The Flip Side

Nuclear power: Is it ‘green’?

Putting Theory to Work
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Striking While the Sun is Hot
Alumnus capitalizes on solar power’s popularity
Greetings from Purdue, and welcome to the second issue of Construction Engineering and Management Impact. This issue examines sustainability and the “green” emphasis we see all around us today.

With the courtesy appointments of nuclear engineering professors Audeen Fentiman and Lefteri Tsoukalas to our faculty, CEM is paving the way for construction students interested in the opportunities available in the field of nuclear power—a field many might never have imagined emerging as a powerful sustainability tool in our nation and the world. In our cover story, Dr. Fentiman speaks about the resurgence of nuclear power and the growing opportunities available in the field to future construction engineers who want their work to contribute to sustainable development.

In our effort to achieve sustainable development, we should consider how we plan, design, construct, maintain-repair-rehabilitate (MR&R), and decommission structures such that we use natural resources with minimal economic, social, and environmental impact. This issue of Impact offers some perspectives on how the construction industry can participate in the drive for sustainability.

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Extreme Makeover

Is nuclear power ‘green’?
Environmentalists surfing the Web must have blinked their eyes in disbelief in April 2006 when Patrick Moore, environmental activist and cofounder of Greenpeace, began advocating for nuclear power.

Conceding that in the early 1970s he and his Greenpeace compatriots had viewed nuclear power as synonymous with nuclear holocaust, a 30-years-older Moore was espousing an entirely new opinion and calling on others to join him: “My views have changed,” Moore wrote in 2006, “and the rest of the environmental movement needs to update its views, too, because nuclear energy may just be the energy source that can save our planet from another possible disaster: catastrophic climate change.

“Look at it this way,” he continued, “More than 600 coal-fired electric plants in the United States produce 36 percent of U.S. emissions—or nearly 10 percent of global emissions—of CO2, the primary greenhouse gas responsible for climate change. Nuclear energy is the only large-scale, cost-effective energy source that can reduce these emissions while continuing to satisfy a growing demand for power. And these days it can do so safely.”

Fellow environmentalist and former publisher of the Whole Earth Catalog, Stewart Brand, jumped on Moore’s bandwagon, telling the New York Times in 2007 that he regretted how he and his fellow environmentalists had created so much fear of nuclear power.

“There were legitimate reasons to worry about nuclear power,” Brand told Times reporter John Tierney, “But now that we know about the threat of climate change, we have to put the risks in perspective. Sure, nuclear waste is a problem, but the great thing about it is you know where it is and you can guard it. The bad thing about coal waste is that you don’t know where it is and you don’t know what it’s doing. The carbon dioxide is in everybody’s atmosphere.”

At the time, Brand also was raising awareness about the need for “green nuclear engineers” to help build and run future nuclear power plants.

Audeen Fentiman, professor of nuclear engineering and construction engineering and management, says the need for nuclear engineers and construction engineers with expertise in nuclear power facilities is critical and growing worldwide, but is particularly acute in the United States.

Fentiman, who also is associate dean of engineering for graduate education and interdisciplinary programs, says that because there was a lack of demand for new nuclear power employees during the final decades of the 20th century, the field didn’t grow.
“No nuclear power plants have been ordered in the U.S. for the past three decades,” she says. “There has been little need for new employees at nuclear facilities. Now the people who have been working in the industry are reaching retirement age just as the industry is on the verge of expansion worldwide.

“But because there was so little demand for new employees between 1980 and 2000, half of the nuclear engineering programs at U.S. universities closed down and several of the programs that remained went to work on nuclear medicine or other applications of nuclear science and technology.

“Purdue is one of the very, very few that kept its reactor running, kept its program going, and kept its focus on nuclear power.”

That consistency of curriculum has paid off for Purdue’s College of Engineering, whose nuclear engineering program is ready to accommodate the uptick in student interest in light of nuclear power’s new green image.

“At Purdue, we are educating three times the number of undergraduates in nuclear that we were five or six years ago,” Fentiman says. "Nuclear engineering pays quite well. Students think, ‘Here’s something green, exciting and new, and it pays well.’

