ANS ANNUAL MEETING

The view ahead: Prospects and challenges

Maybe it was because the nuclear-friendly documentary film *Pandora's Promise* was opening nationwide that week, but those attending the opening plenary session of the American Nuclear Society's 2013 Annual Meeting, held June 16–20 in Atlanta, Ga., appeared revved up, despite some recent negative developments for the industry. Just nine days prior to the start of the meeting, Southern California Edison announced that it was closing both of its San Onofre units. That announcement was preceded by the closing of Kewaunee in May and Duke Energy's announcement in February that it was permanently shutting down Crystal River-3.

And the bad news wasn't limited to plant closings. As the plenary session organizer and general chair of the meeting Stephen Kuczynski, president and chief executive officer of Southern Nuclear, said in his opening remarks, a soft energy market caused by slow economic growth, the shadow of Fukushima Daiichi, a seemingly dysfunctional political system, and market distortions caused by subsidized renewables are just some of the challenges facing the industry.

Kuczynski

Yet those negatives are tempered by what else is happening within the industry, Kuczynski said, including the five new reactors being built in the United States and the 65 reactors being built elsewhere around the world. And despite what has been reported in the media, he said, new construction is proceeding well, laying the groundwork for future projects. Also, he said, the nation's nuclear fleet continues to operate at high levels of safety and reliability.

Unfortunately, the challenges the industry faces are having a significant impact not only on the rate of new construction but also on existing plants, funding levels for research and university programs, and federal, state, and local policy decisions, Kuczynski said. Employing a sports metaphor, he said that the industry will need to adopt a better offensive approach to facing these challenges. "I would say now is a critical time for this industry to address these real challenges, become more energized, more strategic, and much more influential in playing offense versus what seems like a perennial good defense approach," he said.

Kuczynski apparently took his own advice when organizing the plenary session, assembling a strong lineup of speakers who are recognized pros in the nuclear field. And while they are clear-eyed about the hurdles ahead and pulled no punches in their assessment of the current state of affairs, they found reason for optimism.

First up was Commissioner Kristine Svinicki, of the Nuclear Regulatory Commission, who offered her view of what the nuclear playing field could look like five, 10, and 20 years into the future. Within the five-year time frame, Svinicki said, the industry will see the completion of Vogtle-3 and -4, Summer-2 and -3, and Watts Bar-2, along with "substantial progress" on the NRC's review of submitted designs for small modular reactors (SMR) and advanced reactors. Svinicki also said that substantial progress on the implementation of the NRC's proposed Fukushima-related orders should be made in the next five to 10 years, while farther out, 10 to 20 years from now, there may be new knowledge about the underlying phenomena of severe accident progression as research into the Fukushima accident continues.

Svinicki

As for the NRC's future, Svinicki said that she sees the agency's engagement within the international community as continuing to be an important issue, with the NRC working with the global nuclear community on vendor supply chain and quality assurance issues. Other issues the NRC will continue to address, she said, include security issues,

Meeting session coverage:

- *Industry adjustments to recent setbacks*
- *Effects of medical radiation doses*
- *A new nuclear business model?*
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particularly cybersecurity, the effects of budget cuts on agency operations, and the cumulative impact of regulations.

Svinicki also touched on waste and decommissioning issues, noting that the recent reactor closings have put waste management "front and center." While Svinicki said she would not make any predictions about the current legislative efforts to reconstitute a national nuclear waste policy (see page 150), she said that she is confident that the NRC will resolve its court-vacated waste confidence rule, which has caused the NRC to suspend issuing new or renewed licenses. "Although I think it's reasonable to expect subsequent legal challenges to whatever we promulgate, I'm very confident in the way we approached it," she said. "I think it's very sound."

Following Svinicki, Daniel Roderick, president and CEO of Westinghouse Electric Company, took up Kuczynski's good-offense mantra by challenging the nuclear industry to reinvent itself. "Every great industry reinvents itself periodically," he said. Reinventing the industry means listening to the voice of the customer, the market, and the technology, he said.


Roderick

In addressing some of the challenges facing commercial nuclear energy, Roderick attempted to burst the shale gas bubble, saying that the current supply of cheap natural gas that is competing with nuclear cannot be sustained. The problem, he said, is that after a decade of mapping reserves, the gas companies went in, and in a two-year period drilled all the gas-rich sites. "You realize that the day that happened, all those wells started reducing pressure," he said. "So this glut of power that you see is a bit of a misnomer, because they took all of what I'll call the 'top of the tank.'" Eventually, Roderick said, the supply of gas will not be able to keep up with demand, and prices will go up.

