ANS WINTER MEETING

"Ready, steady, go" for new reactors

Despite the global credit squeeze, the economic slowdown, and the power shift in Washington, nuclear industry representatives expect the momentum for new power reactor licensing and construction to continue.

THE THEME OF the ANS Winter Meeting, held November 9–13 at the Grand Sierra Resort in Reno, Nev., was "Nuclear Power—Ready, Steady, Go," and while this was decided before the worldwide crisis in financial markets and the resulting prospects of a recession, speakers at the opening plenary session remained generally positive about the ongoing licensing projects for new power reactors in the United States. While the construction of a nuclear power plant would require billions of dollars in financing, the consensus view was that the money would be available and the terms would be such that the economics would remain attractive.

Nuclear Regulatory Commission member Kristine Svinicki noted, as so many NRC officials have, that licensing for new power reactors is being pursued in a way the agency had not anticipated when the 10 CFR Part 52 regime was created in 1989. The system allows an applicant to apply for a combined construction and operating license (COL) after first obtaining an early site permit (ESP) and referencing an NRC-certified standard reactor design. As it happens, only two of the 17 COL applications submitted to date have followed on ESPs, with one other overlapping a COL application with an ESP application still under review. As for reactor designs, three of the five chosen thus far are still in the certification process, and the two that have been certified are undergoing amendments to match the versions chosen by applicants. Svinicki said, however, that in her view, Part 52 has the NRC ready for the industry's approach to new reactors.


Svinicki

As for readiness elsewhere in the nuclear infrastructure, Svinicki looked at what would be required to build as many as 50 reactors in the next 30 years—which, according to the Energy Information Administration, would roughly maintain nuclear power's capacity to provide about 20 percent of the nation's electricity. She noted that median worker ages in the nuclear industry are in the upper 40s or older, and asked where the new designers, operators, and builders would come from. When she received her degree in nuclear engineering from the University of Michigan in 1988, she said, she was among just a handful of NE graduates at that school. She takes it as a hopeful sign that the enrollment in the same program is now "the highest ever," but Michigan's research reactor was closed in 2003. "There's no getting back the decommissioned reactors as education, training, and research tools," she said.

Svinicki also cited the three-year backlog at Japan Steel Works, the only facility in the world currently capable of making the ultraheavy forgings required for all five of the reactor models that would be built in the United States, and the decline in the past few decades of the number of manufacturers certified by the American Society of Mechanical Engineers to make nuclear-grade components and equipment, with the number of N-stamp holders down from nearly 600 in 1980 to fewer than 200 last year. Since then, however, the number has risen above 250, and substantial corporate investments have recently been announced for reactor component facilities planned by Areva and Northrop Grumman in Virginia and by Westinghouse and the Shaw Group in Louisiana. Svinicki also summarized the NRC's own efforts to expand its workforce, with plans to hire 200 employees over three years, and to impart training and experience to the new hires by bringing back retirees to assist with knowledge transfer.

In keeping with the meeting's theme, much of what she said concerned "ready." On "steady," she stressed the importance of maintaining the strong record of safety and productivity in the current generation of power reactors. As for "go," she restated the Part 52 actions completed and ongoing by the NRC, and said that the rest "is up to you and the rest of the nuclear industry."

Donna Jacobs, senior vice president of planning, development, and oversight at Entergy Nuclear, also touched on the workforce concerns raised by Svinicki (and by many other industry figures in recent years). She cited statistics from the Nuclear Energy Institute showing that 70 percent of employees in all sectors of the nuclear industry are over 48 years old. In five years, 50 percent of maintenance workers could retire or otherwise end their employment. In that same time frame, power reactors could lose 45 percent of workers in radiation protection, and reactor vendors could see 41 percent of their workers depart. Through various training programs and community college efforts, the industry is trying to address this situation. Jacobs said that Entergy expects each new reactor to create 2000 to 3000 construction jobs and 400 permanent jobs, and that her company has submitted COL applications for one new reactor each at Grand Gulf in Mississippi and River Bend in Louisiana. She added that Entergy expects to continue to pursue these projects despite the slowdown in the economy.


Jacobs

"We are not waiting for a renaissance—it is here," Jacobs said, adding that both the public and elected officials are on board. She noted that regulators in Louisiana and Mississippi have approved rate coverage for the new Entergy projects. Jacobs also mentioned the results of a poll of residents in the vicinity of Three Mile Island in Pennsylvania, most of whom lived there during the accident at Unit 2 in 1979. She said that 84 percent of the respondents favored the renewal of the license of Unit 1, which if approved by the NRC would allow operation until 2034.

The pool of trained nuclear personnel might be augmented fairly quickly if an effort is made to attract back the hundreds of people who saw no immediate future in nuclear energy during the industry's doldrums and decided to move on.

