NPRE ILLINOIS
DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

FALL 2016
NEWSLETTER FOR ALUMNI & FRIENDS

HIDRA *achieves* first plasma

DEPARTMENT OF NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING

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NPRE TEACHERS RANKED AS EXCELLENT BY THEIR STUDENTS

Fall 2015

Richard L. Holm

Magdi Ragheb

David N. Ruzic

James F. Stubbins

Clair J. Sullivan

Rizwan Uddin

Spring 2016

Richard L. Holm

William R. Roy

David N. Ruzic

Rizwan Uddin

A Remarkable Year: honoring the past, celebrating our future!

The past year has been filled with a number of exciting milestones that will unfold as you open these pages. In one eventful week, we celebrated "first plasma" in the landmark startup of HIDRA—the Hybrid Illinois Device for Research and Applications facility—as well as the designation of the Illinois Advanced TRIGA reactor as an ANS Nuclear Historic Landmark.

Department Head James F. Stubbins

At the same time, we recognized our outstanding students and faculty in our annual honors banquet, highlighted by a special tribute to Prof. Roy Axford's 50 years on campus and his tireless dedication to outstanding teaching and research in NPRE. These occasions, which we celebrated in one very action-packed week, culminated from years of hard, outstanding work by our students, faculty and staff. With HIDRA in the background, our newsletter cover illustrates how our students' high level of involvement helps us to achieve these remarkable accomplishments.

We are delighted to welcome two new faculty members this year–Katy Huff and Shiva Abbaszadeh. These new assistant professors bring our faculty numbers to 16–the highest faculty count ever for NPRE! Katy and Shiva will contribute to the diversity of research interests and areas of expertise that our faculty cover. This growth in faculty numbers and diversity has allowed us to attract more graduate students to our program–we are now at 90, up from numbers in the mid-60s only a couple of years ago. With the new faculty, we expect our graduate student enrollment to continue to grow to over 100. With a more diverse faculty, we also have been able to widen our prospects for research support.

Our new Master of Engineering in Energy Systems degree has blossomed in the past year and is growing stronger.

"These occasions, which we celebrated in one very action-packed week, culminated from years of hard, outstanding work by our students, faculty and staff."

With the retirement of Prof. Cliff Singer, the leadership of this program has been passed to Prof. Rizwan Uddin. We continue to attract strong students to Energy Systems as we develop and expand the internal and practicum opportunities.

We continue to build on the suggestions from our 2015 External Review Committee report. We have already made several advances in developing more effective faculty participation in departmental administrative operations, allowing us to restructure several of the undergrad and grad degree requirements. Most importantly, we have reduced the number of required coursework credit hours this year, as well as eliminated the minor requirement. This change better aligns our PhD program with many of our sister nuclear programs and many of the other departments within the College of Engineering. This follows the restructuring of our PhD qualifying examination last year. We continue to work on the effective flow of effort in the Department, while keeping an eye on the excellence of our undergraduate and graduate degree programs.

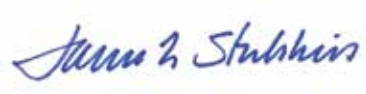
The engineering-based Carle Illinois College of Medicine is moving forward with the naming of King Li from Wake

Forrest as Dean. He plans to concentrate the College's focus on radiology and study of the brain. These areas fit well with the interests and expertise of NPRE faculty in the radiological area, and we look forward to a strong and growing relationship with the new College of Medicine. The development and accreditation of the curriculum is ongoing, and the doors will open to the first class in Fall 2018.

Plans are evolving for NPRE's and the Aerospace Engineering Department's large instructional laboratory remodeling project in Talbot Lab. This project will provide major new laboratory space for both departments, much of which will be dedicated to undergraduate teaching labs. The project calls for a large addition to be constructed onto the southeast area outside the current Talbot Lab building. Formal planning for the layout of this space is underway.

We are very pleased that this also has been an extraordinary year for engaging with our alumni, through programs such as our seminar series, SPEED-Interchange event, and other gatherings. Your contributions to our efforts 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, and we encourage your continued involvement and support. You are always welcome to visit us, meet our new faculty and students, and view our research programs. Your input is vital in maintaining and growing the excellence of our academic program.

Sincerely,



Contents

HIDRA's "First Plasma," first grant, begin new era in NPRE

A new era in the history of Nuclear, Plasma, and Radiological Engineering at Illinois began April 22, 2016, when the HIDRA plasma/fusion facility achieved "first plasma." The joy in NPRE extended into the summer, when the U.S. Department of Energy awarded $1.05 million to support HIDRA's use as a test bed for lithium technology in fusion reactors.

"The College of Engineering, and the Office of the Vice Chancellor for Research put great faith in us, extending the funding to bring HIDRA to the University," said NPRE Prof. David Ruzic, Director of the Center for Plasma-Material Interactions (CPMI) and a key figure in relocating HIDRA from its previous home in Germany. "This grant and others, which we expect in the future, show they made a great decision. Once HIDRA became operational, the fusion community can see its unique utility."

Said NPRE Department Head Jim Stubbins, "HIDRA is the centerpiece in our research portfolio. We were extremely fortunate, through the hard work of our faculty, to acquire a world-class facility that is uniquely qualified to perform plasma-material interaction studies. NPRE has a group of the best scientists in this field and now the world's best facility for their research. Plasma-wall interactions are the major limiting processes that must be solved in order to make magnetic confinement fusion to fruition. With HIDRA and our excellent plasma faculty, we will be at the forefront of providing these solutions."

"First Plasma" Event

A crowd of 100 composed of NPRE faculty, alumni, students and friends of the department filled the CPMI laboratories to witness HIDRA's "first plasma."

The occasion brought much celebration as HIDRA, a combination of a tokamak and a stellarator, contained plasma in a steady state for 50 seconds before the demonstration of the "first plasma" was successfully completed. The audience burst into applause as they viewed the progress on a digital screen, watching the first pink light of the plasma appear and then grow. "This is a great, great day for us," enthused Stubbins at the event.

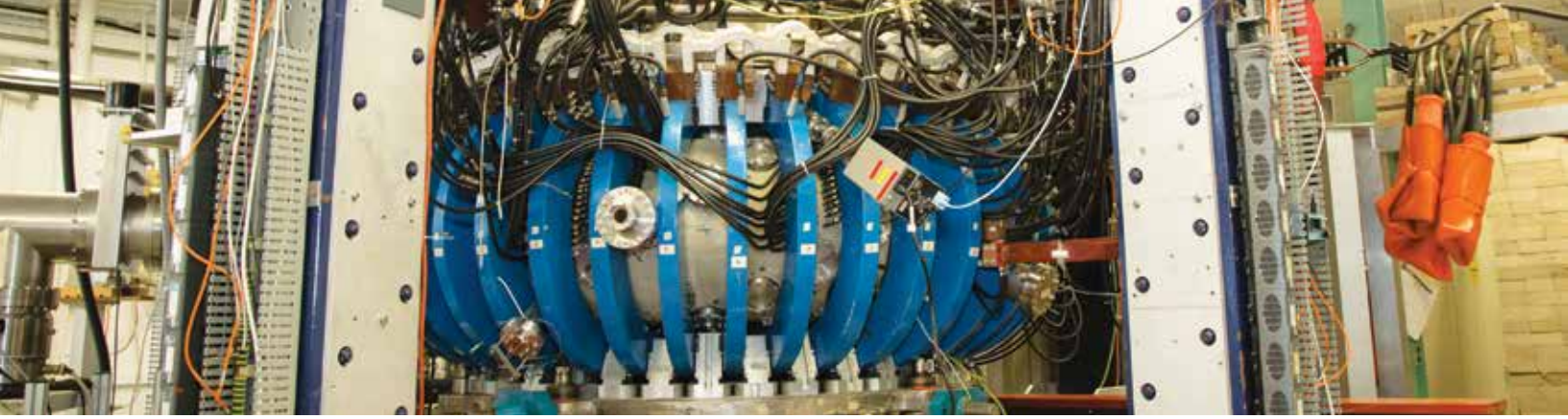
Andreas Cangellaris, Dean of Engineering at Illinois, appreciated the "HIDRA" acronym for the device. In Greek mythology, the Hydra of Lerna had many heads and could regenerate them. Referring to the sprawling machine with its numerous coils and components, the Dean joked, "I can see it has many heads, it has many arms, it has many tentacles."

HIDRA is formally known as the Hybrid Illinois Device for Research and Applications.

Research Prof. Daniel Andruczyk and Prof. David Ruzic

College of Engineering at Illinois Dean Andreas Cangellaris

Department Head Jim Stubbins



Cangellaris marveled at the ability of the Illinois team, headed by Research Assistant Prof. Daniel Andruczyk, in deconstructing HIDRA at its former home at the Max Planck Institute for Plasma Physics (IPP) in Germany, then reconstructing it after many months at the Urbana campus.

Said Ruzic, "Projects like this are only possible because of the phenomenally great students, and postdocs and undergraduates that I have been honored to work with."

Under Andrucyzk's supervision, many students joined in rebuilding the mammoth device. They will continue to learn with it through upcoming research projects as well as through a new course Andrucyzk has developed.

NPRE is one of a handful of U.S. nuclear departments offering such a significant facility for plasma/fusion research and education. Ruzic and his colleagues secured the device upon learning in summer 2013 that the IPP in Griefswald, Germany, wanted to replace it with the construction of the world's biggest stellarator, Wendelstein 7-X, (W7-X) a billion-dollar plasma device for controlled nuclear fusion reaction.

DOE Grant

HIDRA's first grant, from DOE's Office of Fusion Energy Science, will allow CPMI researchers to more readily conduct experiments needed to advance fusion as an energy source. "This fills a critical need for developing lithium technology," Andruczyk said. "HIDRA will be the stepping stone."

Led by Ruzic, CPMI scientists have been working with molten lithium as a plasma-facing component—the components exposed to the plasma inside a fusion reactor's walls. PFCs are needed for the reactor walls to withstand heat damage and hits from fast-moving particles within the plasma without injecting impurities into the plasma.

Previously, the CPMI team had to negotiate time to conduct experiments on large fusion facilities, such as the HT-7 Tokamak reactor in Hefei, China. A complete experiment on the HT-7, which is about twice the size of HIDRA, could take up to six months. The same work might require only a week on HIDRA, Andruczyk maintains. Plus, he said, the large facilities' operators are sometimes hesitant to run untested technology on their machines.

"Having a dedicated machine like HIDRA provides huge opportunities because it means that we can test all the technologies first and find all the problems before we try it on a big machine," he said. "This allows us to be more strategic with the experiments. We will be doing more to try to understand the science behind the plasma.

"HIDRA has a lot of ports that we can dedicate to these material tests," Andruczyk continued. "We can build up the diagnostics not only to know what the plasma is doing, but also to know what the materials and surfaces are doing. We will have cameras to look at what's coming off the surface to see the contaminants."

This is the first large government award for HIDRA since it arrived in Fall 2014 and achieved first plasma in April 2016. The grant is part of a $6 million, three-year project conducted with the Princeton Plasma Physics Laboratory and the Chinese Reactor Experimental Advanced Superconducting Tokamak.

Andruczyk foresees scientists both off and on campus requesting time to use the Hybrid Illinois Device for Research and Applications (HIDRA). "I hope to make HIDRA a user facility and develop a whole capability of testing materials like the way MRL (the College of Engineering at Illinois Materials Research Laboratory) works."

Andruczyk also has created a fundamental plasma course through which students will have hands-on opportunities with HIDRA, and which can involve teachers and members of the Champaign-Urbana community. In addition to helping scientists worldwide advance fusion energy and technology, HIDRA will help develop human capital and bolster NPRE's educational mission.

For more information on HIDRA and its operations and capabilities, please contact Daniel Andruczyk at andruczy@illinois.edu or by calling 217-333-1750.

NPRE faculty establish new laboratory facilities

New laboratory facilities are expanding NPRE's research capabilities in plasma-material interactions with implications for fusion reactors and bioengineering, as well as in fission nuclear power studies.

Ion-Gas-Neutral Interaction with Surfaces (IGNIS)

Led by Associate Prof. Jean Paul Allain, the Radiation Surface Science and Engineering Laboratory (RSSEL), located in the Micro and Nanotechnology Laboratory on the Engineering campus, has developed a novel *in-situ* experimental and characterization facility, IGNIS. IGNIS, Latin for *fire* and standing for Ion-Gas-Neutral Interaction with Surfaces, allows the investigation of materials while changing their properties with different excitation sources.

IGNIS is equipped with varying excitation and analysis tools. Currently, this includes ion sources for modification and characterization via Low Energy Ion Scattering and Direct Recoil Spectroscopy, in addition to a high pressure X-ray source to examine the samples with X-ray Photoelectron Spectroscopy. All these techniques make use of a near ambient pressure hemispherical energy analyzer that allows the RSSEL group to perform these techniques at pressures as high as 20mTorr, an improvement of five orders of magnitude compared with traditional measurements. Surfaces can also be modified via ion irradiation, deposition of materials, and heating of substrates.

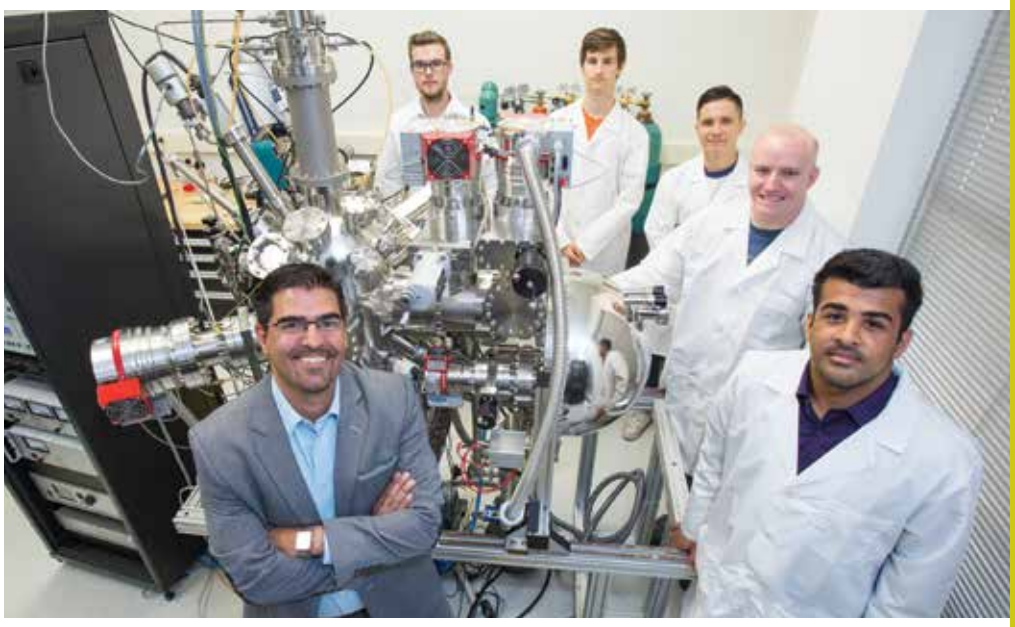
With this facility, RSSEL is taking a novel approach to examine the interaction of surfaces with plasmas, by exposing surfaces to plasmas and energetic particles at ultra-high vacuum conditions, as well as near-ambient pressures while simultaneously conducting surface analysis. The ability to perform experiments and analysis at near-ambient pressures greatly expands the conditions at which the experiments can be run, and allows RSSEL to investigate materials such as biological and catalytic materials.

The ability to conduct surface modifications and analysis in parallel provides the researchers with a unique opportunity of documenting, in real-time, the complex dynamics of Plasma Surface Interactions, allowing the group to unravel the fundamental mechanisms behind nano-structuring phenomena.

The IGNIS facility allows the study of materials used in the various fields in which RSSEL operates. This includes development of materials for nuclear fusion reactor walls, modification of surfaces to improve their bio-compatibility and tailoring the morphology of surfaces with Direct Irradiation Synthesis to provide them with new and unique properties.

