Nuclear Education:

Our doorway to the future.

PURDUE **NUCLEAR**

ENGINEERING**IMPACT**

WINTER 2007-08

New to NE
Faculty brings robust research, commitment to classroom.

Purdue to Penn State
Two alums in the academy at Happy Valley.

Vincent Walter

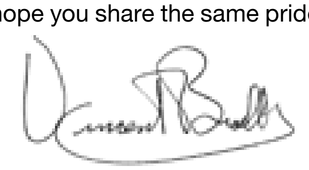
On my mind

You would be hard pressed to find an undertaking that's more important than education. It's through education that we're able to find a better way, build on good ideas, and change the world. So it's fitting that the primary focus of this *Nuclear Engineering Impact*, our fifth if you're counting, is education. I hope you'll take some time to read some of our various perspectives on the subject.

Fall is always a busy time on campus and within the School of Nuclear Engineering. In "Around NE" you will read about three new faculty members and a National Science Foundation (NSF)-sponsored grant that will help researchers develop computational techniques with an eye toward radioactive detective work and homeland security. A nice surprise seeing that so much of our research dollars come from either the Department of Energy or the Nuclear Regulatory Commission, the NSF funding comes, in part, from a strong educational component tied to the research.

Our cover story details "this business of education," and the good news is all the possibilities awaiting our young graduates in the working world. Robert Uhrig, a University Distinguished Professor Emeritus from the University of Tennessee, Knoxville, weighs in with an opinion piece. You can get a closer look into the work of both a new professor (Ahmed Hassanein) and a hard-working student (Vivek Agarwal), catch up with a couple alums (L. E. Hochreiter and Seungjin Kim) now both teaching at Penn State, and see how some current students are "demythologizing" the concepts of nuclear energy on campus.

This education business is truly a great field. At Purdue we have one of the best nuclear engineering programs in the country, and we plan to build on our collective success. And whether you're an alumnus, an industry partner, or just a friend of the school, I hope you share the same pride in our school as I do.



Vincent Bralts
Interim Head, School of Nuclear Engineering

Letter to the editor

October 19, 2007

Dear Purdue *Impact*,

I just got around to reading the "Summer 2007" issue and all I can say is WOW. I was completely amazed by the story about the largest class of nuclear engineering graduates in the school's history. Forty-two undergrads are amazing to me considering I graduated in a class of nine. Kudos to the nuclear engineering department. For *Impact*, keep the great stories coming.

Sincerely,
Mike Feyedelem
BSNE '89

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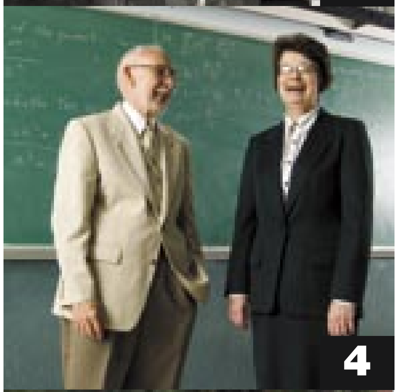

PURDUE UNIVERSITY
COLLEGE OF ENGINEERING

School of Nuclear Engineering

Interim Head.........**Vince Bralts**
Director of Development.........**Michael Stitsworth**
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Graphic Designer.........**Erin Ingram**
Photographers.........**Vincent Walter, John Underwood**
Contributing Writers.........**Amy Page Christiansen,**
.........**C. Lee Lamb, Gina P. Vozenilek**

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Please send them to the following address:

Nuclear Engineering Impact
Purdue University
1435 Win Hentschel Blvd., Suite B120
West Lafayette, IN 47906-4153
E-mail: peimpact@purdue.edu

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Amy Noah
Director of Engineering Advancement
arnoah@purdue.edu
(765) 494-0164

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NSF-Funded

With educational opportunities linked to homeland security, a new project hits home with an unlikely funding source.


Tatjana Jevremovic

Smaller, at least in terms of overall faculty numbers within the College of Engineering, yet robust, the faculty within the School of Nuclear Engineering brings in many millions of dollars in research support to Purdue each year. While much of that funding comes from the Department of Energy and the Nuclear Regulatory Commission, there's a new noteworthy grant coming from an unlikely source—the National Science Foundation (NSF).

Unlikely and a bit of a pleasant surprise, says Tatjana Jevremovic, an associate professor and lead investigator on the project, because "we ranked in the top three out of more than 200 proposals on a project that's pure physics." From the same pool as heavy-weight programs like Harvard, Cornell, and MIT.

And what's at the heart of the physics proposal? "We want to be able to more accurately detect nuclear materials that could be smuggled into the United States," Jevremovic says. Ports could be an especially dangerous meeting point where various radioactive materials could be delivered and assembled later into something like a dirty bomb. "Someone could smuggle in amounts of uranium or plutonium, and we want to find a new way to accurately detect that."

