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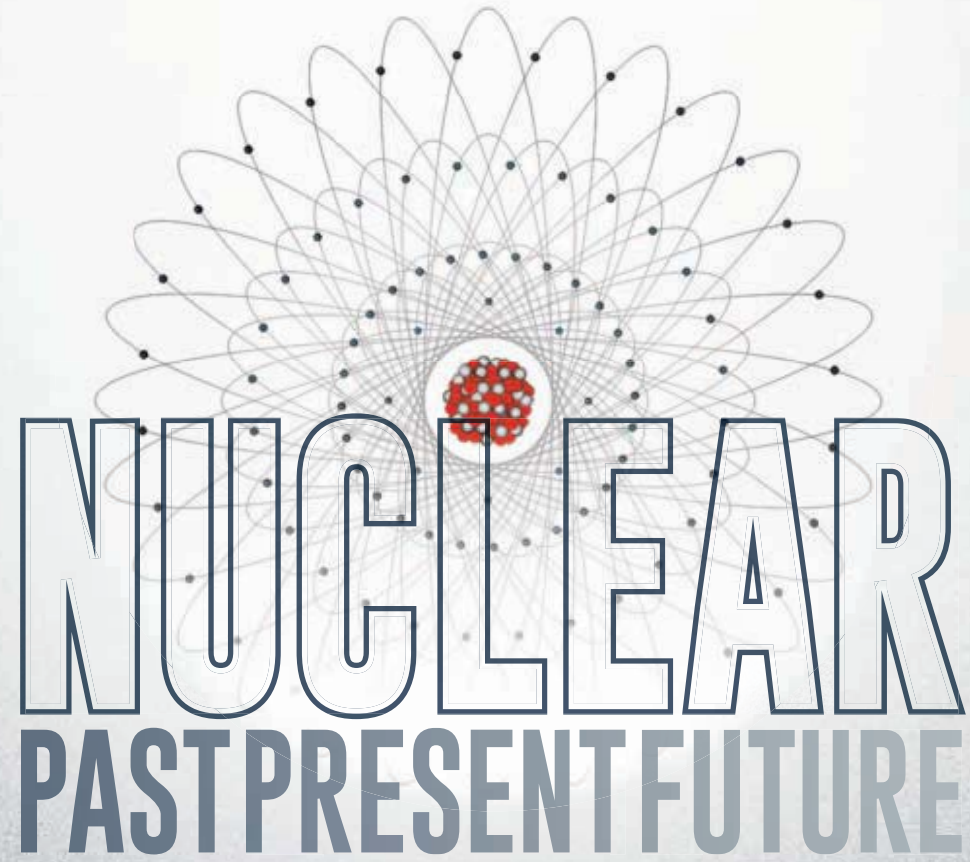
Technology that moves the world
THE MAGAZINE OF ASME
No. 05
136



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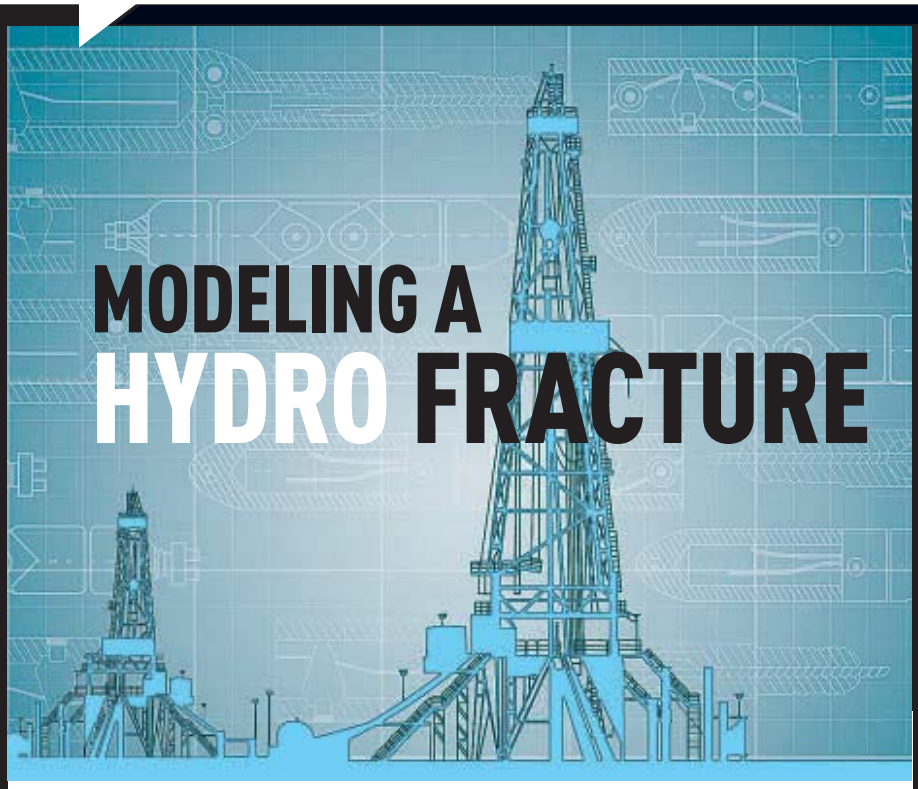
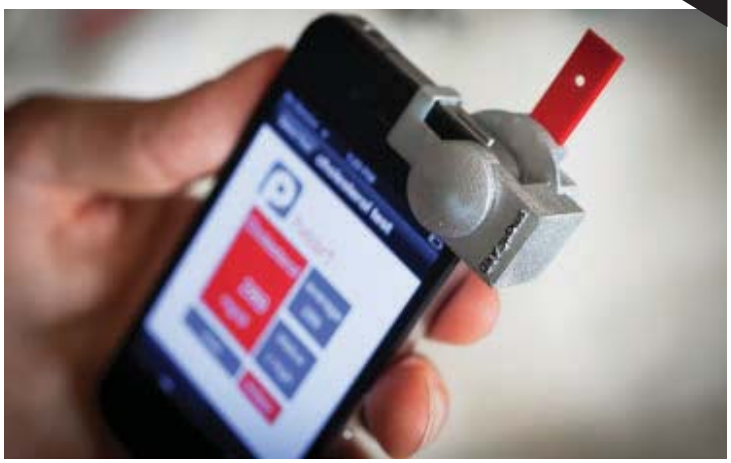


MODELING A HYDRO FRACTURE

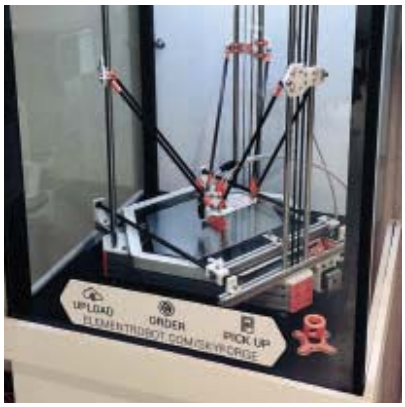
HYDRAULIC FRACTURING TECHNOLOGY HAS KEYED THE BOOM IN energy production in the United States, pulling oil and natural gas from underground formations previously considered impermeable. Using Lawrence Livermore National Laboratory's supercomputer, researchers have developed physics-based software to build a model to accurately simulate how fracking works beneath the surface.



AN APP CAN CHECK CHOLESTEROL

Cornell engineers have created the Smartphone Cholesterol Application for Rapid Diagnostics, or "smartCARD," which employs your smartphone's camera to read your cholesterol level.

For these articles and other content, visit **asme.org.**



MAKING 3-D PRINTING MORE ACCESSIBLE

An engineering student recognized an opportunity when he had to wait for parts to be created for a project on the university's 3-D printers.

VIDEO: THOMAS EDISON: PIONEER OF MODERN INNOVATION

National Park Service archivist Leonard DeGraff discusses Edison's accomplishments in the context of the inventor's time as well as today, and talks about Edison's relationship with professional societies like ASME. **ME**

NEXT MONTH ON ASME.ORG

HARD CIDER MADE EASY

After a long dry spell, hard cider is flowing again in the U.S. Here's a look back at the long tradition of engineering behind America's once and future favorite drink.

VIDEO: 3-D PRINTING FOR THE DEVELOPING WORLD

A Togolese inventor in West Africa has built a 3-D printer using parts gathered from old computers, printers, and scanners found in e-waste dumps.

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***Give me the place to stand, and I shall move the earth*—Archimedes**

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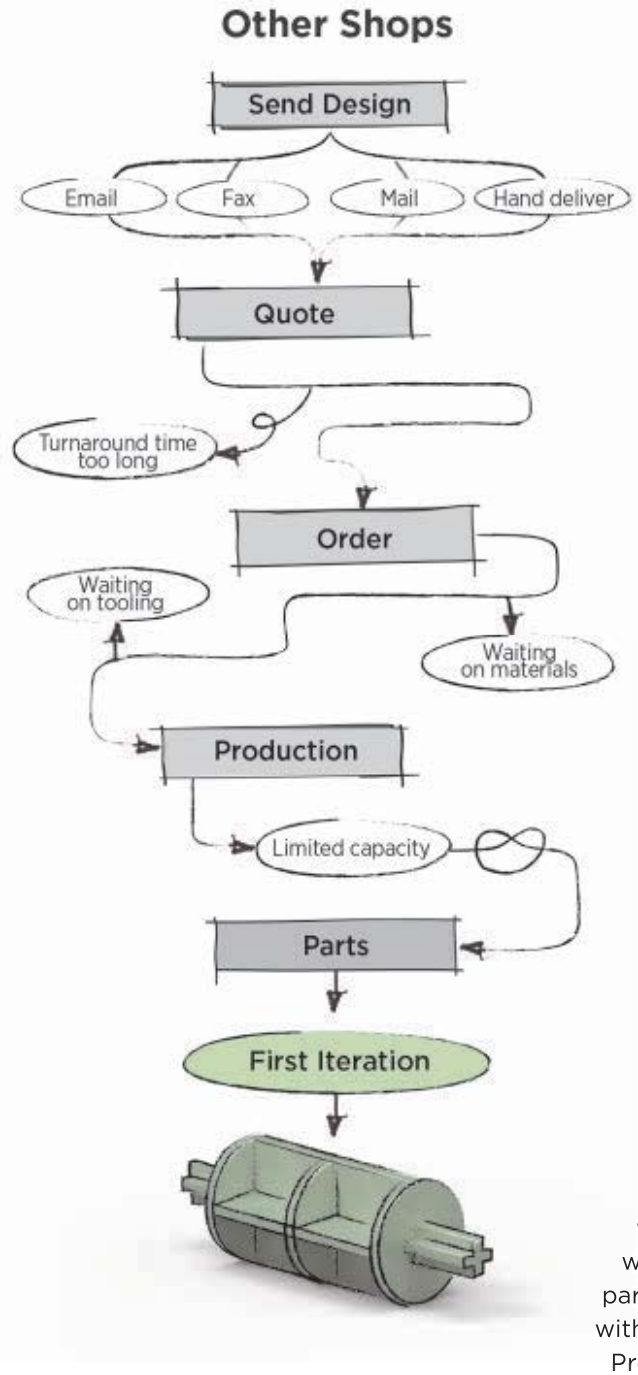

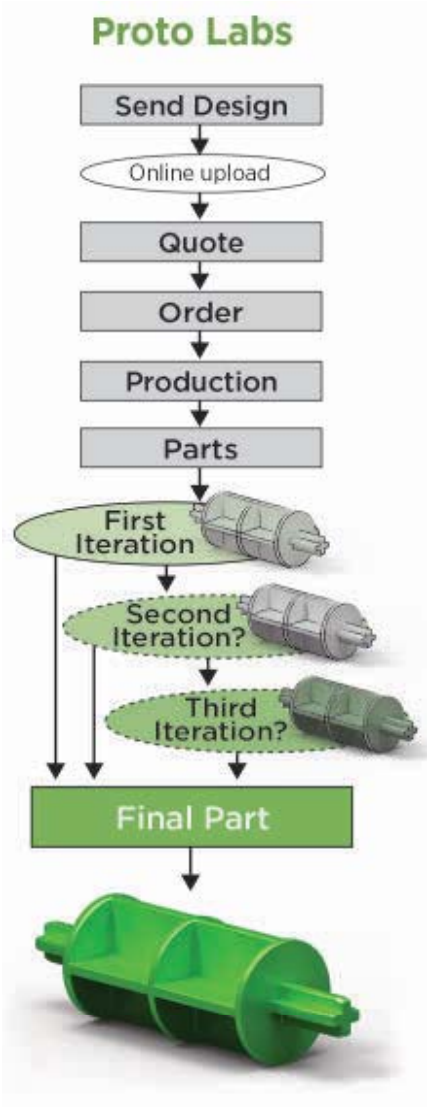

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John G. Falcioni
Editor-in-Chief

COMMEMORATING NUCLEAR CODES AND STANDARDS

I'd be lying if I said I didn't have preconceived notions of the word "nuclear" when I started at ASME, oh so many years ago. And I'm willing to bet that as you read this you can't help but have a visceral sentiment or two yourself about the word. Let's face it, "nuclear" packs a punch.

But I've always been one to believe that few things in life are black or white, so while I may have been inclined to fall on one side of the discussion back in the day, few things for me are absolute. In my way of thinking, points of view surrounding nuclear power are too often on the fringes and that's lamentable because conversations on the fringes bring out heightened and sometimes ruffled feelings instead of salient and respectful exchanges of perspectives.

Because I've always probed—even my own beliefs—my perspectives on nuclear power have never been overt. Biases aside, however, the significant role of ASME in the development of safety codes and standards is undeniable. ASME's Board on Nuclear Codes and Standards oversees eight committees that have issued 22 nuclear codes and standards. At the heart of these committees are almost 1,300 dedicated volunteers who spend hours working on these activities.

In this issue, we help celebrate the 50th anniversary of Section III of the ASME Boiler and Pressure Vessel Code. The Code represents one of the most notable ways that ASME makes its mark on global safety. It is—and ought to be—a point of pride.

Besides celebrating the anniversary of the ASME safety codes program, in this issue we also showcase an article more than a year in the making. Senior Editor Jeff Winters worked with Ken Balkey—whom I've gotten to know well over the course of many years—on a forward facing article looking at the future of nuclear power. Balkey is a consulting engineer at Westinghouse Electric Co. and he's also senior vice president for ASME Standards and Certification. Balkey and Winters, working with co-authors Barbara Snyder and Theodore Meyer, have come up with an insightful article, "Nuclear's Next 40 Years," that I encourage you to read.

You might imagine that publishing an article like this can be challenging. First because we want to make sure we get it right, and then because the authors work at Westinghouse, and working on an article with a large multinational can often be tricky, as the vetting process can be difficult. But Winters tells me the experience was positive overall, and because he's our resident energy expert—and resident skeptic—I believe him.

Each day brings new nourishment to our perspectives on different matters. We hope this issue of *Mechanical Engineering* provides more nutrients for your own perspectives on a critical element in the discourse over global energy—whichever way your preconceived notions might otherwise sway you. **ME**

FEEDBACK

Share some of your preconceptions on energy resources. Email me at ***falcionij@asme.org***

LETTERS & COMMENTS

MARCH 2014

Reader Kraft says outreach to young people is essential to promote engineering.

Two readers question the future of fracking. Another asks us, "What's a MOOC?" And a reader comment makes the case for professional licensing.

WATER FOR OIL

To the Editor: The March 2014 article "Hubbert's Peak, Mitchell's Boom" was interesting and informative, but also provocative. Missing from this and earlier related articles is the impact of steady depletion of our water aquifers to enable the necessary fracking.

Although we are indebted to Mitchell for his persistence in developing fracking technology which admittedly will bring much-needed relief to our economy, such

COMMENT

A BIG WORLD FOR LICENSURE

ASME leads the world in standards, from the dimensions of the smallest screw to the design of a nuclear reactor vessel. That fact was recently discussed on a National Public Radio news program, *The Takeaway*, hosted by journalist John Hockenberry.

A week-long series called "Meeting the Standard," included an interview with Mark Sheehan, managing director for development for ASME Standards and Certification, who pointed out that engineers have been following ASME standards for 100 years. It made me proud to be a part of this profession.

Another organization, the National Council of Examiners for Engineering and Surveying, sets the standard for the practice of engineering. It develops and administers the Fundamentals of Engineering and the Principles and Practice of Engineering exams. Besides having formal education and practical experience, engineers must pass these two exams in order to meet the standards by which every state in the Union certifies them to practice.

In civil engineering, work must be approved by someone licensed in the state in which the work will be done. Not so for mechanical engineers, because most are employed by a company and work under the company's legal status.

Many MEs do not become licensed, but that may change.

I believe that mechanical engineers will increasingly come together with engineers of all disciplines to work on projects they feel passionate about. They will function as independent engineers with entrepreneurial and business skills.

An engineer passionate about solving a problem would recruit engineers worldwide, with the right talents and resources for that project. Micro-companies could be formed for specific projects. When each project is completed, its alliance would be dissolved and everyone would move on to other projects.

None of that can happen unless the members of those alliances are licensed.

Engineers are increasingly needed to address the challenges faced by those living in developing nations. A new global development review, *Demand*, was included with the October issue of *ME* magazine. It highlights a number of case studies of problems in developing countries and the solutions that evolved.

As it turns out, "Meeting the Standard" ended with two people concerned with technology for people living in Third World countries: Heather Fleming, CEO of Catapult Design, and Noha El-Ghobashy, managing director for engineering workforce and global development at ASME. They each described failures when designs did not meet the technology of the local community.

As I listened, I could visualize whole networks of engineers working in alliances, most likely led by mechanical engineers, connecting across the globe, addressing the needs of people.

Engineers want their work to matter, they deeply care about the human condition, and they want to make a difference. And in greater numbers, many engineers are ready to break out of the current corporate boundaries and go their own way. For those wanting to strike out on their own, being a PE is mandatory. **ME**

TOM BROWN, PE, is founder of Dr. Tom's Classroom in Raleigh, N.C. The company provides online PE Exam review courses for mechanical engineers.

can only be temporary. Indeed, Hubbert's 1956 predictions about peak non-renewable energy may ultimately prove about right if water is added to the picture.

If we are soon to begin exporting energy, will the price of such include the effects of depleting our precious water?

Phil Barnes, *San Pedro, Calif.*

PEAK AND REPEAK

To the Editor: "Hubbert's Peak, Mitchell's Boom" is a worthy tribute to Marion King Hubbert, who was the first to make large-scale quantitative predictions of depleting finite resources, in this case petroleum.

The article also points out that thanks to hydraulic fracturing, extraction of fossil oil and fossil gas gained a new lease on life. This too is temporary, as indeed some comments at the end of the article suggest. A new Hubbert's Peak in extraction by fracking will surely be reached. The question is not if, but when.

Last but not least, ASME should take the lead in abandoning phrases such as "oil production," "gas production," and "production" of any other mineral. Because such phrases are not true and are also loaded, in being politically misleading. The fact remains that oil, gas, coal, and other minerals are not being produced. They are only being extracted. And once they are extracted, they are gone, at least for millions of years.

Andres Peekna, *Waterford, Wis.*

'CHALLENGE AND DISCOVERY'

To the Editor: I must respectfully disagree with Mr. Corradin regarding his conclusions on the current state of mechanical engineering ("Working at a Disadvantage," Letters, March 2014).

What I see, as a young mechanical engineer, is a field ripe with challenge and discovery, sharpening the cutting edge of scientific advancement.

There have been unprecedented advances in the last decade in ME arenas such as energy generation, biomechanical engineering, MEMS, and NEMS. The total MEMS market in 2013 was nearly $10 billion, and the industry is poised to grow well into the future.

Granted, advances in computing and communication technologies have reshaped the world, forever changing the way information and data are collected, analyzed, shared, and turned for profit. The electrical, software, and computer engineers certainly deserve credit for their role in this "information revolution," but let us not forget the ME-driven strides in material processing and manufacturing that allow billions of transistors to be placed on the modern CPU.

Smart phones and tablet computers certainly are the driving forces behind the modern workplace and social media, but let us imagine these devices without touchscreens, MEMS gyroscopes, structural packaging, or for that matter, without telecom satellites, most of which have been launched post-Apollo. All of this goes without mentioning that MEs are developing technologies allowing us to produce fossil energy at or near 60 percent efficiency, reshape the global energy marketplace with fracking techniques, and take NEMS from science fiction into a multi-billion dollar industry in the coming decade.

The fact is that no modern technologies are engineered unilaterally by any one engineering discipline. The modern engineering environment requires teamwork across multiple disciplines early in the design phase for successful product development, and the ME has a critical role to play.

To his credit, Mr. Corradin rightly points out the need to draw more intelligent young people into the field of mechanical engineering, but I submit that the problem is not that the field is antiquated, but rather that industry and academia do not do a good enough job selling it.

The answer, in my opinion, is community outreach by ME professionals to engage young people at an early age. Every prospective STEM student has access to a smartphone or computer, and so it is really no wonder that computer science technologies pique their interest.

In order to develop an interest in ME, young scholars must be actively exposed to ME technologies in a way that is both interesting and fun. A primary role of professional societies like ASME is to engage the public in the many fascinating and demanding technical challenges facing mechanical engineers in the coming decades. As members, perhaps we should take some responsibility in this charter.

Steven M. Kraft, *Merritt Island, Fla.*

FEEDBACK

Send us your letters and comments via hard copy or e-mail memag@asme.org (use subject line "Letters and Comments"). Please include full name, address and phone number. We reserve the right to edit for clarity, style, and length. We regret that unpublished letters cannot be acknowledged or returned.

FULL DISCLOSURE

To the Editor: Please, please, when you use an abbreviation, first spell it out ("Educating Rita in the Time of MOOC," Letters & Comments, February 2014).

I had no idea of what "MOOC" is, as did probably 50 percent of your readers.

George Skoda, *Santa Clara, Calif.*

Editor's note: MOOC = "massive open online course."

QUICK ADOPTION OF A FUEL-SAVER

The developer of the fuel-saving winglets used by commercial jet aircraft has come out with an advanced design that promises to save even more. The new design received certification from the U.S. Federal Aviation Administration in early February, and the first set went into commercial service a matter of days later.

THE NEW DESIGN IS A REFINEMENT OF THE Blended Winglets developed by Aviation Partners Boeing. The originals are the upturned wing tip extensions that have been widely adopted by commercial carriers. According to Aviation Partners, Blended Winglets reduce aircraft drag and can improve cruise fuel mileage by as much as 6 percent.

The company said the new version, called Split Scimitar Winglets, can bring another 2 percent reduction in fuel consumption. United Airlines became the first commercial carrier to install and fly the new winglet, about two weeks after the design was certified.

The newly patented design adapts Blended Winglets by replacing the aluminum winglet tip cap with a new aerodynamically shaped winglet tip cap and by adding a ventral strake.

According to APB, the Scimitar design has been certified for Boeing 737-800 series aircraft. The company predicted that it could receive certification for use on the Boeing 737-900ER by late July.

The company said it plans to develop and certify the Split Scimitar Winglet modification for all of the Boeing 737-700, -800 and -900 series aircraft, including Boeing Business Jets.

According to Mike Stowell, chief technology officer at Aviation Partners Boeing, the Split Scimitar Winglets for all the 737 Next Generation aircraft will be aerodynamically the same.

"Structurally, there are different wings which we must account for in the wing modification design and certification," he said. "For example, the 737-800 currently has two structural wing types requiring two different wing modification kits. The three different fuselage lengths must be flight tested as part of the certification. We are evaluating the 757 and 767 for SSW technology."

Aviation Partners said at the time of certification that it had taken orders and options from various carriers for 1,461 Split Scimitar Winglet systems.

An advance on the Blended Winglet, the new Split Scimitar design by Aviation Partners Boeing uses a modified upturning winglet and a ventral strake to achieve a further reduction in aircraft drag.

QUICK FACTS:

WHAT IT IS: Split Scimitar Winglet.

DEVELOPER: Aviation Partners Boeing, Seattle.

WHAT IT DOES: Reduces aircraft drag and improves cruise fuel mileage.

CERTIFICATION: Currently 737-800; modifications to fit other Boeing jets are planned.

In the past 10 years, APB has sold more than 7,000 of the original Blended Winglet systems, and 5,300 of them remain in service on planes flown by more than 200 airlines in more than 100 countries. APB estimates that by the end of 2014 Blended Winglets will have saved the world's airlines more than 5 billion gallons of jet fuel.

Aviation Partners Boeing is a joint venture of Aviation Partners Inc. and The Boeing Co., and is based in Seattle. **ME**

HARRY HUTCHINSON

Cylinders in an undated photo hold uranium taken from Russian missiles to be converted for use in U.S. nuclear power plants.

RUSSIAN URANIUM, BUT NOT FROM OLD WEAPONS

THE SOURCE OF ONE-FIFTH OF THE FUEL for U.S. nuclear reactors dried up last year, but the company involved says there's plenty of uranium in the supply chain.

The Megatons to Megawatts program, a deal between the U.S. and Russia to turn weapons-grade uranium into fuel for nuclear power plants, ended last year. Over 20 years, the program fed the equivalent of 20,000 Soviet-era nuclear warheads into the U.S. power-generation industry. The program had been providing as much as one-fifth of the industry's fuel supply.

Megatons to Megawatts was a venture between U.S Energy Corp. and Russia's Technabsexport, or Tenex. Tenex is owned by Rosatom, the state-run corporation that manages Russia's nuclear energy programs including mining, fuel cycles, and exports.

