, 1999-2005.

Provided nuclear safety support for ten nuclear facilities. Performed safety analysis and unreviewed safety question evaluations, developed and presented criticality safety training for a radiological dispersal device course, preparing dose consequence analysis, and developing the Space and Security Power Systems Facility criticality safety strategy.

Criticality Safety & Systems Engineer, *Argonne National Laboratory-West*, 1991-1999.

Provided systems engineering and criticality safety engineering for the Fuel Conditioning Facility. Tasks included spent fuel sodium removal and radioactive liquid waste processing and developing and maintaining the Fuel Conditioning Facility criticality safety program.

Engineer, *Naval Reactors Facility*, 1989-1991.

Tasks included preparation of the fuel handling criticality safety evaluation for D1G-2 Naval Reactor spent fuel and serving as team lead for a fuel handling cost-time study that identified significant savings.

RESEARCH

Idaho National Laboratory, *INL-ISU Joint-Appointment*, 2013 – present.
Jointly appointed to INL supporting nuclear research conducted at the Materials and Fuels Complex with an emphasis on nuclear safety while simultaneously seeking academic research opportunities in nuclear engineering. Assignments include Versatile Test Reactor safety basis review committee chair and design basis threat radiological, chemical, and biological analysis.

Idaho National Laboratory, *Risk Analysis*, May 2014 – present.
Research centering on nuclear power plant component reliability under flooding conditions in support of the US Department of Energy Light Water Reactor Sustainability program. The research includes experimental methods development using small scale components, full scale component testing, simulation using smoothed particle hydrodynamic computer codes, component reliability modeling development, and design, construction, and operation of a full-scale component testing laboratory. **Funding total: $1,362,635**.

U.S. Department of Energy, *Nuclear Energy University Program***,** Fall 2014 – 2017.
In collaboration with Argonne National Laboratory, developed a reactor physics benchmark evaluation of the Experimental Breeder Reactor II. This multi-year project focused on an addition to the International Handbook of Evaluated Reactor Physics Benchmark Experiments. The project focused on the reactor configuration during the 1986 landmark EBR-II station blackout and loss of heat sink experiments. **Funding total: $400,000**.

Korea Atomic Energy Research Institute, *Pyroprocessing Nuclear Safety*, 2013 – 2017.
International collaboration involving nuclear safety analysis basic research centering on spent nuclear fuel pyro-processing. **Funding total: $286,400**.

U.S. Department of Energy, *Nuclear Safety R&D***,** July 2014 – September 1016.
In collaboration with the Idaho National Laboratory Materials and Fuels Complex nuclear safety group, developing a software application that provides Monte Carlo calculation of radioactive material release dose distributions. The software will be used by decision makers when determining the need for safety systems and controls. **Funding total: $220,000**.

Doctoral Research, *Idaho State University*, Spring 2007 - Fall 2010.
Examined neutron computed tomography for spent nuclear fuel inspection. Identified and analyzed historical neutron radiography measurements. Performed Monte Carlo simulation of radiography measurements as a means of validating tomography simulation. Developed a process of tomography image generation using Monte Carlo simulation results. Adapted the tomography process for anomaly detection using neutron projection differences.

Master's Research, *Idaho State University*, Fall 1991 - Spring 1993.
Prompt neutron decay constant measurement using Rossi's-α method. Measurements were performed using the ISU AGN-201 reactor.

Pyroprocessing, *Argonne National Laboratory / Idaho National Laboratory*, 1991 - 2013.
Indirectly engaged in pyroprocessing research conducted at Argonne National Laboratory-West and Idaho National Laboratory. Participated in installation and operation of process and support equipment, initial demonstration operations, establishing nuclear criticality safety limits and controls, and developing the nuclear safety strategy.

TEACHING

Idaho State University, August 2013 – present.
Courses include: Reactor Physics (NE 4445/5545), Nuclear Systems Laboratory (NE 4447), Monte Carlo Methods and Applications (NE 4458/5558), Reliability and Risk Assessment (NE 4478/5578), Project Design (NE 4496), and Nuclear Criticality Safety (NE 4499/5599).

