NPRE ILLINOIS

DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

FALL 2015

NEWSLETTER FOR ALUMNI & FRIENDS

Former TRIGA Reactor gains ANS National Nuclear Landmark status

DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

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NPRE TEACHERS RANKED AS EXCELLENT BY THEIR STUDENTS

Spring 2015

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Davide Curreli
Tomasz Kozlowski
William R. Roy
David N. Ruzic
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Fall 2014

Davide Curreli
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NPRE continues to shine!

NPRE has had another outstanding year! It has been filled with many exciting events: the former TRIGA reactor has achieved American Nuclear Society National Nuclear Landmark status; a number of our faculty have earned national awards; the HIDRA (Hybrid Illinois Device for Research and Applications) facility has arrived and been reconstructed; our new Master of Engineering in Energy Systems degree has started; undergraduate and graduate student enrollments have remained strong with excellent students at both levels; and a number of international outreach research and educational programs have been initiated. You will read about these developments and events in the following pages.

Department Head James F. Stubbins

In the past two years we have undergone the ABET (formerly the Accreditation Board for Engineering and Technology) review, Fall of 2013 with full accreditation coming in Summer 2014, and our distinguished External Review Committee review in November of 2014, followed by a number of activities this year that were based on some of their recommendations and other initiatives within the Department. These two major external reviews, ABET to examine our BS program, and the External Review to examine the overall status and outlook for all of our educational and research activities, ended with very positive results. Both reviews yielded some suggestions for activities that could further enhance our programs. As with most reviews, the biggest value is in the things we learned during the preparation for these events. This has been followed by two major departmental retreats focused on our undergraduate program, our graduate program, and the strategic planning initiative of which we need to take full advantage for our new faculty and discipline's emerging opportunities. We are already in the process of updating our PhD Qualifying Exam procedures and our PhD degree requirements. As we move forward with these activities, we will keep you informed and rely on your advice on how best to accomplish improvements.

> "We sincerely appreciate those of you who have given generously of your time, energy and resources."

Beyond our own department, we continue to have a very strong College with strong undergraduate and graduate enrollments. The College has been ranked again at 5th place in the U.S. News and World Report Best Graduate Schools in Engineering. Meanwhile, new initiatives are ongoing in the College. The University Board of Trustees has approved an engineering-based Carle Illinois College of Medicine, which will have strong ties to the Engineering College. This transition will take place over the next two years with a formal curriculum in Fall 2017. This development is important to us because of our growing work in the medical imaging area. We will have a strong connection to the new Medical College in addition to our other major connection with Massachusetts General

Hospital, where we started a summer intern program this past summer.

In other good news, NPRE and the Aerospace Engineering Department are sharing a large remodeling project in Talbot Lab. This project, announced in last year's newsletter, will provide major new laboratory space for both departments, much of which will be dedicated to undergraduate teaching labs. Over the past year, this project has evolved from filling the central facility space in Talbot to building a larger addition onto the southeast area on the outside of Talbot. Formal planning for the layout of this space is underway.

This also has been another extraordinary year for our engagement with our alumni, through programs such as our seminar series, the Interchange event, and other gatherings. Thanks to all of you who were able to attend our event last fall in Santa Fe in honor of Roy Axford. More celebrations in his honor are planned for Spring 2016 (please see the back cover).

Your contributions to our program over the past year have given us a tremendous lift. We sincerely appreciate those of you who have given generously of your time, energy and resources. You are always welcome to visit us, meet our new faculty and students, and view our research programs. We have some major celebrations coming in Spring–we hope you can join us then. We always value your input to maintain an excellent academic program.

James F. Stubbins

Willett Professor and Department Head

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Former TRIGA Reactor gains ANS National Nuclear Landmark status

In a lifetime spanning 38 years, the former TRIGA Reactor at the University of Illinois at Urbana-Champaign left a profound impact on nuclear engineering research and education.

That impact now has been officially recognized with the American Nuclear Society's recent designation of TRIGA as a National Nuclear Landmark.

"The Advanced Illinois TRIGA Reactor was a real asset to our educational and research programs," said Jim Stubbins, NPRE Department Head and Willett Professor in the College of Engineering. "Generations of NPRE students were able to enjoy the unique experience of operating and experimenting with our TRIGA Reactor. Our TRIGA was really unique since many of the features were designed by our faculty to provide major experimental and operational features not available with other TRIGA Reactors.

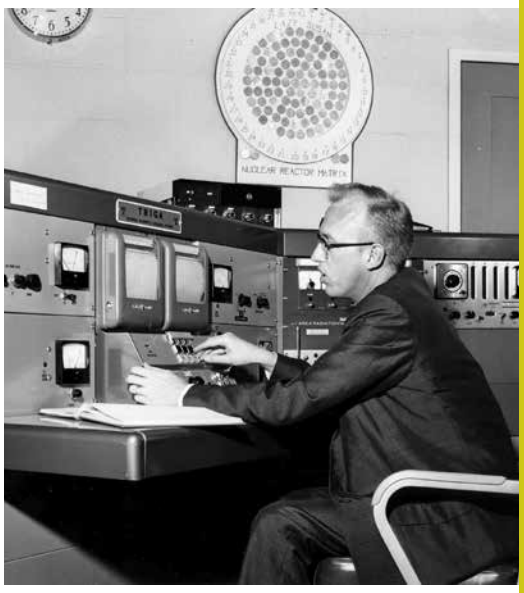
"I continue to appreciate the value that our TRIGA Reactor provided to our students, our research programs, and our community," Stubbins continued. "This award goes beyond the recognition of a major research facility—it is a fitting testament to the ingenuity and vision of the faculty who founded and grew our NPRE program. Their pursuit of excellence in teaching and research and the facilities that support those missions is the guiding principal for all of us who followed them."

Nominating the TRIGA Reactor for landmark designation was Emeritus Prof. George H. Miley, who performed some of the groundbreaking research that led to the facility's significance.

"The existence of the new TRIGA reactor with its unique pulsing and dynamic capability was an important factor that convinced me to join the (Nuclear Engineering) faculty in 1961," Miley said. "Indeed it worked out that I was able to do considerable research that was enabled by having the TRIGA on campus. Thus I was saddened when it was decommissioned, but I am elated that it will now be a National Nuclear Landmark. That is truly a well-deserved recognition for what was an amazing teaching and research facility."

TRIGA, officially known as the University of Illinois Advanced Teaching Research Isotope General Atomic (TRIGA Mark II) Reactor, has been cited for "educating students in reactor operations," and for "groundbreaking research in the areas of fission fragment physics, nuclear pumped lasers, nuclear batteries, neutron activation analysis, radioisotope production, nuclear reactor kinetics, coupled core kinetics, and neutron pulse propagation."

The former reactor now joins other important facilities and sites—including the High Flux Isotope Reactor at Oak Ridge National Laboratory (2014), the Gaithersburg, Maryland-based National Institute of Standards and Technology (NIST) Center for Neutron Research (2013) and the Atomic Energy of Canada Limited's (AECL) Zero Energy Deuterium 2 (ZED-2) research reactor (2010)—that ANS has identified and memorialized for being instrumental in the advancement and implementation of nuclear technology and the peaceful uses of nuclear energy.



Prof. Marvin Wyman in the former TRIGA control room.

TRIGA went critical on August 16, 1960. The reactor was extremely popular; being used primarily for the training of students in nuclear engineering, but also as an interdisciplinary facility, with the Departments of Chemistry and Chemical Engineering, Physiology and Biophysics, Physics and various other engineering departments all competing for time with the facility.

A generation of nuclear engineering students at Illinois were privileged to have participated in research projects, laboratory studies, and operating experiences. Scores of nuclear industry reactor operators trained on the facility, and thousands of visitors touring the TRIGA learned first-hand about the importance of nuclear energy. A number of students entering the nuclear engineering program at Illinois were influenced by their tours of TRIGA, which was a popular stopping point during Engineering Open House.

Administrative decisions led to TRIGA's shuttering in 1998, and fuel removal in 2004. The dismantlement of the remaining portions of the reactor and Nuclear Reactor Building on the Urbana campus were completed in 2012.

TRIGA accounted for many "firsts" in the annals of nuclear engineering:

The second TRIGA on a university campus, the facility initially offered the highest power pulsing capability (30-40ms pulses of 1,000 megawatts, with a 100kW licensed steady operating power).

The addition of a cooling tower a few years after the facility's commissioning allowed an increase in steady-state operation to 1 MW. This, combined with the internal core flux trap, allowed the highest steady-state neutron flux operation of a university TRIGA.

In 1968, the University approved upgrading the reactor and increasing its steady peak power to 1.5 or more, while making it capable of pulsing up to 6,000 megawatts.

TRIGA was equipped with a "through port" that passed by the end of the reactor core and penetrated the shield of the opposite sides. This later allowed important studies of nuclear pumped lasers, since beam alignment was enabled.

TRIGA provided access to a central core pump trap (enabling experiment requiring high neutron fluxes during either steady state or pulsing) and a "rabbit tube" passing through the core to provide rapid insertion and removal of samples for irradiation studies.

A graphite thermal column led from the TRIGA core into the "bulk shielding tank," a large water tank located next to the main TRIGA water tank. This enabled studies of both steady state and pulsed neutron studies of objects located in the bulk shielding tank. Most notable was the Low Power Reactor Assembly (LOPRA) reactor core. This facility allowed a series of coupled core reactor experiments that provided basic data for large power reactor kinetics.

ANS, ON-CAMPUS RECOGNITIONS PLANNED

This official recognition of the former TRIGA Reactor as an American Nuclear Society National Nuclear Landmark will take place during the ANS 2015 Winter Meeting, Monday, November 9.

The recognition will be announced during the Honors and Awards President's Special Session, from 4:30-6:30 p.m. during the meeting being held at the Marriott Wardman Park Hotel in Washington, D.C.

NPRE will host a breakfast reception the following morning (Tuesday, November 10) at the hotel, and the designation will be among reasons for alumni and friends to celebrate. To register for the breakfast reception, go to illinois.edu/fb/sec/36919.

The Department also will host a celebration on the Urbana campus April 21 and 22, 2016. The Spring 2016 celebration will include an Open House of the HIDRA fusion facility, the Virtual Education and Research Laboratory, and other NPRE facilities. See the back cover for more details.

While details will be forthcoming as they are finalized, plans are underway to house a pictorial display of the TRIGA in Talbot Laboratory, as well as establish a permanent marker near the site of the former facility.

Alumni and friends are urged to send to NPRE their memories and photos of the TRIGA. While written accounts are welcome, NPRE particularly encourages alumni and/or friends to share their stories by video. Contact Susan Mumm at s-mumm@illinois.edu to participate.

Former Nuclear Reactor Building on campus

Alumni and friends touring the TRIGA during NPRE's 50th Anniversary celebration in 2008.

Energy Systems students seek "big picture" solutions

Enrollment in the Energy Systems master's degree program at Illinois has grown to 20 students in just a year's time, as the students look for a "big picture" understanding of energy solution project management.

"It's a great beginning, but so far only a small fraction of the potentially interested students know about the Master of Engineering with a Concentration in Energy Systems," said Emeritus Prof. Cliff Singer, who co-directs the program. "There are greater things to come."

"This program will prepare some of our brightest students from multiple disciplines and from all over the world to move into management-level roles in the increasing international energy systems arena," said Department Head Jim Stubbins. "We are proud to lead this initiative to provide a broad foundation in analysis and applications for the future's energy leaders."

Administered by NPRE, the **Master of Engineering in Energy Systems** degree provides a broad interdisciplinary education for a variety of professional career-track students. The students can earn the degree in a year's time, choosing their own paths and areas of specialization from a wide array of courses taught across Engineering at Illinois. An internship or energy systems design project is required, and provides students valuable experience that they can bring to private firms, public agencies and laboratories.

Current students have focused their studies in diverse areas, including:

- Electrical energy conversion, transmission and distribution
- Environmental engineering for energy applications
- Energy markets, reliability, safety and security
- Wind energy
- Chemical and materials engineering
- Geologic energy resources
- Solar energy and climate change
- Biomass energy resources
- Thermal energy systems and combustion engines
- Sustainable construction methods and environmental systems

Several of the current students are international.

"I have had a longing desire to explore alternative sources of power in the bid to resolve the erratic power supply in my home country," said student Olasunkanmi Atinuke Ogunbayo, who came to the program from Nigeria and has a bachelor's degree in chemical engineering. She has concentrated her master's degree studies on biomass energy resources, and has completed a project aimed at reducing the energy consumption of a greenhouse building.

"To reduce the heating demand and resolve heat storage issues, a sustaining hybrid system was designed to capture, recycle and store excess heat," Olasunkanmi said. "The economics of this system and other energy-saving measures applied in the project were also analyzed to see the potential benefit to the consumer/client.

"My experience in the Energy Systems program has been a huge learning curve. I have gained tremendous knowledge of renewable energy, its application, and its downsides. I have gained insight to the best strategies that can be used to apply renewable energy."

Student Maria Gironza also would like to bring energy solutions to her home country of Colombia. "I entered this program because I have always been interested in the renewable energy field, and this program gave me the flexibility to choose the specific fields I like: wind power, energy markets and solar energy."

Gironza, who earned a mechanical engineering bachelor's degree from Texas A&M University, said her master's project will be an extension of an earlier internship that consisted of building a 40-foot, solar energy-powered wooden boat.

Having earned a bachelor's degree in electrical engineering last year in Germany, student Otto Hucke said the Energy Systems program fit perfectly into his plan to study in the United States for a year before continuing graduate studies in Germany in electrical engineering. "I would like to work in a field related to the integration of renewable energy sources in power grids," Hucke said.

"Actually, my study plan now includes one electrical and computer engineering

Cassandra Arenz with a villager in Ghana.

class, and the others are from totally different departments like urban planning, geography, and atmospheric sciences. It becomes interesting when you start to see how all these problems are related to your own field of study."

Student Hursh Hazari, who earned a bachelor's in technology in polymer science and chemical technology at Delhi Technological University in New Delhi, India, realized during his junior year that he wanted to study renewable energy. "I had taken various courses in materials during my undergraduate and always had a fascination for optics. Therefore, I was convinced that solar energy would be a good fit," Hazari said.

In summer 2015, Hazari joined a team of 16 students from 10 different countries across the globe as part of a Green Revolution Project in affiliation with AIESEC Mauritius and UN Habitat. "Our objective was to help the people of Mauritius live sustainably by working alongside the government and local organizations."

Kumaraswamy Madhu Vellakal Chidambara, who has worked as a computational fluid dynamics engineer for the National Center for Supercomputing Applications on the Urbana campus the past four years, thought the Energy Systems degree would provide him with more industry-specific theoretical background and research experience.

"I am planning to do a parametric study of an Illini Motorsports team engine to identify vital design parameters that enhance the performance/efficiency of an internal combustion engine, initially based on one-dimensional simulations and later with detailed 3D numerical simulations," said Vellakal Chidambara of his proposed project. He has a mechanical engineering master's degree from the University of Buffalo.

Cassandra Arenz, Samantha Davidson, and Justin Scarcliff, all earned their undergraduate degrees at Illinois, in physics, agricultural engineering, and crop and soil management, respectively.

"I want to pursue a career in renewable energy at a utilities company, so this was a perfect fit for the kind of work I wanted to do," Arenz said. "I am excited about this program because it allows me to continue to work on my technical skills in engineering, while also developing skills in economics, policy, and communication revolving around renewable energy."

She built her degree project around work she did over the summer for the non-profit organization, Saha Global. "I worked with a team to build a solar charging center in a rural community in Ghana," Arenz said.

Davidson did a 12-week internship over the summer at Environmental Systems Design, Inc., in Chicago. "I was able to work on commissioning (testing HVAC systems and lighting), retro-commissioning, inputing EnergyStar Data into Portfolio Manager, and seeking LEED certifications for different spaces and/or buildings. Through this, I learned a lot about energy efficiency and how to run equipment efficiently."

Scarcliff's farming background has led to his interest in renewable energy, particularly emissions regulations and alternative fuels in large engines.

He currently is doing an internship with Caterpillar, Inc. "I have started researching their micro-grid technology that uses a genset combined with solar cells to produce clean energy in regions that do not have access to power grids."

Olasunkanmi Atinuke Ogunbayo with a poster of her project.

TABER FUND CREATED TO SUPPORT ENERGY SYSTEMS DEGREE

Having worked 30 years in the energy industry, NPRE alumnus Brad Radl is convinced the creation of Illinois' Energy Systems Masters of Engineering is a timely answer to the industry's current needs.

"The energy industry is experiencing a dynamic phase," Radl said. "Efficient, clean and reliable energy provides a key foundation of any advanced economy. Without new talent entering the field, the U.S. as whole faces a risk of falling behind in a key industry.

"The NPRE program by necessity requires students to have a solid understanding of physics and energy principals, providing a natural foundation for understanding many different types of energy production and methods of energy distribution," he continued. "The NPRE program also offers a great mix of knowledge with other engineering disciplines in mechanical, materials, and electrical, to name a few."

