Student Opportunities in Nuclear Energy R&D

Argonne's roots lie in nuclear energy R&D. Argonne-led research supports every main nuclear power system throughout the world. One of our most notable successes has been the development and transfer of the technologies in today's commercial nuclear reactors.

Today, we continue our work in support of current-generation reactor technology while conducting research and development aimed at closing the nuclear fuel cycle and enabling the production of the clean sustainable energy that will be needed for the future.

Argonne's scientific and technical diversity provides the full range of capabilities needed to meet this challenge. Working in diverse, multidisciplinary teams, we are using cutting-edge research and modeling/simulation tools and experiments in many scientific disciplines to translate fundamental scientific understanding into innovative technologies.

http://students.ne.anl.gov
Argonne National Laboratory is the largest federally funded research center in the Midwest. More than 3,350 employees, including more than 1,250 scientists and engineers, work at the Argonne site about 25 miles southwest of Chicago. The laboratory's annual operating budget of around $800 million supports upwards of 200 research projects. Argonne was the nation's first national laboratory, chartered in 1946.

Argonne has five major mission areas, each of which fulfills important governmental and Department of Energy (DOE) responsibilities, as well as providing important benefits to our society at large. They are:

- **Conducting basic scientific research** to further our understanding of the world we live in. Argonne conducts basic experimental and theoretical scientific research in the physical, life and environmental sciences.
- **Operating national scientific facilities** to help advance America's scientific leadership. Argonne operates world-class research facilities like the Advanced Photon Source.

- **Enhancing the nation's energy resources** to ensure America's energy future. Argonne is working to develop and evaluate advanced energy technologies.
- **Developing better ways to manage environmental problems.** Argonne is at the forefront in developing new ways to manage and solve the nation's environmental problems and to promote environmental stewardship.
- **National Security** has increased in significance in recent years for the nation and for Argonne research. Argonne-developed capabilities are helping counter the threats of terrorism.

At the same time, we are also conscious of our responsibility to help the public understand science and to enhance American science, engineering and mathematics education by helping to train nearly 1,000 college undergraduate and graduate students and post-doctoral researchers every year as part of our normal research and development activities.

The Nuclear Engineering Division and its precursors have contributed to the development of civilian nuclear power systems for over 65 years, ever since the dawn of the nuclear age. Over the years, we have significantly expanded our competencies and applied them to problems outside of the civilian nuclear arena.

The mission of the Nuclear Engineering (NE) Division is to advance the design and operation of nuclear energy systems and to apply our nuclear energy-related expertise to current and emerging programs of national and international importance.

We conduct analytical and experimental research in advanced nuclear energy systems, nuclear nonproliferation, and environmental management. Our extensive capabilities in modeling and simulation are applied in the development of diverse engineering systems and the optimization of their performance.

Currently, we have programs in:

- Next-generation nuclear systems analysis, including development of advanced reactor systems for actinide management,
- Advanced fuel cycle and repository performance modeling,
- Reduced Enrichment for Research and Test Reactors (RERTR) design and safety analyses,
- Nuclear regulatory research, including nondestructive evaluation of nuclear plant components, materials testing of corrosion and irradiation effects, and development of new inspection technologies.

Division personnel additionally contribute to improving the operation of existing nuclear energy systems and to resolving issues related to their performance and safety. Finally, we contribute engineering expertise to the design, operation and decommissioning of major facilities at Argonne and elsewhere.

- **Current Generation Nuclear Power Systems**
- **Next-Generation Nuclear Power Systems**
- **Nuclear Nonproliferation**
- **Advanced Nuclear Fuel Cycles**
- **Advanced Simulation Methods**
Examples of NE Student Projects

- Support activities in the area of system dynamics scenario studies that include both the U.S. and the global nuclear fuel cycle developments.
- Theoretical simulation of images of targets scenes as "seen" by a passive millimeter wave (MMW) camera.
- Participate in studies involving various aspects of liquid metal technology, primarily involving stripper films and targets for the Facility for Rare Isotope Beams (FRIB).
- Work with researchers to learn about the thermal-hydraulics simulation capabilities being developed at Argonne and to apply these to study mixing in subassembly flows.
- Development and qualification for advanced alloys for nuclear reactor systems.
- Assist with a variety of tasks related to nuclear energy safety worldwide. Perform literature search in the area of spent nuclear fuel dry storage internationally.
- Active and passive electromagnetic remote sensing techniques. Use the available lab equipment and data acquisition software to collect and examine data.
- Participate in experimental activities focused on sodium technology for fast reactor R&D, and development of measurement techniques and data acquisition.
- System analysis and system dynamics simulation of the nuclear fuel cycle, and deployment scenario studies using Argonne integrated fuel cycle system analysis codes.
- Develop working familiarity with the computational fluid dynamics software package STAR-CCM+. Apply skills to thermal fluid simulation tasks, such as computational mesh development and solution verification analyses, to support the development of Reactor Cavity Cooling System experiment in the Natural Shutdown Test Facility.
- Work with TREAT database to develop significant understanding of these technically complex experiments and the science and engineering that led to their success and usefulness.
- Implement a visual-tactile display for applications in surgical robot system and nuclear reactor simulator.
- Participate in the development and population of a nuclear forensics database containing information on radioactive sources.

The Nuclear Engineering Student Experience

University of Southern California Junior, Summer 2013

“At Argonne, I’m working under Dr. Richard Vilim and Dr. Park, both involved in research relating to nuclear energy modeling and simulation. My project consists of trying to adapt a robotics simulation software to try and simulate a safety and monitoring tool known as Under Sodium Viewing (USV). Basically, there exists a prominent type of nuclear reactor known as a liquid metal fast reactor, which uses liquid metal (almost always sodium), to serve as a coolant for the reactor. However, because the reactor core is submerged in an opaque liquid metal, it becomes impossible to monitor what is going on inside. In comes Under Sodium Viewing, which utilizes ultrasonic scanning to monitor the system through the liquid metal and search for safety concerns such as cracks in the core casing and what not. The idea for USV has been around for roughly 30 years; however, it has recently resurfaced as technology has become available to implement this concept and nuclear reactor safety becomes an even more important issue.

