NUCLEAR, PLASMA & RADIOLOGICAL Engineering

# NPRE NEWS

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

FALL 2024

NEWSLETTER FOR ALUMNI & FRIENDS


# Illinois leads the way with Women in Nuclear

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# DEPARTMENT OF NUCLEAR, PLASMA & RADIOLOGICAL ENGINEERING

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**Syed Bahauddin Alam** | assistant professor
**Daniel Andruczyk** | research associate professor
**Caleb S. Brooks** | associate professor
**Davide Curreli** | associate professor
**Angela Di Fulvio** | associate professor
**Kathryn Huff** | associate professor
**Tomasz Kozlowski** | associate head, undergraduate programs | professor
**Leon Liebenberg** | teaching professor
**Ling-Jian Meng** | professor
**Zahra Mohaghegh** | associate professor
**April Novak** | assistant professor
**Dren Qerimi** | research assistant professor
**Magdi Ragheb** | associate professor
**R. Mohan Sankaran** | professor
**James F. Stubbins** | professor
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**Jianqi Xi** | assistant professor

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**George Miley**
**David Ruzic**
**Clifford Singer**
**William Roy**
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**Robert Stubbers**
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# Dear NPRE Family,

Rizwan Uddin

Disclaimer: This letter was partially written with the assistance of a large language model (LLM). As you're likely aware, these LLMs are driving significant disruptions across society. It's crucial that we prepare our students for the workplaces of the future. While academia continues to navigate its response to these advancements, students are often far ahead of faculty in adopting and utilizing these resources.

Here are the instructions I included in my course syllabus this semester for a 5-page paper:

***LLM (ChatGPT) policy***

*If you want, you can use LLMs (such as ChatGPT) for help with the paper writing part. Grading will reflect the fact that assistance was available from a LLM. In case you do use a LLM, here is what you need to submit:*

*A. All raw text (that is, all prompts, and the responses in their raw form). Put these in an Appendix.*

*B. Any edits that you do to the LLM text should be in track-changes mode, and a version of your paper should be submitted in a form to make it clear what came from the LLM, and what is it that you did.*

*C. A final and clean version of the paper (with all track-changes accepted), appropriately formatted.*

I'm not sure how this will turn out, but what is quite certain is that learning landscape in ten years is likely to be very different from what we have today. It was already becoming challenging to convince students why they should know certain facts without relying on their cell phones. Now it will be difficult to convince them why they should learn how to solve (numerical) problems when their cell phones can solve those problems in much less time.

Maybe the problem is with us! Interesting times ahead, but let's look at the bright side.

As we move through 2024, it's exciting to reflect on our department's progress and evolution. Our commitment to growth and excellence remains strong, and this year has brought both new beginnings and heartfelt farewells.

Our students are at the forefront of our mission, as always. Our award-winning chapters of Women in Nuclear (on the cover) and the American Nuclear Society lead the way with outreach and engagement, and we are proud of all of the work our students do both in and out of the classroom.

This year, we are pleased to welcome two new faculty members to NPRE. Assistant professor Jianqi Xi and research assistant professor Dren Qerimi joined us since my last letter, each bringing fresh perspectives, expertise, and enthusiasm to their respective fields. Their arrival marks another chapter in NPRE's journey as we expand our capabilities and offerings, ensuring our students benefit from the best resources and mentorship possible.

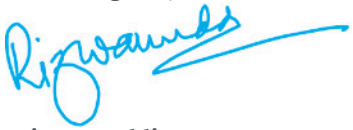
Alongside these new arrivals, we also celebrate the impactful careers of two esteemed colleagues, Professors David Ruzic and Brent Heuser, who have retired after years of dedicated service and leadership. Their contributions to research, teaching, and mentorship have shaped NPRE in countless ways. David's pioneering work in plasma-material interactions and Brent's expertise in materials science have set benchmarks in their fields and inspired generations of students. We are deeply grateful for their lasting legacy in our department. They both plan to continue to engage in research.

Our facilities continue to grow as well, with expanded spaces for research and collaboration in Talbot Laboratory, including our new simulator lab. These facilities, along with a renovated student lounge, reinforce our commitment to providing an environment where both faculty and students can thrive.

The strength of NPRE lies in the support of our community, and thanks to you, we can continue to enhance undergraduate research opportunities and student development programs. This year, we are launching a new fund focused on student development, social events, and professional growth, ensuring our students have the resources they need to excel. You can read about the efforts of one alum, Craig Vodnik, and the impacts of some of our named scholarships and fellowships in the following pages. We are also setting up the Blair and Jennifer Bromley Canada-US Friendship Award to be given to an undergraduate student in NPRE who has demonstrated academic/scholastic merit, and who has shown accomplishments and dedication to one or more of the following: participation in RSOs and professional nuclear organizations such as the American Nuclear Society (ANS), Women in Nuclear (WiN), and North American Young Generation Nuclear (NA-YGN); public engagement; and public education and outreach.

Thank you for being part of this great community. I invite you to explore these pages and stay connected with us through our website and social media.

Warm regards,



***Rizwan Uddin***

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## About the Cover

NPRE is home to multiple award-winning student organizations, including Women in Nuclear, who grace the cover of this year’s issue. They received the Chapter Excellence Award this past summer, continuing a tradition of national recognition for their work. This year’s executive board posed in front of Talbot Laboratory. Pictured are: (Top row, from left) Fundraising Chair **Olivia Hunsberger**, Social Chair **Olivia Evans**, Content Chair **Abby Kuhn**; (middle row, from left) Outreach Chair **Xochil Arteaga**, Secretary **Emily Gillmore**, Co-President **Bella Pequette**; and (Bottom row, from left) Co-President Nitika Purohit, Professional Development Chair **Natalie Weissburg**, Treasurer **Emma Barrera.**

## COVER STORY "Passionate" Illinois chapter of Women in Nuclear stands above its peers

**When you are in the thick of work, sometimes you don't realize your successes until you hear about them from someone else.**

In the case of our University of Illinois chapter of Women in Nuclear (WIN), being named the most outstanding student chapter in the country came as a surprise to its current members, even though it's the second time in five years the chapter has earned such an honor.

The chapter's current leadership is quick to point to their predecessors, including last year's co-presidents, Madeline Morasca and Nataly Panczyk, as a huge contributing factor to their national recognition.

"I didn't really expect it," said co-president Bella Pequette, a senior from Tinley Park, Ill. "A lot of the work that was done was done by previous presidents, like submitting metrics and records of the things that we do. You don't notice how much work you've done until you see it accumulated and realize that you've done a lot."

"As you go through the year, we do one to three events per month," co-president Nitika Purohit, a senior from Boston, Mass., said. "It doesn't seem like a lot, but when you start listing them


all out, you realize it is. When we compare the work we've done with other chapters, I thought the amount of work we'd done was pretty standard, but clearly, it's not."

From month to month, the WIN chapter holds meetings and outreach events in the community. There are also more social

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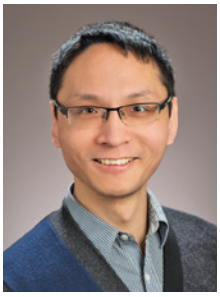
## Jianqi Xi joins NPRE faculty, aiming to advance nuclear materials safety and research

**Assistant professor Jianqi Xi has joined NPRE at Illinois this semester after spending the last few years as a postdoctoral researcher and scientist at the University of Wisconsin-Madison.**

For Xi, the post in NPRE is his first faculty appointment, and he is enjoying the opportunity to fully join the field of nuclear energy and be an independent researcher. "I will develop one independent and interactive research group to extend my modeling efforts to this community," said Xi, who made the move with his wife and infant child. "So far, (the experience has been) pretty good."

A native of China, Xi was awarded his PhD in 2017 from the Materials Science and Engineering Department at the University of Tennessee-Knoxville. His graduate degree work involved the application of advanced computational techniques to study radiation defects in ceramic compounds.

Following his PhD work and a brief postdoctoral appointment at UTK, he joined the Materials Science and Engineering Department at UW-Madison and worked in the area of computational materials science. He developed multiscale micro-



kinetic models to study the behavior of hydrogen during hydrothermal corrosion, as this process pertains to light water nuclear reactors.

After beginning his studies in thermal energy fields, Xi shifted gears in grad school after Fukushima Daiichi nuclear accident in 2011. "I saw the need to join this field and do more to make sure what happened there doesn't happen in the future," Xi said.

He started studying nuclear materials, turning his focus to the degradation of materials in nuclear power plants and trying to improve safety in nuclear power. Currently, his research is based around modeling and providing strategies to help engineers design materials to improve reactor safety.

Xi hopes to add to what longtime Professors James Stubbins and Brent Heuser have built in the materials portion of NPRE with his modeling expertise. His Modeling of Nuclear Materials (MNM) research group currently has one PhD student and two other undergrad students.

# New nuclear simulator at NPRE offers students hands-on, risk-free training in reactor operations

**In recent years, NPRE has expanded the educational and research opportunities for its students and faculty, including new labs in and out of Talbot Laboratory and the establishment and growth of the Illinois Plasma Institute.**

NPRE now also has a classroom-size nuclear simulator that allows students to learn and make mistakes without the risk of a meltdown.

"The simulator's most important role is that it mimics, in an excellent way, the control room of a nuclear power plant," NPRE professor Tomasz Kozlowski said. "What you see on the screen is the simulation of a control room, but behind it is a computational engine that does very accurate simulations of a nuclear reactor, including the vessel, primer system, pressurizer, pumps, valves, even the electrical grid outside of the turbine."

NPRE's simulator can emulate the conditions at both a PWR (pressurized water reactor) or BWR (boiling water reactor), the only two types of commercial reactors currently in the United States.