For the Purdue researchers, which include Jevremovic and her colleagues Chan Choi, Rong Gao, and Lefteri Tsoukalas, the breakthrough challenge will come when they can make those discoveries in real-time through the use of advanced computational techniques. The challenges of fast and accurate detection demand innovations in source/sensing hardware, algorithms and associated software, and system integration. The proposed research concentrates on algorithms and integration and aims at pushing the envelope in detection methodologies. In other words, they want to eliminate many of the current false alarms. "Through a scan we could be looking for something atypical," says Jevremovic, "like a heavy shield in these big cargos." The real-time calculation compares the measurements to the signals, which should result in better speed and efficiency for inspectors.

And while a breakthrough sounds promising in the realm of Homeland Security, the educational component resonated with the NSF, which responded with a $1.2 million grant for three years. The proposal also received high marks by demonstrating how researchers will integrate the results with the education of graduate, undergraduate, and underrepresented students. In addition to the hands-on research opportunities, students from Wright University, a historically black college, will participate in the studies on nuclear materials detection. "We're also planning a number of outreach activities, such as summer internships and an open workshop," Jevremovic says, where an invited public can see how empowered nuclear research can actually help keep and secure the peace. ■ **William Meiners**


Vincent Walter

New Faces in Nuclear Engineering

This fall saw the arrival of three new faculty members to the School of Nuclear Engineering. Shown here on campus beneath the Bell Tower are (left to right) Jean Paul Allain, an assistant professor, Igor Jovanic, an assistant professor, and Ahmed Hassanein, a professor.

Jovanovic received his BS degree in electrical engineering/computer science from the University of Zagreb in 1997, and his PhD in nuclear engineering from the University of California at Berkeley in 2001. He has been with Lawrence Livermore National Laboratory since 2002 as a staff physicist, where he made significant contributions to the field of ultrahigh intensity lasers. His recent activities include research and development in advanced radiation sensors for homeland security and antineutrino detection for cooperative nuclear monitoring. Jovanovic has authored numerous journal articles, book chapters, and invited conference presentations, and has been awarded five U.S. patents.

Allain obtained his PhD and MS degrees from the Department of Nuclear, Plasma, and Radiological Engineering in 2001 and BS in mechanical engineering with a minor in physics from the California State Polytechnic University. He then spent four years as a staff scientist at Argonne National Laboratory where he designed and built the IMPACT (Interaction of Matter with Particles and Components Testing) experimental facility. Allain currently works in both experiments and modeling of particle-surface interaction of mixed materials in fusion thermonuclear experimental reactors and has more than 40 papers in the subject and related areas. In addition, he plans to expand his research to study the fundamental interaction of radiation with soft surfaces and other low-dimensional state systems.

For Hassanein's story, see the "Up Close: Faculty" story on the next page. ■ **W. M.** ➤

Powerhouse Engineering

A new nuclear engineering professor gets juiced up by collaboration.

Professor Ahmed Hassanein is full of ideas. He's hip-deep in magnetic fusion, extreme ultraviolet lithography for the next generation of computer chips, directed energy research for national security projects, and even the bioscience of plaque formation in blood vessels. And this is only a partial list. To read it inevitably creates a question in one's mind: How can a single scientist devote himself to so many different concepts?

First, the scientist works every single day, including weekends. "I haven't taken a day off in years," Hassanein admits. Of course, that does not mean Hassanein is confined to his laboratories day and night. He does get out and see the world, having made countless journeys to Europe and Asia to chair international conferences and professional interest groups. And he also manages to fit in visits to his native Egypt every five years or so.

But a rigorous work schedule is not the only secret to Hassanein's success. His advent to Purdue from his previous post as senior research scientist at Argonne National Laboratory in Illinois was motivated in part by having a ready pool of eager students who can roll up their sleeves and propagate research efforts as they learn nuclear engineering. "I have so many ideas," Hassanein says. "Purdue attracts great students, and they are the future of our country. They will help to do the necessary work on these ideas."

Academia will be comfortable for Hassanein, who has five degrees in nuclear engineering and physics. He is not worried about the infamous exhortation to "publish or perish," because he has to his name more than 300 publications and technical reports in more than 17 journals. At Purdue, Hassanein will teach graduate as well as undergraduate classes and is also developing new courses in several subjects such as nuclear fusion, nuclear physics, radiation damage, computational physics, and plasma-material interactions. He also plans to start a center at Purdue to combine theoretical and experimental approaches to nuclear and advanced engineering research projects. Hassanein envisions an integrated team of undergraduate, graduate, postdoctoral, and research staff working together to solve some of the biggest problems facing humanity, such as the energy crisis.

There's no time to waste. "Fossil fuels will not last," Hassanein says simply. "Basically there will be no choice but to find an alternative." And in the search for the future of renewable energy sources, Hassanein knows the way. Literally.