What I love about Argonne is the environment and just love of learning for the sake of learning. When given my project, my supervisor literally said, ‘I have no idea if this is possible, but I want you to see if it is.’ So. Cool. Each week offers a multitude of interesting seminars for us to attend that extend beyond just the Nuclear Engineering division. Argonne is basically a playground for scientists and people interesting in making new discoveries in their field of work.’

Rice University Senior, Spring 2011

“I will be a senior next year at Rice University in Houston, TX. I am a Chemical and Biomolecular Engineering major. However at Argonne, I applied for an internship in the Nuclear Engineering field. There are so many fields of study and only a minimal amount of background experience is needed, so the doors are open to explore any related field to your major, or so I found.

I learned about Argonne’s summer programs from my uncle, who has worked at Argonne for fifteen years. He has always told me how wonderful it is to work here, and highly suggested I come and take a tour and look around. I fell in love with the atmosphere and environment, as well as with the opportunity Argonne had to offer. I was a little nervous before beginning my internship because I had not had any real research experience, or any interaction with the scientific or professional world prior to this internship. I was relieved to find out on my first day when my supervisor informed me that this would not be a problem and they would teach me everything I needed to know!

The major advantage of an internship at Argonne is that you are put right in the middle of breaking ground research. Nothing learned in a classroom can be substituted for a real hands-on experience. Argonne gives you the opportunity to learn what it would be like to be a scientist and to have a one of kind internship.

My future plans include graduation in the spring from Rice, and then attending graduate school. One day I would love to return to Argonne and pursue a lifelong career here. My internship at Argonne has helped me to realize that I want to pursue a career in research, and there is no better place to do so than at Argonne National Laboratory.”
Argonne Graduate and Undergraduate Student Programs

- **Laboratory-Graduate Research Appointments** are available for qualified U.S. university graduate students who wish to carry out their thesis research at Argonne National Laboratory under the co-sponsorship of an Argonne staff member and a faculty member at the student’s home institution.

- **Guest Graduate Appointments** are available for qualified graduate students who indicate that access to Argonne National Laboratory will be beneficial to their thesis research and to Argonne programs.

- **Thesis-Parts Appointments** support qualified graduate students who wish to visit Argonne for periods from a few days to a few months, so that they may utilize special laboratory facilities.

- **Science Undergraduate Laboratory Internships (SULI) and Student Research Participation Program (SRP)** internships provide special training and research experiences to college and university undergraduate students at the DOE National Laboratories.

- **Community College Internships** provide technical training experiences to community college students at the DOE National Laboratories.

- **Research Aide Appointments**, primarily summer appointments, are designed to provide the Argonne scientific and engineering staff with technical assistance.

- **Cooperative Education** appointments made primarily during the academic year are available to undergraduate and graduate students.

- **Visiting Faculty Program** provides research experiences for faculty and their students from colleges and universities with limited research facilities and those institutions serving populations historically underrepresented in the research community.

The Nuclear Engineering Division has hosted students from:

Aalto University (Finland) · Auburn University · Australian National University · Benedictine University · Bradley University · Brigham Young University · Calvin College · Cambridge University · The Cooper Union · College of New Jersey · Cornell University · DePaul University · Ecole des Mines de Paris (France) · Ecole Polytechnique-Palaiseau (France) · Edinboro University of Pennsylvania · Florida International University · Forschungszentrum Julich GmbH (Germany) · Georgia Institute of Technology · Georgetown University · Governors State University · Grenoble Institute of Technology (France) · Illinois Institute of Technology · Illinois Mathematics & Science Academy · Illinois Wesleyan University · Kansas State University · Kazakh National Technical University (Kazakhstan) · Kennesaw State University · Kettering University · Korea Advanced Institute of Science and Technology (South Korea) · Kyushu University (Japan) · Loyola University Chicago · Lewis University · Massachusetts Institute of Technology · McGill University · Mississippi State University · Missouri University of Science & Technology · North Carolina State University · North Central College · Northwestern University · Ohio State University · Oregon State University · Osaka University (Japan) · Pennsylvania State University · Politecnico di Milano (Italy) · Purdue University · Rice University · South Dakota State University · Southern Illinois University · Edwardsville · Southern Methodist University · State Engineering University of Armenia · Taras Shevchenko National University of Kyiv (Ukraine) · Texas A&M University · Ulsan National Institute of Science and Technology (South Korea) · University of California at Berkeley · University of Chicago · University of Cologne (Germany) · University of Evansville · University of Florida · University of Georgia · University of Grenoble (France) · University of Idaho · University of Illinois-Chicago · University of Illinois-Springfield · University of Illinois at Urbana-Champaign · University of Iowa · University of Massachusetts Lowell · University of Michigan, Ann Arbor · University of Missouri Rolla · University of Pennsylvania · University of Puerto Rico · University of Sao Paulo (Brazil) · University of Tennessee · University of Texas at Austin · University of Texas at Arlington · University of Texas El Paso · University of Texas Pan-American · University of Tokyo Institute of Technology · University of Wisconsin-Madison · Utah State University · Virginia Commonwealth University · Washington University · Western Michigan University

CONTACT > Lee Ann Ciarlette | 630.252.4835 | leeann@anl.gov | Nuclear Engineering Division | students.ne.anl.gov

Argonne National Laboratory, 9700 South Cass Avenue, Lemont, IL 60439

October 2014