Jacques Besnainou, president of Areva Inc. and president and chief executive officer of Areva NC, described his company's focus on carbon dioxide–free energy, which he saw as one of three approaches for energy in the future (the others being energy efficiency/conservation, and fossil-fired generation with carbon capture and sequestration). He pointed out that although Areva is based in France, it is the leading supplier of nuclear energy products and services in the United States, with more than 6000 employees at 45 locations in 20 states.

Besnainou said that Areva is building not only reactors—and he showed photos of Olkiluoto -3 in Finland, Flamanville-3 in France, and the ground clearing at Taishan in China—but an entire industry, including ventures in uranium enrichment (an expansion in France and a new plant proposed for Idaho) and mining. He said that the joint venture with Northrop Grumman will be self-financed and is thus not likely to be affected by the credit crunch, and that it will do for the U.S. EPRs planned for the United States what the Areva facility at Chalon St. Marcel does for the EPRs planned for France.

Joe Belechak, senior vice president of nuclear fuel at Westinghouse Electric Company, mainly addressed larger policy issues for nuclear energy, but his own career arc provided a side note to the general issue of the industry's workforce needs. He mentioned in passing that he had started professionally at Duquesne Light Company (now a part of FirstEnergy) and later left the nuclear industry. He was, in fact, one of many who did so in the years around 1990. He returned to nuclear to take his position at Westinghouse. This was not elaborated on further by either Belechak or the other speakers (or anyone in the audience during the question-and-answer session), but the pool of trained nuclear personnel might be augmented fairly quickly if an effort is made to attract back the hundreds of people who saw no immediate future in nuclear energy during the industry's doldrums and decided to move on.


Belechak

Belechak spoke of the need for a coherent federal energy policy and for "regulatory constructs that create value for all." He also expressed concern over the "lack of movement in addressing spent fuel," noting the public's lack of knowledge on what nuclear waste is, how much there is, and where it is. "We are a quiet industry," he added. He said that the nuclear community needs to tell its story to the public, communicating nuclear's value as a clean and green source of electricity. "We are doing a good job, not a great job," of communicating the facts.

On the specifics of his own company, he said that Westinghouse hired 1300 people in fiscal year 2008 and expects to add another 1000 in FY 2009.

John Kotek, a principal of the consultancy Gallatin Public Affairs and vice chair of ANS's Special Committee on Government Relations, looked ahead to the incoming Obama administration and greater Democratic control of Congress. He said that these developments did not necessarily bode ill for nuclear energy, because of Obama's conditionally favorable position on nuclear and what Kotek described as a "growing number" of Democratic senators who favor new power reactors. He also said that while the new administration might not favor spent fuel reprocessing, the Global Nuclear Energy Partnership might remain in effect as a way of enhancing international control over nuclear material.


Kotek

In addition to Belechak's urging greater communication with the public in general, Kotek said he believes that ANS should deal more with officialdom to ensure that decisions are based on valid information. "I think nuclear is going to fare pretty well," he said. "We need to redouble our communication efforts and make sure the message continues to get out there."

President's Special Session

ANS President Bill Burchill imparts a contagious enthusiasm when he speaks about his initiative, "Getting the Word Out." This special session was informative (and entertaining), providing attendees with information resources and good tips on how to relay the facts about nuclear to members of the general public.


Burchill

Burchill provided an overview of his activities over the past few months, as well as articles that he authored on lobbying versus advocacy and on

nuclear information resources that appeared in the July/August 2008 issue of *ANS News*, and his column and an article on his recent activities in Washington, D.C., in the September/October 2008 issue of *ANS News,* which was available at the meeting.

First on the program was Gwyneth Cravens, author of *Power to Save the World: The Truth About Nuclear Energy,* published in October 2007, which describes Cravens's journey from self-professed antinuclear activist to "a believer" in nuclear-generated electricity and the need for it (*NN,* Nov. 2007, p. 28). Her nuclear education began, she said, when she met D. Richard "Rip" Anderson and tried to "straighten him out about his wrong ideas." But Anderson, a chemist, oceanographer, and environmental health and nuclear safety analyst retired from Sandia National Laboratories, was on a "secret mission," Cravens said, to change people's minds about nuclear.


Cravens

She noted that at first, the information Anderson provided on nuclear "was not basic enough." This led them to conclude that it is important to start with very fundamental factual information. "Don't start in the middle," she said.

As she learned about how electricity is produced, Cravens said, she was astounded by the pollution generated by fossil fuels. The energy choices we make do matter, she said, adding that most people don't think about where the electricity they use comes from, or how it is produced. The mental barriers people have about nuclear power result in the myths blocking the facts. But, she declared, "when you get the facts out, they eventually trump the myths."

People, she said, have a tendency to react with fear to a risk they don't understand, even if the chance of danger might be infinitesimal–such as one in a million, or even one in a billion. And, she emphasized, it is important when talking with the younger generation not to focus on "ancient history," such as the Chernobyl accident. What is important is to present them with the facts—in plain English.