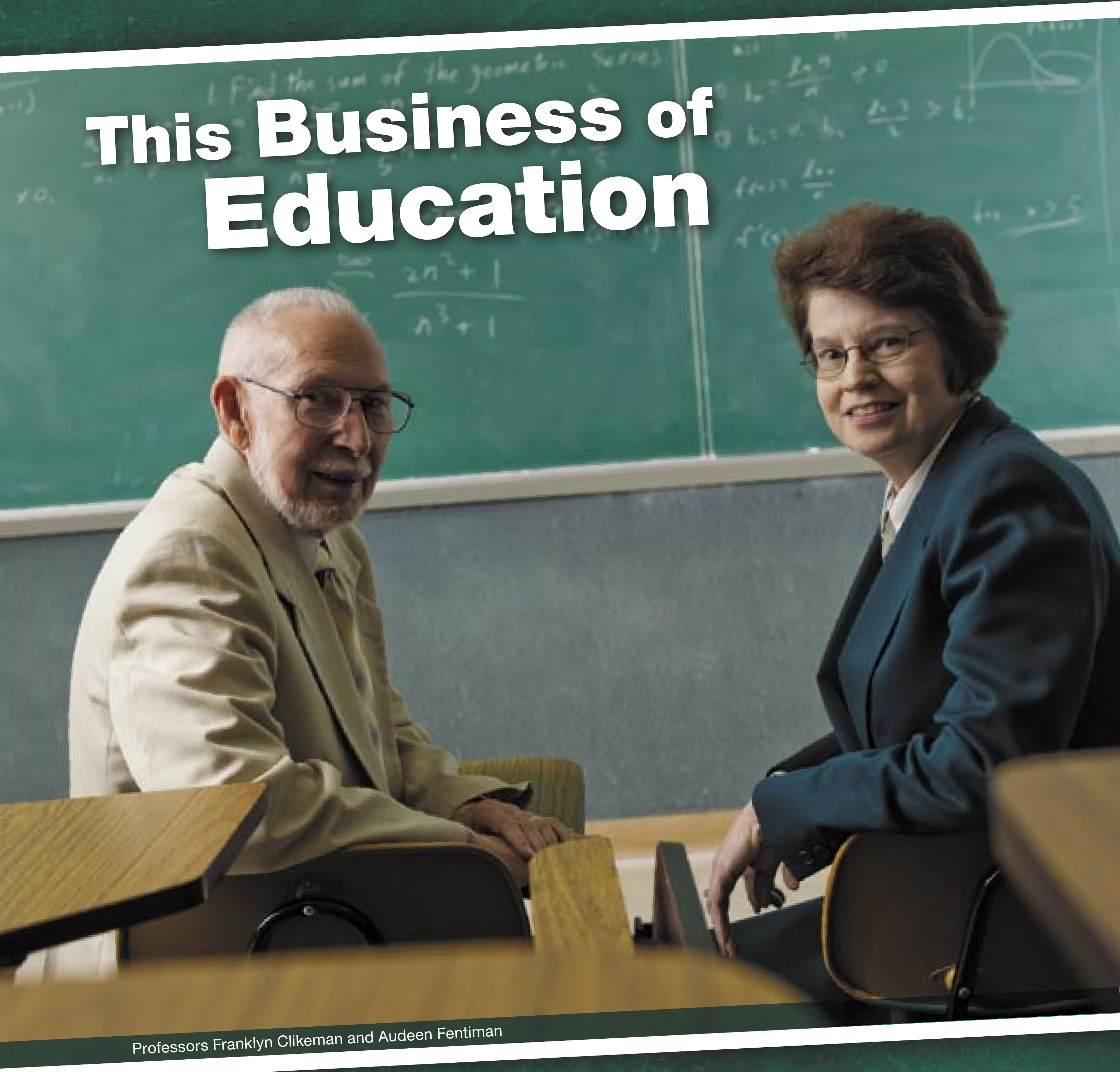
Hassanein is collaborating with an international team of scientists on ITER ("the way" in Latin), which stands for International Thermonuclear Experimental Reactor. ITER, which is being constructed in Cadarache, France, is designed to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes. ITER unites the efforts of the United States, Japan, Russia, China, South Korea, India, and Europe to provide the know-how to someday build the first electricity-generating power station based on magnetic confinement of high temperature plasma—in other words, to capture and use the power of the sun on earth.


Vincent Walter

NE Professor Ahmed Hassanein.

Some of the bright light from Hassanein's endeavors will reflect back on the university he now calls home. "Magnetic fusion research, particularly, for ITER will be an excellent start to put Purdue on the international map," says Hassanein. And it energizes Hassanein himself. "I enjoy new challenges," the busy professor says happily. "I want to take nuclear engineering at Purdue to a higher level nationally and internationally with the help of our current outstanding faculty." ■ **Gina P. Vozenilek**

This Business of Education



Professors Franklyn Clikeman and Audeen Fentiman

As today's students look to become part of the third-generation nuclear workforce, their options are as wide as our responsibility is large.