Radl, BS 80, is President and Chief Technology Officer of Taber International, an engineering services firm providing solutions to fossil-fired power plants, focusing on heat rate gains and nitrogen oxide emissions reductions through applications of intelligent sootblowing, combustion optimization, and hydrogen pressure optimization on generators. Based in Chardon, Ohio, Taber has developed

the Griffin Toolkit, capable of addressing opportunities in 'big data' problem sets and optimization and integration of renewable energy onto the grid.

Radl has created within NPRE the Taber International LLC Fund to support the new degree program.

"The program's mission statement was broad-based to include many aspects of energy production and the social/regulatory environment it is produced in," Radl said. "The industry is in a state of flux and many opportunities now exist to have a large impact on the future. Also, with the aging workforce in the energy industry, it was important to look at ways to encourage innovative engineering minds to become involved in energy issues."

The engineers the new program produces could be helpful to companies such as Taber. "The program provides an opportunity for one or more engineers to become acquainted with energy systems and hopefully move on into the field," Radl said. "New ideas and concepts may be created that mesh with our company goals of real-time control and optimization of the energy production and distribution process."

Illinois partners with MGH on radiological sciences, molecular imaging

NPRE faculty led the effort of several units to establish an official University of Illinois at Urbana-Champaign partnership with Massachusetts General Hospital (MGH) for research collaboration and joint student training efforts in radiological sciences and molecular imaging.

A Memorandum of Understanding was established in January for the MGH Department of Radiology and the Center for Advanced Medical Imaging Sciences (CAMIS) to work with Illinois and as many as 15 Illinois faculty members.

A group of faculties from several Illinois and MGH units put forth extensive effort to create the partnership. The group included Ling-Jian Meng, NPRE Associate Professor; NPRE affiliate Stephen A. Boppart of Electrical and Computer Engineering (ECE), Bioengineering (BIOE) and the Beckman Institute for Advanced Science and Technology; and George El Fakhri, MGH Director of the Center for Advanced Medical Imaging Sciences and Co-Director of the Division of Nuclear Medicine & Molecular Imaging.

"MGH has an excellent clinical radiology program, but not necessarily access to students and the science of imaging. Illinois doesn't currently have access to the same magnitude of clinical radiology expertise—it's something we hope to build," said Boppart, Abel Bliss Professor of Engineering and director of Imaging at Illinois, a campus-wide initiative on imaging.

"This is a nice example of how an internationally known, clinical institution recognizes the value of engineering here at Illinois."

As a leading public research university with one of the top Colleges of Engineering in the United States, Illinois is home to a wide range of cutting-edge biomedical work. The university also boasts several world-class research institutes and laboratories, offering state-of-the-art imaging equipment and facilities for research and advanced technology development.

MGH is regularly ranked as one of the country's top hospitals, and, with over 700 doctorate level radiologists and scientists, the Department of Radiology is among the largest in the United

MGH and Illinois representatives signing the Memorandum of Understanding.

States. The department encompasses a broad spectrum of clinically oriented and disease-driven research, including the discovery of molecular imaging agents and development of advanced medical imaging technologiesto better understand and characterize normal and pathologic conditions and monitor therapy.

The partnership will develop a joint platform for training Illinois students for careers in clinical research and the biomedical industry. This program would allow students to participate in Illinois' rigorous coursework and research activities and, at a later stage of their training, gain concrete research experiences in one of the largest and top-ranked clinical radiology departments.

The agreement provides for a summer internship program for up to six Illinois graduate students at MGH each year, and also has driven an exchange of faculty seminars.

The agreement is intended to develop a Joint Illinois-MGH Program in Radiological Sciences and Molecular Imaging that leverages the strength of Illinois on basic science and technologyand the clinically oriented research MGH carries out. This program will emphasize multidisciplinary and integrative research approaches that combine imaging physics, chemistry, biology, nanomaterials and/or advanced computation techniques for future radiological and molecular imaging applications.

Over the past year, Illinois has been working with the locally based Carle Health System to establish the new College of Medicine on the Urbana campus. The vision is to revolutionize health care by infusing engineering into medical education and research to respond to transformative changes in the health care industry.

"As the need grows to recruit top physician-scientists and physician-engineers to our university and local medical institutions, partnerships such as this one with MGH will provide a conduit for attracting people who share our vision for integrating engineering with medicine," Boppart said.

NSF grant supports project using big data analytics in PRA development

Assistant Prof. Zahra Mohaghegh is the Principal Investigator on a five-year National Science Foundation (NSF) project that integrates big data analytics into Probabilistic Risk Assessment (PRA).

Entitled "A Big Data-Theoretic Approach to Quantify Organizational Failure Mechanisms in Probabilistic Risk Assessment," the $899,000 project is funded by two NSF programs: Science of Organizations (SoO) and Big Data Science and Engineering (BIGDATA).

"Catastrophic events such as Fukushima have made it clear that the capability of integrating physical and social causes of failure into a socio-technical modeling framework is the future of risk analysis," said Mohaghegh. The NSF research aims to quantify this framework for the risk analysis of nuclear power plants. The methodology is also applicable for other high-risk industries, including aviation, healthcare, oil and gas.

Mohaghegh, an expert in PRA, is teaming up with specialists in Organizational Behavior (Co-PI Prof. Cheri Ostroff; University of South Australia) and Information Science (Co-PI Associate Prof. Catherine Blake; University of Illinois at Urbana-Champaign) to advance predictive causal modeling and big-data theoretic technologies for PRA. Current organizational risk contributors lack reliable data analytics, according to Justin Pence, an informatics PhD student and member of Mohaghegh's group in the Socio-Technical Risk Analysis (SoTeRiA) Laboratory. These researchers are expanding the classical approach of

data management for risk analysis by using big data analytic techniques and simulation to uncover organizational contributors to system risk.

This research will advance the Big Data-Theoretic Algorithm; a methodology for extracting and interpreting socio-technical information from unstructured textual communications. The PI's research group has developed the Big Data-Theoretic Algorithm and initiated its application in the nuclear power industry to perform text mining on Corrective Action Program documents. In addition to unstructured data, this research deals with large volume of data to perform uncertainty analysis on large-scale risk frameworks. Mohaghegh is an investor in the Illinois Campus Cluster Program (ICCP), allowing her to use ICCP resources in risk research projects.

A member of the NPRE faculty for the past two years, Mohaghegh has pioneered research in the systematic causal modeling of physical and social failure mechanisms by incorporating Big Data Analytics and spatio-temporal dimensions into PRA. PRA is one of the key pillars of the Risk-Informed regulatory framework for the Nuclear Regulatory Commission (NRC). A growing number of other U.S. government agencies—the Department of Energy (DOE), the Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), the Department of Defense (DOD), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA)—also have begun to use PRA for policy setting and decision-making.

Since coming to Illinois, Mohaghegh and her group have been involved in a large-scale academia-industry project, sponsored by the South Texas Project Nuclear Operating Company. The work has contributed to developing an integrated risk methodology for the resolution of the nuclear industry's 20-year-long and very challenging Generic Safety Issue 191 (GSI-191).

Zahra Mohaghegh

MOHAGHEGH HONORED WITH DEAN'S AWARD FOR EXCELLENCE IN RESEARCH

Assistant Prof. Zahra Mohaghegh has been honored with the 2015 Dean's Award for Excellence in Research from the College of Engineering at Illinois.

Mohaghegh has pioneered research in systematic causal modeling of the interactions of physical and social failure mechanisms and in incorporating Big Data Analytics into Probabilistic Risk Assessment (PRA).

Catastrophic events such as Fukushima and Katrina have made it clear that the capability of integrating physical and social causes of failure into a cohesive modeling framework is the future of risk analysis. Because accident scenarios must consider social and environmental distress, managerial deficiency, and human error in addition to physical and technical system failure, risk analysis requires the development of a common vocabulary within diverse engineering and social science domains in order to address risk emerging from the interface of social and technical systems.

Mohaghegh's work in this area has received considerable recognition. In 2013, she won the George Apostolakis Fellowship Early-Career Award in Risk Assessment. Apostolakis, an Emeritus Professor of the Massachusetts Institute of Technology (MIT) and a former NRC commissioner, has been one of the pioneers in risk-informed approaches, and he now leads the international team assessing the restart of nuclear reactors in Japan. From an applications perspective, Mohaghegh has been involved in a large-scale industry project sponsored by the South Texas Project Nuclear Operating Company, contributing to the development of an integrated risk methodology for the resolution of the nuclear industry's 20-year Generic Safety Issues 191 (GSI-191) challenge.

As an advisor of multidisciplinary graduate students, Mohaghegh is an affiliate of Industrial and Enterprise Systems Engineering (ISE), Beckman Institute for Advanced Science and Technology, Graduate School of Library and Information Science (GSLIS), and Institute of Informatics, in addition to her appointment in NPRE.

Examples of the lab's current research projects include:

- Fire PRA in nuclear power plants;
- Location-specific Loss of Coolant Accidents (LOCA) leading to Emergency Core Cooling System failure;
- Modeling the effects of human and organizational factors on nuclear power plant technical system failure;
- Socio-technical risk-informed emergency preparedness, planning and response modeling for severe accidents;
- Evaluating PRA's monetary value.

International Impact

The SoTeRiA Laboratory aims to establish the University of Illinois as a global leader in Risk Analysis education and research. In March 2015, Mohaghegh's group developed and presented the U.S.-China Probabilistic Safety Assessment Workshop on "Risk-Informed Regulation and Safety Culture," in Shenzhen, China, as part of the DOE's Peaceful Uses of Nuclear Technology (PUNT) program.

The SoTeRiA team coordinated and taught a one-week training workshop on risk-informed regulation and safety culture for the Chinese nuclear power industry. Seventy-two representatives from 28 Chinese nuclear energy organizations and entities attended, including plant managers, operators, engineers, and researchers. NPRE research affiliate Ernie Kee and Ph.D. candidate Tatsuya Sakurahara joined Mohaghegh and Pence in leading the workshop, in collaboration with U.S. regulatory experts Glenn Kelly (retired from the Nuclear Regulatory Commission) and Weidong He from AdSTM, LLC.

With 10 years experience in PRA research, Mohaghegh believes that "while the U.S. leads in risk analysis methods for nuclear safety, PRA researchers applying analysis techniques in countries such as China and Japan must take into account varying geographies, cultures and operating experiences to avoid potentially misleading results." Mohaghegh and her team have initiated collaborations with national and international research institutions in order to achieve tailor-made solutions for high-risk operations around the world.

Impact at the University of Illinois

At the University of Illinois, Mohaghegh and her SoTeRiA team are presenting foundational undergraduate and graduate risk analysis courses to train the next generation for risk analysis in high-consequence industries. In addition to students from NPRE, the courses have attracted students from multiple departments including Civil and Environmental Engineering, Mechanical Science and Engineering, Aerospace Engineering, Industrial Systems and Enterprise Engineering, and Informatics. Risk Analysis courses address fundamental theories of risk-scenario modeling and accident phenomenology, uncertainty analysis, Bayesian and data analysis, probabilistic physics of failure, human error modeling, and next generation PRA methods and tools. Students are provided with hands-on opportunities using PRA software to address real-world risk analysis problems.

NPRE Leadership Speaker Series makes impact on students, wider community

The NPRE Leadership Speaker Series that has brought to the Urbana campus two of the best-known, international experts on nuclear energy over the past two years is having a tremendous impact.

The inaugural talk in 2014 featured Dr. Peter B. Lyons, then-U.S. Department of Energy Assistant Secretary for Nuclear Energy (Lyons has since retired). The 2015 event drew William D. Magwood, Director General for the Nuclear Energy

"I would like to thank our Constituent Alumni and Industry Advisory Board (CAIAB) for investing in this high-profile speaker series that provides NPRE with the opportunity to showcase the world's leading authorities in our disciplines."

—Department Head Jim Stubbins

William D. Magwood

Peter B. Lyons

Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) in September.

"Pete Lyons, who helped orchestrate the resurgence of nuclear power programs in the United States, was a fitting inaugural speaker," said NPRE Department Head Jim Stubbins. "To follow, we have been fortunate to welcome back to campus Bill Magwood, who directed the DOE Nuclear Energy Office at the critical point of rebuilding this country's nuclear program. He visited Illinois in the early 2000's, and made a major difference in the deliberations that influence the future of NPRE. We are thriving now because of his personal intervention more than a decade ago."

Magwood presented "Looking Forward: Nuclear Energy Issues and Opportunities," to an audience of about 200 people. He also toured NPRE facilities, and met with university and College of Engineering administrators as well as NPRE faculty and students.

Magwood has led OECD NEA since September 2014. Based in Paris, France, the intergovernmental organization of 31 industrialized countries, including the United States, maintains and develops the technological and legal basis for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes.

Magwood has extensive experience in both the regulatory and developmental aspects of nuclear energy, including at the international level.

From 2010 to 2014, he served as one of five Commissioners appointed to the U.S. Nuclear Regulatory Commission (NRC). He advocated the importance of nuclear regulatory independence, and the necessity of maintaining strong, credible and technically sound nuclear regulation in the United States and all countries using nuclear power.

Prior to that appointment, Magwood provided U.S. and international clients with independent strategies and advice on energy, environmental and technology policy issues. During this time, from 2005 to 2010, he also sat on various advisory groups and provided technical and policy guidance to members of the U.S. Congress on nuclear research, education and climate change policy.

From 1998 to 2005, Magwood was U.S. Department of Energy Director of Nuclear Energy. During his tenure, he was responsible for the 2010 program and GIF. He was also actively involved in the work of the NEA, serving as a Steering Committee bureau member from 1999 to 2003, and as Chair in 2004 and early 2005.

The Leadership Speaker Series is intended to provide a forum for global leaders to present views and policies, particularly those impacting the disciplines of nuclear, plasma, and radiological engineering, as well as other issues relevant to energy sustainability.

Virtual reality technology creates immersive experience

This story has been re-posted from The Daily Illini website

Paul McCartney stands on stage. His band is in the background warming up for another song. There is the sound of a drum and cymbals starting up a rhythm. Bright lights shine from overhead and from below the stage to reveal the waving arms and excited movements of the eager, cheering crowd. It's after turning around in a full circle that attendees become immersed in the experience.

Until the visors come off, users don't realize they are standing in the virtual reality lab at the University's Talbot Laboratory. The concert experience has been replaced by a classroom with desks, chairs, computers and various virtual reality equipment. This is where a research group led by Prof. Rizwan Uddin experiments with virtual reality devices and programs.

Experiences like the Paul McCartney concert are created through a free app that NPRE undergraduate Cory Scribner downloaded on his Android phone. He can then place his phone into $15 cardboard pieces that resemble binoculars, called Google Cardboard Visors. By looking into them, the images on the phone become three-dimensional, and the viewer feels immersed.

The Google Cardboard Visor isn't the only virtual reality equipment the group uses. There is also the Oculus Rift, a headset that simulates visual contexts present in the real world. It differs from Google Cardboard in that participants can actually interact with objects within the setting. Each Oculus Rift headset is priced at around $350.

"It's not perfect, but it's closer than anybody has ever been in history," Scribner said. "There has been tons and tons of research going into virtual reality, and so far the Oculus Rift headset is currently the best."

Oculus Rift is a private company that was recently bought by Facebook. The research group at the University, which consists of Scriber and Justin Joseph, sophomore in NPRE, uses the device for their virtual simulations and experiments.

Uddin said the research group's focus is to develop and improve upon virtual reality programs that can be used for academic and job training purposes.

Currently, there are virtually reconstructed models of a few of the University's labs on the Oculus, one of which is a chemistry lab in Noyes Laboratory. In this model, participants go through safety training by locating fire alarms, fire extinguishers and emergency exit doors. This basic safety training must be completed before students go on to do experiments.

In regard to workplace training, Uddin said if a company needs to train its personnel but the environment is hazardous because of things such as radiation or the presence of toxic materials, it may be difficult to conduct this training in the actual environment. Instead, a model of that environment can be made, and personnel can be trained through virtual reality.

"There is interest on the part of places which find it very expensive to develop actual physical labs," Uddin said. "So they would like to have these virtual labs where their students can go conduct experiments and collect data in a video-game-like environment."

Uddin's team has also used virtual reality to solve the issue of insufficient space in laboratories.

"About 10 years ago, there were about 15 undergraduate students in any class in the department," Uddin said. "So the lab stations that we had were sufficient. But then our numbers went up to 50, so then the lab stations were not sufficient. So we said, 'OK, half of you will do the lab here in the physical lab, and then the other half will do the virtual lab.' They can do that from home or from the computer lab."

Because the Oculus Rift is still under development, there are a few shortcomings the researchers are working to resolve.

One of those issues is figuring out how participants can interact with items

Prof. Rizwan Uddin shows alumni visitor Ron Knief the features of the Oculus Rift.

around them when they are wearing virtual reality devices.

"It is one thing to be able to just walk around (in virtual reality)," Uddin said. "But if you want to do an experiment—you want to pick up something and put it somewhere else, you want to pour some water—how do you do those things when you are wearing these goggles?"

Joseph said some people are also prone to becoming nauseated while using the Oculus because of incongruences with movement between virtual reality and real life.