GRADUATE STUDENTS

PHD STUDENTS

Aaron Thompson, PhD, *Optimization of Neutron and Gamma Ray Layered Shielding for Hot Cells Containing Used Nuclear Fuel* (2018)

Edward Lum, PhD, *Simulating the Katana Effect - Monte Carlo Neutron Transport Combined with Finite Element Analysis to Calculate Negative Reactivity Due to Duct-Bowing* (2017)

Bilguun Byambadorj, PhD, *Simulating Experimental Breeder Reactor II Approach-to-Critical* (2017)

Tony Riley, PhD, *Process Informed Safeguards Approach for a Pyro-processing Facility* (2014)

MS STUDENTS

Trevor Boaz, MS, *Idaho State University AGN-201 Reactor Power Calibration Cadmium Ratio Improvement Using Monte Carlo Methods* (2018)

Sam Giegel, MS, *Neutron Beam Characterization at the Neutron Radiography Reactor at the Idaho National Laboratory* (2018)

Cody Muchmore, MS, *Categorization and Evaluation of Spray Patterns from Pipe Leaks*, (2018)

Antonio Tahhan, MS, *Performance Improvements to the Portal Evaluation Tank, Characterization Analysis of Nuclear Power Plant Component Flooding Tests* (2018)

Soumadipta Jash, MS, *Instrumentation for Measuring Velocity of Wave Produced by Wave Impact Simulation Device for the Idaho State University Component Flooding Evaluation Laboratory* (2018)

Brittany Grayson, MS, *Level 1 Probabilistic Risk Assessment of an Air Ingress Event at a Pyro-Processing Facility* (2017)

Seth Robison, MS, *Spent Fuel Gamma Ray Shielding Using Automated Importance Variance Reduction* (2017)

Sneha Suresh, MS, *Development of an Interior Component Flooding Fragility Model and Design of Component Evaluation Flooding Laboratory Safety Circuit* (2017)

Andrew Maas, MS, *Developments for the Stochastic Objective Decision Aide and Investigation into Respirable Fraction Parameter Distribution* (2017)

Ryan Stewart, MS, *Sensitivity and Uncertainty Analysis in the Homogenization of the EBR-II Core* (2017)

Quinton Beaulieu, MS, *Determination of the Sodium Temperature Coefficient of Reactivity* (2016)

Emerald Ryan, MS, *Construction of a Smoothed Particle Hydrodynamic Model for Flow Over an Ogee Spillway Comparison to Determine Viability in Modeling Flooding Scenarios* (2016)

Mary Toston, MS, *Parametric Study of Plume Dispersion for Stochastic Objective Decision Aide* (2016)

Bishwo Bhandarai, MS, *Full Scale Door Testing Under Flooding Conditions to Develop Testing Protocol* (2016)

Kushal Bhattari, MS, *SODA Application Design and Development* (2016)

David Kamerman, MS, *The Use of Flooding Fragility Curves in Nuclear Power Plant Risk Analysis* (2016)

Jordan Sheppard, MS, *EBR-II Fuel Depletion Analysis Utilizing SCALE 6.1 TRITON, T6-DEPL Sequence* (2016)

Shawn Seegmiller, MS, *Sensitivity Analysis of the Experimental Breeder Reactor II*(2015)

Andrew Layne, MS, *Approach-To-Critical with the Idaho State University Sub-Critical Assembly* (2015)

EDUCATION

Ph.D., Nuclear Science and Engineering, *Idaho State University*, Pocatello, ID, May 2011
Dissertation: *Spent Nuclear Fuel Assembly Inspection Using Neutron Computed Tomography*

M.S., Nuclear Science and Engineering, *Idaho State University*, Pocatello, ID, May 1993
Thesis: *Prompt Neutron Decay Constant Measurement Using Rossi's-α Method*

B.S., General Engineering, with honors, *Idaho State University*, Pocatello, ID, May 1989

HONORS AND AWARDS

Gold Medallion Award, *Idaho National Laboratory*, for technical leadership of the Fuel Conditioning Facility safety basis upgrade, 2011.

Best Paper Presentation, *American Nuclear Society*, for addressing electrorefiner criticality calculation validation, 2005.

Pacesetter Award, *Argonne National Laboratory*, for devising and conducting a cask drying experiment that resulted in a $200,000 cost savings, 1993.

PROFESSIONAL AFFILIATIONS AND LISCENSE

Member of the American Nuclear Society.