By William Meiners

Vincent Walter

Academics face many pressures these days. The old slogan "publish or perish," however overstated, remains applicable, as do the calls for furthering technologies, making new discoveries, and raising research dollars. Lest we lose our collective ways, however, the education of tomorrow's nuclear engineers should be at the top of every professor's list of responsibilities. And delivering a solid education is a particular point of pride in Purdue's School of Nuclear Engineering.

Although it's one of the smaller schools within Purdue's College of Engineering, our school is one of the larger nuclear programs around the nation—and growing. The Class of 2007 included 42 undergraduates, eight master's students, and 13 PhDs. These young graduates will go to work in a variety of fields, including, but not limited to, nuclear power, medicine, and education.

For Lefteri Tsoukalas, the former head and a current professor of nuclear engineering, this educational responsibility is one he will never take lightly. "We are not just cheerleaders for technology," says Tsoukalas. "Professors adhere to and defend the highest standards of quality, ethics, and professionalism. Our role in society is to be a source of credible information. We are not limited by the ups and downs of the markets and the agonies of the day. So this business of education is really a business of trust."

And with no more important bottom line than the students themselves, Tsoukalas and colleagues are helping develop the technical experts who will work on some of the biggest challenges facing our society—how to maximize our energy production while eliminating greenhouse gases, how to safely treat and eradicate certain diseases, and how to train the next generation of nuclear scientists.

continued on next page

John Underwood

Jean Paul Allain in the classroom.

We Can Rebuild It

Knowledge is indeed powerful; and with an increasingly younger group of freshmen entering the sophomore class each year (at least from their professors' perspectives, as now nearly all freshmen were born after Chernobyl), the need to demythologize the nuclear sciences becomes less stressed in the standard lectures. "With many technical issues solved, students are not burdened by the safety issues of the past," Tsoukalas says. "They also see nuclear power as an important part of the energy mix."

That wasn't the case 20 years ago. With images of mushroom clouds and nuclear destruction equated to nuclear power plants, students were leery of the nuclear sciences. After some 48 nuclear programs started up in the 1960s, many of them started shutting down in the 1980s and 1990s as construction on nuclear plants came to a halt in the United States. Purdue's program, one of the originals, is one of about 30 programs today. "It hit bottom in the late 1990s," says Audeen Fentiman, associate dean of graduate education and professor of nuclear engineering. "In 1999, there were about 500 students enrolled in nuclear engineering around the country. That number tripled by 2005."

Why the turnaround? "Students recognize where the jobs are," Fentiman says. And the job opportunities are plentiful. With many industry and academic professionals zeroing in on their golden years, young graduates are needed to step into those positions.

"The need for people with backgrounds in nuclear science and technology is very broad," Fentiman says. "The nuclear power industry primarily needs BS graduates to help run power plants. Vendors, who design plants, are looking for people with master's and PhD degrees."

In addition to renewed and building interests of nuclear power on our shores (see "Money Sinks to Moneymakers" sidebar), globalization is contributing to a booming job market for graduates. "There's a need for people to work internationally," Fentiman says. "China is buying four nuclear power plants from Westinghouse this year."

The Nuclear Regulatory Commission, ranked in 2007 as "the best place to work in the federal government," is hiring up to 300 new people a year. Similarly, state agencies, national labs (a work haven for PhDs), homeland security outlets, and hospitals are helping make a nuclear engineering degree a rather profitable piece of paper.

Education vs. Industry

In filling the need for human infrastructure in the nuclear pipeline, universities must also find this third generation of educators. "The students could be like I was," says Franklyn Clikeman, professor emeritus of nuclear engineering. "The last thing I was ever going to do was teach."

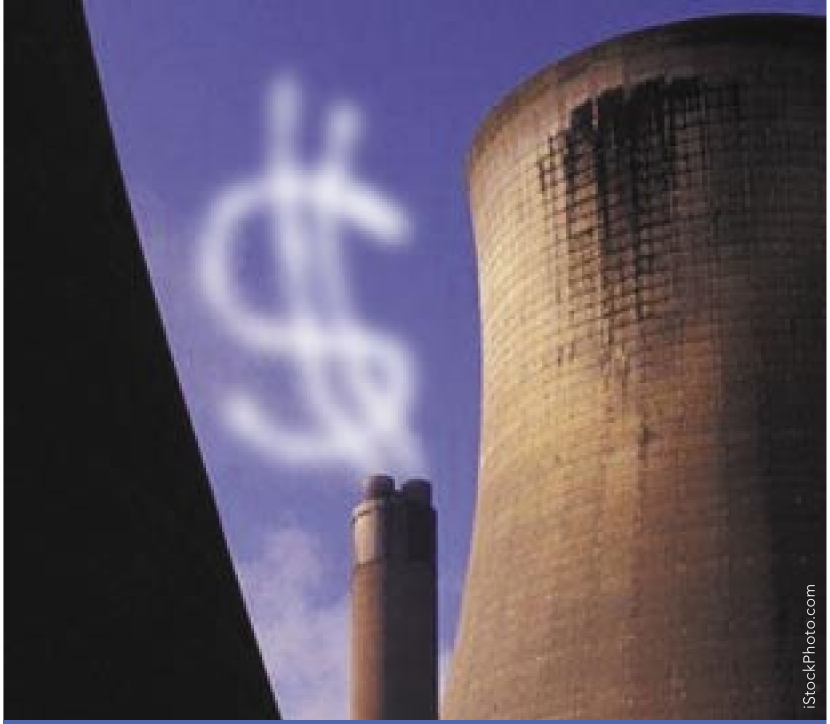
With a 1962 PhD from Iowa State, Clikeman was certain he would be working in one of the national labs, "probably Los Alamos." He had earned his bachelor's degree in 1955 at Montana State College in the "Atoms for Peace" area as inaugurated by President Dwight Eisenhower. Instead of industry, though, he "made the mistake" of saying he wanted to work with neutrons. A presentation at the Massachusetts Institute of Technology led to post-doctoral, assistant, and associate professor positions. He eventually came to Purdue as a professor in 1970 and was in it for life.