And those students are likely to find that jobs are plentiful, given an August 2008 report by the U.S. Department of Energy’s (DOE) Office of Nuclear Energy. The report stated that “Nuclear energy must play a significant and growing role in our nation’s—and the world’s—energy portfolio.”

Signed by the directors of the DOE’s national laboratories, the report also stated that nuclear power, which now provides 16 percent of the world’s electricity, should be further exploited to provide hydrogen and high-temperature process heat as well as electricity: “It is the only existing technology with capability for major expansion that can simultaneously provide stability for base-load electricity, security through reliable fuel supply, and environmental stewardship by avoiding emissions of greenhouse gases and other pollutants. Furthermore, it has proven reliability (greater than 90 percent capacity factor), exemplary safety, and operational economy through improved performance.

“Nuclear energy has great potential for contributing more to our broader energy needs, however. For example, nuclear energy could supplement or even supplant fossil fuels by providing the electricity for electric-powered vehicles, or it could be used to generate hydrogen for vehicles that utilize hydrogen fuel cells. Nuclear energy could also help to generate high-temperature process heat, provide a valuable input for feedstock to chemical production and aid in the production of freshwater from seawater and contaminated surface and groundwater sources.”

With the prospect of growing opportunities in the field of nuclear power plant construction, Makarand ‘Mark’ Hastak, head of CEM, is working to build interdisciplinary educational programs so that CEM students and nuclear engineering students have easy access to curricula in both disciplines. The aim is to offer Purdue engineering students the educational background to succeed in the highly specialized field of nuclear power plant construction engineering management.

In addition, in fall 2009, CEM will make a minor available to all engineering students. Students of nuclear engineering or any engineering discipline who pursue a CEM minor will be required to participate in two internship programs. The requirement for CEM majors is three internships.

“In the area of nuclear power plant construction, we hope to work with our sponsor companies doing work in nuclear construction to help students learn how industry is providing service to nuclear power providers,” Hastak says. “They’re very eager to have our student interns work for them.

“There is a serious need for nuclear construction expertise and we are trying to fill that need.” — Mark Hastak, professor and head of construction engineering and management
There is no question that the “Green Revolution” has passed the watershed moment, and sustainability is certainly a critical component of this movement. With this recently attained momentum, the challenge becomes addressing the disparity in awareness and understanding.

While not a mature market in any sector, there are pockets which have been adopting these principles for decades. Take the “building” market, for example. When thought leaders gathered to form the USGBC (United States Green Building Council), they evaluated how best to make an impact on the environment. They identified that buildings represent the largest opportunity to reduce power consumption and increase energy efficiency. This decision led to today’s benchmark for “green” construction of buildings—the LEED (Leadership in Energy and Environmental Design) Green Building Rating System.

Another tool that attempts to quantify this intangible concept is the Triple Bottom Line. It acknowledges the three stakeholders in any project: the economy, the environment, and the local community. This perspective creates a “modern balance sheet” that addresses impacts unaccounted for in yesterday’s economy.

As a heavy industrial contractor, Bowen Engineering has incorporated sustainability into our methodology for years, we just used different names. Every project we build has a finite budget, finite resources, and our on-site employees performing the work. This is our triple bottom line, and to ignore it would be catastrophic.

We are currently building two water treatment plant projects—one new and one upgrade—and the owner is pursuing LEED certification for both facilities. The “building” components of these projects are minimal compared to the site and civil portion. In a traditional building project, the site and civil work is minimal, so even the most thorough steward of resources may only achieve the minimum LEED standard. But in these projects, management of the site and civil portions is where we make our difference.

To find a “building” project in design or construction today without addressing LEED certification would be a challenge. Yet, to find a heavy industrial project that discusses it would be equally challenging. This will be the next frontier to embrace the movement—but what will it look like? The USGBC has been very responsive to the marketplace by adding new rating systems regularly.

The question remains—is LEED the format for heavy industrial parameters? It is definitely recognized and understood, which could expedite market adoption. At Bowen, we recognize these are some of the challenges we face as we move our “modern balance sheet” forward.

However, it is critically important that we look at every project from a Triple Bottom Line perspective. The challenge in the 21st century will be for all sectors of the construction industry to collaborate to effectively move this “Green Revolution” together versus in fragmented parts.