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Roderick also shared his company's lessons learned in the NRC's combined construction and operating license (COL) application process for new reactor construction under 10 CFR Part 52. The issue with the COL, he said, is that "we got exactly what we asked for." That is, Westinghouse wanted a process where all design issues are settled and approved prior to construction. As is the case with Vogtle, however, if construction realities demand that changes be made, and those changes are not specified in the design, it creates problems that can cause delays. Roderick conceded that as a vendor, Westinghouse shares much of the blame for why it now takes so long to license and build a new reactor.

"I still say the nuclear future is very bright," Roderick said. "I just think it's [going to be] different." In addition to the shale gas bubble, other positives Roderick pointed to include the market certainty created by the new AP1000 reactors being constructed and the continued development of SMRs—although he said that he doesn't believe the first SMRs will be built domestically. "I think the first small modular reactors will be built overseas," he said.

Turning from the arena of fission energy to fusion technology, Edward Moses, the principal associate director of Lawrence Livermore National Laboratory's National Ignition Facility (NIF), spoke about his team's efforts to achieve high-energy fusion ignition. As an introductory aside, Moses said, "I don't consider fission and fusion in competition. I just consider [fusion] the 'other' nuclear energy."


Moses

Moses described the facility at Livermore as a football stadium–sized building, with 192 lasers focused on a BB-sized target. The target contains a capsule with a milligram of hydrogen fuel capable of producing about 40 kilowatt-hours of electricity, he said. The process of using the energy of the lasers to ignite the fuel pellet is analogous to a diesel engine, he said, where fuel is compressed to the point that it ignites.

The goal of ignition, Moses said, is to get more energy out than is put in through the lasers. While he admitted that they haven't gotten there yet, he said they are close, and that NIF has the potential to demonstrate full-scale performance of the fusion system. "We've developed a plant that's based directly on NIF performance," he said, "and we've worked hard on thinking about how you would commercialize this."

In response to the question of why commercial fusion power is always said to be 10 to 50 years away, Moses said that the technology is finally catching up to the predictions. "I have confidence that the needs of our planet are great and this is a potential solution," he said. "And I think we will show that in the next couple of years."

Next, Christofer Mowry, president of Babcock & Wilcox mPower Inc., returned to the sports metaphor theme by touting small modular reactors as an industry game changer. "I would say that in order to change the game, you have to change the playing field itself," he said, noting that SMRs can compete directly with other forms of energy by changing the generation platform.


Mowry

"The real promise of small modular reactors is not what it does for the reactor, but what it opens up in terms of rethinking the nuclear island architecture itself," he said. A below-grade reactor without the need for a shield building and with fewer large, complex cooling systems simplifies the nuclear island and reduces costs, he said, claiming that more than 60 percent of the cost of a typical pressurized water reactor is in the nuclear island.

Mowry also said that SMRs have the potential to change public perceptions of nuclear. Because of their below-grade construction, he said, emergency planning zones would be limited to "inside the fence," with any potential radiological releases contained to less than 1 rem at the site boundary. "That, in our view, is the key for accessing broader deployment, not only in the U.S., but globally," he said.

While last to address the plenary audience, Eugene Grecheck, vice president of nuclear development at Dominion Generation, nonetheless managed to hit it out of the park, giving what was likely the most brutally honest yet passionate presentation of the session. The bittersweet nature of Grecheck's talk was reflected in the opening lines of Charles Dickens' novel *A Tale of Two Cities*, which Grecheck quoted: "It was the best of times, it was the worst of times . . . ."


Grecheck

Certainly, Dominion's decision to close the Kewaunee plant in Wisconsin represents a low point for the industry. Grecheck noted, however, that he had the privilege of being in the control room the day the reactor was shut down for

the final time, and he said the professionalism of the operators and staff was inspiring. "I am so proud of the employees of Kewaunee," he said. "The day the plant shut down, it was just like any other day."

Pointing out that Kewaunee was an excellent plant and the best-performing unit in Dominion's fleet, Grecheck stressed that the decision to close it was purely an economic one. "If this plant were in Virginia it would be running today, and nobody would be talking about it," he said. "This is an accident of geography. It just happened to be located in an area of the country that was deregulated, was in a merchant situation, and because of low demand and low energy prices, it became infeasible to operate it."

The good news, Grecheck said, is that Dominion is continuing to make progress on its COL application for the North Anna -3 project in Virginia. Acknowledging Dominion's recent decision to switch back to using GE Hitachi Nuclear Energy's ESBWR for the project from Mitsubishi Heavy Industries' US-APWR (*NN*, June 2013, p. 26), Grecheck said that the challenge of North Anna-3 is not a licensing issue, nor is it a public acceptance issue. The challenge is in financing the reactor and allocating that financial risk among all the players. "I think we've gone a long way in terms of determining that risk allocation," he said. "But the fact is, we are talking about many, many billions of dollars. It's not an easy thing to do."