Cravens urged audience members, in their dealings with the public and those opposed to nuclear, to act now, reach out, drop their prejudices, and abandon any tendency toward operating in an "us-versus-them" mode.

A pronuclear demonstration

Lisa Stiles, project manager for workforce planning in the Nuclear Business unit of Dominion Resources Services, made her presentation with the assistance of a group of volunteers—most of them students—who served as pronuclear activists, armed with signs and chanting pronuclear slogans.

Titled "Tales of Pronuclear Activism," the presentation featured Stiles as the "narrator" of the story of how pronuclear outreach—undertaken by a dedicated and enthusiastic group of young nuclear professionals—really can produce positive results. They attended events that were organized by antinuclear activists, took note of the issues, asked questions, and spoke one-on-one with concerned citizens to offset the negative messages being delivered. In one case, Stiles explained, they planned a pronuclear rally, with signs, banners, and information pamphlets, and stunned the opposition, as well as the news media, with their success. As these successes accumulated, the group shared its lessons learned with groups in other states, and on the World Wide Web.


Stiles

Stiles noted that pronuclear outreach "does not require a lot of time." Although those who did the organizing did put in more time, she acknowledged, it is "the participation in smaller ways of so many people that makes outreach a success." Those "smaller ways," she said, included making signs, writing letters to the editor, posting comments on blogs, and attending public meetings to make a short statement in support of nuclear.

Pronuclear outreach also does not require a lot of money, Stiles said, noting that there are plenty of ways for individuals to participate. Besides those mentioned above, she said, "for talking points and speaking materials, the ANS Public Information Committee has already created them for you and put them on the Web site."

Among the suggestions Stiles offered for success in responding to the opposition are the following:

- Learn what the concerns are and formulate responses.
- Share with colleagues lessons learned from experiences talking with individuals and groups.
- Answer truthfully when asked who your employer is, but indicate that you are not representing your employer, are on your own time, and are not being paid to attend the event.
- If you're asked a question and don't know the answer, say so, and don't make one up, or speculate, or hypothesize.
- "Always be respectful, even if others aren't," she said. "Taking the high road makes a good impression on the public."

Stiles described a conversation she had with a woman from the Sierra Club during a 2005 meeting. The woman made it clear that she was against nuclear power. Stiles spent some time talking with her, "mostly about spent fuel. At the end of our conversation, she said, 'Well, I'm less against nuclear power.' I consider that a victory," Stiles said. "If I can make one person less likely to protest nuclear, I've made a difference."

Stiles's presentation ended with her group of pronuclear activist volunteers chanting: "What do we want?" "New nuclear." "When do we want it?" "Now!" No one in the audience could argue with that sentiment.

Start small

Candace Davison, senior reactor operator and education and research specialist at Pennsylvania State University, and chair of the ANS Public Information Committee, filled the third speaker's spot on the program. She echoed some comments of the previous speakers, and added that it is best for individuals new to speaking up about nuclear issues "to start small and slowly." Start with one-on-one conversations, she suggested, and then move to speaking in front of small groups. Once some experience is gained, then would be the time to move on to speaking to larger groups.

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Davison

conducts regularly, and directed session attendees to the ANS Web site, with its wealth of information and resources for those who want to have a hand in spreading the word about nuclear science and technology.

In closing, Davison issued a challenge to attendees to go outside their "comfort zone" in the new year—for example, she said, move from talking with individuals one-on-one to speaking to small groups, or from speaking to small groups to speaking to larger groups.

In the brief question-and-answer period that followed the presentations, one audience member asked the presenters what they thought were the biggest misconceptions about nuclear. Stiles responded that people don't recognize what the Nuclear Regulatory Commission does. Cravens replied that people don't distinguish between high- and low-dose radiation, and believe that "man-made" radiation is deadly but that "natural" radiation is okay.

At the end of the session, Burchill presented ANS Presidential Citations to Cravens and to Rip Anderson. Cravens was cited "for her lucid case for nuclear power in her book . . . and her many speaking engagements in support of 'Getting the Word Out.'" The citation also notes that she "clarifies the myths, debunks the fears, and masterfully brings the truth about nuclear to the general public through her own journey of discovery." Anderson was praised "for his valuable contributions to nuclear science and engineering, particularly the use of probabilistic risk assessment techniques in licensing WIPP [the Waste Isolation Pilot Plant], and his role both personally and in guiding Gwyneth Cravens in support of 'Getting the Word Out.'"

Nonreactor decommissioning

A lesson to be learned from the decommissioning of commercial nonreactor facilities is that the work is often fraught with unexpected discoveries. The session titled Decommissioning and Decontamination of Commercial Nonreactor Facilities was replete with examples of surprises that had popped up during various decommissioning jobs.