USEC, one of three major reactor fuel providers in the U.S., handled all of the Megatons to Megawatts uranium. A spokesman said the company has a new deal with Tenex in which USEC "will replace about half of the Megatons to Megawatts material with that from the new contract with Tenex. The contract also has a clause that allows for the quantities to increase to the same level as Megatons to Megawatts if mutually exercised."

USEC "will meet the remaining needs for our contracts from our existing inventory and other potential supply sources," the spokesman added. Those sources include a clause in its contracts with U.S. utilities requiring them to deliver to USEC "the equivalent amount of natural uranium necessary to produce the enriched uranium they have contracted for from us," he said. This uranium was returned to Tenex or held in Tenex's account by USEC.

According to the U.S. Energy Information Agency, U.S. nuclear plants in 2012 purchased 58 million pounds of uranium, 83 percent of which was imported. About 38 percent of the enriched uranium needed to fuel U.S. reactors was supplied by foreign enrichers, the agency adds.

The Washington-based Center for Strategic and International Studies, CSIS, laid out the data in a November 2013 report titled *Recapturing U.S. Leadership in Uranium Enrichment*. The report noted the last U.S. enrichment facility, a gaseous diffusion plant near in Paducah, Ky., was closed in 2013. Pending negotiations with the Department of Energy, it may be reopened using laser enrichment technology from AREVA, the French nuclear energy giant. AREVA operates a nuclear fuel fabrication facility in Richland, Wash.

For the foreseeable future, CSIS says that the U.S. will depend heavily on imports to fuel its reactors. Dependence on foreign sources for reactor fuel soared in the 1990s. Imports went from less than 10 percent of the needs of the nation's reactors in 1993 to nearly 90 percent by 2001—with minimal change since then. **ME**

JACK THORNTON is a contributing writer to *ME*.

TRUE COLORS

RESEARCHERS IN GERMANY HAVE COME UP WITH a way to make spectral analysis faster. They say it works on a mobile platform in real time.

The Fraunhofer Institute of Optronics, System Technologies, and Image Exploitation has developed software called SpectralFinder that can record and quickly analyze vast amounts of hyperspectral data.

Every substance has its own individual color spectrum. Fraunhofer's system uses hyperspectral sensors, capable of generating 130 color values per pixel.

By clicking an image area on the monitor, an algorithm immediately displays where similar surfaces can be found within the live images. For immediate results, the software compares the 130 color values within the image area with the remaining image pixels; it then identifies surfaces that have the best corresponding color values. Color spectra can be compared to a materials database.

"It also operates when the camera or the object is moving. The materials can even be classified while data is still being collected," said Caroline Stolka, a research group staff member.

The system comprising a hyperspectral camera and computer operating SpectralFinder is a prototype. According to Fraunhofer, it has been tested in potential application scenarios in the lab. Potential applications are mineral exploration, environmental monitoring, quality control, and food manufacturing. ■

A new spectral analysis system can distinguish artificial turf (marked in red at left) from natural (right) in real time. Photo: Fraunhofer IOSB

Early prototype (right) for Urbee 2. Jim Kor, sitting in the frame of the car (below), holds a model of the design that will make the trip across the U.S. Photos: Kor Ecologic

COAST TO COAST IN A PRINTED HYBRID

IN MAY 1903, AUTO ENTHUSIAST HORATIO JACKSON, HIS MECHANIC Sewall Crocker, and his dog Bud, set out from San Francisco to New York City in a Winton car. They completed the first-ever cross-country road trip in a motor car in two months and nine days, using 800 gallons of gasoline.

In the summer of 2015, teenagers Cody Kor and Tyler Kor, along with their dog Cupid, will re-enact Jackson's drive, taking just two days and using 10 gallons of bio-fuel in Urbee 2, a 3-D printed hybrid car.

The two teens are sons of Jim Kor, the president of Winnipeg-based engineering group Kor Ecologic, and Urbee 2 is the second prototype of Urbee, a vehicle research project that he started with his team of designers and engineers in 1996. "We used to work on interest-driven research projects and most of them were focused on energy efficiency because of my personal interest," says Kor, who believes powering cars on renewable energy is vital to our civilization's survival. "Urbee has been an offshoot of all those projects."

Originally designed for the 2010 Automotive X-Prize Competition, Urbee represents Kor's vision to build the greenest and most practical car ever made. A mechanical engineer from the University of Manitoba with three decades of experience designing farm machinery, Kor was inspired by Paul MacCready, designer of the human-powered aircraft that won the Kremer Prize. MacCready's strategy was to use all the technology that's available when solving a problem.

According to Kor, "We decided to use whatever we could find to design the greenest car possible—whether it be a fuel cell or a piston engine that made the car more efficient."

Kor and his team decided to build Urbee as a hybrid car. At city speeds, the car runs on electricity, and at highway speeds, it uses an ethanol-fueled internal combustion engine. The first Urbee is capable of reaching more than 200 mpg, and the goal for Urbee 2 is 300 mpg. Its batteries can be charged using a standard wall plug at home or in a parking lot.

Urbee minimizes the amount of energy required to move forward, through efficient aerodynamics. It has three instead of four wheels. According to Kor, "The most resistance will be where the tires poke out of the body, and since we have only three slots where tires poke through, there is less resistance. We wanted to get the force at the tire on the road as low as possible."

To make Urbee *continued on page 14»*

WASHINGTON

BIPARTISAN SUPPORT FOR BILL ON KEY MINERALS

A BILL TO INCREASE THE DOMESTIC SUPPLY of critical minerals used in a wide range of high-technology products has received bipartisan support in the Senate Energy and Natural Resources Committee. Similar legislation passed the House in September on party lines.

Senator Lisa Murkowski (R-AK), the ranking member on the Senate committee, is the sponsor of S.1600, the Critical Minerals Policy Act of 2013. Murkowski introduced the bill in October, with the support of 18 Senators from both parties. The legislation seeks to improve the domestic supply of twenty critical minerals including cobalt, lead, lithium, thorium, and other rare earth minerals.

During a hearing, Murkowski said, "minerals are the building blocks of our economy, critical to our prosperity, our standard of living, and our competitiveness. We need a steady, affordable, and domestic supply of them, mined here, refined here, processed here, and made into products here."

In his opening remarks Committee Chairman Ron Wyden (D-OR) lauded Murkowski and Senator Tom Udall (D-NM) for their work in crafting a bipartisan bill.

David Danielson, the assistant secretary for the Office of Energy Efficiency and Renewable Energy at the Department of Energy, testified about the "importance of ensuring a stable, sustainable, domestic supply of critical minerals."

Lawrence Meinert, mineral resources program coordinator at the U.S. Geological Survey, said the agency is "delighted" that a bill focusing on mineral resources has been introduced. Meinert added, "Any activities conducted to fulfill the objectives of the bill would require substantial resources and would need to compete for funding with other priorities." S.1600 would authorize a critical minerals program but not provide funding.

To see the full text of S.1600, visit the Natural Resources Committee's website: www.energy.senate.gov. ■

continued from page 12 »

COAST TO COAST IN A PRINTED HYBRID

as sustainable as possible throughout the design and manufacturing processes, the team considered building the prototype body panels using fiberglass, but that would have meant a long and labor-intensive process. Stratasys, the key sponsor, offered to make it using a 3-D printer. "We completed the body in clay, scanned it onto the computer, simulated the aerodynamics, and then approached Stratasys to 3-D print it," Kor says.

Working with RedEye, an on-demand 3-D printing facility, the engineering team at Ecologic used ABS plastic and fused deposition modeling to fabricate a light and strong body for the car. Several major body panels were built within weeks.

"To have body parts within weeks is pretty fast," Kor says. "The alternative would have been months using fiberglass, and we couldn't make the small parts as we wanted them to be."

Additive manufacturing processes made it easy and efficient to make design changes. "I realized that when you design for a 3-D printer alone, and not for production processes like casting or extrusion, the processes don't dictate the design. The parts can be changed and be dramatically better," Kor says.

After achieving technical success with Urbee in 2013, the Kor Ecologic team initiated the second prototype, Urbee 2, last spring. While the original Urbee only had its exterior 3-D printed, Urbee 2 will have its interior 3-D printed as well, except the engine and chassis. "Everything you see and touch would be 3-D printed—which is almost 50-60 percent of the car," Kor says.

"EVERYTHING YOU SEE AND TOUCH WOULD BE 3-D PRINTED—WHICH IS ALMOST 50–60 PERCENT OF THE CAR."

Kor says the company has patented certain technology worldwide, and may offer to license it to other car companies or try to build the car and sell it. "After the second prototype, we would need a pilot run of 10 or so units, and then an initial production run could be considered," Kor says. "We visualize an inexpensive car—like the Beetle or Model T—for this century."

Currently, Kor's team is using crash simulation software to streamline the safety features, and also waiting for more funding to complete the second prototype. "We need a year to design, another year to build and test it. Then my two sons would attempt this cross-country trip in Urbee 2," he says.

Whether Kor's sons set a world record is yet to be seen, but Urbee 2 signals that a future where people build and drive 3-D printed cars is a real possibility. ME

CHITRA SETHI / ASME.ORG

NEW NEEDS FOR 3-D

FOOTPATHS, NOT ROADS, CONNECT VILLAGES IN THE NUBA Mountains in South Kordofan, Sudan, and motor vehicles are scarce. The region, caught in the conflict between Sudan and the new nation of South Sudan, is officially a war zone. Yet the area boasts a three-dimensional printing lab.

Daniel, sitting beside Mick Ebeling, CEO of Not Impossible, uses his 3-D printed hand. Photo: Not Impossible Labs

It's there that technology company Not Impossible Labs of Venice, Calif., assembled an international team to launch a prosthetic printing facility intended to help the growing number of children in the area who have lost limbs in the war.

Project Daniel, named for a teenage boy who lost both arms to a bomb attack, fitted its namesake with a printed prosthetic at the facility in late 2013. The customized prosthetic hand, called RoboHand, was invented by Richard Van As, a South African who trained Sudanese technicians to print it.

Local trainees have since printed and fitted two more prostheses. The lab's founders have left the operation in their charge.

While 3-D printing is popular in South Africa, "as for most of Africa that will take some time," he said. "But it will certainly get there. Let's give them a year."

To create an object, printers melt a filament—usually plastic though soft metal or even chocolate can be used. Layers of the melted filament are stacked upon a printing bed to gradually build an object.

The technology leapfrogs some problems more cheaply than traditional methods. There are few roads in the Nuba Mountains, but printing things reduces the need for delivery, Van As said.

"Teaching the guys, I saw more than excitement," Van As said. "Passion to help the less fortunate exceeded any effort or exhaustion. I would say it would be futile to try to stop it." ME

ENGINEERINGFORCHANGE.ORG

THE THREE FACES OF ENGINEERING

Engineering is a human endeavor applying equal parts creativity, art, and science to improve the quality of life.

Modern engineering relies heavily on science. But millennia ago, the Egyptians built the pyramids and the Romans constructed a system of aqueducts long before modern science existed. Eons before civilization, the purely trial-and-error approach archaic *Homo sapiens* practiced when making spears, arrows, and other hunting tools was a manifestation of the engineering art.

Modern engineering, on the other hand, deals with much more sophisticated systems and strives to manufacture affordable, competitive, optimized products. Scientific principles play a dominant role in that effort.

In 1781, James Watt invented a version of the steam engine, which was a main driver of the Industrial Revolution. Thermodynamics developed out of a desire to increase the efficiency of steam engines.

Modern science emphasizes the importance of experiment over contemplation. This non-Aristotelian science is inscribed in the work of Copernicus, Galileo, Newton, Leibniz, and Maxwell, among others. The Space Shuttle, considered the most complex machine ever built, would not have been possible without the powerful predictive tools those scientists have given to humanity.

Ideally, engineering students have to be grounded solidly in mathematics, physics, chemistry, biology, and similar sciences before learning the art of engineering. In France, for example, engineering college students do not enroll in any engineering classes until the fourth year of a five-year program, the first three years being devoted to the humanities, mathematics, and sciences. Students in the United States start their engineering courses a bit early because undergraduate engineering degrees are typically completed in four years.

Starting about two decades ago, the art of engineering was taught at the freshman level. This was done to engage and retain future engineering students who called for an early hands-on experience. Pressures to recruit future students mounted, and this necessitated the teaching of "engineering" classes at the high- and middle-school levels. But in all these cases, the students were not quite ready yet to learn calculus and calculus-based science.

STUDENTS FACED WITH MATH-HEAVY ENGINEERING SCIENCE CLASSES MAY HOWL, "THIS IS NOT WHAT WE SIGNED FOR."

This is all good if it means successful recruiting to the ever-expanding engineering colleges. The country needs more engineers, and this is what it takes to convince young minds to enroll in what is perceived as a difficult study.

But it can leave the student with the erroneous impression that modern engineering can be learned and practiced without a strong foundation in mathematics and physics. When students are faced with engineering science classes, heavily dependent on calculus to express the laws of nature, they howl, "This is not what we signed for."

They wish to continue what they started—making paper airplanes, dropping eggs, and catapulting objects. Many begrudge classes that require them to model, compute, predict, and analyze. But problem-solving and critical-thinking skills acquired in engineering science classes are needed to tackle global warming, to provide sustainable energy and fresh water, to erect optimal living spaces, and to create competitive products from the needle to the airplane.

What to do? I believe early teaching of engineering is necessary. But youngsters should be told that creativity and art are only two parts of engineering. The third part, science, will be taught in due time.

This can be explained even to a five-year-old, but the tutor must know the difference between the trial-and-error art and the science of engineering. The former is what ants practiced for eons. The latter is what humans practice in the twenty-first century. The *Formicidae*'s quality of life is the same as it was when they built their first anthill. That of humans has been improving steadily. ME

MOHAMED GAD-EL-HAK is the Inez Caudill Eminent Professor of mechanical and nuclear engineering at Virginia Commonwealth University in Richmond. Contact him at gadelhak@vcu.edu.

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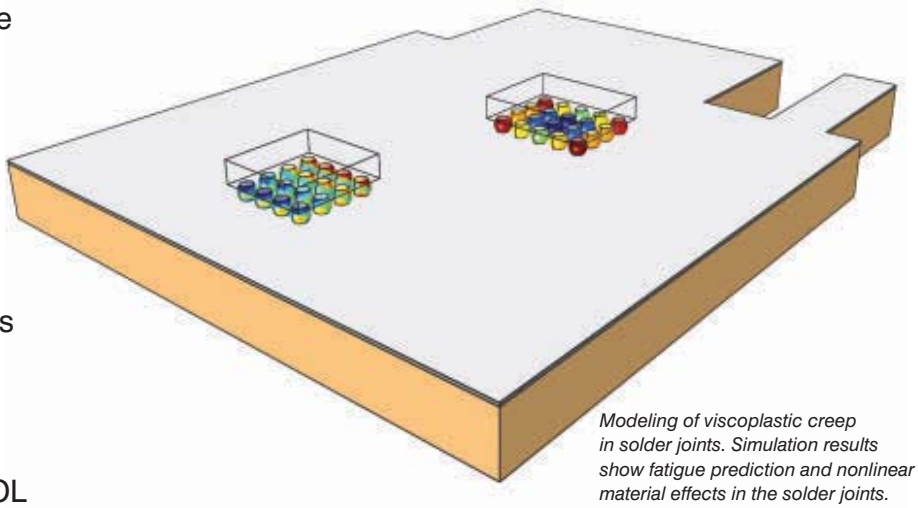

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BENDING GLASS

WHAT DO SOME HIGH-END GOLF CLUBS AND YOUR LIVING ROOM window have in common? They are both made of glass—but in the case of the golf clubs, it's a specialized product, called metallic glass, with the ability to bend considerably and spring back into its original form.

For researchers, tweaking the shearing characteristics of materials such as glass has applications beyond high-tech sporting goods. A team of researchers is working toward even stronger and more elastic glass types which would fail in a ductile fashion instead of shattering. Because the mechanical and magnetic properties of metallic glass are highly adjustable, understanding how to change those characteristics could improve products as diverse as electrical transformers and cell phone cases.

The research team is made up of members from the University of Wisconsin-Madison, Los Alamos National Laboratory, Universitat Autònoma de Barcelona in Spain, and Tohoku University in Japan.

"In glass, localized plastic deformation usually leads to immediate failure," said Seth Imhoff, a Los Alamos National Laboratory materials scientist. "Normally, metal alloys freeze into a collection of crystals in which the atoms line up into very specific patterns.

"In specially designed metal alloys a random atom arrangement can be retained in the solid, which can allow us to tailor a wide range of properties such as the ability to be bent severely and spring back into place," Imhoff said.

Metallic glass deforms plastically by the formation of what are called shear bands. Shear banding can occur on a macroscopic scale in granular materials, as during an avalanche or landslide, but in glass the bands are generally 10-20 nanometers wide, about 3,000 times thinner than a human hair.

Once a shear band forms, it travels quickly across the material and can lead to failure. The material's strength is controlled by how and when they form.

The team is looking at the initiation of shear-banding events to better understand how to control the mechanical properties of these materials so that better properties can be designed, Imhoff said. ME

JEAN THILMANY

Diamond has outperformed many metals in passing along a magnetic effect called spin, which is under investigation as a means of data transmission for future computers.

SPINNING DIAMONDS

FOR THE FIRST TIME, PHYSICISTS HAVE SHOWN that information can flow through a diamond wire. In the experiment, conducted at Ohio State University in Columbus, electrons did not flow through diamond as they do in traditional electronics.

Rather, they stayed in place and passed along a magnetic effect called spin—like a row of sports spectators doing the wave, said Chris Hammel, a physics professor at Ohio State who was lead investigator on the diamond-wire experiment.

Spin could one day be used to transmit data in computer circuits, he said. Hammel added that the experiment showed diamond transmits spin better than most metals in which researchers have previously observed the effect.

Researchers worldwide are working to develop so-called spintronics, which could make computers simultaneously faster and more powerful.

Diamond has a lot going for it when it comes to spintronics, Hammel added. It's hard, transparent, electrically insulating, impervious to environmental contamination, resistant to acids, and doesn't hold heat as semiconductors do.

"Basically, it's inert. You can't do anything to it. To a scientist, diamonds are kind of boring, unless you're getting engaged," Hammel said. "But it's interesting to think about how diamond would work in a computer."

" IT'S INTERESTING TO THINK ABOUT HOW DIAMOND WOULD WORK IN A COMPUTER."

The price tag for the diamond wire didn't reach engagement ring proportions, Hammel confirmed. It cost a mere $100, because it was made of synthetic, rather than natural, diamond. ■

AS A DEAN OF TUFTS UNIVERSITY, Ioannis (Yannis) Miaoulis made waves restructuring the School of Engineering's curriculum to enable freshmen to tackle real engineering projects. He went on to become a leading advocate for incorporating engineering into K-12 school curricula. Today, he is carrying on that work as president and director of the Boston Museum of Science.

Q&A YANNIS MIAOULIS

ME: At Tufts, you taught heat transfer using cooking, and fluid mechanics from a fish's point of view. Why?

I.M: When I took over as dean of engineering at Tufts, one-quarter of the engineering students were transferring to liberal arts. These students were in the top 7 percent of their high schools, with high SAT scores, and a B+ average as freshmen. They said they didn't find engineering interesting, that it was only about math and science. So we decided to introduce real engineering to freshmen. We gathered our best faculty and asked them to teach topics they were passionate about. Within the first year, we became the only engineering school in country where more students transferred into engineering from liberals arts than the other way around.

ME: You led the fight to make engineering part of the K-12 curriculum. Why should everyone learn engineering?

I.M: If you look at our world, 98 percent is designed and 2 percent is natural. The K-12 curriculum has it upside down, 98 percent natural and 2 percent design. Engineering helps children understand the other 98 percent of their world. It shows kids of all abilities and talents how to solve problems they care about, and makes math and science relevant.

ME: What about educators who say they have no time to teach more subjects?

I.M: When it comes to teaching engineering, there's no excuse left behind. At a presentation to science teachers, I was interrupted by a sixth grade teacher who was screaming that he had no time to finish a month-long unit on volcanoes, so how could he find time to teach engineering. So I asked him how much time he spent teaching how cars work, and how often kids find themselves in a volcano versus a car. Yes, the curriculum is full, but it's full of subjects chosen 120 years ago. It might be hard for teachers to change, but kids need to know about the world they live in.

ME: How did you go from a dean of engineering to running the Boston Museum of Science?

I.M: In 1993, the Boston Museum of Science merged with the Boston Computer Museum, and the new board had several engineers. They wanted engineering in the museum, and knew me from Tufts. At the time, I was having trouble finding the right partners to get engineering into K-12 classrooms. I realized that the museum was a wonderful platform to form partnerships, and became interested in the position.

ME: Many people support K-12 engineering as a way to interest students in math and science. Is that your view?

I.M: Do you know what bugs me? When people ask if engineering helps kids learn math and science. I would turn that around, and ask if math and science help kids learn engineering. If you look at direct benefits to society, engineering accounts for most of them. Yet we view it as the stepchild of science and math. Why is trigonometry more important than engineering? Trigonometry is there because it has always been there, and math is untouchable. Why?

ME: If schools taught engineering the way you suggest, how would it change things?

I.M: Simply understanding how the world around us works would enable us to make better decisions about the environment, policy, or even what to buy. But engineering also teaches problem solving, and this is a life skill. It teaches us to identify a need, try a solution, and if it doesn't work, come up with something new. That's why it's hard to teach, because teachers are used to having one correct answer. But in life, there are many possible solutions, not just one. That is what engineering teaches. **ME**

Two labs offer unique amenities for research technology—one to understand the stars and the other for deep-sea exploration.

BE OUR GUEST

The Sanford Underground Research Facility is located underground in a former gold mine, making it the perfect place for the Compact Accelerator System for Performing Astrophysical Research, which will soon be hosted there.

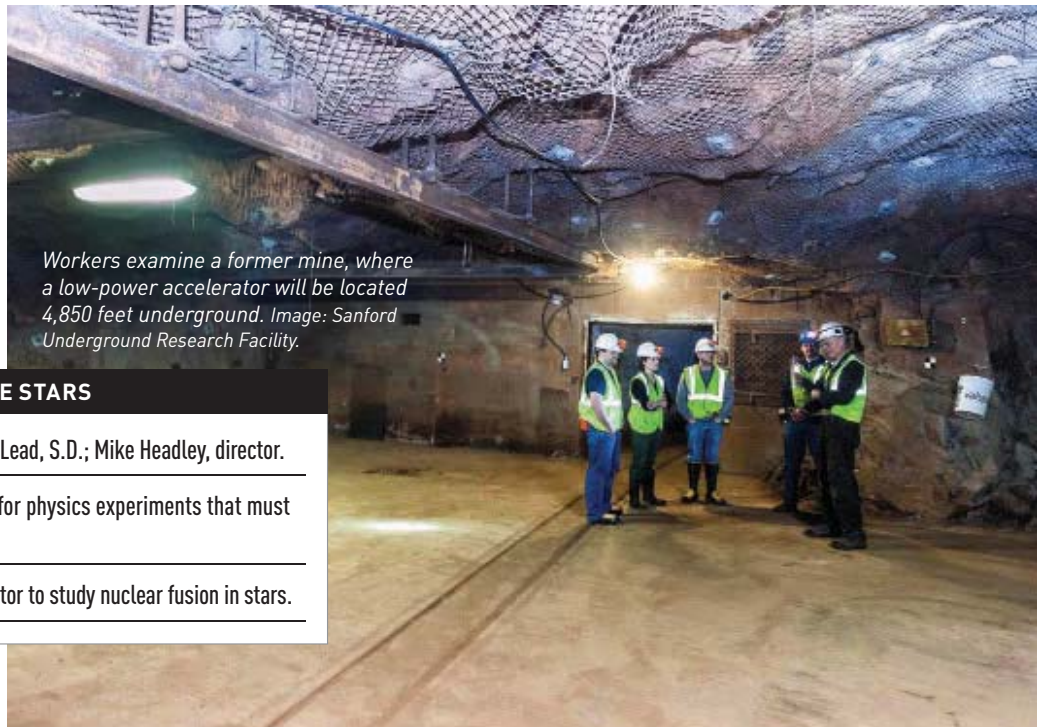
The low-power accelerator associated with CASPAR mimics nuclear fusion in stars, allowing the CASPAR researchers from the University of Notre Dame, South Dakota School of Mines, and Colorado School of Mines to study the process. Stars produce half of all the elements in the universe, so the process that creates elements should be understood, said Manoel Couder, assistant professor of experimental nuclear physics at the University of Notre Dame.

"We understand the recipe of how stars work," Couder said. "But we sometimes can't reproduce that recipe exactly in a computer model."

The experiments with the accelerator will help shape a computer model. The accelerator, which is slated to begin operation in January 2015, has been used in above ground experiments at Notre Dame for ten years, Couder said.

The underground location will bring a new accuracy to the study of nuclear fusion because of the lab's 4,850 feet of rock filtration, which nearly eliminates the cosmic rays that barrage the surface of the Earth and interfere with the study of nuclear fusion in stars, he added.

The laboratory site is expected to be ready by December 2014. While the site is under construction, Couder and Dan Robertson, an assistant professor in the Notre Dame department of physics, will renovate the accelerator for its move underground.



Workers examine a former mine, where a low-power accelerator will be located 4,850 feet underground. Image: Sanford Underground Research Facility.

TO INTERPRET THE STARS

THE LAB Sanford Underground Research Facility, Lead, S.D.; Mike Headley, director.

OBJECTIVE To provide an underground location for physics experiments that must be shielded from cosmic radiation.

