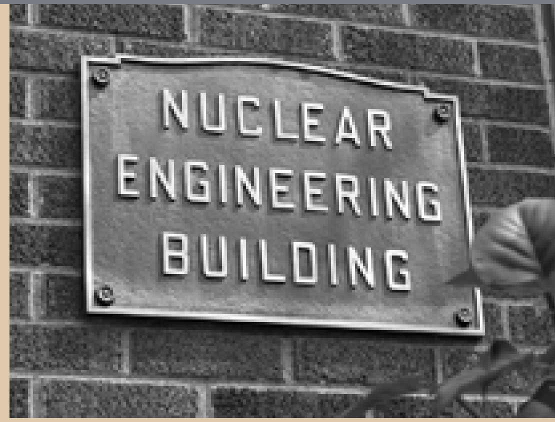

Nuclear Engineering Newsletter

CELEBRATING
60
YEARS

FALL 2020

PURDUE UNIVERSITY | School of Nuclear Engineering

MESSAGE FROM THE HEAD

As we celebrate the 60th anniversary for our school, together with the 120th for the College of Engineering, 2020 also may be remembered as the year that brought us challenges that hamper the basic quality of our lives. The COVID-19 pandemic has altered the way we live, and we find ourselves yet again struggling for racial equity, which calls for common sense in valuing fundamental human rights in a civilized society. As nuclear engineers, we know how to overcome challenges. In fact, we turn difficult situations into opportunities for growth.

In the wake of the digital revolution, Purdue Nuclear Engineering has led the transformation toward intelligent energy systems by attaining the nation's first U.S. Nuclear Regulatory Commission license for an entirely digital nuclear reactor instrumentation and control system for Purdue University Reactor One (PUR-1). The ramification of this achievement is enormous, as it paves the way for new capabilities within the nuclear sector and will benefit both existing nuclear fleets and future advanced reactor concepts. PUR-1, together with Purdue University Multidimensional Integral Test Assembly (PUMA)—the unique scaled replica of an advanced light water reactor—serves as a cyber-physical testbed for a comprehensive balance-of-plant system, providing valuable digital fingerprints of any anomalies during normal and off-normal conditions.

Our distinguished faculty strive to expand the frontier of knowledge by leading cutting-edge and innovative research, including projects to further advance reactor concepts, such as the High Temperature Reactor, the Molten Salt Reactor, and the Versatile Test Reactor. Additionally, our faculty are at the forefront in applying artificial intelligence and deep learning (AI/DL) toward nuclear nonproliferation, as well as novel sensor development for nuclear materials monitoring and nuclear security. Through partnerships with our alumni and the nuclear industry, our faculty also are leading research in nuclear medicine, the medical isotope production reactor, and the Small Modular Reactor concept.

We live in a time of potentially the biggest challenges ever, brought about by climate change and a soaring energy demand that could present a significant threat to humanity unless properly addressed. With its rich history of excellence in nuclear power, world-renowned faculty members, excellent students, and talented staff, the School of Nuclear Engineering continues to thrive. Our school provides the nation and the global nuclear engineering community with top-notch nuclear engineers who will embrace these challenges and provide solutions through clean, safe, reliable and resilient energy. We look forward to seeing you at our in-person anniversary celebration—60 Years of Legacy on Atoms for Humanity—and we send our best wishes to you and your family for a healthy and happy Thanksgiving!

Hail Purdue and Boiler Up for another 60 years and beyond!

Seungjin Kim
Capt. James McCarthy, Jr. and Cheryl E. McCarthy Head, and Professor
School of Nuclear Engineering

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NEW FACULTY

Nuclear Engineering welcomes Yi Xie to Purdue

Yi Xie joined the School of Nuclear Engineering faculty as an assistant professor in summer 2020. Yi received her B.S. in nuclear engineering from the University of Science and Technology in China and her PhD in nuclear engineering from The Ohio State University.

Yi Xie

Before joining Purdue, she worked as a research scientist at Idaho National Laboratory (INL), where she focused on advanced fuel fabrication, characterization, development and examination. She was the inaugural Glenn T. Seaborg Distinguished Postdoctoral Associate at INL. Before joining INL, she was a postdoctoral associate at Virginia Tech. Her current research interests include corrosion in extreme environments, advanced nuclear fuel, sensor and sensor materials, advanced sintering technology and geological repositories of radioactive waste.

"I will be developing a research group at Purdue, capable of testing and analyzing the corrosion (including irradiation-assisted corrosion) of materials exposed to the light water reactor, molten salt reactor, sodium-cooled reactor, lead/lead-bismuth eutectic reactor, and used nuclear fuel dry storage environments using techniques including static and dynamic corrosion testing, electrochemical corrosion testing, and microstructural characterization techniques."

"I'm also developing a big data-based corrosion modeling to estimate the corrosion rate of materials, in the short-term and long-term, in nuclear systems. I'm collaborating with national laboratories and industries to develop the advanced sintering technology and fabricate sensor crystals, structural materials, nuclear fuels, fuel cells and batteries."
—Yi Xie

FACULTY RESEARCH

Every small step that takes us from the earth to the world beyond.

THAT'S MY

GIANT LEAP

FACULTY RESEARCH

Lefteri Tsoukalas: Purdue reactor is 'manna from heaven' for his AI research


Lefteri Tsoukalas

Nuclear Engineering Professor Lefteri Tsoukalas says his work in nuclear engineering goes back to the 1980s when he was a student at the University of Illinois, where he earned his bachelor's, master's, and doctorate degrees.

"I was fortunate to work for a distinguished group of scholars pioneers in instrumentation and control systems. These are the systems that are responsible for the control and the safety of nuclear power plants," Tsoukalas explained.

At this time, computers were revolutionizing the area of control, he said, but the movement wasn't without some angst.

"There was a lot of apprehension about digital systems. It was a little different to develop methodologies for ensuring there were no malicious invasions of the system's regulatory structures that had been set up for first-and second-generation reactors. It took a long time to develop the scientific basis and to ensure the safety and protection of systems."

Of course, the technical age has come a long way in four decades. "A lot of what has come out of nuclear research and nuclear development is now commonplace in many technical innovation areas," Tsoukalas said, citing medical imaging as an example.

"Nuclear is a relatively narrow technical field," but spreads over a wide range of domains.

Tsoukalas' research covers both experimental and model development studies, signal processing techniques—including cutting-edge multi-variant statistical methods—Gaussian processes for background estimation, wavelet analysis and Hilbert-Huang transforms.

He is an expert in deep neuro networks and has personal insight about how artificial intelligence (AI) is being integrated into nuclear power systems and nuclear security.

"One of the ways to broaden the innovation space around nuclear is to respect the need for protecting the technology—for example, from the countries that want to develop nuclear weapons. What is important here is privileged data. We don't want this to be flowing around the internet. Countries go to war over such data. We want this data to be safe, we want it to be absolutely in the right hands, and you can't do this without some AI," Tsoukalas explained.

A modern nuclear reactor can operate for 100 years, but every 11 years, its ensemble of instruments must be updated, he said. "The process of updating has to be absolutely safe. No bugs. No mistakes."

"Essentially the people who design a modern nuclear reactor, the people who will decommission it, and the experts who will operate it, they have to be in a virtual conversation with each other. To achieve this, we introduce artificial intelligence, which makes this dialog amongst experts transparent and safe," he said.

He confides that AI can be very smart, but it can make false assumptions.

"We want to ensure that such fallacies don't occur in an automated system. Having a real, physical system like the Purdue reactor – it is manna from heaven. It's the kind of thing that we can go and test and ensure that our smart neurocomputing is also smart and accurate in its conclusions."

Tsoukalas has nothing but good things to say about Purdue, the opportunities it has afforded him as a researcher, and its position in the field of nuclear energy.

"Purdue has a history of innovation. To be here with students and researchers and to have the first digital reactor in the United states—you can't ask for more."

According to Tsoukalas, nuclear engineering has been the driving force in many technological applications, and the field offers an abundance of career opportunities in research, industry, semiconductors, and systems and control.

"THE SKY IS THE LIMIT WITH OUR STUDENTS"

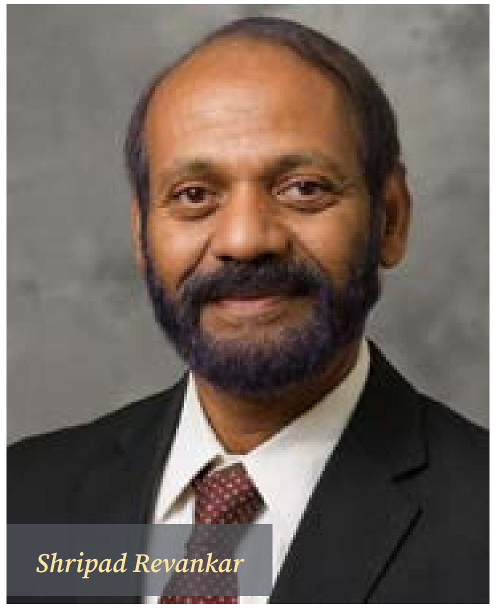

Styliani Pantopoulou and Lydia Lagari, graduate students of Professor Lefteri Tsoukalas, discuss their research on the resilience of a cyber-physical security system. Note: This photo was taken before COVID-19 mask requirements.

"The sky is the limit with our students. About 20–30% go into nuclear power, many of them go into corporate careers as executives, and several go to the national labs where they're leaders in research that has a lot to do with the national missions. It's an exciting place and an exciting discipline, and I would advise anyone who likes physics, but who also likes the computational aspects, to come to nuclear. They will learn a lot of things and have great careers."

FACULTY RESEARCH

Revankar calls nuclear energy 'a beautiful thing,' explains research with modular reactors

School of Nuclear Engineering Professor Shripad Revankar is an expert in the area of gas-cooled small modular reactors, which are classified as generation IV—the latest technology.


