Cross-Continental Partnership

Purdue codes key to Argentina's Atucha II reactor

PURDUE NUCLEAR

ENGINEERING IMPACT

SUMMER 2007

NE's Worldly Faculty
Diversity provides global approach

Senior Design Projects
Students tackle nuclear challenges

up front

On my mind

Vincent Walter

Globalization, regardless of what *that* brings to your mind—a flattened world with outsourced resources and increased opportunities, a seemingly shrunken marketplace, or all of the above and more—is part and parcel of how we need to negotiate the world today. The following pages look at where Purdue's School of Nuclear Engineering fits into that big picture.

For starters, our faculty researchers and students are working on what is perhaps the most daunting problem facing humanity today—energy and where to find it. A small, but diverse group of faculty, originating from various parts of the world, brings unique perspectives to that global problem. You can read about a few of them in the "Up Close: Faculty" feature.

Likewise, our cover story focuses on a rare collaboration between a foreign government and an engineering school. Guided by three researchers and a host of students, the School of Nuclear Engineering is helping the Argentine Nuclear Regulatory Authority bring the Atucha II reactor in Buenos Aires up to safety speed.

The "Up Close: Students" story focuses on the "senior design" projects that are helping prepare undergraduates for the working world. And speaking of students, this academic year we are graduating our largest class ever—63 students. Just as with Jeffery Merrifield's "In My View" piece, I believe this all speaks to great promises—for both our students and the increased role of nuclear energy.

And finally our magazine ends with the "Up Close: Alumni" profile of Paul Zmola. While the School of Mechanical Engineering can claim Dr. Zmola as an alumnus, he has certainly been a great friend to our school through both donation and solicited advice.

What do you make of our impact on the world? We always like to hear how you think we're doing. E-mail us at peimpact@purdue.edu and let us know your thoughts.

Vincent Bralts
Interim Head, School of Nuclear Engineering

From the editor

During a spring photo shoot, I asked one of the very bright nuclear engineering students (pictured on page 6) if he had seen a recent *60 Minutes* piece which spoke favorably of France's reliability on nuclear power. He had, of course. He also said that in addition to the technical skills they're gathering, students need to be political experts on nuclear matters. With this fourth edition of *Nuclear Engineering Impact* we're providing perspectives—both technical and political—as seen from our vantage point at Purdue. And within the themes established by the College side of the magazine we're four for four. The School of Nuclear plays prominently into the big issues of energy, the environment, healthcare, and now globalization.

I hope you'll get a chance to read about the work of our students and faculty here. And don't be shy about dropping us a line to let us know what you think.

William Meiners
Editor
peimpact@purdue.edu

contents

Vincent Walter

iStockPhoto.com

John Underwood

PURDUE
UNIVERSITY
COLLEGE OF ENGINEERING

School of Nuclear Engineering

John A. Edwardson Dean of Engineering........**Leah Jamieson**
Interim Head........**Vince Bralts**
Director of Development........**Michael Stitsworth**
Director, Marketing and Communications........**Rwitti Roy**
Editor........**William Meiners**
Graphic Designer........**Erin Ingram**
Photographers........**Vincent Walter, John Underwood**
Contributing Writers........**Kathy Mayer, Lindy Patterson, Linda Thomas Terhune**

NE Impact is published by the Purdue University School of Nuclear Engineering for 900 alumni, faculty, students, corporate partners, and friends. We welcome your comments.

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

To make a gift to the School of Nuclear Engineering, please contact:
Michael Stitsworth
Director of Engineering Advancement
mstitsworth@purdue.edu
(765) 494-5345

Purdue is an equal access/equal opportunity university.
Produced by the Engineering Communications Office.

Class of 2007

A record number of nuclear graduates received degrees this year.

Vincent Walter

Tatjana Jevremovic, an associate professor of nuclear engineering, led the School of Nuclear Engineering's largest graduating class ever through campus on May 12, 2007.

With 42 earning bachelor's degrees, eight earning master's, and 13 with PhDs, this year's graduating class is the biggest in the history of the School of Nuclear Engineering. On May 12th, many of them paraded through campus in celebratory caps and gowns. Of those 42 undergraduates, at least 10 are matriculating into graduate programs, including seven at Purdue, two to the University of Virginia, and one to the University of Florida.

