University of Pittsburgh hosts nuclear power symposium

BY LARRY R. FOULKE

Known as the birthplace of nuclear power, Pittsburgh, Pa., was a fitting setting for the two-day symposium on nuclear's future.

THE 33RD ANNIVERSARY of the Three Mile Island-2 accident, and the evolution of the nuclear power industry since then, provided the context for a symposium held March 27–28 on the University of Pittsburgh campus. Titled "From Its Birthplace: A Symposium on the Future of Nuclear Power," the symposium was sponsored by the university's Dick Thornburgh Forum for Law and Public Policy and the Swanson School of Engineering.

This symposium stood apart from similar meetings because of the attention that Pittsburgh commands as the birthplace of nuclear power and as a hub of energy industries, and also because of the importance of the TMI-2 accident as a case study of nuclear crisis management under the administration of Dick Thornburgh, who was the governor of Pennsylvania at the time and was in attendance at the symposium. The experience at TMI was again thrust to the forefront by the Fukushima Daiichi disaster in Japan in March 2011.

The symposium comprised a series of presentations by experts in nuclear, fossil, and passive energy sources who discussed various aspects of engineering technology, public health, emergency management, insurance, and financing. Individuals with differing perspectives on nuclear energy were invited to participate. Nuclear energy is part of our future, and the symposium was intended to provide a broad range of views to allow attendees to become more informed.

Nuclear power and alternatives

The agenda featured the rather novel approach of having each panel moderated by a local journalist. The moderator of the first panel, Nuclear Power and Energy Alternatives, was David Shribman, executive editor of the *Pittsburgh Post-Gazette*.

Among the panelists was Patrick Moore, a cofounder of Greenpeace, in which he was an activist from 1971 to 1986. Today, he is a cochair of the Clean and Safe Energy Coalition, which supports the increased use of nuclear energy. Moore provided often-cited facts about nuclear energy and emphasized that "nuclear waste is not waste; it is an important fuel for the future." He said that his view is not *if* we recycle used fuel but *when*. He quoted an authoritative source, the Radiation Effects Research Foundation, which, Moore suggested, has stated that there will be no harm from Fukushima radiation releases. Also, he said, "It will be financially and technically impossible for Germany to replace their nuclear energy capacity with renewables," a statement that was later challenged by another panelist.

Moore

Matthew Wald, the well-known *New York Times* reporter whose news beat is the environment and energy, provided a perspective on what the investor sees with respect to nuclear energy. "When natural gas went from $14 per million Btu to $3 per million Btu, the fuel cost per kilowatt-hour went from nine cents to two cents. So for the near term, it's a no-brainer." He also pointed out that the public often doesn't appreciate the notion of "capacity factor," and so a 1000-MWe solar (or wind) installation is often perceived as delivering 1000 MWe. In reality, however, only a fraction of that level is reliably delivered because of the intermittency of these energy sources. What's more, he said, "the public may perceive that nuclear kills people." They seldom consider that "electricity kills people" or that "electricity saves people." He said that he is not convinced that radiation exposure from U.S. nuclear plants is shortening anybody's life.

Peter Lyons, assistant secretary for nuclear energy at the U.S. Department of Energy, reported on the research being conducted on advanced nuclear fuel materials with enhanced accident tolerance, the recommendations of the Blue Ribbon Commission on America's Nuclear Future (BRC), and the benefits of small modular reactors (SMR). Among the advantages of SMRs that he cited are passive decay heat removal by natural circulation, a smaller radioactive source term in the event of an accidental release, below-grade reactor siting, and a potential reduction in the size of the emergency planning zone.

Lyons

Lyons noted that on March 22, the White House announced potential new funding to advance the development of American-made SMRs, an important element of President Barack Obama's energy strategy. A total of $450 million over five years, subject to congressional appropriations, is to be made available to support first-of-its-kind engineering, design certification, and licensing for one or two SMR designs.

Continued on page 63

Larry R. Foulke, a past president of the American Nuclear Society (2003–2004), is Director of Nuclear Education Outreach at the University of Pittsburgh.

Continued from page 58

Manufacturing these reactors domestically will offer the United States important export opportunities and will advance its competitive edge in the global clean energy race. SMRs, at approximately one-third the size of current nuclear plants, have compact, scalable designs that are expected to offer a host of safety, construction, and economic benefits.