Charter member of the ANSI/ANS-8.26, *Criticality Safety Engineer Training and Qualification Program*, National Standard working group.

American Nuclear Society, Nuclear Criticality Safety Division Secretary, 2014-2016.

Registered Professional Engineer - Nuclear. Idaho license number 8135, obtained in 1995.

PUBLICATIONS

E. D. Ryan, C. L. Pope, Coupling of the Smoothed Particle Hydrodynamic Code Neutrino and the Risk Analysis Virtual Environment for Particle Spacing Optimization, *Nuclear Technology*, submitted for publication.

R. Stewart, E. Lum, C. L. Pope, "Design of an Experimental Breeder Reactor Run 138B Reactor Physics Benchmark Evaluation Management Application, *Journal of Nuclear Science and Technology*, DOI: 10.1080/00223131.2019.1680325.

A. Malicoat, C. L. Pope, "Design Improvements to the ISU AGN-201 Reactor SCRAM, Interlock, and Magnet Circuits," *Annals of Nuclear Energy*, **136** (2020)

A. Wells, E. Ryan, B. Savage, A. Tahhan, S. Suresh, C. Muchmore, C. L. Smith, and C. L. Pope, "Non-watertight Door Performance Experiments and Analysis Under Flooding Scenarios," *Results in Engineering*, **3** (2019)

S. Giegel, C. L. Pope, A. Craft, "Determination of the Neutron Energy Spectrum of a Radial Neutron Beam at a TRIGA Reactor," *Nuclear Inst. and Methods in Physics Research, B*, **454** (2019)

C. L. Pope, C. B. Jensen, D. M. Gerstner, J. R. Perry, "Transient Reactor Test (TREAT) Facility Design and Experiment Capability, *Nuclear Technology* (2019).

Y. I. Chang, R. W. Benedict, M. D. Bucknor, J. Figueroa, J. E. Herceg, T. R. Johnson, E. R. Koehl, R. M. Lell, Y. S. Park, C. L. Pope, S. G. Wiedmeyer, M. A. Williamson, J. L. Willit, R. James, S. Meyers, B. Spaulding, J. Underdahl, M. Wolf, "Conceptual Design of a Pilot-Scale Pyroprocessing Facility, *Nuclear Technology* **205** (2019).

E. D. Ryan, B. M. Savage, C. L. Smith, C. L. Pope, "Comparison of Free Surface Flow Measurements and Smoothed Particle Hydrodynamic Simulation for Potential Nuclear Power Plant Flooding Simulation," *Annals of Nuclear Energy* **126** (2019).

E. Lum, C. L. Pope, "Experimental Breeder Reactor II Reactor Physics Benchmark Evaluation," *Transactions of the American Nuclear Society* **119** (2018).

E. Lum, C. L. Pope, "GODIVA-IV Reactivity Temperature Coefficient Calculation Using Finite Element and Monte Carlo Techniques," *Nuclear Engineering and Design* **331 (**2018).

C. L. Pope, C. W. Solbrig, J. P. Andrus, "Fuel Conditioning Facility Inert Gas Filled Reprocessing Hot Cell Leak Rate Measurement," *Annals of Nuclear Energy* **111 (**2018).

R. Stewart, C. L. Pope, E. Ryan, "Fast Spectrum Reactor Fuel Assembly Sensitivity Analysis," *Annals of Nuclear Energy* **110** (2017).

A. Tahhan, C. Muchmore, L. Nichols, A. Wells, G. Roberts, E. Ryan, S. Suresh, B. Bhandari, C. L. Pope, "Development of Experimental and Computational Procedures for Nuclear Power Plant Components Under Flooding Conditions, *Proceedings of the 2017 25th International Conference on Nuclear Engineering* (2017).

E. D. Ryan, C. L. Pope, "Sensitivity Analysis of an Experimental Breeder Reactor II Fuel Assembly," *Transactions of the American Nuclear Society* **115** (2016).

A. Maas, M. Toston, K. Bhattarai, C. L. Pope, J. P. Andrus, "Recent Progress on the Stochastic Objective Decision Aide (SODA) Application," *Transactions of the American Nuclear Society* **115** (2016).