Shripad Revankar

"A unique feature of this reactor is that it is very safe compared to what we have currently operating. It's a very passive system in 'walkaway type safety" said Revankar, who also is the director of the Multiphase and Fuel Cell Research Laboratory and chairman of the Nuclear Engineering Graduate Program.

"Being small, these reactors have advantages over existing ones. They can operate very safely and need very little maintenance."

Gas-cooled small modular reactors operate at high temperatures up to 1,000 degrees Celsius, are small and transportable, and can power areas that lack gridlines or support existing grids. These reactors also are practically autonomous, with minimal refueling and maintenance needed.

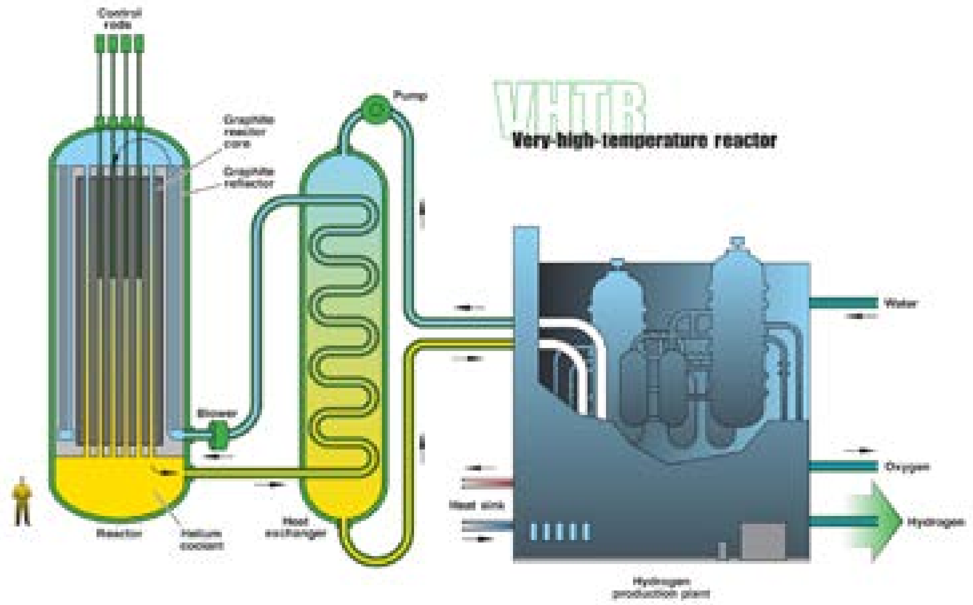
Revankar, referring to himself as a "renewable guy" says nuclear energy complements the emergence of renewable energy, as it produces 55% of America's carbon-free clean energy.

"However, there are drawbacks," he said. "Renewables are intermittent and unpredictable; this is very important to note. They are dependent on environmental conditions They can only use 60% of the day to harvest light. And the wind is unpredictable, of course. It fluctuates. It is important to have a base energy that supplies continuous power that simultaneously supports environmental health," Revankar said.

"You cannot have a continuous power coming from these sources. You need a large base of power. And it must be carbon-free, otherwise you are back to where you started."

When he considers these factors, he always circles back to nuclear energy as the best source of power. "The beautiful thing about nuclear energy is that it is clean. It's sustainable. We can use it long-term—400–500–600 years from now.

In order to be licensed, reactor designs must contain detailed accident mitigation technologies and procedures. Because small modular reactors have not been commercially built/operated yet, the regulatory process is still under way. To this end, Revankar is working to address the consequence of depressurization accidents, in which the reactor has leaks from its primary systems. When this occurs, there is a chance the oxygen from the building will enter and oxidize the reactor core, which can lead to overheating, meltdown and ultimate release of radioactive material.



Revankar is developing an experimental setup in collaboration with Texas A&M University, which does the code modeling, and the Imperial College of London, which has "excellent computational fluid dynamics (CFD) modeling experience" with gas-cooled reactors. Alongside these academic counterparts, they can simulate the consequence of and determine mitigation strategies. This research will help ensure the safety of the gas-cooled reactors and assist developed and developing countries in reducing their greenhouse gas emissions.

In summer 2020, Revankar worked with both undergraduate and graduate students to perform scaling analysis on the experimental system setup, in addition to work with CAD modeling and other design projects.

"WE HAVE A

LEGACY

THAT CAME OUT OF

ALL AREAS OF NUCLEAR ENGINEERING"

The professor considers his research approachable for college students of all ages, relevant, and pertinent to the success of generation IV reactors. He also believes that Purdue, as one of the few universities in the country with a reactor, has a great opportunity for students to gain hands-on experience. Also, as a researcher at a university with a reactor, he is in an excellent position to further his initiatives. But he doesn't discount the people who came before him and paved the way for Purdue Nuclear Engineering to become the premier destination it is today.

"We had outstanding people who set up the foundation for us. We have excellent facilities here.

Revankar's passion for the field is tangible in each conversation he has, and he is driven each day by the enthusiasm and curiosity exuded by his students, nuclear's boundless applications, and the constant evolution and excitement of the field.

"You need a great reason to wake up every day, and that's my reason."

FACULTY RESEARCH

Allen Garner: Antibiotics get a jolt to kill superbugs

COVID-19 has brought home the pressing need to develop novel treatments for infectious diseases. It's a battle we are waging on many fronts. One important struggle opposes the so-called superbugs, microorganisms that have strengthened themselves over time against traditionally effective antibiotic therapies. Our research group at Purdue is devising a counterattack—using pulsed electric fields alongside conventional antibiotics to better kill the germs.

Ever since the discovery and further advancement of antibiotics, microorganisms have been developing resistance to the treatments. This, in turn, has led to increasingly stronger antibiotics, and antibiotics that target different pathways to get at the pathogen. The microorganisms then develop immunity to these treatments—in what essentially is escalating biological warfare.

One major thrust of my research group is the application of intense electromagnetic radiation to manipulate biological cells. We are working on combining this technology with antibiotics to inactivate (kill) antibiotic-resistant microorganisms.

By bringing together novel electric pulse waveforms (to be delivered via needle arrays, creating nanometer-sized membrane pores in the microorganisms that cannot reseal) with various antibiotics, we can enhance the antibiotics' effectiveness and dramatically improve their speed of action with dosages below clinical levels.

We have also demonstrated that we can use electric pulses to make antibiotics effective against microorganisms for which they are not designed paving the way to repurpose existing FDA approved drugs, rather than going through a long and expensive antibiotic development cycle.

My PhD student and I are collaborating with a small company that works out of Purdue University's Birck Nanotechnology Center, Nanovis LLC, to apply electric pulses (EPs) to inactivate microorganisms. We have discovered a novel synergy: Combining these electric pulses at levels insufficient to kill the microorganisms with drug levels that also are inadequate can in fact kill the microorganisms, and act much faster.

Allen Garner

For example, adding even 1/20 of the clinical dose of the antibiotic tobramycin to a train of EPs induced between 2.5 and 3.5 log inactivation after only 10 minutes of exposure—compared with taking hours to induce inactivation using a clinical dose with no EPs (log is a factor of 10, so 2-log is 100 times reduction, 3-log is 1,000 times reduction, etc.). Similarly, combining a series of EPs with a clinically relevant dose of rifampicin, another common antibiotic for treating bacterial infections, induced 7–9 log inactivation over the same time of exposure.

This approach is crucial in treating infections caused by "Gram-negative" microorganisms, such as C. difficile. Gram-negative bacteria (so named because they are identified by a staining technique developed by the Danish bacteriologist Hans Christian Gram in 1884) have a thin cell wall with an outer and inner membrane. The "camouflaged" outer membrane hides the bacterial microorganism's antigens, tricking the body into limiting its immune response.

We have shown that Gram-positive antibiotics, which do not work against Gram-negative bacteria because they cannot pass through their double membranes, can be made effective by combining them with the pulsed electric fields. Novel treatments like these are important because Gram-negative bacteria cause serious infections like pneumonia, and can infect the bloodstream, wounds, and surgical sites. Their resistance to multiple drugs, and to most of our currently available antibiotics, make them potentially deadly.

We are working with industrial partners on additional uses for EPs. For instance, we are exploring the stimulation of muscle and bone stem cells, using electric pulses to speed up cell proliferation for faster bone formation in vitro. We are collaborating with other researchers using electric pulses to activate platelets, causing the release of growth factors to accelerate wound healing. Another application involves extending the shelf life of food, and our research group is exploring uses in agriculture, bioenergy, cancer treatment, and nondestructive testing, among other areas.

Electric pulses may also be of use in fighting COVID-19. Researchers are investigating the possibility of decontaminating areas exposed to the airborne novel coronavirus using microwaves to reduce its infectiousness. This could be of tremendous benefit to medical personnel working in hazardous settings.

Emily Downing, a graduate student under Dr. Garner, conducts analysis of microorganism experiments.

Editor's note: This article was first published Aug. 25, 2020, on the Purdue College of Engineering Medium blog. Medium is an open platform for expert and undiscovered voices alike to dive into the heart of topics and bring new ideas to the surface.

Source:
https://medium.com/@PurdueEngineering

FACULTY RESEARCH

DOE awards $800K to speed up adoption of 3D-printed microreactors

WEST LAFAYETTE, Ind.—The U.S. Department of Energy has awarded an $800,000 grant to Purdue University's College of Engineering for a project to accelerate the introduction of the 3D-printed microreactor—a new type of nuclear reactor with the flexibility and versatility needed for many current energy applications.

The Nuclear Energy University Program funding will enable Purdue to be a key contributor to the Transformational Challenge Reactor Demonstration Program, in which the Department of Energy's Oak Ridge National Laboratory is working to build the first 3D-printed microreactor by 2023. The microreactor also will be the first advanced reactor to operate in the U.S. in more than 40 years. To support this mission, Purdue will develop and demonstrate a novel artificial intelligence method to ensure the quality of the microreactor's components.

