Nolan E. **Goth**

Nuclear Engineer

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Career Profile

Nolan is an R&D Associate of Nuclear Engineering for the Energy Systems Development Group within the Nuclear Energy and Fuel Cycle Division at Oak Ridge National Laboratory. He earned his Ph.D. in nuclear engineering from Texas A&M, an M.S. in nuclear engineering from Texas A&M, and B.S. degrees in nuclear engineering and economics from Missouri S&T.

His primary interests are in experimental and computational thermal-hydraulics. This includes analyzing two large molten salt forced convection loops for fluoride (LSTL) and chloride (FASTR) salts. He is investigating radioisotope thermoelectric generators for land-, sea-, and space-power applications. Other areas include the design of isotope production targets and systems for ^{99}Mo and ^{238}Pu, dynamic modeling of cryogenic neutron moderating systems, and high-temperature pebble bed reactor cores.

Dr. Goth has received recognition from the U.S. Department of Energy for innovations in nuclear technology R&D. The Nuclear Regulatory Commission has granted him a Senior Reactor Operator License. Current funding secured is $190K as a Principal Investigator and $750K as a Contributor.

Dr. Goth's research centers on advancing the technological readiness of advanced fission, neutron, and radioisotope systems. Current Areas of focus include:

- Molten salt reactor development
- Radioisotope thermoelectric generators
- Radioisotope production targets (^{99}Mo and ^{238}Pu)
- Experimental flow visualization measurements
- CFD and heat transfer modeling for high temperature applications

Education

Texas A&M University — *College Station, Texas*

PhD in Nuclear Engineering — *2018*

MS in Nuclear Engineering

Missouri S&T — *Rolla, Missouri*

BS in Nuclear Engineering — *2012*

BA in Economics

Experience

Oak Ridge National Lab — *Oak Ridge, Tennessee*

R&D Associate Nuclear Engineer — *2021 - Present*

- Designed and constructed a molten chloride salt bearing test rig for salt-wetted bearing development
- Designed and tested HALEU targets to address molybdenum-99 domestic supply chain issues

R&D Assistant Nuclear Engineer — *2019 - 2021*

- Analyzed thermal-hydraulics of high-temperature pebble bed reactor cores
- Designed and analyzed fluoride and chloride molten salt heat exhangers and test sections

Texas A&M University — *College Station, Texas*

Graduate Researcher, Fast Reactor Fuel Assembly Flow Characterization — *2015 - 2018*

- Group leader of a six-person team with $1.2M budget
- Designed, procured, constructed, and operated an experimental flow facility

The Babcock & Wilcox Company, mPower SMR — *Lynchburg, Virginia*

Operations Engineer & Project Manager — *2013 - 2014*

- Performed system design reviews of mPower SMR systems
- Developed budget trends, tracked critical paths, and formulated weekly plans

Missouri S&T *Rolla, Missouri*

Senior Reactor Operator & Operations Instructor *2010 - 2012*

- Conducted reactor power maneuvers and supervised fuel movements, material irradiations, and handling activities
- Taught introductory reactor operations classes

Smith-Goth Engineers, Inc. *Springfield, Missouri*

AutoCAD Technician *2006 - 2008*

- Designed and drafted HVAC, lighting, and fire protection systems

Skills

Thermal Hydraulics (Sim)	StarCCM+, OpenFOAM, Ansys, BISON, EcosimPro, COBRA-TF
Thermal Hydraulics (Exp)	Test Loops, Optics, Instrumentation, Sensors, LDV, PIV, SPIV, PTV
Neutronics (Sim)	Serpent, MPACT, MCNP, SCALE/ORIGEN, Homemade Diffusion/Transport/MOC Codes
Neutronics (Exp)	Shielding, Dosimetry, Directional Detectors
Reactor Operations	Senior Reactor Operator, Fuel Movement, Power Maneuver, Operator Training
Programming	Python, MATLAB, LaTeX, C++, SQL
Modeling	Solidworks, AutoCAD, Tecplot, Paraview, Gmsh