T. R. Riley, C. L. Pope, R. W. Benedict, "Safeguards Performance Model for Evaluation of Potential Safeguards Strategies Applied to Pyroprocessing Facilities*," Nuclear Engineering and Design* **301** (2016).

E. S. Lum, C. L. Pope, "Matlab Enhanced Multi-Threaded Tomography Optimization Sequence (MEMTOS)," *Annals of Nuclear Energy*, **91** (2016).

C. L. Pope, K. Bhattarai, J. P. Andrus, "Stochastic Calculation of Radioactive Material Release Dose Consequences," *Transactions of the American Nuclear Society* **112** (2015).

A. Layne, C. L. Pope, "Approach-to-Critical with the Idaho State University Sub-Critical Assembly Using the Modified Source Method," *Transactions of the American Nuclear Society* **111** (2014).

C. W. Solbrig, C. L. Pope, J. P. Andrus, "Thermal Analysis of ZPPR High Pu Content Stored Fuel," *International Journal of Nuclear Energy* Article ID 402351 (2014).

C. W. Solbrig, C. L. Pope, J. P. Andrus, "Transient Response and Radiation Dose Estimates for Breaches to a Spent Fuel Processing Facility," *Nuclear Engineering and Design* **275** (2014).

C. W. Solbrig, C. L. Pope, J. P. Andrus, "Stress and Diffusion in Stored Pu ZPPR Fuel from Alpha Generation," *International Journal of Heat and Mass Transfer* **74** (2014).

C. W. Solbrig, J. Andrus, C. L. Pope, "ZPPR Fuel Element Thermal Stress-Strain Analysis," *World Journal of Nuclear Science and Technology* **4** (2014).

S. W. Morgan, J. C. King, C. L. Pope, "Beam Characterization at the Neutron Radiography Reactor," *Nuclear Engineering and Design* **265** (2013).

C. L. Pope, M. J. Lineberry, "Comparison of Measured and Monte Carlo Results for Neutron Beam Transmission Through an Irradiated Nuclear Fuel Assembly," *Nuclear Technology* **182** (2013).

S. W. Morgan, J. C. King, C. L. Pope, "Simulation of Neutron Radiograph Images at the Neutron Radiography Reactor," *Annals of Nuclear Energy* **57** (2013).

C. W. Solbrig, C. L. Pope, "Cadmium Release from a Reprocessing Electrorefiner Falling Over," *Nuclear Engineering and Design* **255** (2013).

C. L. Pope, "Fuel Assembly Neutron Computed Tomography Using Monte Carlo Simulation," *Transactions of the American Nuclear Society* **107** (2012).

S. W. Morgan, J. C. King, C. L. Pope, "Beamline Model Validation Through Flux Profile and Neutron Activation Measurements at the Neutron Radiography (NRAD) Reactor," *Transactions of the American Nuclear Society* **106** (2012).

J. P. Andrus, C. L. Pope. "Derivation of Accident-Specific Material-at-Risk Equivalency Factors," INL/CON-12-24336, Idaho National Laboratory (2012).

C. A. Van De Graaf, C. L. Pope, J. T. Taylor, "Hazard Categorization Reduction via Nature of the Process Argument," INL/CON-12-24467, Idaho National Laboratory (2012).

C. L. Pope, W. W. Scates, J. T. Taylor, "Hot Cell Window Shielding Analysis Using MCNP," INL/CON-09-15334, Idaho National Laboratory (2009).

C. L. Pope, "Fast Reactor Spent Fuel Processing: Experience and Criticality Safety," INL/CON-07-12106 (2007).

C. L. Pope, E. W. Papaioannou, "Ten Years of Fast Reactor Spent Fuel Processing: Criticality Safety," *Transactions of the American Nuclear Society* **95** (2006).

R. M. Lell, J. A. Morman, C. L. Pope, "Range of Applicability Determination for Validation of LiCl-KCl Fissile Mixtures with Sparse Benchmark Data," Nuclear Criticality Safety Division Topical Meeting, American Nuclear Society (2005).

J. A. Morman, C. L. Pope, "ANSI/ANS-8.26: Nuclear Criticality Safety Engineer Training and Qualification Program," *Transactions of the American Nuclear Society* **91** (2004).

R. M. Lell, C. L.Pope, "Criticality Safety at the ANL-W Fuel Conditioning Facility," Embedded Topical Meeting, American Nuclear Society (2001).