The Purdue project is intended to drive the use of additive manufacturing (also known as 3D printing), computation materials modeling, and AI concepts in creating nuclear reactor components. Goals of all these technologies are to significantly reduce manufacturing costs and development time, and to realistically estimate safety risks while offering reliability and convenient access to nuclear power.

"Microreactors introduce a transformational trend to the nuclear industry—a trend that enables more streamlined construction and deployment processes to address the nation's energy challenges that cannot be overcome solely with large-scale nuclear reactors," said Hany Abdel-Khalik, technical lead for the project and associate professor of nuclear engineering.

Hany Abdel-Khalik meets virtually with John W. Sutherland (top on screen), and Xinghang Zhang.

Nuclear engineering students receive some extra help from Hany Abdel-Khalik. Note: This photo was taken before COVID-19 mask requirements.

"Purdue will fill a technological gap in the nuclear industry, reflecting a broader trend of applying AI strategies to support additive manufacturing (AM). AM enables designs to be adjusted during manufacturing, greatly decreasing production cost and time. Our work is aimed at driving widespread adoption of additively manufactured reactor components by using an AI-powered software system to ensure safety and reliability."

Kurt Terrani, director of the TCR program at ORNL, said, "Synchronized application of additive manufacturing and artificial intelligence techniques are key to providing the most data-rich and cost-effective nuclear component qualification process. This is one of the key goals of DOE-NE's TCR program: using modern technology to deliver a new and better way to deploy nuclear energy.

"The program is engaging the industry, the regulator and, in this case, universities in order to ensure an optimal approach is developed and adopted in widespread fashion. The technical strength of the Purdue team will shore up our ability to deliver on these goals."

"Purdue Engineering has ideal strengths to support the mission of the Department of Energy on the development of additively manufactured microreactors," said project leader John W. Sutherland, the Fehsenfeld Family Head of Environmental and Ecological Engineering. "We bring together deep expertise and collaborative capabilities, encompassing manufacturing, nuclear engineering, materials engineering, environmental engineering, AI and data analytics, nuclear reactors modeling and simulation, and systems engineering. In this project, we'll be blending fundamental science and engineering in a very complex and dynamic environment."

The project team also includes Steven Shade, the Ball Brothers Director of Advanced Manufacturing Initiatives, who is affiliated with Environmental and Ecological Engineering, and Xinghang Zhang, co-principal investigator and professor of materials engineering, with a background in AM and other areas of manufacturing.

Zhang said Purdue's solution will apply reinforcement learning, a kind of AI that uses advanced machine learning strategies to fine-tune the selection of the optimum AM process parameters—such as printing speed and melting temperature in this case—to train the AI models and guide decision making.

Source:
https://www.purdue.edu/newsroom/releases/2020/Q3/purdue-engineering-receives-department-of-energy-funding-to-speed-up-3d-printed-microreactors.html

NE's Xie: 'Making sure materials behave in nuclear reactors'

Energy consumption is increasing, a large fraction of it powered by fossil fuels. But fossil fuel resources are finite and pose the threat of global warming from greenhouse gas emissions. Nuclear energy is an important way to reduce our dependence on fossil fuels and resolve global warming issues. However, even though the safety and efficiency of water-cooled reactors—so-called GEN-II and GEN-III reactors—have improved significantly, nuclear energy still is not playing a global role, due to concerns about issues like accidents, nuclear waste and non-proliferation.

The last commercial GEN-I reactor shut down in 2015. GEN-II reactors make up the majority of present-day power plants in the United States.

Yi Xie

GEN-III reactors began operating in 1996 to provide simpler, standardized designs to reduce cost, extend operating life, provide more safety assurances, and burn fuel more efficiently, according to the International Atomic Energy Agency (IAEA).

New reactors that surpass even water-cooled reactors in safety and economics are on the horizon. These GEN-IV reactors, currently in the design and testing phase, show promise to be safer than the conventional water-cooled type of reactors because their coolants operate under lower pressure, with less material degradation and consequent potential for failure.

Molten salt reactors (MSRs) are one example of this next generation. Molten salt is an excellent coolant as it retains thermal energy very efficiently. But these reactors run at more elevated temperatures than water reactors and face higher radiation levels and corrosion concerns. New structural materials and fuels that can resist this severe environment are needed to realize the potential of MSRs as a cost-effective, safe and sustainable nuclear option for GEN-IV commercial power plants.

Molten salts are complex materials whose properties challenge scientific understanding and prediction; the radiation environment adds further complexities. Studies are needed to characterize radiation-driven speciation—the formation of new variants of the substance—and to predict molten salt behavior and possible degradation of the reactor's structural materials.

Ongoing research that provides a fuller understanding of the behavior of structural materials is critical for the next generation of nuclear energy applications and a more sustainable future.

Structural material degradation is crucial in nuclear applications. The structures include the core, reactor containment and coolant system, and structures used in the fuel cycling system. For example, I am conducting research to develop a method to predict stress corrosion cracking propagation in nuclear-fuel welded dry storage canisters, which are used as repositories for spent nuclear fuel. These canisters are strong enough to resist thermal, mechanical and radiation effects, but they can corrode and rupture due to stress corrosion cracking.

In one research effort, I fabricated a stress corrosion cracking system that can control water chemistry, temperature, pressure, and applied stress to measure crack growth rates during testing. These investigations revealed the fundamental mechanism of structural material degradation and established an experimental database for further studies.

In molten salt reactors and sodium-cooled fast reactors, we need to understand the chemical interactions of fission products with structures and their corrosion effects. I'm exploring the multidimensional characterization of the corroded alloys—a field in which research findings are rare. In addition, I'm developing novel computational methods and machine learning algorithms to predict material failure.

Editor's note: This article was first published Aug. 13, 2020, on the Purdue College of Engineering Medium blog. Medium is an open platform for expert and undiscovered voices alike to dive into the heart of topics and bring new ideas to the surface.

Source:
https://medium.com/@PurdueEngineering

NE PODCAST: PUR-1

Q&A with Clive Townsend, Purdue's PUR-1 Nuclear Reactor Supervisor and Assistant Laboratory Director

Editor's note: Purdue Engineering is presenting a series of podcasts featuring research that addresses critical issues related to societal resilience in the face of crises and efforts to engineer long-term solutions for a more robust future. Nuclear Engineering was recently featured in the series, with NE junior Destiny White (DW) asking questions. Some portions of the transcription have been edited for space and clarity. To listen to any of the College of Engineering podcasts, click here.

DW: Welcome Clive. One of the reasons I feel lucky to study nuclear engineering here at Purdue is because we have a 10-kilowat nuclear reactor on campus. For listeners who might not know about PUR-1, can you explain what is special about the reactor, and how it is used for education and research?

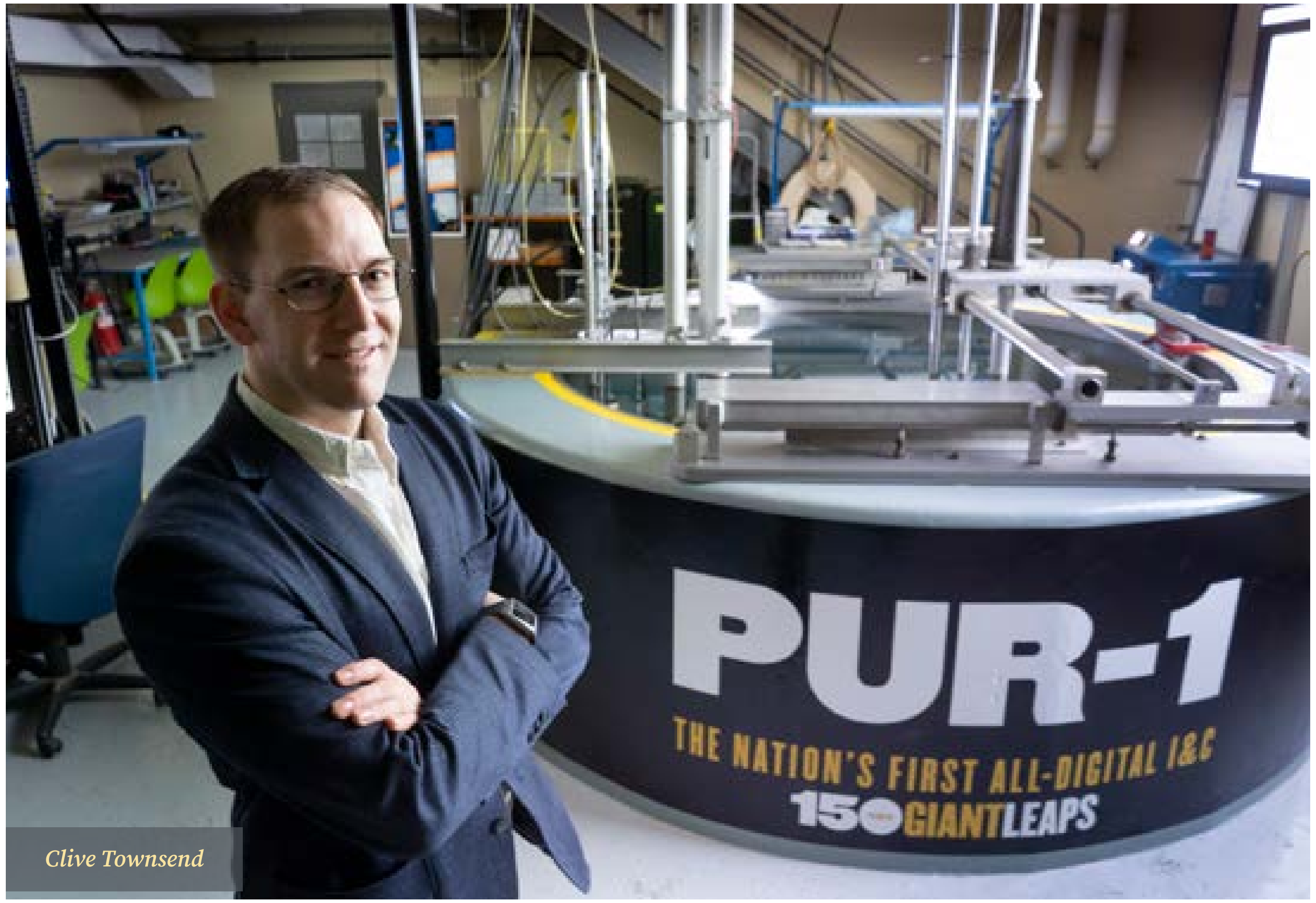
CT: There are 25 reactors across the country at 24 different universities, and Purdue's reactor is one of those. So while it is smaller than some of its peers, it's very, very flexible as a research and teaching institution. As a student, instead of just going to nuclear engineering school and doing basic labs, you can get your hands on an actual reactor doing actual experiments and actual research. All of our students will have the opportunity to spend time on the reactor before they graduate.