Multiphase Thermo-fluid Dynamics Laboratory

Specialized experimental facilities for studying fundamental multiphase flow and system level thermal hydraulics in



Associate Prof. J.P. Allain and his research group

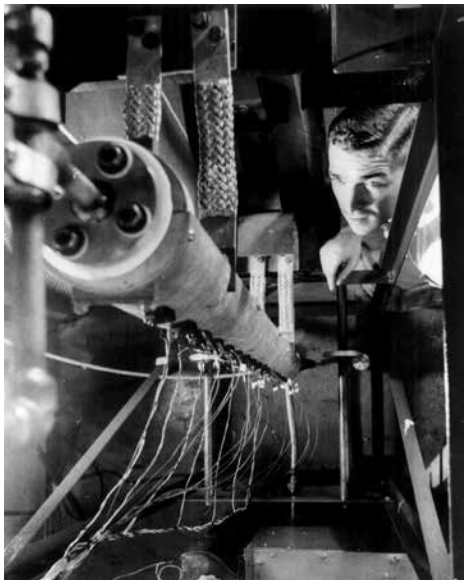
nuclear reactors make up the Multiphase Thermo-fluid Dynamics Laboratory that Assistant Prof. Caleb Brooks has established.

Ongoing fundamental experimental studies with these facilities include wall nucleation, critical heat flux, two-phase mixture transport in adiabatic and phase change flows, natural circulation, thermal hydraulic instability, turbulence in multiphase flow, and bubble dynamics.

"For example, recent ongoing experiments are investigating surface modification through laser texturing for improved boiling heat transfer and higher critical heat flux," Brooks said.

The new facilities, located in the basement of Talbot Laboratory, utilize advanced instrumentation including Laser Doppler Velocimetry (LDA), Particle Image Velocimetry (PIV), local conductivity sensors, and high-speed imaging.

In addition to gaining fundamental understanding of complex heat transfer and fluid flow phenomena, the laboratory aims to provide data necessary for validation of advanced computational tools. Data needs for Computational Fluid Dynamics (CFD) codes and system-level thermal hydraulics codes are targeted with the existing facilities.



The photo on the left is of a young Barclay Jones (now NPRE emeritus professor) in his graduate student days in the 1960s conducting a boiling heat transfer experiment. The photo on the right is of current Assistant Prof. Caleb Brooks in his newly established Multiphase Thermo-fluid Dynamics Laboratory. The lab is equipped with facilities to simulate a reactor channel under natural circulation cooling.

Currently the U.S. Department of Energy (DOE) is funding a project to use one existing facility to simulate natural circulation conditions in nuclear systems for validation of the new nuclear system analysis code, REALP7.

The facility used for these experiments has a nearly 5 meter tall annulus channel, scaled based on a reactor subassembly, with 3 meters of heat length and the remaining 2 meters of unheated length. A high-powered heater used as the inner wall of the annular channel supplies the heated length.

"With this facility boiling, condensing, and flashing, two-phase flow can be studied under forced-convection and natural circulation conditions prototypic of nuclear reactor systems under accident conditions," Brooks said.

TALBOT LABORATORY ADDITION TO INCLUDE NPRE INSTRUCTIONAL LAB SPACE

The first of the addition's three floors will be used to house two instructional laboratories for NPRE—one for materials and the other for radiation measurements.

The other two floors will hold laboratories for Aerospace Engineering, which shares the Talbot Laboratory building with NPRE. The basement will hold a composite manufacturing laboratory, and a nanosatellites laboratory will be located on the second floor.

Construction is projected to start in Summer 2017 and be completed within a year's time.

The proposed addition to Talbot Laboratory

2016 NPRE Leadership Speaker Series—"Nuclear Power: What it means in Illinois"

Speaking at this NPRE-sponsored informational forum and in light of a plan to close two nuclear generating plants in Illinois, a host of state and national policy leaders including Congresswoman Cherri Bustos advocated for nuclear energy.

Exelon Corporation has filed intent to close reactors at the Quad Cities and Clinton nuclear generating stations in western Illinois and central Illinois, respectively. Warning of job and tax base losses sustained from closures, many of the speakers extolled nuclear energy as a reliable energy source that is environmentally friendly, with zero carbon emissions.

Representing the Illinois 17th Congressional District that includes the Quad Cities, Bustos pointed out closures of the two plants would cost 4,300 direct jobs and have a negative financial impact of $1.2 billion. Bustos pressed upon Illinois Gov. Bruce Rauner and leaders of the state House and Senate to pass legislation to protect the plants. "We have until about December to make some kind of decision," she said.

Lonnie Stephenson, International President of the 750,000-member International Brotherhood of Electrical Workers, maintained nuclear energy must be part of a sustainable future. "Nuclear power is so vital," he said. "We can't as a nation keep our energy grid secure and online while reducing our carbon footprint without nuclear."

The federal government is supportive of nuclear energy's role, as well, said John Kotek, Acting Assistant Secretary for the U.S. Department of Energy Office of Nuclear Energy. "President Obama and (DOE) Secretary (Ernest) Moniz have made clear that nuclear energy is an important part of America's clean energy strategy, helping to provide dependable and affordable energy while reducing our carbon emissions."

Kotek's 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.

Cherri Bustos, Lonnie Stephenson, and John Kotek at 2016 NPRE Leadership Speaker Series event

continued on page 24

UPCOMING EVENTS

- **Fall 2016 graduation** | December 17, 2016
- **NPRE/ANS Student Chapter Honors Banquet** | April 13, 2017
- **Spring 2017 graduation** | May 13, 2017
- **Industrial Radiation and Radioisotope Measurement Applications-10 (IRRMA-10) conference** | General Chair, NPRE Assistant Prof. Clair Sullivan } Chicago, IL | July 9–13, 2017

SPEED INTERCHANGE

NPRE invites alumni and friends to take an active role in shaping our students' careers by joining us for the Student Professional Excellence in Engineering Development (SPEED) Interchange program.

SPEED-Interchange provides a wonderful venue for you to get to know NPRE students, and for them to get to know you and your company. NPRE encourages you to learn how you can get involved by contacting Becky Meline, Coordinator of Academic Programs, at bmeline@illinois.edu or by calling 217-333-3598.

New assistant professors expand NPRE's offerings; grow women faculty percentage

With the addition of two new assistant professors, NPRE at Illinois expands its research investigations as well as its representation of women on the faculty.

Kathryn D. Huff, a computational nuclear reactor physicist, joined NPRE for the Fall 2016 semester. Shiva Abbaszadeh, an expert in developing new technology for biomedical imaging instrumentation, will join the department in January. The two new hires grow to 25 percent the ratio of women faculty in the department, a proportion that has been accomplished since 2012 when Clair J. Sullivan became NPRE's first female professor.

To help Huff and Abbaszadeh begin their programs, the U.S. Nuclear Regulatory Commission has provided NPRE with $450,000 over three years. NPRE will match the funding with $150,000 over the same period.

"We are extremely fortunate to have attracted two new, highly talented faculty members," said NPRE Department Head Jim Stubbins. "In the stories below, you will be impressed by how much they have already accomplished and the new opportunities for teaching and research they bring to the department. We are pleased to have them join our excellent group of new faculty members; they bring the total to nine new faculty members in the past five years, and they also bring an even broader diversity to our faculty."

Kathryn D. Huff

World-class computational facilities and the strategic hiring of several other young NPRE faculty drew Huff to begin her academic career at Illinois.

"The computational research here with (the National Center for Supercomputing Applications) is a really good complement to the nuclear department," said Huff, who also will have access to the Blue Waters computing facility.

"And NPRE has attracted so many young and vibrant faculty," she continued. "That really bodes well for the future and gives me the confidence that the department is going to be strong for quite a while.

Huff most recently has been working as a postdoctoral scholar and data science fellow in the Nuclear Science and Security Consortium and Berkeley Institute for Data Science at the University of California-Berkeley. Her focus has been on the scientific pursuit of a safe, emissions-free, sustainable, high-output energy source. Particularly, she is interested in the promise of a closed nuclear fuel cycle, nuclear repository performance, and investigations of safety.

After earning her undergraduate degree in physics at the University of

Kathryn D. Huff

Shiva Abbaszadeh

Chicago, Huff went to the University of Wisconsin-Madison to earn her PhD. She worked with Prof. Paul Wilson to create the Cyclus project, a next-generation agent-based fuel cycle simulator that provides flexibility to users and developers through a dynamic resource exchange solver and plug-in, user-developed agent framework.

In NPRE, Huff plans to work on research questions across a range of challenges including nuclear fuel cycle technology strategy, energy policy, repository safety, and reactor physics. Her research will involve modeling and simulating both the nuclear fuel cycle and advanced reactor designs. Andrei Rykhlevskii, a new NPRE graduate student, and postdoctoral research associate Alex Lindsay, most recently from North Carolina State University, will join Huff in her research on advanced reactor physics simulation.

Additionally, Huff and her colleague, Anthony Scopatz, an assistant professor at the University of South Carolina, will split a three-year, $800,000 grant from the U.S. Department of Energy Nuclear

Energy University Program that will bring machine learning improvements to fuel cycle system analysis. The objective, Huff said, "is to predictively manage simulation of future deployment of reactor and fuel cycle technologies."

Huff also is teaching in Fall 2016, and has goals for revamping NPRE 412 Nuclear Power Economics and Fuel Management. She further plans to be active with the American Nuclear Society Student Chapter at Illinois.

Shiva Abbaszadeh

Abbaszadeh's research will be in developing state-of-the-art imaging technology to provide necessary tools to visualize and detect cancer at the molecular level, and further understanding of disease mechanisms.

Currently a Fellow in the Stanford Molecular Imaging Scholars Program, Abbaszadeh uses signal processing and quantitative characterizations to understand the biological processes of diseases. She works with positron emission tomography (PET), a functional imaging technique, to observe metabolic processes in the body.

Abbaszadeh's addition to NPRE will expand the department's efforts in radiological and medical application technologies of nuclear engineering. "This fits very well with the founding of the University of Illinois engineering-based College of Medicine," said Stubbins.

Abbaszadeh foresees working with Associate Prof. Ling-Jian Meng, who leads the Radiation Detection and Imaging group in developing advanced techniques and instrumentation to tackle medical issues such as diabetes, brain cancer, cardiac diseases, and neurodegenerative diseases. Meng joined NPRE in 2006.

Abbaszadeh also believes a collaboration with NPRE Associate Prof. J.P. Allain holds promise. Allain is an affiliate faculty member of Bioengineering at Illinois and, among other research interests, works with advanced nanostructured biointerfaces for regenerative medicine.

Abbaszadeh did her undergraduate and master's degree work in Iran before moving to Canada for her PhD. As a doctoral student at the University of Waterloo, she worked on developing solid-state avalanche indirect X-ray detectors and a high-resolution amorphous selenium direct X-ray detector using a CMOS active pixel sensor. This detector currently is being investigated for commercialization. The technology Abbaszadeh developed has contributed to a startup company that develops a low-cost, high-resolution X-ray imager to detect lung disease in developing nations.

After earning her PhD in electrical engineering in 2014, Abbaszadeh worked at Stanford developing an advanced PET system dedicated to small animal imaging, and investigating a new semiconductor detector material for enhancing PET performance.

AXFORD, UDDIN, TEACHERS OF THE YEAR; MELINE, STAFF OF THE YEAR

The American Nuclear Society at Illinois student chapter has recognized veteran Profs. Roy Axford and Rizwan Uddin as the 2016 Teachers of the Year, and Becky Meline as Staff Member of the Year.

Axford completed his 50th year of teaching in NPRE this year, and was paid tribute by former and current students and colleagues during the 2016 NPRE/ANS Honors Banquet. Throughout his career, Axford has been recognized with every NPRE departmental, College of Engineering and University of Illinois campus award for his teaching excellence.

Uddin also has been well recognized for his teaching abilities. He has won the NPRE Teacher of the Year Award over 10 times. Nationally, his teaching acumen has been recognized with the 2015 American Society for Engineering Education Glenn Murphy Award and the 2016 American Nuclear Society Arthur Holly Compton Award.

Roy Axford and Rizwan Uddin

Becky Meline

Meline, NPRE's Coordinator of Academic Programs, is the department's chief liaison to the students and has been recognized many times with the Engineering Council Excellence in Advising Award.

$1.1M DOE grant supports Allain group research in novel adaptive and self-healing materials for fusion energy

The use of nuclear fusion as an energy-producing alternative may become more feasible with Associate Prof. J.P. Allain's work in advancing adaptive and self-healing materials.

"One of the challenges for fusion is materials," said Allain, who has been awarded a $1.1 million Fusion Energy Sciences grant from the U.S. Department of Energy to support his team's research. "In fusion, radiation and plasma damages the materials used to build the machines. We're looking for materials that can withstand the damage and tolerate the irradiation; they need to be adaptive to extreme environments."

In this project, Allain focuses primarily on plasma-material interactions that involve the first few microns of the material surface.

His group has been working with materials that have either adaptive and/or self-healing properties. The performance of adaptive materials exposed to a defined extreme environment is either maintained or improved as the materials adapt to that particular environment—in this case, fusion plasma. Upon being damaged, self-healing materials can freely repair themselves without any external influence.

Allain's group has been pioneering this work discovering adaptive materials capable of sustaining the far-from-equilibrium conditions found in thermonuclear reactors. These materials include: nanoporous and mesoporous tungsten composites, extreme-refined doped refractory alloys, and self-healing nanocomposite W-Li pseudo-alloys.

Allain's group also is processing self-healing materials by combining porous solids with liquid metals. "We deal strictly with the surfaces and interfaces of the material, tailoring the surface in a way that it becomes radiation resistant," he said.

Porous materials Allain is designing in bioengineering applications motivates some of the work. Porous materials such as magnesium and titanium can become bioactive when irradiated. The biomimetic self-healing and adaptive properties he studies are adopted in fusion materials applications across the nano and meso scales.

This is the first time this type of work has been done with porous materials including metal sponges and foams. In addition to processing the materials, Allain's group examines results through high-heat flux testing and in-situ characterization to decipher the

dynamic material properties as they evolve during plasma exposure. The researchers also construct multi-scale computational modeling of the plasma-material interfaces.

Allain's students, Hanna Schamis and Felipe Bedoya, spent the summer at Princeton Plasma Physics Laboratory experimenting with various materials.

According to the *PPPL Weekly* newsletter, Schamis' research focused on an alloy of molybdenum (TZM), a substance that will be used to line the fusion reactor divertor, a part of the machine that collects heat and particles from the plasma. Schamis used a device called the Material Analysis and Particle Probe (MAPP) to conduct her experiment and analyze results. MAPP inserts samples of plasma into the machine during experiments. The samples can then be retracted into a vacuum chamber that is part of MAPP. This chamber is fitted with an apparatus for X-ray photoelectron spectroscopy (XPS). X-rays shot at the sample perform XPS and measure the energies of the electrons the elements emit on the surface. This allowed Schamis to analyze over time the plasma's effect on the TZM's chemical composition.

The TZM samples exposed to plasma were first coated with boron in a process called "boronization." The process prevents oxygen, which is an impurity in the tokomak's graphite walls, from entering the plasma and cooling it. Schamis found boronization worked for TZM as well, and succeeded in binding the oxygen to the sample's surface. But as with graphite, the boron wore off with plasma exposure over time.

While Schamis analyzed the TZM sample, Bedoya investigated the effects of boronization and exposure to the plasma on a graphite sample.

Also in Allain's group are graduate students Aveek Kapat, Anton Neff and Eric Lang.

"The development and testing of new materials for fusion energy is a very complex process," Allain contends. "It takes more than a single institution to make this happen and this is why we have established very strong collaborations worldwide."

"The development and testing of new materials for fusion energy is a very complex process. It takes more than a single institution to make this happen and this is why we have established very strong collaborations worldwide."

The group's international collaborations have included work with Prof. Eduardo Saiz from the Department of Materials at Imperial College London, and self-healing systems consisting of advanced metallic alloy (i.e. Fe-Au systems) nanocomposites synthesized by Sybrand van der Zwaag's group at the Delft University of Technology.

For high-heat flux testing, collaborations with the FOM Dutch Institute for Fundamental Fusion Energy Research (DIFFER) in Eindhoven will use the Magnum-PSI linear plasma device. Unique throughout the world, this device simulates conditions expected in future energy-producing fusion reactors. Allain has a long history with FOM-DIFFER, including exchange visits of his students over the past few years.