"Another thing is that the Oculus has too many wires," Joseph said. "While the Oculus is running, there is a ton of data that is being transmitted between the Oculus and the computer. As a result, a lot of wires are needed. It would be much better if the Oculus were wireless. As of now, the wires prevent people from moving, so they have to use an XBOX controller to move around."

There are also problems with leap motion, a sensor that detects one's hands, fingers and arms in a simulation, which are then used to gesture signs to the computer. These researchers use leap motion to enable subjects to interact with the simulated environment using their hands.

"Leap motion has limitations on how it can detect your hands," Scribner said. "Currently, interacting with buttons in the simulation is very difficult because getting the hands to be in the right position and getting them to consistently push a button is troublesome."

NPRE outreach extends to Latin America

NPRE at Illinois has extended its international outreach to Latin America, with faculty collaborations in both Colombia and Mexico.

Efforts by Associate Prof. J.P. Allain and Prof. David Ruzic add to the worldwide impact the Department has been building in countries including Italy, Sweden, Jordan, Japan and China.

"We really value the international connections and are very pleased to embrace these new opportunities to form closer connections with Latin America," said Department Head Jim Stubbins.

J.P. Allain

David Ruzic

COLOMBIA

Having established a working relationship with Colombian scientists over the last several years, Allain was named a Fulbright U.S. Scholar to the country and was granted a 2015-2016 Fulbright-Colciencias Innovation and Technology Award. The designation enabled Allain to spend much of September working with researchers at the Universidad de Antioquia (UdeA), located in Medellin, Colombia, and also with faculty at the Universidad Nacional de Colombia in Bogotá.

Allain's project has been aimed at boosting collaborations with Colombian scientists while developing functional nanomaterials for biotechnology and energy applications. He has been working with UdeA scientists in the area of directed plasma nanosynthesis (DPNS), a technique he and his research team have been developing for various advanced multi-functional materials synthesis in areas of biomaterials and energy.

DPNS will be the subject of a Summer 2016 course Allain is helping to develop for UdeA. He also is helping faculty and students there procure and build a small reactor for use in modifying materials.

From left, postdoctoral research assoicate Kishor Kalathiparambil and NPRE graduate student Matt Szott with Martin De Jesus Nieto Perez in the CPMI laboratory

NPRE students Ian Haehnlein and Wenyu Xu (now an alumnus) with Martin De Jesus Nieto Perez in the CPMI laboratory

"We really value the international connections and are very pleased to embrace these new opportunities to form closer connections with Latin America," said NPRE Department Head Jim Stubbins.

In addition to pursuing the technical goals of his visit, Allain said he observed the Colombian universities' approach to education, and was impressed with the collegial environment.

"There, research groups are made of at least 4-5 professors who are all very much vested in the way students, education and research are developed over time," Allain said. "There's a lot more contact with the students, and that translates into a group environment that's quite different" than what is typical in engineering research in the United States.

"Students (in Colombia) have more than just one advisor, with different expertise that feeds into the students' research, so it is a much more collective and supportive environment in that kind of setup," Allain maintains.

The students the country produces are excellent, he said, and would do well in a world-renowned research institution such as the University of Illinois. "It's access to a whole new population of graduate students."

Allain hopes to spread the word among Illinois faculty about opportunities to engage with Colombian faculty and recruit students. "I feel very strongly about my role with Colombia. I also think that there's a lot Illinois could gain from it."

MEXICO

Over the last several years, Ruzic has been working with his former student, Dr. Martin Nieto-Perez, now an associate professor at CICATA Querétaro, a research and postgraduate education center that is part of the Instituto Politecnico Nacional (National Polytechnic Institute), Mexico's second largest public university and the best-ranked in engineering and applied science.

Two of Nieto-Perez's students have traveled to Urbana to do research in the Center for Plasma-Material Interactions (CPMI), which Ruzic directs. Heriberto Ortiz came in 2010 to implement a triple probe diagnostic in the center's DEVeX device. Carlos Sandoval came in 2015 to do work on wetting properties of liquid lithium as a function of temperature and surface roughness. Ruzic, who plans to teach a short course at

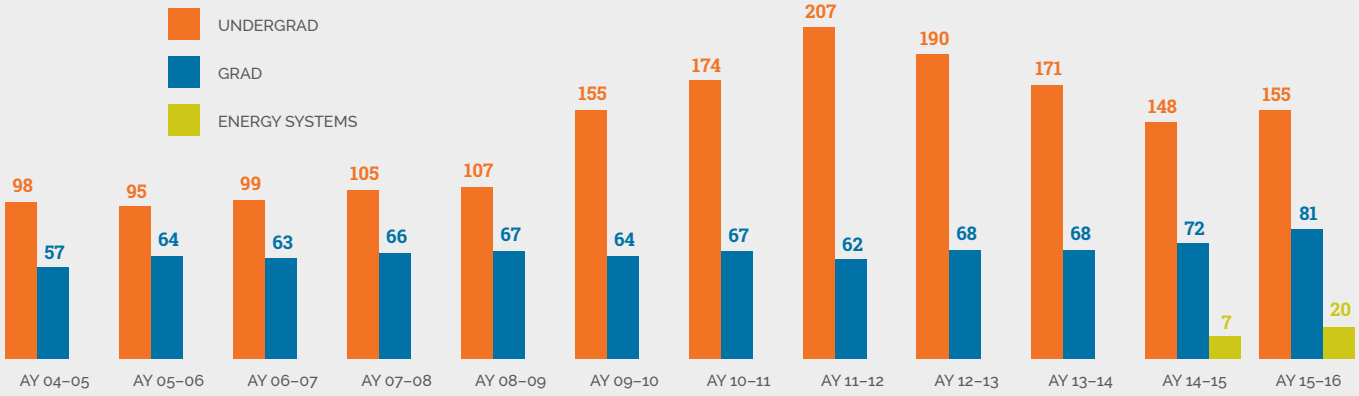
CICATO Querétaro in the winter, said he also gave to Nieto-Perez's lab equipment no longer being used in CPMI.

"My long-term goal is to have an even closer working relationship with the group at UIUC, where we can both strengthen the international dimension when we submit proposals for funding," Nieto-Perez said. "Currently, international collaboration is regarded as a big plus when submitting applications to funding agencies, in particular NSF (the National Science Foundation) and its equivalent here in Mexico, CONACyT. Eventually, proposals that have common goals from both groups would have very good chances of getting funded and much higher impact results."

Conducting science in the United States is valuable for the Mexican students beyond the research work alone, Nieto-Perez believes. "Having experienced working at CPMI, I want my students to have a similar experience," he said. "Knowing different work styles, overcoming a language barrier, getting exposed to a different culture, making new friends: I believe a research experience abroad broadens your horizons and helps prepare you to be a more global scientist."

ENROLLMENT TRENDS

"Enrollments in NPRE remain strong at the undergraduate level and show growth at the graduate level, including our new Masters of Engineering in Energy Systems," said Department Head Jim Stubbins. "This reflects the exciting opportunities that our degree programs offer, particularly on the strength of our new faculty members, our new HIDRA facility, and the growing importance of energy and radiation applications technologies."



SPEED-INTERCHANGE: THE FAST TRACK FOR CAREERS

Student Professional Excellence in Engineering Development (SPEED)-Interchange is the evolution of NPRE's Interchange program.

For several years, NPRE and the student chapter of the American Nuclear Society (ANS) have hosted Interchange, a Fall semester event to promote employer-student networking. NPRE alumni and friends have been invited to campus to talk about their companies to students, as well as offer opportunities for internships and/or permanent positions. The new SPEED-Interchange will have a similar mission, but its platform will feature a series of panel sessions to be held in both the Fall and Spring semesters, with specific subject matter targeted for both panelists and students.

A panel planned for Thursday, Nov. 5, will focus on national laboratories and career paths of interest to graduate students and undergraduates. A panel of experts on nuclear power utilities, support industries and design companies will be planned for January or February, and one for plasma/fusion technologies and radiological imaging and detection will be planned for March.

Alumni and friends interested in participating in the panels and engaging with our students are invited to contact Becky Meline, NPRE Coordinator of Academic Programs, bmeline@illinois.edu, for details.

Faculty reap national awards

RUZIC ELECTED AS APS FELLOW

Prof. David N. Ruzic has been elected a Fellow of the American Physical Society.

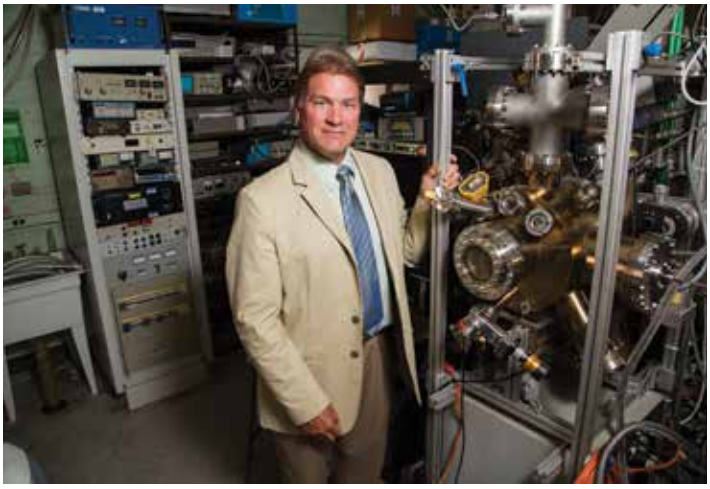
Ruzic, Bliss Professor of Engineering, has been cited "for major contributions toward the use of lithium as a plasma facing component for fusion applications and understanding of plasma-material interactions through innovative experiments."

A member of NPRE's team since 1984, Ruzic has made tremendous contributions to the international store of knowledge on experimental fusion research and plasma technology. He founded and directs the Center for Plasma-Material Interactions, which studies particle-surface interactions relevant to fusion power and materials processing systems through a combination of computational and experimental means.

Among the groundbreaking research activities Ruzic and his group have pioneered in recent years has been the design of a method for molten lithium to self-circulate along the surface of a fusion reactor's diverter, where excess heat is collected and removed. The innovation, Ruzic believes, could reduce the size of a fusion reactor's radius by a third, while allowing it to produce the same volume of energy.

Ruzic's group successfully conducted an experiment of the concept, named LiMIT (Lithium/Metal Infused Trenches), in Ruzic's lab on the University of Illinois Urbana campus, and on an HT-7 Tokamak reactor in Heifei, China, in 2012.

More recently, Ruzic and his CPMI associates scored a coup for the university by acquiring a major plasma fusion facility from the Max Planck Institute for Plasma Physics in Germany. The Hybrid Illinois Device for Research and Applications, (HIDRA), formerly known as WEGA, will make NPRE one of a handful of U.S. departments offering such a significant facility for plasma/fusion research and education. It has been dismantled in Germany and currently is in transport to the Urbana campus.



David Ruzic

Ruzic is a Fellow of the American Vacuum Society and the American Nuclear Society. He was the 2012 winner of the AVS Plasma Prize, and also has won many teaching awards across NPRE, the College of Engineering at Illinois, and campus.

Ruzic has written two books, five book chapters and 160 refereed publications, and has been granted several patents. His plasma research has been featured on the Discovery Science Channel's "Weird Connections" program, bringing international attention to the University of Illinois. In the Spring of 2015 he will teach a massively open on-line course (MOOC) through Coursera titled, "What You Need to Know: Energy, Environment and Everyday Stuff".

Ruzic earned a bachelor's degree in physics and applied mathematics from Purdue University in 1979, then earned a master's and PhD in physics from Princeton University in 1981 and 1984, respectively. He is an affiliate in the Engineering at Illinois' Micro and Nanotechnology Laboratory and Electrical and Computer Engineering Department.

No more than one-half of one percent of APS's 48,000 members are granted the rank of fellowship. Fellowship is a distinct honor signifying recognition by professional peers, and is awarded to recognize exceptional contributions, including outstanding physics research, important applications of physics, leadership in or service to physics, or significant contributions to physics education.

UDDIN CHOSEN FOR ASEE GLENN MURPHY AWARD

Prof. Rizwan Uddin is the 2015 winner of the American Society for Engineering Education (ASEE) Glenn Murphy Award.

The national award honors Uddin for his strong and enduring commitment to advancing the quality and impact of education in nuclear engineering, and for his ability to fully engage students in learning through innovative teaching styles and techniques.

"Rizwan has been at the heart of our teaching and academic activities for many years," said NPRE Department Head Jim Stubbins, a 2010 winner of the Glenn Murphy Award. "He is often teaching multiple courses and is recognized as an excellent instructor by his students. Rizwan has offered distance instruction on an international level and has taken the lead in developing international courses in Italy and Jordan. He is highly deserving of this national recognition."

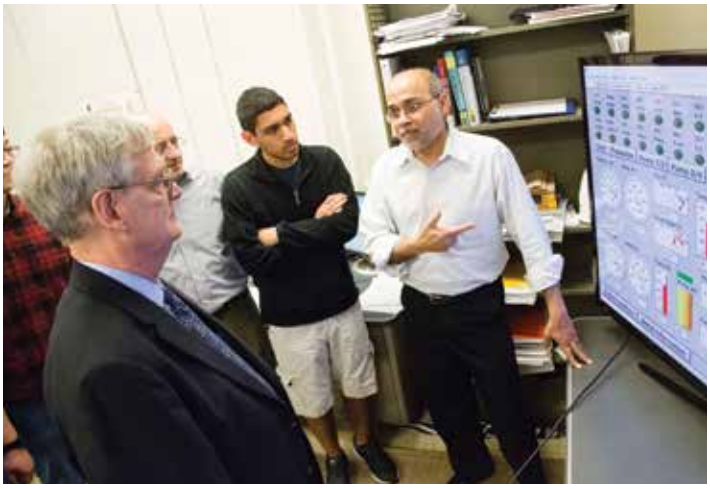
An NPRE faculty member the past 19 years, Uddin has developed major, groundbreaking advances in highly visual interactive teaching environments. Having established NPRE's Virtual Education and Research Laboratory, Uddin has led the effort to develop interactive teaching materials for laboratory and design courses using software and hardware approaches adapted from the video gaming universe.

He has developed an interactive nuclear radiation measurements laboratory environment that is completely virtual. In this learning environment, each student cay conduct experiments individually, taking each step on his or her own, rather than as part of a laboratory team. Or, using the multi-player feature, the experiment can be conducted by a group of students. The innovation tremendously expands the potential for laboratory-based learning, particularly when coupled with increasingly limited access to real (physical) laboratory learning experiences.

The January 2013 issue of *Nuclear News* featured this highly impressive accomplishment on its cover, and it has attracted broad attention across several engineering disciplines.

Uddin also has developed other visual, interactive learning environments using 3-D interactive tools.

This approach allows students to interact directly with virtual representations of "solid" objects and systems where they could not go in reality. It allows students to dive down to atomic-level scales and back up to reactor-level control systems to understand the connection of length scales that would otherwise be impossible to imagine.



Rizwan Uddin, far right

It further allows students to learn about best practices and safety and security-related issues without being at risk of physical danger. As an example, the 3-D interactive learning environment allows a student to "walk" into a (virtual) reactor containment area where there has been a radioactive materials spill. The student can learn to assess the levels of radiation exposure in an environment that could not be replicated in real life, and make timely decisions on how to handle the situation.

This technology compares with flight training simulators or reactor control room simulators, but in a realistic physical environment in which the student can "walk" around, make measurements, and decide on exposure levels and mitigating actions. Three students won the Best Undergraduate Poster award at the 2015 American Nuclear Society Student Conference for work carried out in Uddin's lab.

Uddin's efforts on behalf of his students extend from the laboratory to the classroom. He has shown impressive leadership in devising and implementing new teaching methods to engage students, including the "hybrid-flip teaching" approach.

Praising him highly for this innovative approach to learning, NPRE students have chosen Uddin for the annual departmental teaching award more than ten times over the last twenty years.

Uddin also has been a strong and effective mentor of graduate students. Working with them one-on-one, he has guided beginning graduate students to become first-class, independent researchers in the nuclear field.

Examples of his outstanding successes in mentoring are his string of PhD students who have won the American Nuclear Society (ANS) Mark Mills Award: Allen Toreja in 2003; Quan Zhou in 2005 and Prashant Jain in 2010. This award is presented to the graduate student author who submits the best original paper contributing to the advancement of science and engineering related to the atomic nucleus.

Uddin is a Fellow of the American Nuclear Society and won that organization's Mark Mills Award in 1987, and Young Member Engineering Achievement Award in 1999.

KOZLOWSKI WINS ANS YOUNG MEMBER AWARD

Assistant Prof. Tomasz Kozlowski is the 2015 winner of the American Nuclear Society (ANS) Landis Young Member Engineering Achievement Award.

The award recognizes an individual who has made significant technical contributions in any one of the many engineering disciplines ANS serves.