Among those entering the workforce now are young men and women beginning careers in places as varied as Knolls Atomic Power Laboratory, Westinghouse, Dominion, and the Navy. Congratulations to all our graduates. You've mastered one of the most challenging majors on campus, and the world awaits your input.

■ **William Meiners**

Diversity: Our Measure of Quality

From various parts of the world, the diverse nuclear engineering faculty finds a common language in the search for global solutions.

"Ohayougozaimasu," "Kalimera," or "Buen dia"—Japanese, Greek, and Spanish for "Good morning"—might signal the day's beginning in Purdue's Nuclear Engineering, given the diversity of the school's faculty. Of the school's dozen faculty, eight hail from countries other than the U.S.—Argentina, India, Japan, Greece, Korea, and Yugoslavia. When it comes to research quests, though, they share a common language: nuclear global energy solutions.

"Our diversity comes about because we are reaching for the best talent in the world, and the best people can come from anywhere," says Lefteri Tsoukalas, a professor who joined the Purdue faculty in 1994 and served as head of Nuclear Engineering from 2001 to 2006.

That diversity brings many benefits.

"We're a very globalized faculty," Tsoukalas says. "All of us are involved in international projects. That's the nature of our research activities. It's how we advance technology, check, and verify. It's a network kind of approach, and an easier and faster way."

The school's international involvement includes a group that helped South Korea with nuclear technology, another that's working with regulatory authorities in Argentina (see cover story), and assistance to Chinese colleagues as they establish nuclear engineering education there.

Funding, too, comes from international sources—Japan, France, and Korea, and recently, Argentina.

"Global energy solutions are part of our mission," says Tsoukalas, whose research interests include modeling, diagnosing, and controlling complex power systems; intelligent instrumentation; and human-machine interface.

"There are advantages to nuclear power from the point of view of environmental impact—it's a lot greener, and a lot of energy is given off by small amounts of matter," Tsoukalas says. "It's very compact and a great source of primary energy."

He also notes that world energy demand is growing. "There's still half of the world not using modern energy. A lot of what we're challenged with is the fact that it is becoming more difficult to satisfy the appetite of the developing world for energy and keep us in a hospitable climate."

"We need to collaborate internationally," says Professor Takashi Hibiki, who hails from Japan and joined the nuclear engineering faculty in 2006 after more than a decade of long-distance work with Mamoru Ishii, the Zinn Distinguished Professor of Nuclear Engineeing. Hibiki had earlier spent a year and a half at Purdue doing research; his current work is in thermal hydraulics and reactor safety.

"I wanted to continue that collaboration with Dr. Ishii," he says. "And I have a new collaboration with other faculty here. My background is interdisciplinary, so I like to collaborate."

Another benefit of having faculty from around the world is access to projects in different countries, Hibiki notes. "With faculty from different countries, we have a strong channel to these countries."

Associate professor Martin Lopez-de-Bertodano's work with the government of his native country, Argentina, is one example. "We were able to get that because I'm from there," Bertodano says. His research focuses on experimental two-phase flow, multidimensional models, and turbulence.

"Diversity also helps us because for many years the U.S. was inactive in nuclear engineering work," Bertodano says. "Dr. Ishii was connected to the nuclear engineering community in Japan, which was far more active than the U.S. for many years, so that has helped us."