DW: I'm really looking forward to experiencing this later down in my nuclear career. So could you please explain what your job entails as a supervisor of a nuclear reactor?

CT: I take care of most of the day-to-day operations. This includes regulatory compliance and maintenance, help to set our operational schedule and what kind of research we will get involved with. I work very closely with Dr. Robert Bean who's the facility director, and together, we keep the reactor ready for teaching and training purposes.

DW: PUR-1 was recently upgraded to have all digital instrumentation and controls. How will these upgrades expand teaching, research and outreach capabilities?

CT: The move for PUR-1 to a fully digital control and instrumentation system was really a first in the U.S. fleet of nuclear reactors, including both industry and research facilities. These upgrades enable us to do several things. When you have a digital component, it's much easier to replace because it's just commercially available off the shelf for everything we're using. So this new digital paradigm has a lot of low-hanging fruit where we can enhance the reliability and the resiliency of the industrial fleet. From a teaching standpoint, if Purdue University is looking to engage the next generation of nuclear engineers, these are students who have never lived in a world that doesn't have smart phones, or tablets and laptop computers, and they expect a digital experience. By engaging them on a teaching platform that is more digitally oriented, it's more relatable, and they can understand better than if I give them more analog and traditional dials that they would see in today's fleet. And then from an outreach standpoint, Purdue as a land-grant school has a mission to engage the public and educate them on the topical areas of the day.



Clive Townsend

DW: As a student who has yet to work with the reactor, I understand that there's a lot of appeal to marketing the reactor toward my generation, but at the same time, do you think those skills that we learn from this reactor will be easily transferrable to industry and government organizations that aren't as updated?

CT: When going to a major research-oriented institution like Purdue, the first thing we're going to address is the fundamental characteristics of how a nuclear reactor works, how the safety systems work, and how those two systems work together to provide electricity to the grid. The fundamental physics have not changed. It's just how we control and operate the reactor. So you as a student should be prepared when you go into industry to take your fundamental knowledge and apply it in unique and diverse settings. Because there are so many opportunities in the nuclear space either for upgrades or for the small modular reactor and microreactor fleets, you'll be uniquely positioned as a Purdue student to have had experience in a digital reactor setting, in a small reactor setting, and on top of that, you have the traditional lab experience.

DW: I know I'm already enjoying my Purdue nuclear engineering experience, but what would you want potential students to know about pursuing a career in nuclear engineering?

CT: Pursuing a career in nuclear engineering is much more broad than I think the general public realizes. There's everything from medical applications and medical isotopes to military and defense, to energy and power production, and even radiation safety—for astronauts, for example. There are significant amounts of development going on in the entrepreneurial space with companies like the Oklo reactor and TerraPower and NuScale—all of them developing

Continued on next page

unique reactor systems to deploy in places that traditional nuclear has not been. On top of that, we have 20% of the nation's electricity supply, but over 50 percent of the non-carbon emitting electricity comes from nuclear power. When we look at those things together, there's really no better time than today to become a nuclear engineer.

DW: You've been involved in outreach with high school students to introduce them to nuclear engineering. Why do you think it's important to reach students before they get to college?

CT: I love this question. Think about the first time that you heard about nuclear anything. It was probably with World War II and the Manhattan Project. Because nuclear engineering developed out of this military application, a lot of times the connotations that come with it are initially negative, and then the nuclear community works to shift us back toward understanding the difference between what is nuclear power production and nuclear weapons. When we engage students earlier, we are dispelling that nuclear weapons myth earlier. For today's college cohort, it's more about the impact they'll have. Of course they still want to be employed and make a decent salary, but it's about how they can positively impact the world that matters to them first, and the salary comes second. By engaging high school students earlier, we're moving away from that World War II introduction phase and moving toward positively impacting the world.

DW: It's so clear that you're passionate about this work; you can hear it in your voice and in your energy. But can you explain what that driving factor is, and why you're so passionate about this?

CT: In general, it is because I like to take something that is misunderstood and look at it from all points of view. When I was getting into nuclear engineering in the 2010-2014 range, Fukushima had just happened. If you look at the data, the safety level of nuclear, even including the major accidents we've had, still far outperforms any of the carbon-emitting alternatives. For me, bridging the gap between the misperceptions of the public and advocacy by the nuclear community -- that makes me interested.

DW: How do you see nuclear energy being used in the next five, 10, even 20 years?

CT: The hot topics right now are small and modular reactors, microreactors, as well those that are going to be deployed in spaces that traditional nuclear hasn't been able to use as customers. For example, yesterday's fleet of nuclear reactors was on the gigawatt size and would service an area of approximately a million people, but tomorrow's nuclear reactors are much smaller, and so you'll be able to put in one or two or three modules—up to 12 for new scale—and that will provide a customer base that was just too small for traditional nuclear. There are several projects under way in the very beginning stages with NASA where they are developing these reactors for space. That's a really exciting application that won't be deployed for 10 years, but probably in the 20-year timeframe. There will be many, many careers that are built on these types of applications.

DW: I'm really grateful to Purdue's Nuclear Engineering Department because everyone—the professors and students—are so passionate. It's very clear that this is what they want to do, and they recognize the importance, so I would like to thank you for your time today and sharing about Purdue's nuclear reactor and outreach program.

Analog versus digital GIF above (click to activate)

NE PODCAST: VTR RESEARCH

Versatile Test Reactor (VTR) focuses on accelerating, improving new-generation reactors

Ran Kong

Editor's note: Purdue Engineering is presenting a series of podcasts featuring research that addresses critical issues related to societal resilience in the face of crises and efforts to engineer long-term solutions for a more robust future. Nuclear Engineering was recently featured in the series, with NE junior Destiny White asking questions of staff and faculty members. To listen to any of the College of Engineering podcasts, click here.

Ran Kong was studying about coal power plants during his undergraduate studies in China when an introductory class in nuclear energy changed the course of his career.

"At that time, China put a lot of energy into developing nuclear power to reduce carbon emissions," Kong said. The nuclear industry's reliability, emphasis on safety, and sustainability drew Kong to study nuclear engineering as a way to steer the world away from the toxicity of carbon emitters.

Kong works as a post-doctoral researcher under Seungjin Kim, the Capt. James F. McCarthy Jr. and Cheryl E. McCarthy Head and professor in the School of Nuclear Engineering, and Mamoru Ishii, the Walter Zinn Distinguished Professor of Nuclear Engineering. His work is focused in the Thermal-Hydraulics and Reactor Safety Laboratory (TRSL) at Purdue with the goal of designing improvements for high-performing reactor systems. In the TRSL, Kong has the capability to study fluid mechanics, heat and mass transfer, and safety in nuclear systems. His current focus is his work with the Versatile Test Reactor (VTR), a Department of Energy-funded program intended to accelerate and improve generation IV reactor designs. Kong is collaborating with Argonne National Laboratory and Idaho National Laboratory to design the VTR's sodium-cooled cartridge loop to assist the development of sodium fast reactors.

"When this research is completed, we will develop a computational design tool benchmarked by the experiment data that will help evaluate the VTR sodium cartridge loop," Kong said.

The VTR program contributes directly to the United States' ability to maintain its leadership in advanced reactor technologies, which was threatened by the shutdown of the Fast Flux Test Facility (FFTF) in the 1990s. The VTR re-establishes the testing capability, allowing for the continuous development of new materials and nuclear fuels for the next generation of reactors.

"The VTR is intended to fill this longstanding gap testing capability for rapid and accurate research and development of new materials and nuclear fuels," Kong said. "The VTR is important in realizing the generation IV reactors successfully. This will make the United States a strong competitor in the global market for nuclear power technology, which is estimated at $1 trillion."

In 2018, he said, nuclear power plants in the United States generated more than 800-kilowat hours of electricity, which is 55 percent of carbon-free energy. "More importantly, nuclear power plants operated at a full capacity more than 92% of the time, making nuclear the most reliable energy source in the world."

Kong said that nuclear power has one of the lowest fatality rates compared to other energy sources. "Coal, petroleum, natural gas and hydroelectricity have caused more fatalities per unit of energy due to air pollution and accidents."

Nuclear power generation is projected to grow 73% by 2040, and most of the existing reactors are on track to retire within the next few decades. Thus, the contributions of the VTR are crucial if the United States, and even the world, is to keep up with global energy demand in the future.

"I think the contributions from nuclear engineering will keep increasing," Kong said. "We definitely need new reactors and also need to develop advanced nuclear technology to meet this need. The generation IV reactors are safer, more sustainable and efficient, and have a lower cost."