The huge benefit for the department, in teaching and research, is that it's a full scope simulator. "You could even simulate what happened in Fukushima," Kozlowski said, referencing the 2011 disaster in which an earthquake and tsunami in Japan which resulted in electrical grid failure and damaged nearly all of the Fukushima Daiichi power plant's backup energy sources.

"Another exciting application is to teach about the consequences of transients and accidents for the existing reactor fleet," graduate student Anthony Boyd said. "In an accident, it will be a very stressful environment, so training to handle the situations and mitigate correctly is important. Lastly, it will be key for the advanced reactor space to create simulators for these reactors to train future operators and study their potential transients."

"We're lucky to have a simulator at NPRE that can run operating and accident scenarios for PWR and BWR," graduate student Sohaib Malik said. "Observing how the reactor responds to different transients has really helped me understand nuclear systems and components better."

One of the missing components of the educational experience at NPRE has been the absence of a nuclear reactor since the TRIGA reactor was decommissioned decades ago. The university continues to work to bring a microreactor to campus, which is a long and expensive process. The presence of a simulator fills in the gap for the time being.

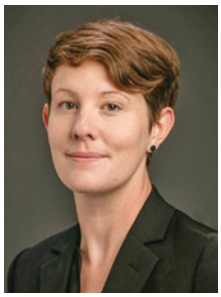
"In terms of research, there are good opportunities to use the developer modules and functionality in the simulator to design and test various neutronics, fluid flow, and heat transfer models, especially for advanced reactors," Malik said.

This year, the simulator is being used in required courses such as NPRE 247 (Modeling Nuclear Energy Systems), 455 (Neutron Diffusion and Transport), 449 (Nuclear System Engineering and Design) and other related electives.

Kozlowski says that at some point, every student coming through will have used it for at least one of their classes.

"As a student getting the chance to work with the reactor simulator, I have appreciated the opportunity to see how the systems and components talked about in class are used in a real control room," Boyd said. "Seeing how the theory we discuss gets applied and impacts the reactor can be helpful for preparing students for the industry."

# Q&A "Dusting off the cobwebs": NPRE's Katy Huff returns to academia after time at Department of Energy



**Just over three years ago, Katy Huff was an assistant professor at NPRE, teaching, researching, and working on the early stages of the university's micro-reactor project. Then Washington came calling, and she was tapped to join the Department of Energy and lead its Office of Nuclear Energy. After three years of public service, where she helped shape national energy policy, she's back at Illinois, ready to take on life in academia again. Below is an edited conversation with the associate professor on her time in D.C. and what she missed during her time away.**

*How does it feel to be back?*

It's great. I love being a professor. I love being on campus. The important work of being with students and doing research is what really makes me happy. Of course, the work at the DOE was also important in its own way, but it was time for me to come back. I really missed it here.

*How often would you think about things (at Illinois) when you were (in Washington, D.C.)?*

Every day. Every day, I thought about the difference between my former life and my life as the Assistant Secretary. Every day, there were important lessons that I'd learned from being a professor that I was able to bring into my job at DOE, like frugality, for example. A lot of folks who come from industry and national labs don't have the kind of perspective on how far a dollar can go in the public sphere that faculty do. That perspective—how to be more frugal and more careful with a dollar, especially a public dollar—really served me a lot. I routinely thought about the billions of dollars that we were proposing to spend, and my default was to compare that to the cost of a graduate student over the course of a year. How many graduate student stipends could these billions of dollars support instead? So, it was very easy for me to make judgments about the value of a decision and reach decisions based on what the right path for an American taxpayer dollar was going to be.

*Does campus feel different to you? Do you feel like you've come back to the same place?*

There's a great Nelson Mandela quote ("There is nothing like returning to a place that remains unchanged to find the ways in which you yourself have altered."). I've been thinking about that sort of theme a lot because Illinois fundamentally is still the strong engineering institution that it was three years ago when I left it…I've changed a great deal, and certainly Illinois has gotten new buildings and new people and it has a nice sheen of newness…Returning to the familiarity of the University has given me a little bit of a mirror to reflect on the ways in which I myself am a bit different than I was three years ago.

*Is it weird to have almost an entire senior class go through that hasn't taken a class with you?*

Oh, it's so disappointing to have missed a whole class of students, because every class is a group of students that have a diversity of ideas, and they shape the students that come after them. It's disappointing to have missed a year or two of those cohorts, and this (Class of 2024) will not have had any classes with me. That's a shame because I love meeting and getting to know all the students that make it through our program. Hopefully, some of them interacted with me at student conferences and whatnot.

*Obviously, there was a distance you had to keep from the university and everyone here while at DOE (to prevent conflict of interest). Did it hurt to not be able to be as closely involved with your Illinois students while you were on leave?*

I was lucky that the university set up the system it did so I could walk away from my grants and students and whatnot to maintain that prevention of conflict of interest. I'm so grateful for the department supporting Madicken Munk to run the research group, but it was really hard to be away from my students. And it's even harder now, looking over how much their dissertation work has progressed and trying to catch up to them. There's a lot of co-learning that happens in the graduate student mentorship activity that I missed out on. I have to catch back up to some of them that are still around and dust off the cobwebs in my brain!

*Was there ever a point when you considered not coming back to Illinois?*

Never. I had many opportunities, especially as I was leaving DOE, that were certainly worth considering. From the beginning, from day one, I wanted to return to Illinois. Not only did I owe it to the university, but I also really love being here. It's a fantastic institution. Being a professor is the best job in the world, and frankly, I owed it to the students, especially the ones that I orphaned the first time.

*Do you feel that you made a difference in your time at the DOE? I realize it may be too soon to know or do you already have a sense of it?*

There are some things that definitely have already had an impact, especially in the university program. By coming in with more of an academic perspective than any of the previous assistant secretaries, I was able to make substantive changes to the university program in (nuclear energy) that will improve it and have already improved it, including the instantiation of the Distinguished Early Career program. We already have a recipient

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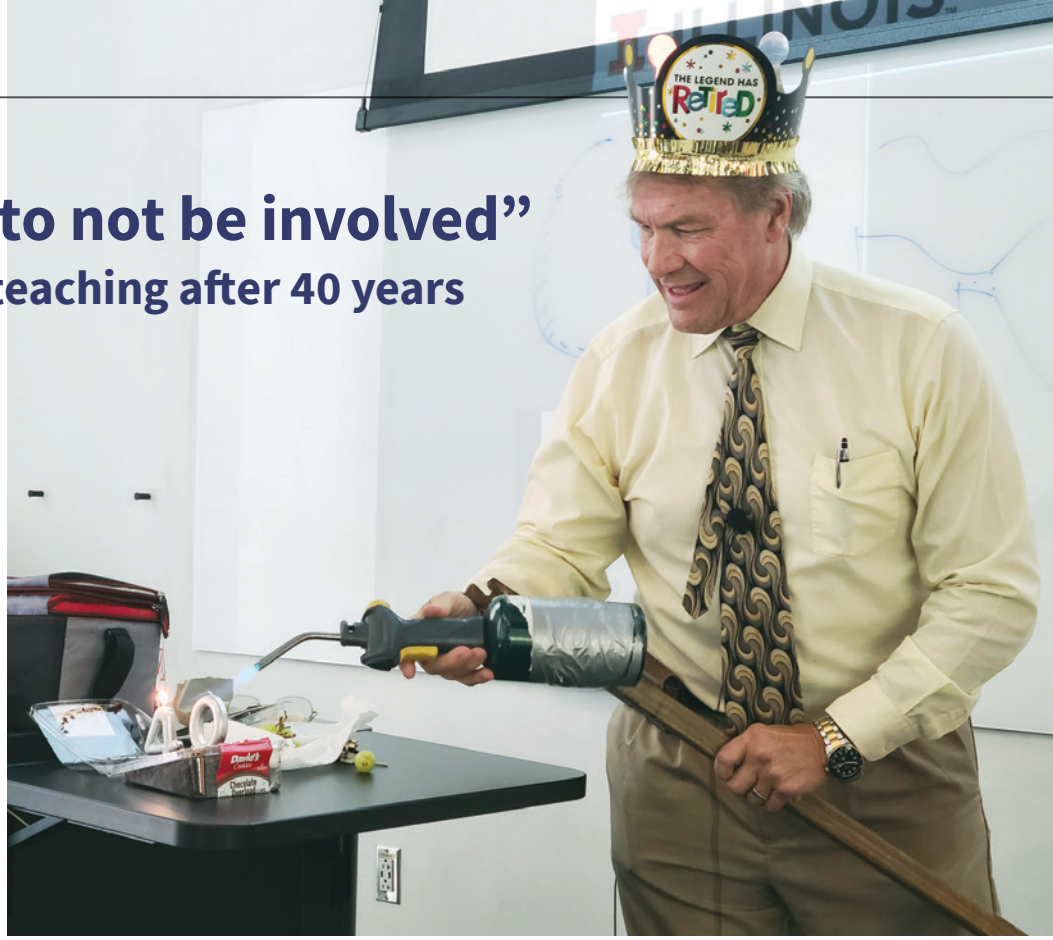
# “I never planned to not be involved”

## Ruzic says goodbye to teaching after 40 years




*“The first time I met Dave was in 2008 when I interviewed for a position at UIUC (which I didn’t get, but that’s for another story). Before that, I only knew that he works on plasma/fusion, and nothing else. When we met, it was quickly apparent I was standing in front of a charismatic, enthusiastic, and brilliant professor, an impressive person in character, mind, and spirit…Over the years, I have gotten to know him better, as a passionate teacher, fierce advocate and caring mentor for his staff and students. His lectures are legendary, his classroom never has a problem with attendance; it is always full of students eager to watch and listen to his every word. A YouTube channel with almost 100K subscribers? Only Dave could do it!*

*Despite his heavy workload and full schedule, he was always available for me with constructive and supportive advice on research, teaching, and navigating the university system. Always positive, inspiring, and brave. Walking on water? Done! Dave, I wish to be as brave as you.”*

***—Tomasz Kozlowski***
***NPRE Professor and Associate Head for Undergraduate Programs***

June 30, 2024 marked the (partial) end of an era in NPRE, as Professor David Ruzic officially retired from teaching at the University of Illinois after 40 years. But by the time fall classes start up again, Ruzic will be back on campus continuing his research both at the Center for Plasma-Material Interactions (CPMI) and the Illinois Plasma Institute (IPI).