As for his honest assessment of the industry, Grecheck said that the "uncomfortable fact" is that in the current market environment, "it is not possible on an economic basis to justify building new [nuclear]." He said, however, that because the current energy situation is unsustainable, Dominion will continue to remain in the nuclear industry for the long haul. He said that making long-term energy decisions based on short-term market realities does not make sense.

Medical health physics

The rising number of radiological diagnostics being performed in hospitals and clinics today has been receiving increased media attention, raising fears of unnecessary and potentially harmful exposures. Most recently, a study published in *JAMA Pediatrics* in June claims that the 4 million computed tomography (CT) scans of the most commonly imaged organs conducted in children each year could result in approximately 4870 future cancers.

David Borrego, of the University of Florida (UF), noted that from 1980 to 2006, there was a sixfold increase in the per capita effective dose from diagnostic medical radiation, with an effective dose estimated at 10 to 300 millisieverts. Borrego, a graduate student in UF's Biomedical Engineering Department, spoke at the session "New Horizons in Medical Health Physics," where he discussed the need for comprehensive dosimetry for interventional fluoroscopic procedures.

Borrego said that patients often receive relatively high radiation doses during interventional radiological procedures, and that there is a need to be able to track the doses on site and quantify any errors. This can be done, he said, using computer analysis of more complex hybrid computational phantoms (models of the human body used for dosimetry studies). In addition, he said, methods for calibrating diagnostic equipment and Monte Carlo simulation of the organ dose dependency on the energy spectrum will further help limit exposure.

It's important that the radiological dose is not limited as a way of reducing radiation exposure, as that may negatively affect imaging accuracy.

Borrego was careful to note that it's important that the radiological dose is not limited as a way of reducing radiation exposure, as that may negatively affect imaging accuracy, and hence diagnostic efficacy.

Wes Bolch, also from the University of Florida, took up the subject of the use of phantoms to estimate radiological doses to patients, providing an overview of the library of hybrid computational phantoms created by the university and the National Cancer Institute. The phantoms are meant to be representative of the average U.S. population of male and female adults and children based on height and weight (50th percentile). The problem, Bolch said, is that the national percentiles are quickly becoming outdated due to the growing obesity epidemic.

To illustrate his point, Bolch presented two slides of maps from the Centers for Disease Control and Prevention (CDC) showing the rates of obesity in the United States between 1988 and 2010. In the 1988 map, no state had a rate of obesity above 15 percent. By 2006, no state had a rate below 15 percent. And by 2010, the majority of the country had a rate above 25 percent, and no state had a rate below 20 percent.

The accelerated rate of obesity prompted UF to update its library of hybrid computational phantoms to better reflect the current population, Bolch said. The university used data from the CDC's National Health and Nutrition Examination Survey to model phantoms primarily based on height and further described by weight. Bolch also discussed the university's efforts to develop patient-dependent phantoms using 3D computer modeling. The patient-dependent phantoms significantly increase the overall accuracy of estimating organ doses, he said.

The medical health physics session was chaired by Glenn Sjoden, of Georgia Tech, who presented an overview of the new Radiological Science and Engineering Laboratory located on the Georgia Tech campus, just a few blocks from where he was speaking. Completed last year, the $4.5-million state-of-the-art shielded laboratory complex is intended to be a premier academic research facility in nuclear and radiological engineering, medical physics, and nuclear security, Sjoden said. The lab houses significant radiation sources and devices for research, training, and education, including a 14-MeV neutron generator, he said.

A new business model?

The panel session "Managing the Spectrum of Risks in the Complexities on New Build Nuclear—Call for a New Business Model to Meet the Challenges and Opportunities in the U.S. and International Nuclear Markets" may have had the longest title of any session at this meeting. Many of the nine panelists cited what are commonly seen as impediments to new nuclear deployment in the United States—low natural gas prices, uncertainties in the 10 CFR Part 52 licensing system, which has not yet led to reactor startup, the slow pace of recovery from the 2008 economic downturn, and the pressure on shareholder-owned businesses to deliver favorable results every quarter. Despite the insistence by session organizers that the current business model does not work, however, only vague ideas of what a better model would look like were presented, and essentially nothing was said about what it would take for such a model to be put into effect.

China, where several reactors are being built at a brisk pace, was cited several times as an example of a model that works, as far as getting the units finished and put into operation. On the panel was Shenjie Gu, deputy chief engineer of the Shanghai Nuclear Energy Research and Design Institute, who noted that China has been forced to make adjustments to accommodate the pace of construction. Nuclear engineering programs have recently been added to more universities to address what looked to be a shortfall in qualified personnel. Implicit in this is China's central planning: Edicts from the national government (and/or the Communist Party) drive project authorization and exe-

cution, as well as support systems such as engineering education. In general, short-term cost is no object, and there is no established system for appeal or protest.