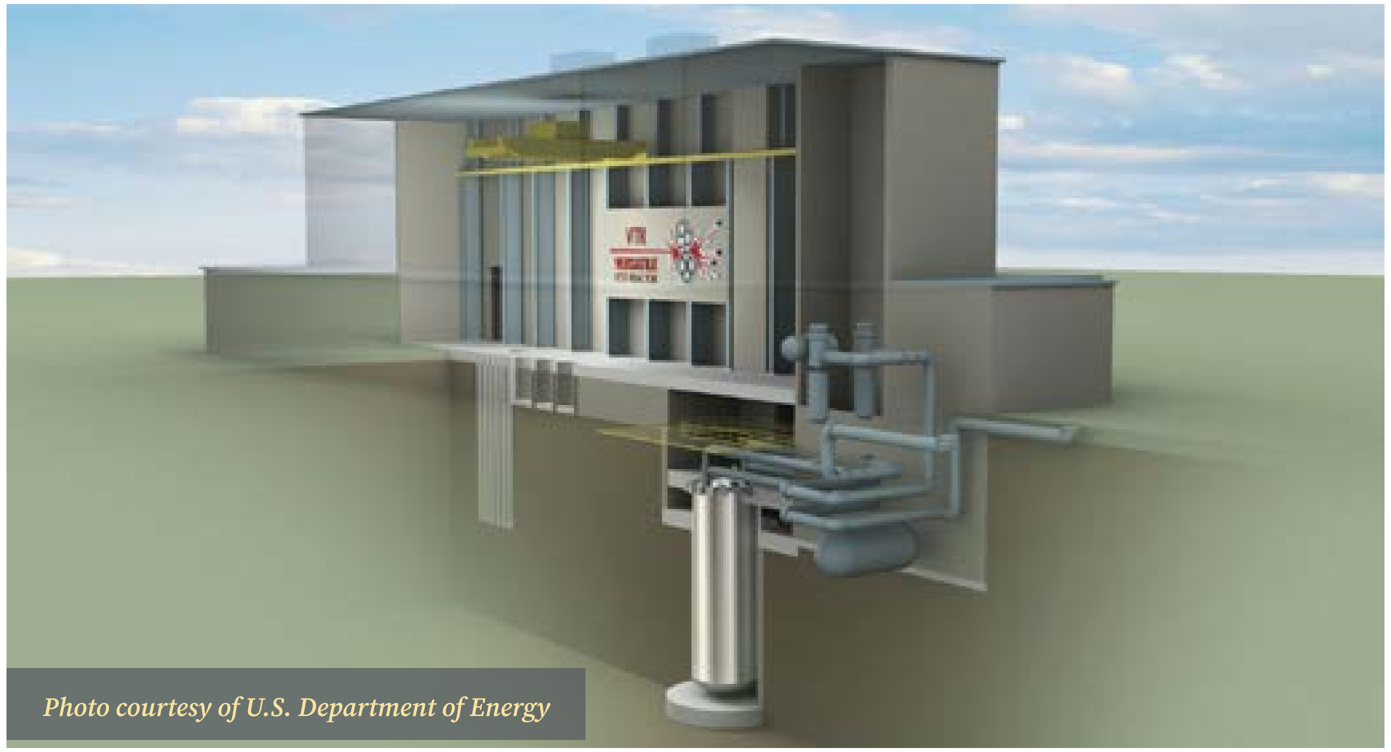


Photo courtesy of U.S. Department of Energy

NUCLEAR POWER PLAY

NE alumnus Don MacFarlane provides substantial gift for future scholarships.

For years to come, undergraduate students in the School of Nuclear Engineering will benefit from a generous gift provided by alumnus Don MacFarlane (MSNE '57, PhD NE '66) during Purdue Day of Giving 2020.

He made a new estate gift of $90,000 to support the Donald R. MacFarlane Scholarship Endowment in Nuclear Engineering. It will be combined with his original 2013 estate gift of $100,000 to the same fund.

"I've had a pretty good connection with Purdue. They were good to me. I have been very fortunate in my life, so I said, 'why not?'"

MacFarlane grew up in Chicago in a section of the city called Beverly. Money for college was tight, so he opted to attend the nearby, "relatively inexpensive" Illinois Institute of Technology (IIT), earning his bachelor's degree in chemical engineering in 1952.

After graduation, he went to work at a research lab for Sinclair Oil, but his stint there was short-lived. In 1954, he was drafted by the U.S. Army during the Korean War, served two years, and in doing so, "qualified for a few bucks" through the GI Bill.

By this time, he was "a little bored" with chemical engineering and was beginning to take a keen interest in the field of nuclear engineering. "I was a young guy looking for an interesting field with a lot of adventure. At that time, the nuclear industry was just evolving and developing," he said, "and there was a lot of talk about building nuclear power plants."

"How could a guy go wrong in a career that is central in generating electric energy with nuclear power, which is so environmentally friendly? The sky was the limit in those days. Everyone was so extremely optimistic about what this was going to do for our power supply, and I bought into it, too. I was just enamored by the whole process."

Chemical engineering had been a good starting point, he shared, "because you learn a lot of stuff relevant to nuclear engineering, like nuclear reactions. It was kind of a natural direction to go."

Putting the GI Bill to use, he entered the master's program at Purdue and earned his degree in nuclear engineering in 1957.

Fresh degree in hand, his next stop was at Argonne National Laboratory in Illinois. This was the Cold War era, a political standoff between Russia and the United States. Americans were alarmed when Russia in 1957 successfully launched into space its satellite, Sputnik, the first man-made object to orbit Earth. This sent the United States government into a Space Race tailspin, worried that the Russians were encroaching on new, technology-based warfare, and feared that the education in the Soviet Union was superior to that of the United States.

"The government panicked," MacFarlane said, "and as a result started sponsored scholarships for PhD students."

Don MacFarlane at the Opera

The National Defense Education Act (NDEA) was passed in 1958, providing federal funding to bolster education in the areas of science, mathematics and modern foreign languages. The NDEA authorized the appropriation of more than $1B over the next seven years to achieve its goals, signaling the expansion of the role of the federal government in the education of its citizens.

"I was qualified to do it because I could finish my PhD in one year if I went back to the same school where I got my last degree and applied all of the previous classes I took. And, I could keep doing research at Argonne earning my full salary. It was a tax-free scholarship essentially. I got a slight raise by going back to school!"

He earned his doctorate in nuclear engineering from Purdue in 1966 and left Argonne in 1974. He then went to work at ComEd utility in Chicago for one year before leaving to start a small engineering consulting business with some of his Argonne colleagues.

Then, in the mid-1980s, he got a phone call from Purdue. His doctorate advisor and professor had retired, "and they wanted me to show up in two weeks to start teaching for the fall term. I scratched my head and said, 'You guys have got to be kidding me.'"

His initial response was to decline, saying he was too busy as a consultant. But it didn't take him long to change his mind, and he ended up teaching three semesters as a nuclear engineering visiting professor.

"You learn new things when you have to teach them. It was a great experience. These kids are sharp, and they kept me on my toes. I formed a lot of good relationships with students," he said.

During this time, his daughter Ginger was a Purdue student, earning her degree in foods and nutrition. "I was actually at her graduation as a member of the faculty," he laughed.

As he wrapped up his professorship at Purdue, he was at another crossroad in his career. His consulting firm had been sold to a "beltway bandit," a private company located near Washington, D.C. that does a large percentage of its business as a federal government contractor. He was still employed by the firm but knew it was time to make a change.

Continued on next page

"I always liked the mountains and the West, so I started talking to some friends out there. I had buddies at Los Alamos National Laboratory (near Santa Fe, NM) and got a job and worked there eight years," MacFarlane said. He retired in 1996 and decided to stay in the area.

At 91 years young, MacFarlane sold his home in early 2020 and moved into a retirement community at the onset of COVID-19. An active and social man, the pandemic and its restrictions have been difficult for him socially. He is grateful that the fitness facilities at his new home have recently re-opened, albeit under strict safety guidelines. He says exercise keeps him physically fit and mentally sharp. He enjoys swimming, weight training, walking on the treadmill, balancing exercises, and punching bags, which, he says with a chuckle, helps him address his frustrations over social distancing.

His daughter Ginger works in hospital food management and lives in the Boston area. He and his son "share some commonalities." Eric MacFarlane earned his master's degree in structural engineering from IIT, works at Los Alamos, and lives 20 minutes away.

MacFarlane says he doesn't know the future of nuclear engineering, but he remains vested in students exploring what the field has to offer without being derailed by financial obstacles.

"There are a lot of smart people. What there isn't enough of is the money to educate them. I feel like the success of the country depends on people being well educated," he said, explaining why he was compelled to establish the scholarship endowment.