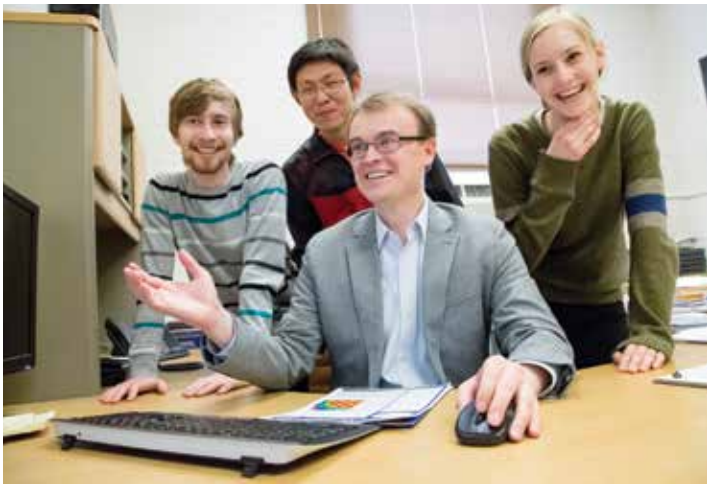
It particularly acknowledges achievement in which engineering knowledge has been applied to yield an engineering concept, design, safety improvement, method of analysis or product that is utilized in nuclear power research and development or commercial application.

"This is a great recognition of Tomasz's contributions to the nuclear field," said Stubbins. "He now joins a very distinguished group of past winners of this major award."

According to Uddin, who nominated Kozlowski, "He not only has been instrumental in the development of advanced computational tools (for best estimate safety codes), he also has been among a small group of experts who have been training the next generation of users of these methods and codes at international workshops."

Kozlowski has been recognized for contributions in the area of uncertainty analysis, and has chaired the Expert Group on Uncertainty Analysis Methodology of the the Organisation for Economic Co-operation and Development's (OECD) Nuclear Energy Agency (NEA). International safety organizations have established the methodology to assess and bound the uncertainty limits of computational nuclear systems analysis.

Further, Kozlowski has taken a leadership role in the BWR (Boiling Water Reactor) stability problem benchmark exercise



Tomasz Kozlowski, seated

that he heads for OECD/NEA and the U.S. Nuclear Regulatory Commission (NRC). "This trust shown in him by these two agencies is due to his expertise in simulating instabilities in BWRs" according to Uddin. His expertise has led to Kozlowski establishing international collaborations stretching from the United States to Sweden, Italy, Brazil and Argentina.

He came to NPRE in 2011 from Sweden's Royal Institute of Technology, Division of Nuclear Power Safety (KTH-NPS), where he had led the Analysis of Reactor Transients and Stability (ARTS) group.

He had earned his bachelor's, master's and Ph.D. in nuclear engineering at Purdue University in 2000, 2001, and 2005, respectively.

SULLIVAN WINS ANS OESTMANN PROFESSIONAL WOMEN'S ACHIEVEMENT AWARD

Assistant Prof. Clair J. Sullivan is the 2015 winner of the national American Nuclear Society (ANS) Mary Jane Oestmann Professional Women's Achievement Award.

The ANS award cites Sullivan "for contributions in the areas of radiation detection, homeland security, nuclear nonproliferation, new course development; and for being an excellent teacher in the classroom."

Clair Sullivan

Sullivan has gained considerable national recognition since joining the NPRE faculty in 2012. She is a member of two multi-institutional efforts:

- the Consortium for Verification Technology (CVT), for research and development in nuclear arms control verification technologies, including nuclear safeguards effectiveness;
- and the Consortium for Nonproliferation Enabling Capabilities (CNEC), to provide the U.S. government with cutting edge research and development to identify and address multi-disciplinary and cross-functional technology, and research needs that are critical to detecting foreign nuclear weapon proliferation activities.

Sullivan's research at the interface of radiation detection and big data analytics and new algorithms led to her selection as a winner of the 2014 Defense Advanced Research Projects Agency (DARPA) Young Faculty Award. The honor is used to identify and engage rising research stars in junior faculty positions at U.S. academic institutions and expose them to Department of Defense needs as well as DARPA's program development process.

Embracing the means of harvesting information through data analytics, Sullivan spent six weeks over the summer in rigorous instruction through The Data Incubator. The program's mission guides researchers with doctorates in science, technology, engineering, and mathematics (STEM) disciplines through understanding and using data analytics, cloud computing and machine learning. Sullivan plans to bring those lessons back to her own students, and possibly develop new courses.

Since joining NPRE, Sullivan has been an invaluable faculty member, significantly strengthening the Radiological Sciences path. Her approach to teaching the Nuclear Radiation Lab class is an example. While students are required to write extensive reports for most of the labs they conduct, Sullivan has modified the format to include in-class presentations instead of lab reports for some of the labs. NPRE students have responded appreciatively at the opportunity to develop their oral communication and presentation skills.

In addition, Sullivan has taken the initiative to create a new course on detector development. Probably among the first of its kind, this unique, hands-on class, modeled after a "maker-lab concept," was offered in Spring 2015. Students in the class used a Raspberry Pi (computer) to develop a radiation detector, and were required to write the software and build the electronics to accomplish the goal. The course was extremely popular among the students.

Those efforts and others led the ANS student chapter to choose Sullivan for the department's Excellence in Undergraduate Teaching Award both in 2013 and 2015.

Sullivan earned all her degrees from the University of Michigan: a bachelor's in astronomy and a bachelor's in physics in 1997; and a master's and PhD in nuclear engineering in 1998 and 2002, respectively. She was part of the university's premier group in radiation detection, then joined Los Alamos National Laboratory, working with the Department of Homeland Security.

Her work on detector development and deployment in the days after the September 11, 2001, terrorist attack earned for her the lab's Distinguished Performance Award in 2004. With her contributions, and technical and leadership skills, Sullivan quickly rose through the ranks to become the Senior Project Leader supporting the intelligence community.

From 2008-2012, she worked for the federal government on nuclear and cyber-related matters. Her research and excellent communication skills also led to her being selected to brief members of Congress on Capitol Hill.

Mixing up a batch of stronger metals

Reprinted from Oak Ridge National Laboratory

Just as a delicate balance of ingredients determines the tastiness of a cookie or cake, the specific ratio of metals in an alloy determines desirable qualities of the new metal, such as improved strength or lightness.

A new class of alloys, called high entropy alloys, is unique in that they contain five or more elements mixed evenly in near equal concentrations and show exceptional engineering properties, such as high strength at elevated temperatures. Alloys more typically are made up of two or three metals.

Assistant Prof. Yang Zhang has joined a team of researchers at Oak Ridge National Laboratory (ORNL) and the University of Tennessee, Knoxville (UT), that has determined this class of alloy retains enhanced mechanical properties even when the mixing is uneven or disordered, which opens up new possibilities for future alloy design.

In a study published in the journal, *Nature Communications*, the team—led by Zhang, Louis Santodonato of ORNL, and Peter Liaw of the University of Tennessee—focused on the structural evolution of the alloy $Al_{1.3}CoCrCuFeNi$, from the high-temperature liquid to room temperature. The team observed the phase transition of the material as it cooled, including the disordered and partially ordered solid solution structures.

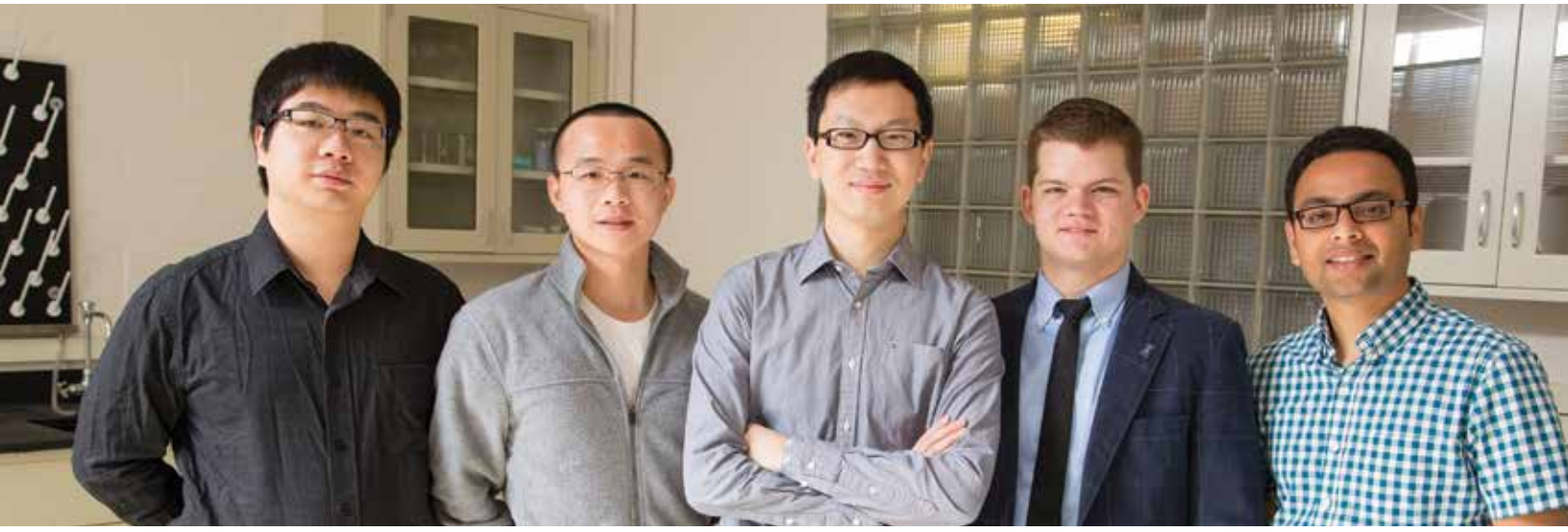
High entropy alloys have been around for more than 10 years, but as Santodonato explains, "The focus has been on the perfectly mixed alloy. We looked at a deviant one and found the effect is still pervasive."

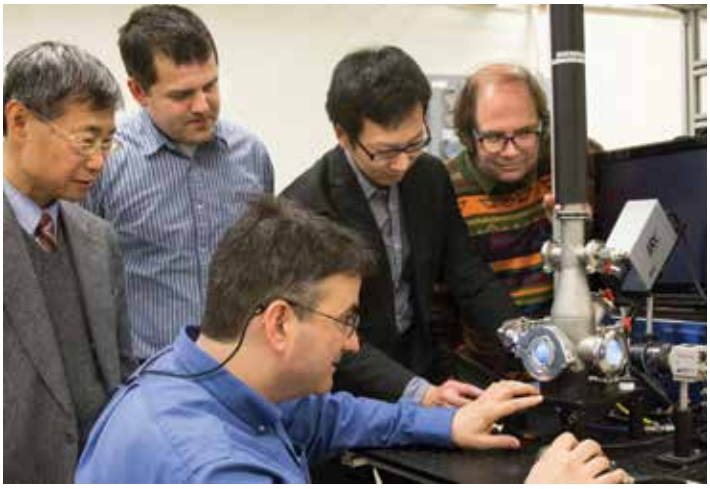
"Neutron scattering experiments reveal the atomic-level structure of the materials."

To study the alloy, the team used neutron diffraction at the Spallation Neutron Source, X-ray diffraction at the Argonne National Laboratory Advanced Photon Source, electron microscopy at the ORNL Center for Nanophase Materials Sciences—all User Facilities operated by DOE's Office of Science—and computational simulations done at DOE's National Energy Technology Laboratory.

To perform the neutron measurements, the team had to levitate the sample and heat it with a high-powered laser.

Yang Zhang, middle, with his research group





From left, Peter Liaw from University of Tennessee, Knoxville; Mikhail Feygenson and Louis Santodonato (seated) from ORNL; NPRE Assistant Prof. Yang Zhang; and Joerg Neuefeind from ORNL align a sample in the sample levitator.

The levitation system is made of a special nozzle designed to produce a gas flow that can trap a small bead of material–about an eighth of an inch in diameter–floating in air above the nozzle. The levitation ensures the sample is not in contact with any solid surface that would melt, react with, and contaminate the sample at these temperatures, while a laser is used to heat the sample as it floats on the gas flow.

The novel part of this work is neutron scattering and, in particular, the ability to follow the evolution of the alloy's atomic structure as it cools from the molten state.

"With neutrons, we can see the atoms," said Zhang. "Neutron scattering experiments reveal the atomic-level structure of the materials. We found this material, although not a true high entropy alloy in the strict sense, still exhibits significant disorder."

"Additionally, the microscopy tells us the larger scale structure of the material, and the simulation shows excellent comparisons to the experimental data," Zhang said.

The team hopes their results open vast possibilities for future alloy designs, including understanding how high entropy alloys may be used in radiation shielding applications.

Work was performed at the ORNL Spallation Neutron Source's POWGEN and NOMAD instruments. UT-Battelle manages ORNL for the Department of Energy's Office of Science. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time.

Genevieve Martin/ORNL

GASOLINE MOLECULE MOVEMENT STUDY COULD LEAD TO MORE EFFICIENT FUEL

Understanding the movement of molecules in gasoline could lead to increasing efficiency in the engines of cars and planes, believes NPRE Assistant Prof. Yang Zhang.

Zhang's research systematically examines the viscosities of alkanes, the major component in gasoline. "Some of the alkanes have higher viscosities—in layman's language—are thicker. Others have lower viscosities and are more liquid-like," Zhang said. "The liquid-like is preferred because it flows more smoothly, and is less likely to jam."

Zhang recently was selected for an American Chemical Society Petroleum Research Fund Doctoral New Investigator Award for this project in which he uses high flux neutron sources at Oak Ridge National Laboratory and the National Institute of Standards and Technology (NIST) to determine the flow of gasoline molecules. The facilities enable Zhang to record the molecules' movements using superfast neutron spectroscopy, a technique examining interactions between matter and electromagnetic radiation.

The research may lead to new ways for petroleum companies to remix components and produce optimized fuels with better fuel efficiency.

Ruzic's energy intro course goes worldwide through Coursera

For years, students across the University of Illinois Urbana campus have had the opportunity to enjoy Prof. David Ruzic's popular Introduction to Energy Sources (NPRE 101) class. Now it will be available worldwide, as one of the university's online Coursera courses.

The online offering, ""What You Need to Know; Energy, Environment and Everyday Stuff," will be available through Coursera's Massive Open Online Course (MOOC) platform, and is expected to debut in March. Ruzic competed across campus to have the course chosen among proposals the university administration considered as MOOCs.

"In some ways, this wraps up and sums up my teaching of the 101 class," Ruzic said. "Students who take it really love it, and I wanted to share this with the world. (Through Coursera) the class will be on the books for years until it gets outdated."

Ruzic has filmed 128 segments, each six to 10 minutes long and arranged in 24 energy-related topics, including an overview of energy, chemistry, fuel cells, electricity and electric grids, coal, oil, natural gas, solar energy, wind energy, hydropower, nuclear energy, nuclear accidents (Chernobyl and Fukushima), nuclear waste, economics and fusion. Designed as a free course, the offering takes about eight weeks to complete online.

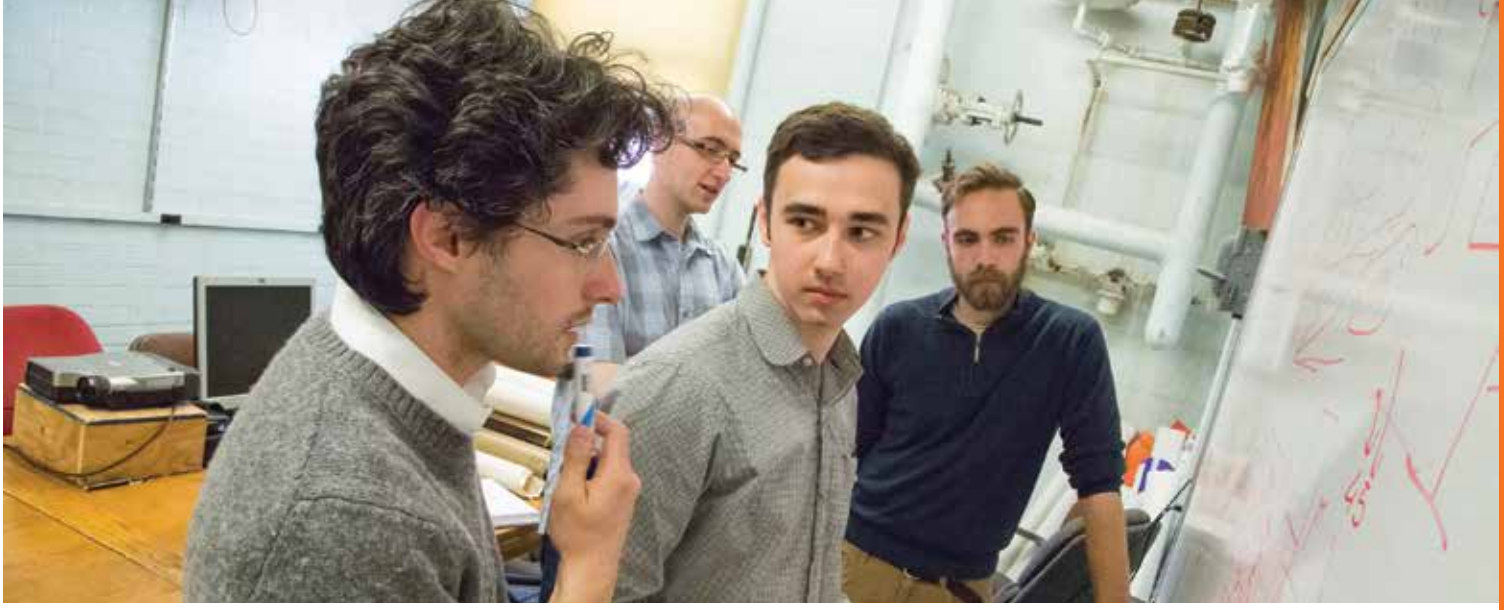
Ruzic will create quizzes and homework for online students who seek course credit. Those students will receive a certificate upon completion.