Certifications and Awards

2021 **ORNL Inventor**, UT-Battelle
2018 **Innovations in Nuclear Technology R&D Award - 2nd Place**, U.S. Department of Energy
2017 **Workshop and First Place Poster**, Consortium for Advanced Simulation of LWRs (CASL) Summer Institute
2017 **Crane Operator**, National Commission for the Certification of Crane Operators
2012 **Magna Cum Laude**, Missour S&T
2011-12 **Senior Reactor Operator License**, Nuclear Regulatory Commission
2008-12 **Bright Flight Scholarship**, Missouri Dept of Higher Education
2008-12 **NRC Scholarship**, Nuclear Regulatory Commission

Professional Service

2014-22 **Reviewer**, Nuclear Engineering and Design Journal
2022 **Reviewer**, International Journal of Heat and Fluid Flow
2021 **Reviewer**, Physics of Fluids
2021 **Reviewer**, Journal of The Minerals, Metals & Materials Society
2020 **Reviewer**, International Journal of Infectious Diseases
2020 **Reviewer**, Journal of Turbulence
2012 **Vice President**, Alpha Nu Sigma Nuclear Honor Society
2008-22 **Member, Session Chair**, American Nuclear Society
2009 **Member**, Kappa Mu Epsilon Mathematics Honor Society

Select Publications

Journal

[1] Thien Nguyen, **Goth, Nolan**, Philip Jones, Saya Lee, Rodolfo Vaghetto, and Yassin Hassan. "PIV measurements of turbulent flows in a 61-pin wire-wrapped hexagonal fuel bundle". In: *International Journal of Heat and Fluid Flow* 65 (2017), pp. 47–59.

[2] **Goth, Nolan**, P Jones, DT Nguyen, R Vaghetto, YA Hassan, A Obabko, E Merzari, and PF Fischer. "Comparison of experimental and simulation results on interior subchannels of a 61-pin wire-wrapped hexagonal fuel bundle". In: *Nuclear Engineering and Design* 338 (2018), pp. 130–136.

[3] **Goth, Nolan**, Philip Jones, Thien Nguyen, Rodolfo Vaghetto, and Yassin Hassan. "PTV/PIV Measurements of Turbulent Flows in Interior Subchannels of a 61-Pin Wire-Wrapped Hexagonal Fuel Bundle". In: *International Journal of Heat and Fluid Flow* (2018).

[4] Thien Nguyen, Nolan Goth, Philip Jones, Rodolfo Vaghetto, and Yassin Hassan. "Stereoscopic PIV measurements of near-wall flow in a tightly packed rod bundle with wire spacers". In: *Experimental Thermal and Fluid Science* 92 (2018), pp. 420–435.

[5] Rodolfo Vaghetto, **Goth, Nolan**, Philip Jones, Mason Childs, Saye Lee, Duy Thien Nguyen, and Yassin A Hassan. "Pressure Measurements in a Wire-Wrapped 61-Pin Hexagonal Fuel Bundle". In: *Journal of Fluids Engineering* 140.3 (2018), p. 031104.

[6] Mason Childs, Rodolfo Vaghetto, Philip Jones, **Goth, Nolan**, and Yassin Hassan. "Experimental Determination and Analysis of the Transverse Pressure Difference in a Wire-Wrapped Rod Bundle". In: *International Journal of Heat and Mass Transfer* (2020).

[7] Brian DeGraff, Matthew Howell, Elvis Dominguez-Ontiveros, **Goth, Nolan**, Wesley Williams, and Drew Winder. "Spallation Neutron Source Hydrogen Relief Analysis for the Cryogenic Moderator System". In: *Cryogenic Engineering and International Cryogenic Materials* (2023). To appear.

[8] **Goth, Nolan**, Frank Liu, Bryan P Maldonado, Pradeep Ramuhalli, Matthew Howell, Ryuji Maekawa, and Sarah Cousineau. "Dynamic systems modeling of the Spallation Neutron Source Cryogenic Moderator System to optimize transient control and prepare for power upgrades". In: *Cryogenic Engineering and International Cryogenic Materials* (2023). To appear.