Joe Nardi, a senior consultant with Enercon Services, has spent about 30 years in the industry, decommissioning and decontaminating nuclear facilities. Many of the sites he has worked on were very old and had been used for a variety of jobs, and most contained a wide range of radionuclides.

Nardi presented what he called his Top 10 List of commercial D&D myths. One myth is that historic site assessments provide accurate information, which in reality is simply not the case. Nardi noted that a lack of valid records and drawings, and sometimes changes in ownership, usually results in many unknowns about a project. At one job, for example, a small laboratory had been walled off and forgotten, and Nardi's work crew discovered it only by chance. In cases like this, Nardi said, an oft heard response from site personnel is "Oh, yeah, now I remember." He said time and money could be saved if the memories of site employees were less foggy.

In another case, Nardi said, some contaminated drums were found by accident after a decommissioning job was thought to be finished. In this instance, the cleanup site was on a hill overlooking a forest by a river. A worker looked toward the river one day and thought he saw something unusual. It turned out to be contaminated drums. "After we found them, one of the guys from the site came forward and said, 'I just didn't want to tell you about that, but I'm glad you found them,'" Nardi said. The worst part about the situation was that Nardi had already told management that the site's decommissioning was complete.

In a third example, existing records did not reveal a site's true history. In this instance, two coin-sized hot spots were found on the floor of a room, and a decision was made to remove the hot spots. "The more floor we peeled back, the more we found," Nardi said. "We just started peeling off the floor, and it just got hotter and hotter and hotter. We ended up taking up all of the flooring." The room, it turned out, had been used for uranium enrichment for the Manhattan Project during World War II. Site records, however, did not reveal this information. The discovery added layers of work for the decommissioning crew.

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Other D&D myths, according to Nardi, are that a facility must be completely characterized before the decommissioning can begin, that an accurate description of how a facility will be decommissioned can be given up front, that core bores taken from the earth will provide an accurate picture of subsurface contaminants, and that detailed characterization of an area's soil contamination will provide a high degree of certainty about the decommissioning costs to be incurred.

Nardi offered words of wisdom tempered by his years of experience in D&D work: "I was told to expect the unexpected, but the unexpected has exceeded my expectations!"

Todd Majer, of the environmental management company De Maximus Inc., talked about the importance of providing information to the local community during decommissioning. At one site in Concord, Mass., citizens were upset that radioactive materials were located "right in the backyard," according to Majer. The 46-acre site is near Walden Pond, made famous by Henry David Thoreau in his book about environmental awareness, *Walden.* Established in 1958, the site is in a wealthy neighborhood and is surrounded by light commercial and residential properties, with a children's day camp to the south. A hiking trail borders the southern edge of the site.

Beryllium and other metal powders were manufactured at the site, and nonradiological contaminants (PCBs) have been found there. The current owner was doing some cleanup, but the community was unhappy with the progress. When De Maximus got involved to start taking samples of contaminants, it held a meeting with community residents during which the cleanup process was explained. "Everything that we would do going forward would be public knowledge and accessible to all of them," Majer said, mentioning a Web site (<www.nmisite.org>) that was established to provide the public with reports about the project.

De Maximus now holds bimonthly meetings to keep the residents updated. So far, "everything has worked very well," Majer said. "I'd like to stress that in those meetings, we have some health physicists from the community group who put the pressure on us about analytical methods, sampling techniques, depth of the samples, locations of sample collections, and so forth."

One surprise found during the site investigation was the discovery of radioactive materials in the soil near an outdoor area that had been used to store waste drums. The drums were filled with a material called conjoint, made up of waste products mixed with concrete. During wintertime, snow accu-

mulated on the drums. Majer speculated that because the conjoint had not yet cured in some of the drums, the radioactive materials had seeped out into the snow on the drum tops. When the time came to relocate the drums off site, the shippers tipped them over to brush off the snow to the ground, where the contaminants leeched into the soil. "This was told to us by a former employee," Majer said. "We take it for what it's worth, and anyone who would take a [soil] sample realized that he was probably accurate."

John Conant, director of engineering compliance for ABB Inc., provided information about another cleanup site in New England that had a history as a nuclear fuel manufacturing plant. The 600-acre site was established in 1956 and was cleaned up by early 2007. A surprise during the job was the discovery of clamshells in a ravine near the northern border of the site, close to a river.


Conant

Conant said that he remembered reading old memos from the 1950s that had been written by the plant's safety manager. The memos said that the clamshells originally had been placed in the discharge area of the waste stream that carried very acidic compounds from the manufacturing plant. The water in the waste stream, Conant said, "was funny colors, and there were dead things lying around leading to the stream. I read that one pH [measurement of the stream] was 2.3—not good." To rectify the situation, plant workers threw clamshells into the discharge area to absorb some of the contaminants, "and it was a pretty effective buffering," he said.