In addition to making energy instruction available across the planet, the online effort will be useful on campus, as well, Ruzic believes. "Many of the segments I produce will be used in NPRE 201 (Energy Systems) or 101. It could be easier (in class) to show a five minute videotape; I could use bits and parts to enhance education."

Through the Coursera partnership, the University of Illinois promotes its land-grant mission by sharing knowledge with people who are unable to physically come to campus. The effort also introduces the university to prospective students and lifelong learners across the globe.

"It's very important name and brand recognition," Ruzic maintains. "The U of I is one of the best institutions in the world and should be seen in that light."

David Ruzic teaching NPRE 101



Davide Curreli, far left, with his research group

Curreli chosen as NCSA Faculty Fellow

The National Center for Supercomputing Applications has chosen Assistant Prof. Davide Curreli as a Faculty Fellow to support his high-performance computing project involving plasma-material interactions and nanostructuring.

According to Curreli, the interaction of plasmas and material surfaces in the edge region of magnetically-confined plasmas poses significant challenges to the plasma-facing components. This obstacle currently limits the successful development of commercially-viable nuclear fusion reactors.

"Taming the Plasma-Material Interface is now one of the top priorities of required fusion science research to get to a demonstration fusion power plant," Curreli said. "When exposed to plasma irradiation, plasma-facing materials exhibit evidence of surface morphology modifications and nano-structuring, with detrimental consequences on the thermo-mechanical integrity of the wall."

Curreli and his group will develop and test on the Blue Waters (BW) supercomputing facility a new high-performance computing (HPC) model for Plasma-Material Interactions and Nanostructuring. "This is the first HPC modeling platform for kinetic analysis of the near-surface behavior of plasma-facing components. The code integrates a general multi-species, fully-kinetic 3D Particle-in-Cell model of the plasma sheath and plasma boundary with a 3D model of the surface morphology," Curreli said. The large-scale production runs that Blue Waters' petascale facilities make possible are required for the work.

"Developing predictive models for plasma-material interaction is not limited in scope to fusion sciences," Curreli maintains. "There is an enormous public benefit if fusion energy technology can produce a cost-effective electric-power generating device."

"Long before that day though, there are additional benefits from understanding how we can control material nanostructuring via plasma processes," Curreli continued. "For example, under the proper conditions of plasma irradiation, we can modify the surface of a tungsten piece and generate the same "fuzzy" nanostructures observed in fusion devices. This opens the possibility to modify the effective surface of a metal sample, and suggests new industrial processes for many applications. The experience gained in the fusion PMI area can be transferred to other fields of science and engineering."

NCSA's Fellowship program provides an opportunity for faculty and researchers at the University of Illinois at Urbana-Champaign to catalyze and develop long-term research collaborations between Illinois departments, research units, and NCSA. This competitive program provides seed funding for demonstration or start-up projects, workshops, and/or other activities with the potential to lead to longer-term collaborations around research, development and education.

Learning detectors—from the inside out

Students in Clair Sullivan's class got to know radiation detectors from the inside out this past spring.

Sullivan, an assistant professor, taught NPRE 498 (Advanced Radiation Detector Concepts) to about a dozen students. She challenged them to use a Raspberry Pi—a credit card-sized, single-board computer available for about $35 at most electronics stores—to program and develop their own detectors from scratch. They were given little direction beyond that, and that was the point.

"Our students are not coming to the lab with the ability to futz with things," Sullivan maintained. "Here, I gave them none of the steps. I said, 'Your end goal is to take this (Pi) and take any detector (in the lab) and make it functional solely off the Pi.'"

Students were allowed to use any information they found, as long as they cited their sources. They were encouraged to share with one another as they made discoveries. In fact, they were given points for sharing, as well as for creating.

"If you stated that you used something, you got points, and the inventor got points as well," Sullivan said.

As an example, graduate student Andrew Groll shared his discovery when he hacked the communication interface of the USB-controlled high-voltage power supplies to make it work on the Pi. Once he figured it out, he posted it to a wiki content management system so other students could use the technique as well.

"I didn't know whether it could be done," Sullivan acknowledged.

She knew the class was hitting its mark when the students taught themselves Python, a programming language common for use with the Pi. "That made my little professor heart go pitter-patter!" she said, smiling.

Clair Sullivan works with students in her Advanced Radiation Detector Concepts class.

"You can't learn this stuff from just reading it."

Twenty-five percent of the grades for the course were based on the steps the students used in pursuit of their goal. "Not being able to make (the detector) work was okay; it was about the process," Sullivan said, adding, "I was blown away by their results."

The students' responses also were positive.

"It's really a learning process," said undergraduate Nick Bridge. "It's difficult, but definitely worthwhile. You can't learn this stuff from just reading it."

While graduate student Groll thought his previous experience gave him an advantage over others in the class, he appreciated Sullivan's approach. "This is one of the most useful classes I've ever taken in this department," he said. "Being able to work with the other students makes it one of the more enjoyable classes, because we're trying to figure out the problem together. It's collaborative learning, and it's more hands-on."

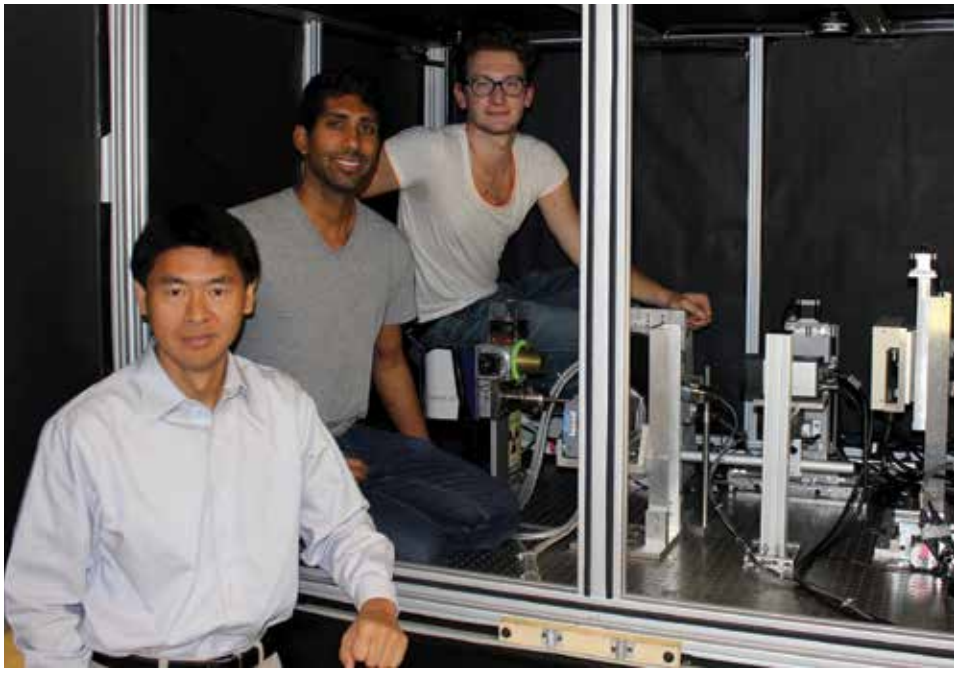
Sullivan was pleased with how the students took charge. "My job in this class was to light a spark and get out of their way," she said.

State-of-the-art functional X-ray facility online in NPRE

NPRE's Radiation Imaging Group now has online a new, state-of-the-art functional X-ray imaging facility.

"The new Functional X-ray Imaging Lab (FXIL) is very comprehensively equipped and is one-of-a-kind in the world," said Associate Prof. Ling-Jian Meng.

The NPRE Department and a $2 million grant from the National Institutes of Health provided funding for Meng's team to construct FXIL, housed in Talbot Laboratory on the Urbana campus. The facility consists of a walk-in closet equipped with four different X-ray sources, a wide variety of X-ray imaging and spectroscopic detectors, an optical



Associate Prof. Ling-Jian Meng, foreground, with his graduate students Jonathan George and Luca Giannoni with the FXIL facility.

photon imaging camera based on state-of-the-art intensified EMCCD detectors, and potentially a regular emission tomography system integrated ion beam line.

FXIL offers highly unique X-ray imaging techniques for a wide range of biomedical imaging applications, including micro X-ray computed tomography (CT), X-ray florescent CT (XFCT), X-ray luminescent CT (XLCT), and nanobeam therapy. It can be used in microbiology and nano-medicine, potentially novel bio-imaging technologies, and to monitor cancer micro-biology, Meng said.

FXIL will allow Meng's team and his collaborators to study X-ray induced/modulated anti-cancer therapeutic techniques. With the strong X-ray beam tuned at specific X-ray energies, one could selectively stimulate a micro-area around or inside a tumor tissue. This stimulation could trigger a local therapeutic effect by releasing anti-cancer drugs that specifically designed nanoparticles carry to the target.

"With the bench-top system, we can focus the beam to stimulate an area as small as 30 microns in diameter," Meng said. "We are exploring a combined X-ray photodynamic therapy and localized X-ray imaging strategy that could allow researchers to visualize the exact therapeutic delivery process, and potentially the inhomogeneous response of the tumor to the treatment."

Meng further plans to use the facility as a teaching device in the current NPRE 435 Radiological Imaging course. He also plans to use the FXIL for a new lab course that is currently under development.

Assistant Profs. Tomasz Kozlowski and Clair J. Sullivan were presented with Engineering Council Advising Awards for 2014-15 by College of Engineering at Illinois Dean Andreas Cangellaris, middle. The American Nuclear Society Student Chapter also chose Sullivan for the 2014-15 Teacher of the Year Award.

NPRE said good-by to Office Administrator Gail Krueger, who moved in May to Dallas with her husband. Good luck, Gail!

The American Nuclear Society Student Chapter chose Office Support Specialist Rodney D. Siders for the first-ever NPRE Staff of the Year Award for 2014-15. From left are Department Head Jim Stubbins, Siders, and ANS Student Chapter President Aveek Kapat.

Just Connections: NPRE's collaboration with Jordan University travels full circle

An international collaboration NPRE began eight years ago with Jordan has gone full circle with the awarding of the first PhD to a student from the program.

Rabie Abdullah Abu Saleem at graduation

Rabie Adullah Abu Saleem's journey at the University of Illinois culminated in his diploma presentation at the December 2014 Commencement ceremony. Six years ago, fresh from having earned a bachelor's in mechanical engineering at Jordan University of Science and Technology (JUST), Abu Saleem had traveled to Illinois to earn graduate degrees in nuclear engineering, with a specialty in computational thermal-hydraulics.

Mohamed Khasawneh, a JUST professor who had come to Illinois in 2007 as a visiting faculty member in Electrical Engineering, and other JUST administrators had persuaded Abu Saleem that Illinois would be a good fit for him.

"They were emailing me back and forth and said it would be a good school," he said. "That's what made me come here."

Now Abu Saleem has completed the circle by returning to JUST as an assistant professor in the university's relatively new Nuclear Engineering Department. The department has awarded 77 bachelor's degrees since its establishment in 2007. NPRE faculty began working with JUST administrators and faculty members that year to assist the country's effort to develop its own nuclear power resources.

NPRE Profs. Rizwan Uddin and Magdi Ragheb traveled to Jordan in March 2007 to make recommendations on curriculum. A scientific and educational delegation from JUST, including the university's president, journeyed to Illinois a year later to continue the collaborative work and tour Illinois facilities.

Then, in 2010, NPRE faculty helped the country plan the first International Nuclear & Renewable Energy Conference (INREC '10) to help define future energy directions for that region of the world.

Unlike many of its neighboring countries, Jordan is not rich in oil and is exploring nuclear power as a means to meet its energy needs. JUST's establishment of its Nuclear Engineering Department was another step in the country's efforts to develop its nuclear infrastructure, and to introduce nuclear power as part of its energy make-up.

Nuclear energy offers a promising approach to meeting Jordan's energy needs–an approach that would reduce the country's dependence on oil imports, create jobs, raise standard of living, and alleviate the burden on the national budget: Jordan has been importing over 95 percent of its energy. In addition to providing electricity to fulfill the growing electrical demands of Jordan, nuclear energy may also be used for water desalination, and hydrogen production.

Within two years, the Jordan Atomic Energy Commission (JAEC) intends to enter into a final contract for the construction of two nuclear units. In September 2014 JAEC signed a project development agreement with Rusatom Overseas for that purpose. Since initiating its Nuclear Engineering Department, JUST also has established its own research reactor, and Abu Saleem plans to incorporate its use in his research. He's excited about the prospect of the country's emerging energy efforts.

"That was one of the main reasons that I wanted to be involved in nuclear; I'll

be one of the first people working on it," Abu Saleem said. He's happy to return to his home country, which he has visited only three times in the past six years. And he plans to recommend NPRE to his students seeking graduate degrees.

"It was interesting; I loved the curriculum" in NPRE, Abu Saleem said. "We covered basically all the things I wanted to learn—radiology, neutronics, materials, hydraulics—I got an idea of everything." He also appreciated the range of electives offered outside NPRE's required courses, and chose several mechanical engineering and theoretical and applied mechanics courses.

"People here made things very easy for me, especially the staff in the department. When I had a problem or a question, it didn't take long for me to get an answer."

Abu Saleem said NPRE also provided opportunities for him to travel to conferences, and he established several connections at Idaho National Laboratory. He found particularly worthwhile his trip in summer 2013 to Sweden's spent nuclear fuel storage facilities.

"(NPRE's offerings) weren't routine; I wasn't just taking classes. I learned much that I can relate to my research."

Working with his NPRE advisor, Assistant Prof. Tomasz Kozlowski, an expert in computer simulations of nuclear reactors, Abu Saleem's doctoral thesis was entitled, "Development of Two-Phase, Two-Fluid Model Solver Based on a High-Resolution Total Variation Diminishing Scheme."

Detection work takes grad students to high-security nuclear facility

The first university group permitted to take measurements at the Nevada National Security Site (NNSS) near Las Vegas included two of Assistant Prof. Clair Sullivan's graduate students.

Mark Kamuda and Jacob Stinnett work with Sullivan in radiation detection research. The students were invited to the high-security facility because Sullivan's investigations are pivotal in two U.S. Department of Energy-funded initiatives: the Consortium for Verification Technology (CVT) and the Consortium for Nonproliferation Enabling Capabilities (CNEC). CVT's purpose is to conduct research and development in nuclear arms control

Jacob Stinnett

Mark Kamuda

verification technologies, including nuclear safeguards effectiveness. CNEC will provide the U.S. government with cutting edge research and development to identify and address multi-disciplinary and cross-functional technology and detect foreign nuclear weapon proliferation activities.

Stinnett develops software for detectors used in emergency first response and border crossing checks, and for treaty verification at nuclear plants around the world. Kamuda creates algorithms for isotope identification after a nuclear detonation.

The visit to NNSS enabled Stinnett and Kamuda to test their software on weapons-grade plutonium and highly enriched uranium, materials unavailable to them in a university setting.

The two students trained at Los Alamos in April to prepare for the four-day journey this past summer to NNSS. They worked in the site's Device Assembly Facility. "It was an enormous concrete and steel structure designed so that if something explodes, it stays within the contained area," Kamuda said. "It had very thick steel doors."

Dressed in full-length pants, hard-toed shoes and eyeglasses, Stinnett and Kamuda were equipped with thermoluminescent dosimeters (TLD), to measure the radiation dose each of them were getting, and personal nuclear accident dosimeters, in case an accident were to destroy the TLDs.

Although neither student was allowed to touch most of the sources they measured, they did get to hold and be photographed with the famous BeRP (Beryllium-Reflected Plutonium) ball, a sphere composed of weapons-grade plutonium. The ball has been the source of many scientific investigations and papers.

"When I showed the BeRP picture to my parents, they said, 'You're holding it. Why are you holding it?'" Stinnett said. He assured his parents he was in no danger.

The facility and the power nuclear weapons can exude impressed the students. In particular, the Sedan Crater, a famous underground testing spot near Groom Lake, Nevada, made an impact when Kamuda and Stinnett toured the site during their visit. The result of a nuclear test in 1962, the Sedan Crater is 300 feet deep and a quarter of a mile in diameter. It can be seen from earth orbit with the unaided eye.

"Seeing the crater itself was very surreal," Kamuda said. "It was a fairly small nuclear explosion, and to have this enormous hole result underground; it moved 11 million tons of earth.

"We were seeing the power of what this has," he continued. " We went with a group and no one said anything for a few minutes; we just stared at it."

Preventing the use of such power for harmful purposes is the objective behind the work Stinnett and Kamuda do. "Keeping someone (dangerous) from making nuclear material is the main thing," Kamuda said.

Ooi gains research fellowship to Spain

NPRE undergraduate Zhiee Jhia Ooi spent six weeks in Spain this summer, conducting research into nuclear thermal hydraulics.