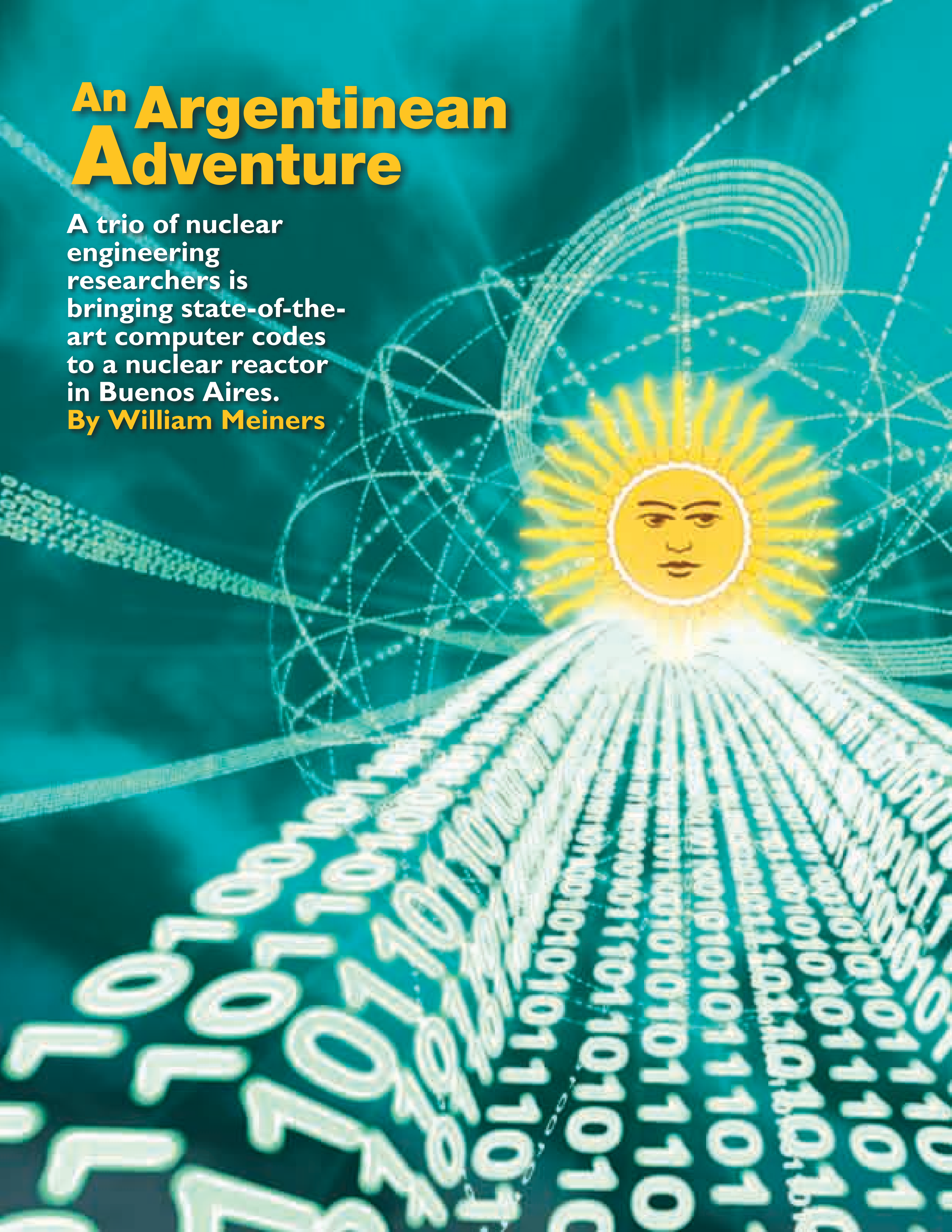
On Purdue's faculty since 1992, Bertodano sees benefits for the school's students, too. "They get exposed to a more diverse culture, more diverse ways of thinking."

Tsoukalas agrees. "There is a lot of shared knowledge in an international context here, and this diversity prepares our students for the global marketplace. They'll go on to work in Japan, France, South Africa, and other countries. This diversity is a great thing. We celebrate it. It's a measure of our quality." ■ **Kathy Mayer**

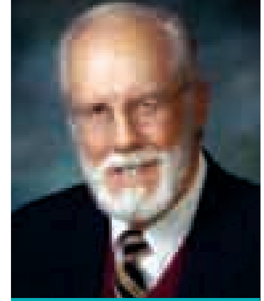
An Argentinean Adventure

A trio of nuclear engineering researchers is bringing state-of-the-art computer codes to a nuclear reactor in Buenos Aires.

By William Meiners



Downar



Ransom

The world over, leaders of countries are searching for energy alternatives. And as nuclear power becomes a viable option for both developing nations and others looking to break free from the stranglehold of fossil fuels, they're coming to America to figure out how to produce it safely. Such was the case when the Argentine Nuclear Regulatory Authority (known as ARN down south) put in a call to Purdue and the School of Nuclear Engineering.

A Purdue first, claims Martin Lopez-de Bertodano, for the university to work with a government institution from Argentina. An Argentinean himself, Bertodano, an associate professor of nuclear engineering, has been instrumental in both building the relationship with his countrymen and helping to navigate the cultural nuances. "The purpose is to use computer codes currently used in U.S. industry to evaluate the safety of their nuclear reactors," he says. "The U.S. Nuclear Regulatory Commission (NRC) spent more than a billion dollars developing these tools, and they want to make them available to the rest of the world community because they want reactors to be as safe as possible."