Conant speculated that the clamshells were eventually dug out of the discharge area and put in the ravine, where they were found during the site cleanup.

That speculation differs from local lore, according to Conant. "There was a lawyer who had another opinion of how they got there," he said. "This area was an old Indian habitat along the river. He thought it might have occurred when the Indians would eat the clams and toss the shells over their shoulders into the ravine. And the shells just accumulated. We just can't figure out how they got the enriched uranium."

Digital I&C

Two sessions at the meeting dealt with the conversion from analog to digital instrumentation and control systems, the first on licensing, the second on the dedication of commercial-grade components. During the first session, Bill Kemper, chief of I&C engineering in the NRC's Office of Nuclear Reactor Regulation, gave a status report on lessons learned thus far in the licensing process. Among his recommendations for applicants is one familiar to those involved in a much larger project—an application for a combined construction and operating license for a new reactor: make the documentation as complete and as high-quality as possible. Kemper said that this would lead to fewer requests for additional information and less interaction with the NRC staff.

As an example of adequate documentation, Kemper cited a vendor's verification and validation (V&V) report that includes specification reviews, life-cycle documents reviewed (with change records), reviewed hardware and software products, V&V performed during system assembly and testing, reviewed life-cycle phase outputs (including list of inputs and V&V effort), review of incremental tests, simulation environment defined with V&V results, and a complete requirements traceability matrix.

The prescriptive aspects of I&C regulation were defended because of uncertainties in the understanding of common-cause failure, with one panelist stating that replacing a chip is not the same thing as root-cause analysis.

Ray Torok, I&C project manager at the Electric Power Research Institute, spoke on EPRI's involvement in technical and regulatory issues. Among the key areas are diversity and defense-in-depth and the human factors aspects of a highly integrated control room, for which EPRI had just released a guide on manual operator actions. He noted that the NRC has endorsed earlier EPRI guidance on licensing of digital upgrades, qualification of components against electromagnetic interference, evaluation of commercial-grade digital products, and generic qualification of programmable logic controllers.


Torok

Torok also added to the lore of cautionary tales in analog-to-digital conversion by mentioning the experience of a flight of F-22 fighter aircraft flying from Hawaii to Japan. The planes' new digital system blanked out completely when they crossed the International Date Line and could make no sense of the time signals it was receiving. Fortunately, Torok said, the flight was accompanying a tanker that had a diverse digital system that could function despite the unexpected data input of the date line.

Chris Wiegand, engineering manager for new plant development at Exelon, addressed digital I&C issues for the five reactor models being considered for new construction. While listing the I&C systems planned for specific applications, he noted that even among these new designs, there is one analog system—the Mitsubishi APWR's diverse actuation system. Among the ongoing and future issues for these reactor models, he listed the treatment of V&V tools as safety related, and uncertainty and slow progress on regulatory concerns—including the failure to show the probability of common-cause failure versus improvement in core damage frequency from the installation of a digital system.

During the subsequent panel discussion and audience participation, it was noted that the main concerns related to cyber security of digital I&C are with "trap doors"—unauthorized computer program modules used solely for fraudulent purposes—that may have been programmed in prior to hardware installation, and not so much with the Internet or wireless networks. The prescriptive aspects of I&C regulation were defended because of uncertainties in the understanding of common-cause failure, with one panelist stating that replacing a chip is not the same thing as root-cause analysis. Asked whether an improvement in core damage frequency with digital I&C had ever been quantified, Torok said that in operating reactors, the improvement is about 16 percent.

In the session on commercial-grade dedication, Steven Arndt, of the NRC's Office of Nuclear Reactor Regulation, referred to the EPRI guidance Torok had mentioned as either fully or conditionally accepted by the NRC for dedication of commercial off-the-shelf items. Viewing the importance of quality and completeness in submittals from a different angle, he said that his office "got beat up by the inspector general about nine months ago" for not being specific enough in its safety evaluations. He also pointed out that one of the EPRI guides (TR-106439) states that not all commercial-grade items can be dedicated for nuclear-

grade applications.

In this session's panel discussion, an audience member noted that software developers are aware that their products are used in safety-critical applications, and asked if they were specifically aware of nuclear-related needs and requirements. Arndt replied that there is enormous diversity among developers, and that domain-specific requirements differ. There is ongoing discussion within the industry on what software reliability is, how to agree on metrics, and how to show that improvement has taken place. He added that in the past five years, various industries—such as nuclear energy, pharmaceuticals, and aerospace—have begun to converge on their standard requirements, and this would eventually mean more uniform criteria for software developers.

Arndt

Developing nations

The southwest African nation of Angola has been working with the Massachusetts Institute of Technology to develop a high-technology education infrastructure, and contacts made through this collaboration gave rise to the appearance of high officials from Angola at the session "Nuclear Energy Prospects for Developing Nations," which was chaired by Andrew Kadak, Professor of the Practice of Nuclear Engineering at MIT. Speaking at the session were Emanuela Afonso Vieira Lopes, the minister of energy, and Maria Cândida Teixeira, the minister of science and technology. Also in attendance was Angola's ambassador to the United States, Josefina Diakité.

