

Wesley Charles Williams, PhD, PE

Group Leader of Advanced Reactor Systems at Oak Ridge National Laboratory

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SUMMARY

Over 20 years of experience in federally funded R&D in advanced nuclear power and oil and gas combined with industry experience in the nuclear power and petrochemical industries as a consultant. Management of large-scale facilities for equipment testing programs including initialization, requirements definition, design, procurement, and execution. Multidisciplinary engineering project management. Focused experience in dynamic thermal-fluid system modeling, experiments, and design. Expert in gas convective heat transfer, nuclear power safety systems, and nanoparticle colloids.

EDUCATION AND PROFESSIONAL RECOGNITION

PhD in Nuclear Science and Engineering, Massachusetts Institute of Technology, February 2007

M.S. in Nuclear Engineering, University of Tennessee, Knoxville, June 2002

B.S. in Mechanical Engineering, University of Tennessee, Knoxville, June 2000

Licensed Professional Engineer in the State of Louisiana (#35171)

EXPERIENCE

2020-present Group Leader (Advanced Reactor Systems Group, Nuclear Fusion and Fission Energy Science Directorate, Oak Ridge National Laboratory)

Managing a group of 11 researchers on approximately \$5MM of DOE funded research. Research is focused in the areas of Thermo-Mechanical modeling of nuclear fuel, thermal-hydraulic subchannel analysis codes, and thermal-fluid modeling of dynamic systems. Product Lead of the AI Initiative on Artificial Intelligence for Robust Engineering and Science Project.

2014-2020 Professional in Residence and PERTT Lab Director (Craft and Hawkins Department of Petroleum Engineering, Louisiana State University)

Director of the LSU Petroleum Engineering Research and Technology Transfer laboratory, a \$20MM 3-acre field-scale testing and experimental facility for oil and gas equipment. Duties included all financial and personnel management with 3 full time employees and 20+ transient student workers. Oversight of approximately \$6.5MM of experimental testing of equipment for major oil industry operators and vendors. Developed testing plans and procedures and requirements, participated in coordination of vendors and workers in the execution of the work. Developed overall safety plan and system for the laboratory, conducted audits of the facility, and coordinated upgrades to the facility.

2013-2014 Mechanical/Process Engineer (CDI Corporation)

Project work for several chemical processing facilities. Collection of requirements and specifications for mechanical and process instrument equipment following industry code. Development of equipment bid and purchasing packages. Calculation of process flows for piping sizing and equipment specification.

2011-2013 Project Manager (Audubon Engineering Company)

Project work for several chemical processing facilities and midstream commodity companies, approximately \$40MM TIC. Collection of requirements and specifications for mechanical and process instrument equipment following industry code. Development of equipment bid and purchasing packages. Calculation of process flows for piping sizing and equipment specification. Pressure piping design and vessel calculation checking. Oversight of mechanical, civil-structural, and electrical/instrumentation design packages. Development of \$2 Billion bid package with Jaragua Equipamentos of Brazil for the PetroBras COMPERG gas processing facility upgrade.

2010-2011 Freelance Engineering Consultant (PHD Engineering, LLC)

Developed and checked Chi/Q calculations for Mitsubishi-Hitachi licensing process submittal to the NRC. Design and construction of a biologically sterilizable flow experiment for a biotech startup company.

2009-2010 Senior Engineering Consultant (ILD, Inc.)

Developed and checked Chi/Q calculations for Entergy Riverbend. Performance of thermal package calculations and checked calculations for several balance of plant efficiency upgrades. Modification of thermal performance code to capture realistic performance parameters.

2008-2009 Senior Mechanical Engineer (Enercon Services)

Performance of engineering change package work for multiple nuclear power plants (Entergy, Southern Company, WCNO). Work involved piping design, equipment selection, instrumentation selection, drawing development and interfacing with engineering and operations at the plant to capture stakeholder inputs. Held unescorted access to Entergy Riverbend and Waterford 3. Participated in EPRI PRA training.

2007-2008 Mechanical Design Engineer (Plant Engineering Services, Fluor)

Project work for several chemical processing facilities and midstream commodity companies. Collection of requirements and specifications for mechanical and process instrument equipment following industry code. Development of equipment bid and purchasing packages. Calculation of process flows for piping sizing and equipment specification. Pressure piping design and vessel calculation checking. Oversight of mechanical, civil-structural, and electrical/instrumentation design packages.