Robert Bowen (BSCE ’62), Chairman and CEO, Bowen Engineering, Indianapolis
Putting Theory to Work

CEM major Jennica Greffe hit the highway last summer, gaining real-world experience in Orlando, Fla.

Few student resumes boast: “Overpass, on-off ramp construction engineering management intern, Interstate-4/State Road 408, Orlando, Fla.” Jennica Greffe’s does. Now a junior, she’ll have three such experiences by graduation.

“Incredible” is how she defines the value of internships. “In class, you learn theory. In the field, you have to think on your feet and know how to interact with people.”

That’s exactly what she did for 13 weeks in summer 2008 in her second Florida internship with construction giant PCL, a Canadian company.

“Jennica interfaced really well with everyone on the team. She did a really good job,” says her supervisor, Jim Holtje, PCL project engineer and one of about 180 PCL employees in Orlando.

PCL regularly offers internships, he says. “We give students experiences with our company and we get experiences with them. They can learn about us; we can learn about them. That’s the whole goal.”

Interns are members of the PCL team, he says. “We try to give them a lot of rope and responsibility. They’re really productive members of the team.”

For Greffe, the experience enhanced her classroom learning.

“I learned so much; I can’t even put it into words,” she says. “I was in the field every day. I learned a lot of technical things. I learned how to deal with subcontractors and the three different owners—the city, state, and tollway division. I operated a cherry picker and saw how concrete was poured up on bridges.”

She also worked on change orders and reporting aspects of the project.

Born and raised in DeKalb, Illinois, Greffe was hooked on Purdue from her visit on a preview day.

A computer design class convinced her that computing wouldn’t be her engineering interest. “I wanted to be hands-on and outside,” she says. CEM fills the bill.

While women are few in her field—“that can be daunting,” Greffe says—she found the Orlando crew to be a real team. “Everyone worked together and was willing to help anyone out.”

Kathy Mayer
Honorary Fraternity Boosts Student Opportunities

Focusing on academic excellence, Beta Tau offers members networking, community service, and social opportunities, as well as access to top employers.

A 3.0 or better GPA will earn construction engineering and management students an invitation to Beta Tau, an honorary fraternity that helps members stay on track academically and gives them an edge when it’s time to job hunt.

This year, 17 members are participating—doing community service, socializing, and planning an annual banquet that puts them face-to-face with industry leaders.

“We also work to further develop the major and get more students interested in becoming construction engineers,” says Logan Cook, a junior and president of Beta Tau.

For CEM senior Brian Beckman, a third-year Beta Tau member, the organization provides important contacts he believes will last a lifetime. “Beta Tau helps me get to know the older and younger classes, which is a great networking opportunity, especially since CEM students accept jobs all over the country, and maybe overseas, too,” Beckman says.

Cook says Beta Tau encourages community through cookouts and service projects, as well as its regular monthly meetings. “One of the highlights of our year is the big banquet in the spring,” he says. “We always have a guest speaker on things going on in the industry. The last two years’ speakers talked about sustainable, green buildings.”

“Invitations go out to all of our sponsor companies, faculty, staff, students, and advisory board members, along with heads of the engineering schools,” says Julio Martinez, academic advisor and associate professor of civil engineering. “The organization is valuable because it is well known within the industry and it gives students leadership skills and activities.”

This academic year, Beta Tau members painted parking lot stripes for Habitat for Humanity. They’ll return in the spring to install a handicap-accessibility ramp.

Beta Tau was launched in 1981 by Purdue graduate and former Purdue professor Donn Hancher (BSCE ’66, MSCE ’68, PhD ’72), now the Terrell-McDowell Chair Professor of Construction Engineering and Management at the University of Kentucky. “We set up Beta Tau to recognize students for academic achievement,” Hancher says.

When he retires and moves back to West Lafayette next year, Hancher says, “I would very much like to rekindle my relationship.” ■ K.M.
Virtual Improvement

Researcher helps construction industry through computer simulation

Construction companies that take the traditional approach to planning their operations may find themselves falling behind their competitors who adopt virtual planning technologies being studied by Purdue researcher Julio Martinez.