Energy economist Rob Graber, a principal of the consulting firm EnergyPath Corporation, asserted that the short-term view held by company shareholders runs counter to the long-term vision needed to establish energy production assets intended to serve for decades. He stated that the price of natural gas could rise steeply if the United States begins exporting liquefied natural gas to Europe and Asia, where prices are currently much higher. In his view, investor risk for natural gas–based generation is higher than it is for nuclear power, both before and after construction.

Graber used the term "optionality" to describe an approach in which an organization seeking to build a new reactor can terminate the process at any one of several stages along the way. He said that the underlying tendency to keep options open and defer committing large sums of money until they are really needed is why many applications for combined construction and operating licenses have been submitted to the Nuclear Regulatory Commission but few engineering, procurement, and construction contracts have been signed. Graber added that this approach, with financial risks being taken by stakeholders rather than by a utility's ratepayers, is being used by the Blue Castle Project, a Utah venture that has been working toward the submission of an early site permit application to the NRC.

Each of the panelists was given the opportunity to make some informal remarks, and the most intriguing remarks came from Amir Shahkarami, senior vice president of Exelon Generation and chief executive officer of Exelon Nuclear Partners, a subsidiary that provides operating services for non-Exelon reactors. He predicted that there would be more mergers among reactor licensees and that operators of large fleets would be brought in to operate single-unit plants. More surprisingly, he said that one Exelon reactor, which he later identified as Clinton, is currently running at a nominal loss to the company, and this has led to a switch in the operating cycle from two years to one, a change that garnered Exelon a Top Industry Practice award from the Nuclear Energy Institute (see *NN*, July 2013, p. 39).

Shahkarami

Shahkarami also said that "nothing is routine" in nuclear, with even the generally well-run program in South Korea having recently been embarrassed by the disclosure of forged test reports on control cable qualification (*NN*, July 2013, p. 47). In response to an audience question on the accountability of nuclear programs in other countries, Shahkarami told about a visit he made to a two-reactor plant outside the United States. In the control room he saw a supervisor and an operator attending to one unit, while no personnel were covering the controls for the other unit, which was at 100 percent power. Shahkarami said that he phoned the chief nuclear officer, who immediately fired the plant manager.

Travers said that one risk for a new nuclear country is "inconsistency" in how the government takes responsibility, and also that the government must recognize that nuclear is "special."

William Travers, director general of the Federal Authority for Nuclear Regulation (FANR) in the United Arab Emirates, provided some insight into the UAE's development of a nuclear program from the ground up in a very short time, including the establishment of FANR. He said that one risk for a new nuclear country is "inconsistency" in how the government takes responsibility. He also said that the government must recognize that nuclear is "special." Gu added that a precondition for the adoption of nuclear power anywhere is political stability in the country.

Travers

Communications

The session "Communicating for New Nuclear Facilities"—sponsored by the ANS Education, Training, and Workforce Development Division and moderated by Mimi Limbach, of Potomac Communications Group—featured a panel of veteran communications professionals in the nuclear field who discussed their efforts to promote a positive message regarding new nuclear construction.

Leading off the discussion was Todd Terrell, director of nuclear development communication for Georgia Power, who is currently involved with Southern Nuclear on the Vogtle construction project in Waynesboro, Ga. Terrell began by noting the main communication points that he and his team stress when talking with customers, including that the Vogtle project's economic value bests the next available alternative by $4 billion. "We explain that when you stack a 60-year capital investment and a 60-year fuel purchase of natural gas against these two new Vogtle units, the units will beat them by $4 billion, even at a low natural gas price," he said.

Terrell

Also, Terrell said, by pursuing Department of Energy loan guarantees and production tax credits, the projected impact of the two new Vogtle units on customer rates has been lowered from the initial estimate of 10 to 12 percent to 6 to 8 percent. He further noted that the construction work at Vogtle is currently the largest job-producing project in Georgia. "At the peak of construction, there will be close to 5000 laborers on site," he said. "Currently, we're around 2500, so we're about half the way there. We'll get to 5000 by about the middle or end of 2014."

Internal communication efforts for the new Vogtle units, Terrell said, include the production of a biweekly online newsletter that according to company surveys has achieved a penetration rate of 75 percent. "Those of you who do communications know that if you get 75 percent of your employees reading your stuff, that's pretty strong," he said. "We also have a 'Yammer' site, which is very similar to Twitter. It's a social, internal communications product, with about 125 employees fully engaged, talking to us every day, asking questions. It's a daily, ongoing discussion that we have with those employees on the project. Eventually, I hope to get half of our project employees involved in it."