Authors of two of the world's most famous codes reside within the faculty of nuclear engineering, so Purdue was uniquely positioned to lend a helping hand. The codes in question—RELAP5, developed by Victor Ransom, and PARCS, developed by Thomas Downar—will be adapted for use in the Atucha II reactor in Buenos Aires, which is projected to be operational by 2010.

Ransom, a professor emeritus, has been involved with safety analysis on computer codes for almost 30 years. His brainchild, RELAP5, is a thermal hydraulics system code that allows for the analysis of fluid dynamics and heat transfer in a reactor, particularly under postulated accident conditions. The head of nuclear engineering from 1990 through 1998, he subsequently spent four years with the NRC on the Advisory Committee on Reactor Safeguards. "That's what the ARN is seeking," Ransom says, "advice on safety regulatory structure. Their regulations aren't as developed as ours."

While the expertise of Bertodano and Ransom falls within the area of thermal hydraulics, Downar, a professor of nuclear engineering, brings reactor physics to the equation. His specialty—spatial reactor kinetics—describes the neutron behavior in a reactor. The PARCS code he developed with his group, which stands for Purdue Advanced Reactor Core Simulator, is used by the NRC to certify the safety of all U.S. reactors. "The Atucha II is a one-of-a-kind reactor in the world," Downar says. "We're looking to support them with state-of-the-art tools."

Coupling Codes in Buenos Aires

Bertodano says the Purdue researchers are coupling the two codes, making them work together for the reactor. Furthermore, they're developing a computational fluid dynamics tool—his strongest suit—to analyze the safety system. "We're combining all of this together," he says. "The nice thing about Purdue is that we were in just the right place to do all of this because we had exactly the right people they needed. That's why they came here and not to any other university.

"With three different faculty from a very small school it's really very multidisciplinary because we're going from nuclear physics to system analysis to computational fluid dynamics. So technically, the problems are very challenging."

But for Bertodano, in particular, the challenge has been met, in part, because of the three-way exchange. "You bring people that have different perspectives on a similar problem," he says, "and by the time you're finished, what you thought was very important is perhaps not so important, realizing there are other aspects that are more important. It's nice to see how the solutions develop when you work with others as opposed to working by yourself."

The global irony is not lost on Ransom. The Atucha II reactor, he says, was designed and constructed by the German company Siemens, which has French connections to Framatome, an allied company. "Argentina," Ransom says, "has really diversified their contacts."

Last March, the Purdue contingent made a spring break of sorts to Buenos Aires to present findings and provide training for the people who will be monitoring the reactor. "We showed them what the behavior of the reactor would be like if there was to be a loss from a coolant accident," Downar says.

continued on next page

"In other words, what happens when a pipe breaks. That's what they need to know."

Andrew Ward (see student sidebar), a master's student in nuclear engineering, also headed south to help train workers on the computer codes. "Andrew has really been the centerpiece of the student group and their involvement," Downar says. "He is doing all the calculations, all the modeling with the PARCS code."

For the Argentineans, the collaboration with the North Americans has proved most beneficial. "Purdue not only accomplished the job in a short amount of time, but there we found the most advanced expertise and tools in the world for the two major problems we are interested in," says Nicolás Riga, the project manager responsible for licensing of Special Projects of the ARN.

Going Global Again?

While the success of the Argentinean project could very well lead to work with foreign companies in the future, Bertodano doesn't see the school morphing into its own global corporation. "We're not industry," he says. "They use us when they don't have an idea about how to approach a problem. We can help them think it out. But after that they hire industry. For problems that start at zero, or when they want to develop a new tool like we're doing for the ARN, they come to us."

It also pleases the students, he notes happily, as groups familiar with RELAP5 and PARCS codes get a chance to work on something with a very real-world application. And in a world in dire need of safe, effective nuclear power, what better chance to get that experience than by helping develop computer codes to be utilized as far south as Argentina? ■

Erin Ingram

The key collaborators, including the Purdue researchers, their students, and three gentlemen from the Argentine Nuclear Regulatory Authority, confer on campus last winter.