DEVELOPMENT Location of a low-power accelerator to study nuclear fusion in stars.

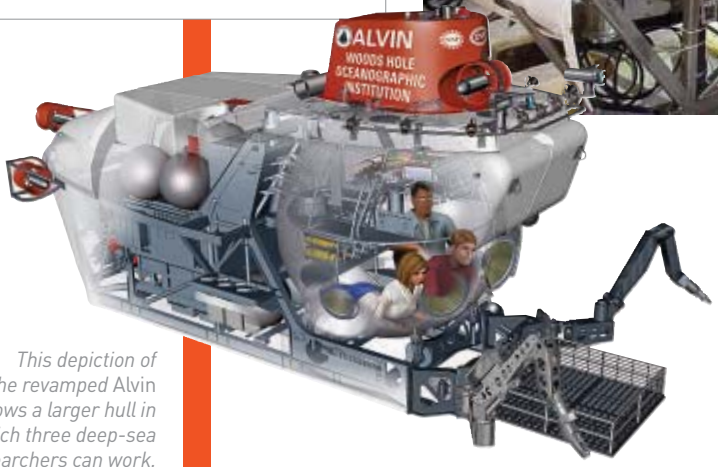
Workers disassembled Alvin *for renovation. The titanium personnel sphere has been separated from its foam pack.*

DEEP SEA DIVER

THE LAB Woods Hole Oceanographic Institution, Woods Hole, Mass.; Susan Avery, president and director.

OBJECTIVE Exploration and study of the ocean.

DEVELOPMENT The deep-diving submersible *Alvin* returns to work.



This depiction of the revamped Alvin *shows a larger hull in which three deep-sea researchers can work.*

After a three-year overhaul, the United States' deepest-diving research submersible, *Alvin*, has been cleared to return to work for its 50th year exploring the ocean's depths.

Alvin carries a pilot and two science observers on missions that last about eight hours. Woods Hole operates the U.S. Navy-owned sub for the National Deep Submergence Facility on behalf of a consortium of universities and research organizations conducting deep ocean research.

The submersible has been out of service since December 2010 undergoing an upgrade that included a larger hull with five viewports—rather than the previous three—for improved visibility and overlapping fields of view, a high-definition imaging system, and an improved command-and-control system, said Pat Hickey, *Alvin*'s manager and a chief test pilot.

Now *Alvin* can operate in depths of up to 12,400 feet. A certification dive to 14,700 feet comes later this year, said Steven Schulze, who certified the sub. He's the Naval Sea Systems Command's executive director of Undersea Warfare for the Department of the Navy.

Upgrades also included improvements to *Alvin*'s launch system and its storage hangar on board its support vessel, the *Atlantis*, Hickey said.

"By repositioning the manipulators we increased our work area, and the larger science basket allows us to load up to 400 pounds of exterior equipment and samples," he added. "An additional lateral thruster now allows the sub to hover like an underwater helicopter."

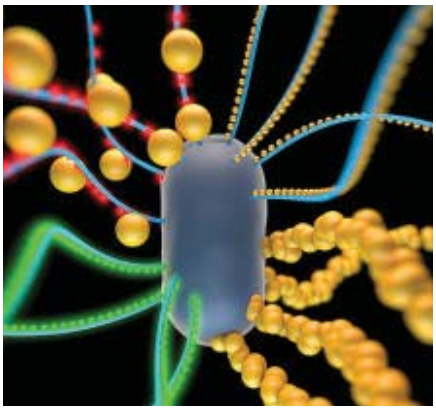
Among other trips for 2014, *Alvin* is scheduled to conduct researchers on three expeditions in the Gulf of Mexico to examine the impact of the *Deepwater Horizon* oil spill. They'll look at the effect of ocean acidification on deep-water corals and study deep-water oil seeps, Hickey said.

The second stage of *Alvin*'s upgrade depends on funding and on improvements to lithium-ion battery technology, he said. That stage will bring battery and hydraulics systems to 21,300-feet diving capability. **ME**

Alvin *prepares to be launched from its support vessel, the* Atlantis. *Images: WHOI.*

IT'S (KIND OF) ALIVE!

INSPIRED BY NATURAL MATERIALS SUCH AS BONE—A MATRIX of minerals and other substances, including living cells—engineers have coaxed bacterial cells to produce biofilms that can incorporate nonliving materials, such as gold nanoparticles and quantum dots.



A rendering of a living material, in this case a bacterial cell engineered to produce amyloid nanofibers that can carry quantum dots (shown in red and green) or gold nanoparticles. Image: Yan Liang

These living materials, created by researchers at the Massachusetts Institute of Technology in Cambridge, can combine the advantages of live cells with those of nonliving materials. The cells, for instance, can respond to their environment, produce complex biological molecules, and span multiple length scales. Nonliving materials can add functions such as conducting electricity or emitting light.

Materials developed by this approach could one day be used to design solar cells, self-healing materials, or diagnostic sensors, said Timothy Lu, an assistant professor of electrical engineering and biological engineering at MIT.

"Our idea is to put the living and the nonliving worlds together to make hybrid materials that have living cells in them and are functional," Lu said. "It's an interesting way of thinking about materials synthesis, which is very different from what people do now, which is usually a top-down approach."

Lu and his colleagues worked with the bacterium *Escherichia coli* because it naturally produces biofilms that contain so-called curli fibers—amyloid proteins that help *E. coli* attach to surfaces.

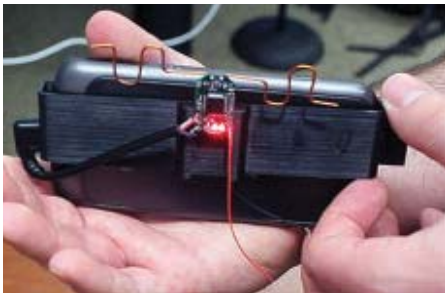
Each curli fiber is made from a repeating chain of identical protein subunits called CsgA, which can be modified by adding protein fragments called peptides. These peptides can capture nonliving materials such as gold nanoparticles, incorporating them into the biofilms.

By programming cells to produce different types of curli fibers under certain conditions, the researchers were able to control the biofilms' properties and create gold nanowires, conducting biofilms, and films studded with quantum dots, or tiny crystals that exhibit quantum mechanical properties, Lu said.

The researchers also engineered the cells so they could communicate with each other and change the composition of the biofilm over time, he said. ■

LOW-POWER GESTURE RECOGNITION

Mute the song playing on your smartphone in your pocket by flicking your index finger in the air? This kind of gesture control for electronics could soon become an alternative to touchscreens, said the researchers who have built a low-cost gesture recognition system.



Gesture recognition technology works with the device, like this cell phone, still in the user's pocket. Photo: University of Washington

The system, from computer scientists at the University of Washington in Seattle, runs without batteries and lets users control their electronic devices with simple hand movements. The devices don't even have to be in immediate view, said Shyam Gollakota, an assistant professor of computer science and engineering who helped build the system.

The system can be implemented for less than a dollar and doesn't require a battery, he said.

The prototype, called AllSee, uses TV signals as both a power source and the means for detecting a user's gesture command.

The researchers built a small sensor that can be placed on an electronic device such as a smartphone. The sensor uses an ultra-low-power receiver to extract and classify gesture information from wireless transmissions within the air.

When a person gestures with the hand, it changes the amplitude of the wireless signals that always hover around. The AllSee sensors recognize unique amplitude changes created by specific gestures, Gollakota said.

The sensors harvest power from wireless transmissions, thus using three to four times less power than existing gesture recognition systems. This allows for mobile devices to always have the gesture technology on, he said. ■

DEVELOPMENTS IN AIR TRANSPORTATION

BY RICHARD W. ROBBINS, PRESIDENT, TRANSCONTINENTAL & WESTERN AIR INC., NEW YORK.

The head of the company that would become Trans World Airlines was an ASME member who commented on the new crop of commercial airplanes eighty years ago.

LOOKING BACK

Retractable landing gear and low-wing, twin-engine monoplanes were emerging commercial designs when this article was printed in May 1934.

This year has seen the arrival of the ten-passenger Boeing 247, a new departure in transport aircraft. It led the way in the change from the all-metal cantilever high-wing monoplane type of design (Ford, as example) to the low-wing type. It also embodies a new type of metal construction in that the skin of the fuselage and wing is smooth and carries a share of the structural stress. The low-wing feature is essential to efficient employment of a retractable landing gear in the monoplane type. This plane has a cruising speed of approximately 170 mph, and in scheduled operation has maintained a station-to-station speed of 155 mph. Improved chairs, wider aisle, and considerably lower noise level than in the Ford have all combined to make this airplane popular with air travelers.

Another new transport to be welcomed by the public this year has been the new Curtiss-Wright "Condor." This 15-passenger airplane is a biplane, of metal construction and fabric covered, with retractable landing gear. It has a cruising speed of 140 mph. It is the first airplane to be scientifically soundproofed, with the result that the noise level in the passenger cabin is lower than in any other passenger transport previously operated.

It is noteworthy that both the Boeing 247 and the "Condor" are bi-motored airplanes. In this respect the Boeing and the Curtiss-Wright companies have led the way toward replacement on a large scale of tri-motored aircraft with bi-motored aircraft, which type promises to be more efficient aerodynamically and more economical to operate. The Boeing 247 is powered with direct-drive supercharged Pratt & Whitney Wasps. The "Condor" is powered with geared unsupercharged Wright Cyclone F's. ME

A STREAK BY ANY NAME

On May 26, 1934, the diesel-electric Pioneer Zephyr, a streamlined stainless steel train owned by the Chicago, Burlington, and Quincy Railroad, traveled more than 1,000 miles from Denver to Chicago averaging an unprecedented 77 mph and reaching a top speed of more than 112 mph, near the land speed record at the time. The train, built by the Budd Co., became nicknamed "The Silver Streak." It was designated an ASME Historic Mechanical Engineering Landmark in 1980.

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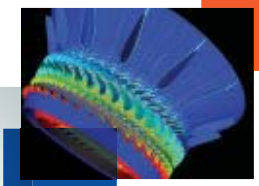
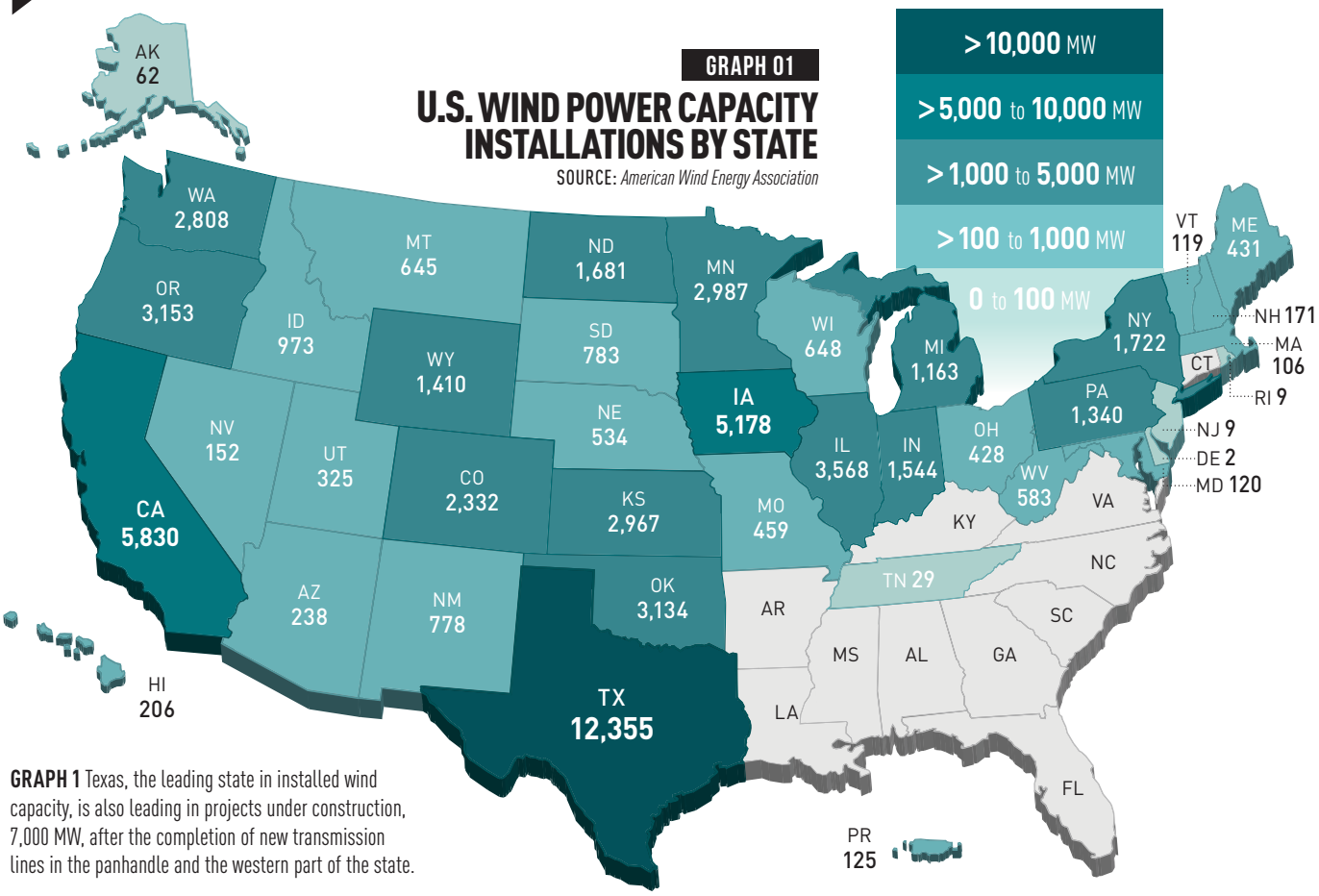




GRAPH 1 Texas, the leading state in installed wind capacity, is also leading in projects under construction, 7,000 MW, after the completion of new transmission lines in the panhandle and the western part of the state.

BY THE NUMBERS: WIND ENERGY SET TO SOAR

Record-setting number of wind farms were being built in 2013.

The year 2013 saw construction start on an unprecedented number of wind farms thanks to the extension of a federal-government production tax credit that had been set to expire at the end of 2012, according to an industry association report. It offered a 2.3-cent credit for each kilowatt-hour of electricity generated by renewable energy resources, including wind.

According to the American Wind Energy Association, which regularly tracks the market, installed U.S. wind capacity reached 61,108 megawatts at the end of 2013, with the addition of 1,084 MW within the year itself.

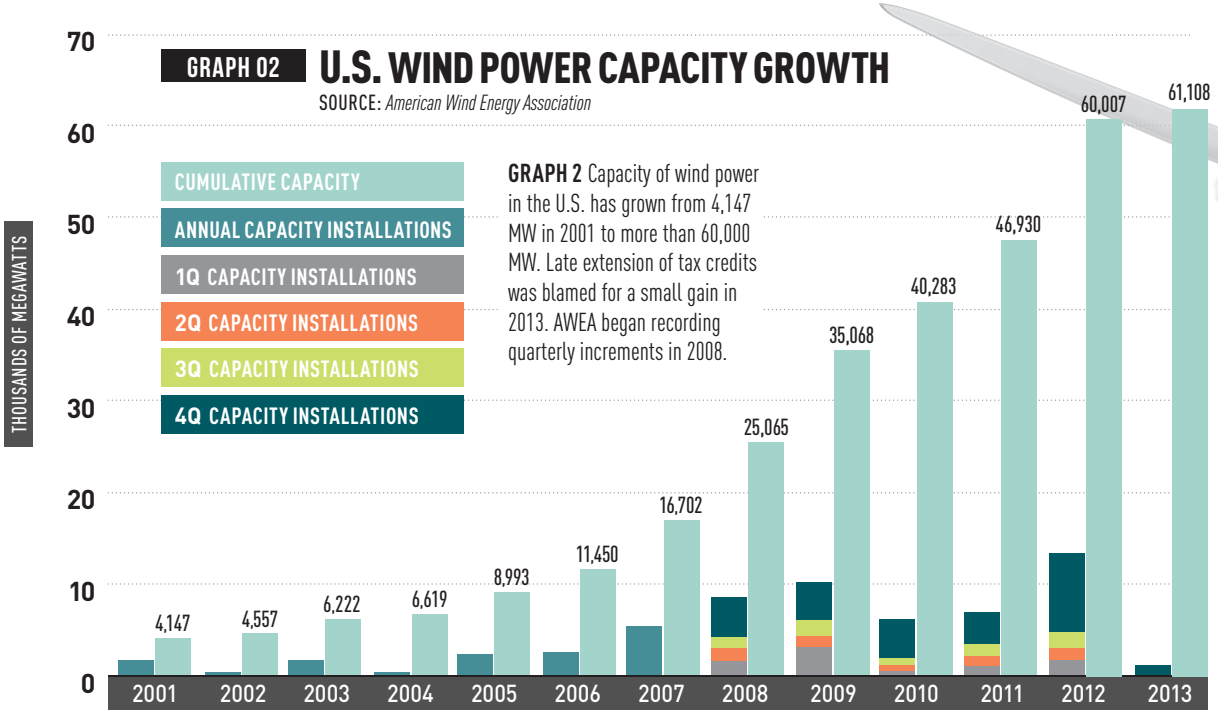
Construction, as opposed to completions, presented a different picture. At the end of 2013, wind energy projects set to total 12,300 MW in capacity were actively under construction across 20 states, including 10,900 MW that started construction during the fourth quarter of 2013. There were more than 90 projects actively under construction in 2013, the most wind projects ever being built at a single time, according to the AWEA U.S. Wind Industry Fourth Quarter 2013 Market Report.

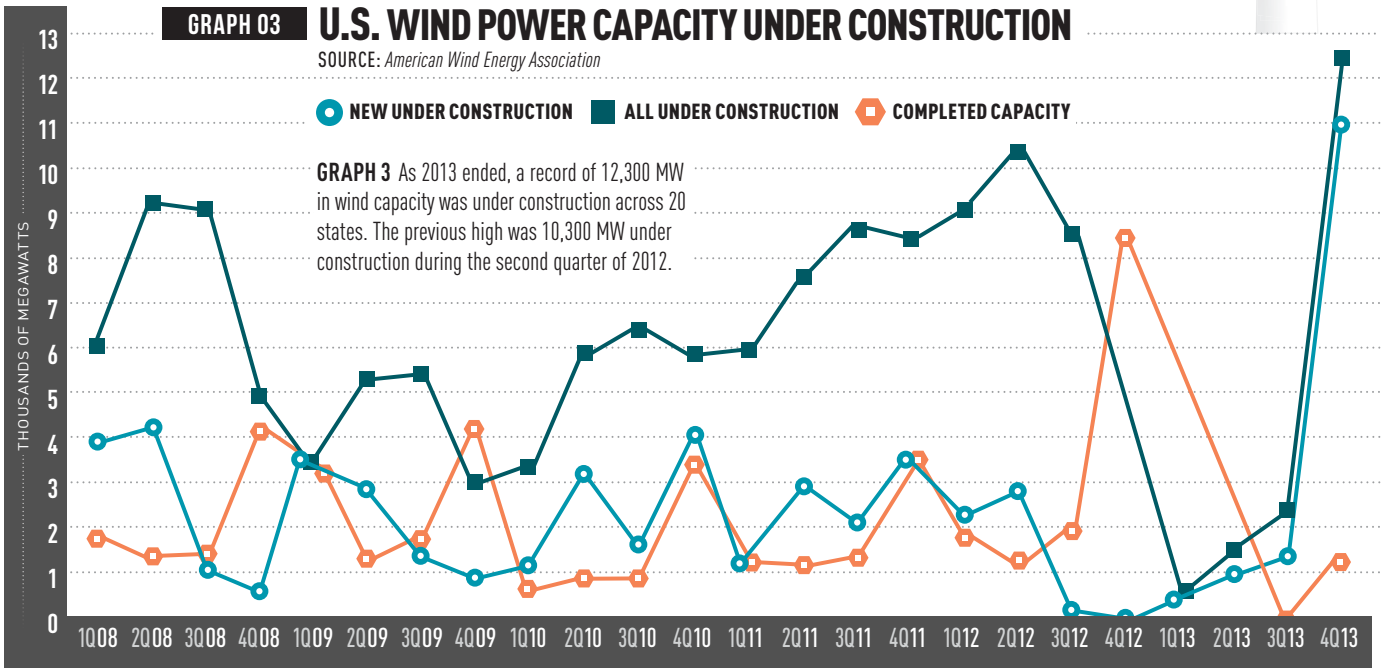
At the end of 2012, the U.S. had 60,007 MW of wind energy capacity, up considerably from 46,930 MW for 2011. Total U.S. nameplate capacity in 2001, the first year for which the report was published, was 4,147 MW.

Record installation, or completion, of 13,133 MW in wind-power capacity marked the year 2012. About 92 percent less capacity came on line in 2013. The report attributed the decline to the late extension of the production tax credit and of an investment tax credit that also aided wind energy producers. The Internal Revenue Service extended those credits in April 2013.

Projects are currently being built in more than 20 states, and Texas leads with 7,000 MW under construction. Iowa, with 1,050 MW under construction, is a distant second. Texas is adding wind capacity after the 2013 completion of the Competitive Renewable Energy Zone transmission lines in the panhandle and the western part of the state.

Other top states for 2013 building activity include Kansas, with 722 MW, and North Dakota, with 632 MW under construction.





The cost of wind energy fell by 43 percent over the past four years thanks to technological advancements and to a stable U.S. wind policy. Utility companies looking to take advantage of those low prices as well as to diversify their portfolios and to hedge against future fuel volatility signed a record number of long-term contracts in 2013, according to the report.

At least 60 wind-power purchase agreements were signed or announced in 2013, totaling nearly 8,000 MW, with 5,200 MW yet to start construction. Both Google and Microsoft signed long-term wind-power purchase agreements to run Texas data centers, according to the AWEA.

The AWEA reported separately that total generation from wind power last year topped 4 percent of the U.S. power grid for the first time. According to the association, wind sources generated 4.13 percent of all the electricity in United States in 2013.

According to the U.S. Energy Information Administration, 30 percent of all new generating capacity for the past five years has been delivered by wind. **ME**

JEAN THILMANY

F30

We tend to think of infrastructure as roads and bridges, water mains and sewers. But power plants are every bit as much infrastructure. And the decision of whether to maintain or replace, which must be made when bridges or tunnels reach the end of their lives, is a necessary one to determine with the power infrastructure as well.

The United States has a fleet of 100 nuclear power plants that provide nearly 100,000 megawatts of nameplate capacity and about 20 percent of the net generation. That nuclear fleet has provided many benefits: It is the most reliable source of electrical generation with stable generation costs. Nuclear plants emit no carbon dioxide, and they have a small land footprint compared to other carbon-free energy sources.

Most of those nuclear plants were built in the 1970s and 1980s and each was given a forty-year operating license from the U.S. Nuclear Regulatory Commission. Because of proactive efforts to create and comply with the existing License Renewal Rule (for 40 to 60 years of plant operation), some 53 reactors that reach their 40 years of licensed life by 2020 can now be kept online representing 45,000 MWe of generating capacity (equivalent to the total electrical generation from all sources in 2010 of California and New York). Similarly, the existing License Renewal Rule supports the potential for an additional 45 reactors to reach 40 years of licensed life by 2030 and then continue to produce electricity representing another 51,000 MWe of generating capacity (equivalent to the total electrical generation in 2010 of Pennsylvania and Alabama). Two more have licenses that expire after 2030.

The question to maintain or replace this nuclear generating capacity is complicated by the difficulty in building new plants. New plants are multi-billion-dollar investments. It has been difficult to convince capital markets to make that money available at reasonable costs. (The generating capacity that has been added in the U.S. in recent years has been in the form of natural gas and wind power facilities, which are smaller and easier to finance.)

With increasing carbon restrictions and the growing demand for electricity, reliable, carbon-free baseload electricity generation is more important than ever for the United States.