Terrell's external communication efforts in support of the Vogtle project include the use of a speakers bureau—for presentations to customer groups, key influence groups, and conferences—and a strong reliance on video, with a six-to-eight minute "timeline" video produced every quarter, updating the project's status. "It's a very highly polished product," he said. "We even hired former lo-

cal TV anchor and former host of HGTV's *Ground Breakers*, Joe Washington, to help us host it. We get a very high penetration rate and viewership on these videos. We know our regulators look at them. We know the investment community looks at them. We know the media look at them, because it shows up on their social pages." The most recent such video, released at the end of May, reached over 114 000 viewers via tweets and retweets on Twitter, according to Terrell. In addition, he said, there is an online photo file that is available to the public, with 25 to 50 new photos added every month.

Terrell described Georgia Power's media relations strategy as "very proactive and organic," with one-on-one media briefings featuring Buzz Miller, the utility's executive vice president of nuclear development. "We make proactive pitches to media that we want to bring to the site," Terrell said. "And then organically, when good opportunities come our way, we set those up also. I had four or five examples just within the last 30 days with media we've had to the site—the *New York Times*, the *Economist*, the *Atlanta Journal Constitution*. Right now, we're working on a State Department request. They would like to bring 10 foreign national media outlets to the site, probably in the August time frame. They will be *New York Times*–type media outlets from Poland, Slovenia, Czech Republic, and India, and we're working right now to set that up."

The Vogtle project's major communication challenges, according to Terrell, include the increased sophistication of antinuclear groups and the difficulty in maintaining message discipline. "We're one-third complete, we're one-half complete—we've said both of those in public forums, and it depends on which metric you're using," he explained. "It's going to take us 10 or 12 years to finish this project from when we started talking about it in 2005–2006. In that regard, we are one-half complete. But if you look at major construction milestones, we're one-third complete. It's a real challenge within our own company to make sure we maintain message discipline on where we are."

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Terrell gives a good deal of the credit for the success of Georgia Power's communications strategy to the structure of the team he leads. "I don't have 20 people working for me," he said. "There are three of us who work for the project—one at the site and two of us here in Atlanta. Anything that we need in terms of video support, photography support, even media relations support, we leverage through our operating company or our operator, Southern Nuclear. It's a highly matrixed organization. It works well because we all believe in one another. There is teamwork coordination consistency."

Gilbert emphasized in his presentation the importance of aggressively pursuing the media marketplace. "We have a good story to tell."

Next to speak was Vaughn Gilbert, external communications director for Westinghouse Electric Company, manufacturer of the AP1000 pressurized water reactors being used in the Vogtle construction project.

Gilbert

Gilbert opened his talk with a video—a new Westinghouse commercial that was debuted by company CEO Daniel Roderick at the opening plenary session the day before—that illustrated the change in approach the company has taken to communications over the past few years. Up until 2009–2010, Gilbert said, Westinghouse was mostly engaged in "preaching to the choir," with 80 percent of its advertising budget going toward trade publications. "We still very much want to support those publications, because they've been very good to us," he said. "But we realize that we have to expand our approach."

Gilbert also pointed out that Westinghouse's advertising messages tended to be product and technology focused, limiting their impact on anyone from outside the industry. "We're now emphasizing clean air, jobs, sustainability, reliability, and energy independence," he said. "And that's worked pretty well. We've increased our advertising budget. About 50 percent is going to focused audiences, such as inside the Beltway. We're doing some things on Wall Street and in Europe as well, relative to the investment communities. We're also going to start taking our messages to the people who are actually going to live by these plants and who are going to get their electricity from these plants."

Another change in Westinghouse's communication strategy is in the area of community outreach activities, according to Gilbert. "We noticed that we were going only to schools and focusing only on science and technology," he said. "We were talking to kids who were already contemplating careers in engineering. Of course, that's important, and we'll continue that, but now we're talking to a broader range of young people, encouraging them to be advocates for nuclear energy simply because of their concerns about global warming or clean air."

Gilbert also emphasized in his presentation the importance of aggressively pursuing the media marketplace. "In the last four years," he said, "we've worked with the *Wall Street Journal*, Matt Wald of the *New York Times*, PBS's *Nova*, *PBS NewsHour*, and the Associated Press. We have a good story to tell."

The session's final presenter was Amy Lientz, communications and governmental affairs director for the Idaho National Laboratory, who spoke on the challenge of advocating the modernization of INL's aging infrastructure in a time of budget cuts and continuing resolutions. "For solutions, I tend to lean heavily on the policy side," Lientz said. "Of course, we in communications have done a lot of things to build public awareness—i.e., speakers bureaus, tours, etc. But what we find really makes a difference is going to our congressmen and other decision-makers. When we go to them with ideas for new facilities, they want to know what's the relevance, what's the impact, and do you really, really need it? Is there a customer at the end of the road? We have to make sure our forecasting and our market analyses are as strong as ever."