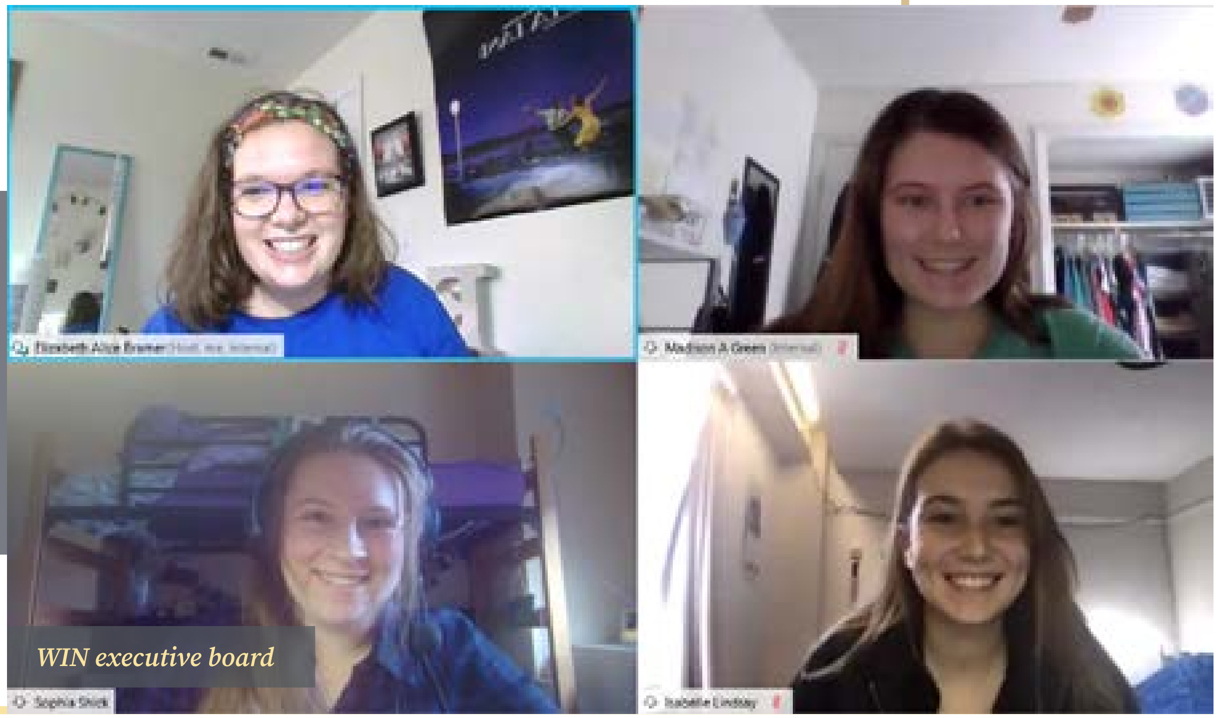
"And really," he said, "I kind of felt like I'd gotten all of this education for nothing. I ended up getting two advanced degrees from Purdue that hardly cost me anything."

Sources:
https://history.house.gov/HouseRecord/Detail/15032436195
https://study.com/academy/lesson/the-space-races-impact-on-math-science-education-in-the-us.html

EVENTS

Purdue WIN hosts 2020 virtual conference

The persistent pursuit of new possibilities



WIN executive board

"We were so happy to have such a broad outreach and to meet people from all different walks of the nuclear industry and academia," Bramer said. "We hope to continue to host and attend events like this in the future."
— Liz Bramer, WIN president

The Purdue University student chapter of WIN (U.S. Women in Nuclear) hosted the 2020 Region III Conference in September.

With the theme "Nuclear Now," the event covered topics relevant to progressing nuclear engineering into the future by learning what members can do right now.

"Purdue WIN was the first student chapter to host the conference in Region III history. We had a great turnout with a vast increase in attendance from last year, and the conference was a great success," said Liz Bramer, WIN president.

Bramer, who is set to graduate with a degree in nuclear engineering in 2022, also is a student ambassador for NE and a peer counselor for the Purdue Office of Future Engineers.

Topics included:
- Diversity and inclusion in industry and academia
- Emotional intelligence
- The future of nuclear
- Nuclear engineering in higher education

Rita Baranwal, assistant secretary for the Office of Nuclear Energy, U.S. DOE was the keynote speaker.

Other speakers included:
- William D. Magwood, IV, Director—General of the OECD/NEA
- Maria Korsnick, CEO of Nuclear Energy Institute (NEI)
- Suzanne Jaworowski, senior advisor, Office of Nuclear Energy DOE
- Sue Abrue, Nuclear Regulatory Commission and Purdue College of Engineering 2020 Distinguished Alumna
- Caroline Cochran, founder and COO of Oklo Inc.
- Katy Huff, University of Illinois Urbana-Champaign

EVENTS

Purdue hosts national TRTR meeting

NE's Townsend secures high-ranking goverment officials as participants

Purdue University virtually hosted the 2020 National Organization of Test, Research, and Training Reactors (TRTR) Sept. 27-Oct. 1, 2020.

The event was organized by Purdue's PUR-1 Nuclear Reactor Supervisor and Assistant Laboratory Director Clive Townsend, who just finished his year-long term as TRTR chairman.

Despite the necessity to move the annual meeting online and the challenges that decision created, the event was well attended with an agenda packed full of relevant topics and dynamic speakers. In fact, Townsend shared, this format worked in his favor.

"Hosting a virtual meeting certainly presents challenges with coordinating technology, schedules, and the multitude of platforms people use to access content. However, it provides significant advantages in accessing higher-caliber speakers because they don't need to travel physical distances. We leveraged this to have two NRC commissioners (Christopher T. Hanson and Jeff Baran) and the Deputy Assistant Secretary for Reactor Fleet and Advanced Reactor Deployment in the Office of Nuclear Energy from the Department of Energy (Alice Capitoni)," Townsend said.

As he was planning the event, Townsend noted a recurring problem—audio quality. So he went on the hunt for a format more conducive to hosting a large meeting.

What he found was a relatively new virtual event platform, Hubilo, the product of a startup. The software enhances audience engagement and networking. "It allows you to isolate the speaker on one video set and have everyone else on another one," he said.

Clive Townsend

The platform also offers a live Q&A chat bar as well as an anonymous question feature.

Each year, topics at the meeting are centered around three main initiatives: current research activities; operational challenges and upgrades to facilities; and regulatory issues

"There were significantly more anonymous questions than named ones," Townsend said. "Sometimes participants might want to ask a question that is aggressive or pointed or could rub someone the wrong way. (This platform) certainly resulted in more questions being asked."

One of the main challenges in the nuclear community is the aging fleet of operational research reactors, Townsend said, with only 25 remaining at universities or colleges. "We are particularly focused on bringing focus to these unique national assets and the platform for human capital development, advanced science, and public outreach they provide."

On the bright side, he added, the University of Illinois at Urbana-Champaign and Texas Abilene University have shown interest in installing new research reactors. "So the most exciting time to be involved in the last several decades."

As host, Townsend had originally planned to hold the meeting in Chicago to make travel easier for attendees. On one of the days, a bus was going to transport attendees to Purdue to tour PUR-1, which in 2019 was upgraded from an analog system to being 100% digitally controlled.

The digital conversion was a result of the DOE awarding Purdue a grant to replace instrumentation and the control system with a state-of-the-art upgrade through its Nuclear Energy University Program (NEUP). The new digital technology allows more data to be processed and analyzed and increases capabilities such as predictive analytics, machine learning and artificial intelligence.

Built in 1962, the reactor is a Materials Test Reactor (MTR) with plate type uranium/aluminum fuel. It is the first and only nuclear reactor operating in the state of Indiana.

The TRTR organization is dedicated to education, fundamental and applied research, application of technology in areas of national concern, and improving U.S. technological competitiveness around the world. According to its website: "These research reactors have been the workhorses of the education and research infrastructure, and with continued support can remain so well into the future."

Townsend, who will serve one more year on the TRTR executive committee as immediate past chair, earned his B.S. in physics and nuclear engineering (2014) and his M.S. in nuclear engineering (2018), all from Purdue.

TRTR

NE NEWS

NE's new home will be in Lambertus Hall of Gateway Complex

Multidisciplinary facility will improve student learning, industry partnerships, virtual labs, job-ready education.

Lambertus Hall- the northern hall. The School of Nuclear Engineering will be on the fifth floor of Lambertus Hall, overlooking Potter, Knoy, and Electrical Engineering.

With the completion of new Purdue Gateway Complex—scheduled to open during the 2022–2023 academic year—the School of Nuclear Engineering will have a new home.

In March 2020, to make way for the facility, Michael Golden Engineering Laboratories and the Nuclear Engineering Building were demolished. The school is temporarily located in Wang Hall. The new complex will expand the footprint of the two buildings it replaces by more than 2.4 times—from a 105,000 square feet to approximately 255,000 square feet.

Composed of two connected facilities, the state-of-the-art space will provide collaborative, industry-focused opportunities for the College of Engineering and Polytechnic Institute. The design will increase both the quality and quantity of instructional lab space, provide more dedicated space for active learning, and bring together labs that are currently geographically separated.

A $40M gift from the Lilly Endowment for the project will advance Indiana's 4.0 leadership, a term that refers to the rise in smarter factories and a greater incorporation of digital and analytical technologies into systems and processes. The space is being designed to improve student learning and expand the state's pipeline of talented engineers and technologists. This innovative, multi-disciplinary complex will directly connect students, faculty, and businesses and is anticipated to jumpstart new partnerships that benefit the state of Indiana. The complex includes two halls, named for generous alumni donors.

William and Martha Dudley Hall is in recognition of the couple's $11M gift. William (Bill) Dudley Jr. earned his B.S. in civil engineering in 1974 and was awarded an HDR in 2015. Martha (Marty) Dudley earned her A.A.S. in architectural drafting from IUPUI in 1979 and her B.S. in building construction tech in 1981 from Purdue Northwest-Hammond. The 145,000-square-foot Dudley Hall will host a student success center with academic advisers and programs, including Engineering Honors, Office of Professional Practice, Minority Engineering, and Women in Engineering. It will consist of five stories and a basement.

Peter and Ann Lambertus Hall is named in recognition of the couple's $10M gift. This 110,000-square-foot-space will house the School of Nuclear Engineering on the fifth floor overlooking Potter, Knoy and the Electrical Engineering buildings. Other features include flexible learning labs, the "Build at Scale" Lab, and a two-story Industrial Engineering lab. Peter Lambertus is a 1967 graduate of Purdue, earning his B.S. in electrical engineering in 1967.

The Gateway Complex will accelerate Purdue's vision to become a national leader in STEM online education by scaling up virtual labs for both on-campus and off-campus learners. Through the Lilly Endowment's investment, the complex will be a large-scale prototype facility designed to incubate the development of virtual labs. It will be the first university facility in the nation dedicated to creating virtual labs at an extensive scale.