Ruzic said he first began thinking about retirement about four years ago, after he had completed 36 years of service.

“I think I came to the realization that I don’t have enough time to work on all my research projects,” he said. “The Illinois Plasma Institute has been very successful. The work with ASML, the fusion work now has private fusion companies. There’s the ***U.S. C.H.I.P.S. Act***, with all the areas I’ve been working in are now going very strong. (My work) with Starfire (Industries) is going great.

“For instance, I have 18 graduate students, which is way, way too many. So how can I spend more time with the students doing research? And my answer was, duh, I can retire. Because then, all the time I spend teaching and the time I spend doing service activities, I will be able to spend working on research instead… and hopefully a few more fun activities that my wife would enjoy doing, too.”

Much can change over 40 years. When Professor Ruzic began his teaching career in the mid-1980s, the Internet was a long way from being a part of our everyday lives and changing how research was done and spread. Plasma science and engineering evolved in that time, but what has been consistent over the decades is how Ruzic approached his job.

“The qualities people talk about me are often my enthusiasm and personal involvement, and that hasn’t changed,” Ruzic said. “I have clearly learned a lot more, become a lot wiser, seen a lot more things…As a professor, especially a young professor, you’re constantly worried. Am I going to get enough funding to be able to pay for the students to pay for my own summer salary to pay for the equipment we need? Where is the next grant going to come from? I don’t worry anymore… I think the change in me is when you’re not worried about that as much, you can make sure that the students are progressing, and you can try to get your new ideas and concepts out.”

*I will never forget the first night I flew into Champaign. David and Marilyn picked me up from the airport and drove me to my apartment. David*

*was so enthusiastic about the University and town and you could see the love he has for the place. The next day he picked me up in his convertible, that is always an experience and he showed me around the university and lab. After settling in and getting all the things sorted out, he helped me with getting a car rental so I could get all the basics I need for my place. The next day David sits me down and asks where do I want to be, what is my goal? This is a question all students and post-docs get and its one I have adopted as well. Our jobs as professors and advisers is to help the people we look after become the best they can. For me, I wanted to work at PPPL (Princeton Plasma Physics Laboratory), and within about a year, I was over at PPPL. I will never forget and always cherish the advice, help and time that David put in to make me the best version of me. He has a way of doing that with everyone."*

***—Daniel Andruczyk***
***NPRE Research Associate Professor***
***Coordinator, Master's of Engineering in Plasma Engineering***

Fusion. Semiconductors. Microchips. EUV. Lithography. Atmospheric pressure plasmas.

Those are all terms and concepts that have been hallmarks of Ruzic's research over the years, but what has set him apart, besides his devotion to his students, has been his work to integrate that research with industry.

Through his time developing CPMI and now IPI, Ruzic has found ways to bridge the gap between between the lab and the marketplace. That also includes his work with Starfire Industries, a technology firm run by Brian Jurczyk and Robert Stubbers, two of Ruzic's former postdoctoral researchers.

"I took some interest in and worked with the company and it has grown tremendously in the products that they've developed, some of which I'm the first name on the patent," Ruzic said. "It's one thing to say, 'Hey, I've got this idea.' It's another to actually sell a product that uses it. And that's not something a professor usually gets to do."

*"One of my fondest memories with David occurred when I was a graduate student. During a conference in California, David and a few of us from the CPMI group attended an evening social/networking event. Suddenly, a gentleman approached David. It turned out he was a senior director at Intel. He greeted David warmly and said, "David, thank you for giving us some of the best engineers we've ever had. Your students are the only ones who know how to get things working right from the start." That moment was one of the highlights of my graduate school experience and made me incredibly proud to be part of David's group."*

***—Dren Qerimi***
***NPRE Research Assistant Professor***

After 40 years, thousands of lectures, and hundreds of classes, that part of Ruzic's career is over. He will now fully turn his attention to his research, the continued mentorship of graduate students, and the succession plan for CPMI and IPI.

"All of them can continue, and my involvement can lessen overtime," Ruzic said. "However, like (Professor Emeritus) George Miley, I never planned to not be involved. George (who is in his 90s) still has a studentTherefore, I would like to be in that position, where for the rest of my life, I have at least some research involvement.

"I sincerely hope that when I come back, I'm working fewer hours per week, right? It might be impossible just because of my personality. But I'm hoping that that's the plan."

*"I am very fortunate to have had such a great professor, advisor, and mentor as Professor David Ruzic. His contagious curiosity of experimental work and his fiery passion to teach inspired my career immensely. From preparing explosive in-class demonstrations to repairing lab equipment to enhancing presentation skills for conferences, Prof. Ruzic's guidance and enthusiasm helped shape me into the engineer I am today. Congratulations, Professor, on a great education career and thank you for all that you have taught me!"*

***—Bob Lofgren***
***NPRE BS '08, MS '10***

# Paper from Alam group examines sensor degradation, the missing piece in nuclear plant monitoring

Understanding materials degradation is critical to determining nuclear power plant lifespans, but analyses overlook a key factor for nuclear plant applications: how the sensors used to assess the materials also degrade. A new paper shows how sensor degradation can be explicitly determined from real nuclear plant data and used to determine more accurate remaining useful and efficient lifetimes for nuclear reactor pressure vessels.

Researchers at the University of Illinois Urbana-Champaign, led by NPRE assistant professor ***Syed Bahauddin Alam***, have implemented a data-driven model for sensor degradation for reactor pressure vessels based on nearly 26 years of data from the Ameren Missouri Callaway Reactor 1. As reported in the journal ***npj Materials Degradation***, the model allowed the researchers to considerably refine calculations of the nuclear reactor pressure vessel's lifetime.

"Despite the importance of understanding sensor degradation in assessing quality, reliability and safety of nuclear reactor pressure vessel, there's very little data-driven work on the nuclear plant and asset monitoring," Alam said. "Ours is one of the first works to incorporate nuclear plant data into existing sensor models and calculations for reactor pressure vessel, and we're continuously expanding it to include more data and create more powerful models."

Materials in nuclear reactors are subjected to extreme heat and radiation, so they naturally degrade. Assessing this degradation is critical to determining when reactor components have reached the end of their useful lives. While this is a major research focus in nuclear power, most efforts do not consider how the degradation of sensors used to monitor the reactor pressure vessel can impact assessments.

"Degradation of reactor components and pressure vessel is itself a statistical process, but the degradation of the sensors adds another statistical process on top of that," said Raisa Hossain, a graduate student in Alam's group and the study's lead author. "We used an established and proven algorithm called the Kalman filter to simultaneously extract the details of both the component and sensor degradations from the final sensor readings, where the two degradations compound."

When the researchers simulated pressure vessel degradation with their model, they found that excluding sensor degradation led to noticeably different estimates for the remaining useful life. Alam and his group plan to build on this result and develop even more sophisticated methods for safety and reliability analysis.

"We demonstrated that data-driven degradation models are possible, but we're in the process of building machine learning models that can very accurately capture degradation effects," Alam said. "We're even having distributed fiber optic sensors in our lab to test out our ideas."

The study, "Sensor Degradation in Nuclear Reactor Pressure Vessels: The Overlooked Factor in Remaining Useful Life Prediction," is available online. DOI: ***10.1038/s41529-024-00484-4***

Kazuma Kobayashi, a graduate student in Alam's group, also contributed to this work. Alam is also a faculty affiliate of the National Center for Supercomputing Applications at Illinois.

## COMMENCEMENT

# SoTeRiA Laboratory teams up with law school to analyze risk-informed regulation of advanced nuclear reactors

The Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory, led by NPRE Associate Professor Zahra Mohaghegh, has teamed up with UIUC College of Law Professor Arden Rowell on a new research grant from the Nuclear Regulatory Commission (NRC). The grant, titled "Context-Based Analysis of a Risk-informed, Performance-based Regulatory Approach for Advanced Nuclear Reactors," will span from 2024 to 2027.

This project aims to address the NRC's needs in researching performance-based, technology-inclusive safety assurance, evaluating technical gaps and major uncertainties in assessing risk for advanced reactors. By focusing on the engineering-informed legal and regulatory context, the team will conduct a context-based analysis to better understand the legal and institutional frameworks for regulating advanced nuclear reactors. The project will systematically evaluate engineering, legal, and policy literature regarding the existing approaches for regulating technological systems to identify potential scholarly gaps of risk-informed performance-based approaches to regulating advanced nuclear reactors. The team will also develop a case study on the regulation of an advanced nuclear design and share insights and recommendations.

The Principal Investigator (PI), NPRE Associate Professor Zahra Mohaghegh, emphasized the value of this project as a collaboration between engineering and law experts to support NRC's risk-informed regulation. "Because accident scenarios must consider social and environmental distress, managerial deficiency, and human error as well as physical and technical system failures, I believe that risk analysis and risk-informed regulation require the development of a common vocabulary within diverse engineering and social science domains to address risk emerging from the interface of social and technical systems," said Prof. Mohaghegh.