Lientz

Continued

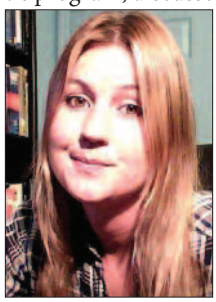
Lientz also stressed the importance of Idaho's Leadership in Nuclear Energy Commission, an advisory body created in February 2012 by Gov. C. L. "Butch" Otter and charged with making recommendations to the governor on policies and actions that will ensure the continued viability of INL, as well as the state's nuclear industry in general. The commission is chaired by the director of the state's Department of Commerce and includes members of the Idaho legislature, local officials, and representatives from INL, universities, the nuclear industry, and the public. "[The Leadership in Nuclear Energy Commission] has done more for us on the policy side than anything else," Lientz said. "We have been able to bring our message to the public through the governor. And it's not just our message, it's the message of the Department of Commerce leadership and the governor, saying how important it is to carry on what INL is doing, to carry on nuclear energy in the state of Idaho. And that's made a huge difference with the congressional leaders in Washington."

The question-and-answer period that followed the presentations included a question for Lientz regarding the best ways to recruit the next generation to the industry. "We have definitely embraced social media, and that's helped a lot as a recruiting tool," she said. "Everything from Facebook to Tumblr to YouTube. With the videos, we've learned from the younger generation in our focus groups what works and what doesn't. They want the videos short, with snappy phrases and lots of pictures. They don't want a lot of words."

Science advocates

The session "Communicating for New Nuclear Facilities" was immediately followed by "Communicating for Science," a companion session that largely focused on funding for scientific research in a budget-cutting environment. This session, moderated by Potomac Communications' Laura Hermann, featured participants from academia and the national laboratories.

The session opened with a presentation by Kara Schmitt, a Ph.D. candidate at the Florida Institute of Technology. Schmitt, who came to the nuclear field after spending six years with the now-canceled space shuttle program, discussed lessons learned from her NASA experience that she has found to be applicable to nuclear organizations, including the importance of proper communication.


Schmitt

"Document everything, and make sure that information is accessible to everyone," Schmitt said. "An open-door policy can save lives. At NASA, we had something called the 'time-out policy.' Any employee at any time could stop a launch. Now, you would be 'that guy,' but you could do it if you raised valid concerns. Also, over communicate—through e-mails, newsletters, employee meetings, and other channels. It's better to hear something twice than not at all. At the same time, though, take caution not to overburden people with signage, or it will go unread."

"Over communicate—through e-mails, newsletters, employee meetings, and other channels. It's better to hear something twice than not at all."

Speaking next was Craig Williamson, executive director of the South Carolina Universities Research and Education Foundation (SCUREF), a nonprofit consortium formed in 1988 to bolster education and research programs in energy, environmental management, national security, and health-related areas for its member institutions and for universities throughout the United States. Among the programs SCUREF manages, Williamson said, are the Rickover Graduate Fellowship in Nuclear Engineering, the Nuclear Forensics Graduate Fellowship Program, and the Nuclear Nonproliferation International Safeguards Fellowship Program, in addition to scholarship and university/faculty programs. Williamson also noted that SCUREF manages university-based research for the Savannah River National Laboratory and provided logistical support to the Blue Ribbon Commission on America's Nuclear Future.

"For the successful development of programs like these, you have to use historical precedents," Williamson said. "You have to go back and see what was successful. The first thing I learned when I started doing this back in the late 1970s was that the Atomic Energy Commission's Special Fellows Program was a highly successful program. I talk about that program all the time when I'm talking to potential sponsors."

Also significant, according to Williamson, is the need to maintain a diffuse funding base. "If you have one funding sponsor, that sponsor could go away," he said. "You have to try to bring in lots of different entities. They may not provide you financial support, but if they provide you with constituency support, that's really important. In developing programs, too, you always need to develop a champion within the government agency. If you don't have that champion, the program will go away."

Williamson said that programs must also be subjected to continuous validation. "If you're working for the DOE, if you're working for the NRC, or any federal agency, you have to continue to show how you're meeting their mission at every meeting," he said. "If you forget to do that, you're going to lose your credit."

Williamson also stressed the importance of having all program sponsors engaged in the decision-making process. "There are a lot of contractors like myself who go about thinking that we know all the answers," he said. "We can run programs really well. We don't need the government to do anything for us. But that's a fatal mistake. Make sure they're involved. All I've ever done in my career is to make recommendations. I never make decisions."

Another vital component for the long-term success of any program, Williamson noted, is leverage. "You actually need to have the universities put up their own money," he said. "If they don't do that, then the sponsors will think they're not really engaged in the program, and they'll just walk away."