Due to the nature of self-healing and adaptive materials being strongly coupled to their environment, in-situ characterization is critical. Allain has developed a state-of-the art facility in the Micro and Nanotechnology Lab (MNTL) known as IGNIS (Ion-gas-neutral Interaction with Surfaces). IGNIS is capable of observing the surface composition and morphology in-situ during particle irradiation under conditions mimicking the nuclear fusion plasma edge.

In addition to using the in-situ IGNIS facility Allain's group has developed at Illinois, the group has collaborated significantly with Stephen Donnelly's group at the University of Huddersfield in using their MIAMI device, an in-situ irradiation TEM. Work on additional in-situ facilities has been planned with Sandia's new ion-beam facilities in collaboration with Dr. Khalid Hattar, an alumnus of Materials Science and Engineering at Illinois.

Allain also will be working closely with NPRE Prof. James Stubbins, a co-principal investigator on the project, to understand thermo-mechanical properties of these complex materials.

To enhance the understanding of both the processing and performance of the proposed adaptive and self-healing materials systems, experimental research will be closely coupled to on-going efforts in multi-scale computational modeling with Prof. Brian Wirth at the University of Tennessee Knoxville (UTK).

Allain selected as Faculty Entrepreneurial Fellow to innovate bioactive interfaces

The College of Engineering at Illinois chose Associate Prof. J.P. Allain, for the Faculty Entrepreneurial Fellows program this fall.

The program allows faculty to rotate out of the classroom and other service to the university for at least a year to focus on taking a developing technology and evaluating its commercial potential. Fellows direct students in conducting experiments, building prototypes, visiting potential customers, studying the market, conducting proof-of-concept research, and growing entrepreneurial opportunities.

The course teaches students commercialization of plasma technology to improve biomedical implants. Several engineering students will learn what it takes to form a startup company when they go through the process of developing and commercializing plasma technology that Allain, an associate professor, has in mind for improving orthopedic, dental and spinal cord implants.

Allain and three graduate students will mentor the seven undergraduates who will divide into teams to build the prototype and conduct customer discovery and market research. “We need to gain an understanding of the value chain around bioactive interfaces,” he said. “It’s the innovation that we’re trying to accelerate.”

The prototype team will build a plasma source that can interface and modify the surface of biological implants. “We induce nanopatterning and nanostructuring to implant interfaces such as dental implants, prosthetics and orthopedics,” Allain said. “If a hip is fractured, that device may not adhere very well and can be extremely painful to the patient. It’s better to integrate it to the bone.

“The gap that we’re addressing is being able to apply 3D geometry to modify surfaces that are complex. We can change a single source surface to provide different functions.”

A plasma source can make varying modifications to separate regions of a material so that each region carries out a specific job, or the source can separately modify differing materials used on the same implant.

One of the teams in Allain’s course will focus on dental implants. “One of the biggest challenges is to innovate the surface without changing the chemistry,” Allain said. “We need to have a physical interface at the nanoscale so that (the implant) integrates with bone and can work with antibacterial surfaces.”

Another team will build their work around implants for prosthetics and orthopedics. “We will work with neurosurgeons that are experts in spinal cord injury and with people who are working with maxi facial implants,” Allain said.

J.P. Allain

University of Chicago Booth School of Business MBA students will advise the teams on marketing strategy. “The MBA students can provide methodology and tools for how to study this and what to look for,” Allain said. “Even with the best implant, we won’t be able to enter the market until we understand how to price (the product), and the impact of competition.”

Allain’s fourth team will examine the commercialization possibilities the technology may have for other disciplines, including energy, tooling and aerospace industries.

Allain formed his own startup company in 2012 based on technology he had developed, and is eager to pass that knowledge on to students. “I’m passionate about innovation,” he said. “I think when I looked at the work that was coming out of my research lab, I didn’t want that work to just end up in journal papers. I wanted what we were advancing to impact people.”

NIH awards Meng $2.4 Million to develop combined nuclear/ MR imaging system

The National Institutes of Health has awarded $2.4 million to support Associate Prof. Ling-Jian Meng in developing the MRC-SPECT-II system, an advanced nuclear/MR multi-modality imaging system for *in vivo* imaging of therapeutically-engineered neural stem cells (NSC) in mouse brain.

"We are quite proud that this award not only came through a stiff competition, but also arrived with the highest possible review score of the top 1 percent from the review panel, in recognition of our outstanding progress in developing several enabling technologies and the potential impact of this project to the field of radiological imaging" Meng said.

"In this project, we are going to apply the latest semiconductor technology and a unique artificial compound eye gamma camera design to construct a (single-photon emission computed tomography) SPECT system that could offer a nice balance between imaging resolution, sensitivity, and the ability of acquiring both functional and morphological information of the object – a combination unmatched by any other existing imaging technique." Meng said. "With this promising imaging technique, we will be able to visualize a small number (a few hundred) of NSCs moving across brain tissues and re-distributing around brain tumors within living mouse at a very high spatial resolution (of <250um). This imaging capability could provide invaluable insights for understanding the fate and migration of neural stem cells in the brain."

Meng and his team will collaborate with Dr. Chin-Tu Chen's group at the University of Chicago and Prof. Michael Lesniak's group at Northwestern University to use the MRC-SPECT-II system to characterize the efficacy of stem cell therapy for treating glioblastoma multiform (GBM), one of the most aggressive forms of brain cancer.

Prior to this latest award, the National Institute of Biomedical Imaging and Bioengineering (NIBIB) has also supported several other projects of Meng's group in developing semiconductor X-ray and gamma ray imaging sensors and instrumentations for X-ray fluorescence computed tomography (XFCT), X-ray luminescence computed tomography (XLCT), positron emission tomography (PET), and SPECT.

"While the scope of this project is to develop the MRC-SPECT-II system, the resultant imaging system would be an important building block for our long-term effort to establish a unique integrative imaging platform that utilizes a broad range of electromagnetic (EM) radiation, including radiofrequency, UV, visible and IR, X-ray and gamma ray, to facilitate different image contrast mechanisms." Meng said. "This would allow researchers to visualize various physical, chemical, and physiological processes that are spatially, temporally, functionally entangled in complex organisms. The development of this integrative imaging approach would open the door for simultaneous multi-dimensional, multi-functional assessment of various disease models and therapeutic approaches in living animals and in patients."

Associate Prof. Ling-Jian Meng and his research group.

NPRE researchers to validate computer coding for nuclear power plant operations

NPRE researchers will collaborate in experiments and simulations to validate new computational tools the U.S. Department of Energy has developed for nuclear power plant design and safety analysis.

Caleb Brooks

Tomasz Kozlowski

"As design processes improve, so must simulation results."

Assistant Profs. Caleb Brooks and Tomasz Kozlowski will work with NPRE alumni, Ling Zou, a scientist at Idaho National Laboratory (INL), and Brian Golchert of Westinghouse Electric Co., on the $800,000, three-year project.

Simulating nuclear reactor systems is complicated because of the wide range of system conditions and associated physics. Also, codes must take into account regulatory demands in justifying safe operations and shutdowns of nuclear power plants. The challenges create a need for a considerable amount of validation data under varying conditions and configurations.

"As design processes improve, so must simulation results," Kozlowski said. "We need new high fidelity core simulators for accurate prediction of new and innovative nuclear reactors. The new codes require extensive verification, validation and uncertainty quantification effort. Verification is done by the INL team as part of development. Validation is a much bigger effort that requires new experimental data that's consistent with the fidelity level of the simulator being validated."

Brooks will conduct experiments and produce data using his newly established Multiphase Thermo-fluid Dynamics Laboratory, housed on campus in Talbot Laboratory. Kozlowski will run the simulations. "Validation is the process of comparing of the experimental data with the simulation results," Brooks said.

"We have a new facility that can simulate a reactor channel under natural circulation cooling," Brooks said of the new lab. "(The facility) is equipped with detailed instrumentation for measuring the heat transfer and fluid flow required for a comprehensive code validation."

MOHAGHEGH HONORED WITH 2016 ENGINEERING COUNCIL AWARD FOR EXCELLENCE IN ADVISING

Zahra Mohaghegh

Assistant Professor Zahra Mohaghegh has received the 2016 Engineering Council Award for Excellence in Advising. Given to the top 10 percent of engineering advisors, the award recognizes the important role their work plays in the academic planning process of engineering students.

Mohaghegh directs the Socio-Technical Risk Analysis (SoTeRiA) Laboratory in NPRE. She and her research team advance Probabilistic Risk Assessment (PRA) for nuclear power plants and other high-consequence industries.

Axford Tribute: "Mighty Fine"

In a touching tribute, students, alumni, and colleagues feted Prof. Roy A. Axford on his accomplishment of 50 years of teaching at the University of Illinois at Urbana-Champaign.

"Mighty fine," was Axford's "old Texan" thank you for the outpouring of affection during the 2016 Honors Banquet of NPRE and the American Nuclear Society at Illinois student chapter. Several former students expressed their gratitude for Axford while celebrating student, faculty and alumni excellence at the April 21 occasion.

Among the many highlights in the Axford celebration was the ceremonial presentation of a $42,000 check from Exelon Corporation and many of its employees to support the Axford Fellowship Fund. The amount represented gifts from the company as well as donations to match gifts from Exelon employees.

Exelon representatives Ed McVey and Bruce Rash made the presentation. Said McVey, "The check represents more than just the $42,000 that's there. It represents the money, the thoughts and admiration and respect that your students that are working at Exelon right now have for you. You showed us what it means to be devoted to a profession and to the people that you work with."

Said 2016 NPRE Distinguished Alumni Award winner Steve Coggeshall, "I want to thank Dr. Axford for the complex stuff that he taught me, and letting me make my own mistakes." Having presented a special seminar, "So You Want to be a Data Scientist," to a packed university audience earlier in the day, Coggeshall, Chief Analytics and Science Officer at ID Analytics, credited his understanding of Lie group techniques to Axford's instruction. Also appreciated was the professor's encouragement as Coggeshall pursued a music degree at the same time he earned his NPRE PhD.

Both Coggeshall and Bill Myers, NPRE 2016 Advocate Award winner, brought along slides of equations Axford taught them. "I still go back to all these notes from all those classes from time to time," said Myers, Deputy Group Leader for the Advanced Nuclear Technology Group at Los Alamos National Laboratory. "Just this week I was using some of these same equations you see on this sheet to put together a talk."

Alumnus Scott Ramsey, who earned his PhD in 2009, told about the reason he had for pursuing graduate school at the same university where he earned his bachelor's degree. "I knew that I wanted to work for the best, and that's Roy Axford," Ramsey said.

As a researcher at Los Alamos, Ramsey spoke of the national lab's "Axford Mafia," a group of several former Axford students who have made substantial contributions to nuclear science over the years. In introducing a video in which several of them offered thanks for Axford's influence, Ramsey said, "Above all else we have this reputation for penetrating insight and an unflinching fearlessness with regards to technical rigor. These are qualities that we inherited from Professor Axford."

Also offering congratulations were alumni Mindy Bogart and Dr. William Croisant, and Axford's colleagues, NPRE Emeritus Profs. Barclay Jones and George Miley.

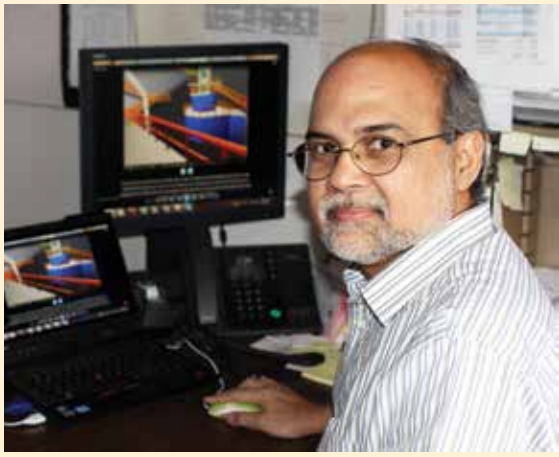
Axford concluded the celebration with a few words of his own. Thanking Anne Axford, his wife of 62 years, and his NPRE colleagues, the professor said. "A long journey can't be made without the help and support of a lot of people."

As the first person to have earned a doctoral degree in nuclear engineering from Massachusetts Institute of Technology (1958), Axford taught at both Texas A&M University and Northwestern University before coming to the University of Illinois in 1966.

Axford was instrumental in developing NPRE's curriculum, and served many years as a consultant to Los Alamos National Laboratory.

Uddin chosen to direct Energy Systems MEng degree, EaSE Council

NPRE Prof. Rizwan Uddin became Director of the Master of Engineering in Energy Systems Program and of the Energy and Sustainability Engineering (EaSE) Council early this summer.



Rizwan Uddin

Uddin will continue leading the programs that NPRE Emeritus Prof. Cliff Singer and Materials Science and Engineering Prof. John Abelson had initially established within the College of Engineering. Administered by NPRE, the Energy Systems master's degree program began accepting graduate students in Fall 2014, and a total of eight students have graduated in its first year (Fall and Spring graduations).

"This is a program in its infancy, but we see significant potential and room for growth."

The degree addresses a need for education and training in the areas of energy and sustainability engineering to fulfill the demands of the global workforce. The Master of Engineering in Energy Systems degree provides a broad interdisciplinary education in energy systems for a variety of students who will find such a background useful in the pursuit of their career goals.

The Energy Systems degree arose from the EaSE graduate certificate option that the College began offering in January 2010. The option was designed to provide graduate students with a background in a core engineering discipline combined with an understanding of energy and sustainability challenges.

The EaSE initiative's goals have been to promote interdisciplinary research joining fields of science, engineering, environment and policy; educate and train the global workforce; engage industrial partners; and link the College of Engineering efforts to complementary programs on the Illinois campus.

"This is a program in its infancy, but we see significant potential and room for growth," Uddin said. "We hope to build on an excellent start and plan to add new options for our students."

In addition to his new duties, Uddin serves as a Faculty Affiliate of the campus Institute for Sustainability, Energy and Environment (iSEE) since Fall 2015. He serves on iSEE's steering committee, launched in 2013 with a goal of providing an umbrella to research, education, and outreach activities in the areas of energy, environment and sustainability. The Institute was created to lead an interdisciplinary approach to researching solutions for the world's pressing sustainability, energy and environmental needs for today and tomorrow.

Taber Scholars find flexibility in designing their Energy Systems programs

Energy Systems students selected for the first Taber International Scholarships are focusing on a diverse set of energy studies.

John Flanagan and Anthony Ekeopara

One is comparing benefits of electrically-powered vehicles to those running on biofuel. Another wants to determine how solar and wind systems can power rural communities while reducing carbon emissions. A third is excited to explore all technologies in producing clean energy.

Anthony Ekeopara of Nigeria and John Flanagan of Wheeling, Illinois, were chosen this spring as the 2015-16 Taber Scholars. Kevin Kubis of Chicago, Illinois, was more recently chosen as the 2016-17 scholar.

Anthony Ekeopara

Ekeopara came to Illinois in August 2015 having earned a bachelor's degree in electrical engineering two years earlier from Covenant University, Ota, Ogun State. He worked for the Transmission Company of Nigeria for a year as a field engineer on high voltage electric transmission and equipment maintenance. Wanting to acquire theoretical and practical experience about renewable energy production, integration, and transmission, he searched the web to locate a master's degree program.

Considering those at Purdue and Illinois, he picked the latter because of its flexibility. "(Energy Systems) allowed me to choose my program based on my interest," Ekeopara explained.

Students of Energy Systems, administered within the College by the Nuclear, Plasma, and Radiological Engineering Department, complete a project or internship in addition to coursework.

Ekeopara is conducting a life-cycle analysis comparison of vehicles that run on biofuels to plug-in battery-powered vehicles running on electricity from a variety of sources, including off-peak nuclear power, solar, wind, natural gas, and coal. "Most families charge their cars at night, and nuclear power plants have a constant power supply. I'm trying to see if that tradeoff is more environmentally and economically beneficial than biofuels."

Nuclear waste storage will be one of the issues Ekeopara will consider in examining the comparison.