She has dedicated most of her professional life to socio-technical risk analysis, beginning with her Ph.D. thesis on organizational safety risk analysis, and later with her Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory at UIUC. Her contributions to nuclear safety include projects such as the risk-informed resolution of Generic Safety Issue-191, the IAEA project on risk-informed methods for advanced water-cooled reactors, and leading the risk management focus area of the DOE review panel of the Carbon Free Power Project for the small modular reactor plant. Additionally, she has consistently applied her expertise in nuclear risk analysis to a wide array of technological challenges, thereby contributing to enhancing policymaking and regulation across sectors. Examples include her service as a member of the Committee on "Transport Airplane Risk Assessment Methodology" and the Committee on "Improving the Efficiency and Effectiveness of the Coast Guard Certificate of Compliance Examination Program for Gas Carriers" of the U.S. National Academies of Sciences, Engineering, and Medicine.

Co-PI Arden Rowell brings to the project her experience as an academic specializing in risk regulation and decision making by federal agencies. Her involvement will integrate an applied policy element, magnifying the impact of the project by ensuring that its key findings and recommendations can be incorporated into law and policy.


"The NRC's legal responsibility to regulate nuclear energy has never been more important," Rowell emphasizes. "Reactor technology is advancing rapidly even as the risks of relying on fossil fuels become increasingly apparent. How can NRC best regulate the risks and opportunities presented by advanced reactor technologies, while still staying true to its legal and democratic mandate to protect people and the environment? This is a legitimately difficult question, and I hope that our collaboration can help NRC craft a creative but implementable answer."

Prof. Rowell's experience collaborating with engineers, scientists, and social scientists has generated a broad body of work meant to support agencies in making complex decisions, including in the face of multiple hazards and extreme risks; where they must balance catastrophic risk with extreme "upsides;" in managing environmental, climate, and long-term risks; and in integrating ethical, economic, and psychological concerns into agency decision making, including in circumstances where agencies must work within a complicated legal and regulatory landscape. More generally, Prof. Rowell's interdisciplinary expertise in law, human behavior, and risk analysis enriches the team's ability to design solutions that can be effectively used by the NRC—while remaining implementable by industry and democratically accountable to the public. Finally, her focus on public welfare and safety is invaluable in ensuring that the public policy goals of safety and sustainability are furthered by this research.

Professors Mohaghegh and Rowell are affiliated with the Beckman Institute for Advanced Science and Technology at UIUC, where engineering and non-engineering experts collaborate to address complex real-world problems. They have previously collaborated on a DOE project and are now looking forward to a new collaboration under this NRC grant, supporting the enhancement of risk-informed performance-based regulatory approaches. This project will aid decision-makers and stakeholders in ensuring safe, resilient, sustainable, and socially and environmentally responsible technological advancements for nuclear energy.

# Liebenberg unveils innovative textbook redefining energy systems education with real-world projects and sustainable solutions

NPRE teaching professor Leon Liebenberg has released a transformative new textbook, *Energy Systems: A Project-Based Approach to Sustainability Thinking for Energy Conversion Systems*. Published by John Wiley and Sons, this state-of-the-art guide is set to redefine how energy systems are studied and understood in today's rapidly evolving field.

This pioneering textbook offers a comprehensive and multidisciplinary exploration of contemporary energy technologies, designed to serve as an essential reference for both students and practitioners. Unlike traditional texts, Liebenberg's book employs a guided self-study approach, breaking down complex theories into "bite-sized" chunks. It features a wealth of practical resources, including numerous worked examples, quantitative and qualitative practice problems, and ten real-world mini-projects. Additionally, readers will benefit from exclusive interviews with emerging energy innovators and engineering students, providing fresh perspectives on the future of energy.

At the heart of Energy Systems are pressing questions that challenge readers to "reimagine our future" with a strong emphasis on sustainable energy solutions. The book is structured to align with the entrepreneurial mindset, encouraging critical thinking and innovation throughout its chapters.

The textbook delves into the core principles of thermodynamics, fluid mechanics, and quantum mechanics, while exploring a broad spectrum of energy conversion technologies. Topics include energy supply and demand, the science of global warming, sustainability interpretations, chemical fuels, carbon capture and storage, various combustion engines, vapor power and refrigeration plants, nuclear power, solar energy, fuel cells, wind and water energy, and energy storage solutions. The final chapters focus on strategies to decarbonize transportation, industry, buildings, and the electric power sector.

Energy Systems stands out for its practical, easy-to-use organization, ideal for a 14-week course schedule. It strikes a balance between theoretical insights and real-world applications, providing readers with the tools and knowledge needed to assess energy systems and envision innovative solutions.

Key features of the textbook include:

- Seamless integration with a standard course timeline
- A blend of theoretical and industry-related content with real-world examples
- Valuable teaching resources such as mini-projects, practice problems, remedial appendices, and online study notes

This book is an invaluable resource for students and instructors in courses related to Energy Conversion Systems, Energy Science, Sustainable and Renewable Energy, and the broader Social, Technological, Economic, Environmental, and Political contexts. Energy professionals will also find it an essential tool, thanks to its in-depth summaries and practical problem-solving approach.

Liebenberg himself will be using the book in his courses this year, including:

- ENG 571 (Theory of Energy and Sustainable Engineering)
- ENG 471 (Energy and Sustainable Engineering Seminar)
- ENG 572/3 (Professional Practicum/Capstone Project)
- NPRE 480 (Energy and Security)

*Energy Systems: A Project-Based Approach to Sustainability Thinking for Energy Conversion Systems* is now available from John Wiley and Sons.

## NPRE PARTNERS WITH FILIPINO COMPANY TO TRAIN NUCLEAR STUDENTS

The Philippines' Manila Electric Company, known as Meralco, is set to send five scholars to the U.S. and China to study nuclear engineering as part of its Filipino Scholars and Interns on Nuclear Engineering (FISSION) program. The scholars will attend the University of Illinois Urbana-Champaign and Harbin Engineering University for two years, followed by internships at nuclear technology firms. Upon their return in 2028, the students will join Meralco's nuclear power generation unit. Representatives from Meralco were on campus this fall to sign a memo of understanding with Grainger College of Engineering dean Rashid Bashir, with NPRE faculty Caleb Brooks, Leon Liebenberg and Rizwan Uddin on hand for the signing

# Regulatory milestones achieved by USNC-UIUC partnership represent step forward for advanced reactor technology

The partnership between University of Illinois Urbana-Champaign (UIUC) and Ultra Safe Nuclear Corporation (USNC) has secured a pair of regulatory outcomes that contribute directly to project success and represent a significant step forward for advanced nuclear in general.

An issue faced by many designers of advanced reactors is that current Nuclear Regulatory Commission (NRC) regulations and design criteria are quite specific to the currently operating fleet of large light water reactors. Many of these have been noted as either inapplicable or otherwise overly cumbersome for advanced reactors. UIUC and USNC are partnering in effort to deploy a USNC Micro Modular Reactor (MMR™) at the UIUC campus as a research reactor. As part of pre-application engagement, UIUC has submitted several topical reports. Once approved, the NRC issues Safety Evaluations (SE) which enable the use of the reports in future applications.

There are many regulations contained in Title 10, Chapter I, of the *Code of Federal Regulation* (CFR) which represent binding requirements on any holders of NRC licenses to operate nuclear facilities. Significant regulatory uncertainty for prospective licensees arises from the specificity of these regulations to large light water reactor technology. Beginning in December 2022, UIUC and USNC have been engaging with the NRC to relieve this uncertainty. On July 25, 2024 the NRC issued a SE affirming that the screening of regulations by the partnership was found to be acceptable. The result is a well-documented discussion of how NRC regulations apply to the USNC MMR reactor that can be directly applied in forthcoming applications. Moreover, the regulatory clarity provided here will streamline future MMR, and indeed other high temperature gas-cooled reactors, deployments.

Further—and also on July 25, 2024—UIUC and USNC received a second key SE for the topical report entitled "University of Illinois Urbana-Champaign High Temperature Gas-cooled Research Reactor: Micro Modular Reactor (MMRTM) Principal Design Criteria". Principal Design Criteria (PDC) represent a further area of potential regulatory uncertainty in how the NRC determines that a design can achieve adequate protection of the public. With this additional SE, a clear path forward is established for MMR deployments.

These timely approvals by the NRC represent significant milestones for USNC and UIUC. Application of the approved MMR PDCs will provide assurance that USNC's design process satisfies the NRC's rigorous regulatory requirements and reduces risk in subsequent license applications.

For more info on the UIUC Microreactor Demo Project, visit ***https://npre.illinois.edu/about/illinois-microreactor-project***. For more information on the MMR, visit ***https://www.usnc.com/mmr/***. For more information on the regulatory outcomes achieved by this project, visit ***https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/licensing-activities/pre-application-activities/university-of-illinois-at-urbana-champaign.html***

# Novak, Andruczyk projects selected to receive federal funding for technology to enable fusion power plants

NPRE faculty members April Novak and Daniel Andruczyk are part of new projects that have been selected for funding from the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E).

The funding is part of the Creating Hardened And Durable fusion first Wall Incorporating Centralized Knowledge (CHADWICK) program, which aims to explore promising alloy design spaces and manufacturing processes to develop next generation materials to strengthen the a fusion power plant's first wall, which surrounds the fusion core.

> "We're looking forward to working with ARPA-E and to take a major step towards commercializing fusion technology."
>
> —*April Novak*

Novak's group has been awarded $1.87 million to develop an open-source centralized library to assess and document the radioactivity of materials that are being used in fusion power plants. The tool will be made available to the fusion community to rapidly assess new materials and their techno-economic impact on the cost and anticipated electricity generation of fusion power plants.