Renowned for his student-centric focus, Clikeman, says Tsoukalas, was the "go-to professor." At the graduate level, he supervised or co-chaired 15 master's students and seven doctoral students in all. "I tried to do a good job of mixing the research and the teaching," Clikeman says. No small task within the aforementioned pressures of academia.

Today Clikeman advises students to determine what they want to do before deciding on how far to take their education. "The master's degree is very good in nuclear engineering," he says. "A PhD changes your whole path.

"There are lots of job opportunities and lots of decisions to be made with the PhD," he continues. "Some students continue through school because they're afraid to go to work. That's not the right motivation."

But with the potential dawn of a "new nuclear age," the tough choice of whether to teach or work could be a win-win for today's nuclear students, who will, in effect, make up the industry's third-generation workforce. And for those teachers assigned with their education, that's a lofty responsibility. ■



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Money Sinks to Moneymakers

There was a time in this country when building a nuclear plant was a long and expensive process. Once plants were built, some U.S. utilities found they could not run them efficiently, and it became cheaper to sell plants rather than close them down and dispose of the wastes. Now, with a whole fleet of nuclear power plants (104 to be exact) running at more than a 90 percent capacity rate, that old money sink is looking more like a cash cow. And as an alternative to coal, nuclear power is also environmentally green.

"This country has not had a long-term energy policy," says Audeen Fentiman, associate dean of graduate education and professor of nuclear engineering. "It changes depending on who's been elected most recently. We're going to be forced into developing a policy that allows us to sustain our environment, which will bring nuclear power to the forefront."

So with new nuclear plants on the U.S. horizon, Fentiman points to four key building steps that will promote the long-term investment needed to cut loose from our dependence on foreign oil and reduce greenhouse gas production. The following will help streamline the process, lessening costs and leading to profits.

- The Nuclear Regulatory Commission (NRC) has to issue a license to build a nuclear power plant. A combined construction/operation license, however, saves time and money.
- The NRC must certify standard reactor designs. There are currently four to choose from, so the design need not be reinvented each time.
- Early site permits (often next door to existing nuclear plants) allow builders to pick an approved design on an approved site.
- In the 2005 Energy Policy Act, the federal government offered financial incentives to cover costs of unexpected delays for the first six reactors built. While they won't pay for delays attributable to company mistakes, the feds will pay, for example, if somehow the rules are changed. ■ **W.M.**

To Industry or To Academia?

Weighing his career options, a doctoral student ponders life after Purdue.

When it came time to say goodbye to his coastal, metropolitan hometown of Chennai, India, while holding only a handful of books and aspirations to get a master's degree in electrical engineering from a university in the United States, Vivek Agarwal was ready.

For Agarwal, a doctoral student in the School of Nuclear Engineering, leaving home was all part of the plan. "At the time, I wanted to just get a master's degree," he says. "The U.S. was a better option because engineering degrees are practical. In India, they're very theoretical. To come to the U.S. and apply my knowledge in a practical way was very attractive."

Vincent Walter

Vivek Agarwal, Nuclear Engineering PhD student.

Agarwal's decision to fly across the Atlantic received a mixed reaction. His father and brother were cooperative, but his mom wondered why he wanted to go so far away. "I'm very grateful to my family. That was a big move for my parents," says Agarwal. Peronally for me "It's a big sacrifice, and no one was sure how I'd adjust to this culture, and how I'd manage."

Just how did he manage? Agarwal says that upon landing in Knoxville, Tennessee, where he studied for a master's degree in electrical engineering from the University of Tennessee, he never felt homesick—due in large part to the hospitality from the other Indian students he stayed with.

"The biggest adjustment I made was cooking. I never cooked back home in India," jokes Agarwal. "I still remember when my roommate and I first started cooking. We burnt a lot of stuff. Now I'm doing OK."