With plans to graduate in December, Ekeopara hopes to gain practical experience in the field, and contribute to innovation in renewable energy production, grid integration and grid reliability. Long range, he would like to return to his homeland equipped with knowledge that will benefit his country. "In Nigeria, there is not sufficient

Kevin Kubis

innovation; there is a 7.5 percent loss in electricity in transmission," he said. "My gaining some practical knowledge and experience might help with that."

John Flanagan

A work trip to Africa also inspired Flanagan to pursue the degree in Energy Systems. He had earned bachelor's degrees in mathematics and French in 2008 from Loyola University, and then went to work for Pearson Education.

"I noticed that the people had limited access to electricity. It got me to think about energy and its relation to the quality of life. I had been studying renewables independently for about a year, and it felt like this was a good thing for me to be pursuing."

"I worked in their North American Higher Education Mathematics Software Development Division. I developed assessment software for higher education math classrooms," he said. "While there (in March 2015), I was in an impoverished area south of Cape Town. I noticed that the people had limited access to electricity. It got me to think about energy and its relation to the quality of life. I had been studying renewables independently for about a year, and it felt like this was a good thing for me to be pursuing."

Flanagan spent the summer working for Saha Global and installing solar charging stations in rural areas in Ghana. Native female entrepreneurs own the stations. "This empowers women to be in business and provides access to electricity," Flanagan said.

"During my summer in Ghana I witnessed how a successful non-profit brings solar energy solutions to areas where energy poverty is high," he said. "I learned the dynamics and scope of non-profit work including how an enterprise identifies and embeds itself inside a region and how to thoughtfully and collaboratively provide a solution with the buy-in from the people you are helping in a culturally sensitive way.

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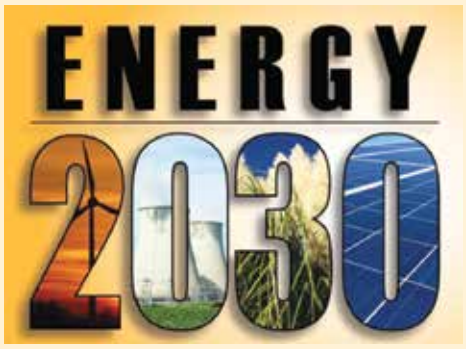
NPRE ALUMNUS AND FACULTY PRESENT DURING ENERGY 2030 FORUM



Energy experts including NPRE alumnus K.R. Sridhar as well as Emeritus Prof. Cliff Singer and Profs. Jim Stubbins and Rizwan Uddin presented at the *Energy 2030: Paths to a Sustainable Future* event held on the Urbana campus in September.

Sponsored by the University of Illinois Institute for Sustainability, Energy, and Environment (iSEE), the event focused on the potential for improvements in energy efficiency, alternative forms of renewable energy, and other low-carbon sources of energy to meet societal needs for electricity, transportation, and heating more sustainably in the future. The Congress provided a forum to discuss the near- and medium-term challenges on the path toward sustainable energy consumption, as well as key takeaways for an agenda of actionable research and policy directions that could contribute to long-term solutions.

Sridhar, principal co-founder of Bloom Energy, presented the keynote address, "Disruptive Trends in the Energy Sector," which examined how changes to the energy landscape are disrupting traditional models. Prior to founding Bloom Energy, Sridhar led a team developing technologies to sustain life on Mars for NASA. For his work, Fortune Magazine cited him as "one of the top five futurists that are inventing tomorrow today." Sridhar is a member of the National Academy of Engineering and has served on many technical committees, panels and boards. He has over 50 publications and is a sought-after speaker and advisor on energy and environmental issues.

Singer moderated the session, "Nuclear Power: A Panacea for Future Energy Needs?" at which both Stubbins and Uddin spoke. Stubbins presented "Poseidon's SONGS," detailing how advances in nuclear power systems are an important component to meet both the evolving energy needs and environmental goals over the next 30 years. Uddin, an iSEE faculty affiliate, gave the talk, "Comparing Energy Sources (Nuclear vs. Fossil)," in which he outlined factors to be taken into account to allow development of a rigorous mathematical model for cost benefit and risk analysis associated with different energy sources (nuclear vs. carbon emitting) and technologies.

For other speakers and topics, view the iSEE Congress 2016 website, sustainability.illinois.edu/outreach/isee-congress/isee-congress-2016/

"This (Fall 2016) semester I'm taking a design class called Sustainable Products for Subsistence, where I will work on a product design and develop a business model to serve people living in subsistence. The course brings together businesses and students to develop products and services for subsistence. I hope to learn the methods of how a for-profit business model can provide solutions and enhance quality of life and contrast its efficacy and outcomes with non-profit work."

Although he hasn't yet pinpointed a project for the Energy Systems degree, Flanagan finds himself drawn to studying how electrification can impact communities' economic status. "I'm hoping to primarily work on this in the long term, but it might be a side project as I network and figure out my own business or someone else's business."

In addition to courses for the degree, Flanagan is taking an entrepreneurship class with the Technology Entrepreneur Center at Illinois to learn how to develop business models.

Kevin Kubis

This past academic year while a senior in Mechanical Sciences and Engineering at Illinois, Kubis worked on a design project involving lighting from solar panels. "I found myself fascinated by renewable sources of energy," he said. "I also found myself disheartened by the bleak future for global warming, in large part due to dirty energy production methods.

"I made it a goal to pursue a career in clean energy that would help alleviate this problem. After doing research of different programs, I realized the M.Eng. in Energy Systems is an absolute perfect fit because of the flexibility in specialization areas and the exciting courses they offer!" Kubis said.

Kubis hasn't pinpointed his project work yet, but will focus on renewable energy production. "I am anxious to start exploring possibilities and getting to work," he said

About the Taber International Scholarships

NPRE alumnus Brad Radl, the President and Chief Technology Officer of Taber International in Chardon, Ohio, established the scholarship program as a means to support the Master of Engineering program in Energy Systems. Taber International is 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.

WHITTINGHILL PROVIDES STUDENTS ASSISTANCE IN ENERGY SYSTEMS PROGRAM


Amy Whittinghill

Amy Whittinghill joined the College of Engineering in January as the Coordinator for Master of Engineering Programs, and now coordinates the MEng degree in Energy Systems.

In this role, Whittinghill assists new students with the admission process; provides current students with general academic advising; and helps the director, NPRE Prof. Rizwan Uddin, develop the program.

Whittinghill completed her bachelor's of arts degree in psychology from the University of Illinois at Chicago in 2000. She has worked in higher education admissions, academic advising, and academic records since 2003. She moved from the Chicago area to Urbana in January 2015 to join the university's Graduate College as the Degree Certification and Records Coordinator.

Whittinghill's favorite aspect of working in higher education is collaborating with students to help them meet their educational goals. She currently is pursuing her Master of Social Work degree through the MSW Outreach Program at Illinois.

M.Eng. in Energy Systems

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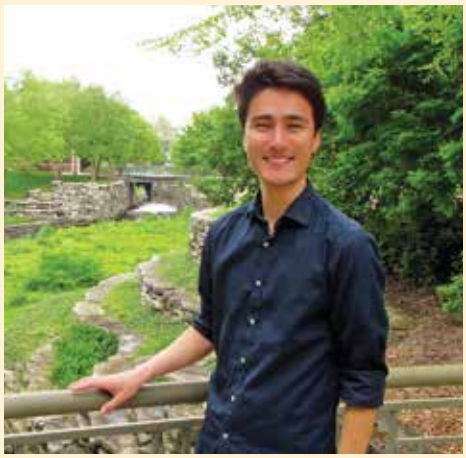
Energy Systems grad earns Tesla internship, Race to Zero competition success

Otto Hucke's decision to pursue his Energy Systems Master of Engineering degree at Illinois led to his internship with Tesla Motors as well as a role on the solar decathlon Race to Zero team's national second place finish.



Otto Hucke

Hucke came to Illinois in Fall 2015 to take a "gap year" from earning a master of science degree in electrical engineering from Karlsruhe Institute of Technology in Germany, where he had earned a bachelor's in 2014.

"My number one thing was that I definitely wanted to go abroad," Hucke said. Looking for a program to focus on electrical engineering, power generation and renewables, Hucke was encouraged after speaking with former Energy Systems program co-director Cliff Singer.

"This is a flexible program," Hucke said. "Here, I can take urban planning, geography and atmospheric sciences. I'm seeing the big picture, a broader view and I really love it. You have to be an expert as an engineer, but it's also good to know how your field relates to the others."

Energy Systems students are required to do a project as part of the program, and Hucke chose working with the Illinois team for the U.S. Department of Energy's Race to Zero competition. The team proposed a retrofit design for an existing small, multi-family housing building, showing that energy needs could be met with renewables. Hucke said the analysis showed where the energy deficits were, what conservations could be made through intelligent design and new technology such as insulation and a heat pump, and how remaining energy needs could be met through a solar photovoltaic system.

"We were able to reduce the energy consumption by 85 percent through conservation," Hucke said. "It was good to collaborate with other students; I never worked before with architects, business students, and civil engineers. It was interesting because everyone can contribute to the project and has a different view. I liked this interdisciplinary approach."

"This is a flexible program. Here, I can take urban planning, geography and atmospheric sciences. I'm seeing the big picture, a broader view and I really love it. You have to be an expert as an engineer, but it's also good to know how your field relates to the others."

Having spent the summer at Tesla, which builds cars running on electricity, Hucke gained the opportunity to focus on sustainable transport and its interaction with power grids. "I knew that Tesla was a great company and I wanted to work for them," he said. "Electric cars are one part of the sustainable future."

Upon finishing his internship and Energy Systems degree, Hucke had plans to return to Germany to finish his MS degree. He may also pursue a master's in business administration. "I would love to work for a company that implements renewable energy in power grids, or for Tesla, of course."

NPRE GAINS WIDE ANS RECOGNITION

NPRE at Illinois was particularly successful in gaining American Nuclear Society recognition over the past year, with national honors for the contributions of facilities, faculty, alumni and students.

As we pledge to vigilantly pursue our mission of excellence in teaching, research, and service, these next pages and articles celebrate NPRE's impact on nuclear engineering, and the devotion of our people to the discipline.

This handsome marker is located where the former TRIGA reactor formerly stood.

Former TRIGA becomes national ANS Nuclear Historic Landmark

The American Nuclear Society (ANS) honored the University of Illinois Advanced Teaching Research Isotope General Atomic reactor (TRIGA Mark II) with the ANS Nuclear Historic Landmark Award on April 22, 2016.

The TRIGA Mark II stood on the east side of the College of Engineering campus from 1960-1998, educating students on reactor operations. Students were required to take a laboratory class in which they operated the reactor to enhance their understanding of reactor physics concepts.

The TRIGA was also one of the most important and adaptable reactors in the world for Nuclear-Pumped Lasers (NPL) and other significant research due to the facility's unique core configuration. The reactor had a through port that allowed researchers led by NPRE Emeritus Prof. George H. Miley to place large laser cavities next to the core of the TRIGA for important studies of nuclear-pumped lasers. Miley drafted the nomination for the landmark designation.

National American Nuclear Society President Eugene Grecheck, right, helps Department Head Jim Stubbins reveal the TRIGA Reactor marker.

"The historic research studies carried out at the TRIGA Mark II facility continue to have significant impact on nuclear science and engineering," said national ANS President Eugene S. Grecheck, as he presented the designation and unveiled a handsome marker constructed at the site of the former reactor. Grecheck spent the day on the Urbana campus meeting with NPRE faculty and students.

ANS identifies and honors sites or facilities at which outstanding accomplishments took place, and which were instrumental in the advancement and implementation of nuclear technology and the peaceful uses of nuclear energy.

"Several generations of nuclear engineering students at the University of 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 toured the TRIGA to learn first-hand about the importance of nuclear energy," said NPRE Department Head Jim Stubbins.

Although administrative decisions led to the TRIGA's closing in 1998, with fuel removal in 2004, the research and educational opportunities made possible at this facility will be noted in nuclear engineering history through TRIGA's designation as an ANS Nuclear Historic Landmark.

NPRE displays artifacts from the TRIGA reactor and nuclear engineering history on the second floor of Talbot Laboratory.

NPRE alumni have been generous in supporting the construction of the marker that now honors the TRIGA in perpetuity. The department also has created a display of important artifacts from the TRIGA and nuclear engineering history. The display can be found at the second floor west entrance of Talbot Laboratory, 104 S. Wright St.

To view a video and more photos from the dedication celebration, go to http://npre.illinois.edu/news/former-triga-becomes-national-ans-nuclear-historic-landmark.

2016 NPRE Leadership Speaker Series, *continued from page 9*

Speakers also included Illinois State Sens. Donne Trotter, Chapin Rose and Neil Anderson, who have sponsored Senate Bill 1585 that promotes market-based solutions to keep the plants open. The bill would establish a Low Carbon Portfolio Standard (LCPS) that would help reduce carbon emissions, increase renewable energy and maintain a stable and secure electricity supply.

Held to consider the economic and environmental impact nuclear power has upon the state, as well as the consequences of limiting the resource as an energy provider, the event was co-sponsored by the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) and North America's Building Trades Unions.

The event held October 18, 2016, in Chicago was part of NPRE's Leadership Speaker Series, intended to provide a forum for global leaders to present policies and platforms that shape the sciences of nuclear, plasma and radiological disciplines.

"Illinois is the birthplace of nuclear power," said NPRE Department Head Jim Stubbins. "The state has been an international leader in the development and uses of nuclear energy. With about half of the electricity in Illinois coming from nuclear power plants, we should value and preserve them all for their major current and long-term contributions to energy and a low-carbon environment in Illinois."

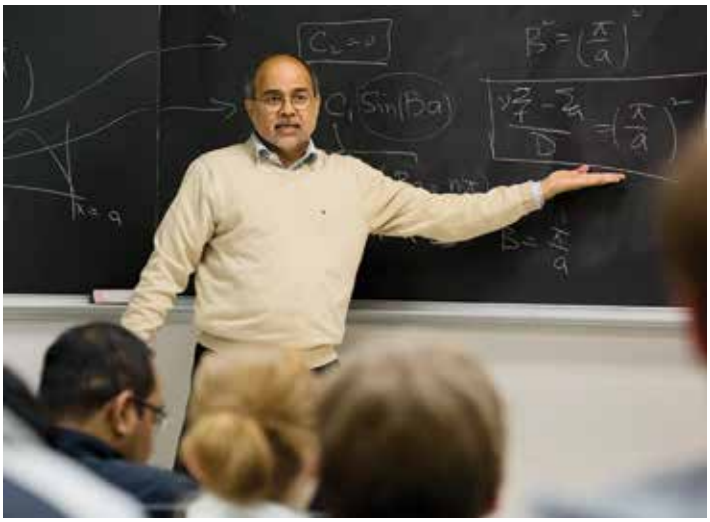
Other speakers at the forum were:

- Jeffrey Binder, Director, Applied Research Institute at the University of Illinois
- David Foster, Senior Advisor, DOE
- Matt Bennett, Senior Vice President, Third Way
- Maria G. Korsnick, COO and incoming President & CEO, Nuclear Energy Institute
- William Hite, General President, United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry, United States and Canada
- Petros Sofronis, Director, WPI International Institute on Carbon Neutral Research, University of Illinois
- David Boyd, MISO External Affairs Team
- Susan F. Tierney, Senior Advisor, Analysis Group
- Tim Followell, City Administrator, Clinton, Illinois
- Henry Marquard, Director of Government Affairs, Quad Cities Chamber of Commerce

For a full video of the forum, go to youtube.com/watch?v=NXDpeOTMchc

Uddin wins ANS Arthur Holly Compton Award

The American Nuclear Society has recognized Prof. Rizwan Uddin with the 2016 Arthur Holly Compton Award for his excellence and innovation in teaching.



Through a unique teaching style that emphasizes student learning and involvement in the classroom, Uddin has made a tremendous impact on the evolution of the learning process through interactive and innovative techniques, according to NPRE Department Head Jim Stubbins.

- Uddin was among the first on the Urbana campus to implement a "flipped" classroom model in one of his classes (Reactor Physics). He made video lectures available to be watched at home in advance, reserving class time for Q/A, discussions, problem solving, and interactive learning.
- He has pioneered the development of a 3D, computer game-like model of a radiation lab, in which students can conduct virtual experiments.

In addition, Uddin has elevated NPRE's instructional and learning activities and standards at both the graduate and undergraduate levels.