Martinez, associate professor of civil engineering in CEM, is using support from the National Science Foundation for his research that combines discrete-event simulation (DES) and virtual reality for construction operation planning. His work enables construction companies to carry out their operations virtually to maximize their risk awareness and adjust their plans accordingly before operations begin. Used at its full potential, Martinez says the DES-based virtual reality unique to his research can help construction decision makers save lots of money for their firms by improving how they plan, how they manage risk, and by increasing their overall efficiency.

"Through DES-based virtual reality, I want the people who are in the experience to feel that they are actually watching and moving about in a place where a construction operation is going on," Martinez says. "There are uncertainties. While we have an expectation of how it’s going to come out, without prior virtual construction, we have no serious understanding of how it can develop."

Martinez cites the example of a construction project requiring ready-mix concrete deliveries. "We could have the truck come and we would watch what happens, looking to find ways to make the process more efficient," he says. "We would ask, ‘Did I have too few people waiting for the delivery to place the ready-mix? Did the trucks have to wait? Or did I have too many people, so some were standing around with nothing to do?’"

Martinez’ research is geared toward enabling construction firms to tailor their own simulations specifically to their unique construction operations and to avoid the common and costly practice of learning about their inefficiencies after operations are under way.

“Simulation lets you go through that first day on the job, see how it went and how you can do better tomorrow and the next day, and so on,” Martinez says. “By the time you are ready to start the actual project, you’ve gone through the complete improvement process virtually, so the operation has already run virtually at peak performance.”

Born and raised in the Dominican Republic, Martinez obtained his five-year professional degree there at the Universidad Católica Madre y Maestra. Subsequently, he came to the United States where he completed two master’s degrees, one in civil engineering and another in construction engineering and management. He earned his PhD in civil engineering at the University of Michigan. After 10 years on the faculty of Virginia Tech in Blacksburg, he joined the Purdue faculty in 2007.

Martinez says he is gratified when fellow researchers benefit from his work and when his research inspires his students. “When I develop an idea and my colleagues at other schools build upon it to do their own work, that’s very satisfying,” he says. “And it is very rewarding when you find bright minds and are able to help them develop the ability to find their own tough scientific questions and answer those questions in widely applicable ways.”

Julio Martinez, associate professor of civil engineering in CEM, combines discrete-event simulation with virtual reality to help construction firms plan their operations more effectively and efficiently.
Ralph Parrott is very bullish on renewables. After spending more than a year marketing solar products and construction services in Texas and Louisiana as founder and president of Alternative Power Solutions, Parrott (BSCEM ’91) is very optimistic that his company has the right niche at the right time and place.

“The sky is the limit for this particular market,” he says via cell phone while on the move after visiting a Houston housing facility for the elderly where a rooftop solar panel will soon be installed. “I think I timed it well. This first year has not been easy, but the first year was just getting our name out there and getting people to know that there is solar available.”

Parrott’s company designs and installs residential and commercial solar systems for power generation, water and pool heating and pumping, attic fans, LED lighting systems, and energy audits.

For now, while the cost of solar technology is high compared to conventional technologies, and homeowners’ associations are balking at the appearance of solar panels, Parrott says units of government are his best customers.

“I’m most optimistic about the fact that governmental entities are looking to reduce their energy consumption,” he says. “The largest projects that we’ve got are government entities. They want to spur the economy and ease the pressure on utilities. If their consumption is reduced by just 1 percent, they can ease that pressure. They have the ability to make a huge impact.”

For now, Parrott says, government agencies are more concerned about consumption reduction than saving money on their power bills.

“They aren’t concerned with return on investment as much as business owners are. Here in Houston we have a very renewable-energy-minded mayor. It’s about the city’s carbon footprint, but he also knows that he can create jobs by doing these things.”

Parrott says he is grateful to his Purdue CEM education for having trained him to think outside the box and analyze problems. “What Purdue does is help nurture that thought process that allows you to think of different ways to do it—to solve problems. A Purdue education teaches you to learn anything. I’ve worked in oil fields, sold pipeline services, and dealt with a lot of things.”