A Twist of Fate

Agarwal's program was delayed for one semester, a year and a half into his master's degree. And it was during that time when he connected with Andrei Gribok, a professor of electrical and computer engineering at Tennessee, who would be influential in getting Agarwal to Purdue. His major advisor at the university placed him under Gribok for that semester, and it was under his guidance where Agarwal became interested in his current area of study: pattern recognition.

"I was also debating whether I should go into industry or academia after finishing my master's degree," explains Agarwal. "I initially hesitated to ask Gribok because I thought he'd be biased.

"He told me that if I go into industry first, I would never return to academia because of the money, the pay cut I'd have to take. And he told me that I'd lose my patience and ability to sit in a lecture."

Agarwal would argue back, saying that, with determination, one could do anything. "Gribok would never get offended," recalls Agarwal. "He'd laugh and say, "You'll see!" So, I decided to send a few applications to some top doctoral programs."

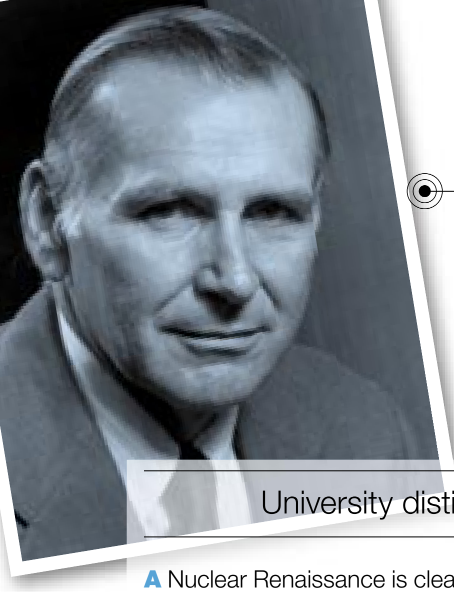
One morning, Gribok walked into Agarwal's office to talk over his PhD choices and asked if he wanted to go to Purdue. And Agarwal said that he had been considering the electrical and computer engineering program there.

"But, he asked me if I'd be interested in nuclear engineering at Purdue, and he told me that he knew a Purdue professor that did similar pattern recognition research." That professor, Lefteri Tsoukalas, collaborates on a project with Gribok.

Tsoukalas has nothing but praise for Agarwal's work. "Vivek came to our program in fall 2005 and quickly established himself as one of our best graduate students," he says. "He is passionate about education, and his superb technical skills have a magnetic impact on younger students."

When asked about his plans after receiving his PhD from Purdue, Agarwal says that down the lane, he'll eventually enter academia and teach back home in Chennai, where his path began.

C. Lee Lamb



in my view

Innovative Uses of Nuclear Energy

University distinguished professor emeritus, University of Tennessee, Knoxville

A Nuclear Renaissance is clearly evident from a wide variety of activities undertaken by electric power utilities. The licenses of most nuclear plants are being extended to 60 years, many plants—"on hold" for years—are being finished, and within the next two years, the Nuclear Regulatory Commission expects to receive applications to build 27 new nuclear power reactors at 18 sites. While expected to meet the needs of the utilities based on normal growth in the next two decades, this nuclear awakening doesn't take into account additional innovative uses of electricity that are needed if we are to address crucial environmental issues, such as melting of glaciers and ice caps near the earth's poles.

The culprits here are fossil fuel combustion in power plants (almost 70 percent of all electric generation) and in internal combustion engines used for almost all transportation (cars, trucks, trains, and planes). The alternatives are nuclear energy, wind energy, solar energy, hydro energy, and "carbon neutral" renewable processes where the growing process utilizes the carbon released by combustion. Both solar and wind energy are subject to both cyclic and unpredictable periods of operation, and there are virtually no remaining hydro sites in the United States, leaving nuclear energy as the primary future source of electricity.

The fuels include hydrogen and synthetic carbon-based fuels, as well as the use of plug-in hybrid-electric vehicles (PHEVs). Each of these processes require immense amounts of carbon-free electricity from hundreds of 1000 MWe plants beyond the current ~950 GWe (gigawatts) electrical generating capacity of the U.S. The U.S. has about 225 million cars and light utility vehicles (SUVs, pickup trucks, vans, etc.) that use more than 9 million barrels of gasoline every day to travel some 7.56 billion miles. In addition, there are several million trucks, some 8,000 airliners, 2 million general aviation aircraft, and perhaps 1,000 military aircraft using about 4 million barrels of diesel and jet fuel daily. Hence, 13 million of the 20 million barrels of petroleum fuel used per day in the U.S. is used for transportation, of which almost two-thirds is imported.