Vieira Lopes said that while Angola is interested in making use of nuclear technology, this interest would not extend to electricity production in the near future. She said that the entire country's generating capacity is about 1000 MWe, and current plans call for adding more hydropower. Angola joined the International Atomic Energy Agency in 1999, opened a radiation laboratory in 2004, and has begun to develop regulatory institutions. Vieira Lopes also noted the problems the country has had—colonial domination by Portugal and then 30 years of civil war—and said that only in the past six years of peace has it been possible to begin forming a stable society, let alone one that could adapt quickly to new technologies.

Teixeira said that there is some use of radioactive materials in agriculture (seed development) and fisheries (control of algae blooms), but much of the current work in establishing the technical infrastructure for radiation protection has been on the development of an inventory of radiation sources. When Portugal ended its colonial rule, she said, all of the radiation professionals left the country, and orphan cesium-137 and cobalt-60 sources were left behind in an oncology center. The IAEA has sent three expert missions, and the sources have been transferred to South Africa. The IAEA may also help revive the defunct cancer facility.

Also addressing the session was Ambassador Hamad Al Kaabi, permanent representative to the IAEA from the United Arab Emirates (UAE). Al Kaabi gave specific target dates for the widely reported plan for the oil-exporting country to buy, build, and operate its first nuclear power plant (contract award in 2010, first concrete in 2012, first reactor startup in 2017). He said that there would not be a competitive bid process for the reactor order, and procurement details are still being worked out. He noted that the UAE expects electricity demand to reach 40 GWe by 2020, and the country is already importing natural gas from nearby Qatar. Solar power is expected to provide only 6 percent of the nation's electricity by 2020, and burning more oil (and importing coal) would not be environmentally acceptable. Plans exist for a Federal Authority for Nuclear Regulation, an Emirates Nuclear Energy Corporation, and an international advisory board. At present, the UAE is assessing two sites and may choose one or two reactor models. In response to a question, Al Kaabi said that the UAE may sign the IAEA's Additional Protocol (to place the highest level of IAEA control over the nuclear facilities) in early 2009.

Al Kaabi gave specific target dates for the widely reported plan for the UAE to buy, build, and operate its first nuclear power plant (contract award in 2010, first concrete in 2012, first reactor startup in 2017).

Workforce pipeline

The fast-approaching future will find the nuclear industry in the United States looking for workers to fill job openings. Up to 35 percent of its workers will be of retirement age within five years, according to Carol Berrigan, director of industry infrastructure at the Nuclear Energy Institute. "Fortunately—or unfortunately, because of the stock market—the current economic downturn seems to be keeping people in their jobs a little longer," she said during the session "International Collaboration in Nuclear Energy Technology Education." "But, inevitably," she added, "we'll see these people retire at some point, and it's in the interest of the industry to look at replacing them with the most highly skilled, educated workers that we can."

Berrigan

The same problem exists around the world, as countries scramble to fill the nuclear worker pipeline. One ongoing project, supported primarily by grants from the Department of Education to certain U.S. universities, is the joint effort by the United States and Russia to cultivate a common nuclear engineering curriculum.

Currently, students in Russia are introduced to the nuclear industry through an intensive five-year program in physics and mathematics, according to session organizer Ivan Maldonado, an associate professor of nuclear engineering at the University of Tennessee (UT). Whether U.S. universities can adapt to such a program is being evaluated by the U.S.-Russia collaboration, he said. For example, the program could be altered to reduce it from five years to four, or it could become a combined bachelor's/master's degree program over the five years.

Maldonado

While the session included panelists who offered U.S. and French perspectives on education measures, none of the three scheduled speakers from Russia's Moscow Engineering Physics Institute were present. "Unfortunately," Maldonado said, "for a number of reasons, they were not able to attend."

One audience member offered an explanation for the Russians' absence. "The old order is being pushed aside. That is, the people who lead the industry and who were technical leaders are no longer being listened to," said Walter Sadowski, a visiting senior scientist in physics at the University

of Maryland. Sadowski explained—"and I'm now 'quoting' the Russian press; it's not my personal experience," he said—that the Russian government has decided that leaders of the nuclear industry "are lawyers and financial people. This has led to quite a bit of unhappiness on the part of the old guard who are technically based." He added, "The fact that no Russians came to this meeting is rooted in these difficulties."

Thus, information about the collaboration was not provided during the session. Stepping in, however, to supply comments about Russia's nuclear experience was Pavel Tsvetkov, an assistant professor of nuclear engineering at Texas A&M University and a graduate of the Moscow Engineering Physics Institute.