He has major responsibilities for initial interaction with NPRE's incoming freshmen, and in teaching/co-teaching their introductory class, NPRE 100. His ability to engage them in both classroom and laboratory experiences has enhanced their interest in nuclear engineering, and has resulted in increased enrollment for the department.

Uddin has helped introduce non-traditional student engagement activities with international locations in Italy and Jordan, and has encouraged exchanges of undergraduate student learning between those countries and Illinois. He has also introduced undergraduate research opportunities through his own research program.

Uddin is an excellent mentor for graduate students. Several of his advisees have received the ANS Mark Mills Award, made to a student author submitting the best original technical paper that contributes to the advancement of science and engineering related to the atomic nucleus. Uddin won the award himself in 1987.

An ANS Fellow, Uddin has been included on the List of Teachers Ranked Excellent every year since he began at Illinois in 1996. He has been chosen as the NPRE Teacher of the Year a dozen times, including in 2016. He also received the 2015 American Society of Engineering Education Nuclear Division Glenn Murphy Award, honoring "a distinguished engineering educator."

Earning a BS in 1980 in mechanical engineering from Middle East Technical University, Uddin earned his MS and PhD from NPRE in 1983 and 1987, respectively. He then was a research assistant professor and an assistant professor at the University of Virginia before returning to Illinois.

The Arthur Holly Compton award was established in 1966 in honor of the late Arthur Holly Compton to recognize and encourage outstanding contributions to education in nuclear science and engineering.

Mohaghegh wins ANS Mary Jane Oestmann Professional Women's Achievement Award

Assistant Prof. Zahra Mohaghegh is the 2016 winner of the American Nuclear Society Mary Jane Oestmann Professional Women's Achievement Award.

Mohaghegh is cited for her leadership, entrepreneurship, substantial multi-disciplinary research and scholarly contributions in the area of probabilistic risk assessment (PRA). She is noted for her pioneering introduction of human and organizational factors in PRA of socio-technical systems in nuclear and other fields.

Prior to joining NPRE's faculty in January 2013, Mohaghegh established her expertise through Soteria Consultants, LLC, a risk management consulting firm she founded in 2010 in Boston after earning her PhD from the University of Maryland. The company initiated a multi-year, large-scale collaboration with the South Texas Project Nuclear Operating Company, and Mohaghegh brought the project with her to Illinois.

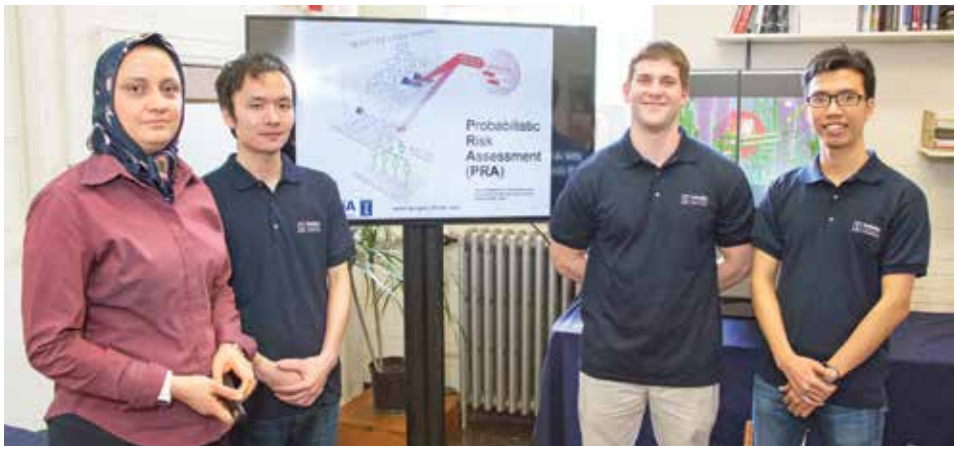
In the Socio-Technical Risk Analysis Research (SoTeRiA) Laboratory Mohaghegh has since established in NPRE, she and her graduate students develop new approaches for advancing PRA. They have been involved in the risk-informed resolution of Generic Safety Issue 191, a long-standing issue for commercial nuclear power plants and the Nuclear Regulatory Commission. Her research laboratory focuses on two key areas of scientific innovation: (1) spatio-temporal causal modeling of underlying social and physical failure mechanisms in PRA, and (2) the incorporation of big data analytics into PRA.

Mohaghegh is a recipient of a five-year National Science Foundation (NSF) grant for Big Data Analytics in risk assessment, the 2016 Engineering Council Award for Excellence in Advising, the 2015 Dean's Award for Excellence in Research from the College of Engineering, the George Apostolakis early-career award in risk assessment, and the Zonta International Award for her contribution to modeling large-scale complex systems.

Mohaghegh was the technical chair for the ANS Risk Management topical meeting in November 2013. In March 2015, she and her research team developed and presented the U.S.–China Probabilistic Safety Assessment Workshop on "Risk-Informed Regulation and Safety Culture" in China, as part of the U.S. Department of Energy's Peaceful Uses of Nuclear Technology (PUNT) program. She is the author of a book and over 40 conference and journal publications on risk analysis.

Mohaghegh has developed and taught undergraduate and graduate courses in PRA across engineering disciplines and to non-engineering students. Furthermore, the SoTeRiA Laboratory has initiated collaborations with national and international research institutions and has plans to expand socio-technical collaborations to achieve tailor-made solutions for high-risk operations around the world.

The Oestmann award of the 11,000-member ANS recognizes outstanding personal dedication and technical achievement by a woman in the fields of nuclear science, engineering, research or education.



Assistant Prof. Zhara Mohaghegh with her students.

Huff wins ANS Young Member Excellence Award

New Assistant Prof. Katy Huff is the 2016 winner of the American Nuclear Society's Young Member Excellence Award.

Huff, a computational nuclear reactor physicist who joined the NPRE faculty this summer, has been cited for her outstanding contributions to advanced modeling and simulation, in particular in the fuel cycle analysis area, and her tireless leadership within ANS. The award recognizes a young member who has demonstrated overall excellence in a variety of areas, and Huff will be presented an engraved plaque at the ANS Winter Meeting in Las Vegas in November.

Huff has been active within the 11,000-member ANS organization since her graduate school days beginning in 2008 at the University of Wisconsin.

Currently, she chairs the Fuel Cycle and Waste Management (FCWM) Division. She also has served as that division's vice-chair and secretary-treasurer, and served as secretary of the ANS Young Members Group. Huff has organized and chaired many sessions for national ANS meetings, and, while FCWM secretary/treasurer, restarted a newsletter to provide members with timely information.

"At a time when the ANS is making it easier for young members to become involved, Katy has set an example for all young members of how to do this in a way that is both faithful to her professional and intellectual interests and allows her to make a difference in the organization," said Paul Wilson, University of Wisconsin engineering physics professor and Huff's PhD advisor. Wilson nominated Huff for the award.

She expects to continue her ANS activities by advising the student chapter at Illinois. "Supporting the ANS students is really an important responsibility," Huff has said.

In addition to her ANS activities, Wilson cited Huff's academic research, and particularly her contributions to the Software Carpentry Foundation, which holds workshops teaching best practice computational skills to researchers in science, engineering, medicine and related disciplines. Huff was a leader in organizing one of the first such workshops in 2011, and had a hand in developing most of the curriculum that was taught. A founding member of the foundation's steering committee, Huff served as the committee's first chair.

In 2015, she and co-author, Anthony Scopatz, released their book, "Effective Computation in Physics," which offers a long-form companion to the two-day workshop curriculum.

Her interests in applying cutting-edge computations to nuclear engineering will continue in NPRE, as she works on a U.S. Department of Energy-funded project to bring machine learning improvements to fuel cycle system analysis.

Prior to joining NPRE, Huff worked as a postdoctoral scholar and data science fellow in the Nuclear Science and Security Consortium and Berkeley Institute for Data Science at the University of California-Berkeley. Her focus has been on the scientific pursuit of a safe, emissions-free, sustainable, high-output energy source. Particularly, she is interested in the promise of a closed nuclear fuel cycle, nuclear repository performance, and investigations of safety.

In NPRE, she will concentrate on research questions across a range of challenges including nuclear fuel cycle technology strategy, energy policy, repository safety, and reactor physics. Huff's research will involve modeling and simulating both the nuclear fuel cycle and advanced reactor designs.

Miley honored with ANS Seaborg Medal

Vigorous and prolific in his lifetime pursuit of nuclear science's far-ranging possibilities, Prof. Emeritus George H. Miley has been honored with the American Nuclear Society Seaborg Medal.

The award recognizes an individual who has made outstanding scientific or engineering research contributions to the development of peaceful uses of energy. Seaborg Medal recipients reflect a high degree of scientific acumen, imagination and unusual talents in scientific research, and have made significant contributions to applications of nuclear technology.

In his 55-year career in what is now Nuclear, Plasma, and Radiological Engineering at Illinois, Miley has been at the forefront of many of the discipline's most notable milestones.

"Prof. Miley is informally called 'The Father' of nuclear pumped lasers by U.S. and Russian scientists working in the area," according to NPRE Department Head Jim Stubbins. "He has also been termed 'The Father' of advanced fuel fusion by fusion scientists internationally. In addition, he is often referred to as 'The Father' of the nuclear battery and has written the definitive text on this topic, *Direct Conversion of Nuclear Radiation Energy*."

In selecting Miley for the Seaborg Award, the 11,000-member ANS organization has cited his extensive and creative contributions to nuclear science and engineering research and education including fission reactor, nuclear-pumped laser, plasma and fusion science and technology.

After joining the Illinois faculty in 1961, Miley and his students performed research on neutron pulse propagation, coupled core kinetics and reactor dynamics. Over a 10-year period, this work provided new understanding of large fission reactor core dynamics.

Starting in 1963, he and his students pioneered work on U.S. neutron-pumped lasers, developing much of the basic theory and experimentally discovering five new laser types. In 1970 he achieved operation of the first direct electron-beam pumped laser that has since impacted applications ranging from medical to industrial uses.

In the early 1970s, Miley spearheaded and became first director of Illinois' interdisciplinary fusion program. Through ANS, he published the book, *Fusion Energy Conversion*, introducing the possibility of advanced fusion fuels such as DHe3 and p-B11 to reduce neutron damage to materials and neutron-induced radioactivity, while allowing increased energy conversion efficiency through direct energy conversion methods.

Miley also contributed to developing Inertial Confinement Fusion (ICF).

Presented the prestigious Edward Teller Award in 1995, he was cited for work on core ignited ICF targets and advanced fuel targets. More recently he and his students have developed a new "fast ignition" process using directed deuterium beams.

Over the last 15 years Miley has researched the basic physics of Low Energy Nuclear Reactions (LENR)—a modern form of "cold fusion." In 2011 he created and four years later sold a start-up company, LENUCO, to study LENR. He also founded and continues to operate a small company, NPL Associates, in which graduate students have worked on plasma-based projects that the Department of Energy and National Aeronautics and Space Administration support.

These and other research achievements of Miley's have been noted with numerous recognitions:

1992, the Outstanding Achievement Award from the ANS Fusion Energy Division for contributions to fusion science and engineering, especially research on understanding advanced fuel fusion systems.

2003, the Institute of Electrical and Electronics Engineers Nuclear and Plasma Sciences Award for research achievements in fusion energy. This was largely in recognition of his contributions to the understanding of alternate confinement fusion systems such as ICF.

2004, the ANS Radiation Science and Technology Award in recognition of

"Prof. Miley is informally called 'The Father' of nuclear pumped lasers by U.S. and Russian scientists working in the area. He has also been termed 'The Father' of advanced fuel fusion by fusion scientists internationally. In addition, he is often referred to as 'The Father' of the nuclear battery and has written the definitive text on this topic."

achievements in research on nuclear pumped lasers, radiation energy conversion, and IEC neutron sources.

2006, the Preparata Medal of the International Society for Condensed Matter Nuclear Science for his contributions to understanding the nature of low energy nuclear reactions.

2006, the Integrity in Research Award.

While conducting his research, Miley supervised the doctoral studies of more than 60 students over the years. The students have gone on to provide leadership in a variety of fields, including professorships at major universities to high positions in industry and government.

Miley has authored or co-authored 10 books, and has edited or co-edited 20 more. His other publications—in book chapters and articles in books, journals, conference proceedings, and reports—number about 500. He also holds many patents. Miley's effort as the first Editor of the ANS journal, *Fusion Technology*, played an important role in strengthening the then "new" Fusion Energy Division of ANS. Later, he served as Editor-in-Chief of two prestigious Cambridge University Press journals, *Laser and Particle Beams*, and *Journal of Plasma Physics*.

Miley's career included considerable service as well as research. He chaired the burgeoning Nuclear Engineering Program at Illinois for a dozen years beginning in 1975. Serving on the Nuclear Regulatory Audit Committee (NRAG) for the Clinton Nuclear Power Plant from 1984-1996, Miley headed subcommittee review of operator training, as well as water chemistry and emergency preparedness. He currently serves on the Governor's Radiation Protection Advisory Committee, and has chaired the Governor's Technical Advisory Committee on the Illinois Low Level Nuclear Waste Site and Committee on Industrial uses of Radiation Sources in Illinois.

Miley has been very active in ANS over the years, presenting over 90 talks in technical sessions, serving on the boards for four different divisions, serving on the board of directors, and serving on various committees. He is an ANS Fellow, and is also a Fellow of the American Physical Society and IEEE, and is an Associate Fellow of the American Institute of Aeronautics and Astronautics. He has consulted at various companies and three national laboratories: Los Alamos, Lawrence Livermore and Argonne.

NPRE PhD wins 2016 ANS Mark Mills Award

Yinbin Miao

Recent NPRE PhD Yinbin Miao is the 2016 winner of the American Nuclear Society Mark Mills Award.

The award recognizes the graduate student author who submits the best original technical paper contributing to the advancement of science and engineering related to the atomic nucleus. Graduating in summer 2015, Miao currently is a postdoctoral researcher in the Nuclear Engineering Division at Argonne National Laboratory.

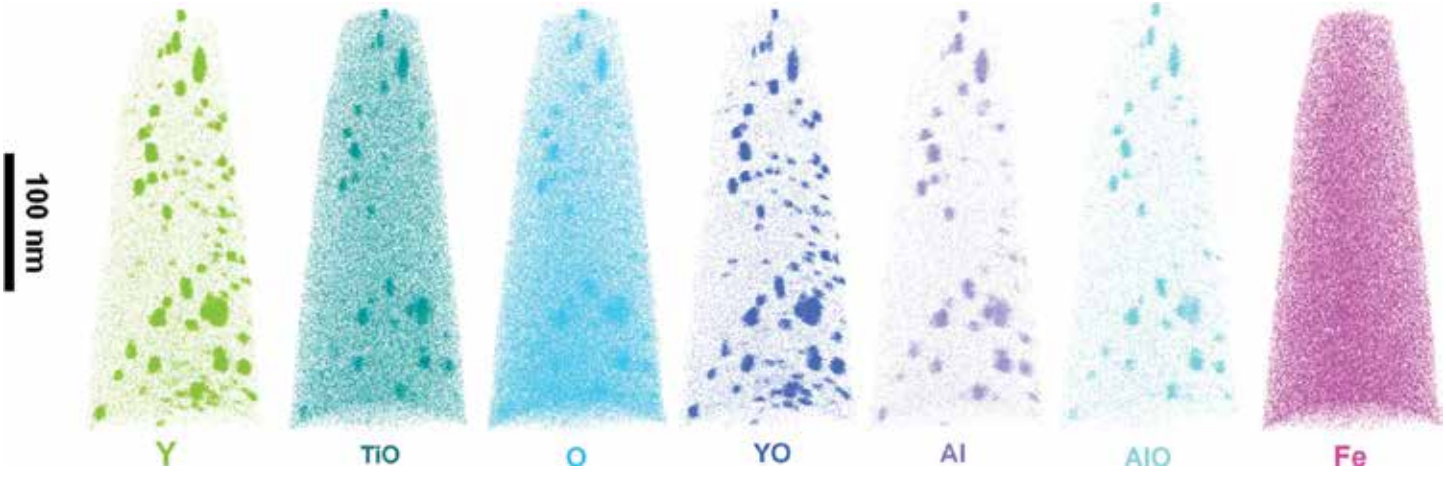
Miao's paper is based on his dissertation, in which he developed a unique approach to understanding the nature of high temperature strengthening in stainless steels with oxide dispersion strengthened (ODS) particles. These microscopic ceramic particles are embedded inside a metallic material. Since they are ceramic, they will not melt at high temperature, and provide a great deal of additive strength to metal even as it approaches its melting point.