Nuclear's next 40 years

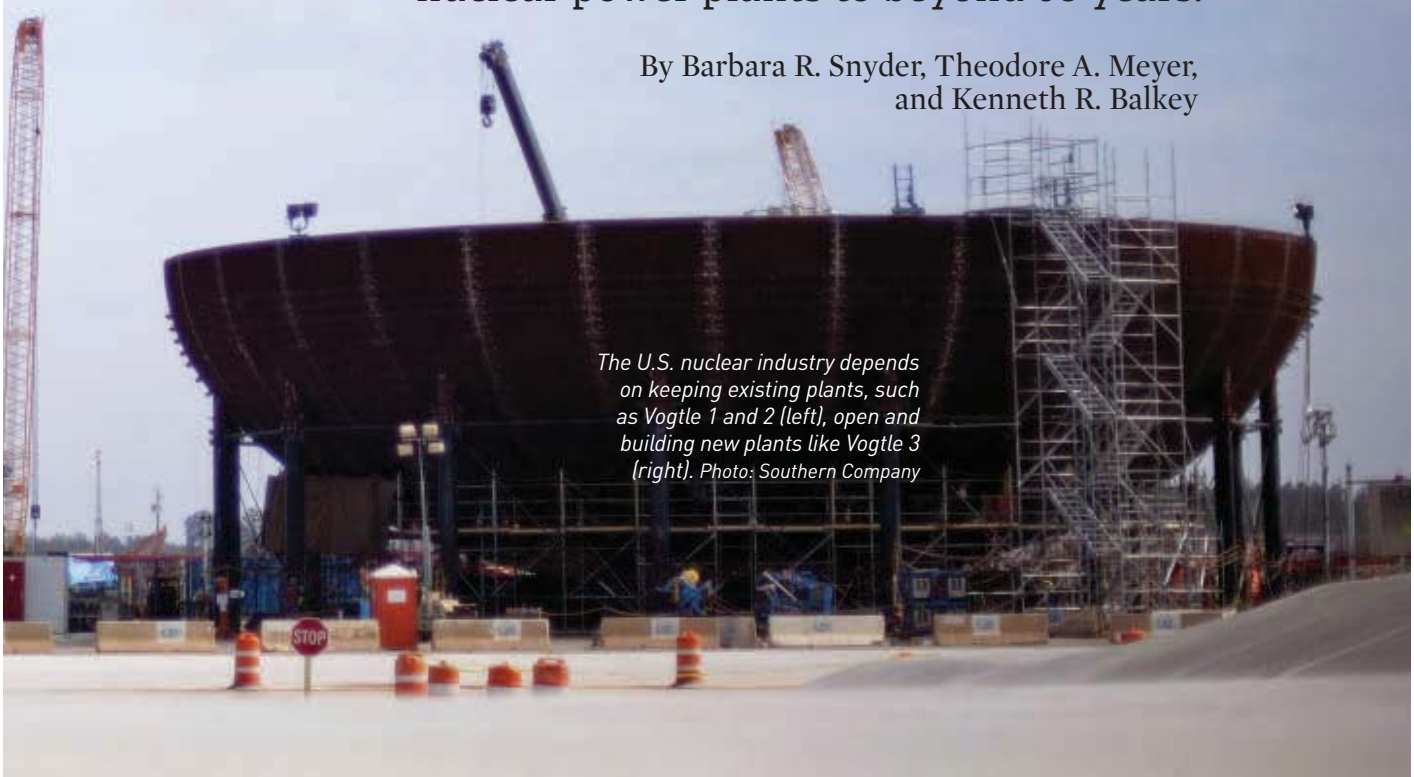
To ensure a reliable source of electric generation, we must take steps to continue to operate nuclear power plants to beyond 60 years.

By Barbara R. Snyder, Theodore A. Meyer, and Kenneth R. Balkey

Nuclear energy, which currently supplies 20 percent of the nation's electricity, is the only electricity source that can fulfill that need. Because of the long lead times for new nuclear installations, we must look to our current nuclear operating fleet, which has been providing energy safely for decades, to meet those energy demands while also considering how additional nuclear plants can bolster our nuclear energy supply into the future.

With the expiration of their 40-year licenses imminent, most commercial nuclear plant owners either have requested or are expected to request a twenty-year extension for their operating permits. Seventy three units have already had their licenses renewed.

But looking farther into the future, it is becoming clear that an extension of 20 years is not sufficient. To continue to have



The U.S. nuclear industry depends on keeping existing plants, such as Vogtle 1 and 2 (left), open and building new plants like Vogtle 3 (right). Photo: Southern Company

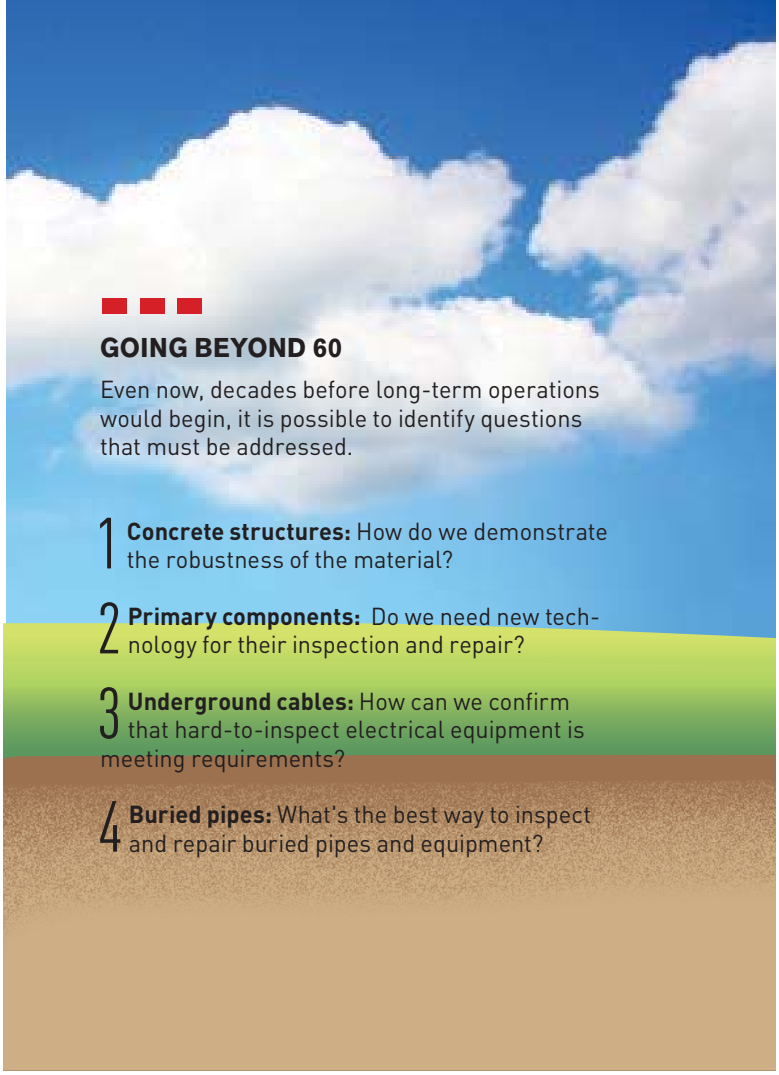
nuclear power as part of the energy mix, stakeholders in the U.S. nuclear industry must begin to take steps to ensure that plants are able to operate for at least 80 years, which is called long-term operation. Some of the lessons learned by the U.S. nuclear industry in preparing plants to operate out to 80 years can be applied to other plants in other parts of the world.

To receive their 20-year license extensions, nuclear power plants had to address a number of challenges. In particular, there were questions about how material properties change as structures age in difficult environments. Such materials-related questions included metal fatigue, the effects of borated water on stainless steel components, the integrity of welds, especially the reactor vessel, and the potential for corrosion in the containment liner.

Fortunately, the nuclear industry began working on the outstanding questions concerning license renewals well in advance. Indeed, while the first license extension was approved only in 2000, the initial generic assessment of life extension was completed by the Electric Power Research Institute in 1979 and the first pilot plant life-extension project—for Dominion Generation's Surry plant in Virginia—was completed by EPRI in 1986. After this work was completed, the initial License Renewal Rule (to 60 years) was issued by the U.S. NRC in 1991, and after four years of substantial interaction with the nuclear industry, substantive changes were made to the License Renewal Rule in 1995.

While changes to the rule were pending, work began on the development of the first License Renewal Application. This was done to extend the operating license for two units at Constellation's Calvert Cliffs Nuclear Power Plant, which became the first facility to receive a renewed license.

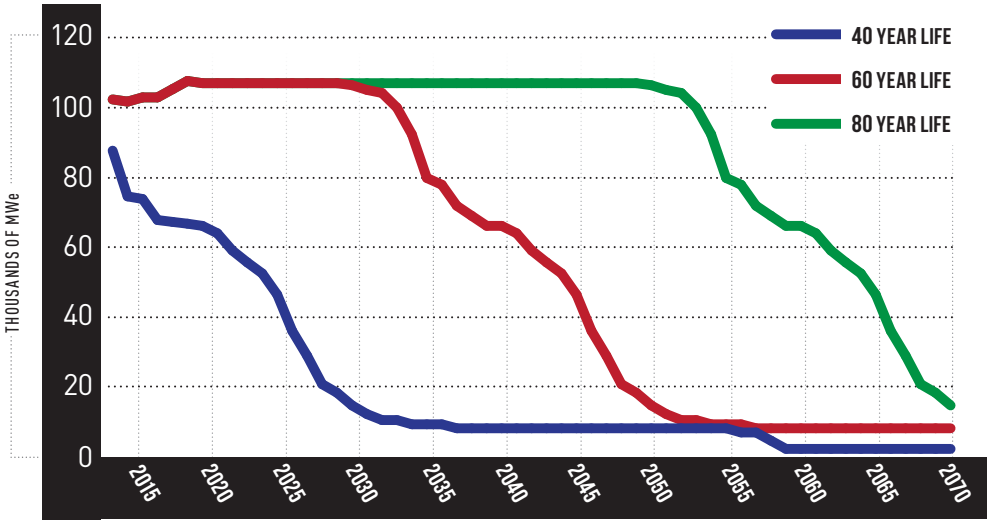
In addition to all these steps, the pertinent ASME Section XI Boiler and Pressure Vessel Code requirements were modified to support license renewal. Similar steps, plus the development of new solutions for emerging aging issues, will need to be applied for second license renewals, extending the operating life of these reactors to 80 years. In recent years, engineers, scientists, regulators, and others have



GOING BEYOND 60

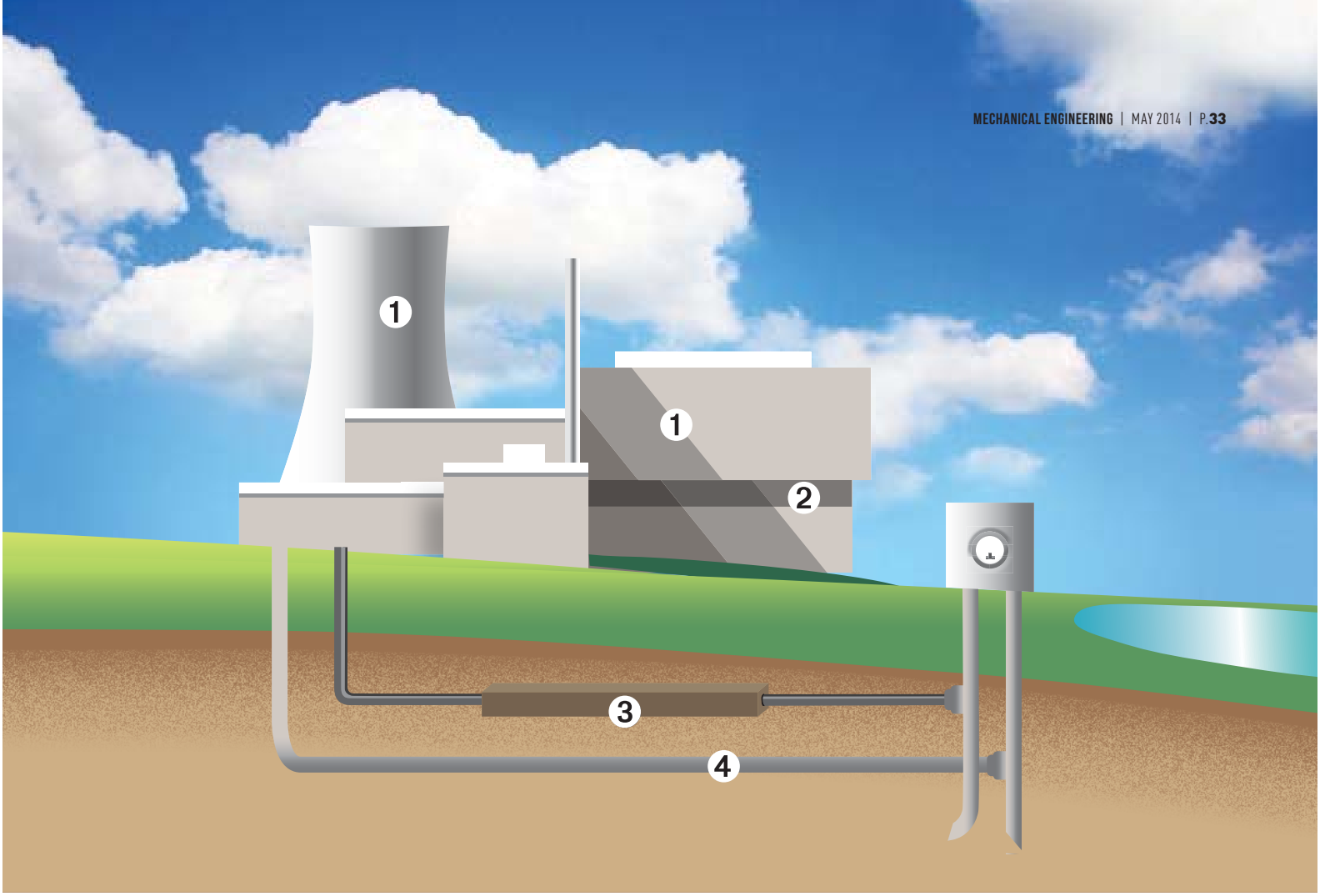
Even now, decades before long-term operations would begin, it is possible to identify questions that must be addressed.

1. **Concrete structures:** How do we demonstrate the robustness of the material?
2. **Primary components:** Do we need new technology for their inspection and repair?
3. **Underground cables:** How can we confirm that hard-to-inspect electrical equipment is meeting requirements?
4. **Buried pipes:** What's the best way to inspect and repair buried pipes and equipment?



PROJECTED NUCLEAR CAPACITY FROM U.S. PLANTS (CURRENTLY OPERATING AND UNDER CONSTRUCTION) TO 2070

Even with existing nuclear plants operating to 60 years and starting up new plants currently under construction, the sector's capacity will decline starting in the 2030s. An 80-year life sustains nuclear power until additional new plants can be built.



begun to look at the challenges that might arise for such long-term operation. What will we need to do to keep nuclear power plants that were built in the 1970s safe and operational in the 2050s?

We need to evolve plant aging management programs to address continued and emerging aging issues. Some of the technical areas that require more focused attention than currently needed are already clear.

Even now, 20 years before long-term operations would begin, it is possible to identify some of the major questions confronting aging nuclear plants.

■ *What new technologies are required for the inspection, repair, or replacement of primary components?* The integrity of the reactor vessel, reactor internals, and primary side piping is an important technical area for long-term operation. These components are part of the plant's defense in depth and are exposed to both high temperatures and radiation. These components are inspected and managed under existing plant programs. Further investigation can help reduce uncertainties for long-term operation. The areas for further investigation include the development of advanced repair techniques and new materials. Ultimately, it will have to be determined whether continued inspection and potential repair of these components will be sufficient.

■ *How do we demonstrate the robustness of concrete for long-term operation?* The concrete containment building has had exposure to environments that could cause chemical interactions and induce strain. The internal support structures have had prolonged exposure to high temperatures and radiation that could impact strength. Lessons learned from recent operating experience involving concrete structures have also demonstrated the inability of a plant to continue to operate if the containment structure is damaged. Further investigation is needed for long-term operation to demonstrate the strength of concrete and the ability to inspect through concrete and rebar structures. As part of the defense-in-depth of a plant, determining the merit of inspection and repair versus replacement of concrete structures is imperative for long-term operation.

■ *How do we confirm that the requirements for electrical equipment are being met for long-term operation?* Nuclear plants have near-term license renewal commitments to develop and implement Cable Aging Management Programs to continue to operate beyond the initial license of 40 years. They also have to address submerged cables, which are typically part of electrical power cable systems that are buried underground and may be partially exposed to water or moisture. Unfortunately, some of these cables may not have been designed to be submerged, and they can be difficult to access for inspection. For long-term operation, the ability for all cables to perform their function may need to be considered. Certainly, plant operators need to confirm that the requirements for electrical equipment are being met during the extended period of operation.

■ *What are the best ways to inspect and repair or replace buried equipment?* It is imperative that underground piping systems, which typically transport cooling water, can be inspected. It is now known that damage in the corrosion-resistant piping coatings can cause small leaks. While such leaks may not have created safety hazards (because there is still sufficient cooling for the plant) those small leaks can introduce exposure to radiation, even though the levels are so slight as to be below regulatory limits. The discovery of these leaks has led to a reexamination of the buried-equipment issue to determine changes to the design, maintenance, and inspection of buried piping. In addition, companies are developing technologies for monitoring the corrosion on the soil side of the piping and installation of cathodic protection to prevent corrosion of piping and structures. The issue likely will rise to greater importance over the course of long-term operation.

■ *How do we improve nuclear power plant performance and economics?* The additional challenge of economic issues and plant performance encompasses upgrades to instrumentation and control systems. Advanced technologies for long-term operation will enhance plant workers' job performance by improving the human-system interface for the main control room, routine maintenance activities, and plant outages. Operational efficiency is important, and when prioritizing upgrades, nuclear plants place the highest priority on those that are safety related, followed by those that improve efficiency and economics.

Just as the nuclear industry began tackling the issues underlying license renewal decades in advance, the industry today is proactively addressing the technical areas for long-term operation. It should not require another 20 years before the second renewal of an operating license is approved, because the regulatory structure, for the most part, exists today, and plant owners understand the requirements for management of the aging of nuclear plants. The U.S. Nuclear Regulatory Commission expects that the first subsequent license renewal application to go from 60 to 80 years of operation will be submitted in 2018. The NRC and industry groups must assure themselves that they have identified any changes in aging issues and have defined or developed methods to manage the anticipated aging in the 60-year-and-beyond time period.

Industry resources must commit to demonstrate the necessary understanding of any significant changes in aging issues beyond 60 years. Also, the U.S. NRC must adjust its guidance for compliance with regulatory requirements to account for any industry findings regarding aging management beyond 60 years.

Therefore, it is important that industry bodies, such as the Electric Power Research Institute and utility owners groups, and suppliers—along with the individual utilities and plants that are the leading candidates for operation beyond 60 years—collectively assure themselves and the U.S. NRC that the pertinent aging issues are identified and appropriate aging management methods are defined or created. It is also important that the nuclear utility industry interact with the U.S. NRC to demonstrate that the plants can be operated safely beyond 60 years.

IT'S A TESTAMENT TO THE WORKMANSHIP EVIDENT IN THE CONSTRUCTION OF THESE PLANTS THAT WE CAN TALK ABOUT EXTENDING THEIR LICENSES TO THE 2050s.

Associated government agencies are doing their part. The Department of Energy's Light Water Reactor Sustainability initiative has a multi-year program with three pathways: materials aging and degradation, advanced instrumentation, information, and controls, and risk-informed safety margin characterization. The DOE is also collaborating with other industry programs, such as the Electric Power Research Institute Long-Term Operation Program, Nuclear Energy Institute, and the U.S. Nuclear Regulatory Commission.

ASME has a longstanding role in support

Plants such as the H.B. Robinson 2 Nuclear Station in Hartsville, S.C., are licensed to operate for 60 years. The necessity of long-term operation could see their service life extended even further.

As nuclear power plants enter long-term operations, the inspection, testing, and repair of components will be more critical than ever. Standards may need to be modified to reflect this.

of the safe operation of nuclear plants, and the society and its volunteers are working to make long-term operation a viable option.

One area that was addressed for first license renewals was the references to time frames in the ASME BPV Code Section XI requirements dealing with nuclear power plants. These requirements were put in place at a time before the need for extending the life of reactors—let alone long-term operation—was widely recognized.

But there was more to be done than just removing those references to a 40-year time frame. The ASME BPV Code Section XI Special Working Group on Nuclear Plant Aging Management was formed in the 1990s to study the technical, economic, and regulatory aspects of extending the operational life of nuclear power plants. The group was also charged with determining which changes were needed in the Section XI rules to manage the aging of systems, structures, and components of nuclear plants.

Similarly, new or modified standards or Code Cases need to be a considered for incorporating inspection, testing, and repair of components in aging nuclear plants. Several significant aging issues have already been addressed by changes to ASME Boiler Code Standards. Some examples include **Code Case N-638:** *Ambient Temperature Temper Bead Welding* and **Code Case N-722-1:** *Visual Examination Requirements for Susceptible Welds,* which provides visual examination requirements for Alloy 600/182/82 locations, requiring insulation removal. **Code Case N-770**: *Butt Weld Inspection Requirements* and **Code Case N-754:** *Optimized Overlays* address crack repair methodologies.

To support the continued operation of nuclear power plants for long-term operation, the ASME BPV Code Section XI Special Working Group on Nuclear Plant Aging Management has the charter to recommend additions or changes to current ASME BPV Code Section XI requirements.

When the existing fleet of nuclear plants was designed, it was expected that they would one day be replaced. It's a testament to the fine workmanship evident in the construction of these plants that we can even be talking about extending their licenses to the 2050s. They were truly built to last.

In order to achieve long-term operation, the reactors we have need to be taken care of, and the regulatory, standards, and management programs that govern them now need to continue to evolve. Fortunately, that work is being done, and we expect that these reactors will provide us with safe, carbon-emissions-free electricity for decades to come. **ME**

BARBARA R. SNYDER, P.E., is a principal engineer at Westinghouse Electric Company in Cranberry Township, Pa., and secretary of the ASME Boiler & Pressure Vessel Code, Section XI, Special Working Group on Nuclear Plant Aging Management. **THEODORE A. MEYER** is the chief engineer of engineering services at the Westinghouse Electric Company in Cranberry Township, Pa., and chair of the ASME Boiler & Pressure Vessel Code, Section XI, Special Working Group on Nuclear Plant Aging Management. **KENNETH R. BALKEY**, P.E., is a consulting engineer at Westinghouse Electric Company in Cranberry Township, Pa., and senior vice president, ASME Standards and Certification. He is also adjunct faculty lecturer in the University of Pittsburgh nuclear energy program.

NUGENIA engages stakeholders in the European nuclear industry to research materials aging and performance.

A global effort

The issue of long-term operation isn't limited to the United States and its unique regulatory and commercial environment. Efforts are ongoing in Europe and elsewhere.

The International Atomic Energy Agency and the Nuclear Energy Agency of the Organization for Economic Co-operation and Development have assembled working groups that span the international nuclear industry to draw conclusions related to long-term operation and aging management.

The IAEA standards provide a consistent and reliable means of ensuring the effective fulfillment of safety obligations. These standards are applied by various regulatory bodies and operators around the world to enhance safety in nuclear power generation. When addressing long-term operation, two IAEA safety standards are typically used: Periodic Safety Review of Nuclear Plants, Safety Guide and the IAEA Safety Report Series No. 57. Each has multiple sections dealing with evaluating the continued operation of nuclear power plants.

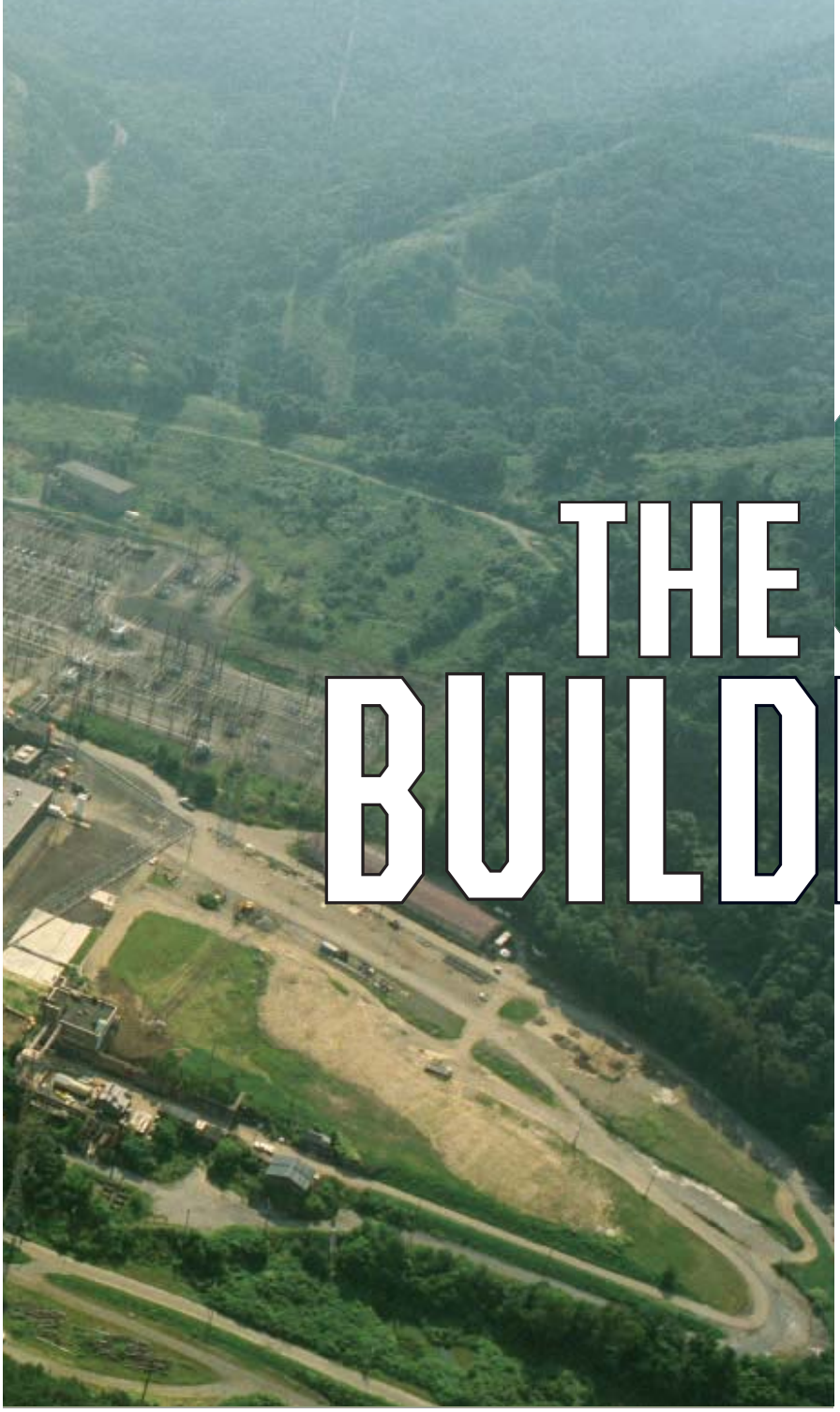
In Europe, there is a long history of collaborative efforts in materials performance and aging research and development as one technology area of **NUGENIA**—The Nuclear Generation II & III Association. The NUGENIA collaboration is supported by the European Union and engages most stakeholders in the European nuclear business. Research on reactor materials aging, cable and polymer aging, and concrete aging will support decisions for long-term operation. ■

Beaver Valley Nuclear Power Station in Shippingport, Pa., generates 30 times the power of the first U.S. commercial plant. Original site of the dismantled Shippingport Atomic Power Station reactor is at right.
Photo: FirstEnergy Corp.