2002-2007 Research Assistant (MIT & DOE)

Design, procurement, and construction of benchtop experiments for the characterization of thermo-physical properties of nanofluids and to assess their potential as a nuclear reactor coolant. Performance of RELAP and custom system code analysis for gas cooled reactor safety system performance. Support of the testing of RELAP/ATHENA for gas coolants. Design of active-passive safety systems for the gas cooled fast reactor. Discovered hot channel starvation issues during loss of coolant accidents. Developed correlations for mixed convection heat transfer and methodology for capturing transitions between forced-mixed-free convection heat transfer regimes.

2002 (Summer) NESLS Fellow (Oak Ridge National Laboratory)

Evaluation of the economic performance of a reduced size balance of plant to match with the

modular Westinghouse IRIS reactor. Modification of existing computer code for thermal performance assessment of wet steam turbine cycles.

2000-2002 Research Assistant (University of Tennessee, Knoxville)

Design of modularized systems for the Westinghouse IRIS and a Generation IV Lead-Bismuth reactor concepts. Creation of CAD models and the development of modularization sizing for barge mounting of reactors.

OTHER ACADEMIC EXPERIENCE

Assistant Professor of Mechanical Engineering, University of Louisiana at Lafayette, 2013-2014, teaching 508 Project Management for graduate level students

Instructor, Louisiana State University, Physics Department, Physics 2102 - Electricity and Magnetism, Spring to Summer 2010

Lecturer, Louisiana State University, Osher Lifelong Learning Institute, Fall 2009

Lecturer, DOE Nuclear Summer Institute, Thermal Hydraulics Experiments for Nuclear Engineers, 2007

Teaching Assistant, MIT-National Academy for Nuclear Training Reactor Technology Program for Utility Executives, 2004 and 2005

MEMBERSHIPS AND PROFESSIONAL AFFILIATIONS

Member of American Nuclear Society, American Association of Drilling Engineers and American Society of Mechanical Engineers, Louisiana Nuclear Society

PUBLICATIONS

63 peer reviewed journal and conference papers including 1 book chapter. 1224 citations, h-index of 13.

Coutinho, R., Williams, W., Waltrich, P., Mehdizadeh, P., & Scott, S. (2017). A model for liquid-assisted gas-lift unloading. Paper presented at the 18th International Conference on Multiphase Production Technology.

Coutinho, R. P., Waltrich, P. J., Williams, W. C., Mehdizadeh, P., Scott, S., Xu, J., & Mabrye, W. (2020). Experimental Characterization of Two-Phase Flow Through Valves Applied to Liquid-Assisted Gas-Lift. *Journal of Energy Resources Technology*, 142(6), 063007.

Coutinho, R. P., Williams, W. C., Waltrich, P. J., Mehdizadeh, P., Scott, S., Xu, J., & Mabry, W. (2018). The Case for Liquid-Assisted Gas Lift Unloading. *SPE Production & Operations*, 33(01), 73-84.

Driscoll, M., Hejzlar, P., Delaney, M., Williams, W., & Matos, C. (2004). Compressed Gas Emergency Power Supply for GFR Service. Paper presented at the Transactions of the American Nuclear Society.

Eapen, J., Williams, W. C., Buongiorno, J., Hu, L.-w., Yip, S., Rusconi, R., & Piazza, R. (2007). Mean-field versus microconvection effects in nanofluid thermal conduction. *Physical review letters*, 99(9), 095901.

Feo, G., Sharma, J., Kortukov, D., Williams, W., & Ogunsanwo, T. (2020). Distributed fiber optic sensing for real-time monitoring of gas in riser during offshore drilling. *Sensors*, 20(1), 267.

Feo, G., Sharma, J., Santos, O., Williams, W., & Ogunsanwo, T. (2020). Multiphase flow characterization and modeling using distributed fiber optic sensors to prevent well blowout. Paper presented at the Optics and Photonics for Sensing the Environment.

Feo, G., Sharma, J., Williams, W., KortuKov, D., & Toba, O. (2019). Application of Distributed Fiber Optics Sensing Technology for Real-Time Gas Kick Detection. Paper presented at the SPE Annual Technical Conference and Exhibition.

Feo, G., & Williams, W. C. (2017). Quantitative Analysis of High Pressure Hazards in Oil and Gas Field Operations. Paper presented at the SPE Health, Safety, Security, Environment, & Social Responsibility Conference-North America.

Goudarzi, N., Mohafez, M. H., & Williams, W. (2019). Fluid Structure Interaction Analyses of Wind Turbines: The North Carolina Jennette's Pier Turbines Case Study. Paper presented at the ASME Power Conference.