[9] Bryan P Maldonado, Frank Liu, **Goth, Nolan**, Pradeep Ramuhalli, Matthew Howell, Ryuji Maekawa, and Sarah Cousineau. "Data-Driven Modeling of a High Capacity Cryogenic System for Control Optimization". In: *IFAC-PapersOnLine* 56.2 (2023), pp. 3986–3993.

[10] Bryan P Maldonado, Frank Liu, **Goth, Nolan**, Pradeep Ramuhalli, Matthew Howell, Ryuji Maekawa, and Sarah Cousineau. "Transient Optimization of the Cryogenic Moderator System Controller at the Spallation Neutron Source for Improved Performance". In: *IEEE Control Systems Letters* (2024). To appear.

Conference

[1] **Goth, Nolan**, Mason Childs, Philip Jones, Saya Lee, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "Particle Image Velocimetry Measurements in a Wire-Wrapped 61-pin Hexagonal Fuel Bundle". In: *American Nuclear Society Winter Meeting*. 2016.

[2] **Goth, Nolan**, Philip Jones, Mason Childs, Saya Lee, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "Pressure Measurements in a Wire-Wrapped 61-Pin Hexagonal Fuel Bundle". In: *American Nuclear Society Winter Meeting*. 2016.

[3] **Goth, Nolan**, Philip Jones, Saya Lee, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "Velocity and Pressure Measurements in a Wire-Wrapped 61-Pin Hexagonal Fuel Bundle". In: *Engineering Turbulence Modeling and Measurements 11*. 2016.

[4] Rodolfo Vaghetto, **Goth, Nolan**, Mason Childs, Philip Jones, Saya Lee, D.T. Nguyen, and Y.A. Hassan. "Flow Field and Pressure Measurements in a 61-Pin Wire-Wrapped Hexagonal Fuel Bundle". In: *American Nuclear Society Winter Meeting*. 2016.

[5] **Goth, Nolan**, Philip Jones, Saya Lee, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "Time-Resolved PIV/PTV Measurements on Interior Subchannels of a Wire-Wrapped 61-pin Hexagonal Fuel Bundle". In: *American Nuclear Society Annual Meeting*. 2017.

[6] **Goth, Nolan**, Philip Jones, D.T. Nguyen, Rodolfo Vaghetto, Y.A. Hassan, Aleksandr Obabko, Elia Merzari, and Paul Fisher. "Comparison of Experimental and Simulation Results on Interior Subchannel of a 61-Pin Wire-Wrapped Hexagonal Fuel Bundle". In: *17th International Topical Meeting on Nuclear Reactor Thermal Hydraulics*. 2017.

[7] **Goth, Nolan**, Philip Jones, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "Turbulent Transverse Plane PIV Measurements on a Wire-Wrapped 61-Pin Hexagonal Fuel Bundle". In: *26th International Conference on Nuclear Engineering*. 2018.

[8] **Goth, Nolan**, Lance White, William Headley, D.T. Nguyen, Rodolfo Vaghetto, and Y.A. Hassan. "High Resolution Transverse Plane PIV Measurements of a 61-pin LMFBR Fuel Bundle". In: *American Nuclear Society Winter Meeting*. 2018.

[9] Lance White, **Goth, Nolan**, Thien Nguyen, Rodolfo Vaghetto, and Yassin Hassan. "High-Fidelity Velocity Measurements in a Totally Blocked Interior Subchannel of a Wire-wrapped 61-Pin Hexagonal Fuel Bundle". In: *Thermal Hydraulic Simulations and Experiments for the Safety Assessment of MEtal cooled reactors (SESAME)*. 2019.

[10] **Goth, Nolan**, Marilyn Delgado, Trevor Howard, and Kevin Robb. "Molten Salt Air-Cooled Heat Exchanger Fluid Dynamics". In: *American Nuclear Society Winter Meeting*. 2020.

[11] **Goth, Nolan**, Trevor Howard, Jorge Navarro, Eliott J Fountain, Nesrin Ozgan Cetiner, and Chris Bryan. "Design and Heat Generation Rate Analysis of LEU-UAlx Dispersion Target Plates for Irradiation in the High Flux Isotope Reactor". In: *American Nuclear Society Annual Meeting*. 2021.