The U.S. Department of Energy is nearing the end of a five-year $1.2 billion program to develop hydrogen-fueled automobiles. Using hydrogen in fuel cells to propel vehicles has the advantage that the efficiency of the process is about twice that of internal combustion systems. Unfortunately, hydrogen does not exist in nature and cannot be "mined"; it must be produced by electrolysis (~25 percent efficient) or thermo-chemical processes (~50 percent efficient at 950° C). Hydrogen also has an extremely low volumetric density and is very difficult to store or transport as a gas at 10,000 psi or as a liquid at ~20° K. A national network of hydrogen fuel stations as well as more than 900 new 1000 MWe nuclear power plants to generate hydrogen would be required. A second alternate fuel would be synthetic hydrocarbon fuels or "synfuels" made from elementary olefin molecules produced using the Fischer Tropsch process used by Germany to make aviation fuel in World War II and by South Africa for transportation fuel during its embargo. If the carbon is obtained from carbon dioxide in the flues of fossil plants and the hydrogen is produced using nuclear electricity, the whole process is carbon neutral. Indeed, it is possible to reduce the overall level of carbon dioxide by one-third while making synfuels for cars, vans, buses, trucks, trains, ships, and planes. To replace all this transportation fuel would require ~255 million tons of hydrogen per year of which 20 percent could be generated with today's spare capacity, and the other 80 percent would require ~936 additional 1000 MWe nuclear plants. The direct use of electricity in PHEVs (automobiles and light utility vehicles only) theoretically could replace ~75 percent of the gasoline used today, some 6.7 of the 9 million barrels used per day. For electricity costing $0.08 per kWh, the equivalent cost of a gallon of gasoline is ~$0.98 without tax and ~$1.33 with tax. If all these vehicles were replaced with PHEVs, ~425 new 1000 MWe nuclear plants would be required.

Regardless of which approach is used to replace imported petroleum, it's clear that nuclear energy is a critical component of the energy future in this country. Students who choose nuclear engineering will have unlimited opportunities in their chosen field and will be well rewarded financially. Those who enroll in Purdue's School of Nuclear Engineering will be particularly fortunate because of the outstanding rankings and reputations of Purdue and its nuclear program. ■ **Robert E. Uhrig**

A Big Ten Connection: Purdue University to Penn State

Two former Boilermakers, now Nittany Lion professors, reflect on their bygone days in West Lafayette.


L. E. Hochreiter


Seungjin Kim

Between them, they have four engineering degrees from Purdue University, earned four decades apart. Both are experts in nuclear thermalhydraulics. L. E. Hochreiter (MSNE '67, PhD '71) took the industry route while Seungjin Kim (MSEE '92, PhD '99) pursued academia. Now they are faculty colleagues in the nuclear and mechanical engineering department at Penn State University.

They share a love of their years in West Lafayette and wear with zeal either black and gold or blue and white—depending on the occasion. From neighboring offices and common classrooms, they teach, mentor, and guide, imparting their knowledge of nuclear engineering and inspiring students. And both say they are glad to have a fellow Boilermaker in Happy Valley.

"It is great having another Purdue PhD on faculty. We complement one another in our research area, and he's doing an outstanding job," Hochreiter says of Kim.

Purdue is especially well known for its thermalhydraulics, Kim says, so both he and Hochreiter are highly regarded because of that link. "Dr. Hochreiter is a great mentor to me" he adds. "We share the same specialty, and we are planning to collaborate."

Kim joined Penn State this summer as an assistant professor of nuclear and mechanical engineering after four years as an assistant professor of nuclear engineering at the University of Missouri-Rolla. His passion for teaching grew at Purdue, where he was a teaching and research assistant, did a post-doctoral fellowship, and was a visiting assistant professor.

"The thing I like most is interacting with young minds ready to explore," Kim says. "I feel most content when I see students come into my office full of questions and confused faces and, after some explanation and discussion, leave with big smiles."

Hochreiter joined the Penn State faculty full-time in 1997 after teaching distance education courses part-time for Penn State for 10 years. He also taught part-time at Carnegie Mellon University. After Purdue he began a successful career at Westinghouse Nuclear Engineering Systems Division in Pittsburgh, working in nuclear safety and reactor core thermal-hydraulics and advancing to Advisory Engineer and Consulting Engineer, which is the company's top technical position.

An early retirement option at Westinghouse and a faculty retirement at Penn State coincided, and Hochreiter was poised for the opportunity. "It's a lot of fun working with students," he says. "When I teach courses in reactor engineering, nuclear safety, and reactor thermalhydraulics, I have experience and can impart realism in class."

Kim also was in the right place at the right time as a graduate student working with Mamoru Ishii, the Zinn Distinguished Professor of Nuclear Engineering and a foremost authority in reactor thermalhydraulics, to help develop a groundbreaking model for two-phase flow transport employing interfacial area transport equation. "I was very fortunate to be part of it," Kim says.

Both professors can't say enough about the benefits of their Purdue experience. "Purdue shaped me as a person and a researcher. I was provided with an excellent education and research opportunities that I dare say no other universities can match," Kim says.

Hochreiter adds: "I can't tell you how thankful I am for the education I got at Purdue. I'm quite sure I would not be where I am today without having gone to Purdue. It opened up so many doors—it's amazing."