Tsvetkov

Tsvetkov said that not many nuclear engineering graduates stay in the Russian industry, and that the country is taking steps to revitalize the industry, including establishing a centralized nuclear university. The goals, he said, are to expand Russia's nuclear production and to support a nuclear weapons complex, a nuclear power complex, and a science and engineering complex.

Tsvetkov added that Russia's economic hardships have made it difficult to complete the construction of new nuclear plants in the country, and that other problems stem "from demographics, the aging of personnel, and the desire to compete globally." Russia is also "beginning to see an absence of efficient quality control systems," he said.

Raymond Juzaitis, head of the Nuclear Engineering Department at Texas A&M, said it was important on an international basis to "socialize a safety culture at the educational levels." In this age of worldwide terrorism, students pursuing a nuclear education need to be aware that "both nuclear security and nuclear safety are elements of our profession," he said, noting that the Nuclear Regulatory Commission has provided grants to U.S. universities to revise their curricula to emphasize safety.

Juzaitis

Juzaitis also observed that the industry has to deal with nuclear proliferation resistance in a quantitative and rational manner, as it has done with safety. The reason, he explained, is that nuclear can be used either as a civilian energy source or as a latent capability that could one day allow some governments to turn to nuclear weapons. "We as nuclear professionals have to be attuned to that," he said. "Only when the world sees this industry taking an active, self-disciplined approach to both safety and proliferation will we truly attain sustainability."

Explaining the French effort to expand its workforce was Dominique Greneche, assistant director for Areva's Research and Development Division. Greneche said that France in early 2007 began a movement to boost nuclear education and training, with three goals in mind: to create excitement in the engineering schools and universities about a nuclear education, to enhance or support a specific education (for example, neutron physics at the highest level), and to create an international master's degree program (the courses for which would be taught in English).

Greneche

The international master's, Greneche said, is a two-year program through which students can pursue one of five fields of study: research and development, design, operation, dismantling and waste management, and the fuel cycle. The inaugural class began in 2008 with 20 students, although these students started in the second year of the program. (Greneche said he didn't know why the program was set up this way.) The initial "first-year" class will begin in 2009. The program's objective, he said, is to have 200 students enrolled within two or three years.

Areva, too, just launched a process "to find young blood with good talents," he said. An internal training course in nuclear, scheduled to start early in 2009, was being prepared within "the Université Areva." In addition, Electricité de France (EDF) recently created a special foundation for teaching nuclear energy. Greneche said there is "very close cooperation" between Areva and EDF in this endeavor. And an institute to teach energy (not just nuclear) is being created in Paris with the help of France's Atomic Energy Commission.

Concerns exist in France, however, about being able to attract enough qualified people to fill the worker pipeline, according to Greneche. One of those concerns is salaries. "Generally speaking, engineers are lower paid than managers in some other economic sectors, such as finance," he said. The second concern is paying for the training of prospective employees. "Money to fund this education is limited because the nation and industry must cope with numerous other priority investing in R&D and elsewhere," he said. The third concern is finding qualified teachers. "We have a lack of students, but we also have a lack of teachers. We have to launch programs to train teachers in nuclear," he said.

Lee Dodds, head of the Nuclear Engineering Department at UT, suggested that real-time interactive distance learning could alleviate the problem of not having enough qualified teachers to go around. The best teachers, he said, could offer courses in their areas of specialization to students located anywhere in the world. For example, UT's distance-learning nuclear engineering program has students participating internationally from Canada, Brazil, and Mexico, and in the United States from California, New York, and throughout Tennessee.

Dodds

"It does not matter where the professor is located. It does not matter where your students are located," Dodds said. Through distance learning, all of the students "are receiving this lecture and interacting with the professor, asking questions, getting answers in real time."

John Gutteridge, manager of the NRC's Nuclear Education Program, provided statistics related to the U.S. education pipeline. The nuclear industry as a whole (not just nuclear power) will need an influx of 90 000 new workers within 10 years; the number of U.S. research reactors has plummeted from more than 60 to 25; the undergraduate and graduate student population in nuclear engineering went from 1800 students in 1990, to 600 students in the late 1990s, to more than 3300 students currently; and the number of nuclear engineering programs at U.S. institutions (following the same time frame as given for students) went

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from about 50 programs to fewer than 30 programs, to more than 30 programs currently.

New reactor updates and trends

An event that has taken place at the last several national ANS meetings was held again in Reno, despite continuing changes in its nature—is it a committee meeting or a technical session?—and in its time slot, venue, and nominal sponsorship. What has come to be referred to familiarly as "the new reactors session" was held early Sunday afternoon, and its organization, overseen by Ted Quinn, vice president of Longenecker Associates and an ANS past president (1998–1999), is now known as the Nuclear Construction Working Group of the Operations and Power Division. At the Anaheim meeting last June, the event was held in a ballroom with a dais and an audience, as at a technical session. In Reno, the event was held in a conference room, with participants seated around a large central table, as it has often been in the past. What remained unchanged was the wealth of information made available during the event, much of which does not emerge in the more formal, large-audience presentations on new reactor projects.