Not to be outdone by an all-nuclear talk, Anthony Cugini, director of the DOE's National Energy Technology Laboratory, gave a spirited description of the nation's natural gas, coal, and oil technologies. "We are using fossil energy today with reduced environmental impact," he said. He noted that the U.S. Energy Information Administration and the International Energy Agency say that the future energy portfolio will use fossil fuel supplies and will be similar to today's current portfolio. "Fossil energy has a future whether we want it or not," he said. One of the DOE's primary strategic goals, he noted, is "to protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy."

Finally, Matthias Kurth, former president of Germany's Federal Network Agency, related his country's decision to stand down from the future use of nuclear power. He noted that 75 percent of Germany's population backs the decision; the German public just doesn't want to accept the perceived risk. This opinion is not based just on Fukushima, but is also a complex combination of concerns about the events of 9/11, proliferation, and waste disposal. The shift in Germany's energy policy after Fukushima reversed the decision made in 2010 to extend the working lives of its nuclear reactors by an average of 12 years and provides for a staggered phaseout of nuclear power.

While the world may question the wisdom of this new policy, Kurth said that he considers that Germany may reap economic benefits from the move. Germany is the biggest industrial power to renounce nuclear energy, he said, which puts it under pressure to develop smart energy storage, consumption, metering, and generation.

Roughly 20 percent of Germany's electricity comes from nuclear power, raising the question of how the shortfall will be made up. The official commission that has studied the issue reckons that electricity use can be cut by 10 percent in the next decade through more efficient machinery and buildings, Kurth said, and natural gas will be used for initial backup. Some independent analysts believe that coal power will benefit if wind plans don't deliver what is needed.

Kurth posited that in its "fundamental" rethink of energy policy, Germany could set an example for other countries. "Germany can be a trailblazer for a new age of renewable energy," he said. "We can be the first major industrialized country that achieves the transition to renewable energy, with all the opportunities—for exports, development, technology, jobs—it carries with it."

Kurth's somewhat skeptical fellow panelists reacted to his comments, and one said, "You can't run a Mercedes factory with solar energy."

During the question-and-answer session, the issue of nuclear versus natural gas received the biggest share of the dialogue, and there was general agreement that the competition will depend on the structure of the market. It was also agreed that the history of natural gas price volatility would indicate that all eggs should not be put into the natural gas basket.

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Moore responded passionately to a question from the audience about the effects of radiophobia and the cost of dose avoidance. "We make people afraid of things they cannot see or sense, yet we know quite well what numbers constitute safe levels," he said. "It's a matter of education and factual information." Wald put this question in terms of today's "tort mentality." "If somebody does something that you think may shorten your life, it's a tort. People seem to believe they have a constitutional right to live forever."

The effect of new seismic requirements as a result of Fukushima also elicited some attention. Wald noted that he had looked at the effects of last August's earthquake near the North Anna plant in Virginia. At North Anna, he said, "they have raised output power to use the extra design margin." He noted that it's not the big structures that worry him, but the little stuff—relay cabinets and switches that can change positions during an earthquake. "This will take a lot of analysis," he said.

America's nuclear future

The moderator of the second panel was Doug Heuck, publisher of *Pittsburgh Quarterly* magazine and program director of Pittsburgh Today. This panel featured experts that considered America's nuclear future.

The first panelist was Vicky Bailey, a member of the BRC and president of Anderson Stratton International. She noted that the BRC was established by a presidential memorandum dated January 29, 2010, that placed it under the authority of the DOE. The commission submitted its final report to Energy Secretary Chu on January 26, 2012 (*NN*, Mar. 2012, p. 89; the full report is available at <www.brc.gov>). Bailey summarized the report's findings and recommendations.

Bailey

David Lochbaum, director of the Union of Concerned Scientists' Nuclear Safety Project, acknowledged that although nuclear power will be part of the United States' energy future, "we need to look at and fix problems of the past. Aging plants are likely to suffer from the fact that aging components and systems become more likely to fail as they continue to operate."

He stated that the best protection against failure at nuclear plants is a strong federal regulator, but in his view, a number of issues signal that the U.S. Nuclear Regulatory Commission is an ineffective regulator. "A most egregious failure of the [NRC] is routinely waiving fire rule violations at nearly half the nation's 104 commercial reactors, even though fire presents one of the chief hazards at nuclear plants," he said.

Fires present a special risk to nuclear plants because they can knock out cables needed by control room operators to safely cool down a reactor, Lochbaum said. The Browns Ferry plant in Alabama, where a devastating cable fire 36 years ago prompted the NRC to adopt tough new fire rules, still doesn't comply with the requirements to protect cables, he added.