The proposed project addresses the challenge of siloed computational workflows across fusion engineering teams, which has historically hindered collaboration and workforce development.

"We are thrilled to join ARPA-E's CHADWICK program in solving a major challenge to fusion materials development—centralizing activation and techno-economic analysis methodologies by providing fast-running, open-source capabilities to evaluate material suitability for fusion end-users accounting for activation- and cost-related design criteria," Novak, an assistant professor, said. "We're looking forward to working with ARPA-E and to take a major step towards commercializing fusion technology."

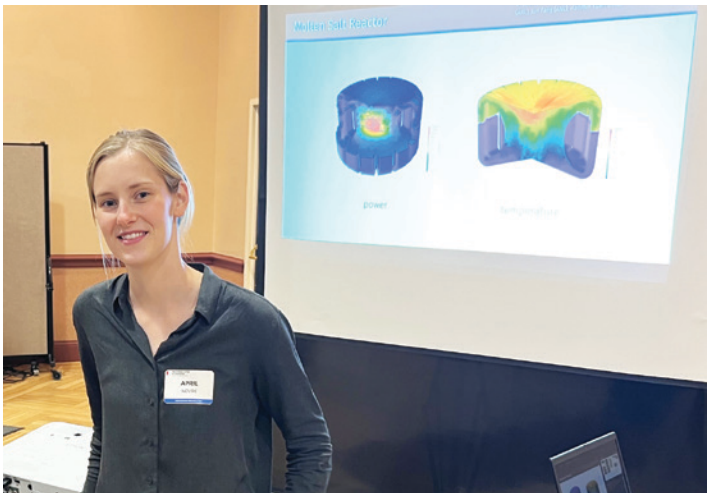
UIUC is also part of a team being led by Savannah River National Laboratory that has been awarded $1.5 million to address irradiation-induced embrittlement and swelling through Machine Learning-informed design of a three-dimensional (3D) structure that will be filled primarily with molten lithium and present a Li plasma facing component (PFC).

SRNL will develop a suitable material and 3D print the geometrically complex structures that will control how much liquid metal is exposed to the fusion reaction without excessive evaporation. Using liquid metal in fusion power plants provides the opportunity to continuously replace the first wall and repair the irradiation damage from the fusion reactions. The project develops novel approaches to keeping the liquid in place, and its success will help validate that the inside surface of a fusion power plant chamber can be made of liquid instead of solid material.

"Lithium provides a self-healing surface, while the 3D structure will help contain and keep the lithium where it's needed," Andruczyk said. "The Center for Plasma Material Interactions in NPRE offers a unique set of facilities that SRNL was keen to use, including HIDRA, which is the steady state stellarator that is able to provide the types of plasma exposures to test these kinds of components."

CPMI and research associate professor Andruczyk, who is leading the Illinois effort, are recognized around the world as one of the leading labs in lithium technology development and understanding the intricate relationship between plasma and materials.

"The work done here will go a long way in solving many of the challenges that 3D printed components may have in future fusion reactor environments," Andruczyk said.

# Q&A Making an impact: A Q and A with NPRE alum Craig Vodnik

**Craig Vodnik graduated from Illinois with a Bachelor's degree in Nuclear Engineering in 1992, but his winding path back to NPRE has included time in e-commerce and entrepreneurship. He presently lives in Austin, Texas and travels back to Urbana-Champaign often to offer his expertise to current students. Vodnik sat down for an interview in October to talk about what drives him to give back to the U of I and NPRE.**

*This interview has been edited and condensed.*

### *How often would you say you come back to campus?*

I'd say it's probably twice a year roughly, and usually for between four and seven days, depending on what's happening.

### *What is the feeling when you come back?*

It's actually energizing to be back on campus and to see all of the progress that's happening, in terms of new programs and, frankly, the intelligence of the students. I constantly think I probably wouldn't have gotten into this university if I applied now because the students are so smart and so kind. They're very mature, and…they're driven. Maybe it's sort of selective bias because I'm typically involved with the entrepreneurial activities and so I see some of those kinds of students.

It's very energizing for me to see that that kind of activity. This is the first time that we did the Founders Week activities, and that was really exciting to see. Again, the progress of the entrepreneurial ecosystem on campus and how it's not just a bunch of individual random conversations that are happening, but it's now very focused…activities that bring a lot of different people, different parts of the entrepreneurial ecosystem to campus, which is going to help more entrepreneurs be hopefully successful by having this focus on it and the Illini Angels, which is a new thing. It's really exciting to see what's going on campus nowadays.

### *Is that the part of the reason you keep coming back? What do you get out of being around the students and the faculty?*

The University of Illinois is a place where I can have impact on the next generation. My journey to entrepreneurship was very nonlinear. When I was on campus, I never thought I'd be an entrepreneur. In fact, I wasn't for 15 years or so after I left. So that was clearly much later in the future. But as I reflect on being an entrepreneur, the more I'm on campus, the more I understand how the time I spent on campus and in my studies helped me become an entrepreneur and why I really enjoyed that, which I just never would have expected. I like being able to come back and give back to and have an impact on hopefully the next generation of entrepreneurs that will come out of the university… not many alumni actually can have the kind of impact that people like me can have here.

### *What made you want to start contributing your time and money?*

When I started coming back to campus while I was still running my business and it was actually one of my clients who's also an alumni who connected me with the entrepreneurial ecosystem and the TEC (Technology Entrepreneur Center). I just was unaware of really any of that happening here and had not been connected to the campus for a long time. When I came back, I started seeing what was going on and I was not donating to the university. I was just sort of exploring and then I found ways that I can connect with the University and connect with my own past to a certain extent. I realized how excited people were to have the opportunity to talk to me and to maybe learn a few key lessons that I've learned over many years. As it kind of went along, I just realized that there were more opportunities for me to make an impact.

### *What would you tell an alum in your position who may be hesitant about contributing or giving themselves or coming back if they were to ask you?*

Every alum probably has some value to give back to the university. It could be in their time. It could be in small donations. It could be much bigger than that. It just really depends. But I believe that any alum that wants to give back…there is a way for them to do that and so, it really just depends on the point in their career that they are or how much they really want to just speak to students.

We had a question from a student in the class that that I was talking to where they wanted to know what it's like to be in a company, to work in a company. How can they find a good job? And that's not my expertise. There are students who…want to go into a company, get a really good job, and they would love to talk to somebody that's been in the workforce for five years or 10 years and how their experience at the university and what they did to just go from being a student to being a full-time employee.

There's a lot of need for that, too, and that doesn't require to have started a business and run it for 20 years and all those other things…One thing I would add is that for departments that are smaller like NPRE, the impact that someone who is a graduate can have in just spending a few hours once a year or every couple of years is much greater.

Because the department is small, you have the ability to impact maybe one person really deeply and you can make those unique connections in spending just a half a day here.

# Engineering Open House showcases NPRE students' innovative exhibits, sparking interest in nuclear and plasma technologies

At Engineering Open House this year, NPRE was represented by the efforts of the University of Illinois' chapters of the American Nuclear Society and Women in Nuclear. The two student organizations had a total of seven different exhibits: DC Glow, Fusor, Mousetrap Reactor, Model Nuclear Reactor, Model Pet Scan, Cloud Chamber, and the radiation table.

DC Glow, an up-close demonstration of plasma being created and manipulated using electric fields and permanent magnets, was awarded second place for Outstanding RSO Exhibit.

> "People tend to fear anything 'radioactive,' which is a potential barrier to nuclear energy."
>
> —*William Roy*

"Many people helped prepare for EOH this year through ANS's Underclassmen Round Table to grow in their technical application abilities," said Piper Fernau, who served as the WIN chapter's content chair. "The volunteers at EOH were hopeful of introducing visitors to the benefits of nuclear power as well as the other applications of nuclear engineering. We were hopeful to excite young visitors with our exhibits and inspire them to pursue the field of engineering."

NPRE grad student Stephen Armstrong said, "I ran the fusor and DC Glow at the ANS exhibit. The fusor is a new plasma chamber made by freshmen this year. I took part because I love sharing my passion for plasma and fusion. I hope the attendees learned a little about how plasmas are used in daily life."

The students had some help with the exhibits. NPRE lecturer Dr. William Roy presented the Cloud Chamber Exhibit in his office. The exhibit contained thorium-242, a naturally occurring radionuclide that emits alpha particles, and its overall theme was to show and talk about sources of background radioactivity that we live with every day.


"People tend to fear anything 'radioactive,' which is a potential barrier to nuclear energy," Roy said. "We noticed some people moved away from the chamber when we said that there was something radioactive inside. We wanted to reduce that anxiety by showing that alpha radiation can be shielded by one's skin. We went on to say that Illinois is number one in terms of using nuclear energy."

## GRAD STUDENT FRITCHIE SERVES AS GCOE DIVERSITY AMBASSADOR

Jacob Fritchie, a third-year master's/PhD student in NPRE, is a member of the Grainger College of Engineering's Graduate Student Diversity Ambassadors. As student leaders, they assist with recruitment and retention of engineering graduate students with diverse experiences and goals, and who come from many educational, socio-cultural, geographic, and familial backgrounds. The ambassadors engage with prospective students, serve as positive role models, act as on-boarding mentors, host events, and support graduate students throughout their experience at Grainger Engineering.