Working with collaborators of Assistant Prof. Caleb Brooks, Ooi's project, "Two-phase Flow Gas-liquid Measurements in Channels," was made possible through the Summer Undergraduate Research Fellowship-Abroad (SURF-Abroad) program of the Office of Undergraduate Research at Illinois. Ooi worked with Prof. Sergio Chiva and Dr. Raul Martinez-Cuenca at James I University in Castellon de la Plana, Spain.

Zhiee Jhia Ooi

"I was working with the Multi Flow Group (MFG) to develop a new turbulent dispersion model using Computational Fluid Dynamics," Ooi said. "My job was to conduct experiments, collect experimental data, and process the data so that it could compared to that from the model that was being developed. I also had the opportunity to use various equipment such as the conductivity probes, Laser Doppler Anemometry (LDA) system, and high-speed camera.

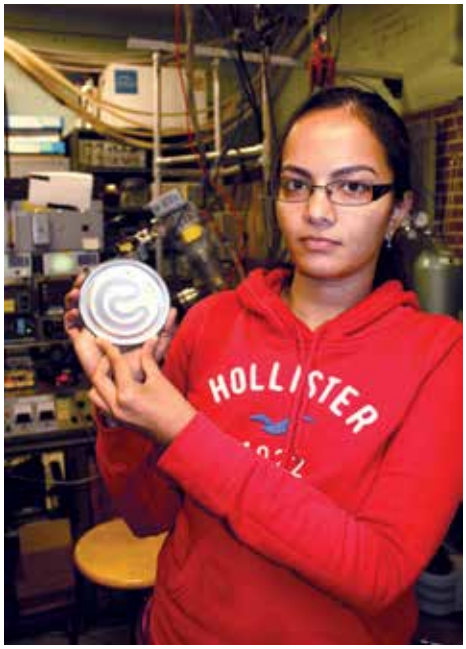
"The main goal of this project is to publish a paper on this topic by the end of the year," Ooi continued. "The tasks are divided between the MFG, me, and Professor Brooks. The MFG will be conducting more experiments and I will be processing the data."

The student has been working with Brooks since Fall 2014 in helping to design and build a two-phase flow boiling loop for the study of wall nucleation characteristics. The student plans to go to graduate school after earning his bachelor's degree.

"It's a really steep learning curve between undergrad and graduate thesis work," Brooks said. "Theses kinds of six-week programs can really help with that curve. If he can do this, he can be effective from day one (as a graduate student)."

Raman wins AVS award

The American Vacuum Society (AVS) has recognized graduate student Priya Raman for her innovations in magnet pack development for use in High-Powered Pulsed Magnetron Sputtering (HPPMS/HiPIMS).



Priya Raman

Raman was awarded the *Dorothy M. and Earl S. Hoffman Scholarship*, one of the five top-level national awards named at the 61st International AVS Symposium held in November 2014 in Baltimore.

She is also a named inventor on a patent on this device, which will become a new product of the Kurt J. Lesker Company. The patent was submitted through the Center for Plasma-Material Interactions, directed by Raman's advisor, Prof. David Ruzic.

AVS selected Raman for the scholarship award after a general competition in which eight graduate research applicant finalists presented their work to the Awards Committee at the International Symposium.

Among other projects, CPMI researchers strive for continuous innovations in computer chip processing. Raman's work has been to improve the quality of thin film coatings on the chips by understanding the plasma mechanics that optimize the coating process.

She collaborated on the work with NPRE alumnus Brian Jurczyk, President and Co-Founder of Starfire Industries. Raman earned a master's degree in NPRE in 2012, and expects to complete her doctoral studies next year.

AVS established the Hoffman Scholarships to recognize and encourage excellence in graduate studies in the sciences and technologies of interest to the society.

Lively sees advantages in hearing impairment

With near perfect grades as an undergrad, a National Science Foundation fellowship award to pay for graduate school, and a key role in innovative research involving nano-patterning of surfaces, Mike Lively is doing well by anyone's standards.

He hasn't been hindered by the fact that, even with his hearing aids, his auditory perception is just 50 percent. Rather, he believes his hard of hearing, a condition he has had since childhood, has its advantages.

"I think about things and see things differently," Lively maintains. "I perceive things in ways that other people miss."

His advisor, Associate Prof. J.P. Allain, agrees. Illustrating, Allain recalls how a visiting colleague commented on Lively's intuitive nature while doing research. "He said Mike can see through certain problems that others can't," Allain said. "(Mike's) other senses are heightened; and he's okay with it."

Lively reads lips, and adjusts to classroom situations by using an FM microphone system. "The professor wears an FM mike unit that transmits directly to my hearing aids, so no one else is affected. This has had the side effect that my professors always know my name from the very start of the class—you can imagine this can be useful sometimes."

Having earned his bachelor's from Purdue University in 2014, Lively chose to follow Allain to Illinois for graduate school. Allain made the switch in 2013.

Lively does computer modeling for directing ion beams to make patterns on materials such as silicon, used by the semi conductor industry primarily for computer chips. Mentored at Purdue by Allain's former graduate student, Eric Yang, Lively helped develop code that produces a realistic description of radiated ions' interaction with the silicon, and was an author of subsequent papers on the research. Work done previous to their study made assumptions about the interactions without considering the nature on an atomic scale.

"We can no longer neglect (the mechanics) because those become critical in how one can nanopattern from the bottom up," Allain said. "Atom by atom, we create new materials; you can't do that without understanding the mechanics."

A second paper Allain, Yang and Lively have produced from the research has been accepted recently for publication in the journal, *Physical Review B* of the American Physical Society. Lively notes

Mike Lively

with a smile that while it's his second publication, it marks Allain's 100th.

Lively continues to develop improvements to the model. The group's original work expected atoms to be knocked off the surface when the ions hit. Instead, Lively realized the surface was growing larger. By picking up on that phenomena, "we're now looking at how we can improve the physical framework of the model in order to correct it," Lively said.

Allain said the researchers are working to understand how the material's surface relaxes after the ions' initial bombardment. "We know that atoms move about on the surface then self-organize to form patterns," he said. "Mike has been thinking about the appropriate model to do this."

"Minor details are actually significant in the model for our particular application," Lively noted.

His attention to the details provides Allain a great advantage in setting up corresponding experiments. "We don't have to stretch far in interpreting the model's results, whereas in other models you do."

Understanding this kind of molecular dynamics requires time, patience and extensive consideration of all elements involved. "The ions create craters (on the material's surface). It takes about a week to get one set of craters," Allain said. "It's a whole other computational scheme to conduct the relaxation (of the surface)."

Lively has drafted a proposal to the National Center for Supercomputing Applications (NCSA) to gain access to petascale computing for the work. He also hopes to use Blue Waters, **the** fastest supercomputer on the Urbana campus, and XSEDE (Extreme Science and Engineering Discovery Environment), a network of computer resources across the country.

While much of his work has involved programming, Lively chose as an undergrad to apply his conceptual and mathematical thinking skills to nuclear engineering. "It sounded like more fun than electrical engineering," he said. "My intellectual makeup is very academic; I knew as a freshmen I wanted to do research and grad work."

Lively recalls Allain was quick to set the course. "In the first meeting I had with him, JP asked me, 'Do you know what a tokomak (fusion reactor) is?' I said, 'No.' He handed me two textbooks and that was the meeting. The next meeting, he gave me 150 pages of research work to read."

Allain then assigned Yang to mentor Lively. Now as a graduate student, Lively is mentoring undergraduate Ryan Gonsalves, a mathematics major in the group. Lively values the teaching opportunity, and believes he could add something special to being a faculty member sometime in the future.

"As a professor, I would like to inspire more deaf and hard of hearing individuals into science and engineering," he said. "When I look at the deaf community, there's positive things that can come out of seeing the world and interacting with the world in a different way."

In addition to his own talents that Lively adds to the research group, he helps others in Allain's team hone their skills. Allain said he realized this during conference calls among group members.

"When we sit down and put a speaker on, we now become more conscious of what we say because Mike needs to hear," Allain said. "We become more descriptive about what we say and the conversation we engage in; it makes our discussions more in-depth."

Seven NPRE students traveled to Okarshamm, Sweden, over the summer to examine first-hand the country's spent nuclear fuel storage facilities. Participating this year were students Jeff Geringer, Holly Hernandez, Chris Kuprianczyk, Aristidis Loumis, Katie Mummah, Seung Joon Oh, and Gustavo Pereira. The course included trips to Clab (an interim geological repository for spent fuel), the Laxemar Site (study area for bedrock and surface geology), the Äspö Hard Rock Laboratory (research laboratory for geological spent fuel disposal), and the Canister Laboratory (development center for spent fuel encapsulation technology).

Radiation Imaging Group has successful summer

Second Place, Best Poster Presentation Award, Society of Nuclear Medicine and Medical Imaging (SNMMI) 2015 Annual Meeting

Graduate student Xiaochun Lai was recognized for his poster presentation on the group's development of simultaneous imaging using Single-Photon Emission Computed Tomography (SPECT) and Magnetic Resonance Imaging (MRI).

While the MRI is a powerful tool in producing high resolution imaging of soft tissues, it is a slow sensitive imaging tool. On the other hand, SPECT and Positron Emission Tomography (PET) are high sensitive imaging tools, equipped with probes to study bioprocesses on the molecular level. Associate Prof. Ling-Jian Meng's group has been able to overcome challenging technological issues of strong interference in the two techniques' modalities to enable them to work simultaneously.

"The (SPECT) detector has to work inside the MRI, where it is a tough environment for the radiation detector," Lai said. "(The MRI's) magnetic field is about 60,000 times higher than the one of Earth, and this strong magnetic field will make the convection detector malfunction. Besides, the detector is not allowed to degrade the performance of the MRI: the MRI field requires very high uniformity, with the difference less than several parts per million. Any magnetic component in the detector will distort this field and consequently affect the performance of MRI imaging."

Over the past five years, Meng's group has constructed an ultrahigh resolution stationary magnetic resonance-compatible SPECT system for small animal imaging using second-generation energy-resolved photon-counting (ERPC) detectors. The system can achieve very high resolution with relatively high sensitivity.

A potential application for the system is in tracking neuro stem cells, being considered by scientists as possible carriers for targeted delivery of therapeutics to brain tumors.

Finalists for Young Investigator Award, SNMMI 2015 Annual Meeting

Graduate students Jonathan George and Andrew Groll both were picked to be among the top five finalists and were recognized with Honorable Mentions in competition for the Young Investigator Award in the SNMMI Conference's Computer and Instrumentation competition.

George's project, "Evaluation of X-ray Fluorescence Emission Tomography for Real-time Assessment of Photodynamic Therapy Effect," studies the use of x-ray fluorescence emission tomography (XFET) for assessing the therapeutic effect of x-ray induced photodynamic therapy (PDT) in real-time.

According to George, "X-ray fluorescence occurs when an incident x-ray interacts with a high atomic weight, freeing an electron from an orbital. Another electron moves into the vacant orbital, and the energy difference between orbitals emits a fluorescent x-ray of known energy. These fluorescent x-rays can be detected and imaged in a process called XFET."

In PDT treatment, a photosensitizer compound uses a specific wavelength of light or x-rays to active a drug and kill nearby cells. "X-ray induced PDT, as compared to typical optically induced PDT, can penetrate into deeper parts of the body to precisely activate the PDT effect in a deeply embedded tumor," George said.

George's experimental study evaluated XFET's feasibility for this purpose.

Groll's work, "Evaluation of Hybrid Pixel-Waveform (HPWF) CdTe and CZT Detectors for Sub-500 μm Resolution PET Imaging for Mouse Brain Studies," explored the use of CdTe semiconductor detectors for use in small animal PET imaging.

"Semiconductor detectors have been seen as a challenge to the field that is filled with scintillation detectors," Groll said. "Prof. Meng and I have been pushing toward acceptance of semiconductor detectors for imaging transgenic mouse models, which can represent some form of neurodegenerative disease. In order to adequately investigate the biology of these models, higher resolution imaging systems are necessary, which is what semiconductor PET would offer."

Groll's paper, "Hybrid Pixel-Waveform (HPWF) CdTe and CZT Detectors for

Xiaochun Lai

Jonathan George

Andrew Groll

Dan Strat

Sub-500 Um Resolution PET Imaging Systems," also won fourth place among 1,500 student submissions at the Institute of Electrical and Electronics Engineers, Nuclear Science Symposium & Medical Imaging Conference held in November.

Engineering at Illinois Scholars Undergraduate Research (ISUR) Program

Senior Dan Strat has been selected for this program for his project to combine two imaging methods: X-ray induced luminescence-computed tomography (XLCT) and X-ray induced fluorescence computed tomography (XFCT).

"X-ray luminescence uses X-rays to induce the emission of visible light, while X-ray fluorescence uses X-rays to induce the emission of other X-rays," Strat said. "The major concept of these methods is that nanoparticles would be injected into the body near a region of interest. These nanoparticles get excited inside the body via stimulation by an X-ray beam and then emit either visible light or other X-rays. The emitted photons are detected by special detectors and are then processed into an image."

While X-ray induced luminescence has a higher sensitivity, it lacks in tissue penetration because visible light cannot pass through tissue easily. Conversely, fluorescence has higher tissue penetration, but lower sensitivity. Combining the two will allow researchers to accentuate the strengths of each.

"Naturally, a system where the strengths of one modality make up for the weaknesses in the other seems like the next logical step in the evolution of X-ray stimulated emission tomography," Strat said.

ISUR offers selected students a two-semester experience with a research learning community. Through ISUR, students become familiar with research methodologies, develop research skills, gain exposure to what graduate school entails, and gain experience needed for graduate school acceptance. ISUR scholars present their research in an annual expo held in the spring.

Undergrad wins ANS, DOE scholarships

Undergraduate Kathryn Mummah has won scholarships from the American Nuclear Society and the U.S. Department of Energy.

The ANS Decommissioning & Environmental Sciences Division Undergraduate Scholarship is awarded to engineering or science major students pursuing one of a number of areas: decommissioning/decontamination, management/characterization of radioactive waste, or restoration of the environment or nuclear engineering.

Mummah also won one of the 59 Nuclear Energy University Program (NEUP) scholarships the DOE awarded to undergraduates nationwide in engineering and science programs related to nuclear energy.

Also winning DOE NEUP fellowships this year have been new April Novak and Christopher Keckler, both of whom earned their bachelor's degrees in NPRE in May. Both are attending the University of California-Berkeley for graduate school.

Seniors' design for plasma coating technique wins Hang Award

A plasma technique NPRE students have crafted to enable portable metal coating in atmospheric conditions has won the 2015 Daniel F. Hang Outstanding Senior Design Award.

From left, Ian Haehnlein, Jake McLain and Jan Uhlig were members of a team winning the 2015 Daniel F. Hang Outstanding Senior Design Award. Other members were Eric Gillum and Aveek Kapat.

Recent bachelor's degree graduates Jake McLain of Lockport, Illinois; Eric Gillum of Lake Villa, Illinois; Ian Haehnlein of Mokena, Illinois; Jan Uhlig of Chicago, Illinois; and Aveek Kapat of Oviedo, Florida, worked as a team on the project, Twin Atmospheric Plasmas for Deposition through Evaporation of Conductive Coatings (TAPDECC).

"TAPDECC uses both an arc plasma and a microwave plasma, concurrently," said McLain. "Currently, industry standard coating techniques use a stationary vacuum system, which utilizes a controlled environment within a vacuum.

"TAPDECC could be used to further the industrialization of films on items such as tool bits and touchscreens, as well as repair damages to coatings on surfaces such as airplane windows, on site, saving time and money," McLain said.

The Hang award was created in honor of the late Emeritus Prof. Daniel F. Hang, one of the Department's founders. Hang, who died at the age of 95 in December 2013, was passionate about nuclear engineering design, and emphasized the coupling of economics analysis with successful design work. He also strongly advocated students becoming licensed Professional Engineers.

Device answers, 'What's for breakfast?'

Three graduate students were among the finalists in the 2015 Cozad New Venture program for their high-tech spin on the age-old question, "What's for breakfast?"

The BreakfastBox device, the brainchild of inventors Peter Fiflis, Pawel Piotrowicz and Matthew Szott, is to the morning meal what the Keurig is

to coffee. The gadget was born from hunger pains the three had felt but had found little time to satisfy. "We would come into the lab, sometimes without eating breakfast, because we might be working long hours as grad students," Fiflis explained. Being engineers, they decided to solve the problem and automate the process with a new device.

The BreakfastBox, an internet-enabled countertop appliance, was designed to have breakfast cooked and ready for hungry users right when they need it in the morning. "The idea," said Fiflis, "is that you as a user would load up your BreakfastBox on the weekend with raw ingredients into a refrigerated section. Over the course of the week, you could then order a breakfast for the next morning (on an app) on your phone. All you have to do is specify what you want and the time that you want it ready. BreakfastBox then takes care of the rest, dispensing material from the refrigerated section onto a pair of skillet type heaters and cooks breakfast according to the users' tastes."