Nuclear power began out of military necessity. The first—uncontrolled—uses were the blasts that devastated Hiroshima and Nagasaki. A decade later, the military used nuclear power for propulsion in the USS *Nautilus*.

But from the beginning, that unprecedented power was also seen by engineers and researchers as having the potential to be harnessed for constructive ends. Controlled fission reactions could be the heat source for large-scale thermal plants that could power cities. That vision was in the minds of the engineers who designed and built the first commercial nuclear power plant in the United States, which went on line at Shippingport, Pa., in 1957.

It was no coincidence that the civilian use of nuclear power grew hand in hand with ASME Codes and Standards. The engineers who designed the pressurized water-cooled reactors at the heart of the *Nautilus* and Shippingport power plant, which is now an ASME



THE CODE BUILDERS

The first nuclear power plants required the **largest pressure vessels ever built** at that time. To ensure they would be safe required a new section of the **ASME Boiler and Pressure Vessel Code.**

By Sidney Bernsen, Bryan Erler, Dana K. Morton, and Owen Hedden

Historic Mechanical Engineering Landmark, recognized that they were essentially pressure vessels. As a result, they designed those reactors in a way consistent with the existing ASME Boiler and Pressure Vessel Code rules.

That approach worked, but it was clear from the outset that it wouldn't work indefinitely. The Shippingport reactor had an output of 60 megawatts of electricity, and its pressure vessel was the largest ever built at the time. Sam Cerni, a design engineer who worked on the Shippingport core, recalls that the reactor operated at 2,000 psia and was designed for 2,500 psi.

The vessel, designed and fabricated by Babcock and Wilcox, weighed 153 tons, had an inside height of 32 feet, an inside

diameter of 109 inches and the wall was about 8 inches thick.

To be economically competitive, the output of nuclear reactors would need to be substantially increased beyond Shippingport's nameplate capacity of 60 MW. But the fabrication capabilities of the ASME Code at the time put limits on the potential size of pressure vessels and plants using the existing Code rules. There also were thermal stress conditions and radiation effects unique to nuclear plants, and they were not adequately treated by the Code as it existed in the 1950s.

Thus there was a need for a revised set of design and fabrication rules to facilitate the development of safe, economically competitive water-cooled reactors contained in pressure vessels. These rules were codified in the first edition of the ASME Boiler and Pressure Vessel Code Section III, which was completed in 1963 and published 50 years ago this year, in 1964.

Technicians in 1957 watch an industry in the making. The reactor dome is lowered into place over the reactor pit at the Shippingport Atomic Power Station. The unit had a nameplate capacity of 60 MW. Photo: FirstEnergy Corp.

From the outset, both regulators and industry realized that the best way to develop many of the needed rules for the design, construction, and operation of nuclear facilities was the national standards consensus process. This process, followed by the American National Standards Institute and other recognized standards-issuing bodies such as ASME, brings together the expertise of individuals from government, industry, academia, and other stakeholders. The general public is invited to read and comment on the proposed drafts of standards.

By the 1950s this process had a long history of assuring public safety and was encouraged as a way to assure that the best expertise was applied to the development of practical and necessary rules.

Frank Williams was an engineer who was involved in the Section III process from the start. In a 1990 book, *The Code*, author Wilbur Cross quotes Williams at length. Williams recalled how ASME's interest in conventional pressure vessel equipment led to an interest in developing nuclear codes and standards.

"In the early days of nuclear involvement," Williams said, "we at Taylor Forge, along with several other companies, such as Kellogg and Westinghouse, made a lot of equipment in the form of pipe fittings, piping, nozzles, and the like for an experimental plant and for the very first nuclear power plant at Shippingport. At first we talked informally about this subject, and then proposed the course of action we felt we should take. The result was the formation of a study committee."

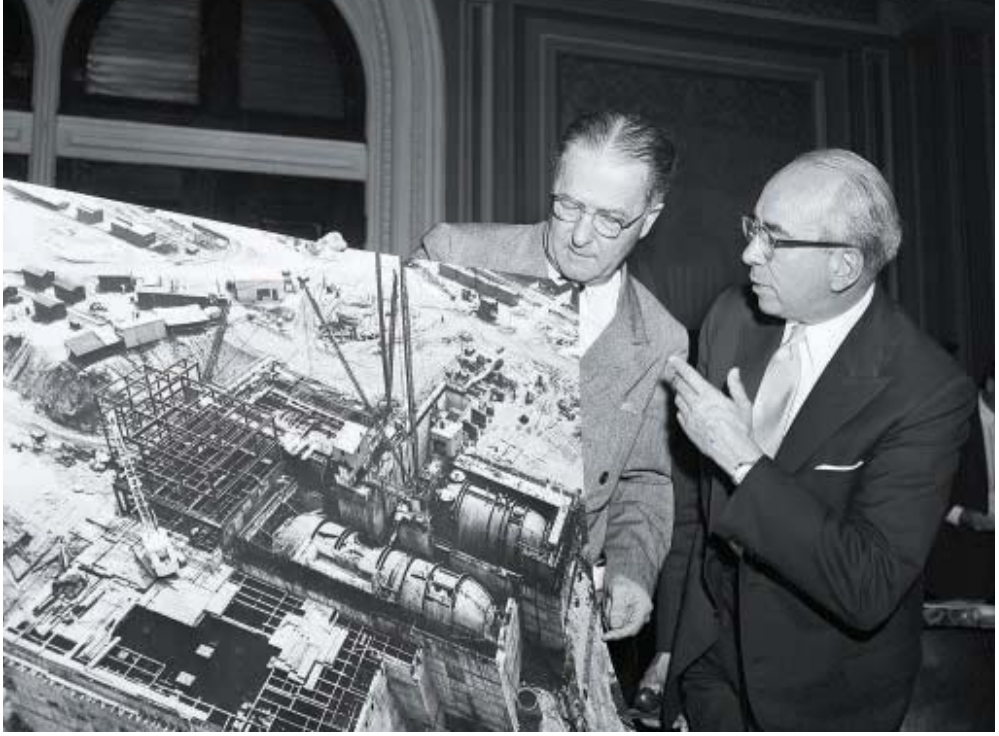
A meeting in Tulsa led to the formation of a separate ASME Boiler and Pressure Vessel Code subcommittee in 1955, and Williams, because of his knowledge of the codes, was its first chairman. The nuclear Code, Williams wrote, took the name Section III, because that had once designated a section of the Code for locomotive boilers, and as he put it, that section "had become defunct."

Another volunteer who served on the Subcommittee on Nuclear Power when Section III was approved in the 1960s is Keith Wichman, now a retired engineer who still participates in the activities of the nuclear Code.

"The ASME Subcommittee on Nuclear Power was formed to develop rules for the construction of nuclear vessels," Wichman wrote in an e-mail. "The first edition of Section III drew heavily upon the Navy document, 'Tentative Structural Design Basis for Reactor Pressure Vessels and Directly Associated Components,' which was issued in a revised version in 1958. The contents of that document were instrumental in the design and construction of the components that powered the first nuclear submarines."

Several key figures in the development of the Navy rules were subsequently important to the development of Section III. They included Bernard Langer of Bettis Atomic Power Laboratory (for whom the ASME Bernard F. Langer Nuclear Codes and Standards Award is named), William Cooper of the Knolls Atomic

Nuclear code provisions have reached beyond power plants and even to other industries.



Clinton Anderson (left), chairman of the Joint Congressional Committee on Atomic Energy, and Lewis L. Strauss, Atomic Energy Commission chairman, in 1956 with a photograph of the Shippingport Atomic Power Station, then under construction. Photo: Corbis-Bettmann

Power Laboratory, and James Mershon of the Navy Bureau of Ships, who was Wichman's boss and would later join the Atomic Energy Commission.

In the years following the first publication of Section III, the coverage of the Code expanded to incorporate piping requirements (which were originally developed separately by the ASME B31 Committee as B31.7), pressure retaining components for pumps and valves, equipment and piping supports, reactor vessel internal structures, and other features of nuclear power plants.

Subsequent editions added requirements for steel and concrete containment structures, high-temperature reactors, containments for spent fuel and radioactive waste, use of materials such as graphite, and other components for advanced reactor designs.

Since 1963, ASME has developed many additional codes and standards to maintain the safety of operating nuclear power plants and those planned for the future. These codes and standards were extended to cover other nuclear facilities, such as spent fuel storage, and they have been implemented by national and local government agencies and other regulatory bodies worldwide.

Several of them, such as spent fuel storage, nuclear fuel and waste processing, waste management, and equipment and fuel fabrication, have been extended beyond nuclear power plants to other nuclear facilities. Some, such as the special requirements for air and gas treatment and for cranes handling special equipment, have been adopted for use in other industries.

The original concept of nuclear power plant designers was that the higher standards adopted for design and fabrication would make in-service examinations unnecessary, and little attention was given to provisions for access.

By 1966 the Atomic Energy Commission recognized that a planned program of periodic inspections would be needed. They began to develop criteria, and in 1968 a joint AEC-industry Code development program began under the auspices of the ANSI N-45 Committee. A draft Code was published by ASME in 1968, and Section XI of the Boiler and Pressure Vessel Code, *Rules for Inservice Inspection of Nuclear Power Plant Components*, was published in 1970.

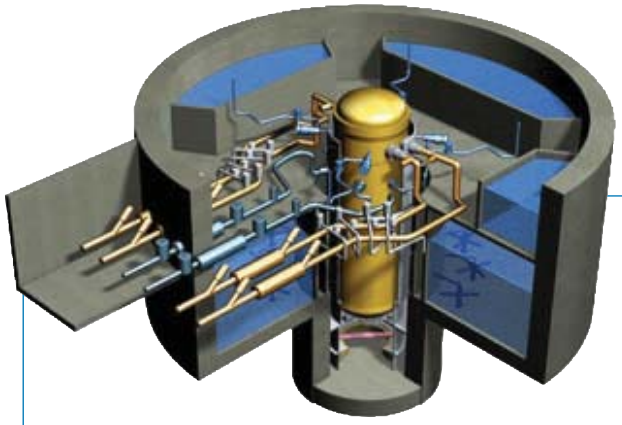
Section XI is directed toward the owners of nuclear power plants. The owners' needs proved to be significantly different from the Section III rules for construction of the nuclear components. Section XI responded by providing new requirements appropriate for operating plants. These rules have addressed repair methods, analytical evaluation techniques, non-destructive evaluation methods, and acceptance standards appropriate for ultrasonic examination.

The pressure vessel for Shippingport, weighing 153 tons with an inside height of 32 feet, was the largest made to that time.

The first commercial reactors were fabricated from stainless steel and low-alloy ferritic steel. To enhance the corrosion resistance to chloride environments (which could result from condenser leakage) plants implemented a new high-nickel alloy. This material proved susceptible to corrosion in a pure water environment, and Section XI addressed this situation with enhanced inspection requirements, and new mitigation and repair techniques.

Over the years the number of nuclear plants worldwide and their individual power levels have increased substantially, the largest operating units have output in excess of 1,300 MW. Units with power output in excess of 1,500 MW are under construction. Essentially all of them have safely and reliably produced a significant portion of the world's electrical power with minimal environmental pollution.

Modern plants require partial refueling every year or two and run annually at full power over 90 percent of the time. Nuclear power plants typically have the lowest operating costs. When operating at full capacity, they have lower power costs than all other options except existing hydroelectric installations.



GE Hitachi Nuclear Energy says its Economic Simplified Boiling Water Reactor uses natural forces such as gravity, evaporation, and condensation, not pumps and valves, to assure safety in the event of a malfunction.
Image: GE Hitachi Nuclear Energy

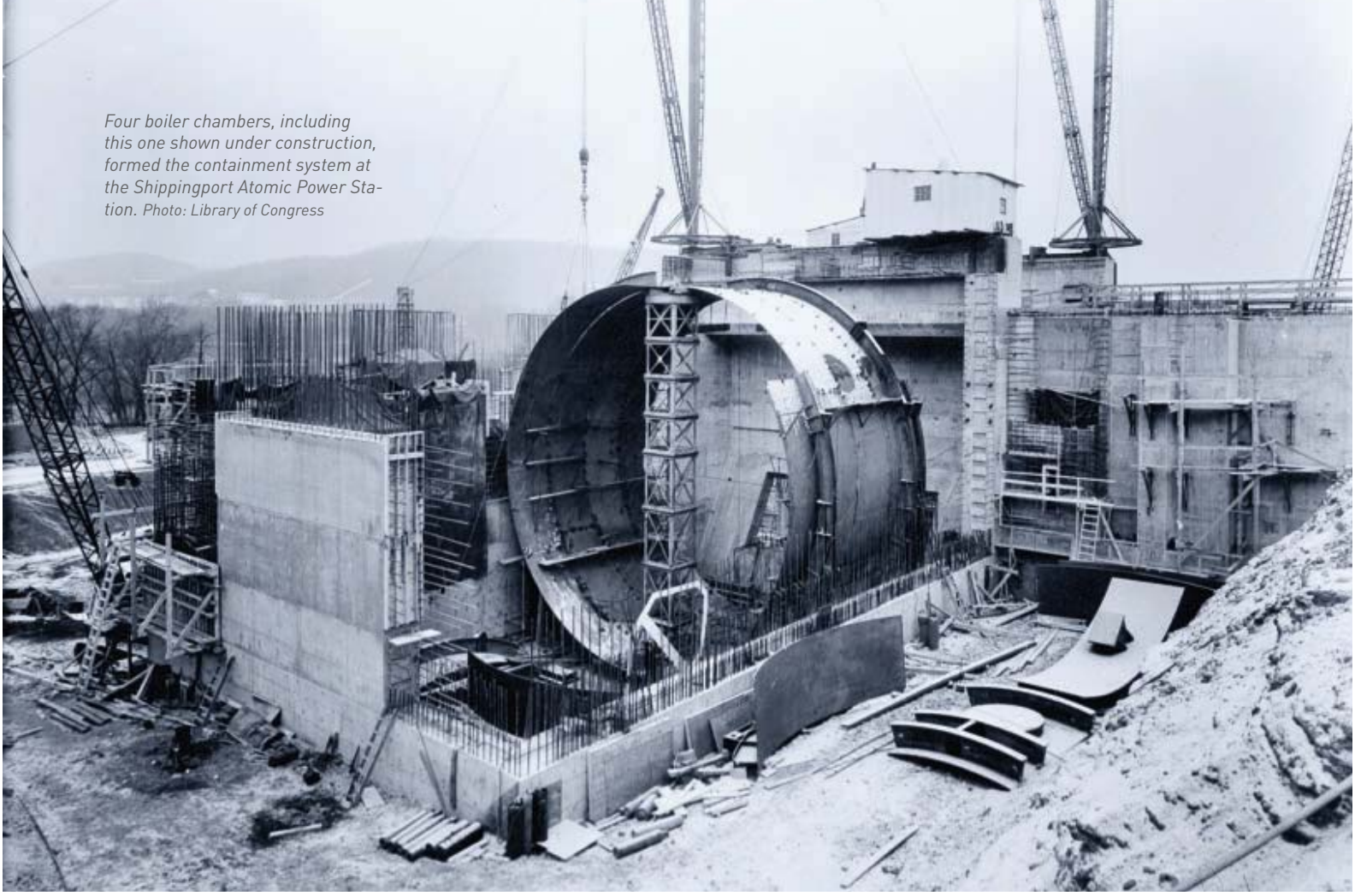
Not only has the Code grown in scope over the past 50 years, it has become international. It was the origin for the French nuclear code and for those of Japan, Russia, and Korea. Many countries, including Canada and Spain, have adopted the ASME Code. Out of the current 1,000 ASME Section III Nuclear Certificates, over half are international.

As the Code has become international, so has its governing process. The Section III Committee has recently met in Japan and Korea. In addition, International Working Groups have formed in Korea, India, Germany, and China, which is building four AP1000 reactors.

International Working Groups permit non-U.S. technical experts to participate in the development of the Code in the same manner as members of other working groups within the committee hierarchy. The evolution of the Code will require greater participation and contribution from the global nuclear engineering community.

The evolution of the Code will require **greater participation from the global engineering community.**

AREVA delivered components to Finland for Olkiluoto 3, one of the first Generation III+ European Pressurized Reactors.
Photo: AREVA



Four boiler chambers, including this one shown under construction, formed the containment system at the Shippingport Atomic Power Station. Photo: Library of Congress

As we look to the future of nuclear power we see dynamic events, some global and others focused regionally. Future plant designs promise to be as safe as current designs, or safer. They will be less costly to construct and more efficient to operate. There are also discussions about further extending the life of the current fleet of reactors in the United States. The current Code will be required to change to reflect these new designs and circumstances.

The Code is developed and maintained by consensus committees. Within the consensus committee hierarchy of standards committee, subgroups, and working groups, hundreds of technical experts participate as volunteers, representing the best and brightest engineers from industry, academia, and government. Meetings are open to the public.

It has always been a project of many hands and minds. Section III has been developed, maintained, and expanded over these 50 years by countless engineers who have volunteered their time and effort with support from ASME staff. We also recognize the corporate sponsorship of volunteers provided by utilities, architect engineers, manufacturers, as well as government agencies.

The current Code will be required to **change to reflect new designs and circumstances.**

There are about 500 volunteers working today to maintain and improve the Section III Code. Nearly 1,300 volunteers serve ASME Nuclear Codes and Standards groups. Volunteers in Code development are participating in addition to meeting the demands of their full-time jobs. They make the effort to assure continuing safety and to resolve daily issues requiring their knowledge and experience.

Long-time member and past Section III committee chair Richard Barnes aptly describes the influence of the volunteers: "These folks work tirelessly and quietly, but their influence extends throughout the Code like yeast does in bread."

Barnes tells an anecdote, which conveys the sense of teamwork among consensus committees, involving long-time volunteer Doug Cooper of Atomic Energy of Canada Ltd., and Don Landers of Teledyne Brown Engineering, who was considered a legend among those who worked on the Code:

"I will never forget the night that Doug Cooper received the ASME Dedicated Service Award at the National Board Banquet," Barnes said. "Don Landers presented it to him, and when Don said the recipient was Doug Cooper, Doug was shocked; he was speechless in fact. He came to the stage to receive his award and when he went to the microphone to speak the only thing he said, and he repeated it twice, 'I don't deserve this; there are so many others.' " **ME**

SIDNEY BERNSEN is a member of ASME's Board on Nuclear Codes and Standards. **BRYAN ERLER** and **DANA K. MORTON** are members of the Section III Committee. **OWEN HEDDEN** is a member of the Section XI Committee.

A group

As the industry's needs expanded, so did the scope of ASME's **nuclear codes and standards.**

When the first edition of Section III of the ASME Boiler and Pressure Vessel Code appeared 50 years ago, it provided rules for three classes of pressure vessels for nuclear power plants.

This was, however, the birth of an industry, an entire supply chain that would eventually provide one-fifth of the electricity consumed annually by the United States. So it quickly became apparent that the industry needed to address many issues besides the design and construction of the reactor vessels. More guidance was needed—and welcomed—by the industry and other stakeholders.

Section III eventually grew to encompass rules governing the construction and inspection during the building of storage tanks, piping, pumps, valves, containments, and other components of nuclear power plants. The code also addresses containment systems for storage and transport packaging of spent fuel and high-level radioactive material and waste.

Section XI of the BPVC concerns inservice inspection of critical components in nuclear power plants. It includes provisions for repair or replacement of components, and procedures for evaluating plant operating events.

Over the years, new committees formed to address issues ranging from quality assurance to risk management.

In contrast to the Boiler Code rules for nuclear components, which were essentially incorporated by reference into the U.S. Nuclear Regulatory Commission's regulations and therefore required for licensing, several standards were developed for voluntary adoption by the users. However, most of them have been identified by the Nuclear Regulatory Commission as acceptable methods for meeting its requirements and have frequently been treated as requirements. Regulatory endorsement of standards is consistent with government policy to prefer to endorse standards that represent the affirmation of all affected and knowledgeable interests, such as those developed by ASME Standards and Certification, rather than issue government rules and guidance.

Today, ASME's Board on Nuclear Codes and Standards oversees six committees, in addition to Section III and Section XI. Together the eight committees have issued 22 nuclear codes and standards.

There are almost 1,300 volunteers participating in the various nuclear committees, subcommittees, and working groups. They include approximately 100 international participants from eight countries besides the United States.

The following are the additional nuclear codes and standards committees and their products.

Fifty years ago, the new Code helped give birth to an industry.

Quality Assurance

In the late 1960s, a high-level committee under the aegis of the American National Standards Institute reviewed the status of nuclear standards. After consulting with the former Atomic Energy Commission, ANSI concluded that there was a need for standards to assure that the quality of plant construction was acceptable.

As a result, ANSI asked its committee N45, which was managed by ASME, to develop a series of quality assurance and control standards. The first standard to be issued covered a general quality assurance program. Later, the group issued several

effort that grew

construction-phase control and inspection standards.

After the Board on Nuclear Codes and Standards was created, this activity was transferred to a newly formed ASME Committee on Nuclear Quality Assurance and the individual standards were consolidated. They currently reside, along with requirements developed over that past 40 years, in a single document, NQA-1 *Quality Assurance Requirements for Nuclear Facility Applications*.

The original scope of the QA standard covered nuclear plants and was recognized by the Nuclear Regulatory Commission for meeting its requirements. Subsequently, it was expanded to cover other nuclear facilities and also adopted by the U.S. Department of Energy for its facilities.

Sidney Bernsen

Operation and Maintenance

The ASME Operation and Maintenance Standards Committee was established in the late 1970s with the direction from the Board on Nuclear Codes and Standards to develop standards and guides for testing of nuclear power plant components in operating plants. The primary focus of the committee was testing of pumps, valves, and snubbers to replace similar sections in place at that time contained in Section XI of the Code.

To date, the committee has developed a document comprising three divisions for industry use and regulatory endorsement. The latest approved version is the 2012 edition, OM-2012a *Operation and Maintenance of Nuclear Power Plants*.

Division 1 contains Code requirements for testing nuclear power plant safety-related pumps, valves, and snubbers. It also incorporates risk-informed testing for components and provides for upgrades necessary for new generation construction. Division 2 consists of standards, and Division 3 has guides. Both provide testing methodologies for other nuclear plant components such as heat exchangers and diesel generators.

The U.S. Nuclear Regulatory Commission has endorsed Division 1 with minor exceptions. Other international regulatory bodies have also endorsed this standard.

The work of this committee has spawned nuclear industry users groups as well as a triennial NRC/ASME symposium on pump, valve, and snubber testing.

John Zudans

Nuclear Air and Gas Treatment

In 1971, the ANSI N45.8 Committee was organized to develop standards for high-reliability air cleaning equipment for nuclear facilities and corresponding tests to confirm performance of the equipment. Two standards, ANSI/ASME N509-1976 and ANSI/ASME N510-1975 were published.

In 1976, the committee was reorganized as the ASME Committee on Nuclear Air and Gas Treatment. The scope of responsibility increased to include the development of standards for design, fabrication, inspection, and testing of air cleaning and conditioning components used in nuclear facilities. ASME AG-1 was the new standard resulting from the increased scope. The standard contains requirements, specific prohibitions, and guidance for construction activities.

The first edition of AG-1 *Code on Nuclear Air and Gas Treatment* was approved by the American National Standards Institute in 1985. The current version is AG-1-2012. This Code provides requirements for the performance, design, fabrication, installation, inspection, acceptance testing, and quality assurance of equipment used in nuclear power plants. In addition the committee has produced ASME-N511-2007 *In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air-Conditioning Systems*.

Thomas Vogan

Qualification of Mechanical Equipment

Federal regulations require measures to ensure that key equipment in nuclear power plants operates as specified under extreme environmental and emergency conditions. These include seismic and other conditions occurring in the event of accidents. While the NRC published rules and guides, the development of qualification standards was assumed by the nuclear standards community.

In the early 1970s, initial development of qualification standards was assigned to the ANSI N45 Committee. This committee initiated separate working groups, one on valves and one on pumps, to prepare standards to ensure that pumps and valves used in nuclear plants would function as specified. Subsequently these groups became separate subcommittees, reporting to different standards committees. After the ASME Board on Nuclear Codes and Standards was formed, the mechanical engineering scope of these standards was assigned to a new ASME Committee on Qualification of Mechanical Equipment, and the Institute of Electrical and Electronics Engineers assumed the responsibility for environmental qualification standards.