In addition, the tiny particles are an important contribution to the material's resistance to irradiation. The particle interfaces provide an excellent place for absorbing metal atoms that radiation displaces, and prevents the displaced atoms from binding together to form internal defect clusters.

To gain this understanding, Miao performed *in situ* deformation transmission electron microscopy experiments as well as *in situ* tensile deformation experiments at the Advanced Phonon Source at Argonne. He also performed atom probe tomography (APT) studies at Oak Ridge National and Idaho National laboratories.

This prestigious award covers only a portion of Miao's research accomplishments. He continues to perform molecular dynamics (MD) modeling to understand the influences of irradiation effects on modeling UO_2 surrogate material (e.g. CeO_2 and (Ce+La) O_2) and irradiation damage results in γ-Uranium using a newly developed Modified Embedded Atom Potential (MEAM).

His recent papers are "On the microstructure and strengthening mechanism in oxide dispersion-strengthened 316 steel: A coordinated electron microscopy, atom probe tomography and in situ synchrotron tensile investigation," and "In situ synchrotron tensile investigations on the phase responses within an oxide dispersion-strengthened (ODS) 304 steel" in the journal, *Materials Science and Engineering* A, and "The interfacial orientation relationship of oxide nanoparticles in a hafnium-containing oxide dispersion-strengthened austenitic stainless steel," in the journal, *Materials Characterization*.



This graphic shows an atom-by-atom reconstruction of a needle tip of Y-Ti-O nanoclusters in ODS 304 stainless steel.

ANS Illinois chapter recognized as country's top student section

The American Nuclear Society Student Chapter at Illinois has been honored with the 2016 Glasstone Award, recognizing the society's most outstanding student section in the country.

The award acknowledges ANS student sections that have accomplished notable achievements in public service and the advancement of nuclear science and engineering.

The Illinois chapter has finished a particularly active year, culminating in the organization's results at the ANS Student Convention held in late March and early April. With seven awards, including a Commendation for Service and Leadership for 2015-16 chapter President Kathryn Mummah, the chapter took home more prizes than any other university group attending.

"We did very well; it was very successful," Mummah said. "To win seven different things, we really brought our 'A' game."

"The success of our students at the ANS Student Conference is a true reflection of the quality of their academic and research work as well as their great leadership capabilities," said NPRE Department Head Jim Stubbins.

The Illinois chapter brought 53 students to the convention, the most of any university besides the host school, the University of Wisconsin-Madison. After Illinois, the top number of attendees from any one visiting university totaled 20 individuals.

Mummah and other ANS officers started efforts last fall to recruit NPRE students for the conference. In addition to increasing attendees, the recruitment efforts also persuaded 30 NPRE students to become new members of ANS.

The Glasstone Award was established in 1969 when the late Dr. Samuel Glasstone contributed funds to ANS to be used specifically for an annual award to the outstanding Student Section.

Among the Illinois chapter's award-winning presentations, projects and posters at the student conference were:

- "Crystalline Rock Repository in the Northeastern United States: An Analysis of Technical, Political, Economic, and Logistical Feasibility;" Best Presentation in Fuel Cycle & Waste Management Division; presenter Shanna Bobbins and group members Steven Jensen, Michael Benedict and Kevin Chowaniec
- "High Power Pulsed Magnetron Sputtering Magnet Pack Modeling for a Linear Magnetron;" Best Presentation in Material Science & Technology Division; presenter Jake T. McLain
- "Development of Virtual Labs, Games and Training Tools at the University of Illinois 3D Immersive Exercises;" Best Presentation in Education & Work Force Development Division; Justin Joseph
- "Public Image in Spent Fuel Disposal: Lessons Learned from Sweden's SKB;" Best Presentation in Public Image Division; Kathryn Mummah
- "Solar Thermal Radionuclide Updraft Tower (STRUT);" Second Place for Best Poster Presentation; Aristidis (Aries) Loumis, Ari Krause, and John Karahalios
- "Utilization of Commercial Nuclear Reactor Fleet for the Production of 99Mo;" Third Place for Best Poster Presentation; Dan Strat.

ANS Illinois chapter members at the national student convention.

Other projects entered from Illinois were

- "A 3D, Interactive and Virtual Dose Minimization Game for Education and Training;" Education, Training & Workforce Development Division; Gavin Mattingly
- "Computational Investigation into Hydrogen Diffusion, Threshold Energies and Recoil Events in Alpha-phase PdHx;" Materials Science & Technology Division; Joseph Serio
- "Radiation Sensor Network within a Virtual Environment;" Nuclear Nonproliferation & Policy Division; Christian D. Zircher
- "Remote Assessment of Radioactive Security Threats: Prototyping of an Energy Capable Mobile Detection Unit;" Detection & Measurement Division; Andrew N. Groll
- "Spatio-Temporal Methodology for Estimating Loss-of-Coolant Accident Frequencies in the Risk-Informed Resolution of Generic Safety Issue 191;" Operations & Power Division; Nicholas W. O'Shea

National American Nuclear Society President Eugene Grecheck met with ANS at Illinois student chapter members during NPRE events in April.

"To win seven different things, we really brought our 'A' game."

- "Digitization of Flow Control in the Recirculation System of a BWR;" Poster Presentation; Jonathon M. Helck, Cory Powers, and Nicholas Bridge
- "Conceptual Design of a High-Performance Plasma Thruster Using Electron Bernstein Wave (EBW) Heating and REBCO Superconductors;" Poster Presentation; Jared C. Bowman

NPRE STUDENTS WIN ANS SCHOLARSHIPS

American Nuclear Society (ANS) national scholarships have been awarded to two NPRE students.

Kathryn A. Mummah of Wheaton, Illinois, has been chosen for the ANS Decommissioning & Environmental Sciences Division Undergraduate Scholarship. Daniel O'Grady of Evergreen Park, Illinois, has won the ANS Raymond DiSalvo Memorial Scholarship.

This is the second year in a row that Mummah, a senior, has won the Decommissioning & Environmental Sciences scholarship, awarded to engineering or science major students pursuing one of a number of areas: decommissioning/decontamination, management/characterization of radioactive waste, restoration of the environment, or nuclear engineering.

The DiSalvo Scholarship awarded to O'Grady is named for Raymond DiSalvo, who joined ANS in 1974 and very quickly became an active and important participant in their technical conferences.

NPRE welcomes record number of graduate students

A record number of 91 students are enrolled in graduate study this fall in NPRE.

Making this the largest enrollment in at least a dozen years, the total graduate student number has been boosted by the arrival of 21 new students, coming to Urbana-Champaign from eight countries: the United States, Poland, Taiwan, the People's Republic of China, the United Arab Emirates, Jordan, Lebanon, and Russia.

Department Head Jim Stubbins believes NPRE's hiring of eight new faculty members, doubling the total faculty since 2011, is one reason for the increased interest among graduate students.

"I think we had more students accept us because of our faculty. There's a lot more opportunities to work with people," Stubbins said.

The new faculty has expanded the department's impact in nuclear power research, with expertise gained in computational, experimental, materials and risk analysis aspects. New investigations in plasma/fusion technologies have been undertaken, particularly since the arrival of the HIDRA (Hybrid Illinois Device for Research and Applications) facility. NPRE's contributions to radiological and nuclear medical applications also are on the rise, and will continue to grow with the addition of faculty member Shiva Abbaszadeh in January.

Hanna Schamis, coming to NPRE from the University of Michigan, plans to work with Associate Prof. J.P. Allain on plasma-material interactions for fusion applications. "We are studying the correlation between the plasma performance on NSTX-U (a tokamak at Princeton Plasma Physics Laboratory) and the surface chemistry of the plasma-facing components," Schamis said.

Having earned a bachelor's from the Massachusetts Institute of Technology, Nate Colgan wants to examine nuclear power's implications for space exploration. "I've decided to study thermohydraulics and cooling/power generation systems for small reactors that could be used as a power source for a manned Mars or lunar base in the near future," Colgan said. Working with Assistant Prof. Caleb Brooks, Colgan has gained a Fellowship from the Nuclear Regulatory Commission to support his studies.

Andrei Rykhlevskii will work with new Assistant Prof. Katy Huff on coupled neutronics and thermal hydraulics simulations for advanced reactors. With an undergraduate degree at Moscow State Technical University in Russia, Rykhlevskii will pursue an academic career and hopes to become a professor.

New graduate student Matthew Parsons will delay his arrival at the Urbana

campus for a year while he works at ITER (the International Thermonuclear Experimental Reactor in France) on a Fulbright Scholarship. The ITER project aims to make the long-awaited transition from experimental studies of plasma physics to full-scale electricity-producing fusion power stations.

When he does arrive in Urbana, Parsons, who earned his bachelor's from Drexel University, will work on HIDRA with Prof. David Ruzic and Research Assistant Prof. Daniel Andruczyk. "Specifically, I'll be developing new plasma control techniques for HIDRA in an effort to enhance HIDRA's abilities to test the novel reactor materials technology being developed at CPMI (the Center for Plasma-Material Interactions).

"I chose NPRE because it is one of the few programs in the world where I will be able to get hands-on experience with a working fusion experiment," Parsons said. "HIDRA has some unique capabilities that will allow it to address some significant research challenges facing the development of fusion energy. That's an opportunity too good to pass up!"

STUDENTS

Large number of NPRE students gain DOE scholarships, fellowships

Eight NPRE students have gained scholarships and fellowships from the Department of Energy Nuclear Energy University Program. With two fellowships and six scholarships, these represent the highest number of NEUP awards made to NPRE students in any single year.

The Energy Department has used NEUP's Integrated University Program to award more than $5 million for 57 undergraduate scholarships and 33 graduate fellowships nationwide to students pursuing nuclear energy-related disciplines at universities across the country. Through this program, undergraduates receive a $7,500 scholarship, while fellowship winners receive up to $50,000 annually over the next three years.

The graduate fellowships also include $5,000 toward a summer internship at a U.S. national laboratory or other approved facility to strengthen the ties between students and the DOE's nuclear energy research programs. Selected students study a breadth of critical nuclear energy issues, from fuel cycle sustainability to reactor efficiency and design.

The NPRE scholars are undergraduates Alyssa Hayes of Gurnee, Illinois; Patrick Hering of Crystal Lake, Illinois; Jeremy Mettler of Sioux Falls, South Dakota; Kathryn Mummah of Wheaton, Illinois; Daniel O'Grady of Evergreen Park, Illinois; and Grant Schumock of Geneva, Illinois.

Mummah and O'Grady also recently won national scholarships from the American Nuclear Society.

NPRE graduate students with NEUP fellowships are Joseph Bottini of Framingham, Massachusetts; and Katherine Hepler of Lincoln, Illinois. Several other NPRE graduate students have won a number of other highly competitive national and international awards:

- **Nathan Colgan** | Nuclear Regulatory Commission Fellow
- **Gianluca Panici** | IBM Fellow
- **Matthew Parsons** | Fulbright Fellow
- **Victoria Riso** | NRC Fellow
- **Heather Sandefur** | Stewardship Science Graduate Fellow, DOE National Nuclear Security Administration

Student excellence recognized at Honors Banquet

Nearly 100 students were recognized during the 2016 NPRE & ANS Honors Banquet.

Held in April in conjunction with the American Nuclear Society at Illinois Student Chapter organization, the NPRE event recognizes students for earning awards from the Department, College of Engineering, campus, national organizations and corporate partners. The event is sponsored in part by the Edward E. Mineman Memorial Endowment Fund. 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.

NPRE DEPARTMENTAL AWARDS

The **NPRE Outstanding Academic Achievement Awards** to a Graduating Senior are presented to graduating seniors with the highest cumulative grade point averages

- Justin D. Weberski of Saint Charles, IL

To view more photos of NPRE's 2016 Honors Banquet, go to NPRE's Facebook page.

NPRE-at-Illinois

Information on other student award winners may be published separately in this newsletter.

The **NPRE Outstanding Undergraduate Research Awards** are presented to undergraduate students who have performed exemplary research in the Department.

- Daniel J. O'Grady of Evergreen Park, IL
- Zhiee Jhia Ooi of Malaysia

The **Catherine Pritchard Undergraduate Scholarships**, honoring former NPRE secretary Catherine Pritchard, are presented to students who have shown academic ability and activities leadership during their first three years, to be used during the senior year of study.

- Jeremy J. Mettler of Sioux Falls, SD
- Kathryn A. Mummah of Wheaton, IL

The **Roy A. Axford Undergraduate Scholarship**, honoring NPRE Professor Roy A. Axford, is presented to a continuing student of high academic ability and achievement.

- Daniel J. O'Grady of Evergreen Park, IL

The **George H. Miley/Low Energy Nuclear Reactions (LENR) Undergraduate Scholarship**, honoring NPRE Prof. George H. Miley, is presented to a highly motivated, continuing undergraduate student in the Department.

- Steven A. Stemmley of Bethalto, IL

AMERICAN NUCLEAR SOCIETY AT ILLINOIS STUDENT CHAPTER AWARDS

The Student Chapter of the American Nuclear Society selects the **ANS Undergraduate Outstanding Service Award** recipient. The undergraduate student who has most actively supported the ANS Student Chapter and its programs throughout the academic year is honored.

- Aristidis T. Loumis of Champaign, IL

The Student Chapter of the American Nuclear Society selects the **ANS Graduate Outstanding Service Award** recipient. The graduate student who has most actively supported the ANS Student Chapter and its programs throughout the academic year is honored.

- Jake T. McLain of Lockport, IL

OTHER STUDENT HONORS

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

The Nuclear Regulatory Commission directs this program that includes support for education in nuclear science and engineering, to develop a workforce capable of supporting the design, construction, operation, and regulation of nuclear facilities and the safe handling of nuclear materials.

SCHOLARSHIPS

- Matthew E. Kabelitz of Northbrook, IL
- Daniel C. Martin of Glencoe, MO
- Jeremy J. Mettler of Sioux Falls, SD
- Emilio M. Mondragon of Arlington Heights, IL

- Kathryn A. Mummah of Wheaton, IL
- Dhruval K. Patel of Hanover Park, IL
- Eric J. Riewski of Champaign, IL
- Grant M. Schumock of Geneva, IL
- Andrew J. Shone of Saint Charles, IL

CONTINUING SCHOLARSHIPS

- Michael J. Benedict of Darien, IL
- 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
- Daniel J. O'Grady of Evergreen Park, IL
- Joseph N. Rajchwald of Glenview, IL
- Steven A. Stemmley of Bethalto, IL

FELLOWSHIPS

- Joseph L. Bottini of Framingham, MA

CONTINUING FELLOWSHIPS

- Peter A. Mouche of Naperville, IL
- Jacob B. Stinnett of Champaign, IL
- Carolyn A. Tomchik of Buffalo Gove, IL
- Nathan P. Walter of Evanston, IL

National Academy for Nuclear Training Institute of Nuclear Power Operations

The Academy's fellowship and scholarship program—started by the Institute of Nuclear Power Operations shortly after the Three Mile Island accident—served the industry well for 35 years by supporting students and furthering the knowledge and skills needed to sustain and effectively operate the industry. The NANT program was discontinued this year as other government—and utility—sponsored academic assistance programs have been established to encourage and support students and nuclear engineering and science programs. The students listed below represent the last fellows and scholars in the program in NPRE.

SCHOLARSHIPS

- Kathryn A. Mummah of Wheaton, IL

FELLOWSHIP

- Katherine C. Hepler of Lincoln, IL

Consortium for Nonproliferation Enabling Capabilities (CNEC)

Sponsored by the U.S. Department of Energy National Nuclear Security Administration CNEC's goal is to become the preeminent research and education hub dedicated to the development of enabling technologies and technical talent for meeting present and future grand challenges in nuclear nonproliferation. The education and training of graduate students who are actively involved in research relevant to nonproliferation is a key component of the CNEC mission.