Vincent Walter

Keepers of the Codes

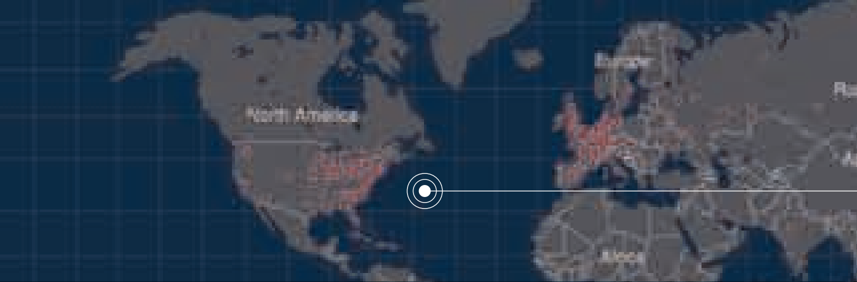
They're practically a rite of passage. So say a number of nuclear engineering students about the Purdue-originated codes that translate to power plant safety. At least that has been the case for this foursome of nukes, who also gained some very real-world experience while in pursuit of their various degrees. All of them logged time in the Atucha II Project—the Purdue-Argentinean collaboration (on page 4)—which is a nice addition to any resume.

Ben Collins (far right), the lone undergrad in the bunch, is a graduating senior likely heading to Berkeley and a nuclear graduate program at the University of California. Originally from Martinsville, Indiana, he cut his teeth on the PARCS code under the tutelage of Professor Tom Downar. Upon receiving his master's degree in August, Tim Drzewiecki (standing) will apply his coding skills in a job at Duke Energy in Charlotte, North Carolina. Away from his home in Munster, Indiana, Drzewiecki is following in the footsteps of Matt Cameron (BSNE '05) at Duke.

While graduation looms further off for Nathan Lafferty (foreground), a graduate student from Evansville, and Andrew Ward (center), a PhD student from Chicago, the two worked on the codes and even spent some time in Argentina during the project. Lafferty, most familiar with RELAP5, developed by Victor Ransom, a professor emeritus, followed Ward down south last spring.

"We were trying to tailor the program to their needs," Ward says, "and then train them on how to use it." The particular challenge of the two-week training outweighed any language barriers, though Ward speaks some Spanish. "They speak a Spanish version of Castellano there, but most people speak English, too."

The intensity of the training did keep the students from learning the tango, however. The coupling of the codes, it seems, and getting the Atucha II workers up to speed, ranks first on everyone's dance card. ■



The World's Operating Nuclear Power Reactor Units*

Arentina	2	China	5	India	14	Romania	1	Spain	9
Armenia	1	Czech. Rep.	4	Japan	54	Russia	30	Sweden	11
Belgium	7	Finland	4	Lithuania	2	Slovak Rep.	6	Switzerland	5
Brazil	2	France	59	Mexico	2	Slovenia	1	Taiwan	6
Bulgaria	6	Germany	19	Netherlands	1	So. Africa	2	Ukraine	13
Canada	20	Hungary	4	Pakistan	2	So. Korea	16	U.K.	32
								U.S.	104

Looking Back to Move Forward*

How technical lessons learned last century can lead to a nuclear renaissance in this one.

With energy and environmental concerns forcing many people to reexamine their views, there is considerable talk these days about a nuclear renaissance. But the future of nuclear power is often seen through a rear-view mirror. So much of what has shaped the technology is to be found in the past. As with so many things, looking back to understand our history can help us better steer the technology to a desirable future.

It's a history that began with a bang. The power of the atom was demonstrated for the world in 1945 through the atomic weaponry used in Hiroshima and Nagasaki. A year later, the Atomic Energy Act endeavored to develop peaceful uses of nuclear technology, and the Atomic Energy Commission (AEC) formed with broad oversight over the utilizations of nuclear science and technology. The AEC was tasked with the joint responsibility to both promote and regulate all uses of nuclear energy—potentially conflicting responsibilities. In 1949, the USSR tested its own nuclear weaponry, effectively making the Cold War would be the major geopolitical constraint for the next several decades.

From the beginning, non-weapons nuclear technology emphasized nuclear power generation. In 1957, the U.S. put online the first commercial nuclear power station, Shippingport, a type of reactor called a pressurized water reactor because the reactor coolant (water) passing through the reactor core is not allowed to boil. In 1960, a different design called a boiling water reactor went critical in Dresden, Illinois—allowing the primary coolant to boil in the reactor core. As civilian applications required larger and larger reactor designs, more advanced institutional arrangements were needed to ensure the safety and protection of the environment.