"I wanted to join the Diversity Ambassadors because I am passionate about working to create a welcoming environment for students from all backgrounds," Fritchie, a native of Palestine, Ill., said. "NPRE has provided me with a supportive space to learn, and I am eager to continue contributing to the improvement of our department and Grainger College of Engineering diversity, equity, and inclusion efforts. I look forward

# Four NPRE grad students named Mavis Future Faculty Fellows

**NPRE is well represented among this year's crop of Mavis Future Faculty Fellows, with four of the department's graduate students—Harun Ardiansyah, Aya Hegazy, Hammad Khalid, and Yifan Mao—taking part in the program.**

The Mavis Future Faculty Fellows (MF3) Program in The Grainger College of Engineering was developed to facilitate the training of the next generation of great engineering faculty. The Grainger College of Engineering is internationally recognized for the impact of our research and the strength of our graduate education. The doctoral programs that produce this reputation are primarily research-focused and may not provide students interested in academic careers with the opportunity to gain the knowledge of how to become a highly productive faculty member.

To help address this need, the Office of Graduate, Professional and Online Programs facilitates the MF3 Program where fellows participate in a series of workshops, seminars, and activities that cover various aspects of an academic career. Weekly seminar themes include describing life as a faculty member, writing cover letters and CVs, preparing for campus interviews, and defining and achieving success as a faculty member. These seminars are available to all engineering graduate students.

According to the GCOE, the three main components to the MF3 Program are research, teaching, and mentoring. Fellows will have an opportunity to develop and enhance their skills in these core areas through various professional development activities.

**Ardiansyah** said that he applied for the fellowship to enhance his career prospects. "I applied for the fellowship to start my journey to be a faculty member in the future," he said. "I think the fellowship will help me navigate the intricacies of a faculty job search."

He has degrees from the Universitas Gadjah Mada in Indonesia (BS in nuclear engineering) and the University of Michigan (MS in nuclear engineering and radiological sciences).

**Hegazy**, a native of Egypt, came to NPRE after getting her Bachelor's in Engineering (nuclear engineering) from the University of Alexandria and has received various honors and accolades during her time at Illinois.

"I am dedicated to advancing the future of nuclear energy," Hegazy said. "I believe that nuclear power offers a sustainable and viable solution to our global energy challenges and needs. Through the Mavis fellowship, I aim to develop the essential skills to educate and mentor the next generation of nuclear engineers as a future faculty member."

**Khalid** earned his B.S. in Mechanical Engineering from the Pakistan Institute of Engineering and Applied Sciences (PIEAS) and his M.E. in Nuclear Energy, Science, and Engineering from the North China Electric Power University (NCEPU) in Beijing. During his M.E. studies, he worked as a graduate research assistant at the Beijing Key Laboratory of Passive Safety, focusing on the jamming phenomenon inside a Pebble Bed Reactor (PBR) using advanced discrete element methods. He is currently a research assistant in associate professor Zahra Mohaghegh's Socio-Technical Risk Analysis (SoTeRiA) Research Laboratory.

His research focuses on developing risk-informed strategies for the safe introduction and deployment of automation technologies in nuclear power plants. This includes creating novel methodologies to assess the trustworthiness and enhance the transparency of AI-based technologies, providing crucial evidence for the operational acceptability and feasibility of these technologies, and informing large-scale investments to ensure safe and efficient plant operations.

**Mao**, who earned a previous degree at Illinois, said the fellowship "offers rigorous curricula covering a wide range of topics essential for aspiring future faculty members. I believe these courses, workshops, and hands-on training will alleviate the stress of applying for faculty positions and improve my chances of success."

to working with faculty and students to foster the growth of our diverse community."

Fritchie's research focuses on radiation detector characterization, crucial for advancements in nuclear verification technologies. He furthers his passion for international safeguards and nuclear nonproliferation through his role at Sandia National Laboratories in the International Safeguards and Engagements department.

As a first-generation college student and queer individual from a rural area, Fritchie has been actively involved in diversity, equity, and inclusion efforts, holding leadership roles to foster a welcoming environment. He has served on the Campus Honors Program student council, the Elks National Foundation Scholar Advisory Board, Collegiate 4-H executive committee, the U of I Institute of Nuclear Materials Management student chapter, the NPRE Graduate Student Advisory Committee, and the Engineering Graduate Student Advisory Committee.

Outside of his academic and professional pursuits, Fritchie is an avid music enthusiast who enjoys exploring different genres and attending live concerts. He also loves hiking and has visited over 50 national park sites.

# 2023–24 NPRE Scholarship Impact Statements

## CATHERINE PRITCHARD SCHOLARSHIP

### Piper Fernau

**MAJOR:** NUCLEAR, PLASMA AND RADIOLOGICAL ENGINEERING

**YEAR:** SOPHOMORE (CURRENTLY A JUNIOR)

**FAVORITE CLASSES:** PHYS 212: ELECTRICITY & MAGNETISM

*Why did you want to become an engineer at The Grainger College of Engineering?*

I chose engineering because the application of science has always been a passion of mine, and I can pursue that best through engineering. I chose Nuclear, Plasma, and Radiological Engineering because of how important nuclear power is and how useful plasma can be in its applications. I chose The Grainger College of Engineering specifically because of how renowned the school is for nuclear engineering, and the strong community here.

*What do you want to do after you graduate? What is your dream job?*

I plan on continuing school to receive a Ph.D. My dream job is to be a research scientist in plasma applications. I would love to be able to continue research into the use of plasmas for helping the environment.

**MESSAGE FROM PIPER:**

*"Through this scholarship I am able to focus more on my school work as well as my research. The ability to focus on school and research rather than an outside job allows me to perform better in my classes as well as create a stronger community with my classmates. The ability for me to focus on research is also providing me valuable first-hand experience in what I am truly interested in. The research I am pursuing is a great learning experience as I am able to better understand applications of what I learn in class before and after I learn the material. I sincerely appreciate receiving this scholarship and it has made my college experience easier as I am less stressed about paying bills and for tuition."*

## CONSTELLATION SCHOLARSHIP

### Emily Gillmore

**MAJOR:** NUCLEAR, PLASMA AND RADIOLOGICAL ENGINEERING

**YEAR:** FRESHMAN (CURRENTLY A SOPHOMORE)

**FAVORITE CLASSES:** MATH 285: INTRO DIFFERENTIAL EQUATIONS

*Why did you want to become an engineer at The Grainger College of Engineering?*

I chose nuclear engineering because I am passionate about clean energy sources and wanted to combine my fascination with nuclear processes with my love for the environment.

*What achievement are you most proud of and/or what are you looking forward to accomplishing this year?*

I am very proud of myself for choosing the right school, The Grainger College of Engineering. I look forward to continuing to do undergraduate research.

*What do you want to do after you graduate?*

After graduation, I want to work on improving the efficiency and sustainability of nuclear reactors.

**MESSAGE FROM EMILY:**

*"Only a year ago, I didn't think I could attend this school because I wouldn't have been able to afford it. I am so lucky to have received this scholarship that allows me to pursue the education of my dreams and takes some of the burden of loans off of my back. But this scholarship doesn't just help me financially. Having people that believe in my future and my future accomplishments motivates me to work harder. Receiving this support so early in my educational career means the world to me.*

*Thanks to you, I will be able to do research and focus on school. I have had so much fun and learned so much since coming here and I am so glad I was able to. I will not take your investment lightly and will do my best to put it to the best use I can. Thank you so much."*

# DAVID N. RUZIC SCHOLARSHIP

## Aryan Panigrahi

**MAJOR:** NUCLEAR, PLASMA AND RADIOLOGICAL ENGINEERING

**YEAR:** SENIOR (GRADUATED IN MAY)

**FAVORITE CLASSES:** NPRE 423: PLASMA LABORATORY

*Why did you want to become an engineer at The Grainger College of Engineering?*

I wanted to be an engineer because I wanted to work in a field where I could gain technical knowledge with real-world impact. I chose Nuclear, Plasma and Radiological Engineering as I wanted to work with energy, and Nuclear seemed like the best choice. I went with The Grainger College of Engineering as it was one of the few places that let me pursue a degree in NPRE.

*What achievement are you most proud of and/or what are you looking forward to accomplishing this year?*

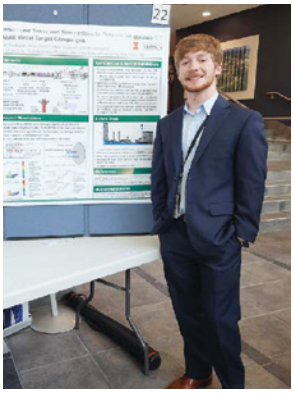
My greatest accomplishment is getting into the École polytechnique fédérale de Lausanne (EPFL, Swiss Federal Institute of Technology Lausanne) for my summer internship. I am looking forward to learning more from NPRE 423 and getting into a decent job or graduate school.

*What do you want to do after you graduate? What is your dream job?*

After graduation, I would like to work at a job where I can apply the knowledge and skills I have gained in college.

**MESSAGE FROM ARYAN:**

*"Receiving this scholarship is one of the best achievements in my college career. It made me feel like my efforts were being appreciated. The scholarship had a big impact on me. Thanks to the scholarships I received and the stipend I received from my internship, I was able to cover all my expenses in Switzerland and have a stress-free and fun-filled summer experience. The summer internship gave me a great experience in working with plasmas and taught me how to adapt to new surroundings and start a brand-new project with new members. This also made me suggest my juniors to apply for this experience as well."*



## Riley Trendler

**MAJOR:** NUCLEAR, PLASMA AND RADIOLOGICAL ENGINEERING

**YEAR:** JUNIOR (CURRENTLY A SENIOR)

**FAVORITE CLASSES:** NPRE 421: PLASMA AND FUSION SCIENCE; MATH 257: LINEAR ALGEBRA WITH COMPUTATIONAL APPLICATIONS; PHYS 325: CLASSICAL MECHANICS I

*Why did you want to become an engineer at The Grainger College of Engineering?*

Since middle school, I have wanted to develop the clean energy sources of the future. I found nuclear energy to be the most promising, powerful, and reliable source of energy, with nuclear fusion being the holy grail. To contribute to the field of fusion energy, I need to be equipped with vast technical knowledge, an array of research skills, and strong leadership experience. The Grainger College of Engineering is providing me with all of this and more, so that I may finally help put fusion power on the grid.