Parrott recommends that CEM students and students in all engineering disciplines give renewables serious thought when considering their career options. “I’m a businessman and I’m doing this because I want to make money. I encourage people to look at alternative energy and renewable energy. There’s an extreme shortage of quality, educated people.”

A native of Lafayette, Ind., Parrott would like to expand his business enough to have a presence near his roots one day. But he isn’t likely to stop there.

“I’d like to have a location in Indiana—wherever there’s a location with sun and a local government.” ■ A.R.
Motivated, well-prepared high school students who hope to study construction engineering and management at Purdue have new reason to anticipate that they’ll receive a scholarship that their academic achievements deserve.

Thanks to generous Purdue donors, the university’s Access & Success campaign is matching scholarship donations of $25,000 or more. Dollar-for-dollar matching funds are available for donations as large as $5 million.

“CEM is such an outstanding program and we’ve always had a history of having talented students,” says Madonna Wilson, director of development for CEM. “Scholarships give them a step up so that they won’t be facing huge debt when they graduate. It just makes the quality CEM program and a Purdue engineering education that much more attainable to students.”

The scholarships are named for the donor or can be named for someone the donor wishes to honor.

To help qualified students receive a scholarship and pursue a CEM education, you or your organization can participate in supporting scholarships for the CEM Access & Success campaign by contacting Wilson at (765) 494-6490 or wilson47@purdue.edu.

A new twist on tradition

Construction engineering and management has added named lectureships to its opportunities for those who wish to contribute to the program’s growth and progress. A minimum of $500,000 is being sought to support endowed lectureships that will recruit visiting professors as well as representatives of industry.

Meanwhile, a minimum of $1 million is sought for each of two endowed professorships planned as joint professorships. One is between CEM and nuclear engineering and the other pairs CEM and mechanical engineering.

In addition, $1 million is being sought to endow a director for the CEM internship programs and support is being sought for two endowed junior faculty positions. A minimum of $500,000 is needed to support each of the junior faculty positions. ■ A.R.

Scholarship winners Mark Cermak (left) and Dan Groszek (right) have made the most of their CEM opportunities. Cermak is shown during his internship working for PCL Construction Enterprises, Inc., on a four-story underground parking garage and the five-story office building above it in Los Angeles. Groszek worked on an apartment building in Los Angeles for Webcor Builders.
According to a 2006 report by the Bureau of Labor Statistics, 23.2 percent of all occupational injuries to wrists, hands and fingers resulted in time away from work. The construction industry accounted for 47.5 percent of all hand injuries.

Three years of injury records at Kiewit Corp. show that hand injuries are common here. I knew Kiewit wasn’t the only company encountering hand injuries, but I was concerned about our employees and how these injuries were affecting them and their families.

Construction workers’ hands are their most valuable and used tool, and therefore are exposed to a variety of hazards. The preconceived notion in the construction industry is that hand injuries are inevitable, but a good hand injury prevention program can help to change that perception.

Typically, the first thing that comes to mind for hand injury prevention is to wear gloves. However, wearing gloves is only one part of a good hand injury prevention program.

Hand injuries can and will be prevented when workers are engaged in a program that asks them to:

- Think about where they place their hands, anticipate the potential results of their actions, and place their hands accordingly.
- Avoid pinch points under, around, and between moving objects.
- Use tools as described by the tool manufacturer—with all the supplied guards and handles installed properly.
- Always select and use the proper tool for the required task.
- Select gloves that match the task to be performed.
- Watch out for each other and communicate hand hazards.

Hand injuries can be prevented in the construction industry, but it takes more than wearing a pair of gloves. ■ Eric Grundke, Corporate Safety Director, Kiewit Corp.
Seemingly the stuff of futuristic gaming, this illustration uses rocket experimentation data from Purdue researchers. The two figures shown in repetition are Delayed Detached Eddy Simulations of combustion instability in an experimental rocket combustor. Guoping Xia, a senior research scientist, and Randy Smith, a graduate student, created the simulations while working with Charles Merkle, the Reilly Professor of Engineering with appointments in aeronautics and astronautics and mechanical engineering. The experiments are conducted by a research group led by William Anderson, an associate professor of aeronautics and astronautics.