The first qualification standard to be issued for valves was ANSI N278.1-1975, which covered the preparation of functional specifications. Subsequently ANSI B16.41 was issued to cover functional qualification requirements for power-operated active valve assemblies for nuclear power plants. In 1994 the QME committee published QME-1 1994 that included seismic and functional qualification of active mechanical equipment, including pumps and valves. This standard replaced ANSI 278.1-1975 and has been revised several times to incorporate experienced based information and analytical techniques. The 2007 version has been endorsed by the U.S. Nuclear Regulatory Commission.

An updated version of the standard was issued in 2012 and includes new sections on standardization of experienced-based seismic equipment qualification and the qualification of dynamic restraints. It also requires that users of the standard must provide a Qualification Specification.

Tom Ruggiero

The development of standards never ends. Committees are already working on the next generation.

Cranes for Nuclear Facilities

The ASME Standards Committee on Cranes for Nuclear Facilities was established in 1976, shortly after the U.S. Nuclear Regulatory Commission issued NUREG-0554, written guidelines for safety-critical or single-failure-proof cranes (i.e., cranes that cannot drop a load with the failure of a single component). While the NUREG provided guidelines, there was need for standards to capture, maintain, and extend the guidelines to appropriate design requirements and details as well as manufacturing, storage, erection, inspection, and testing. In 1980, the committee's scope was broadened from nuclear power plants to include other critical load-handling facilities.

The committee maintains two ANSI approved standards, NOG-1 *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)* and NUM-1 *Rules for Construction of Cranes, Monorails, and Hoists (with Bridge or Trolley or Hoist of the Underhung Type)*. Both the standards can be applied to cranes at facilities other than nuclear plants, where enhanced crane safety may be required.

The committee's membership is derived from the nuclear power industry, aerospace industry, crane manufacturers, crane suppliers, the U.S. Navy, the U.S. Department of Energy, and the U.S. Nuclear Regulatory Commission. The standards have been adopted for critical load handling by industry and government participants.

Aaron Kureck

Standards support prosperity and, more important than that, **they maintain public safety.**

Nuclear Risk Management

Probabilistic risk analysis was introduced to nuclear power plant safety evaluations in the 1970s. It was refined to evaluate plants after the Three Mile Island accident, and use of risk information was introduced into the ASME Codes and Standards in the late 1990s by providing risk-informed alternative rules for in-service inspection and testing and for selected operation and maintenance activities.

Probabilistic risk analyses evolved over a period of more than 30 years from relatively simple, limited-scope evaluations to rather complex, full-scope modeling of the plant. During this time, there was no standard to determine the technical capability, fidelity, and adequacy of the risk assessment. As codes, standards, and regulatory applications evolved, there was clearly a need to develop standards for risk analysis to support these applications.

The ASME Board on Nuclear Codes and Standards in 1998 initiated a project to develop an appropriate risk analysis standard. The initial standard, ASME RA-S-2002 *Standard for Level 1 / Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications* was published in 2002, with Addenda issued in 2003 as ASME RA-Sa-2003.

The initial scope of this standard covered currently operating light water nuclear power plants at power, since practices for this scope were the most highly developed and supported most of the current applications. In parallel, the American Nuclear Society undertook efforts to develop standards to cover internal and external conditions, long-term release probability, and offsite consequences that were not addressed by the ASME standard. These areas required more time and technical effort since their considerations were not as highly developed or as well understood at the time. ANS eventually published standards covering internal fires and external events, such as earthquakes, flooding, and tornadoes.

Now several of these standards have been combined into a single document, ASME/ANS RA-S-2008. The standard is the responsibility of one committee, which reports to the ASME Board on Nuclear Codes and Standards and to the American Nuclear Society's Standards Board. The latest approved version of the standard is Addendum B (ASME/ANS RA-Sb-2013).

This joint committee has now prepared and issued, or will shortly issue for trial use, PRA standards for advanced light water reactors and non-light water reactors, and extensions to evaluate the risk from long-term containment failures and off-site consequences.

Sidney Bernsen

The Future

The development of standards never ends. Committees are already working on the next generation of their standards. They are incorporating recent experience and integrating new technologies, from materials to theoretical tools.

The ASME/ANS Nuclear Risk Management Committee, for example, is currently expanding the scope of the standard to cover risk at shutdown and from long-term maintenance of containment and releases to the public after an accident. In addition, requirements for advanced reactors and the lessons learned from the Fukushima accident are under development.

The reason that the work must continue is simple to understand. It has to do with the fundamental purpose of all standards: Standards exist to serve all the stakeholders in an industry—manufacturers, regulators, insurers, operators of equipment, but also the members of the general public who happen to be in the neighborhood. In short, standards support prosperity and, more important than that, they maintain public safety. ME

ASME
SETTING THE STANDARD

INTERNATIONAL PETROLEUM TECHNOLOGY INSTITUTE

From the International Petroleum Technology Institute Board Chairman – May 2014

On behalf of the International Petroleum Technology Institute (IPTI), I welcome the opportunity to tell my fellow ASME members of the successes that IPTI, through its three Divisions, has achieved over the past year. The IPTI of ASME is comprised of three divisions: the Petroleum Division (PD); the Ocean, Offshore, and Arctic Engineering Division (OOAE); and the Pipeline Systems Division (PSD). These three divisions have been quite active over the past several years and have continued to expand their local and global reach. To follow the activities of IPTI and its individual Divisions, visit the IPTI group on ASME.org (http://go.asme.org/IPTI).

IPTI MISSION

IPTI is aligned with ASME's mission statement in three core areas of energy, global impact and engineering workforce development. The following Division updates highlight our dedication to serving the local and global community by advancing, disseminating and applying engineering knowledge through technical workshops, conferences, presentations and training initiatives in various countries. Similar to ASME volunteers throughout the Society, the numerous volunteers in the IPTI Divisions consistently demonstrate their commitment to achieving ASME's stated goal of communicating the excitement of engineering and improving the quality of life. The Division summaries will highlight the successes and the growth that IPTI and its individual Divisions have experienced globally due to the efforts of our tireless volunteers.

However, it is important to recognize that we could not achieve this success without strong support from the ASME staff. IPTI, through the Institute model, primarily draws upon the skills of dedicated IPTI staff that, in turn, leverages the broader ASME staff resources, thus empowering IPTI volunteers to succeed in their initiatives.

CONFERENCES AND EVENTS

The foundation of IPTI Division success is rooted in successful world-recognized conferences. During Division conferences around the world, I am continually surprised when people ask me about IPTI's interest in hosting a workshop or conference in their country. This is a testament to the power of the ASME brand and the global respect it generates — a direct result of the hard work that goes into putting on world-class events by volunteers and staff. These conferences allow us to achieve the ASME goal of knowledge sharing through paper presentations and networking.

You may have heard about the following IPTI signature events such as the annual Offshore Technology Conference (OTC) in Houston, the annual Ocean, Offshore, and Arctic Engineering (OMAE) conference, and the biennial International Pipeline Conference (IPC) in Calgary. In addition, each IPTI Division hosts other events and I encourage you to visit www.asme-ipti.org to learn more about our events and to register.

IPTI is also examining opportunities to bring subject matter expert volunteers from the three member Divisions together to organize one event. For example, we are partnering with another Society to co-sponsor an LNG conference in 2014 that examines the LNG lifecycle challenges from unconventional natural gas extraction, transportation, processing and offshore structures. In addition, we are also exploring the feasibility of hosting an event focused on asset reliability/integrity that encompasses the oil and gas lifecycle represented by the three individual Divisions.

Our IPTI volunteers are excited about

(Continued next page)

the ever-expanding portfolio of technical engineering courses and workshops. The courses offered by the Divisions are designed to appeal to a broad audience, from entry-level engineers to senior engineers who seek more master-level knowledge. The IPTI Divisions are able to attract world-recognized subject matter experts to provide this training, which is offered both locally and internationally in classroom format. We also utilize webinars to expand some offerings. In addition, recognizing that some international training offerings are not viable at North American pricing, the IPTI Divisions and volunteer trainers come together to offer training affordable to our international community. To learn more about our training initiatives and to register visit our website at www.asme-ipti.org.

STUDENT MEMBERSHIP

IPTI recognizes that a key solution to the coming shortage in engineering expertise is to make students aware of the challenges and exciting work offered by an engineering career, and how their contributions will make a difference in society. To help achieve this objective, IPTI volunteers provide presentations to young students and sponsor teacher workshops. All IPTI Divisions have active and growing programs that continually engage engineering students and young professionals. These programs are successful in communicating the many benefits of entering the mechanical engineering field and becoming a member of ASME, and include networking opportunities, scholarships and intern programs, and skill enhancement through training initiatives. Through the IPTI Divisions, we sponsor student paper competitions at many of our conferences, and go to great lengths to welcome all students to our events by offering student registration fees at a fraction of the regular cost.

If you are a student or young professional, I encourage you to join IPTI and one of its Divisions and discover the career-enhancing opportunities available to you. For a complete listing of our student programs and scholarships, including applications, please visit www.asme-ipti.org. In addition, we are always looking for student volunteer leaders and will happily provide you the support you need to succeed.

AWARDS PROGRAM

In professional societies such as ours, people volunteer to give back to society through knowledge sharing. Awards are a way for volunteers to realize that goal by encouraging new ideas, provide mentoring and, sometimes, financial assistance so students can achieve their potential. In addition, awards help recognize those individuals at any career level who have helped contribute to the practice of engineering. To learn more about our awards, visit our website at www.asme-ipti.org.

We're proud of our abilities and eager to recognize our successes. And we're excited about ASME-IPTI's future and would like to share that excitement with you. ■

Joe Paviglianiti
Chair, IPTI Board

Happy Birthday! The Petroleum Division is 90 years old!

In the last few decades the Petroleum Division has continued to expand its programs with a focus on Global Impact and Workforce Development, just as its founders did. By the end of the 20th century, ASME was considered the premier organization for any mechanical engineer in the oil and gas industry and remains the center of service and recognition for mechanical engineers around the world today.

Even 90 years ago, these engineers were focused on Global Impact, Workforce Development and Energy. For example, Hollis Porter, the founding chair in 1925, worked on standards for the protection of industrial workers in the transmission and distribution of power. And many more PD Chairmen, represented by the awards named in their honor, have contributed to the Society's legacy of excellence.

Art Lubinski was the Petroleum Division chair in 1969 and an ASME Fellow. He studied the behavior and performance of oil well tubular (casing and drill pipes) and promoted drilling techniques, which are used to this day. The Petroleum Division bestows an award at OTC given annually in his honor.

Keith Thayer was Petroleum Division chair in 1984 and ASME President in 1997. The Keith Thayer Early Career award was established to recognize an engineer for outstanding performance, effort and dedication to Petroleum industry early in his or her career.

Allen Rhodes was Petroleum Division chair in 1961 and ASME President in 1970. The Rhodes Petroleum Industry Leadership Award was established as an award for significant contribution to the petroleum industry demonstrated through management and motivational skills, entrepreneurship, innovative methods, outstanding leadership within the corporate structure and in the industry as a whole.

Karl Geoca was named chair of the Petroleum Division in 1988 and is a former member of the ASME Board of Governors. The Karl Geoca Award was established in 1995 to honor distinguished and meritorious achievement or service in the field of petroleum mechanical engineering.

Over the years, more than 20 past chairmen have served on the ASME Board of Governors and three served as ASME President.

Our current Petroleum Division Executive Committee members are:

- Jennifer Bell, current ASME PD Chairman and IPTI Board Member, Co-founder & Sustainability Analyst, Elements Offshore
- Doreen Chin, PhD, PE and ASME Fellow, Surface Engineering Advisor in Upstream Unconventionals, Shell E&P Company
- Christopher M. Barton, Senior VP, Global Offshore Business Development, Wood Group Mustang, Inc.
- Justin Whitehead, Global Program Development Manager-Shell Portfolio, FMC Technologies
- Leith McDonald, Offshore Pipeline Technical Authority, US Pipelines & Logistics Division, BP
- Kieran Kavanagh, Group Technology Director, Wood Group
- Jean-François Saint-Marcoux, Engineering Expertise Director & Technical Authority, Subsea 7

To the past 89 PD Chairmen, I wish a "Happy Birthday." As the 90th Chair and as an example to future chairs of the Petroleum Division, I hope to "pay it forward" just as those who preceded me have done so well. ■

Jennifer Bell
Petroleum Division Chair
2013-2014

Petroleum Industry Awards

Petroleum Industry Awards Gala

February 21, 2014 • Houston, Texas

This event honors individuals and companies who have made significant contributions to our industry in recent years and raises funds for our scholarship programs that encourage aspiring engineers to keep the pipeline flowing for our industry.

2014 AWARD WINNERS

The Rhodes Petroleum Industry Leadership Award

Helge Hove Haldorsen, Statoil

This award was established to recognize significant contribution to the petroleum industry demonstrated through management and motivational skills, entrepreneurship, innovative methods and outstanding leadership within the corporate structure and in the industry as a whole.

Helge Hove Haldorsen and Phil Collins, Vice Chair IPTI Board

The Silver Patent Award

Colby Ross, Halliburton

Patents are a major achievement in the career path of a petroleum mechanical engineer. ASME's petroleum division seeks to encourage and recognize engineers holding patents.

Volunteer of the Year

Joe Fowler, Stress Engineering

Established by the staff of the Petroleum Division to recognize a volunteer who has exemplified extraordinary qualities such as professionalism, commitment and initiative.

The Ross Kastor Educators Award

Jack Christiansen, University of Houston

This award recognizes dedication to improving engineering and science awareness for students and the enhancement of education for future leaders. The award winner must also have a strong interest in furthering student education.

The Outstanding Faculty Advisor Award

Tony Snell, California Maritime Academy

Created to honor those faculty members who demonstrate remarkable commitment to their students in pursuit of a mechanical engineering education and career.

To learn more about the Petroleum Division Awards and its past winners, please visit http://asme-ipti.org/petroleum-division/awards/

The Keith Thayer Exceptional Early Career Engineer Award

Vicki Blocker Risinger, FMC Technologies

Presented in recognition of outstanding dedication, effort and performance by an early career professional.

Keith Thayer, former PD chair and ASME President, Award namesake with Vicki Blocker Risinger

The Project Excellence Award

PetroBras Marlim Project

The ASME-PD Project Excellence Award is awarded to innovative and ground-breaking projects. The award recognizes excellence in engineering, project management and acknowledges innovative projects. It highlights the importance of professional engineering and project management in achieving high performance in projects. ■

2014 OTC

Founded in 1969, the Offshore Technology Conference organizes the world's foremost events for the development of offshore resources in the fields of drilling, exploration, production and environmental protection. OTC is held annually at Reliant Center in Houston.

OTC ranks amongst the largest 200 trade shows held annually in the United States and is among the 10 largest meetings in terms of attendance. Attendance consistently exceeds 80,000, and more than 2,700 companies participate in the exhibition. OTC includes attendees from around the globe, with more than 120 countries represented at recent conferences.

OTC is sponsored by 14 industry organizations and societies, who work cooperatively to develop the program each year. OTC also has two endorsing organizations and ten supporting organizations. OTC is governed by a Board of Directors made up of 15 representatives, 12 from OTC's sponsoring organizations and three from OTC's endorsing organizations. ■

OTC Mission Statement

OTC is organized and operated exclusively to promote and further the advance of scientific and technical knowledge of offshore resources and environmental matters. ■

Arthur Lubinski Best ASME Mechanical Engineering Paper presented at OTC – 2014

2014 WINNER

OTC-25403-MS

Subsea Wellhead and Riser Fatigue Monitoring in a Strong Surface and Submerged Current Environment

Scot McNeill, Puneet Agarwal, Dan Kluk, Kenneth Bhalla, Ron Young, *Stress Engineering Services, Inc.*
Steve Burman, Stergios Liapis, Saurabh Jain, Vikas Jhingran, Stephen Hodges, *Shell*
Early Denison, *Consultant*

Abstract

A drilling campaign was recently undertaken by Shell Oil Company in a region with high surface and submerged currents. The water depth ranged from 5500-7000 ft at the various well sites in the region. Strong surface currents with maximum speeds of 4.5-5.0 knots were measured using an Acoustic Doppler Current Profiler (ADCP). In addition, submerged currents with maximum speed of around 1.5 knots were recorded. High fidelity Subsea Vibration Data Loggers (SVDLs) were used to monitor the in-situ riser and BOP stack vibrations due to the arduous current environment, as well as wave and vessel-driven motions.

A semi-analytical method was developed to estimate wellhead fatigue damage directly using the measured BOP stack motion data. High quality vibration data from the SVDLs were used in conjunction with analytical transfer functions to directly compute stress time histories and S-N fatigue damage at any location of interest in the conductor/wellhead/BOP system. The method was utilized in a larger fatigue reconstruction scheme that was applied to subsea wellhead and riser fatigue monitoring activities during drilling operations in the region. ADCP data was correlated to the SVDL data to determine the source of vibrations at low and high frequencies.

Simultaneous ADCP and SVDL data were also used to calibrate SHEAR7 v4.2 parameters. In between SVDL deployments, wellhead and riser stress and fatigue values were determined using the calibrated SHEAR7 models, driven by the measured current profiles. Wellhead motions were tabulated from ROV video and used to validate vibration reconstruction from the SVDL data and predictions from SHEAR7 simulation. Using these methods, stress and fatigue life consumption estimates are robust to unavailability of ADCP data and/or ROV video and/or data from one or more SVDLs.

Normalized vibration, stress and fatigue consumption are presented over the riser deployment period. It was found that moderate speed submerged currents, which extend over a broad range below typical fairing depths, lead to significantly higher wellhead stress and fatigue life consumption rate than higher speed surface currents. The sensitivity of a typical wellhead and BOP stack to lower-frequency vibrations was examined. It is shown that because the submerged currents are of a lower speed, they excite modes that are closer in frequency to the "flagpole" mode of the casing/wellhead/BOP subsystem, leading to higher wellhead motion and stress.

The methods introduced herein provide rapid turn-around of raw data to fatigue consumption, enabling informed decisions to be made in adverse conditions. The methodology is easily extendable to real-time fatigue monitoring using a cabled system or acoustic modem to transmit data to the surface. In addition, the significance of regional submerged currents for wellhead stress and fatigue is highlighted, as well as considerations for vibration mitigation. (http://asme-ipti.org/lubinski-best-paper/)

PETROLEUM DIVISION

2014 Lubinski Paper Nominees

OTC 25275	L. Brown, Deep Water Pipeline Repair in the Gulf of Mexico
OTC 25354	A. Newport, Espirito Santo: Operational Feedback on the Use of Steel Risers on a Turret Moored FPSO
OTC 25396	P.A. Cooper, BP Angola PSVM Project: Production Flowline Lateral Buckling Design
OTC 25117	C. Olsen, Lessons Learned - Counter-acts Used to Install Pipelines Offshore in Very Soft Clay
OTC 25259	K. Lewis, Subsea Well Response Project Enhances International Well Incident Intervention Capabilities
OTC 25188	L. Zhang, Reliability Analysis of Lazy Wave Steel Catenary Riser (LWSCR) Using Real-Time Monitoring Data

2013 Lubinski Paper Winner and Nominees

2013 Winner

OTC 23943 Design Guideline Strategies for HPHT Equipment (http://asme-ipti.org/lubinski-best-paper/)
Authors: H. Brian Skeels, Kwok Lun Lee, Anand Venkatesh
FMC Technologies

2013 Nominees

OTC 24162	Porciuncula et al., Cascade and Chinook Subsea Development: A Challenging and Successful Case History
OTC 24099	Sum et al., Multiphase Flow Modeling of Gas-Water-Hydrate Systems
OTC 24025	Ma et al., A Historical Review on Integrity Issues of Permanent Mooring Systems
OTC 23928	Pathak et al., Design Method Combing API and ASME Codes for Subsea Equipment for HPHT Conditions Up to 25,000 psi Working Pressure and Temperature to 400°F

PIPELINE SYSTEMS DIVISION

From the Pipeline Systems Division Chair – May 2014

It is a very exciting time for the Pipeline Systems Division (PSD) of the International Petroleum Technology Institute (IPTI). In 2013, we had a number of successes and planted seeds for future growth of our division and the pipeline industry as a whole. PSD provided support to successful pipeline conferences and workshops around the world. Conferences were held in India, Canada, Colombia and Brazil. We also established relationships with the next generation of pipeline engineers.

PSD continued to provide training content to pipeline engineers from experienced PSD instructors. Under the new structure of ASME Training and Development, Codes and Standards training courses will be offered in the same training week as PSD training courses. This change will better serve the pipeline community in a complete and robust manner.

(Continued next page)

PIPELINE SYSTEMS DIVISION

Communities of engineers are getting together to move the industry forward. Based on the successful model used to form the PSD Technical Chapter in India, PSD has supported the development of a PSD Chapter in China. Professor Minxu Lu joined the PSD Executive Committee at its Annual Planning Meeting to discuss the China chapter's vision for aiding the pipeline community in China with PSD supporting their efforts. PSD has also supported a dynamic group of young pipeline engineers in Canada (YPAC) as they rally the support of early career engineers in the pipeline community.

There is a lot of positive momentum as we move into 2014 within PSD. We are in search of new volunteers in the global pipeline community to help advance some of the PSD initiatives to completion. PSD actively drives the pipeline industry forward through involvement with conferences, committees, technical knowledge development and industry networking opportunities. PSD aids the development of pipeline engineers by supporting young pipeliner groups, local chapter organizations, and industry outreach. PSD is made up of members who care for the industry and are committed to making it safer and more reliable. If you are interested in being part of this dynamic group of professionals, please contact Kimberly Miceli at *MiceliK@asme.org*.

Taylor Shie
Pipeline Systems Division Chair
2013-2014

PSD Conferences

India Oil & Gas Pipeline Conference

Feb. 1-2, 2013
Jaipur, India

The fourth edition of the India Pipeline Conference was held February 1st and 2nd in Jaipur, India. This conference has grown every year and is on track to grow even more in the next edition in 2015. The 2013 conference had 178 delegates that attended six technical tracks and a total of 21 technical presentations. The technical tracks included:

- Pipeline Design, Materials and Construction
- Pipeline Operations and Maintenance
- Pipeline Project and Risk
- HSE and Regulatory
- New Emerging Technologies
- City Gas Distributions

The 2015 edition of the India Pipeline Conference will be held in Delhi, India in January of 2015.

PSD Conferences

Banff Pipeline Workshop

April 8-11, 2013

Banff, Alberta, Canada

The biennial Banff Pipeline Workshop was held for the 12th time in Banff, Canada. At this workshop, two keynote addresses were given to the 822 delegates on the topic of Performance and Perception. There were 34 sessions divided into 13 topical working groups with six tutorials. This workshop continues to be a success for ASME and the workshop co-sponsors. The thirteenth Banff Pipeline Workshop is scheduled for April 12-15, 2015, in the same location.

ASME International Pipeline Geotechnical Conference

July 24-26, 2013

Bogota, Colombia

There was an identified need for a pipeline geotechnical conference in South America in response to high profile ground movement-induced pipeline failures. PSD partnered with the Asociacion Colombiano del Ingenieros (ACIEM) together with local and regional industry sponsors to deliver a highly successful first edition of the conference in Bogota, Colombia on July 24 -26. Industry need was met with industry expertise and knowledge sharing to truly move the industry forward. There were four tracks to the conference:

- Geohazard Considerations for Design and Construction
- Geohazard Risk Assessment and Pipeline Integrity Management Planning
- Monitoring, Mitigation and Emergency Repairs
- Poster Paper Track

In all there were 30 technical presentations/posters and work was initiated on a Recommended Practice (RP) of geohazard management. The purpose of the Pipeline Geohazard Management RP is to provide engineers, technologists, technicians and managers with clear, concise and practical guidelines for the development, implementation and effective performance of engineering management of geohazards on pipelines, regardless of the transported product. Volunteers are welcomed to contribute to the RP.

The second edition of the ASME International Pipeline Geotechnical Conference will be held in April of 2015 in Florianópolis, Brazil.

PSD Conferences

Rio Pipeline Conference

September 24-26, 2013
Rio De Janeiro, Brazil

The Rio Pipeline Conference and Exposition was held September 24th to 26th in Rio de Janeiro, Brazil. This was the 5th edition of the conference and was a great success with 1,600 registered delegates. The 2013 Conference Chair was PSD's Executive Committee member Byron G. Souza Filho. PSD was also able to perform four full-day professional development courses to serve pipeline industry in Brazil. The four courses were:

- Subsea Pipeline Design Overview
- Pipeline Hydraulics Design
- Pipeline Geohazard Management
- Pipeline Construction

This conference was unique because the ASME Board of Governors met in Rio at the same time. The Board of Governors was able to attend functions in and around the conference so they could understand how the pipeline industry has been supported in Brazil by PSD. At a conference-wide ceremony, ASME President Madiha Kotb presented the 2013 Global Pipeline Award to Petrochina Pipeline Company and the Institute of Chemistry Chinese Academy of Sciences for research on technologies for the preparation and application of nanometric pour point depressant in waxy crude oils.

The conference organizers arranged for young professionals to attend the conference at no cost and provided them with two days of presentations from the global pipeline community. PSD was well represented in this forum. Past PSD Chair Marcelino Gomez started the session with a speech about the need for involvement of the youth in Brazil in the technical development of the country. Current PSD Chair Taylor Shie gave a presentation on how ASME is providing professional development opportunities in the pipeline industry and the engineering community as a whole. On the second day of the session, PSD-sponsored representatives from the Young Pipeliners Association of Canada presented how young professionals in Canada are joining together to move the pipeline industry forward.