Also speaking about the pursuit of funding was Shannon Bragg-Sitton, senior nuclear engineer at Idaho National Laboratory and former associate professor at Texas A&M University. "The one piece of advice I want to offer, having been on both sides of [the funding] equation fairly recently, is to keep it simple," she said. "If you overwhelm a potential sponsor with your brilliance, the vastness of your technical experience, and your ability to accomplish this goal, you're going to lose that customer. I have seen this happen with a colleague who has some really great ideas but who tends to alienate and confuse the customer. The customer doesn't really know what the project is anymore because this colleague involves too much detail, too much information. So keep it simple. Keep it clear. And be straightforward with your message, whether it's a written proposal or a presentation you're giving to the potential sponsor. If you don't get your ideas and your goals across within the first couple of slides or the first couple of paragraphs, you might


Bragg-Sitton

as well go home."

David Pointer, a computational fluid dynamics nuclear engineer at Oak Ridge National Laboratory and former chair of ANS's Public Information Committee (now the Communications Committee), emphasized the role that communication plays in securing funding. "When we're sitting in meetings at ANS and we're talking about the strategic communications plan that some of us have been helping ANS develop, we often hear that we're nuclear engineers. That we're technical professionals. That we're not communicators. And I would tell everyone that they are wrong, because part of our job is to propose the work we're going to do, gather the requirements, execute the work, communicate the progress, and communicate our results. And then we need to transfer that technology to somebody who can actually use it. We are all communicators, whether you like it or not."

Pointer

New build worldwide

In the session on power reactor construction around the world, John Kelly, the Department of Energy's deputy assistant secretary for nuclear reactor technology, presented a summary of the current status of new reactor construction in the United States, with or without direct DOE involvement. Kelly called the Obama administration "supportive" of nuclear power expansion and said that the new energy secretary, Ernest Moniz, is a "strong supporter," especially of small modular reactors (SMR). He said that the DOE projects that nuclear power will produce about 870 terawatt-hours of electricity in 2035, up from 790 TWh in 2010, and noted the construction that is under way on TVA Nuclear's Watts Bar-2 and the four new AP1000 reactors at Southern Nuclear's Vogtle and SCANA/Santee Cooper's Summer sites.

Kelly

Kelly mentioned the July 1 application deadline for the DOE's second funding opportunity for SMR development, stating that the agency plans to announce the results (the designs chosen to receive support and the funding amounts) around the end of September. He noted in passing NuScale Power's announcement in April that its NuScale reactor could shut down safely without additional power, water, or operator action (*NN,* June 2013, p. 32), although this was not to be taken to mean that this design might have an advantage over the others for which funding applications were expected.

Kelly also briefly touched on some developments outside the United States. In China, he said, nuclear-grade construction began in December 2012 on the high-temperature gas-cooled reactor (HTGR) in Shidaowan, which would be the country's first substantial power generator using that technology. He also cited China's work with its first fast-neutron reactor on the grid and the development, through the Generation IV initiative, of the use of fluoride salt coolant. Kelly noted that in Russia, the BN-800 fast-neutron reactor is to start up in 2014, while the BN-1200 is in the design stage, along with a lead-bismuth coolant demonstration within Gen IV.

Gu noted that China could get into the worldwide SMR race, with China National Nuclear Corporation developing a design called the ACP100.

Shenjie Gu, deputy chief engineer of the Shanghai Nuclear Energy Research and Design Institute, provided more detail on China's nuclear program, notably its use of technology transfer to extend the Westinghouse AP1000 pressurized water reactor design to become China's own CAP1400, which is to be deployed in China perhaps as early as 2018 and exported to other countries. Gu said that the design will be finished next April, and the first construction project is planned for Shidaowan, not far from where the HTGR is being built. This would be a demonstration unit, to be built by the government rather than by one of the nuclear utilities, and the site could also accommodate a demo of another step-up design (in the 1700-MWe range). Gu added that the development of a 2100-MWe reactor is also being considered.

In effect, Gu said, an AP1000-based reactor with peak power below 3500 MWt is Westinghouse intellectual property, while AP1000-based designs above that level, developed by China, will belong to China. As for the AP1000s now being built, Gu said that Sanmen-1 is expected to begin power operation in October 2014.

In some respects, reactor construction is slowing down in China. The CPR1000 reactors (based on the French CP3 design used in China's first large PWRs) that are being built or planned at specific sites may be the last of their kind. Gu also noted that China could get into the worldwide SMR race, with China National Nuclear Corporation developing a design called the ACP100.

Asked about China's decision after the Fukushima Daiichi accident in Japan to freeze the development of inland power reactor sites, Gu said that this was done to allow for further studies on the possible effects of plant operation (and accidents) on China's two major river systems, where the plants would be built. He said that the studies may be completed by around 2015, and that if a case can be made that there would be effectively no radioactive releases to the river systems, work would resume on inland reactors.