Lochbaum

While no member of the public has ever been injured from a fire at a U.S. nuclear plant, and the NRC says that the reactors are safe, Lochbaum said that he believes that the agency is pushing its luck. He noted that the regulator is leaving decades-old fire hazards in place and is failing to enforce its own rules. He added that hazards at other plants include unprotected equipment,

inadequate fire doors, and missing alarms and sprinklers.

Peter Sena, president and chief operating officer of FirstEnergy Nuclear Operating Company, a subsidiary of FirstEnergy Corporation, addressed issues that influence the future of nuclear power for utilities operating in deregulated marketplaces. He indicated that electricity prices in the deregulated—or competitive—marketplace have four main drivers: electricity demand, which has rebounded slowly and incompletely since the recession; natural gas prices, which are currently very low; coal prices; and environmental regulation. With these factors in mind, the nuclear future in the deregulated marketplace will entail the continued safe, reliable operation of existing nuclear facilities, the extension of operating licenses of existing plants, and the implementation of power uprates where possible.


Sena

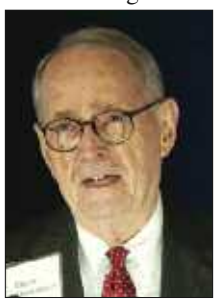
Also, Sena said, SMRs could be attractive in many respects to utilities operating in the deregulated marketplace. "It's a great technology," he said. "It is safe and has promise, but more work remains on issues such as economy of scale, certainty in the regulatory structure for SMRs, and treatment of additional emergency planning zones."

During the Q&A portion of the session, Sena said that nuclear operators are taking numerous actions to ensure that plants remain in safe, reliable operating condition. He noted that essentially all components in FirstEnergy's nuclear plants have been replaced with new parts, and so challenges that would be due to aging components likely will not be an issue as operating licenses are extended from 40 years to 60 years.

Ann Bisconti, president of Bisconti Research Inc., a public opinion and communications research company, explained reasons for public opinion trends. Historically, she said, the public has seen nuclear energy as important for the future, but many people are ambivalent due to concerns about safety. After the TMI accident, support for building more nuclear power plants declined slightly, but rebounded after one month. The country was in the midst of an energy crisis, she noted, and so it was later, in 1982, when this crisis ended and a lack of perceived need caused a drop in support for new nuclear power plants. The Chernobyl accident in 1986 created a teachable moment, and as a result, perceptions of nuclear power safety became more favorable, she added.

Despite a moderate downturn in favorable opinion following the Fukushima accident, Bisconti continued, trends over the past three decades show strong growth in support for nuclear energy. The shift is due partly to more favorable safety perceptions and partly to a growth in awareness of the benefits that nuclear energy provides, she said. Large percentages of the public associate nuclear energy with reliable electricity, efficiency, clean air, affordability, and energy independence.

Thornburgh asked Bisconti why fewer people associate nuclear energy with a climate change solution than with the other attributes. She explained that many Republicans do not believe in climate change and so do not see nuclear energy as a climate-change solution. Democrats, far more than Republicans, she said, link nuclear energy with a solution to climate change. Bisconti noted that if one were speaking to a group of Republicans, it would probably not be a good idea to start the discussion with points about nuclear energy and climate change, as they could fall on deaf ears.


Thornburgh

In response to questions earlier in the symposium on how to communicate about radiation from nuclear power plants, Bisconti said that radiation is perceived to be unnatural, unfamiliar, uncontrolled, and deadly. She said that research has found that it helps to convey that radiation is natural (an ever-present and essential part of nature), familiar (technologies used to save lives), controlled (measured, monitored, and contained), and safe (measured levels versus safe levels set by the regulator).

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TMI-2, Chernobyl, Fukushima

The moderator of the third panel was Kathy Kiely, managing editor of the Sunlight Foundation Reporting Group. She is a former reporter who covered the TMI-2 accident for the *Pittsburgh Press*. Kiely related the story of how she was a junior reporter substituting for a colleague in Harrisburg, Pa., at the time of the accident while there to cover another story. She said that she heard about "something going on at the nuclear plant," and it was only natural that since she was there, she was soon immersed in the coverage of the unfolding events.

Thornburgh further reminisced about his experiences on March 28, 1979. He said that it started out as a pretty mundane day for a relatively new governor. He was hosting a breakfast meeting for newly elected legislators to present his budget and make a pitch for support when the breakfast was interrupted by a call from his emergency management director. In an instant, the day was less mundane. "I knew right away I was in for exciting times," he said.