Fiflis has moved on with the concept, and is working with the Chicago startup firm, Maestro, to design a similar device focusing on dinners. "Our vision is to create excellent quality meals designed by professionals chefs in the homes of the users that purchase our appliance, taking much of the hassle out of cooking dinner, while still providing a delicious meal. Through contacts made in the Cozad competition I was put in touch with the founder of Maestro, and I'm now bringing the knowledge gained from BreakfastBox to Maestro," he said.

Student excellence recognized at Honors Banquet

Over 90 students were recognized during the 2015 NPRE&ANS Honors Banquet.

The event, held in April, recognizes students for earning awards from the Department, College of Engineering, national organizations and corporate partners. The Edward E. Mineman Memorial Endowment Fund sponsors the event. NPRE alumnus Edward F. Mineman, BS 84, and his brother Blaine A. Mineman, AB 85, Political Science, MBA 87, established the fund to honor their father.

Alpha Nu Sigma Society Spring 2015 Initiates

ANS Student Chapter Graduate Outstanding Service Award–Department Head Jim Stubbins, recipient Andrew N. Groll, and ANS President Aveek Kapat

ANS Student Chapter Undergraduate Outstanding Service Award–Department Head Jim Stubbins, recipient Shanna M. Bobbins, and ANS President Aveek Kapat

Catherine Pritchard Undergraduate Scholarship–Recipients Kathryn A. Mummah and Shanna M. Bobbins with Department Head Jim Stubbins

2015-16 ANS Student Chapter Officers–(front, from left) Vice President Jeremy J. Mettler; Treasurer Steven A. Stremmley; Secretary Aristidis E. Loumis; (back, from left) Social Chair Cory M. Markham and President Kathryn A. Mummah

Exelon Corporation Energy for Education Scholarships–(front, from left) Department Head Jim Stubbins and recipients Lauren E. Roby and Kathryn A. Mummah; (back, from left) Exelon representatives Bruce Rash and Ed Mcvey, and recipients Steven A. Jensen and Kevin J. Chowaniec

Roy A. Axford Undergraduate Scholarship–Recipient Justin D. Weberski with Department Head Jim Stubbins

George H. Miley LENR Undergraduate Scholarshp–Emeritus Prof. George Miley, recipient Brandon T. Lee and Department Head Jim Stubbins

NPRE Outstanding Achievement Award to a Graduating Senior–Department Head Jim Stubbins with recipients Jonathan D. Rolland and April R. Novak (recipient Louis J. Chapdelaine not pictured)

NPRE Outstanding Undergraduate Research Award–Recipients Christopher T. Keckler, Jake T. McLain, and Dan G. Strat with Department Head Jim Stubbins

American Nuclear Society student chapter President Aveek Kapat at 2015 Engineering Open House. The ANS group won First Place, Presentation of Society.

To view more photos of NPRE's 2014 Honors Banquet, go to NPRE's Facebook page.

NPRE-at-Illinois

OTHER STUDENT AWARDS

2015 American Nuclear Society Student Conference Best Undergraduate Poster Award

- Shanna M. Bobbins of Bedford, NH
- Justin V. Joseph of Glenview, IL
- Cory L. Scribner of Champaign, IL

Nuclear Regulatory Commission—University of Illinois at Urbana-Champaign Nuclear Engineering Scholarship and Fellowship Program

SCHOLARSHIPS

- Michael J. Benedict of Darien, IL
- Joseph L. Bottini of Framingham, MA
- Kevin J. Chowaniec of Willowbrook, IL
- Peter M. Conway of Lemont, IL
- Quincy R. Crawford of Mahomet, IL
- Nicholas J. Dadufalza of Seven Valleys, PA
- Steven J. Jensen of Mount Prospect, IL
- Christopher T. Keckler of Naperville, IL
- Daniel J. O'Grady of Evergreen Park, IL
- Joseph N. Rajchwald of Glenview, IL
- Steven A. Stemmley of Bethalto, IL

CONTINUING SCHOLARSHIPS

- Mikhail S. Finko of Clarendon Hills, IL
- Christopher A. Kuprianczyk of Chicago, IL
- April J. Novak of Downers Grove, IL
- Nicholas Rivera of Chicago, IL

CONTINUING FELLOWSHIPS

- Peter A. Mouche of Naperville, IL
- Aaron J. Oaks of Brea, CA
- Jacob B. Stinnett of Champaign, IL
- Nathan P. Walter of Evanston, IL
- Carolyn A. Tomchik of Buffalo Grove, IL

National Academy for Nuclear Training Institute of Nuclear Power Operations

SCHOLARSHIPS

- Kathryn A. Mummah of Wheaton, IL
- Jonathan D. Rolland of Sayville, NY

FELLOWSHIP

- Christopher A. Kuprianczyk of Chicago, IL

College of Engineering at Illinois—Wilmer Hellenthal Scholarship

- Zoe R. Richter of Manito, IL

College of Engineering at Illinois—Schlader Memorial Scholarship in Engineering

- April J. Novak of Downers Grove, IL

Alpha Nu Sigma Society

SPRING 2015 INITIATES

- Joseph L. Bottini of Framingham, MA
- Zhikun Cai of Jiaomei Town, China
- Michael M. Cheng of Chicago, IL
- Quincy R. Crawford of Mahomet, IL
- Xiang Liu of Zhongxiang, Hubei, China
- Jeremy J. Mettler of Sioux Falls, SD
- Daniel J. O'Grady of Evergreen Park, IL
- Nathan C. Reid of Naperville, IL
- Xia Sang of Shanghai, People's Republic of China
- Steven A. Stemmley of Bethalto, IL
- Christian D. Zircher of Burr Ridge, IL

CONTINUING MEMBERS

- Michael P. Christenson of Champaign, IL
- Daniel T. Elg of Wheaton, IL
- Peter R. Fiflis of Indian Head Park, IL
- Mikhail S. Finko of Clarendon Hills, IL
- Jonathan George of Bolingbrook, IL
- Abhishek Jaiswal of Kathmandu, Nepal
- Steven J. Jensen of Mount Prospect, IL
- Aveek S. Kapat of Oviedo, FL
- Christopher A. Kuprianczyk of Chicago, IL
- Xiaochun Lai of Shanghang, People's Republic of China
- Daniel C. Martin of Glencoe, MO
- Benjamin C. Masters of Urbana, IL
- Yinbin Miao of Shanghai, People's Republic of China
- Peter A. Mouche of Naperville, IL
- Aaron J. Oaks of Brea, CA
- Nicholas W. O'Shea of Chicago, IL
- Jason A. Peck of Fairview Heights, IL
- Pawel A. Piotrowicz of Chicago, IL
- Priya Raman of Chennai, India
- Joseph A. Serio of West Chicago, IL
- Ryan A. Switts of O'Fallon, IL
- Matthew M. Szott of Orland Park, IL
- Carolyn A. Tomchik of Urbana, IL
- Jan P. Uhlig of Chicago, IL
- Justin D. Weberski of Saint Charles, IL
- Xu Wu of Urbana, IL
- Weicheng Zhong of Champaign, IL

University Honors—2015 Senior 100 Honorary

- Nicholas Rivera of Chicago, IL

University Honors—Chancellor's Scholars

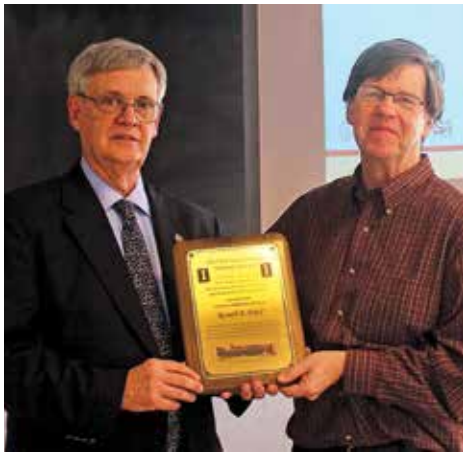
- Quincy R. Crawford of Mahomet, IL
- Zoe R. Richter of Manito, IL
- James M. Stearns of Elgin, IL

University Honors—James Scholars

- Bilal Arshad of Astoria, NY
- Joseph L. Bottini of Framingham, MA
- Peter M. Conway of Lemont, IL
- Quincy R. Crawford of Mahomet, IL
- Karla M. Del Cid-Ledezma of Rio Rancho, NM
- Austin G. Enfinger of Fredericksburg, VA
- Steven J. Jensen of Mount Prospect, IL
- Justin V. Joseph of Glenview, IL
- Aveek S. Kapat of Oviedo, FL
- Brandon T. Lee of Hermosa Beach, CA
- Daniel C. Martin of Glencoe, MO
- Jeremy J. Mettler of Sioux Falls, SD
- Matthew M. Moukheiber of Wheaton, IL
- Kathryn A. Mummah of Wheaton, IL
- Daniel J. O'Grady of Evergreen Park, IL
- Joseph N. Rajchwald of Glenview, IL
- Ashley C. Roberts of Peoria, IL
- Xia Sang of Shanghai, People's Republic of China
- Grant M. Schumock of Geneva, IL
- James M. Stearns of Elgin, IL
- Steven A. Stemmley of Bethalto, IL
- Justin D. Weberski of Saint Charles, IL

Knief chosen as 2015 Distinguished Alumnus

Dr. Ronald A. Knief, a Nuclear Criticality Safety Engineer and Principal Member of the Technical Staff at Sandia National Laboratories, is NPRE's 2015 Distinguished Alumni Award winner.



NPRE Distinguished Alumni Award winner Ron Knief with Department Head Jim Stubbins

Knief has been recognized *for contributions to the store of knowledge in reactor safety, especially criticality safety, and risk management for the nuclear power industry; and for excellence in providing performance-based education and training.* Since 1998, he has had the major responsibility for training and certification of operator personnel at Sandia's "Technical Area V" research reactors, hot cell, and irradiation facility.

Knief spent the 1990's as a "road-warrior" consultant, specializing in nuclear safety, training, and risk management. Clients included the U.S. Department of Energy (DOE) and most of its nuclear-contractor sites, the U.S. Nuclear Regulatory Commission (NRC), and many NRC nuclear-fuel-facility licensee sites. Various projects have taken him to Canada, the United Kingdom, France, Sweden, Japan, Russia, and the Ukraine.

At TMI for the 1980 decade, Knief served initially as Manager of Training for the TMI site with subsequent roles in corporate training and education, programmatic nuclear safety for TMI-2 recovery and defueling, and corporate risk management. The latter activity included the first of five risk management meetings extending through 2013 where Assistant Prof. Zahra Mohaghegh, NPRE's own resident risk assessment and analysis expert, served as program chair for the American Nuclear Society (ANS) embedded topical meeting, "Risk Management for Complex Socio-Technical Systems."

Knief was Associate/Assistant Professor of Chemical & Nuclear Engineering at the University of New Mexico from 1974 to 1980, developing and teaching most of the graduate courses in nuclear physics, reactor theory, systems, and safety. He also directed the radiation-measurement and reactor-operations laboratories. Knief developed and has continued to serve as advisor and faculty member for the UNM Nuclear Criticality Safety Short Course programs that have educated many of the world's practitioners.

Knief started his professional career at Combustion Engineering in reactor physics, computational analysis, and fuel management after having earned his doctorate at Illinois. He earned a bachelor's degree in physics, mathematics, and economics at Albion College in Michigan in 1967.

In addition to his text on criticality safety, Knief has written *Nuclear Engineering–Theory and Technology of Commercial Nuclear Power*; has edited three books on risk management (with another in progress); and has contributed to 2012's *Encyclopedia of Sustainability Science and Technology* as well as earlier encyclopedias and handbooks.

An ANS Fellow, Knief now chairs the Nuclear Installations Safety Division as he had done earlier for two other technical divisions and two local sections. He is involved in developing ANS standards for criticality safety, critical experiments, and fast-burst reactor operation. Knief received the 1985 NCS Division's Achievement Award and the 2012 ANS Robert L. Long Training Excellence Award.

View Dr. Knief's video at youtube.com/watch?v=Xo0hFl0v1Tg .

McVey chosen for Advocate Award

Frequently on campus working with students interested in the nuclear power industry and, particularly, Exelon Corporation, alumnus Edward A. McVey is the 2015 winner of the NPRE Advocate Award.

McVey, who earned his bachelor's degree in NPRE in 1983, was recognized for *dedicated leadership in serving as a liaison between the nuclear industry and NPRE, and for undertaking generous initiatives to build the resources that serve NPRE students.*

For years, McVey has advised NPRE students and has helped many of them secure internships, jobs, and scholarships. He has participated actively in NPRE's annual Interchange event, a job fair type structure in which representatives come to campus to share career advice with students and tell them about companies. McVey has devoted a generous amount of time to present seminars and talks in the department, and is a member of the NPRE Constituent Alumni and Industry Advisory Board.

He also has been key in helping to build the endowment of the Axford Fund, named for NPRE Prof. Roy A. Axford and used to provide student support.

McVey began his career in June 1983 at LaSalle County Nuclear Power Station working for Commonwealth Edison Company and continued his work for the company, known today as Exelon Corporation. McVey started as a Preoperational and Startup Test Engineer, and later joined the Reactor Engineering Group there, beginning his love of reactor physics and operation.

He held increasing levels of responsibility in the LaSalle Engineering organization until 1993, at which time he obtained full Certification as a Senior Reactor Operator. In 1994 he joined the Corporate Nuclear Fuels Organization, responsible for all fuels-related support for all three of the then-ComEd BWR plants.

Since then, he has held increasing management level responsibilities, as well as periodic temporary assignments at LaSalle, Clinton and Dresden nuclear stations. He has been part of two mergers of major domestic nuclear utilities (PECO and Constellation) that have resulted in the Exelon fleet growing from six plants to 14.

In April 2014, following the merger of Exelon and Constellation, McVey became the Director of BWR Core Design, responsible for the core design activities of fourteen BWR reactors at eight different plants utilizing fuel from three different domestic fuel vendors.

He has been the BWR Owners Group Chairman for the Reactivity Controls Review Committee for ten years of his career, including the last seven. In this role, McVey has the opportunity to lead Reactor Engineers across the domestic fleet in BWR reactor operational practices and resolution of technical issues.

Department Head Jim Stubbins with NPRE Advocate Award winner Ed McVey

In 1988 McVey became involved in the recruiting of new engineers for the company as part of his supervisory role.

"I have always made that role a priority for me. I have found it very rewarding to make connections with young engineers looking for a contact from the company that they can rely on to give them sound advice on career decisions.

"I take a personal interest in everyone I meet as part of the recruiting process and feel that this has helped Exelon recruit some of the top nuclear engineers in the nuclear power industry," he said. "There is nothing better than seeing someone I helped recruit or even nominate for a scholarship make a positive contribution to the nuclear industry."

View Ed McVey's video at npre.illinois.edu/news/mcvey-wins-2015-npre-advocate-award

Alumnus Eric Rozek, new Commander of the USS Mississippi.

Rozek, Balagna gain command of nuclear submarines

Reprinted from U.S. Navy news releases

Cmdr. Eric Rozek, who earned a master's degree in NPRE in 2003, relieved Cmdr. Michael Luckett as commanding officer of the Virginia-class fast attack submarine USS Mississippi (SSN 782) on June 5. Fellow NPRE alumnus, Cmdr. Kurt Balagna, BS 97, relieved Cmdr. Chester Parks as commanding officer of the Los Angeles-class attack submarine USS Annapolis (SSN 760) on April 2.

As Rozek, a native of St. Paul, Minnesota, assumed command of Mississippi, he expressed how honored and humbled he is to have been selected to take charge of such a professional and accomplished group of submariners.

"It is an honor and privilege to serve as your commanding officer," said Rozek, during the ceremony held at the submarine piers on Joint Base Pearl Harbor-Hickam. "To the crew and the families of the Mississippi, it has been a pleasure getting to know each of you and thank you for your professionalism and openness throughout turnover. Here in Pearl Harbor, we are surrounded by many reminders of what it could mean to serve our great nation."

The ceremony for Balagna, a native of Farmington, Illinois, took place at Naval Submarine Base New London (SUBASE). "Growing up in a small farming community in central Illinois, a thousand miles from the nearest seacoast, the prospect of joining the Navy seemed distant," said Balagna. "After much consideration while attending college, I decided to enlist and serve my country as my father and grandfathers had. However, I never imagined that someday I would achieve this milestone–commanding a submarine."

USS Mississippi is the fourth and newest Virginia-class fast attack submarine to be homeported in Pearl Harbor. The submarine is 377-feet long, displaces 7,800 tons, and is equipped to carry torpedoes and Tomahawk missiles, and possesses the capacity to insert special operations forces into a multitude of environments and battlefield scenarios.

Fast-attack submarines like Annapolis have multi-faceted missions. They use their stealth, persistence, agility and firepower to deploy and support special force operations, disrupt and destroy an adversary's military and economic operations at sea, provide early strike from close proximity, and ensure undersea superiority.

USS Annapolis is the fourth ship to be named for Annapolis, Md., site of the U. S. Naval Academy. The boat was built by Electric Boat Division of General Dynamics Corporation in Groton, Conn., and the keel was laid down June 15, 1988. The submarine was christened and launched on May 18, 1991, and commissioned April 11, 1992. The crew compliment includes 14 officers and 138 enlisted Sailors.