Guo, R., Chen, Y., Waltrich, P. J., & Williams, W. C. (2018). An experimental investigation on flow pattern map and drift-flux model for co-current upward liquid-gas two-phase flow in narrow annuli. *Journal of Natural Gas Science and Engineering*, 51, 65-72.

Hejzlar, P., Kim, S., & Williams, W. (2005). Transient ATHENA/RELAP5-3D Calculations for a 600MWth Plate-Type Helium GFR. Retrieved from

Hejzlar, P., Pope, M. J., Williams, W. C., & Driscoll, M. J. (2005). Gas cooled fast reactor for generation IV service. *Progress in Nuclear Energy*, 47(1-4), 271-282.

Hejzlar, P., Williams, W. C., & DRISCOLL, M. J. (2004). Hot channel flow starvation of helium cooled GFRs in laminar natural convection. *Transactions of the American Nuclear Society*, 91, 202-204.

Jang, J., & Williams, W. (2003). Preliminary evaluation of heat transfer models for high temperature gas cooled reactors. Korea, Republic of: N. p., 2003. Web.

Kunju, M., Nielsen, J., Chen, Y., Santos, O. L., Williams, W. C., Ribeiro, P., & Chagas, F. (2019). A Pilot Study on Time-Dependent Dissolution of CO₂ in Oil for Prediction of Gas Kick Behaviors in Non-Aqueous Fluids. Paper presented at the International Conference on Offshore Mechanics and Arctic Engineering.

Lee, W., Jang, J., & Williams, W. (2003). Preliminary evaluation of heat transfer models for high temperature gas cooled reactors. Paper presented at the Korean Nuclear Society.

Li, C. H., Williams, W., Buongiorno, J., Hu, L.-W., & Peterson, G. (2008). Transient and steady-state experimental comparison study of effective thermal conductivity of Al₂O₃/water nanofluids. *Journal of heat Transfer*, 130(4).

Lima, C., Lavorante, L., Williams, W., Beisl, C., Reis, A., Carvalho, L., & Moriss, M. (2017). Deciphering injection-induced seismicity: A conceptual model for explaining discrepancies between Oklahoma and North Dakota activities. Paper presented at the 51st US Rock Mechanics/Geomechanics Symposium.

Miller, L. F., Khan, M. K., Williams, W., & Mynatt, F. (2002). Evaluation of Two 300 MWe Fourth Generation PbBi Reactor System Concepts. Paper presented at the International Conference on Nuclear Engineering.

Muglia, M., Dubbs, L. L., D'Anna, L., Vermillion, C., Mazzoleni, A., Granlund, K., . . . Husain, I. (2019). Towards an Integrated Hybrid MHK Prototype at the Jennette's Pier Wave Energy Test Site in Nags Head, North Carolina USA. Paper presented at the AGU Fall Meeting Abstracts.

Mynatt, F. R., Townsend, L., Williamson, M., Williams, W., Miller, L. W., Khan, M. K., . . . Sawhney, R. (2003). Design and layout concepts for compact, factory-produced, transportable, generation IV reactor systems. Retrieved from

Nahri, S. Y., Chen, Y., Williams, W., Santos, O., & Sun, T. (2019). Buoyancy Induced Convection of Riser Gas in Deepwater Drilling Operations. Paper presented at the International Conference on Offshore Mechanics and Arctic Engineering.

Nahri, S. Y., Chen, Y., Williams, W., Santos, O., Thibodeaux, L., & Zhu, J. (2019). Understanding the Phenomenon of Dissolved Gas Migration of Gas in Riser During Drilling Operations. Paper presented at the International Conference on Offshore Mechanics and Arctic Engineering.

Nwaka, N., Chen, Y., & Williams, W. (2019). Riser Gas Equilibrium for Oil Based Muds with MPD Considerations. Paper presented at the Offshore Technology Conference.

Pagan, E., Williams, W., Kam, S., & Waltrich, P. (2016). Modeling vertical flows in churn and annular flow regimes in small-and large-diameter pipes. Paper presented at the 10th North American Conference on Multiphase Technology.

Pagan, E., Williams, W., Kam, S., & Waltrich, P. (2017). A simplified model for churn and annular flow regimes in small-and large-diameter pipes. *Chemical Engineering Science*, 162, 309-321.

Pagan, E. V., Williams, W., & Waltrich, P. J. (2016). A simplified transient model to predict liquid loading in gas wells. Paper presented at the SPE Western Regional Meeting.