In the closing session of the conference, Former PSD Chair Marcelino Gomez received the ASME Fellow award. ASME PSD is excited to have such a great relationship with the Rio Pipeline organizing committee and looks forward to the next edition in September of 2015. ■

Global Pipeline Award Finalists

Company	Entry Name	Country
Gas Transboliviano	New Rio Grande River Crossing by Horizontal Direction Drilling	Bolivia
Hindustan Petroleum Corporation Ltd. HPCL	OFC-based Pipeline Intrusion Detection System (PIDS)	India
Petrochina Pipeline Company and Institute of Chemistry Chinese Academy of Sciences	Research on Technologies for the Preparation and Application of Nanometric Pour Point Depressant in Waxy Crude Oils	China
MARINOVATION	CoilFlatLine – A Game-changing Approach for Ultra-deepwater Pipelines	France
CTDUT- Pipeline Technology Center	Pilot Unit for Capacitating and Training in Cathodic Protection and in Anticorrosive Coatings	Brazil

Outreach

China Pipeline Systems Division Technical Chapter

China has a vast and expanding pipeline network and a large community of pipeline engineers. PSD currently supports the biannual China International Pipeline Conference. Following the most recent conference, pipeline engineers expressed a desire to form a PSD chapter in China to do more for the pipeline community. Professor Minxu Lu discussed opportunities for regional pipeline workshops and training courses on topics that were relevant to the local engineers. PSD is encouraged by the enthusiasm of the new chapter in China and is excited to support their efforts. The China Pipeline Systems Division chapter was presented a Certificate of Appreciation for their efforts at the PSD Annual Planning Meeting. ■

Young Pipeliners Association of Canada (YPAC)

YPAC is an organization developed as a way for young pipeline engineers to work together for the betterment of the pipeline industry. YPAC is made up of pipeline engineers under the age of 30 or who have less than 10 years experience in the pipeline industry.

Past PSD chairs participated in the founding and growth of the organization. YPAC and PSD have three shared core objectives:

1. Leadership in the industry.
2. Supporting education and technical transfer.
3. Promoting international cooperation.

PSD has financially supported YPAC in its efforts to grow the young pipeline engineer community. These sponsorships include:

- Banff Pipeline Workshops 2013 – Sponsorship provided an exhibit booth, 8 registrations and accommodation for YPAC members.
- Rio Pipeline Conference 2013 – 4 members traveled with the PSD Executive Comittee to Rio. YPAC also met with the IBP Youth Committee and presented to approximately 150 young pipeliners. YPAC best paper winners were honored by the conference and included in the proceedings.
- University of Calgary, Engineering Students' Society 3rd and 4th Year Dinner
- Sponsorship and participation in the annual golf tournament that serves as a major fund raiser for the group. ■

Rafael Mora: A Guardian of Pipeline Integrity

According to Rafael Mora, native son of Colombia and émigré to Canada, an engineer is not someone who just goes to work. "An engineer," he says, mechanical or otherwise, "is someone who cares about the world around him or her and strives to make a difference through engineering on integrity." Rafael puts this notion into practice every day and, with the founding and development of the International Pipeline Geotechnical Conference and the Pipeline Geohazard Management Recommended Practices, is making sure that engineering knowledge will be shared for the betterment of mankind for years to come.

His journey to engineering innovator of pipeline integrity and maintenance was a circuitous one. Born in a small village in Colombia, he seemed destined for a career in medicine per his mother's desire. But when his brother became a doctor and fulfilled the maternal dream, Rafael was free to indulge his passion for engineering technology. While earning his various engineering degrees from the University of La Gran Colombia (1986), UNAM, Mexico in 1993, and his MBA from UNET-UFPS, Venezuela-Colombia in 1997, Rafael was actively engaged in trying to make the world a better place. While still pursuing his undergraduate degree, he developed an innovative structural analysis software package and was contracted as a "pre-graduate" consultant at two engineering companies primarily engaged in the design and construction of buildings and bridges.

After graduation, Rafael started working on a pipeline maintenance software package for Occidental Petroleum — a project he completed in a mere three months. This success facilitated his entrance into a major joint venture pipeline company and kicked off his teaching career in 2007 as an adjunct professor in the Master of Engineering program at the University of Calgary. In the years since his emigration to Canada, Rafael has held the positions of In-Line Inspection Project Manager/ Data Analyst, Senior Integrity Specialist, Senior Engineer/Integrity Lead to Integrity Advisor with his current employer, Imperial Oil Canada. With the opportunity to work from the Arctic to the Southern Cone, his was an impressive engineering career indeed, but one that left him hungering for a greater role in "benefitting mankind."

In 2011, a pipeline rupture and subsequent explosion resulting from a landslide caused more than 30 fatalities and 80 injuries in a remote Colombian village. Stirred to action, Rafael felt that this kind of tragedy could have been prevented with a more proactive approach to pipeline integrity and maintenance, particularly in areas around the world afflicted by such geohazards as landslides, earthquakes, flooding, etc. His first step was to create an environment in which engineers could meet and share information on the impact of geohazards on pipelines. This environment became an event — the first ASME International Pipeline Geotechnical Conference (IPG) held in Bogota, Colombia in 2013 — through the participation and guidance of many engineers from North and South America and with the support and cooperation of the Asociacion Colombiano de Ingenieros (ACIEM). Out of this environment, the Pipeline Geohazard Management Recommended Practice document emerged and Rafael seized on the opportunity to share this collected information and best practices with the rest of the world, particularly in areas where pipeline integrity is critical to ecological and human health and safety. The second edition of the conference will be conducted in 2015 in Florianópolis, Brazil.

"We will hold the conference where there are pipeline geohazard issues to be addressed," he explained. "We need to become more proactive. We need to prevent pipeline ruptures instead of mitigating damage to people and the environment after they occur."

Rafael Mora became an ASME member in 2002. Through his participation in the International Pipeline Conference in Calgary — submitting papers, taking tutorials, working with engineers worldwide, coordinating tracks, contributing paper reviews, and setting up panel discussions and sessions — he has developed a keen appreciation for the association's reach in connecting engineers, innovation and knowledge sharing, particularly in addressing a "knowledge gap" such as there was in the area of pipeline integrity, maintenance and geohazards.

To young engineers just starting out on their career paths, Rafael encourages them to consider pipeline systems engineering as pipeline transmission and distribution networks grow all around the world. He sees good potential for great engineering in pipelines — the kind of engineering that makes the world a better, safer place, which is, in his opinion, the most important reason to become an engineer in the first place. ■

OMAE 2014

San Francisco
33nd International Conference on Ocean, Offshore and Arctic Engineering
June 8 – 13

Join your colleagues from industry, academia and government at the 33rd International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2014) in San Francisco.

OMAE 2014 is the ideal forum for researchers, engineers, managers, technicians and students representing scientific and industrial communities around the world. The OMAE Conference provides them opportunities to:

- Promote international cooperation in ocean, offshore and arctic engineering.
- Meet and present advances in technology and its application in industry.
- Exchange ideas and experiences while promoting technological progress.

OMAE2014 will be held at the Palace Hotel, in beautiful San Francisco, California, USA. Known for its beauty, its free spirited and friendly residents, its many landmarks and its commitment to leading the nation in environmental concerns, San Francisco is also surrounded by other beautiful locales including the world-famous Napa and Sonoma Valleys and Monterey Peninsula and Carmel-By-The-Sea.

Conference website: www.omae2014.com

OMAE 2013 took place in Nantes, France, from June 9-14, 2013. Attendees enjoyed beautiful Nantes, the "most livable" city in Europe, known for its history, culture, tourism and ecological sensitivity. Considered a great success, paper submissions, quality and attendance far exceeded expectations. There were 1,167 participants from 44 countries with a total of 896 papers published.

Future OMAE Conferences:
2015 – St. John's, Newfoundland.
2016 – Busan, Korea.
2017 – Trondheim, Norway.

Is your city interested in hosting OMAE in the future? Please visit www.ooae.org for details.

OUTREACH FOR ENGINEERS SPECIALTY FORUM AT OMAE

Each year, the Ocean, Offshore and Arctic Engineering Division (OOAE) of the IPTI hosts Outreach, a specialty forum at the International Conference on Ocean, Offshore and Arctic Engineering (OMAE). This forum is designed for students and early professionals seeking employment who would benefit from an improved understanding of the offshore industry.

Highlights of the forum include presentations of:

- Various technologies required ranging from geosciences to mechanical/structural engineering and project management.
- Job opportunities and possible career paths.
- Site tours focusing on the host city's cultural and historical attractions.

In addition, networking and team building events educate and make Outreach both a professionally valuable and fun experience. Through the generosity of our Sponsors and the OOAE Division, scholarships are made available to qualified students and early professionals to attend this event and the OMAE Conference.

For further information about applying for the Outreach program, please visit http://www.ooae.org/outreach/ ■

2014 – 2015 ASME-IPTI Events Schedule

Annual ASME OTC Golf Tournament
May 3, 2014
Houston, TX, USA

Offshore Technology Conference (OTC)
May 5-8, 2014
Houston, TX, USA

ASME Best Mechanical Engineering Achievement (BMEA) Award
Judging and Reception at OTC
May 5, 2014
Houston, TX, USA

Short Courses at the International Conference on Ocean, Offshore and Arctic Engineering
June 7-8, 2014
San Francisco, CA, USA

International Conference on Ocean, Offshore, and Arctic Engineering (OMAE)
June 8-13, 2014
San Francisco CA, USA

Floating Production Systems and Pipelines Training Week
September 8-12, 2014
Houston, TX, USA

International Pipeline Conference (IPC)
September 29-October 3, 2014
Calgary, AB, Canada

ASME India International Oil & Gas Pipeline Conference (IOGPC)
January 16-17, 2015
Delhi, India

Arctic Technology Conference (ATC)
March 23-25, 2015
Copenhagen, Denmark

International Pipeline Geotechnical Conference (IPG)
April 16-17, 2015
Florianópolis, Brazil

Banff Pipeline Workshops
April 12-16, 2015
Banff, AB, Canada

OTC Brasil
October 27-29, 2015
Rio de Janeiro, Brasil

For information on events visit: www.go.asme.org/IPTI

Upcoming Training Events — 2014

Short Courses at the International Conference on Ocean, Offshore and Arctic Engineering
June 7-8, 2014
San Francisco, CA USA

June 7
Marine Renewable Energy
Vortex-Induced Vibrations
Shipbuilding Best Practices

June 8
Transportation Engineering
Fundamentals of Deepwater Riser Engineering
Marine Cost Estimating for Engineers

Floating Production Systems and Pipelines Training Week
September 8-12, 2014
Houston, TX, USA

September 8
Integrity Management
Fundamentals of Deepwater Riser Engineering

September 8-10
Onshore Design and Construction

September 9
Fundamentals of Deepwater Project Development

September 9-10
Defect Assessment

September 10
Subsea Pipeline Design Overview

September 10-12
Design and Analysis of Floating Structures

September 11
In-Line Inspection
Engineering Ethics in Action - A.M. Session
Engineering Ethics in Action - P.M. Session

September 11-12
Offshore Design and Construction

September 12
Stress Corrosion Cracking

For more information on training, visit: http://asme-ipti.org/upcoming-courses/

ASME
SETTING THE STANDARD

Training & Development

Setting the Standard for Workforce Learning Solutions

SPRING 2014

Spring 2014 Training Courses for Engineers and Technical Professionals

May 2014 – Atlanta, Georgia USA

PD475	The New Engineering Manager: Moving from Technical Professional to Manager	19-20 May
PD599	BPV Code, Section III, Division 1, Class 1 Piping Design	19-20 May
PD146	Flow Induced Vibration with Applications to Failure Analysis	19-21 May
PD349	Centrifugal Pump Design and Applications	19-21 May
PD389	Non-Destructive Examination-Applying ASME Code Requirements (BPV Code, Section V)	19-21 May
PD395	API 579-1/ASME FFS-1 Fitness for Service	19-21 May
PD523	Quality Assurance (QA) Considerations for New Nuclear Facility Construction	19-21 May
PD615	BPV Code, Section III, Division 1: Class 1, 2 & 3 Piping Design Combo Course	19-21 May
PD674	International Business Ethics and FCPA	19-21 May
PD683	Probabilistic Structural Analysis, Design and Reliability-Risk Assessment	19-21 May
PD685	The New Engineering Manager: Moving from Technical Professional to Manager and Strategic Thinking Combo Course	19-21 May
PD702	Process Safety and Risk Management for Engineers	19-21 May
PD014	B31.3 Process Piping Design	19-22 May
PD448	BPV Code, Section VIII, Division 2: Pressure Vessels	19-22 May
PD672	BPV Code, Section XI, Division 1: Inservice Inspection 10-Year Program Updates for Nuclear Power Plant Components	19-22 May
PD691	Piping Design, Fluid Mechanics, and Fluid Transient	19-22 May
PD581	B31.3 Process Piping Design, Materials, Fabrication, Examination and Testing Combo Course	19-23 May
PD681	International Business Ethics and FCPA Combo Course	19-23 May
PD686	Layout of Piping Systems and Process Equipment and the Utilization of 3D Modeling	19-23 May
PD600	BPV Code, Section III, Division 1, Class 2&3 Piping Design	21 May
PD676	Strategic Thinking	21 May
PD268	Fracture Mechanics Approach to Life Predictions	21-23 May
PD382	How to Predict Thermal-Hydraulic Loads on Pressure Vessels and Piping	22-23 May
PD606	NQA-1 Requirements for Computer Software Used in Nuclear Facilities	22-23 May
PD680	Understanding the Foreign Corrupt Practices Act	22-23 May
PD457	B31.3 Process Piping Materials Fabrication, Examination & Testing	23 May

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May 2014 – London, England

PD673	Design and Selection of Heat Exchangers	19-20 May
PD615	BPV Code, Section III, Division 1: Class 1, 2 & 3 Piping Design	19-21 May
PD633	Overview of Codes & Standards for Nuclear Power Plant Construction	19-21 May
PD645	BPV Code: Section IX Welding and Brazing Qualifications	19-21 May
PD448	BPV Code, Section VIII, Division 2: Pressure Vessels	19-22 May
PD644	Advanced Design and Construction of Nuclear Facility Components Per BPV Code, Section III	19-22 May
PD643	ASME B31.3 Process Piping	19-22 May
PD621	Grade 91 and Other Creep Strength Enhanced Ferritic Steels	21-23 May
PD634	Comparison of Global Quality Assurance and Management System Standards used for Nuclear Applications	22-23 May

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June 2014 – Houston, Texas USA

PD539	Bolted Joints and Gasket Behavior	2-3 June
PD624	Two-Phase Flow and Heat Transfer	2-3 June
PD410	Detail Engineering of Piping Systems	2-4 June
PD442	BPV Code, Section VIII, Division: & Fabrication of Pressure Vessels	2-4 June
PD513	TRIZ: The Theory of Inventive Problem Solving	2-4 June
PD010	ASME A17.1 Safety Code for Elevators and Escalators	2-5 June
PD171	Pump and Valve Selection for Optimum System Performance	2-5 June
PD184	BPV Code Section III, Division 1: Rules for Construction of Nuclear Facility Components	2-5 June
PD622	BPV Code: Plant Equipment Requirements	2-5 June
PD013	B31.1 Power Code	2-6 June
PD443	BPV Code, Section VIII Division 1 Combo Course	2-6 June
PD598	Developing a New Inservice Testing Program	2-6 June
PD601	Bolting Combo Course	2-6 June
PD665	BPV Code, Section 1: Power Boilers	2-6 June
PD190	BPV Code, Section IX: Welding, Brazing and Fusing Qualifications	3-5 June
PD231	Shock and Vibration Analysis	3-5 June
PD359	Practical Welding Technology	3-5 June
PD386	Design of Bolted Flange Joints	4 June
PD575	Comprehensive Negotiating Strategies	5-6 June
PD577	Bolted Joint Assembly Principles Per PCC-1-2013	5-6 June

Visit go.asme.org/houston4

June 2014 – Milan, Italy

PD391	ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids	16-17 June
PD146	Flow Induced Vibration with Applications to Failure Analysis	16-18 June
PD389	Non-Destructive Examination-Applying ASME Code Requirements (BPV Code, Section V)	16-18 June
PD442	BPV Code, Section VIII, Division 1: Design and Fabrication of Pressure Vessels	16-18 June
PD635	ASME NQA-1-2008/1A-2009 Quality Assurance Requirements for Nuclear Facility Applications	16-18 June
PD699	Reliability Excellence Fundamentals	16-18 June
PD171	Pump and Valve Selection for Optimum System Performance	16-19 June
PD616	API 579 /ASME FFS-1 Fitness-for-Service Evaluation	16-19 June
PD632	Design in Codes, Standards and Regulations for Nuclear Power Plant Construction	16-19 June
PD643	ASME B31.3 Process Piping	16-19 June
PD672	BPV Code, Section XI, Division 1: Inservice Inspection 10-Year Program Updates for Nuclear Power Plant Components	16-19 June
PD675	ASME NQA-1 Lead Auditor Training	16-19 June
PD443	BPV Code, Section VIII Division 1 Combo Course	16-20 June
PD665	BPV Code, Section 1: Power Boilers	16-20 June
PD684	BPV Code Section III, Division 1: Rules for Construction of Nuclear Facility Components	16-20 June
PD686	Layout of Piping Systems and Process Equipment and the Utilization of 3D Modeling	16-20 June
PD441	Inspection, Repair and Alteration of Pressure Equipment	19-20 June
PD583	Pressure Relief Devices: Design, Sizing, Construction, Inspection and Maintenance	19-20 June

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Register now: U.S. and Canada 1.800.843.2763, Outside North America 001.973.882.1170

FLUID OR SOLID FLOW

CD-ADAPCO, MELVILLE, N.Y.

STAR-CCM+, A COMPUTATIONAL FLUID dynamics system for solving engineering equations for fluid or solid flow, heat transfer, or stress, has been upgraded to version 9.02. A new feature is volume rendering, which gives users a look inside the flow. Also new is a dispersed multiphase model to be used to simulate impinging water issues. A tumble-and-swirl cost function is included within this version.

Star-CCM+ performs calculations involving flow, heat transfer, or stress. Image: CD-adapco

TECHNICAL APP MAKING

MAPLESOFT, WATERLOO, ONTARIO.

The technical computing software, Maple, has been upgraded to version 18. This version introduces specialized tools for engineering analysis and includes more technical application development tools than available in the past. Now also included is time-series analysis capabilities that support modeling and analysis, pattern finding, forecasting, and the visualizing of data that varies over time. Improvements have also been made to signal processing, control systems design, and physics capabilities within this version, according to the developer.

DESIGN IN THE CLOUD

AUTODESK, SAN RAFAEL, CALIF.

Fusion 360 has been updated. The design tool resides on the developer's servers rather than on a user's desktop and is therefore always available via a mobile or desktop computer with an internet connection. New within the update is the capability to capture commands within a historical and editable timetable. Users can rely on this timetable to change dimensions or the form to a previously created design. The dashboard has been revamped as well. Users can now input text as a sketch, which will then be selectable for commands such as extrude and revolve.

ONLINE TRAINING

ASCENT, FRAMINGHAM, MASS.

Ascent—Center for Technical Knowledge now offers its latest Autodesk Official Training Guides, Creo courseware, and Catia courseware in an online e-learning format in addition to its traditional guides and e-books. The online format includes step-by-step procedures, hands-on exercises, and review questions that reinforce understanding. The online content is drawn from the developer's traditional courseware and is self-paced. Reporting transcripts allow the tracking of each employee's training progress.

ROBOT PROGRAMS

DENSO ROBOTICS, LONG BEACH, CALIF.

The developer's recently released Enhanced Multirobot simulation and offline programming software serves as a master controller for robot project files imported from the company's WINCAPS III application. WINCAPS III allows a robot to be programmed on an offline computer. With the software, users can simulate and program up to 16 Denso robots within a single automation working cell. Users can import CAD drawings in standard VRML and DirectX formats and input or change variables. They can also verify reach, determine obstacle clearance, detect collisions, troubleshoot programs, and determine cycle time.

CAD AND RENDERING

IRONCAD, ATLANTA. LUXION, IRVINE, CALIF.

The CAD-maker IronCAD and the rendering-software-maker Luxion have teamed to create KeyShot for IronCAD. The software offers CAD users access to KeyShot's rendering capabilities, which work directly within the IronCAD products. Users can create 3-D models and generate visuals for communication and collaboration. Assembly structure is saved. During the design process, users can update and make changes from within the CAD interface and have the changes automatically reflected in the rendered image.

CAD TRANSLATED

ZW3D, GUANGZHOU, CHINA.

The CAD software ZW3D CAD/CAM has been upgraded to version 2014. Improvements include an integrated file translator that supports up-to-date formats of most design software, a simplified feature manager, and accelerated part-configuration capabilities. A new function allows for more user control of the entire or partial tool-path. ME

SUBMISSIONS

Submit hard copy or e-mail memag@asme.org, using subject line "Software Exchange." *ME* does not test or endorse software described here.

ENDRESS + HAUSER, GREENWOOD, IND.

The Micropilot FMR5X series of free space radar level transmitters has software with multi-echo tracking algorithms and functions to suppress interference echoes. The company claims the device is accurate to ±0.078 inch (2mm) for level measurement of liquids and bulk solids. The liquids can be measured in metal or plastic tanks, stilling wells and bypass chambers.

LEVEL TRANSMITTERS

REVOLVING HEAD

SCHUNK INTEC INC., MORRISVILLE, N.C.

The RVK has a revolving head that can collect several workpieces before transferring them. The gripper in the working position can be operated independently from the other grippers, which remain in the gripped state when not in use. The RVK allows for lower cycle times and fewer transport strokes in a pick and place system.

LABORATORY HOMOGENIZERS

OMEGA ENGINEERING, STAMFORD, CONN.

The HMG-10 series of laboratory homogenizers has a 144 watt, high-torque motor with a variable speed adjustment and is manufactured from 316 stainless steel. The HMG-10 series generator probes can quickly lock into the special adaptor to provide hands-free ejection of the probe, minimizing the chance of accidental contamination.

QUARTER HP GEARMOTOR

BODINE ELECTRIC CO., NORTHFIELD, ILL.

The new type 34B4/FV-5N gearmotors combine Bodine's 34B brushless dc motor with a right-angle gearhead, a built-in PWM speed control, and an optical encoder. Gearmotor power is 1/4 hp (187 watts), with continuous torque up to 104 lb-in. (12 Nm) and rated output speeds from 63 to 500 rpm. Gear ratios range from 5:1 to 40:1. Integrated control uses a pulse width modulation interface for voltage control, amplifier enable, direction, and dynamic braking inputs. Closed-loop feedback to the external control is provided by an enclosed 1024 PPR, two-channel quadrature, optical encoder.

RUGGED ACCELEROMETERS

MEASUREMENT SPECIALTIES, HAMPTON, VA.

The 801X series of rugged, internally shielded loop power accelerometers are designed to connect to 4-20 mA readout devices or directly into a PLC/DCS control system. The sensors offer a dynamic range of ±5 g to ±50 g in either an RMS or peak output for use in a variety of industrial environments. The Model 8011 and Model 8012 are hermetically sealed and operate in temperatures from -40 °C to +85 °C.

PIEZO DRIVER

PI (PHYSIK INSTRUMENTE) L.P., IRVINE, CALIF.

The compact E-836.03 piezo driver provides for the operation of low-voltage multilayer piezo actuators and piezo positioning systems. It can source and sink peak currents to 100 mA and provides an output voltage range of -30 to 130 V. The module runs on 24 volts and integrates the high-voltage supply for the piezo driver as well as the other required supply voltages.

ELECTRONIC VENT

W.L. GORE & ASSOCIATES, ELKTON, MD.

The PE3 series of portable electronic vents allows a typical airflow of 3,300 ml/min/cm^3—equalizing internal pressure, reducing stress on the seals, and eliminating transducer bias. Vents serve as a barrier against liquid, dust, and dirt, enabling the device to meet Level 7 of the IEC's liquid ingress protection standard (IPx7) — immersion protection at one meter for 30 minutes.

POWER SUPPLIES

AUTOMATIONDIRECT, CUMMING, GA.

Rhino PSB series DIN rail mount single-phase and three-phase input power supplies with IP20-rated terminals are designed for applications that require a basic dc voltage power supply. The series features rugged plastic or aluminum housings. Five new models are approved for Class I, Div. 2 hazardous locations and one new unit is UL 1310 recognized (NEC Class 2).

THREADED STUDS

PENNENGINEERING, DANBORO, PA.

PEM self-clinching threaded studs are intended as alternatives to weld studs or other joining methods with fewer production steps. They install quickly, securely, and permanently using a standard press. The product lineup includes flush-head studs for use in aluminum or steel sheets as thin as 1 mm.

SUBMISSIONS

Submit electronic files of new products and images by e-mail to memag@asme.org. Use subject line "New Products." *ME* does not test or endorse the products described here.

HIGH-CURRENT TEST LEADS

MUELLER ELECTRIC CO., INC., AKRON, OHIO.

Coolflex45 stackable, retractable 10 AWG banana test leads are rated to 600 V, 45 A at 105 °C. Testing conducted by an independent certified laboratory exposed Coolflex45 cables to overload currents of 70 A for 15 seconds, resulting in an 8 °C temperature rise.

CUTTING TORCH

ESAB, FLORENCE, S.C.

The Oxweld SCT-1500 TR manual straight cutting torch features ESAB's patent-pending Elite Series Universal Swirl Injector gas mixing technology that provides an optimum mix of gas to improve cutting efficiency while reducing the potential for damaging flashback.