Kim, a Korean native, appreciated Purdue's diverse environment. "In our lab, we had students from many different countries—Argentina, China, France, India, Japan, Korea, Saudi Arabia, Turkey, and the United States. Interacting with people from different cultural backgrounds gave me opportunities to learn more about other cultures and improved me as a person," he says.

A native of Buffalo, New York, Hochreiter became focused on one particular student during his days at Purdue—his future wife, Susan Alice Novak (BA History '64, MA History '70). They met while traveling on the train from Indianapolis to West Lafayette after a holiday break. "We split a cab from the train station to the dorms then I asked her out," he says. "We just celebrated our 41st wedding anniversary."

Hochreiter remembers attending a Purdue alumni tailgate lunch in recent years prior to a Purdue-Penn State football game played on Joe Paterno's field. He and his wife wore black and gold sweaters and their two children, both Penn State alumni, were in blue and white. "Everybody looked at us strangely," he laughs.

Kim recalls cold games in Ross-Ade Stadium shaking key chains for the kick-off, and being in the stands for a buzzer-beating shot when Purdue beat Indiana University in basketball. "A big part of being a collegian is you cheer for your university," he says.

Even while the professors enjoy reminiscing, they are forward-thinking in their discipline. "We're seeing a bright future for students," Hochreiter says. "It's national news that there's a shortage of nuclear engineers and there are good job opportunities."

"It's a great time for those of us who educate nuclear engineers who will lead the nuclear engineering industry in the future," Kim says.

While 40 years apart on the Purdue alumni rolls, from offices right next door at Penn State, the philosophies and enthusiasm of Hochreiter and Kim couldn't be closer together. ■ **Amy Page Christiansen**

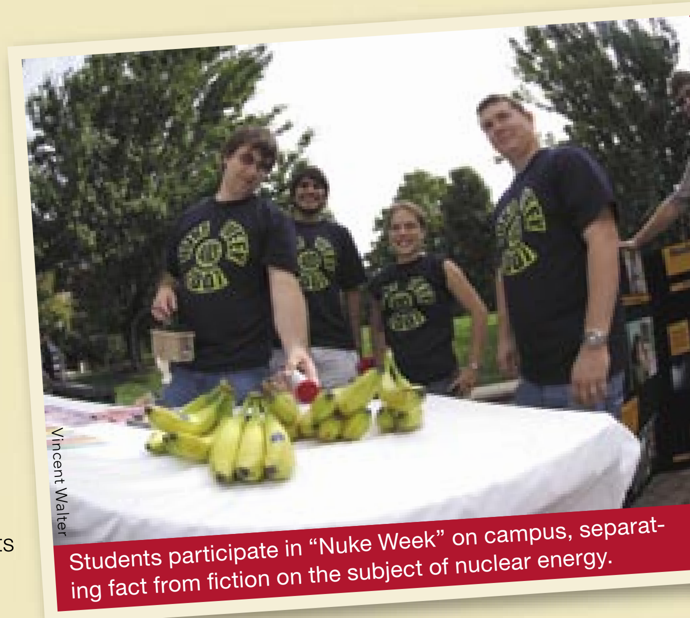
check it out

Yes, We Do Have Bananas (as seen on TV)

And they've got small amounts of radiation, say students from the American Nuclear Society.

Any time students declare themselves a nuclear engineering major, they're bound to become spokespeople for an often misunderstood industry. Late last September, during "Nuke Week," student representatives from the American Nuclear Society, primarily undergraduates, were given the task of educating fellow Boilermakers about the misconceptions of nuclear energy. And not just students were listening. *The Nightly Business Report* had their cameras rolling for a special on the future on nuclear energy. See it for yourself at the following link: **www.pbs.org/nbr/site/features/special/energy-options-nuclear_home/**

The group handed out pamphlets offering nuclear energy facts in a question-and-answer format. They showed *The China Syndrome*, an Academy-Award-nominated movie from 1979 born out of the concept (though it's a scientific impossibility) that if an American nuclear plant had a meltdown, it could bleed through the Earth's core, ultimately affecting China. And students passed out bananas, which contain small amounts of radiation. Their point: radiation surrounds us on a daily basis, and when armed with the real facts behind the proper use of nuclear energy, Americans are more likely to come around to it. If nothing else, it's food for thought. ■ **W.M.**



Vincent Walter

Students participate in "Nuke Week" on campus, separating fact from fiction on the subject of nuclear energy.

aperture

This is an image of a quantum dot produced by a simulation using the nanoHUB, a Web site created by the Purdue-based Network for Computational Nanotechnology. NanoHUB is used by more than 3,000 national and international researchers and educators each month. This image shows the computed second excited electron state of a quantum dot nanodevice in which electrons resonate and emit pure bright light. Quantum dots are the basis of the new, energy-efficient, long-lasting, ultrabright light-emitting diodes (LEDs) that are becoming widely used in highway traffic signals.