Rusconi, R., Williams, W. C., Buongiorno, J., Piazza, R., & Hu, L.-W. (2007). Numerical analysis of convective instabilities in a transient short-hot-wire setup for measurement of liquid thermal conductivity. *International Journal of Thermophysics*, 28(4), 1131-1146.

Santos, O. L., Williams, W. C., Sharma, J., Almeida, M. A., Kunju, M. K., & Taylor, C. E. (2021). Use of fiber optic information to detect and investigate the gas-in-riser phenomenon. Paper presented at the SPE/IADC International Drilling Conference and Exhibition.

Sharma, J., Santos, O. L., Feo, G., Ogunsanwo, O., & Williams, W. (2020). Well-scale multiphase flow characterization and validation using distributed fiber-optic sensors for gas kick monitoring. *Optics Express*, 28(26), 38773-38787.

Thiberville, C., Wang, Y., Waltrich, P., Williams, W., & Kam, S. I. (2019). Modeling of Smart Pigging for Pipeline Leak Detection: From Mathematical Formulation to Large-Scale Application. Paper presented at the SPE Gas & Oil Technology Showcase and Conference.

Thiberville, C., Wang, Y., Waltrich, P., Williams, W., & Kam, S. I. (2020). Modeling of Smart Pigging for Pipeline Leak Detection. *SPE Production & Operations*, 35(03), 610-627.

Thiberville, C. J., Waltrich, P.J., Williams, W.C., & Kam, S. I. (2016). Vertical and Horizontal Flow Loop Tests for Field Scale Drilling and Production Applications. Paper presented at the 2016 Offshore Korea Technical Conference, Busan, Korea.

Thiberville, C. J., Wang, Y., Waltrich, P., Williams, W. C., & Kam, S. I. (2017). Evaluation of Software-Based Early Leak Warning System in Gulf-of-Mexico Subsea Flowlines. Paper presented at the SPE Annual Technical Conference and Exhibition.

Thiberville, C. J., Wang, Y., Waltrich, P., Williams, W. C., & Kam, S. I. (2018). Evaluation of Software-Based Early Leak Warning System in Gulf-of-Mexico Subsea Flowlines. *SPE Production and Operations*, 33(4).

von Holt, H., Kam, S., & Williams, W. C. (2017). Theoretical Evaluation of Foam Proppant Carriers. Paper presented at the AGUFM.

Waltrich, P. J., Capovilla, M. S., Lee, W., de Sousa, P. C., Zulqarnain, M., Hughes, R., . . . Archer, A. (2019). Experimental Evaluation of Wellbore Flow Models Applied to Worst-Case-Discharge Calculations for Oil Wells. *SPE Drilling & Completion*.

Waltrich, P. J., Capovilla, M. S., Lee, W., Zulqarnain, M., Hughes, R., Tyagi, M., . . . Singh, J. (2017). Experimental evaluation of wellbore flow models applied to worst-case-discharge calculations. Paper presented at the SPE Health, Safety, Security, Environment, & Social Responsibility Conference-North America.

Wang, Y., Edrisi, A., Williams, W., & Kam, S. I. (2015). Foam Drilling Hydraulics Calculations Using Two Foam- Flow Regimes. Paper presented at the 19th Annual Gulf of Mexico Deepwater Technical Symposium, New Orleans, LA.

Wei, T., Hejzlar, P., Feldman, E., & Williams, W. (2005). A semi-passive approach to GFR depressurized decay heat removal accidents. Paper presented at the Proceedings of the International Conference on Advances in Nuclear Power Plants (ICAPP'05).

Wibisono, A. F., Ahn, Y., Williams, W. C., Addad, Y., & Lee, J. I. (2013). Challenging issues in iPWR with single phase water naturally circulating system. Paper presented at the International Congress on Advanced Power Plants.

Wibisono, A. F., Ahn, Y., Williams, W. C., Addad, Y., & Lee, J. I. (2013). Studies of various single phase natural circulation systems for small and medium sized reactor design. *Nuclear Engineering and Design*, 262, 390-403.

Williams, W. (2002). Regenerative Heater Optimization for Steam Turbo-Generation Cycles of Generation IV Nuclear Power Plants with a Comparison of Two Concepts for the Westinghouse International Reactor Innovative and Secure (IRIS). Retrieved from

Williams, W. (2017). Synergistic Opportunities Between Nuclear Energy and the Oil and Gas Industry. Paper presented at the 2017-Sustainable Industrial Processing Summit.