[12] **Goth, Nolan**, Trevor Howard, Jorge Navarro, Eliott J Fountain, Nesrin Ozgan Cetiner, and Chris Bryan. "Thermal-Hydraulic Analysis and Experimental Flow Testing of LEU-UAlx Dispersion Target Plates for Irradiation in the High Flux Isotope Reactor". In: *American Nuclear Society Annual Meeting*. 2021.

[13] **Goth, Nolan**, Trevor Howard, Jorge Navarro, Eliott J Fountain, Nesrin Ozgan Cetiner, and Chris Bryan. "Component-and System-Level Thermal-Hydraulic Modeling of LEU-UAlx Dispersion Target Plates for Irradiation in the High Flux Isotope Reactor". In: *19th International Topical Meeting on Nuclear Reactor Thermal Hydraulics*. 2022.

[14] **Goth, Nolan**, Jorge Navarro, Eliott Fountain, Alex Huning, and Chris Bryan. "Preliminary Design Status of HALEU Annular Targets for Irradiation in the High Flux Isotope Reactor". In: *American Nuclear Society Annual Meeting*. 2022.

[15] **Goth, Nolan**, Duy Thien Nguyen, and W. David Pointer. "Investigation of Point Contact Strategies for CFD Simulations of Pebble Bed Reactor Cores". In: *American Nuclear Society Annual Meeting*. 2022.

[16] **Goth, Nolan**, Duy Thien Nguyen, Kevin Robb, and Ethan Kappes. "Numerical Investigation of Cartridge Heater Performance Applied to the FASTR Main Heater for Molten Chloride Salts". In: *American Nuclear Society Annual Meeting*. 2022.

[17] Bryan Maldonado, Frank Liu, **Goth, Nolan**, Pradeep Ramuhalli, Matthew Howell, Ryuji Maekawa, and Sarah Cousineau. "Data-Driven Modeling of a High Capacity Cryogenic System for Control Optimization". In: *22nd World Congress of the International Federation of Automatic Control (IFAC)*. 2023.

[18] Thien Duy Nguyen, **Goth, Nolan**, Pablo Moresco, Vincent Jodain, and Vivek Rao. "Preliminary experimental and numerical studies of light-core vortex rings". In: *American Nuclear Society Annual Meeting*. To appear. 2024.

[19] Nick Russell, **Goth, Nolan**, Richard Howard, and Jim Nash. "Generation III 238Pu Production Target Hydraulic Characterization". In: *American Nuclear Society Annual Meeting*. To appear. 2024.

Technical Reports

[1] **Goth, Nolan**, Jorge Navarro, Chris Bryan, Chad Denbrock, Robert Wahlen, and Terry Grimm. *Preliminary Thermal-Hydraulic Analysis of the UTA–2 Subcritical Linear Accelerator–Driven System*. ORNL/TM-2022/2494. Oak Ridge National Lab.(ORNL), Oak Ridge, TN (United States), 2022.

[2] **Goth, Nolan**, Jesse Brown, Tarek Ghaddar, and Logan Scott. *Optimal Chloride Salt Mixture for a Fusion Blanket*. ORNL/TM-2023/3052. Oak Ridge National Lab.(ORNL), Oak Ridge, TN (United States), 2023.

[3] Duy Thien Nguyen, **Goth, Nolan**, Pablo Moresco, Vincent Jodoin, and Vivek Rao. *Design and Testing of the Vortex Ring Facility*. ORNL/TM-2023/2843. Oak Ridge National Lab.(ORNL), Oak Ridge, TN (United States), 2023.

Thesis & Dissertation

[1] **Goth, Nolan**. "Design and PIV Measurements on a Wire-Wrapped 61-Rod Hexagonal Fuel Assembly Experimental Facility". MA thesis. Texas A&M University, 2017.

[2] **Goth, Nolan**. "Analysis of Experimental PIV/PTV Measurements on a Matched-Index-of-Refraction 61-Pin Wire-Wrapped Hexagonal Fuel Bundle". PhD thesis. 2018.