Kotek named to DOE Nuclear Energy Office post

Reprinted from U.S. Department of Energy news release

President Barack Obama has appointed NPRE alumnus John Kotek as the Acting Assistant Secretary for the Office of Nuclear Energy. The Office is responsible for conducting research on current and future nuclear energy systems, maintaining the government's nuclear energy research infrastructure, establishing a path forward for the nation's spent nuclear fuel and high-level nuclear waste management program, and a host of other national priorities.

John Kotek

Prior to his role as Acting Assistant Secretary, Kotek, BS 89, served as the Principal Deputy Assistant Secretary for the Office of Nuclear Energy. Prior to that, he was a Managing Partner of the Boise office of Gallatin Public Affairs, a public affairs and strategic communications consulting company. Kotek advised energy, natural resources and other clients facing complex communication and government relations challenges.

From 2010–2012, Kotek served as Staff Director to the Blue Ribbon Commission on America's Nuclear Future, which recommended a new strategy for managing nuclear waste in the United States. Kotek led the development of the Commission's final report to the Secretary of Energy, engaged in regular communications with Congressional and White House staff, and served as media spokesperson.

From 2003-2006, Kotek was Deputy Manager of the U.S. Department of Energy's (DOE's) Idaho Operations Office. In that role he was responsible for development and management of the Idaho National Laboratory contract and interface with the INL cleanup effort.

Before joining DOE in July 2003, Kotek worked for Argonne National Laboratory as the Generation IV and Nuclear-Hydrogen Programs Manager. He directed Argonne's participation in the Generation IV technology roadmapping project, an international effort focused on evaluating and developing the next-generation of nuclear energy systems.

In 2002, Kotek was the American Nuclear Society's Glenn T. Seaborg Congressional Fellow. He served in the Office of Senator Jeff Bingaman (D-NM), Chairman of the Senate Energy and Natural Resources Committee.

Kotek started his career with DOE's Office of Nuclear Energy, Science and Technology. He held several positions during his nine years with DOE-NE, including Associate Director for Technology, Associate Director for Management and Administration, and Chief of Staff.

Kotek has been active as an alumnus in the NPRE Department, and has served on NPRE's Constituent Alumni and Industry Advisory Board.

Class News

1970s

Mark Prelas, MS 76, PhD 79, is Professor of Electrical and Computer Engineering at the University of Missouri in Columbia, Missouri. Previously, he was Professor and Director of the university's Nuclear Science and Engineering Institute.

Robert Penn, BS 77, is a private nuclear energy consultant in the Lynchburg, Virginia area. He works on strategic projects, transition planning and implementation, and assessments. He retired in December as an Outage Manager for AREVA, Inc.

1980s

Glenn A. Carlson, BS 79, MS 83, MS 83 Mechanical Engineering, is a Senior Nuclear Engineer at Xcel Energy, a leading combination electricity and natural gas energy company. Previously, Carlson was an Advisory Engineer for Safety Analysis and Methods for Babcock & Wilcox mPower, Inc.

1990s

Mike Giacobbe, BS 91, MS 95, PhD 99, is the Head of Analytics and Consulting at JLT Speciality US, one of the world's largest providers of insurance, reinsurance and employee benefits-related advice, brokerage, risk management advisory and associated services. Previously, Giacobbe was Managing Director at Aon Risk Solutions.

Terrill A. Laughton, BS 92, MS 96, is Vice President/General Manager for Integrated Demand Resources at Johnson Controls, a technology and industrial company that provides its customers with advanced energy storage systems, building and facility management, and energy efficiency among other services. Previously, Laughton was Johnson Controls' Vice President of Sales and Operations for Integrated Demand Resources. He has been with the company since 2008.

Martin Neumann, BS 99, MS 04, PhD 07, is Director of Business Development at View|Dynamic Glass, which specializes in dynamic glass and electrochromic glass, green technology, intelligent windows, and nanotechnology. Prior to December, Neumann was Director of Technology at View|Dynamic Glass.

2000s

Jason T. Harris, MS 02, has joined the faculty of the Purdue University School of Health Sciences. Formerly at Idaho State University, Harris has goals in his new position of revitalizing the health physics program, expanding the relationship between Health Sciences and Engineering, developing nuclear nonproliferation and security, and co-leading a large inter-university initiative. Harris's wife, **Maria A. Okuniewski, MS 04, PhD 08,** will be joining Purdue's School of Materials Engineering faculty. Okuniewski previously worked for Idaho National Laboratory.

Steve Weiss, BS 07, MS 08, works for SAP, an enterprise application software company in San Francisco. Weiss is Product Manager of the IMPACT Program, an intensive rotation program focused on enterprise software product development and go-to-market strategies. Weiss earned a Master of Business Administration from Harvard Business School in 2014.

Xiang (Frank) Chen, MS 08 Materials Science and Engineering, PhD 12, is a Research Engineer at ArcelorMittal, the world's leading steel and mining company. Previously, Chen was a postdoctoral research associate at Oak Ridge National Laboratory.

2010s

Ian Percel, BS 08, MS 12 Mathematics, is a Solutions Engineer at Codifyd, which helps e-commerce companies navigate and meet the challenges they face in the digital commerce marketplace. Percel also is an NPRE PhD student.

Carl Rytych, BS 10, MS 13, is a System Engineer for Exelon's Clinton Power Station.

Rabie Abu Saleem, MS 11, PhD 14, is an Assistant Professor at the Jordan University of Science and Technology.

Zachary Kriz, BS 11, MS 15, is an engineer at Exelon Corp.'s Clinton Power Station.

Yinbin Miao, MS 11, PhD 15, is a Postdoctoral Fellow at Argonne National Laboratory.

Cody Morrow, BS 12, is a Quality Assurance engineer for Kapow, a Chicago company that connects companies with venues to book unique client events.

Rijan Shrestha, MS 12, PhD 15, is a Computational Scientist for Intel Corp.

Wenyu Xu, MS 12, PhD 15, is a Unit Process Engineer for IBM.

Molly Bilderback-Ulrich, BS 13, is an independent contractor at H3D, Inc., which offers the world's highest-performance imaging spectrometers. Bilderback-Ulrich earned a master's degree in nuclear engineering in 2014 from the University of Michigan.

George McKenzie, BS 13, MS 14, is a doctoral student in NPRE.

Nivedita A. Vaidya, BS 13, works for Wipro EcoEnergy on its Energy Management Project. The company provides sustainable solutions for energy consumption and management.

Louis Chapdelaine, BS 14, is a graduate student in the University of Wisconsin Department of Nuclear Engineering and Engineering Physics.

Wei-Ying Chen, PhD 14, is a Postdoctoral Fellow at Argonne National Laboratory.

Soonwook Jung, PhD 14, is an Electrical Engineer for Applied Materials.

Jonathan Rolland, BS 14, is a Reactor Engineer at the Exelon Corp. LaSalle Power Station.

Michael Cheng, BS 15, is a graduate student in NPRE.

Mikhail Finko, BS 15, is a graduate student in NPRE.

Eric Gillum, BS 15, is a graduate student in NPRE.

Garrett Gusloff, BS 15, is an Equipment Operator for Exelon Corp.'s Braidwood Power Station.

Ian Haehniein, BS 15, is a graduate student in NPRE.

Aveek Kapat, BS 15, is a graduate student in NPRE.

Christopher Keckler, BS 15, is a graduate student at the University of California-Berkeley.

Timothy Kelly, BS 15, is a Reactor Engineer for Exelon Corp.'s Quad Cities Power Station.

Christopher Kuprianczyk, BS 15, is a graduate student in NPRE.

Xiaochun Lai, MS 15, is a PhD candidate in NPRE.

Jun-Li Lin, MS 15, is a PhD candidate in NPRE.

Sarika Malani, BS 15, a graduate student in the Master's of Engineering Energy Systems program.

Jake McLain, BS 15, is a graduate student in NPRE.

Ian Miller, MS 15, is a nuclear engineer for ENERCON Services, Inc.

April Novak, BS 15, is a graduate student at the University of California-Berkeley.

Peter Ota, BS 15, is a Radiological Control Technician for the Pugent Sound Naval Shipyard.

Jessica Pachicano, BS 15, is a graduate student at the University of Wisconsin-Madison.

Aditya Patel, BS 15, is a Systems Engineer for Exelon Corp.

Nicholas Rivera, BS 15, is a Management Consulting Analyst at Accenture, which deals in management consulting, systems integration and technology, business process outsourcing, and application and infrastructure outsourcing.

Zehuan Song, BS 15, is a graduate student in NPRE.

Molly Sullivan, BS 15, is an associate business consultant for Sapient Global Markets, a consulting firm for capital and commodity market participants, regulators and intermediaries.

Jan Uhlig, BS 15, is a graduate student in NPRE.

Hao Xiong, MS 15, is a Python Developer for Delvv, Inc.

Christian Zircher, BS 15, is a graduate student in NPRE.

DEATHS

Henry T. Sampson, MS 65, PhD 67, the first African American to earn a PhD in nuclear engineering from the University of Illinois at Urbana-Champaign, died June 4, 2015.

Sampson had won the 2009 Engineering at Illinois Alumni Award for Distinguished Service, recognizing his inventions, including the gamma electric cell; his contributions concerning direct conversion of nuclear energy to electricity, rocket propulsion, and computer simulation of electrical systems; and his contributions as a writer and historian in tracing the Black film industry.

Prof. George Miley with his student Henry Sampson in the mid-1960s.

Sampson spent most of his career at Aerospace Corporation in El Segundo, California, working as a project engineer and then as director of planning and operations, Directorate of Space Test Program. He led senior engineering staff in every phase, from planning to launching, and space operation of several satellites. He was a vanguard engineer in examining how to power satellites.

Sampson and NPRE Emeritus Prof. George H. Miley were awarded a patent in 1971 for the invention of the gamma-electric cell, a direct-conversion energy device that converts the energy generated from the radiation of high-energy gamma rays into electricity. Other Sampson patents include a binder system for rocket propellants and explosives and a case-bonding system for cast-composite rocket propellants, both related to the manufacturing and production of solid-propellant rocket motors.

Sampson frequently has been cited as an authority on the contributions of African-Americans in cinema and performing arts in the U.S. His seven books include a two-volume set, "Blacks in Black Face: A Source Book on Early Black Musical Shows" (released in June 2014), and several reference books examining the frequently overlooked contributions of African-Americans in American stage and cinema from the end of the Civil War to the beginning of the radio and TV age.

Scholarship recipients, donors appreciate lessons learned from Roy Axford

"He shared so much collective wisdom with his students that no student in NPRE has ever left Illinois unaffected by the teaching and leadership of Prof. Roy Axford."

That statement, from NPRE alumnus Louis J. Chapdelaine, who won the Axford Scholarship in both 2013 and 2014, reflects the thinking of most NPRE alumni who experienced Professor Axford in the classroom. "Not only did I take his courses for a year, but the entire NPRE curriculum was designed by him and benefited from his incredible wisdom and experience," said Chapdelaine, now a nuclear engineering graduate student at the University of Wisconsin.

NPRE's veteran faculty member will celebrate 50 years on campus in 2016. One way the Department is commemorating that anniversary is by building the Axford Fund endowment to benefit those for whom Professor Axford cared most: his students. Currently, the fund provides scholarships for undergraduate students. Fellowships for graduate students could be a possibility, depending upon the fund's growth.

Alumni and friends are invited to campus April 21 for an official celebration of Professor Axford's accomplishments. *See more details on the back cover.*

Among those who have taken particular interest in the campaign has been alumnus Edward A. McVey, 2015 winner of the NPRE Advocate Award. McVey started a grassroots fund-raising effort among his colleagues and fellow NPRE alumni at Exelon Corp. by offering a match to their individual donations.

"Remember where you came from, how you got there, and who helped you get there," McVey said is a motto by which he lives.

Alumnus Stephen Coggeshall, Chief Analytics and Science Officer for ID Analytics in the San Diego area, also has been generous in supporting the Axford Fund.

"Dr. Axford was an excellent teacher, one of the best I've ever had," Coggeshall said. "He touched many people's lives, providing guidance and inspiration. Dr. Axford gave me very good advice as well as the leeway to discover pathways on my own.

"Recipients of this scholarship should take the time to understand some of Dr. Axford's outstanding traits and qualities," Coggeshall maintained. "He took the time to understand material deeply and he prepared thoroughly. His guidance and example helped shaped me for my career."

Timothy Grunloh, a 2010 Axford Scholarship winner and now a nuclear engineering PhD student at the University of Michigan, said his efforts as a teacher were instructed by Professor

Axford's example. "He once said that he wrote tests as learning experiences rather than contests of the student vs. the teacher, especially because he knew who would win that, with the last part accompanied by a smirk," Grunloh recalled. "When I was writing homework problems for a small class I recently taught, I often thought of this to avoid the trap of trying to prove something about myself, rather than truly contributing to the students' learning."

Lauren (Coutant) Garrison, a 2006 Axford scholarship recipient and now a Weinberg Fellow at Oak Ridge National Laboratory, said that Professor Axford's lessons continue to impact her even though her research interests now focus on fusion materials. "While my day-to-day work does not involve the topics that Dr. Axford taught, his unique style of teaching and deep understanding of the mathematics behind nuclear phenomena are things I will never forget," Garrison said.

See "A Word from Roy Axford," Professor Axford's own recollection of the history of nuclear engineering education, at youtube.com/watch?v=YdN87P-32gc.

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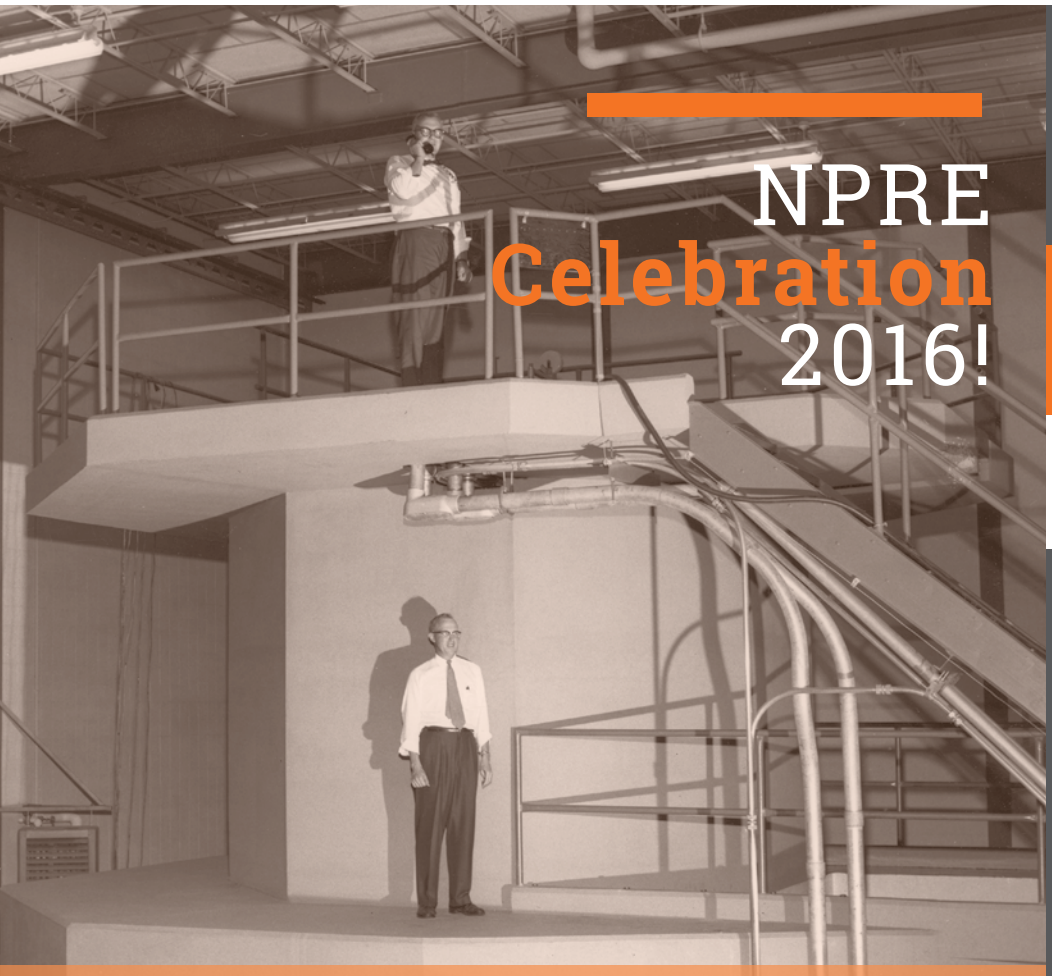

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Mark your calendars now for **April 21–22, 2016,** as the NPRE family celebrates two special events:

The former TRIGA reactor's designation as an ANS National Nuclear Landmark

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The 2016 NPRE/ANS Honors Banquet, the annual venue in which we recognize our excellent students, faculty and alumni, will kickoff the celebration the evening of Thursday, April 21. A dedication for TRIGA and an Open House of NPRE laboratories, including the new HIDRA fusion facility, will take place during the afternoon of Friday, April 22.

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