Williams, W., Bang, I., Forrest, E., Hu, L., & Buongiorno, J. (2019). Preparation and characterization of various nanofluids. Paper presented at the 2007 Cleantech Conference and Trade Show Cleantech 2007.

Williams, W., Buongiorno, J., & Hu, L.-W. (2008). Experimental investigation of turbulent convective heat transfer and pressure loss of alumina/water and zirconia/water nanoparticle colloids (nanofluids) in horizontal tubes. *Journal of Heat Transfer*, 130(4).

Williams, W., Forrest, E., Hu, L., & Buongiorno, J. (2006). Preparation and Characterization of Water-Based Nanofluids for Nuclear Applications. Paper presented at the Proceedings of the 2006 international congress on advances in nuclear power plants-ICAPP'06.

Williams, W., Hejzlar, P., Driscoll, M., Lee, W., & Saha, P. (2003). Analysis of a convection loop for GFR post-LOCA decay heat removal from a block-type core. Program for Advanced Nuclear Power Studies.

Williams, W., Taylor, C., Almeida, M., Sharma, J., Waltrich, P., Chen, Y., . . . Ogunsanwo, O. (2020). Distributed Sensing and Real Time Visualization of Gas Kick Dynamics in a Full-Scale Wellbore. Paper presented at the SPE Annual Technical Conference and Exhibition.

Williams, W. C. (2002). Conceptual design and layout of the balance of plant for a generation IV nuclear power plant using the Westinghouse International Reactor, Innovative & Secure (IRIS).

Williams, W. C. (2006). Fundamental issues of nanofluid behavior. Paper presented at the International Conference on Nuclear Engineering.

Williams, W. C. (2007). Experimental and theoretical investigation of transport phenomena in nanoparticle colloids (nanofluids). Massachusetts Institute of Technology,

Williams, W. C. (2011). If the Dittus and Boelter equation is really the McAdams equation, then should not the McAdams equation really be the Koo equation? *International Journal of Heat and Mass Transfer*, 54(7-8), 1682-1683.

Williams, W. C. (2015). Gas-Based Nanofluids (Nanoaerosols). In *Heat Transfer Enhancement with Nanofluids* (pp. 453-469): CRC Press.

Williams, W. C., McLean, J. (2015). Using NASA's GFSSP Code for Steady State and Transient Modeling of Gas Cooled Reactor Passive Safety Systems. Paper presented at the Proceedings of the 16th International Topical Meeting on Nuclear Reactor Thermalhydraulics (NURETH-16), Chicago, Illinois, USA.

Williams, W. C., BUONGIOMO, J., & HU, L.-W. (2007). The efficacy of nanofluids as single-phase convective heat transfer enhancing coolants for nuclear reactor applications. *Transactions of the American Nuclear Society*, 96, 481-484.

Williams, W. C., Buongiorno, J., & Hu, L. W. (2006). Heat Transfer Enhancement in Nanofluids. Paper presented at the 2006 ASME Energy Nanotechnology International Conference.

Williams, W. C., Hejzlar, P., Saha, P., & Driscoll, M. J. (2004). Comparative Analysis of Decay Heat Removal Approaches for a Block GFR Core. In.

Williams, W. C., Hejzlar, P., & Driscoll, M. J. (2004). Decay heat removal from a GFR core by natural convection. Paper presented at the Proceedings of the 2004 international congress on advances in nuclear power plants-ICAPP'04.

Williams, W. C., Hejzlar, P., & Saha, P. (2004). Analysis of a Convection Loop for GFR Post-LOCA Decay Heat Removal. Paper presented at the International Conference on Nuclear Engineering.

Williams, W. C., & McLean, J. (2015). Improvements in pipeline failures after World War II. *International Journal of Greenhouse Gas Control*, 100(42), 699.

Williams, W. C., Hejzlar, P., Driscoll, M.J., Lee, W.J., & Saha, P. (2003). Analysis of a convection loop for GFR post-LOCA decay heat removal from a block-type core. In.

Williams, W. C., & Townsend, L. W. (2002). Initial Balance of Plant Design and Layout for Westinghouse IRIS (International Reactor Innovative and Secure) generation IV Reactor Concept. Paper presented at the Transactions of the 2002 American Nuclear Society Annual Meeting.

Williams, W. C., Zhao, K., Lu, B., Szaflarski, A., Kim, P., & L.F., M. (2001). Modular Lead-Bismuth Eutectic Reactor (MLBER) Design Concept. Paper presented at the Proceedings of the 2001 American Nuclear Society Winter Meeting, Reno, NV.