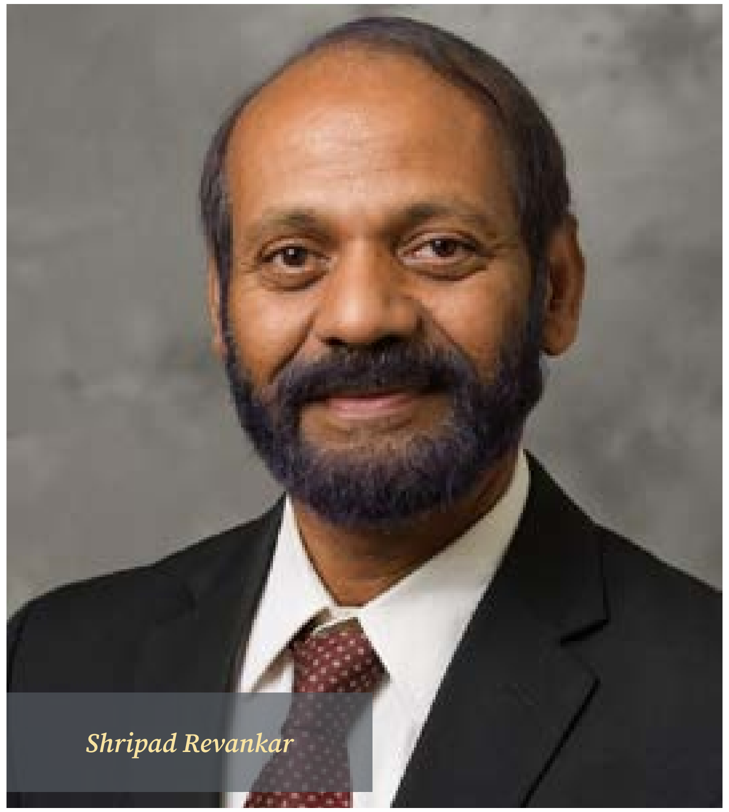
The Gateway Complex design reimagines how students, faculty, and industry partners connect. Companies that co-locate in the facility also are anticipated to benefit from direct interactions with students and faculty. Industry spaces will act as both a workspace and a showroom for the company, with participating partners having unprecedented access to valuable expertise, visibility, and resources. Indiana companies will have better opportunities to recruit students by working alongside them on projects and research throughout their undergraduate experience.

Sources: Purdue Gateway Complex Report to Lilly Endowment Inc., July 2020
https://www.buildingindiana.com/what-is-industry-4-0/

Construction is under way.

FACULTY AWARDS

ANS selects Revankar for Technical Achievement Award



Shripad Revankar

Shripad T. Revankar is the recipient of the Thermal Hydraulics Division Technical Achievement Award from the American Nuclear Society (ANS) for the year 2019.

This award is the highest accolade given by the ANS Thermal Hydraulics Division (THD). It is presented annually to a member of the THD in recognition of outstanding past or current technical achievement. It is based on a major contribution to the state of the art, an important publication, a major technical achievement, or a sustained record of accomplishment and technical excellence in the art or science of thermal hydraulics. Revankar, ANS Fellow and member since 1988, was selected for his technical contributions over three decades in thermal hydraulics and reactor safety.

Revankar was presented with the award in a ceremony during the THD Special Technical Session at the ANS Winter Meeting and Expo on Nov. 18, 2019, in Washington D.C. A plaque celebrated him with these words, "For his significant contributions to reactor thermal hydraulics through experiments, and for the modeling of phenomena important in the analysis of nuclear reactor safety and applications."

The award recipient must be recommended by a previous recipient with a minimum of three other letters of support. Revankar was humbled to learn six previous recipients had written letters in support of his accomplishments in addition to his original nomination. "I have worked in this field for a long time, since 1984, so I was happy to be recognized in this way," Revankar said.

Previous recipients from Purdue University include: Mamoru Ishii, the Walter Zinn Distinguished Professor of Nuclear Engineering (1989); and Victor Ransom, professor emeritus and former department head of nuclear engineering (1999).

Ishii Inducted into Purdue Innovator Hall of Fame

Mamoru Ishii

Mamoru Ishii, the Walter Zinn Distinguished Professor of Nuclear Engineering, was among the 25 scientists and researchers to be inducted into the Purdue Innovator Hall of Fame.

The program, created in 2013, recognizes scientists and researchers who have made a positive impact on global society through their research. It has honored 137 Purdue innovators.

Research of the inductees includes drug discovery, energy, food security, space exploration, cybersecurity, health, Internet of Things, spectrometry, biomedical devices and industrial systems.

A full list of inductees can be viewed here.

Bean selected for 2020 Best Teacher Award

Robert Bean

Nuclear Engineering Assistant Professor **Robert Bean** was named the recipient of the 2020 Best Teacher Award.

It is presented annually to an outstanding teacher in the Purdue University School of Nuclear Engineering who display excellence in teaching. Winners are selected by the NE student body.

In the 2019-20 academic year, Bean taught NUCL110 (introduction to energy engineering), ENGR103 (introduction to engineering in practice), NUCL305 (nuclear engineering undergraduate laboratory), NUCL504 (nuclear engineering experiments), and NUCL 597 (nuclear power and nonproliferation)

His research interests include the application of advanced safeguards to the design of nuclear facilities (specifically next-generation nuclear reactors, aqueous processing plants, and pyroprocessing facilities), as well as radiation detection and measurement (gas detectors, solid state detectors, gamma spectroscopy, neutron detectors).

STAFF AWARDS

PUR-1 team receives College of Engineering Award of Excellence

Dean Mung Chiang, Clive Townsend, Robert Bean, and David Storz

Every year the College of Engineering recognizes staff with Awards of Excellence. On Dec. 6, 2019, **Robert Bean, David Storz,** and **Clive Townsend** received the Team Award for their work on the Purdue University Reactor Number One (PUR-1).

Their award includes the following citation: "For their exemplary leadership, extraordinary efforts and dedication in establishing the first-of-its-kind in U.S. history, a fully integrated all-digital nuclear reactor, leading to profound impacts on nuclear engineering education, research and existing and future reactor fleets."

Over the course of this multi-year effort, Team PUR-1 has worked to upgrade the reactor's power from 1 kW to 10 kW and devoted themselves to working with the U.S. Nuclear Regulatory Commission (US NRC) to have PUR-1's license amendment approved for a 100% digital instrument and control (I&C) system. This was the first application of its kind for the US NRC. While this rigorous review process was going on, Team PUR-1 continued its educational mission by holding undergraduate and graduate laboratory classes, leading tours, performing public education outreach on nuclear energy, and collaborating with researchers on and off the Purdue campus.

The School of Nuclear Engineering is incredibly proud of all the hard work Team PUR-1 has put into this long and challenging project. We can't wait to see what they are able to achieve with the new capabilities of PUR-1.

Reece, Luse named Bravo Award winners

Kellie Reece, administrative manager and administrative assistant to Nuclear Engineering Head Seungjin Kim, and **Teresa Luse,** associate administrative assistant, were recognized in spring 2020 with Purdue's Bravo Award.

The Bravo program recognizes excellence that exists among employees across the University. It is an after-the-fact discretionary program designed to provide recognition for substantial accomplishments. Staff members are rewarded when they stretch beyond what is asked and achieve on another level.

Discretionary cash awards of up to $1,000 are provided to the honorees.

Kellie Reece

Teresa Luse

STUDENT AWARDS

National

Recent grads, current students win DOE, NRC awards


Jeremy Marquardt

Jeremy Marquardt was awarded a Rickover Fellowship from the Naval Reactors Division of the Department of Energy (DOE). This opportunity is considered one of the most prestigious fellowships in the nation, awarded to top students pursuing a PhD in nuclear engineering.

The four-year fellowship is intended to provide education on the maintenance and development of science and engineering technology pertaining to naval nuclear propulsion and advancing fission energy development.

Jeremy received his bachelor's degree in nuclear engineering from Purdue in May 2020. He plans to perform research on AI/machine learning applications to nuclear reactor control, maintenance, and accident mitigation.


Adam Dix

Adam Dix has been awarded a Department of Energy (DOE) Nuclear Energy University Program (NEUP) Fellowship. The fellowship is awarded to students pursuing nuclear energy-related disciplines at universities across the country. Dix will receive up to $50,000 a year over the next three years to help pay for his graduate studies and research, plus $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. He will study a breadth of critical nuclear energy issues, from fuel cycle sustainability to reactor efficiency and design.

Adam received his bachelor's degree in nuclear engineering from Purdue in May 2020. Adam's future plan, once he receives his PhD, is to work at a national laboratory on liquid metal thermal-hydraulics and fast reactor safety, with an eye toward helping licenses and encouraging their widespread adoption.


Caleb Darr

Caleb Darr was awarded a $7,500 NEUP scholarship from the DOE for the 2020-2021 academic year. The award is given to students enrolled in Integrated University Program (IUP)–approved universities, which includes Purdue. Darr is a senior set to graduate in 2021.

PhD student Stockett wins first place for energy policy paper

Nuclear Engineering PhD student **Paul Stockett** won first place in the Innovations in Nuclear Technology R&D Awards sponsored by the U.S. Department of Energy (DOE), Office of Nuclear Technology R&D for Innovative Nuclear Technology.

Stockett's award is in the category of energy policy. His award-winning research paper, "Nonproliferation in the New Space Age: Where Do We Stand?" was presented at the Institute of Nuclear Materials Management Annual Meeting in July 2019.

The Innovations in Nuclear Technology R&D Awards program is designed to:

1) Award graduate and undergraduate students for innovative nuclear-technology-relevant research publications

2) Demonstrate the Department of Energy's commitment to higher education in nuclear-technology-relevant disciplines

3) Support communications among university students and Department of Energy representatives


Paul Stockett

The program awarded 24 prizes in 2020 for student publications relevant to innovative nuclear technology. In addition to cash prizes, award winners have opportunities to participate in events such as the 2020 Nuclear Technology R&D Annual Meeting, the 2020 American Nuclear Society Winter Meeting, and an Innovators' Forum designed to engage students in advancing innovations in nuclear technology.