B. P. Singh, a former manager of the Department of Energy's Nuclear Power 2010 program, looked beyond the usual focus on near-term reactor licensing to his current DOE assignment as a program manager for the Advanced Fuel Cycle Initiative (AFCI). He said that while the continuing resolution by Congress carried fiscal year 2008 funding levels into FY 2009 (because a federal budget for FY 2009 was not enacted by October 1, when the fiscal year began), the DOE's Office of Nuclear Energy has chosen to limit AFCI activities to the level recommended by the version of the budget that had been approved by the House of Representatives. Current AFCI spending is therefore at the level of about $90 million for the year, about half of what would be available if FY 2008 funding had been continued. Singh said that in addition to the advanced fuel cycle research and development activities, work thus far has included a memorandum of understanding with the Tennessee Valley Authority for a feasibility study of an integrated fuel cycle with such elements as mixed uranium-plutonium oxide fuel and fast reactors. Beyond that, he said, DOE personnel were preparing to communicate the goals of the program to the transition team for the incoming Obama administration.


Singh

Although he was unable to attend this meeting, David Matthews, director of the Division of New Reactor Licensing in the Nuclear Regulatory Commission's Office of New Reactors, sent presentation slides summarizing the current status of applications for combined construction and operating licenses (COL). Apart from information often stated elsewhere at the meeting—that the NRC had received 17 COL applications for 26 reactors, for example—the most significant points were on the issues that have arisen most often in these reviews (site hydrology and geology and recirculation screen design in the proposed reactor models), and on the NRC's exploration of potential effects of aircraft crashes into plant structures (such as spent fuel pools) which could lead to new amendment proposals for 10 CFR Part 52.

Dan Keuter, vice president of nuclear business development at Entergy, spoke mainly on the prospects for high-temperature gas-cooled reactors (HTGR), but he also mentioned a nearer-term activity: the company's effort to spin off its merchant reactors into a separate company called Enexus. He said that the strong return on investment of the merchant plants, which are mostly in the Northeast, are making it difficult for Entergy to obtain rate relief for its regulated plants in the mid-South. The spinoff might allow the regulated plants to be considered separately. To maintain continuity, Entergy and Enexus would jointly own another company, to be called Equagen, that would operate all of the reactors owned by Entergy and Enexus (plus Nebraska Public Power District's Cooper plant, which Entergy currently operates under a contract). Keuter said that the initial schedule for the Enexus spin-off—which was to be done by the end of 2008—will probably be delayed into 2009. He said that this "may not be the optimal time," because of the need to obtain $4.6 billion in financing.

On the HTGR, as represented by the DOE's Next Generation Nuclear Plant (NGNP) proposal, Keuter said that Entergy's interest is not just that of a long-range vision for the future of nuclear power. He noted that Entergy's service area includes numerous refineries and chemical plants with a vast demand for process heat, and the NGNP's projected ability to cogenerate process heat and electricity might be ideal to meet that demand. Keuter said that the NGNP, currently planned for the Idaho National Laboratory, would go through a 10 CFR Part 52 licensing process, with a COL application submitted to the NRC. There would not, however, be an application for design certification, he noted, because the NGNP would be a one-of-a-kind prototype, and later HTGR designs would evolve from NGNP experience.

Sandra Sloan, manager of regulatory affairs for Areva NP, asked whether the NGNP should be licensed under 10 CFR Part 50. . . . She argued that there could be a "significant risk" commercially if every aspect of the NGNP were subject to the Part 52 mandatory hearing process.

Because there would be no certification, as standardization is worthwhile only if more than one reactor is built to the standard, Sandra Sloan, manager of regulatory affairs for Areva NP, asked whether the NGNP should be licensed under 10 CFR Part 50. Part 50 is the process under which the current fleet of operating reactors was licensed, and one in which each reactor's design was reviewed separately from all others. She argued that there could be a "significant risk" commercially if every aspect of the NGNP were subject to the Part 52 mandatory hearing process. Keuter replied that the NRC has expressed a preference for the NGNP to be licensed under Part 52.

Another frequent attendee who was not present was Ann Bisconti, president of Bisconti Research. Like Matthews, however, Bisconti sent slides to be presented. They showed the results of the company's latest poll of attitudes on nuclear power, drawn from telephone contact with about 1000 adults from September 18 to 21. The results showed continued momentum in favor of nuclear power, with 74 percent in favor of nuclear power generally (with 24 percent opposed), 72 percent considering nuclear power to be safe (15 percent disagreeing), and 69 percent in favor of the construction of new power reactors (29 percent against).—*E. Michael Blake, Rick Michal, and Betsy Tompkins* NN