Los Alamos
NATIONAL LABORATORY
EST. 1943

Los Alamos National Laboratory (LANL), a multidisciplinary research institution engaged in strategic science on behalf of national security, seeks an **Engineering Technologist 1** for our **Weapons Test Engineering Group.**

Engineering Technologist 1 – Job IRC32935

As a mechanical engineering technologist, the successful candidate will serve as a technologist engaged in component, subsystem, and system testing that includes test design and planning activities, data acquisition functions, data interpretation activities, and formal reporting. Testing activities include executing test objectives, setting up testing environments, and executing instrumentation requirements. Responsible for supporting the testing processes by performing supporting tasks such as test planning documentation, test fixture design and fabrication, instrumentation layout and installation, data acquisition equipment interfacing, and written test results reporting. Additionally, participates in the development of new testing technologies and facilities, and implements quality assurance requirements.

Position requires an Associate's degree in Engineering Technology, or an Associate's degree in a technical field. The degree shall have been earned at an accredited institution. Equivalent years of relevant experience in lieu of a degree will be considered; however, this will require evidence of participation in publications where the applicant contributed extensively to the written product both in content and form. Must possess demonstrated experience in planning and executing tests involving components preferably in shock, vibration, and thermal environments. Experience in the use of data acquisition systems required. Knowledge in the use of some typical engineering software for data acquisition, analysis, and display such as Mathcad, MATLAB, EXCEL, LabView, Origin, or other similar software is also required.

To apply and learn more about the position,
please see **Job IRC32935** at **careers.lanl.gov**.

EOE

Los Alamos
NATIONAL LABORATORY
EST. 1943

Los Alamos National Laboratory (LANL), a multidisciplinary research institution engaged in strategic science on behalf of national security, seeks an R&D Engineer for our Weapons Test Engineering Group.

R&D Engineer 4

As a lead mechanical test engineer with an emphasis on dynamic testing of components, the successful candidate will serve as a lead test engineer engaged in component, subsystem, and system vibration, modal, and shock driven testing. The main functions of this position are to provide dynamic testing consultation to customers for proper test requirements identification; design tests that meet the testing requirements; execute tests; conduct extensive data review of the results for performance and trend analysis; and create reports of the testing activity and results. Tasks also include test component design and analysis; component fabrication technical oversight; test scheduling; test coordination; and creating test-related documentation. Additional job responsibilities include participating in the development of new testing technologies and facilities, and implementing quality assurance requirements.

A Master of Science degree, or a PhD in Mechanical, Aerospace, or Structural Engineering, or a related field, is required. Must possess extensive experience in mechanical test engineering planning and execution in shock, vibration, and modal test environments, as well as in evaluating dynamic testing results, data analysis, and assessing and reporting performance. Extensive knowledge in the use of some typical engineering software for data acquisition, analysis, and display is essential. Must have extensive experience in selecting instruments and establishing signal conditioning parameters. Demonstrated ability to analyze data on various consumer products required. Experience in the engineering design and analysis of components where concepts are turned into realistic parts in three dimensional modeling software, and analyzed using Computer Aided Engineering (CAE) tools such as Finite Element Analysis (FEA) method software, are required.

To apply and learn more about the position,
please see **Job IRC32494** at **careers.lanl.gov.**

EOE

ETH

Eidgenössische Technische Hochschule Zürich

Swiss Federal Institute of Technology Zurich

Professor of Systems and Control

The Department of Mechanical and Process Engineering (www.mavt.ethz.ch) at ETHZurich invites applications for a professorship in systems and control.

The successful candidate is expected to develop a strong and visible research program in the area of systems and automatic control. The candidate should be able to bridge solid theoretical foundations, development of computational methods, and applications to areas such as energy conversion systems, transportation systems, and mechatronics.

Candidates should hold a PhD degree and have an excellent record of accomplishments in mechanical engineering or related fields with a specialization in systems and control. In addition, commitment to teaching undergraduate level courses (German or English) and graduate level courses (English) and the ability to lead a research group are expected.

Please apply online at www.facultyaffairs.ethz.ch

Applications should include a curriculum vitae, a list of publications and statements of future research and teaching activities. The letter of application should be addressed **to the President of ETH Zurich, Prof. Dr. Ralph Eichler.**

The closing date for applications is August 31, 2014.

ETH Zurich is an equal opportunity and family friendly employer and is further responsive to the needs of dual career couples. In order to increase the number of women in leading academic positions, we specifically encourage women to apply.

POSITIONSOPEN

ROSE-HULMAN INSTITUTE OF TECHNOLOGY'S MECHANICAL ENGINEERING DEPARTMENT, a recognized leader in undergraduate engineering education, invites applications for a visiting position beginning fall 2014. The targeted area of specialization is in mechanics at the level of assistant professor. However, exceptional applicants in any area of specialization and at all levels will be considered. Applicants must have a strong commitment to undergraduate engineering education, including a passion for classroom teaching and laboratory instruction, and a commitment to life-long personal and professional development. An earned Ph.D. is required or near completion. A B.S. degree in mechanical engineering and industrial experience are desirable. Essential job functions include: classroom teaching and student advising; curriculum development and improvement; and service and committee work. For full consideration please apply on-line at: https://jobs.rose-hulman.edu. Additional information is available at: www.rose-hulman.edu/me/. Screening will begin immediately. EEO/AA.

MAINTENANCE ENGINEER w/ bachelor's degree in any engineering field & 1 yr. exp. as Maintenance Engineer. Operate, maintain, & repair mechanical & electrical building equipment. Test faulty equipment & diagnose cause of malfunction. Replace defective components & wiring. Job loc.: North Houston area. To schedule an interview, fax resume to Mr. Hun Y. Sim, president of WKND Corporation d/b/aMercadoSabadomingo,at(713)780-1070.

NANJING TECH UIVERSITY FACULTY POSITIONS in College of Mechanical and Power Engineering. This announcement invites applications for tenure-track faculty positions in: Mechanical Engineering, New Energy Science and Engineering, Welding Technology and Engineering, Mechanical Design Manufacturing and Automation, Vehicle Engineering, Process Equipment and Control Engineering. Required Qualifications: Ph.D. in Mechanical Engineering or a closely related field is required. Initial appointments are at the assistant professor level. Exceptionally qualified candidates at the associate or full professor level may also be considered. Rank and salary are commensurate with experience as well as accomplishments. Candidates should send their applications to chunlei-shao@njtech.edu.cn. Application requirements include a CV, list of publications, statements of research and teaching plans. Applications received before December 31, 2015 will be guaranteed full consideration. For additional information please visit: http://www.njtech.edu.cn.

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CONSULTING

FATHY WINS NSF HONOR

ASME MEMBER HOSAM FATHY, ASSISTANT professor of mechanical engineering at Pennsylvania State University, has been awarded a National Science Foundation Early Career Development Award. The award provides five years of funding for researchers and supports junior faculty with exceptional promise in teaching and research.

Fathy received a $400,000 grant for "Identifiability Optimization in Electrochemical Battery Systems." His work seeks to develop new models for thermo-electrochemical lithium-ion batteries and to improve battery diagnostics.

BERTOLDI RECOGNIZED AS YOUNG INVESTIGATOR

KATIA BERTOLDI, ASSOCIATE PROFESSOR IN applied mechanics at the Harvard School of Engineering and Applied Sciences, will receive ASME's 2014 Thomas J. R. Hughes Young Investigator Award, which recognizes achievements in applied mechanics for researchers under the age of 40. The award will be presented at the Applied Mechanics Division Honors and Awards Banquet during the ASME International Mechanical Engineering Congress and Exposition in Montreal in November.

Bertoldi won recognition for her contributions to the theory and simulation of the mechanics of soft materials and structures. Her work focuses on the nonlinear behavior of materials and structures.

Bertoldi is also a Kavli Scholar at the Kavli Institute for Bionano Science and Technology at Harvard.

ASME SEEKS MANUSCRIPTS FOR NEW RISK JOURNAL

ASME AND THE AMERICAN SOCIETY OF CIVIL Engineers are each producing one volume for a two-part journal that will address risk and uncertainties in the civil and mechanical engineering aspects of engineered systems. ASME is currently accepting submissions for its volume of the new journal, *The ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems*, through the ASME Journal Tool web site.

The quarterly journal will present state-of-the-art research and best practices for ensuring a full discussion on issues related to risk and uncertainty. Part A of the journal, to be published by ASCE, will focus on the civil engineering aspects of these topics. ASME's volume, Part B, will concentrate on mechanical engineering.

Bilal M. Ayyub, professor of civil and environmental engineering and director of the Center for Technology and Systems Management at the University of Maryland, College Park, is the editor for Part B.

Papers for the inaugural issue should be submitted by June 30. ■

LACK OF PATHWAYS IS AN "ENGINEERING EMERGENCY"

FAILURE TO TAP THE CREATIVE POTENTIAL of millions of black and Latino Americans is hurting the nation's ability to stay at the forefront of innovation. That's one of the conclusions of "Engineering Emergency: African Americans and Hispanics Lack Pathways to Engineering," the most recent data release from Change the Equation, a nonprofit, nonpartisan, CEO-led initiative mobilizing the business community to improve the quality of science, technology, engineering, and mathematics education in the United States.

ASME was one of a number of engineering organizations that hosted an event on Capitol Hill marking the release of the report. ASME President **Madiha El Mehelmy Kotb** attended the event on behalf of the Society. Said Kotb, "By dramatically improving the participation of women and talent from other under-represented groups in the STEM workforce, the U.S. can leverage the diversity of these individuals to fuel the innovation necessary for our global competitiveness, as well as meet the challenges of a changing world."

The report explores gaps in the engineering pipeline. While African Americans and Latinos constitute a third of the college-age population, together they earn fewer than 16 percent of all engineering degrees. It is projected that by 2022, 9 in 10 new engineering jobs will require at least a bachelor's degree. At present, most engineering credentials earned by African Americans and Latinos earn are below the bachelor's level.

"ASME is committed to achieving a truly diverse and inclusive science, technology,

ENGINEERING RECOGNIZES NEW FACES

EACH YEAR, ENGINEERING SOCIETIES nominate members 30 years or younger for the New Faces of Engineering program in recognition of their contributions to the profession and society. ASME member **Stacy Moss** was selected to be one of the 13 New Faces for 2014.


Stacy Moss

Moss and the other New Faces winners were announced in a full-page ad in *USA Today*. The program is administered by DiscoverE.

Moss is a shock and survivability analyst at the Naval Undersea Warfare Center Division Newport. According to the center's commander, Captain T.W. Cramer, "Moss has quickly proved herself as one of the best shock and survivability analysts in this organization." She leads a Weapons Systems Integration Team and is responsible for such technology as weapon shipping, handling, and stowage systems.

"Ms. Moss represents the best qualities in an engineer," Cramer said, "and is an outstanding representative of Division Newport, as well as the ASME organization."

Moss received her bachelor's and master's degrees in mechanical engineering from the University of Massachusetts in Amherst.

Three ASME student members—**Ashton Archer** of Kansas State University in Manhattan, **Emily Miner** of Worcester Polytechnic Institute in Massachusetts, and **Meredith Campbell** of Daniel Webster College in Nashua, N.H.—were ASME's three finalists for the 2014 New Faces of Engineering-College Edition program, a spin-off that recognizes the achievements of engineering students. ME


New student faces: From left, Ashton Archer, Emily Miner and Meredith Campbell.

Supporting diversity: From left, ASME President Madiha El Mehelmy Kotb, Gayle J. Gibson of DuPont, and ASME Past President Victoria Rockwell on Capitol Hill.

engineering, and mathematics workforce in the U.S. and worldwide," Kotb said. "With the predicted changes in future U.S. workforce demographics, increasing the participation of women and underrepresented groups in the U.S. STEM workforce must become a 21st century national imperative."

Other co-hosts included the American Society for Engineering Education, the American Society of Civil Engineers, DiscoverE, IEEE-USA, the National Action Council for Minorities in Engineering, the National Center for Technological Literacy at the Museum of Science Boston, and the Society of Women Engineers. **ME**

MATERIAL GAINS

A materials properties database promises **new support for the Boiler and Pressure Vessel Code.**

THE ASME BOILER AND PRESSURE VESSEL CODE HAS COME a long way since it was introduced in 1914. It is used in 100 countries. It has expanded to more than a dozen volumes. And there is no end in sight.

More than 1,000 volunteer technical experts work on various committees to maintain a program continually improving. They update the code to accommodate advancements in engineering and materials, and to refine design requirements for industrial projects.

One of the essential elements to the process is knowledge of materials properties, which inform many of the formulas set forth in the code volumes. The codes rest on a vast library of that kind of information.

In order to make the information more accessible to code committee volunteers—and also to manage, preserve, and centralize it—ASME is developing an advanced digital database system to store and retrieve its information on materials properties.

When a new material is proposed for BPVC acceptance for use in specific designs and construction, its materials properties data package is submitted to the relevant code committees for review and approval. Corresponding design and construction rules can be developed based on the approved data package.

Managing the materials properties data in a centralized *continued on p.70*

PART OF A SERIES IN WHICH ASME PAST PRESIDENTS DISCUSS KEY ISSUES.

Presidential Oral Histories:

ASME and Globalization

ASME PRESIDENTS The Oral History Archives

For the first 90 years of its existence, ASME concerned itself chiefly with engineering in the U. S. But ASME's presidents played a pivotal role in broadening the Society's focus during the last few decades of the 20th century.

Since the 1970s, ASME presidents have traveled the globe representing an increasingly global organization and forging its connections with international counterparts. As **Richard Folsom** (1972-73) said in an oral history interview: "We've got to look at engineering on an international basis, to have an influence and gain experience."

ASME's international presence dates to a 1970 conference known as "Arden House." As president, **Donald E. Marlowe** convened the conference to consider ASME's activities for a new era. It was at Arden House that ASME declared its official goal to "strengthen ties among engineers worldwide."

In subsequent years, ASME worked towards establishing cooperative ties with its sister societies worldwide. Each president became a global ambassador. Among the most traveled, **Arthur Bergles** (1990-91) signed agreements of cooperation with societies in France, Belgium, Italy, Norway, Yugoslavia, Argentina, and Israel.

Nathan Hurt attended summits in 1991-92 with engineering societies in Australia, Colombia, France, Germany, Greece, Hong Kong, Israel, and Singapore.

ASME leaders saw the need for members to be ready for an increasingly international marketplace. For this reason, **Reggie Vachon** (2003-04) advocated for a "Mobility of Engineering Credentials" working group.

Leaders began to view engineering challenges as international. "The Earth's atmosphere, the ozone layers which are disappearing—this is an international problem," Folsom said.

Terry Shoup (2006-07) saw the continuing need for international focus. "The fastest-growing segment of our membership is from outside the U.S.," he said. "Our codes and standards are now in places where they weren't before. Our technical conferences are more global than ever."

Or as Vachon expressed it: "We're in a world where people have to interact, and the practice of engineering is across borders." ■

JOSHUA OLESKER / ASME PUBLIC INFORMATION

continued from p.69

and authoritative database system will offer many benefits. Every year, as thousands of engineering professionals interact with BPVC, a tremendous amount of materials properties data from industries, academia, and government research institutes from around the world flows through ASME's code committees. With proper implementation, a centralized database can effectively serve as a reservoir to accumulate and organize this wealth of information.

A modern database system can also provide a tangible platform that supports collaborations across different engineering and scientific communities in development of new materials, modeling techniques, structural design methods, and manufacturing processes. Furthermore, as ASME becomes increasingly international, an advanced materials properties database will benefit the greater global BPVC community.

The ASME Materials Properties Database project kicked off in June 2012. A Materials Database Working Group was established under the ASME Committee on Materials and meets quarterly to oversee the design, development, and implementation of the database system. The working group provides expertise and is establishing the processes for collecting, interpreting, qualifying, and preparing materials properties data for inclusion in the database.

ASME is collaborating with the Oak Ridge National Laboratory and will draw heavily on the lab's experience in developing a similar digital resource, the Gen IV Materials Handbook database system, which was sponsored by the Department of Energy to support international materials collaboration for nuclear programs.

The ASME Materials Properties Database will be designed to provide authoritative and consistent data to support BPVC development and maintenance. As a long-term digital materials information reservoir, the database structure will be flexible to suit not only the current ASME codes and standards, but also their future growth. To ensure a smooth development and immediate operation, a "piecewise development strategy" has been adopted, by which the database system is designed, constructed, and operated piece by piece over time. The piecewise strategy, divided into two phases, also provides flexibility to adapt any design modifications in response to the fast advancement of information technologies, as well as funding fluctuations.

Phase I creates a Data File Warehouse for the collection and consolidation of past materials properties data files, which are scattered among various existing databases. The warehouse will be the destination of future material properties data files as they are submitted to ASME. The Data File Warehouse will manage these electronic data files in a well-organized fashion with certain search functions so that users can easily find the information they need for BPVC development.

In Phase II, an advanced Digital Database system will be created that can manage digital materials data by its basic information elements, i.e. the individual data points, with powerful data processing functionalities so that desired sets of data values can be easily called out for reformat, tabulation, comparison, analysis, or transfer to external modeling and simulation software. The Digital Database system will provide high traceability to manage not only data but also relations between data. A user should be able to start from a material's generic data and trace to its pedigree data, test data, statistical data, microstructure data, and design data. Or the starting point could be one of the specific areas which would trace to the material's generic data.

The Digital Database contents will be supplied from the Data File Warehouse and be linked back to their original data files in the warehouse so that users can trace the origin of the digital data for authentication and verification as needed.

To meet the potential security requirements of materials properties data contributors, the ASME Materials Properties Database has sophisticated access control capabilities and has the ability to restrict access to selected data to certain database users or by a given code project as established within the database.

As the database system grows, new data management features will be added to enhance its performance and address emerging challenges for ASME codes and standards development and maintenance. It is envisioned that once the ASME Materials Properties Database is well established in a few years it will allow cyberspace to be used so that all ASME codes and standards can be conveniently traced back to the original supporting materials data from which they have been developed.

Roots for discrepancies and inconsistencies in ASME codes and standards can be quickly tracked down and eliminated. Design rules can be effectively reviewed and updated as new material properties data packages become available. The digital database system will allow custom development of Application Programming Interfaces that provide direct data transfer between the database and external software, which would create great opportunities for ASME to support advanced modeling and simulation, integrated computational materials engineering, and computer aided engineering for ASME codes and standards related developments. **ME**

TO LEARN MORE

"Gen IV Materials Handbook Functionalities and Operation (3A)—Handbook Version 3.0—", ORNL/TM-2011/248_3A, U. S. Department of Energy Generation IV Nuclear Energy Systems Program, U. S. Department of Energy, February 15, 2012, Weiju Ren.

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WEIJU REN is senior research staff member and **LIANSHAN LIN** is post-doc in the Materials Science and Technology Division at Oak Ridge National Laboratory. **JOHN GRIMES** is project manager with ASME Standards Technology LLC.

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The land speed record has stood at 763 mph for 17 years.

Can an American team do better in a repurposed 1957 jet fighter?

QUICKEST ON THE GROUND

ED SHADLE SPENT HIS CHILDHOOD AS A PIT rat in the Okanagan Valley in northern Washington State and his teen years living an *American Graffiti* lifestyle.

The role of pit rat encompassed many things, but all of them around racecars, even soapbox derby racecars. *American Graffiti* the same, though the racecars weren't made from soapboxes.

"My uncle got into dirt-track stock car racing and I went with him," Shadle said. "Time went on, and as a teen in the late '50s I raced at a local airport where for 50 cents in gas you can race all night."

Times change—50 cents of gas can take you just a few miles these days—but not Shadle's love of racing. This time, his goal is more ambitious than winning a small-time dirt-track race. Shadle is the project manager and owner of a team aiming to break the land speed record.

That's a jet-propelled task. *ThrustSSC*, powered by two Rolls-Royce turbofan engines, set the current record in 1997 by exceeding the speed of sound in the Black Rock Desert of Nevada. The car, developed by a British team, was driven a Royal Air Force pilot, Andy Green.

The rules are simple enough: Cars must make two passes in opposite directions within one hour on a fixed-length course. A new record must exceed the previous one by at least one percent to be validated.

For Shadle's team, based in Kent, Wash., the attempt will be made by a former military airplane stripped of its innards and wings. Shadle found the 56-foot-long F-104 Starfighter through a friend and hauled it back from Maine, where it had been displayed in a yard.

A team of 35 volunteers, including engineers at Boeing and other companies in the Seattle area, has outfitted the former plane with suspension, steering, and wheels. Power is provided by a GE LM-1500 turbojet.

The North American Eagle uses the fuselage of an F-104, a supersonic interceptor made by Lockheed Martin.

A team of 35 volunteers has converted the aircraft into a car propelled by the thrust of a GE LM-1500 turbojet.

The team's principal driver, Jessi Combs, has so far taken the racecar up to 440 mph, clocked in a 2013 test run.

The racing team based in Kent, Wash., uses the Alvord Desert in southeastern Oregon as its proving ground.

A parachute slows the vehicle after driver Jessi Combs—the world's fastest woman on four wheels, according to Autoblog.com—hits the brakes.

The crew has renamed the now wingless former fighter the *North American Eagle*.

With Combs as driver, the *North American Eagle* reached a speed of 440 mph in the Alvord Desert in southeastern Oregon in October 2013. Shadle is also a team driver.

For an American team, setting the land speed record will be no easy feat, Shadle admits. Other countries fund teams and projects and employ full-time engineers.

"If we had funding, that would really speed up the cycle," he said.

Repurposing a 1957 aircraft may seem an odd choice for land speed racing, but Shadle argues that it makes perfect sense. The F-104 is a single-engine supersonic interceptor made by Lockheed Martin.

"I wanted to use an F-104 because aerodynamically it could reach the speeds we needed," Shadle said. "We didn't have to redesign a vehicle. We just attached wheels to it to make a car."

The airframe was covered with dirt and grease when it arrived. A power wash revealed the painted ghostly letters FG-783. Shadle researched the plane to find it had been used as a chase plane for the U.S. Air Force and for the NASA X-15 experimental plane, which set speed and altitude records in the early 1960s.

According to Shadle, "The minute I saw this plane, I felt like, 'That's my baby.' " ME

JEAN THILMANY

ASME DECISION POINT DIALOGUES

CRITICAL THINKING, CRITICAL CHOICES: WHAT REALLY MATTERS IN STEM

Beginning in June, WATCH the **ASME Decision Point Dialogues: *Critical Thinking, Critical Choices: What Really Matters in STEM***, an important program engaging thought leaders in a unique Socratic dialogue tracing a hypothetical case tugging at the heart of the issues confronting the future of STEM education—recorded at this year's **US News STEM Solutions Conference**.

See celebrated journalist John Hockenberry lead 12 influential Science Technology Engineering and Math leaders through a myriad of intricate cultural, economic and education-related conflicts such as:

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- **Should STEM learning be turned on its head?**
- **Is it a matter of money—for teachers, for tools, for resources?**
- **Do U.S. educators have something to learn from how STEM is taught in other countries?**

MODERATOR

John Hockenberry, host of National Public Radio's The Takeaway

PANELISTS INCLUDE

Madiha Kotb, ASME President

Arthur Levine, President, Woodrow Wilson Foundation

Michele Lezema, Executive Director, The National GEM Consortium

Ioannis Miaoulis, President & Director, Museum of Science, Boston

… and many others

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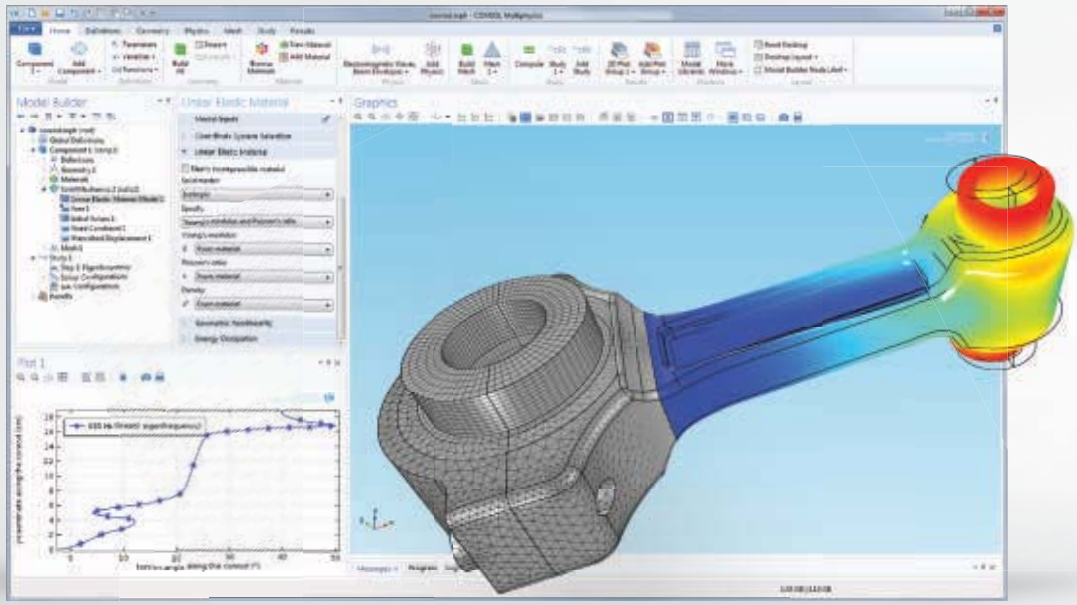

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