The 1970s were marked by energy concerns and growth of the environmental movement, as well as serious anticipation of nuclear power expansion to address both concerns. In 1974, the Atomic Energy Reorganization split the AEC into two separate organizations: the Nuclear Regulatory Commission (NRC) and what eventually became the Department of Energy (DOE). The NRC is an independent agency tasked to regulate the civilian use of nuclear energy to protect both the public health and safety and the common defense and security. One of the many tasks of the DOE is to promote the civilian use of nuclear technology.

The 1979 Three Mile Island (TMI) accident put the breaks on U.S. nuclear power expansion seen earlier in the decade. No nuclear power station has been ordered since, and the industry focus transitioned toward operations and safety. TMI also demonstrated major communication challenges in adequately alerting the general public to an accident.

The NRC played a role in the phenomenal improvements in reliability and safety over the last 25 years. Growing to an organization of nearly 3,200 professionals with resident inspectors at each and every nuclear power station in the country, the NRC was ranked this year as one of the best three government places to work.

As a result of the increased safety and productivity of the 104 operating plants we regulate, government officials, citizens, and Wall Street analysts all have a much more positive view of nuclear power than they did in the aftermath of TMI. Given the significant challenges of global warming, more and more of the public are looking to nuclear as a carbon-free source of new power generation. Underscoring this potential interest in building new plants is the continued need to maintain the existing fleet at its high standards of efficiency, productivity, and safety—clearly the most important part of our mission.

To achieve this mission requires a broad and deep understanding of not just the technology, but how to best move it forward. Some of our major challenges include replacing an aging workforce with new scientific experts, helping enhance the safety of reactors outside of the U.S., managing expectations of this "second bandwagon" of nuclear support, and learning to communicate with a new generation. A tall order on all accounts, but part of the overall challenge we're accepting wholeheartedly at the NRC. So when we look back in another 50 years, we'll have a success story to share. ■ **Jeffrey Merrifield, Commissioner, U.S. Nuclear Regulatory Commission**

*This article was based on Jeffrey Merrifield's speech delivered to NE students and faculty as part of the Spring 2007 colloquim.

Designing Seniors

Three senior design teams tackle nuclear challenges in *the* project of their final year.

NE's largest senior class ever broke off into three design groups.

The Purdue campus could someday be fueled by nuclear power, instead of its current coal. The feasibility of installing a nuclear power plant, which would pose an alternative energy source to dwindling coal reserves, was among the topics studied by students in the School of Nuclear Engineering's senior design project (NU 449-450).

Felisa Limón was on the team that took on the power plant for its project, a capstone to four years of study that is generally acknowledged as causing great pain and great gain. Seniors devote two semesters to the work, teaming up in the fall to propose ideas and settle on a project and then, in the spring, diving headlong into the project.

Nuclear Engineering's graduating class of 2007 has the largest crop of seniors the school has seen. A couple years ago, there were 25 graduating seniors in the program. Professor Tatjana Jevremovic, who oversaw the 2007 projects, attributes the "nuclear renaissance" to a growing recognition worldwide of the importance of finding alternate energy sources.

For Jevremovic, the challenge of overseeing so many seniors was finding a way to break 45 students into teams of manageable size—and then to keep track of their progress. The result was three teams:

- Team A (12 students): Design of a reactor that could power a rocket to Mars and then, once there, serve as the electricity power source on the Mars surface.
- Team B (20 students): Design of the Purdue Nuclear Power Plant, which would serve as the primary energy source for the university and replace the coal plant south of campus.
- Team C (13 students, advised by Professor Chan Choi): Design of a fusion power plant, a topic described by Jevremovic as very challenging but one about which the team was very passionate.

To an outsider, all of the projects sound very challenging. The teams must consider their topics from all angles, drawing on the knowledge they have gained throughout their college years. For example, the nuclear power plant team had to develop the logistics, examine the potential educational uses of a campus plant, undertake an economic analysis, complete the structural design, explore safety issues, and so on.

Chad Webber, manager of the Mars project, coordinated a team of 12 engineers and oversaw design of the cooling system for the reactor core. He will work with a nuclear management company in Minnesota after graduation and says the project appealed to his interest in astronomy and the planets and introduced him to "a process very similar to any engineering situation of design and optimization."