*What achievement are you most proud of and/or what are you looking forward to accomplishing this year?*

I am very proud of the grades I get in my classes, which have been all A+'s thus far. Currently, I'm proud of the grades I'm getting on my lab reports in a notoriously time-consuming class, NPRE 423, in my major. This year, I look forward to taking on more independent projects in my research at the Center for Plasma-Material Interactions.

*What do you want to do after you graduate? What is your dream job?*

After I graduate, I intend to pursue a PhD in nuclear engineering at a university with cutting-edge liquid lithium research. My dream job is to conduct research at a private fusion energy company and develop the liquid lithium technologies that make fusion energy commercially viable.

**MESSAGE FROM RILEY:**

*"I am honored to receive this scholarship, as it affirms that I have potential in the field of plasma and fusion science and engineering. This scholarship has further deepened my motivation to succeed in this field. This money ensures I can intensely concentrate on research at the Center for Plasma-Material Interactions (CPMI), which I am deeply grateful for. I have found research to be my most valuable experience in college. Additionally, this scholarship has shown me the importance of giving back to future generations of engineers. I applied to be an engineering learning assistant for the introductory ENG 100 course so I can share my advice and attitude with future engineers. I hope to continue to give back to younger engineers in the future. Thank you for providing this gift and for everything else you have done."*

# 2023–24 NPRE Fellowship Impact Statements

## BARCLAY G. JONES FELLOWSHIP

### Yifan Mao

**AREA OF STUDY:** NUCLEAR ENGINEERING

**RESEARCH GROUP:** ANALYSIS OF REACTOR TRANSIENTS AND STABILITY (ARTS)

***Why did you want to become an engineer at The Grainger College of Engineering?***

Becoming an engineer is always a goal I tried to pursue. My undergraduate college, due to the size limitation, doesn't have direct engineering major suitable for my interest. I still gained enough background knowledge and well-prepared to study in NPRE at UIUC. I gained interests in energy through undergraduate studies, and nuclear, along all the current energy production industry, is one of the most promising green energies. I want to know more about this field, and The Grainger College of Engineering is one of the top colleges in this field.

***Tell us about your research activities and focus area.***

My research focuses on the two-phase, two-fluid phenomenon modeling, which is important for the light water reactor safety analysis. But it's versatile and can be applied to other research areas to solve practical problems.

***What do you want to do after you graduate? What is your dream job?***

I would like to be a research scientist working in a national lab or a faculty professor here in the United States.

**MESSAGE FROM YIFAN:**

*"Your generous contribution to this fellowship means a lot to me as it affords me the opportunity to delve deeper into my research pursuits, free from the financial burden. I have recently joined the department, and I am now in my second year of Ph.D. studies here in the NPRE department. I spent some time changing my lab and trying different research projects in my first year before finally finding what I wanted to do. Thus, the second year is critical for me to catch up with my fellow scholars, and this fellowship has made it way easier for me. Thank you!"*

### Harun Ardiansyah

**AREA OF STUDY:** NUCLEAR ENGINEERING, NUCLEAR REACTOR PHYSICS

**RESEARCH GROUP:** ANALYSIS OF REACTOR TRANSIENTS AND STABILITY

***Why did you want to become an engineer at The Grainger College of Engineering?***

In my culture, engineer is a highly regarded job. In particularly, being a nuclear engineer is a dream that I had since my high school. I chose The Grainger College of Engineering because of its diversity of people and research.

***Tell us about your research activities and focus area.***

My research focuses on the diagnosing anomalies in nuclear reactor by computational means using neutron noise theory. I will implement this theory to advanced reactors.

***What do you want to do after you graduate? What is your dream job?***

I would like pursue career in academia. I want to be a professor.

**MESSAGE FROM HARUN:**

*"I would like to express my profound gratitude for the incredible gift that you generously provided. As one of the beneficiaries of your donor gift, I am beyond thankful. It is an opportunity that has transformed my life and opened doors to a brighter future. I just started my own little family, and this fellowship has been a lifeline for my family and me this year. It relieved the burden of tuition fees and enabled us to meet daily expenses, creating a sense of financial stability and security that we had never experienced before. I had the privilege to engage in meaningful research, expand my knowledge through study abroad programs, and contribute to my community through volunteer work. These experiences have enriched my education and broadened my perspective. Your generosity has inspired me to give back to future students aspiring to become Grainger Engineers. I want to be a source of support and encouragement for them, just as you have been for me. Your legacy of kindness and generosity will continue through the lives you've touched. In closing, I want to thank you from the bottom of my heart for your unwavering support. Your gift has not only alleviated financial burdens but also ignited a fire of determination and gratitude within me. The Grainger experience has been nothing short of transformative, and I am deeply thankful for the role you played in it."*

### Roberto Fairhurst Agosta

**AREA OF STUDY:** NUCLEAR ENGINEERING

**RESEARCH GROUP:** ANALYSIS OF REACTOR TRANSIENTS AND STABILITY

***Why did you want to become an engineer at The Grainger College of Engineering?***

When I was a kid, I always wanted to build and fix "things." During my high school years, those things became robots and during college, those things became nuclear reactors. My interest in nuclear reactors developed with the purpose of helping society to achieve its goal while providing a reliable and clean form of energy.

***Tell us about your research activities and focus area.***

*continued on page 23*

# 2024 Awards

## NPRE Department Awards, Scholarships, and Fellowships

**Outstanding Academic Achievement Award to a Graduating Senior**

Brady Moore

Ethan Nicolls

Nataly Panczyk

Olivia Stojak

**Outstanding Undergraduate Research Award**

Nathan Glaser

Riley Trendler

**Rising Undergraduate Research Award**

Spencer Fargusson

Grant Roche

**Barclay G. Jones Endowed Fellowship**

Harun Ardiansyah

Roberto Fairhurst Agosta

Yifan Mao

**Catherine Pritchard Undergraduate Scholarship**

Piper Fernau

**Daniel F. Hang Outstanding Senior Design Award**

Riley Fisher

Jake Mitstifer

Madeline Morasca

**David Neil Ruzic Undergraduate Scholarship**

Richard He

Linus Ringstad

Nikhil Vishnoi

**Felix T. Adler Fellowship**

Noor Ahmed

Samuel Dotson

**George H. Miley LENR Undergraduate Scholarship**

Adam Kim

**Marvin E. Wyman Memorial Scholarship**

Arist Hu

**Nguyen Thi Cuong Graduate Fellowship**

Md Fazlul Huq

Mohammad Mustafa

**Roy Axford Scholarship/ Fellowship**

Sari Alkhatib

Linus Ringstad

**NPRE Visionary Scholarships**

Tony Arroyo

Emma Barrera

Spencer Fargusson

Andrew Gura

Matias Habib

Michael Jerva

Justin Leon

Xavier London

Giuseppe Paladino

Patrick Tomasiak

Gabriel Walton

## American Nuclear Society, University of Illinois Student Chapter Awards

**Undergraduate Outstanding Service Award**

Piper Fernau

Riley Trendler

**Graduate Outstanding Service Award**

Stephen Armstrong

**Students' Award for Excellence in Undergraduate Teaching**

April Novak

**NPRE Staff Award**

Sarah Drum

## American Nuclear Society National Recognitions

### 2024 ANS STUDENT CONFERENCE

**Best Undergraduate Fusion and Plasma Physics Presentation**

"Analysis of Fluoroelastomer and Perfluoroelastomer Degradation in Various Plasma Conditions"

Nick Connolly and Collin Jeckell

**Best Graduate Reactor Physics Presentation**

"Coupled Multiphysics Modeling of the Kilowatt Reactor Using Stirling Technology (KRUSTY)"

Mahmoud Eltawila and April Novak

### ANS SCHOLARSHIPS

**ANS Undergraduate Scholarship**

Piper Fernau

Jack Gerrity

Arnav Goyal

Owen Strong

**William R. & Mila Kimel Nuclear Engineering Scholarship**

Riley Trendler

**Hans P. Loewen Memorial Scholarship**

Emily Gillmore

**ANS Graduate Fellowship**

Ethan Nicolls

## Other Scholarships and Fellowships

### NUCLEAR REGULATORY COMMISSION

**University of Illinois at Urbana-Champaign Nuclear Engineering Fellowship Programs**

Nicholas Dailey

Oleksandr Yardas

### U.S. DEPARTMENT OF ENERGY

**NEUP Fellowships**

Anthony Boyd

Bruce Ciccotosto

**University Nuclear Leadership Program Scholarships (2023–24)**

Elijah Capps

Riley Fisher

Davin Hess

Olivia Hunsberger

Dimitri Kalinichenko

Jake Mitstifer

Madeline Morasca

Caleb Olson

Nataly Panczyk

Ryan Pierpaoli

Thomas Posthuma

Nitika Purohit

Ceser Zambrano

**Goldwater Scholarship**

Riley Trendler

### NATIONAL SCIENCE FOUNDATION

**Graduate Fellowship**

Brandon Kamiyama

### NUCLEAR NONPROLIFERATION INTERNATIONAL SAFEGUARDS

**Graduate Fellowship**

Jacob Fritchie

### NNSF STEWARDSHIP SCIENCE

**Graduate Fellowship**

Sean Peyres

### UNIVERSITY OF ILLINOIS

**Sloan University Center for Exemplary Mentoring Affiliates**

Giovanni Diaz

Isaac Pedroza

Carly Romnes

**SURGE Fellowship**

Amanda Bachmann

Giovanni Diaz

Nina Mihajlov

Djenan Mouna Soumahoro

Isaac Pedroza

### GRAINGER COLLEGE OF ENGINEERING SCHOLARSHIPS

**Clare Boothe Luce Undergraduate Research Award**

Nitika Purohit

**DaRin Butz Foundation Research Scholar**

Piper Fernau

**Illinois Scholars Undergraduate Research (ISUR) Scholar**

Sean Peyres

**Engineering Visionary Scholarship**

Tony Arroyo

Nataly Panczyk

Nitika Purohit

Olivia Stojak

Patrick Tomasiak

Riley Trendler

**Illinois Engineering Achievement Scholarship**

Michael Doyle
Emily Gillmore
Richard He
Ayah Roussi
Oliver Stehlik
Gabriel Walton