FELLOWSHIP

- Karl A. Roth of Martinton, IL

College of Engineering at Illinois, University of Illinois Scholarships, Awards and Honors

Dren Qerimi of Joliet, IL, and Nirali P. Shah of Skokie, IL, were selected for the **Fred A. Eggers Engineering Scholarship**, established in 1981 in honor of Mechanical Engineering alumnus Fred A. Eggers.

Zoe R. Richter of Manito, IL, was selected for the **Wilmer Hellenthal Scholarship**, established in 1993 in honor of Mechanical Engineering graduate Wilmer Hellenthal.

Kevin J. Chowaniec of Willowbrook, IL, was selected for the **Phillip Lazzara Memorial Scholarship**, established in 2003 by the Lazzara Family Foundation.

Karla Del Cid-Ledezma of Rio Rancho, NM, was selected for the **Robert M. Stephens Engineering Scholarship**, made possible by an estate gift from Newlyn C. Stephens to honor the memory of her husband.

The **Illinois Scholars Undergraduate Research (ISUR) Program** 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. Dan G. Strat of Lincolnwood, IL, was selected for the 2015-16 academic year, and Jazz D. Kroeger of Washington, IL, and John B. Smith III of Saint Charles, IL, have been selected for the 2016-17 academic year.

PhD candidate Abhishek Jaiswal of Kathmandu, Nepal, was selected as a **Computational Science & Engineering (CSE) Fellow** for his work on glass-forming metallic liquids. Advised by Assistant Prof. Yang Zhang, Jaiswal wants to develop a quantitative understanding of the atomic-scale dynamics of glass-forming metallic liquids.

Andrew N. Groll of Hardwood Heights, IL, and Daniel T. Elg of San Leandro, CA, have been accepted as **Mavis Future Faculty Fellows f**or the 2016-17 academic year. The MF3 Program in the College of Engineering was developed to facilitate the training of the next generation of great engineering professors. The three main components to the MF3 Program are research, teaching and mentoring.

Alpha Nu Sigma Society

ANS established Alpha Nu Sigma as a national honor society with the objective to recognize high scholarship, integrity, and potential achievement in nuclear science and engineering.

SPRING 2016 INITIATES

See page 38, top right.

Exelon Corporation | Energy for Education Scholarship

This scholarship program was established to encourage talented students interested in a career with Exelon Corporation. Exelon does business in 48 states, the District of Columbia and Canada, and is one of the largest competitive U.S. power generators.

- Shanna M. Bobbins of Bedford, NH
- Aristidis T. Loumis of Champaign, IL
- Adewale A. Adeyinka of Hoffman Estates, IL

Alpha Nu Sigma Society Spring 2016 Initiates

- Jin Whan Bae of Champaign, IL
- Carlos Felipe Bedoya Arroyave of Valle del Cauca, Colombia
- Andreas M. Giakas of Rockford, IL
- Matthew E. Kabelitz of Northbrook, IL
- Brandon T. Lee of Hermosa Beach, CA
- Kathryn A. Mummah of Wheaton, IL
- Dhruval K. Patel of Hanover Park, IL
- Eric J. Riewski of Champaign, IL
- Jifu Zhao of Urbana, IL
- Yuhui Zhao of Chicago, IL

CONTINUING MEMBERS

- Joseph L. Bottini of Framingham, MA
- Zhikun Cai of Jiaomei Town, China
- Michael M. Cheng of Chicago, IL
- Michael P. Christenson of Champaign, IL
- Quincy R. Crawford of Mahomet, IL
- Daniel T. Elg of San Leandro, CA
- 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
- Xiaochun Lai of Shanghang, People's Republic of China
- Xiang Liu of Zhongxiang, Hubei, China
- Daniel C. Martin of Glencoe, MO
- Benjamin C. Masters of Urbana, IL
- Jeremy J. Mettler of Sioux Falls, SD
- Peter A. Mouche of Naperville, IL
- Daniel J. O'Grady of Evergreen Park, IL
- 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
- Nathan C. Reid of Naperville, IL
- Xia Sang of Shanghai, People's Republic of China
- Joseph A. Serio of West Chicago, IL
- Steven A. Stemmley of Bethalto, 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
- Christian D. Zircher of Burr Ridge, IL

University of Illinois Chancellor's Scholars

Chancellor's Scholars are strongly motivated, academically gifted students who excel in leadership. Students participate in honors seminars, attend Scholar Adventurers presentations, and participate in social, intellectual and cultural activities, plus maintain a minimum cumulative GPA of 3.25.

- William R. Brockschmidt of Jacksonville, IL
- Quincy R. Crawford of Mahomet, IL
- Luke A. Hanselman of Monticello, IL
- Parth P. Patel of Huntley, IL
- Zoe R. Richter of Manito, IL
- James M. Stearns of Elgin, IL

University of Illinois James Scholars

This honors program is named for the fourth president of the University, Edmund J. James who believed that scholarship and research are fundamental to human progress. During his presidency, from 1904-1920, he brought world-class scholars to campus, developed graduate programs, and fostered community among faculty and students. He helped build Illinois's international reputation.

- Adewale A. Adeyinka of Hoffman Estates, IL
- Bilal Arshad of Astoria, NY
- Adolfo Baca of Addison, IL
- Joseph L. Bottini of Framingham, MA
- William R. Brockschmidt of Jacksonville, IL
- Peter M. Conway of Lemont, IL
- Quincy R. Crawford of Mahomet, IL
- Karla M. Del Cid-Ledezma of Rio Rancho, NM
- Siobhan M. Fox of Oak Lawn, IL
- Luke A. Hanselman of Monticello, IL
- Steven J. Jensen of Mount Prospect, IL
- Justin V. Joseph of Glenview, IL
- Brandon T. Lee of Hermosa Beach, CA
- Daniel C. Martin of Glencoe, MO
- Jeremy J. Mettler of Sioux Falls, SD
- Kathryn A. Mummah of Wheaton, IL
- Raymundo Muro-Barrios of New Lenox, IL
- Daniel J. O'Grady of Evergreen Park, IL
- Parth P. Patel of Huntley, IL
- Joseph N. Rajchwald of Glenview, IL
- Nathan C. Reid of Naperville, IL
- Xia Sang of Shanghai, People's Republic of China
- Austin J. Schmidt of Sycamore, IL
- Grant M. Schumock of Geneva, IL
- Jack T. Stahl of Arlington Heights, IL
- Steven A. Stemmley of Bethalto, IL
- Dan G. Strat of Lincolnwood, IL
- Justin D. Weberski of Saint Charles, IL
- Yuhui Zhao of Chicago, IL

KUMAR WINS JONES FELLOWSHIP

Graduate student Vineet Kumar was chosen for NPRE's Barclay G. Jones Fellowship. Alumni built the Jones Fund to honor the former NPRE department head and current professor emeritus.

"I am honored to receive this fellowship instituted to recognize Professor Barclay Jones's contributions," said Kumar. "Through this fellowship, I get a complete tuition refund and a monthly stipend to meet my living and other expenses. This has helped me in pursuing my doctoral degree and given me additional motivation to do research. I would like to thank Professor Jones, and the NPRE faculty, staff and alumni for their contribution towards his fellowship."

NPRE Emeritus Prof. Barclay Jones, graduate student Vineet Kumar, and Department Head Jim Stubbins

Under direction of Assistant Prof. Caleb Brooks, Kumar studies two-phase flows focusing on subcooled boiling and condensation for improving our predictive capabilities in transient operation and accident scenarios of pressurized water reactors.

Part of his research concentrates on collecting experimental data of natural circulation flows in a vertical annular test rig which is under construction. The application of this is to study passive cooling systems which are the new standard for reactor safety to provide long term cooling capabilities without operator intervention in light water reactors.

Kumar also works to improve sub-cooled wall boiling and condensation models in forced convective flows through experimental and analytical techniques.

"NPRE has a tradition of strong research focus on thermal-hydraulics and reactor safety and there are a substantial number of faculty engaged in experimental and computational modeling research," Kumar said of his reasons for choosing to conduct his work in the department.

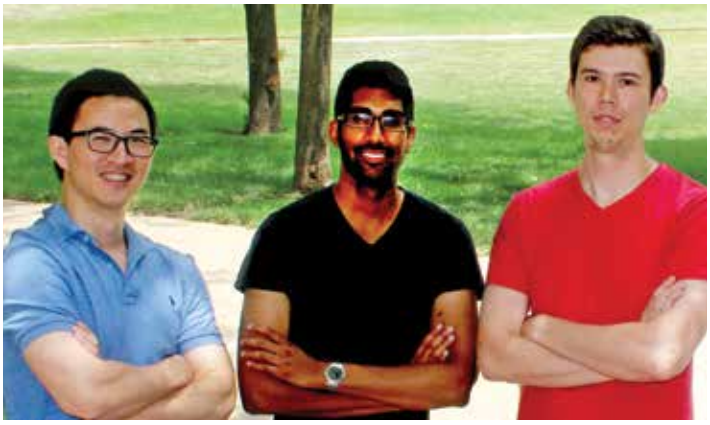
Over the past year alumni also helped achieve endowment status for the Roy Axford Fund Fellow, which will be awarded in 2017.

Radiological students excel in international competitions

Institute of Electrical and Electronics Engineers Nuclear Science Symposium/ Medical Imaging Conference

Graduate student Andrew N. Groll's paper won Third Place, Best Paper Competition among 130 student submissions at the IEEE NSS/MIC in fall 2015. Groll submitted "Hybrid Pixel-Waveform CdTe Detectors: Towards Sub-300 um Resolution PET Imaging of Transgenic Mice with Neurodegenerative Diseases," with researchers from Massachusetts General Hospital/Harvard Medical School. The work is highly valued for its potential application in preclinical studies aimed at investigating various transgenic mouse models with neurodegenerative disease through specialized CdTe hybrid semiconductor detectors. Specifically, Groll's interests lie in looking at the onset of beta-amyloid and tau protein formation in Alzheimer disease based models. The secondary benefit of this work is that a focus on Alzheimer's leads to natural application in other brain diseases as well. Currently, many individuals are exploring Chronic Traumatic Encephalopathy (CTE) which is a brain stem disease just recently found in many NFL athletes. The physiological markers present in AD are very similar to that of CTE leaving many opportunities for expanded research.

Graduate student Xiaochun Lai's paper was selected as **Finalist for Best Student Paper Award** at the IEEE NSS/MIC. Lai submitted "First Sub-500μm-Resolution Simultaneous SPECT/MRI Imaging with the MRC-SPECT-I: An Ultrahigh Resolution MR-Compatible SPECT System Using Highly Pixelated



Graduate students Xiaochun Lai, Jonathan George and Andrew Groll

Semiconductor Detectors." This presentation reports the latest progress on the development of one of the world's first SPECT camera allowing simultaneous SPECT and MR imaging, and the first simultaneous MR-SPECT images of therapeutically-engineered neural stem cells in mouse brain.

Society of Nuclear Medicine and Medical Imaging (SNMMI) 2015 Annual Meeting

Lai was recognized with **Second Place, Best Poster Presentation Award**, for his poster on the group's development of simultaneous imaging using Single-Photon Emission Computed Tomography (SPECT) and Magnetic Resonance Imaging (MRI). Groll and fellow graduate student Jonathan George 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.

NPRE UNDERGRAD WINS S&L SCHOLARSHIP

The College of Engineering at Illinois has selected NPRE senior Jazz Kroeger as a 2016 recipient of the Sargent & Lundy Scholarship.

Kroeger, of Washington, Illinois, was drawn to NPRE by an interest in nuclear engineering and now hopes to pursue a medical degree to become a radiologist. He plans to earn his bachelor's degree in Fall 2017.

The Sargent & Lundy Fund was established in 2000 by a dedicated group of Engineering at Illinois alumni and friends employed at Sargent & Lundy, a design firm that provides comprehensive services for complex power generation and power transmission projects. This fund provides scholarship support to high-achieving students from across the college.

Project to Boost Radionuclide Production Wins Hang Design Award

A student project to retrofit commercial nuclear reactors to create a supply of medical radionuclides was chosen as the 2016 winner of the Daniel F. Hang Senior Design Award in NPRE.

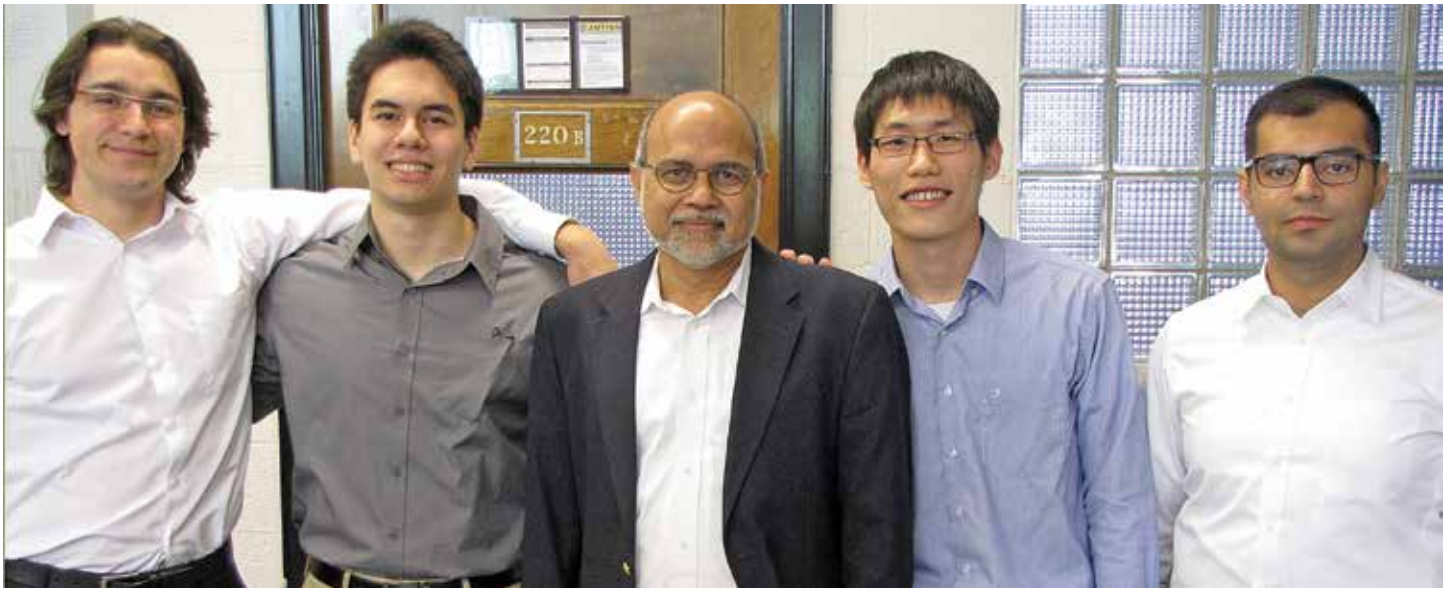
"Reactor- based 99Molybdenum Fabrication," a project of NPRE seniors Waleed Ahmed, Zhiee Jhia Ooi, Joseph Rajchwald, and Dan Strat, was conceived as a short-term solution to an imminent shortage of ^{99}Mo. A reactor-produced radioisotope, ^{99}Mo is used in radionuclide generators to produce technetium ^{99}m, which prepares radiopharmaceuticals for scanning the brain, parotid, thyroid, lungs, blood pool, liver, heart, spleen, kidney, lacrimal drainage apparatus, bone, and bone marrow.

The students maintain that a growing demand for medical radionuclides has strained current facilities' capacity to produce ^{99}Mo. They further noted that the two primary facilities producing the bulk of the isotope's supply in the United States are expected to cease operating within five years.

The students' design called for molybdenum pellets to be activated by inserting them into high flux regions of the cores of current nuclear reactors. The students used MATLAB programming to model the reaction yield with consideration of decay schemes.

"From a physical and mathematical perspective, the production of ^{99}Mo via the in-core instrumentation system proves feasible," according to the project abstract. "Further analysis shows that this method is economically feasible only when considering natural Mo^{98} oxide as the sample."