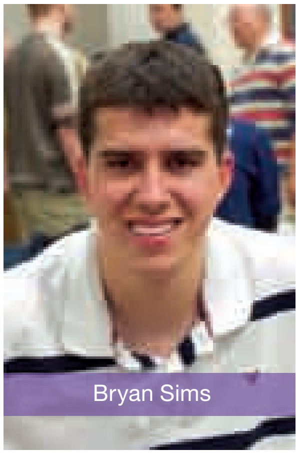
Each team member is assigned a specific portion of their project, but they must all be conversant about the design as a whole. Carolyne Joseph, who like Limón

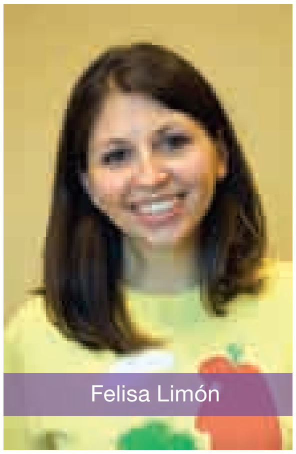
Professor Tatjana Jevremovic kept students on course.

John Underwood


Carolyne Joseph


Chad Webber


Bryan Sims


Felisa Limón


Between calculators and chalkboards, students set about finding solutions.

aspires to be an astronaut, worked on the power plant design. She was responsible for the team's engineering survey, the educational potential of the power plant, the security measures to be maintained at the facility, and the state laws and regulations affecting the project.

"The project has helped me understand every aspect involved when designing a new plant—from licensing to economics, to primary and secondary systems," Joseph says. "It's been challenging and highly educational. Large-scale projects like these encompass many different aspects of engineering design that are not posed in everyday classes."

Limón, who is the group leader for the power plant group's government and education portions, says the experience afforded her the opportunity to explore the "non-engineering" side of projects and work in a large team, which requires facing the complexity of real-life workplace communication.

For Bryan Sims, in charge of the plasma physics code development group for the fusion plant team, the senior project was the culmination of a four-year interest in fusion energy, an interest that will follow him into Purdue's doctoral program in nuclear engineering.

"It has been a terrific experience, watching optimistic words turn into something that is physical, something based on reality," Sims says. "This project has shown us how little we know, despite four years of excellent instruction."

The senior design project's reputation is widely known. "It is the project that students know about beginning freshman year," Limón says, "so I entered the class wide-eyed and scared. It is a challenging experience, but nothing that I can't handle."

And when it gets too much to handle, each of the students has ways to avoid meltdown—Limón exercises, Joseph sings or plays softball, Webber joins friends for dodgeball, and Sims goes salsa dancing. ■ **Linda Thomas Terhune**

Let's Build Something!

Purdue alumnus Paul Zmola, a well-known leader, pioneer, and philanthropist in the field of nuclear engineering, enjoys helping great ideas get to work.

Paul Zmola's senior photo in the *Purdue Debris*, 1944.

Let's figure out what needs to be done and work on it: that's the can-do philosophy of Paul Zmola, who earned his bachelor's ('44), master's ('47), and doctorate ('50) degrees in mechanical engineering from Purdue. A distinguished pioneer in nuclear technology, Zmola has given to Purdue generously and mindfully for over 20 years, always asking first of those in his areas of interest, "What needs to be done?"

"Purdue is a 'let's build something' type of school," Zmola says of where he developed his attitude of thoughtful, active contribution to the world of knowledge and learning. "Instead of exploring only in esoteric areas, the people at Purdue investigate real area problems, go at it, and see what they can do."

During his time at Purdue in the 1940s and early '50s—before the advent of the university's nuclear engineering program—Zmola focused on the study of heat transfer, fluid mechanics, and thermodynamics. But when he graduated and asked himself what needed doing, he discovered the world of nuclear energy. And so he got to work. In the 1950s he began his career with Oak Ridge National Laboratory and later joined Combustion Engineering, Inc. (a major vendor for nuclear reactors; now part of Westinghouse), where he was involved in the creation of the first nuclear-powered electric drive submarine and in early nuclear power stations coming online in the U.S. From there his passion for nuclear engineering grew, unfolding in a life of important contributions to both innovation and understanding in this vital field.