This began a 10-day period that was harrowing, at the very least. Thornburgh said that he didn't have details and had trouble getting information, and that no one seemed to have a firm grip on the facts. After he called then President Jimmy Carter to ask for help, Thornburgh said, Harold Denton, director of the NRC's Office of Nuclear Reactor Regulation at that time, was assigned to be Carter's personal representative.

Thornburgh had high praise for Denton and said that he considers Denton to be the true hero of Three Mile Island. Denton served as the technology translator for a politician, Thornburgh noted. And so, a Republican governor got help from a Democratic president. "When you have a crisis of this magnitude, there is no room for politics," he said.

Denton himself was the first panelist to relate recollections of the events surrounding TMI. His instructions from President Carter consisted of three messages, which Denton said he remembers well to this day: (1) "Keep me fully informed," (2) "You will get the resources you need," and (3) "Work closely with Governor Thornburgh." Eventually there were 70 to 80 NRC employees on site, plus 40 from the DOE.


Denton

Denton noted the following significant issues that came out of his experience with the TMI accident:

- The occurrence of extensive core melt in the first few hours of the accident.

■ The importance of containment.
■ The unnecessary scare over the hydrogen bubble.
■ The significant reduction in risks of future accidents because of the lessons learned.
■ The essential role of industry.
■ The availability of and need for vital information from the control room.
■ The importance of emergency planning and preparation (the stimulus for the Federal Emergency Management Agency).
■ Public access to timely and accurate information.

Denton's remarks reminded Thornburgh of an anecdote relating to the importance of the coordination of emergency planning. Early on, Thornburgh said, he had asked his emergency management team to check on the emergency readiness of the surrounding counties. His representative came back later in the day with an ashen face and explained that Dauphin County, east of the island, had an emergency plan that had people evacuating to the west over the John Harris Bridge, which crosses the Susquehanna River. Then he noted that Cumberland County, west of the island, had an emergency plan that had people evacuating to the east over the same bridge. And so, in the event that an evacuation had been necessary, the evacuating hordes would have met head on at the bridge. Clearly, Thornburgh said, coordination is key.

Adolf Birkhofer, managing director of the Institute for Safety and Reliability at the Technical University of Munich, in Germany, put the Chernobyl accident into perspective. "A lot of the lessons learned from Chernobyl were not followed at Fukushima," he noted, adding that reactor operators must be told "why" certain things are done, as well as "how" they are to be done.

Important lessons learned from Chernobyl that Birkhofer cited include the importance of safety culture and the role of human factors; the need for probabilistic safety assessments; more thorough analyses of severe accidents; the importance of emergency planning for plant management; improved operating procedures and rules; the strengthening of containment; and the development of worldwide safety standards.

Isao Kato, deputy general manager of the Nuclear Power Department of Tohoku Electric Power Company, described how the Onagawa nuclear station, which is located even closer to the epicenter of the earthquake than Fukushima Daiichi, escaped the issues faced at Fukushima. He noted that the population of the town of Onagawa was 10 016 in February 2011. Following the earthquake and tsunami, about 1000 people were dead or missing and about 3300 houses were destroyed.


Kato

The Onagawa site houses one General Electric BWR-4 and two BWR-5 units that began operation in 1984, 1995, and 2002, respectively, Kato said. As at Fukushima, fuel tanks toppled and all emergency diesel generators tripped shortly after the earthquake. However, the site did not completely lose off-site power. One of five off-site power sources remained in service, and all three plants achieved cold shutdown amidst the earthquake and tsunami. Kato noted that although the site grade put the emergency diesel generators at 14.8 m and the tsunami reached 13 m, seawater did reach some emergency cooling systems by internal flooding through seawater intake structures. A fire broke out in the turbine section of the plant and increased levels of radioactivity were measured, he said, but overall, the effects of the earthquake and tsunami were much less dramatic than those at Fukushima.

Brian Johnson, vice president of U.S. markets for GE Hitachi Nuclear Energy's new plant business, provided a review titled "Nuclear power: Yesterday, today, and tomorrow," with a message of simplicity and safety in new designs. He noted that the boiling water reactor design has evolved and grown in simplicity, and that the ABWR (Advanced BWR) actually eliminates the recirculation loops, thereby eliminating the external piping and valves, significantly reducing the complexity of the design and a major source of dose to the workers. Taking this simplicity a step further, the ESBWR (Economic Simplified BWR) utilizes full natural circulation in driving flow through the reactor core, so there are no internal or external pumps.