NPRE presents the Hang Award annually for the best senior design project in the department. The award is named for the late Prof. Daniel F. Hang, who was passionate about nuclear engineering design, and emphasized the coupling of economics analysis with successful design work. Professor Hang also strongly advocated students becoming licensed Professional Engineers. The award recognizes Professor Hang's commitment to and legacy in NPRE, particularly for undergraduate student professional development.



From left, students Dan Strat and Joseph Rajchwald, Prof. Rizwan Uddin, and students Zhiee Jhia Ooi and Waleed Ahmed

MUMMAH EARNS COLLEGE, CAMPUS LEADERSHIP AWARDS


Kathryn Mummah

NPRE undergraduate Kathryn Mummah was selected for college- and campus-level leadership awards this past spring.

The 2015-16 president of the American Nuclear Society (ANS) student chapter at Illinois, Mummah received the William R. Schowalter Award that the student-operated Engineering Council presents to recognize leadership skills, creativity, and encouragement of others through activities and dedication to the College of Engineering at Illinois.

Mummah, of Wheaton, Illinois, also was chosen for the Edith and Harry Darby Leadership Scholarship that the campus Student Affairs Office administers. The Darby Award is based on outstanding academic merit, as well as high achievement and excellence in campus leadership. It is expected that the winners will hold leadership positions in the upcoming academic year.

Mummah demonstrated leadership in recruiting NPRE students to attend and present at the national ANS 2016 Student Conference held at the Univeristy of Wisconsin in March. Nearly one-third of NPRE's 155 undergraduates attended.

BOBBINS CHOSEN AS KNIGHT OF ST. PAT


Shanna Bobbins

Shanna Bobbins, a senior in Nuclear, Plasma, and Radiological Engineering, was among 10 Engineering at Illinois students chosen as the 2016 Knights of St. Patrick.

Each year, the College honors 10-15 students who have demonstrated leadership, excellence in character, and exceptional contribution to the College and its students. The award is among the highest honors an Engineering at Illinois student can receive.

The American Nuclear Society (ANS) Student Chapter at Illinois nominated Bobbins, a Bedford, New Hampshire, native, who is focusing her studies on nuclear power and safety.

Bobbins has been active within ANS, having served as secretary and external vice president of the organization. She has led several professional development and educational events for ANS, including a visit to the Missouri University of Science & Technology research reactor. Bobbins was instrumental in developing ANS exhibits for Engineering Open House, as well as outreach programs with the local Boy Scouts. Also this year, she has initiated a Women in Nuclear (WIN) chapter under the ANS umbrella.

ANS recognized Bobbins' contributions by choosing her for the Spring 2016 Undergraduate Outstanding Service Award.

In addition to those activities, Bobbins has worked for Prof. David Ruzic as a teaching assistant in NPRE 101, Orientation to Nuclear, Plasma, and Radiological Engineering.

PECK WINS LAM RESEARCH OUTSTANDING GRADUATE STUDENT AWARD


Jason Peck

Lam Research Corporation, a Fremont, California, company that is the leading supplier of wafer fabrication equipment and services to the global semiconductor industry, has recognized NPRE graduate student Jason Peck with an Outstanding Graduate Student Award.

The honor recognizes Peck's work with plasma etching and PECVD of thin films. Peck is exploring the effects of introducing laser exposure to the plasma etching process, and has been able to activate etching in gas chemistries that normally do not etch, and enhance etch rates in recipes that do. He and his colleagues have studied standard materials of Si and SiO_2, and have explored other material candidates with which the laser-enhanced etching would perform well, particularly metals.

NPRE student helps develop winning startup in Nuclear Innovation Bootcamp

NPRE undergraduate Aries Loumis was a member of the winning team in the Nuclear Innovation Bootcamp that encourages student entrepreneurial thinking in design projects using nuclear energy.

Titled "Nuclear Upended," the inaugural boot camp, held in August 2016 at the University of California-Berkeley, brought together 25 students from nine countries to learn about nuclear energy's role in business development. With the help of mentors in nuclear industry and academia, the students divided into five teams to compete in the challenge of designing their own startup companies.

Loumis's team, Auzel, chose to develop technology for nuclear power plants to harvest energy from nuclear waste storage casks. The team worked on the premise that captured energy could be used as a backup power supply in times of emergency at the plants, or, during non-emergency periods, be used to reduce the plants' draw from the grid.

The design of the Auzel team, which included students from Purdue University, the Imperial College of London, the University of Missouri-Columbia and UC-Berkeley as well as Loumis, used photovoltaic cells to capture energy from infrared light emitted from the waste casks.

Auzel's business plan showed the company would break even in 7.6 years, and that customers buying the product would save money after 15 years. "I think the timespan would be fine because of the lifetime of the reactor in general," Loumis said, while also noting the technology's safety benefits of providing plants with backup power in case traditional power is lost.

Loumis's senior design project in Spring 2016 had a similar goal as the Auzel work, but his idea varied in that energy would be collected and harvested from the updraft of heat rising from nuclear waste storage casks. The work earned him second place in the poster competition at the American Nuclear Society (ANS) Student Conference last spring.

Loumis and the other Auzel members are discussing possibilities of pursuing the startup further. Meanwhile, he and another partner are pursuing technological development with his senior design project idea.

The boot camp was extremely worthwhile, Loumis believes. "I feel like the nuclear world is somewhat at a standstill in terms of innovation because of all the high regulations and fear regarding nuclear," he maintained. "I wanted to join the movement of the next generation of innovators and promote change within the nuclear community."

Student Aries Loumis has the microphone at the Nuclear Innovation Bootcamp.

Sridhar named to NAE

KR Sridhar, an alumnus of Nuclear, Plasma, and Radiological Engineering at Illinois and Chief Executive Officer and principal co-founder of Bloom Energy Corp., has been named to the National Academy of Engineering.

Sridhar, MS 84, PhD 90 *Mechanical Engineering*, was among five Illinois alumni, as well as Electrical and Computer Engineering Prof. Philip Krein, to be included in this year's class of NAE, one of the highest professional honors an engineer can garner. Its total 2,277 members and 233 foreign associates are an elite group distinguished by their outstanding contributions to the fields of technology and engineering.

Sridhar was recognized for contributions to transport phenomena and thermal packaging of electrochemical systems and generation of clean, reliable, and affordable power.

Producing such power from a wide range of renewable or traditional fuels has been the mission of Sridhar's company, based in Sunnyvale, California. Since its founding in 2001, Bloom Energy has been changing the way that energy is generated and consumed through the production of its energy servers, known as Bloom Boxes. These servers result in significantly lower electricity generation costs and greenhouse gas emissions.

Among Bloom Energy's most recent customers have been Morgan Stanley Global Headquarters in New York City, the AEG STAPLES Center in Los Angeles, and the Hyatt Regency Greenwich in Chicago.

Sridhar's novel contributions to clean energy production are so unique that he has attracted significant media attention, including a feature on 60 *Minutes* in 2012.

Prior to founding Bloom Energy, Sridhar was Director of the Space Technologies Laboratory (STL) at the University of Arizona where he was also a professor of Aerospace and Mechanical Engineering. Under his leadership, STL won several nationally competitive contracts to conduct research and development for Mars exploration and flight experiments to Mars. Sridhar's work for the NASA Mars program that involved conversion of Martian atmospheric gases to oxygen for propulsion and life support was recognized by *Fortune Magazine*, where he was cited as "One of the Top Five Futurists Inventing Tomorrow, Today."

Department Head Jim Stubbins, alumnus KR Sridhar, and Emeritus Prof. Barclay Jones

Sridhar was named one of *Time* magazine's "Tech Pioneers Who Will Change Your Life" in 2009, produced one of the publication's "50 Best Inventions of 2010," and earned the University of Illinois Department of Mechanical Science Engineering Distinguished Alumnus award in 2011. He is a member of the American Society of Mechanical Engineers (ASME) and the American Institute of Aeronautics and Astronautics (AIAA).

Binder to direct Argonne's Energy and Global Security sector

NPRE alumnus Jeffrey L. Binder has been appointed Associate Laboratory Director for Argonne National Laboratory's Energy and Global Security (EGS) directorate.

Jeffrey L. Binder

Binder will be leading EGS in advancing Argonne's missions in energy technology and in global and national security.

He brings to the position more than 25 years of experience working in national laboratories and academia.

Most recently, Binder served as the first Director of the Illinois Applied Research Institute (ARI) at the University of Illinois at Urbana-Champaign. In that position since 2013, he has led applied research efforts to complement and integrate with the university's missions in science, education, and economic development. He also was interim director of the Critical Infrastructure Resilience Institute.

As ARI director, Binder built relationships with federal agencies, the national laboratory system, the private sector, and other research universities.

Before starting in ARI, Binder worked at Oak Ridge National Laboratory (ORNL) from 2003-2013, rising to the position of Associate Laboratory Director for Nuclear Science and Engineering.

He was responsible for operating nuclear facilities and leading technology development and application programs that impacted fields ranging from basic science to reactor development to national security. Binder held a variety of other technical leadership positions, developing an engineering-scale demonstration project of spent nuclear fuel recycling and playing an instrumental role in the rebirth of ORNL's isotope program.

His career included tenure at Argonne from 1990 to 2003, holding a variety of positions culminating as director of the U.S. International Nuclear Safety Center.

Binder earned three degrees in NPRE: a bachelor's in 1985, a master's in 1987, and a PhD in 1990. He also earned a master of business administration from the University of Chicago.

Among his awards, Binder was recognized with the Secretary of Energy's Significant Achievement Award in October, 2011, for his contributions in leading the U.S. Department of Energy's response to the accident at the Fukushima Daiichi Nuclear Power Station in Japan.

He was presented NPRE's Distinguished Alumni Award in 2014, and is a member of the alumni group, the NPRE Constituent Alumni and Industry Advisory Board.

Coggeshall: 2016 NPRE Distinguished Alumnus

Honored with the 2016 NPRE Distinguished Alumni Award, Dr. Stephen Coggeshall returned to the Urbana campus recently to present a special seminar as well as join in the 50th anniversary celebration of Prof. Roy Axford.

Stephen Coggeshall

Coggeshall, Chief Analytics and Science Officer for ID Analytics in San Diego, California, presented "So You Want to be a Data Scientist," to a packed room on April 21. This talk, discussing aspects of data science relevant to people beginning their careers in the growing field, was presented from the perspective of a 25-year practitioner who has built and managed teams of data scientists across multiple industries.

Coggeshall has worked closely with ID Analytics, a leader in consumer risk management, since the company's inception, and has been instrumental in building the company's initial technical team and product roadmap. He has spent a 20-plus year career leading scientists to build practical solutions to difficult business problems using advanced analytics.

Prior to joining ID Analytics, Coggeshall served as an Executive Director at Morgan Stanley, working in the areas of asset allocation, portfolio analysis, stock selection, proprietary derivatives trading and behavioral forecasts of investors and financial advisors. He co-founded and was Chief Executive of the analytics consulting company, Los Alamos Computational Group, which worked primarily with Morgan Stanley.

Prior to that, Coggeshall served as Group Vice President of the technology development organization at HNC Software. He also co-founded the Center for Adaptive Systems Applications (CASA), where he managed a group performing consumer

behavioral and portfolio modeling and analysis (CASA was purchased by HNC Software in 2000).

Coggeshall's experience prior to CASA includes work in machine learning and adaptive computation; leading teams working with Citicorp, MasterCard and the Internal Revenue Service building applied solutions using advanced mathematical algorithms.

He spent 11 years at the Los Alamos National Laboratory in the field of laser fusion. Recognized throughout the industry for his work, Coggeshall received a Lifetime Achievement award from the *San Diego Business Journal* in 2012. A frequent presenter, Coggeshall co-authored "Foundations of Predictive Analytics," and his research has appeared in national news media such as the *Wall Street Journal*, *TIME Magazine*, and the *Today Show*.

Coggeshall holds undergraduate degrees in math, music and physics. From Illinois, he earned a master's in music in 1984, and a masters and Ph.D. in nuclear engineering in 1982 and 1984, respectively.

Myers: 2016 NPRE Advocate

William L. Myers is the 2016 winner of the NPRE Advocate Award.

Myers, who earned all three degrees in Nuclear, Plasma, and Radiological Engineering at Illinois (BS 95, MS 90, PhD 95), has been cited "for demonstrated leadership in building the resources that honor NPRE faculty and support NPRE students."

William L. Myers

Myers has demonstrated many times his commitment to giving back to his Alma Mater. Over the years he has worked with other alumni, including Mike Giacobee and Terrill and Debbie Laughton, in establishing and building several endowed NPRE funds: the Catherine Pritchard Scholarship, the Barclay Jones Fellowship, and, most recently, the Roy Axford Fund.

When presented the Advocate Award in April, Myers joined other NPRE alumni and friends in lauding Axford as he celebrated his 50th year of teaching at Illinois. Axford, who directed Myer's PhD program, had helped arrange for him an internship at the Los Alamos Critical Experiments Facility (LACEF) during the summer of 1989.

Myers has worked at Los Alamos ever since, and is now the Deputy Group Leader for the Los Alamos National Laboratory's Advanced Nuclear Technology Group.

He has served as team leader for the Active Interrogation team and currently serves as the programmatic team leader for the Criticality Experiments team. The team is responsible for executing the programmatic work performed at the National Criticality Experiments Research Center (NCERC), located at the Device Assembly Facility (DAF) at the Nevada National Security Site (NNSS—formerly known as the Nevada Test Site).

YOUR NPRE GIFTS COUNT!

The $42,000 given to NPRE by Exelon Corporation and many of the company's employees who are NPRE alumni helped endow the Roy Axford Fund at Fellowship status! NPRE will use the fund to support a graduate student in 2017 - a prime example of how much your gifts count! Find out how you can support NPRE's programs by contacting advancement directors Erin Kirby, **ekirby2@illinois.edu**, 217-244-1901, or Ross Williams, **rwilli@illinois.edu**, or go online to **npre.illinois.edu/about/make-donation-online**.

From left, Exelon representatives Ed McVey and Bruce Rash with Department Head Jim Stubbins

Teaching on the banks of the Boneyard: Ruzic explains hydropower

On a fair spring day, dressed, appropriately, in an Illini blue blazer and bright orange tie, David Ruzic strides through the middle of the Boneyard Creek cutting across the University of Illinois Engineering Quad.

A white board nearby stands steady in the stream as Ruzic wades in his muck boots, waving his arms emphatically, lecturing to the nearly 100 students lining the banks of the Boneyard. On first glance, he's like a revivalist collecting converts. But Ruzic isn't preaching—he's teaching—as he explains the power of hydropower.

For many of the years that the NPRE professor has taught NPRE 101-Introduction to Energy Sources, he has brought his class to the Boneyard to lecture on energy production through water flow. Fulfilling a general education requirement, the course is open to all majors on campus so it needs to appeal to more than just engineering students.

"I bring a lot of demonstration material for every single lecture I give, and I needed to teach a lecture about hydropower," Ruzic said. "It occurred to me we have a river on campus, so why not bring people to it to teach them."

"It turns out, (the Boneyard) is a terrible, lousy source of hydropower; it's only about 4 inches deep and was built to take all the rainwater away, not generate power," Ruzic continued. "But it's illustrative of the concepts and possibilities you need for hydropower, and people learn a lot more because they're not sitting in a chair in a classroom."

Steven Sabatini, one of the students in the class, appreciated the change of scenery. "I thought it was a good change of pace to take things outside. The notes were a bit sloppy, but I definitely retained the lesson and won't forget the information."

Said Ruzic's teaching assistant, Jeremy Mettler, "Using the Boneyard Creek to demonstrate hydropower is a great example of how Professor Ruzic's uniquely engaging teaching style helps to better inform students about key topics that will be extremely relevant in the coming decades."

A consummate teacher whose skills have been recognized with nearly every honor the university has to offer, Ruzic tends to entertain as he educates. On the first day of NPRE 101, he has appeared in a cloud of smoke; classroom demonstrations often involve explosions; and he has even set up an old-fashioned still to show how corn becomes ethanol. Students have voiced their appreciation–Ruzic's name perpetually appears on the List of Teachers Ranked Excellent by their students.

"I can only reach people if they come to class, so if you make the class fun and interesting they look forward to going to it everyday," he said. "By adding a little appropriate showmanship, people keep attending and it keeps them alert."

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