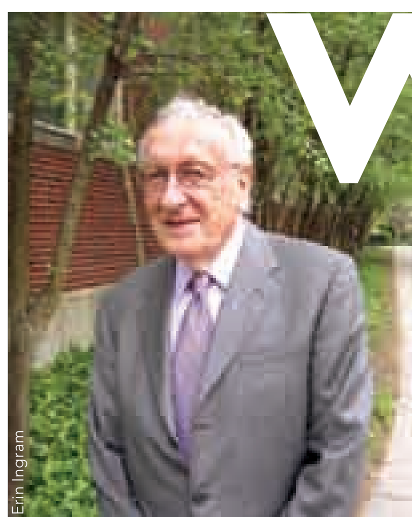
"What strikes me as especially important to understand about the potential of nuclear power is that these energy systems are not just technical," says Zmola, "they're environmental, political, and perceptual as well."

Consider the issue of clean air, Zmola says. Our primary source of energy—coal—contaminates the atmosphere with CO_2 as it's processed. The generation of nuclear power, on the other hand, doesn't require air at all, and makes use of careful methods for managing spent fuel. "It's a cleaner way to produce energy and with less costly methods of managing the environmental impact."

Furthermore, Zmola explains, all of the elements of nuclear power generation have been tried and tested; they've been run on a large scale for some time. There are 444 nuclear power reactors operating worldwide (104 in the U.S.). Twenty percent of the electric energy we use in this country is already nuclear-generated. Numbers abroad can be even higher. In France, for instance, they're operating on almost 80 percent nuclear energy, says Zmola.

With political tensions rising around issues of energy and the environment, nuclear technology can play a meaningful role. Still, he says, "We too often try to solve technical problems by political means, and political problems by technical means," stressing the importance of keeping an eye on the real issues surrounding nuclear power.

Another area of great nuclear potential and of great interest to Zmola is the field of medicine. "The area of nuclear medicine and the opportunity to develop new diagnostics with radioactive tracers is incredible." Zmola's



Paul Zmola in front of the NE building.

"What strikes me as especially important to understand about the potential of nuclear power is that these energy systems are not just technical; they're environmental, political, and perceptual as well."

–Paul Zmola

most recent grant to Purdue's School of Nuclear Engineering is helping Lefteri Tsoukalas, a professor of nuclear engineering, look into instrumentation that will allow scientists to view images of living molecules. Currently, when researchers image atomic structures, they have to crystallize a sample and then use the Bragg Diffraction to establish the structure of the molecule, essentially the same method as used by Watson and Crick to discern the structure of the DNA molecule.

Tsoukalas explains cold neutron spin spectrometry, the instrumentation that could image living molecules: "Proteins, peptides, many of the molecules of life need to be imaged in life conditions—when they are in liquid form. When you crystallize them you lose some of the relevant and important structure. Dr. Zmola is helping us determine whether we can use ultra cold neutrons, near absolute zero, to create a microscope, so to speak, that would look at the building blocks of life—all the food and information-related molecules that are involved in living cells, and observe the way the 'the real thing' works.

Zmola (circled) was part of the Society of Automotive Engineers.

To be a member of the Reamer Club, Zmola (standing center) had to be, according to the *Purdue Debris*, an "independent student with notable achievements in activities and scholarship."

"He's a remarkable man," Tsoukalas continues. "He's very well-informed and interested in the birth of ideas. We're just so grateful not only for his support but also for his ideas and for his mentorship."

In recent years, Zmola has given generously to help the school attract traditionally underrepresented students, and he's also made significant contributions for more than 20 years to the College of Consumer and Family Sciences, in memory of his wife, a Purdue Extension specialist in the 1960s who died at an early age. He was presented with the Friend of Purdue Award in 1992.

When asked about his longstanding devotion to Purdue, Paul Zmola answers simply, "The faculty members, the other students, and all the people I knew during my time at Purdue helped me so much. People went out of their way to help. It was delightful. I can't think of a better circumstance for a bright, motivated student to have ideas and get things accomplished." ■ **Lindy Patterson**

This image of Earth's city lights was created with data from the Defense Meteorological Satellite program Operational Linescan System, which NASA uses to map urbanization. The brightest spots are the most urbanized but not necessarily the most populated. (Compare Western Europe to China and India, for example.) See "Prime Numbers" on page 10 (college side) for a numerical quick look at our world.