Johnson

NRC Commissioner William Magwood was the final panel speaker. He described the NRC as "4000 people passionately devoted to the health and safety of the public." Magwood said that Fukushima brought nuclear energy back to the public's consciousness. The 9.0-magnitude earthquake and the 15-m tsunami wave certainly resulted in what he called a "bad day at the plant," as core damage is believed to have occurred in Units 1, 2, and 3, and hydrogen explosions took place in Units 1, 3, and 4.


Magwood

At the NRC, he said, the Emergency Operating Center was activated for 24-hour-a-day, seven-day-a-week operation for nine weeks. A team of advisers was dispatched to Tokyo, and there was coordinated monitoring with the DOE and the Environmental Protection Agency. The Fukushima event stimulated special inspections at U.S. nuclear power plants and the launching of the Near-Term Task Force to analyze the accident and its impacts.

Magwood stated the following as among the major lessons learned from Fukushima:
■ "We must understand the specific risks facing each individual plant."
■ "We can't predict every event, and planning for recovery from a disaster is at least as important as preparing for a disaster."
■ "We must understand the potential for common-cause failure of on-site and off-site power."

Magwood stated that U.S. nuclear plants are safe. Issues that may be addressed as a result of the Fukushima experience, he said, include new regulatory regimes to address beyond-design-basis accidents and an examination of the need to go beyond safety and address large socioeconomic disruptions. Is the latter a function of the NRC? he questioned. This, he said, needs to be decided.

Before allowing questions from the audience, Kiely asked each panelist, "What is the one thing that we can do to regain public trust?"

Thornburgh responded, "Candor, patience, concentrated effort at education. Industry must play it straight; regulators must regulate."

Denton added, "Lay out the facts. Don't stop regulation with the design basis accident. We must do something to limit release of long-lived radioactive isotopes, and we must let operators vent containment through filtered vents if necessary."

Birkhofer declared, "Nuclear power plants must follow absolute, strict safety." And Kato said, "We must become more prepared than we were."

Johnson emphasized, "We must teach the public what radiation means," and Magwood said simply, "Operate plants safely!"

Luncheon speakers

At the luncheon session on the second day, participants were treated to a video link with U.S. Sen. Lamar Alexander (R., Tenn.), who focused particularly on the current status of nuclear power in the United States. "It gives us 70 percent of our clean electricity, and this is one of the most important things we need to emphasize," he said. "Planning to provide this energy by windmills would be the equivalent of going to war in sailboats."

Continued

He called the nuclear renaissance more of a nuclear reawakening—a "coming into awareness." Congress is taking important steps to help this reawakening, he said, and last year, after a good bit of discussion, Congress approved $100 million for research, development, and licensing of small reactors.

"We do face challenges that we must acknowledge in our efforts to build 100 new nuclear plants, which is what I think we need to do," Alexander said. "One of those challenges is Fukushima. The response in Japan has been to shut off most of their reactors. It's hard for me to see how Japan could get rid of 30 percent of its electrical capacity and still be a major economic power. Shutting down nuclear power is not the solution."

He added, "The other serious challenge to nuclear power is really a great advantage to our country, and that's the low price of natural gas." The big problem we faced just six or seven years ago, he said, was the high price of natural gas. Utilities were going bankrupt, big chemical companies were thinking about moving overseas, and farmers were complaining about the cost of fertilizer. "Other countries are paying four to five times as much for natural gas as we are in the U.S. . . . That's one reason why in other parts of the world they are moving ahead with nuclear."

Legal and financial aspects

The moderator of the final panel session was Bill Flanagan, executive vice president of the Allegheny Conference on Community Development and host of the show "Our Region's Business" for local television station WPXI.

Barton Cowan, senior counsel at Eckert Seamans Cherin & Mellott and a visiting professor of law at West Virginia University, started off the session by providing the mostly technical audience a tutorial on three major legal issues associated with nuclear power: Fukushima and "reasonable assurance," license renewal and federal preemption, and the Price-Anderson Act.