**Illinois Engineering Outstanding Scholarship**

Nitika Purohit
Olivia Stojak
Patrick Tomasiak

**Illinois Engineering Freshman Scholarship**

Arnav Goyal
Brett Heberer
Matthew Lotze
Owen Strong

**Illinois Engineering Excellence Scholarship**

Jack Gerrity
Nikhil Vishnoi

**PATHWAY Engineering Scholarship**

Krystian Szeliga

**Illinois Engineering Premier Scholarship**

Matias Habib
Sara Meyer

**Grainger Engineering Scholarship**

Riley Trendler

**FIRST© Robotics Engineering Scholarship**

Aiden Coleman

**Harold and Ruth Hayward/ Tau Beta Pi Scholarship**

Brady Moore
Riley Trendler

**Kirkwood Scholarship for Women in Engineering**

Nataly Panczyk

**Patterson Family Scholarship**

Emma Barrera

**Robert M. Stephens Engineering Scholarship**

**Sargent and Lundy Engineering Scholarship**

Brady Moore
Nataly Panczyk

**William L. and Elizabeth A. Ackerman Scholarship**

Justin Leon

## College Honors

**Henry Ford II Scholar Award**

Ethan Nicolls

**Harvey H. Jordan Award**

Brady Moore

**Kay Simmons-Kappes Award**

Arnav Goyal

## University Honors

**Dean's List**

Eligible undergraduates must have achieved a GPA for a given semester that places them in the top 20 percent of their college. The following listing is for Fall 2023.

Suleymaan Ahmad
Logan Blume
Elijah Capps
Vijay Chaudhari
Evan Cohen
Matthew Disimone
Michael Doyle
Riley Fisher
Colman Flynn
Jack Gerrity
Emily Gillmore
Arnav Goyal
Andrew Gura
Matias Habib
Samuel Hart
Richard He
Brett Heberer
Arist Hu
Olivia Hunsberger
Amber Hunter
Collin Jeckell
Michael Jerva
Adam Kim
Rhys MacMillan
Madelyn Maidak
Brady Moore
Ethan Nicolls
Zachary Nordan
Jennifer Oribello
Nataly Panczyk
Sean Peyres
Thomas Posthuma
Richard Pickering
Ryan Pierpaoli
Linus Ringstad
Grant Roche
Olivia Stojak
Owen Strong
Michael Todorov
Riley Trendler
Nikhil Vishnoi
Ryan Wais
Ceser Zambrano
Boyue Zhang

**Chancellor's Scholars**

Chancellor's Scholars are motivated, academically gifted student leaders. Students participate in honors seminars, attend Scholar Adventurers presentations, and participate in social, intellectual and cultural activities, and maintain a minimum cumulative GPA of 3.25.

Arnav Goyal
Olivia Hunsberger
Brady Moore
Zachery Nordan
Owen Strong
Riley Trendler

**James Scholars (Fall 2023–Spring 2024)**

This honors program is named for the University's fourth president, Edmund J. James who believed 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. His achievements helped transform Illinois into a campus of international importance.

Tony Arroyo
Emma Barrera
Aiden Coleman
Christopher Gonzalez
Arnav Goyal
Olivia Hunsberger
Aiden Junier
Dimitri Kalinichenko
Justin Leon
Matthew Lotze
Madelyn Maidak
Bryan Park
Jason Ponsiano
Linus Ringstad
Anne Showel
Oliver Stehlik
Mason Sterling
Krystian Szeliga
Nikhil Vishnoi
Gabriel Walton

## Grainger College of Engineering Honors

**Mavis Future Faculty Fellows (2024–25)**

Harun Ardiansyah
Aya Hegazy
Hammad Khalid
Yifan Mao

## Alumni Recognitions

**NPRE Advocate Award**

The NPRE Advocate Award recognizes alumni and friends who have demonstrated their loyalty to NPRE through volunteer efforts, financial contributions, and/or other forms of advocacy.

Craig Vodnik

"To Craig Vodnik, for his devotion to NPRE and his support to the present and future students of the department."

**NPRE Distinguished Alumni Award**

The NPRE Distinguished Alumni Award is presented to alumni who make notable advances in the field of nuclear science, and/or lasting contributions to society in general.

Justin Schwartz

"To Justin Schwartz, for his scientific, technological and administrative achievements in higher education and his commitment to training future generations of scientists and researchers."

## "Passionate" Illinois chapter of Women in Nuclear stands above its peers, *continued from page 5*

activities, whether it be nail painting parties in the Talbot student lounge, a group yoga class or joint events with the award-winning American Nuclear Society chapter.

When asked what may set this chapter apart from other top ones in the country, Purohit pointed to the enjoyment Illinois's members get from their time in WIN. "We're all very passionate and excited about the events we host," she said. "It doesn't feel like work."

Being a part of WIN has improved experience of its members inside and outside of the classroom.

"It's definitely helped me make a lot of friends, especially among upperclassmen," social chair Olivia Evans, a junior also from Boston, said. "Everyone is really welcoming. It's nice to be able to go to events and know people."

"The friends and connections we make in WIN really help in classes, when we're all together," Pequette said. "Being able to reach out to people you know to work on homework or study together is great."

And though the name of the group is Women in Nuclear, events and meetings are designed to include students of all genders. For the best chapter in the nation, WIN is for all.

"One of our foundational pillars is community, and I feel like we really try to hit on that the most," Purohit said. "We want to make sure that everyone feels included. Women in Nuclear is foundationally meant to help women feel more comfortable in nuclear departments, but it's for anyone and everyone who wants to feel comfortable in a group of people."

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## 2023–24 NPRE Fellowship Impact Statements, *continued from page 20*

As a research assistant, my daily activities focus on a wide range of topics within my field. I am currently working on two main projects. One focuses on the thermal-fluids analysis of an advanced microreactor, while the other studies accurate methods to support the development of safety analyses for research reactor experiments.

### *What do you want to do after you graduate? What is your dream job?*

My dream job will allow me to fulfill my dream of helping humanity achieve its goals by developing a carbon-free form of energy that meets that enables its growth.

**MESSAGE FROM HARUN:**

*"Thank you for supporting me. This fellowship has allowed me to focus my efforts in doing impactful research in my field while allowing me to get one step closer to attaining my degree."*

## "Dusting off the cobwebs": NPRE's Katy Huff returns to academia, *continued from page 7*

here at Illinois in Assistant Professor April Novak. And a handful of recipients around the country that are exactly the kind of early career faculty that didn't have an opportunity for a kind of career award in the existing Office of Science/NSF structure. Having an opportunity in the Office of Nuclear Energy is so important for those early career faculty, and I'm gratified to have helped create it.

I have also had an impact with regard to uranium and uranium supply, including investment in domestic supply chain and the ban on Russian uranium. We developed a uranium strategy that is now in motion to support the expansion of enrichment and conversion in the U.S., but time will tell whether it's sufficient to displace dependence on Russian uranium.

I think also about the way that the Office of Nuclear Energy functions. During my time there, you know well, I'm sure I had an impact. The office certainly had an impact. All of its staff, contributors and its general mission, I think, continued to advance while I was there, which has a great impact on the world. But, that's not entirely due to me. Obviously, it's entirely due to the broader staff there at the office.

### *Did you have any starstruck moments?*

Absolutely. I met Presidents, I met (Ukrainian) President (Volodymyr) Zelenskyy before the war started. I met and actually talked to at some length to President (Emmanuel) Macron of France. I've met the president of Ghana (Nana Akufo-Addo). Those sorts of interactions are just incredibly moving. I obviously will never forget any of those. I've met our own President, President Biden. I was certainly starstruck, but we had real work to do in all of those cases, and having work to do with at that level with people like that really puts into perspective the impact you can make and how important nuclear energy is to nations all across the world.

### *Are you looking forward to not having to look at things at a macro level and being one of the faculty here again?*

Absolutely. I think the nice thing about having experienced that perspective at the macro scale is that now I think I have an even better understanding of what kind of impacts I can make with innovations at the micro scale on those bigger, macro scale problems. I think the relevance of my research will be clearer to me as I move forward, and I'll be able to pursue even more relevant lines of inquiry at the micro scale.

### *So, what are your ambitions now that you're back working with students and you prepare to do it fully again in the fall?*

Well, I have some good research ideas. I'll be putting in some clever proposals across the space of proposal opportunities, and I look forward to getting my existing graduate students across the finish line. That's going to be a main focus, and I'll be dusting off my brain as I teach reactor kinetics, checking whether or not it's like riding a bike. I'm pretty sure the cobwebs are clearing.

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