During the panel discussion after the papers were presented, a session attendee asked how the lack of a carbon tax in the United States affects nuclear power. Kelly said that the DOE's Energy Information Administration does studies of various alternative conditions, including various costs added to carbon dioxide emissions from power plants. He said that if there were a carbon tax, nuclear's share of the nation's electricity production could easily increase from the current 19 percent to about 30 percent.

Nuclear with other sources

A session on hybrid energy and another on advanced and Generation IV reactors included presentations that addressed nuclear energy as not the only energy source in a system, but either as one participant enabling other energy sources, or coordinated to maximize nuclear's advantages in a diverse set of sources. In both sessions, Charles Forsberg, of the Massachusetts Institute of Technology, presented papers that were based to some extent on concepts he described in an article in these pages last year (*NN,* Sept. 2013, p. 33), such as the use of nuclear energy to extract hydrocarbon fuels from the vast underground deposits of kerogen (also known as shale oil) in the western United States.

Forsberg emphasized that the systems he proposed were intended to maximize revenue for their nuclear portions. He showed a chart demonstrating the downside of nuclear power's ability to operate as a baseload electricity provider, with high capacity at all times. Demand varies at different times of day, as does the availability of renewable sources such as solar energy. Over long time frames, the cost of nuclear is low, but on an hourly basis, as grid operators deliver elec-


Forsberg

tricity to customers, the priority given to renewables can put nuclear power in a position of getting what amounts to a "negative price" for its electricity. Forsberg explored systems that would be available to produce electricity only when the price is high, and avoid the negative price hours by directing the nuclear heat to other purposes at those times.

In the hybrid energy session, in addition to the kerogen extraction and conversion system described in the September 2012 article, Forsberg presented the concept of a fluoride high-temperature salt-cooled reactor with a cold-leg temperature of around 600 °C (well above the 460 °C freezing temperature of the fluoride-lithium-beryllium, or "flibe," coolant) and a hot-leg temperature of 700–800 °C (within the strength of existing materials for the reactor and piping). The lack of water means that there would be no tritium produced in the coolant, so there would be no need for an intermediate heat exchanger, and the heat transferred from the salt could go directly to steam for industrial processes or public use.

In the session on advanced/Gen-IV reactors, Forsberg spoke on still more variants of the same theme. He stated that the Chinese Academy of Science decided last year to develop a 2-MWt fluoride-cooled test reactor to begin operation by 2017, and in response to a question on another paper, Forsberg said that China expects to commercialize a fluoride-cooled reactor with pebble-bed fuel by 2030.

The kerogen extraction system was explored in more detail by Daniel Curtis, also of MIT, in a paper coauthored by Forsberg. Curtis said that there has not yet been a full life-cycle analysis, but he believes that the use of nuclear heat would lead to the lowest level of greenhouse gases among all of the possible options for extracting, processing, and using the kerogen-based fuels. He noted that there is "a lot of unexplored design territory," and siting the reactors needed to make full use of the kerogen deposit would entail the establishment of what amounts to an army base for security.

Nuclear energy is sometimes referred to as disruptive, in the sense that its lack of greenhouse gas emissions and its ability to replace sources that produce such emissions could disrupt (for a while at least) the economy that is currently based heavily on the use of fossil fuels. In a presentation on fast-neutron reactors and energy storage at the hybrid energy session, Cal Abel, of the Georgia Institute of Technology, proposed an example of expanded nuclear energy use aimed at fitting in with the current economy rather than disrupting it.

Abel noted that a great deal of the business for railroads comes from the hauling of coal from mines to power plants, and as coal use dwindles—in many regions, it is being replaced by natural gas for electricity production—there may already be economic disruption taking place for railroads. Abel suggested taking the coal-fired Plant Yates in Georgia and adding power reactors, producing emission-free process heat to convert the coal delivered to the plant into liquid fuel for transportation. While this would not do away with life-cycle greenhouse gas emissions, it would produce transportation fuel and thus reduce the need for oil imports, allow continued use of the infrastructure of Plant Yates (which might otherwise close), and uphold the business-as-usual of coal producers and railroads.


Abel

The observation was made that federal law has been interpreted by the courts to require grid operators to use energy from renewables whenever it is available, regardless of cost, and with priority over other sources.

During the audience input opportunities in these sessions, there was a great deal of discussion of the policy and practice of renewable energy use in the United States. The observation was made that federal law has been interpreted by the courts to require grid operators to use energy from renewables whenever it is available, regardless of cost, and with priority over other sources. Abel stated his opinion that this treatment of renewables amounts to coercion.—*E. Michael Blake, Tim Gregoire, and Michael McQueen* NN