STUDENT AWARDS

National

NE undergrad, grad students selected for NRC awards

Emily Downing and Catalin Harabagiu are the recipients of the U.S. Nuclear Regulatory Commission (NRC) Fellowship, awarded to top students pursuing nuclear engineering graduate degrees.

Caleb Darr, Trevor Drouillard, Jacob Minnette, Destiny White and John Zupke are the recipients of the U.S. NRC Scholarship, awarded to top undergraduate students pursuing nuclear engineering degrees.

ANS awards 4 scholarships to NE students

The American Nuclear Society (ANS) has awarded several scholarships to Purdue Nuclear Engineering students. There were 59 scholarship recipients receiving awards totaling $157,000 for the 2020-2021 academic year. Students, all pursuing degrees in nuclear science and technology, were selected by the ANS' Scholarship Policy and Coordination and NEED committees. Purdue selectees were as follows:

William R. & Mila Kimel Nuclear Engineering Scholarship
- Jeremy Mateja

Fusion Energy Division Dr. Kenneth R. Schultz Undergraduate Scholarship
- Jacob M. Halpern

ANS Graduate
- Junghyun Bae
- Adam Darr

University

Lee and Ozerov awarded Purdue fellowships

PhD student **Joeun Lee** received the Ross Fellowship, a fellowship awarded by the Purdue Graduate School to incoming graduate students.

The Ross Fellowship is earmarked for doctoral applicants. Those selected receive four years of stipend/salary and tuition coverage.

Stepan Ozerov is the recipient of the Asire Fellowship awarded by Purdue University to top students pursuing a PhD degree in nuclear engineering.

This award recognizes commitment to and efforts toward enhancing the graduate student community within the School of Nuclear Engineering and the College of Engineering. Funds are provided by the Vincent P. Reilly Scholarship Fund/Horace W. and Helen K. Asire Scholarship Fund.

College of Engineering

Loveless, Lagari selected for presitgious awards

Amanda Loveless was selected for the 2019-2020 Outstanding Research Award, which recognizes students who have demonstrated excellence and leadership in research through publications, participation in professional organizations and willingness to mentor others. She was given a certificate and $2,000 award. Amanda received her PhD in 2020 and is a post-doctoral research assistant at Purdue.

Pola Lydia Lagari received the 2019-2020 Magoon Award, which is given to outstanding teaching assistants and instructors. The $2,000 award is in memory of Estus H. and Vashti L. Magoon, who have influenced the lives of many engineering educators. It is made possible through the Estus H. and Vashti L. Magoon Endowment. She is a graduate research assistant with the School of Nuclear Engineering.

Department

Several NE students win excellence awards

Adam Dix is the recipient of the Outstanding Senior Award in recognition of excellence in academic achievements and exemplary leaderships.

Jennifer Firehammer, Alyssa Granito, Natalie Houghtalen and Jonathan Parker are the recipients of the Outstanding Leadership Award in recognition of exemplary service, willingness to assist, and demonstration of inspirational leadership.

Pola Lydia Lagari is the recipient of the School of Nuclear Engineering's Distinguished Service Award in recognition of exceptional efforts and demonstration of leadership in a time of need.

Department Endowed Scholarships

Seven NE students win alumni–funded scholarships

Thanks to the philanthropic gifts made by Purdue alumni, the following named scholarships were awarded for the 2020-2021 academic year.

Anderson Nuclear Engineering Scholarship:
- Jackson Wolf
- Evan Frishholz

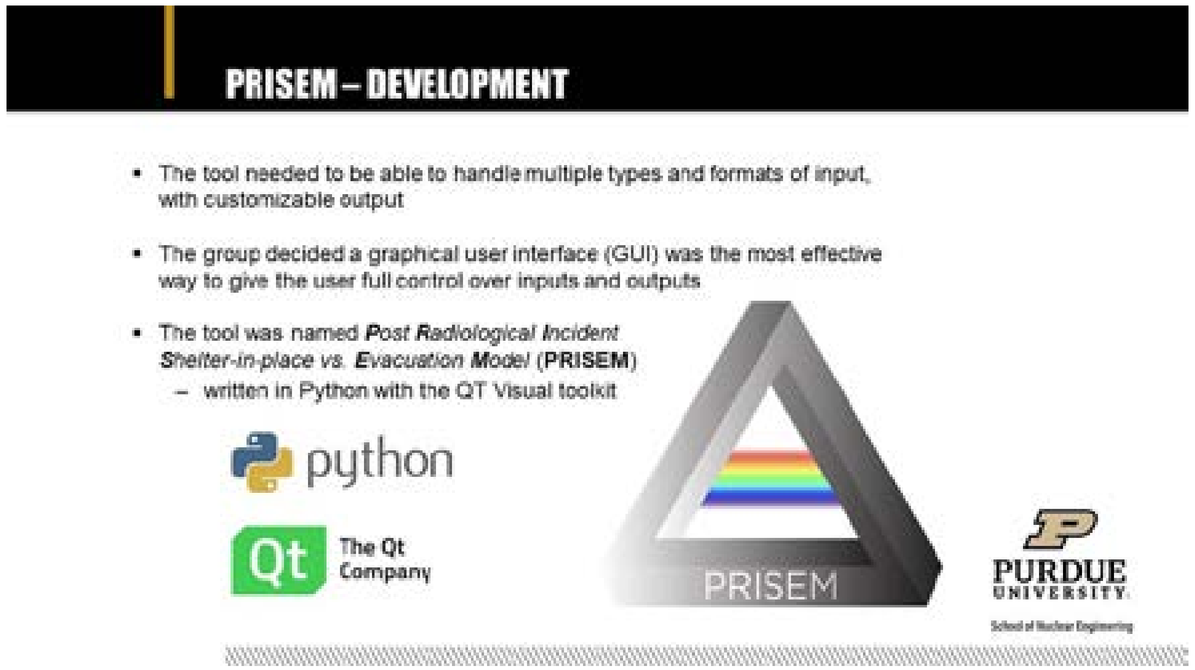
Blattner Nuclear Engineering Scholarship:
- Jacob Halpern

Krauss Nuclear Engineering Scholarship:
- Oscar Lastres
- Sarah Lang

Plein Nuclear Engineering:
- Sarah Larson
- Isabelle Lindsay

OTHER NEWS

Purdue nuclear team is finalist for ANS design competition



A team composed of undergraduate students from the School of Nuclear Engineering has been announced as a finalist for the 2020 American Nuclear Society (ANS) Student Design Competition and is invited to make a presentation at the ANS 2020 Winter Meeting and Nuclear Technology Expo to be held in November 2020.

Competing against the University of Tennessee, University of Illinois Urbana-Champaign, University of Sharjah, and North Carolina State University, the teams will make their presentations at the ANS Winter Meeting.

The Purdue team will present on their project, "Design of a Novel Decision-Making Tool for the Analysis of Shelter-in-Place During a Radiological Release."

The Purdue team includes David Champlin, Mark D'Aloia, Emily Downing and Elizabeth Jaye. Team mentor is Todd Smith, of the U.S. Nuclear Regulatory Commission, and the faculty advisor for the team is Shripad Revankar.

NE set to offer online master's degree program

The School of Nuclear Engineering at Purdue University is excited to announce the new online Master of Nuclear Engineering degree program, to be launched in Spring 2021. We are happy to provide this continuing education opportunity to those of you who are seeking advanced knowledge in nuclear engineering that can be achieved at your pace. A great opportunity to learn from our world-renowned faculty!

Read the full article:
https://engineering.purdue.edu/NE/news/2020/Online-Engineering-Master-Of-Nuclear-Engineering

NE undergrads participate in SURF program

Two undergraduate students participated in the 2020 Summer Undergraduate Research Fellowship (SURF) program hosted virtually by the College of Engineering Undergraduate Research Office.

SURF matches undergraduates with a faculty member and graduate mentor who introduce them to the research tools used on the cutting edges of science, engineering, and technology. Students participate in research activities over a 10-week period of an 11-week program in the summer.

Lorin Breen and Allen Garner (PI), nuclear engineering associate professor and undergraduate program chairman, presented the project "Finite Element Modeling of Transmembrane Potential Under Applied Electric Fields." Their research centered around the biological response to Pulsed Electric Fields (PEFs), electroporation, cell inactivation, Finite Element Method, and the use of Maxwell 3D for calculations.

Jacob Minnette, along with Nathan Boyle, an NE post-doctoral research assistant, and Rusi Taleyarkhan (PI), nuclear engineering professor, presented the project "Optimization of Centrifugally Tensioned Metastable Fluid Detectors (CTMFD) for Alpha and Neutron Detection." Their research involved metastable fluids, radiation detection, degassing, and spectroscopy.

Source:
https://engineering.purdue.edu/Engr/Research/EURO/surf-symposium

NE starts new student organization, MINES

The School of Nuclear Engineering has a brand new organization, Minorities in Nuclear Engineering and Sciences (MINES), which is intended to provide a means for public education regarding nuclear energy, policy and technology. Its mission also is to facilitate minority recruitment into the nuclear sciences and develop a cross-disciplinary network of minorities and allies across industry and academia.

The 2020-2021 student officers are: Destiny White, president; Jalen Rice, treasurer; and Joshua Rodriguez, secretary. NE Head Seungjin Kim is serving as the interim faculty advisor.

Mines members participate in professional development and mentorship opportunities and outreach efforts to community colleges, elementary and high schools.

"The nuclear field is shrouded in public misunderstanding, which makes recruitment of individuals of all races difficult. It is MINES' goal to plant and spread the seed of positive nuclear knowledge in underrepresented minority populations so that the nuclear workforce and academia may reap the benefits from increased diversity and inclusion," White said. "We also hope to develop a welcoming culture for people of all backgrounds at Purdue NE so that minorities and allies in nuclear STEM feel supported and uplifted."

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