C. L. Pope, "Fuel Conditioning Facility Zone-to-Zone Transfer Administrative Controls," *Transactions of the American Nuclear Society* **83** (2000).

R. M. Lell, C. L. Pope, "Criticality Safety Requirements for Transporting EBR-II Fuel Bottles Stored at INTEC," Embedded Topical Meeting, American Nuclear Society (2000).

TECHNICAL REPORTS

Plant Integral Risk-Informed System Health Program, D. Mandelli, Z. Ma, R. Youngblood, S. St. Germain, C. Smith, P. Talbot, S. Hess, D. Dube, A. Winter, J. Burr, C. Pope, J. Miller, M. Robbins, D. Das, M. Azarian, J. Coble, INL/EXT-19-55808, Idaho National Laboratory, Research Report (2019).

Conceptual Design of a Pilot-Scale Pyroprocessing Facility, Y. I. Chang, R. W. Benedict, M. D. Bucknor, J. Figueroa, J. E. Herceg, T. R. Johnson, E. R. Koehl, R. M. Lell, Y. S. Park, C. L. Pope, S. G. Wiedmeyer, M. A. Williamson, J. L. Willit, R. James, S. Meyers, B. Spaulding, J. Underdahl, M. Wolf, ANL/NE-Landmark-CRADA-12 (2018).

Nuclear Power Plant Component Flooding Fragility Research, C. L. Pope, B. Savage, S. Jash, B. Johnson, C. Muchmore, L. Nichols, E. Ryan, S. Suresh, A. Tahhan, R. Tuladhar, A. Wells, C. L. Smith, INL/EXT-18-45247, Idaho National Laboratory, Research Report (2018).

Evaluation of Run 138B at Experimental Breeder Reactor II, A Prototype Liquid Metal Fast Breeder Reactor, E. S. Lum, C. L. Pope, R. Stewart, B. Byambadorj, Q, Beaulieu, EBR2-LMFR-RESR-001, International Handbook of Evaluated Reactor Physics Experiments (2018).

Nuclear Power Plant Mechanical Component Flooding Fragility Experiments FY-2017 Report, C. L. Pope., B. Savage, B. Johnson, C. Muchmore, L. Nichols, G. Roberts, E. Ryan, S. Suresh, A. Tahhan, R. Tuladhar, A. Wells, C. Smith, INL/EXT-17-43439, Idaho National Laboratory, Research Report (2017).

Nuclear Power Plant Mechanical Component Flooding Fragility Experiments Status, C. L. *Pope*, B. Savage, B. Johnson, C. Muchmore, L. Nichols, G. Roberts, E. Ryan, S. Suresh, A. Tahhan, R. Tuladhar, A. Wells, C. Smith, INL/EXT-17-42728, Idaho National Laboratory, Research Report (2017).

Flooding Fragility Experiments and Prediction, C. Smith, B. Bhandari, C. Muchmore, A. *Tahhan*, A. Wells, L. Nichols, C. L. Pope, INL/EXT-16-39963, Idaho National Laboratory, Research Report (2016).

Status of the Flooding Fragility Testing Development, C. L. Pope, B. Savage, A. Sorensen, B. *Bhandari*, D. A. Kamerman, A. Tahhan, C. Muchmore, G. Roberts, E. Ryan, S. Suresh, A. Wells, C. Smith, INL/EXT-16-39115, Idaho National Laboratory, Research Report (2016).

Progress on the Industry Application External Hazard Analyses Early Demonstration, C. L. Smith, S. Prescott, J. Coleman, E. Ryan, B. Bhandari, S. Sludern, C. L. Pope, R. Sampath, INL/EXT-15-36749, Idaho National Laboratory, Research Report (2015).

Industry Application External Hazard Analyses Problem Statement, R. H. Szilard, J. Coleman, C. L. Smith, S. Prescott, A. Kammerer, R. Youngblood, C. L. Pope, INL/EXT-15-36101, Idaho National Laboratory, Research Report (2015).

P*rototype Consequence Modeling Tool Based Upon the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) Software*, C. L. Pope, B. Byambadorj, C. Hill, E. Lum, B. Nield, J. Swanson, Idaho National Laboratory, Research Report (2014).