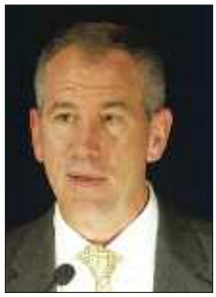
"The events at Fukushima Daiichi highlighted the possibility that extreme natural phenomena could challenge the prevention, mitigation, and emergency preparedness defense-in-depth layers," he said. And so, he added, the NRC has issued an order that modifies current facility licenses and requires provisions for mitigation strategies for beyond-design-basis external events for each facility. Also, he said, "Additional defense-in-depth measures will be required so the NRC can continue to have 'reasonable assurance' of adequate protection of public health and safety in mitigating the consequences of a beyond-design-basis external event."

Regarding the second major issue, Cowan noted that 71 plant licenses have been renewed for an additional 20 years, and 14 renewals are currently in progress. The NRC renewed Vermont Yankee's license on March 11 of this year, even though the state of Vermont opposed the relicensing, he continued. The U.S. District Court for the District of Vermont ruled in favor of the NRC's jurisdiction for this action, and the state brought suit against the ruling. Oral argument for the lawsuit was scheduled for May of this year, Cowan noted. The government has twice ruled in favor of Exelon, the operator of the plant, thus overriding Vermont statutes. Indian Point, in New York, is undergoing a similar process whereby the state government is attempting to restrict necessary permits.

Cowan then recited the history of high-level waste and Yucca Mountain, a history well known to followers of waste policies (or the lack thereof) in the United States. He explained the nuclear liability coverage afforded by the Price-Anderson Act, which provides a liability limit of $12.6 billion.

Mark Cooper, a senior research fellow for economic analysis at Vermont Law School, used Cowan's $12.6-billion figure to illustrate his point: "Even though that amount is constitutional, it is insufficient." The cost of Fukushima is currently estimated at $250 billion, he said, which makes $12.6 billion woefully inadequate. Cooper talked further about the tension between safety and economics. "Can we have safety at an affordable cost?" he asked. "Nuclear power is neither affordable nor worth the risk. Nuclear power may be necessary in 2030, but it's not ready yet, so let's be clear to the public. Low-ball numbers lead to public mistrust. Japan uses half the energy per capita than the U.S.," he said. "Why can't we be as smart?"

In contrast to Cooper's assessment, Stephen Kuczynski, president and CEO of Southern Nuclear Operating Company, explained how and why Southern Company (the parent company of Southern Nuclear) is "out front" in building two new nuclear units at the Vogtle site in Georgia. The rationale, Kuczynski explained, is "having a standard passive design that's cost competitive after it's built, and promoting economic benefits—up to 5000 jobs over the next few years. Nuclear plants are reliable, and the Vogtle site is in a state with a good regulatory environment for new build. There is good federal support, and if you have a 60-year mindset, building makes a lot of sense."


Kuczynski

The final panelist, Robert Powelson, chair of the Pennsylvania Public Utility Commission, opened his presentation with an overview of Pennsylvania's current energy mix. "Nuclear power accounted for 38 percent of the state's power generation mix," he said. "Pennsylvania has over 47 000 MW of installed capacity, making the state a net exporter of power." He added, "In the last PJM [Interconnection LLC] capacity auction, over 3000 MW of coal generation did not clear the PJM auction." He explained, "It will be very difficult to build a new nuclear plant in the PJM marketplace, due in large part to $2.50 [per million Btu] natural-gas pricing." He added that many Pennsylvania nuclear plant operators have done uprate projects at their existing plants. Since 2004, he said, over 1500 MW of uprates have taken place in Pennsylvania. He also complimented Southern Company on the Vogtle plant's new nuclear build as an opportunity for the nation to see how new nuclear plants can be built on time and on budget. Powelson emphasized, "We can't run the country on wind and solar."


Powelson

Summary and reflections

The symposium concluded with a wrap-up from John Metzger, director of the Nuclear Engineering Program in the University of Pittsburgh's Swanson School of Engineering. "The history of both commercial and naval nuclear power in the U.S. provides the gold standard of industrial safety," he reminded the audience. As heard during this symposium, he said, despite TMI and Fukushima being billed as disasters, no one was killed at TMI and there were no long-term health effects due to radiation. At Fukushima, no one was killed due to the radiation release, and it appears that the long-term health effects will be negligible. "That does not sound like a disaster," Metzger said. "However, there are others that may not agree, and that is why we had this symposium.


Metzger

"The ground rule in organizing the symposium was that it was not to be a platform for the nuclear industry," Metzger said. "It was to be an objective appraisal by national experts, and I believe that in these past two days we have been successful."

The entire proceedings of the seminar will be made available for viewing on the Dick Thornburgh Forum Web site at <www.thornburghforum.pitt.edu>. NN