

ANS ANNUAL MEETING

Opportunities in the next millennium

“NUCLEAR SCIENCE IS alive and well,” said outgoing ANS President Ted Quinn as he kicked off the plenary session at the 1999 American Nuclear Society Annual Meeting, held June 6–10 in Boston, Mass. The conference, “The Atom in the Next Millennium,” was chaired and organized by Ted Feigenbaum, of Northeast Utilities. The six plenary speakers indicated that opportunities will abound for nuclear science and technology in the future, but that these opportunities will be lost unless they are prepared for now.

U.S. Rep. John E. Sununu (R., N.H.), elected to his post in 1996 (and reelected in 1998), made Congress’s role in nuclear policy decisions the focus of his talk, presenting the good news and bad on several issues. Sununu, who holds a BA and an MA in mechanical engineering from the Massachusetts Institute of Technology and an MBA from the Harvard



Sununu

Graduate School of Business, pointed out that he is one of only six engineers in the House of Representatives. That is unfortunate when “in this day and age so many of the policy issues that we deal with are technologically driven,” he observed. Sununu cited as examples environmental issues, hazardous wastes, Superfund site cleanup, and Y2K issues. An engineer’s perspective is needed to make technically sound decisions when so much is at stake, Sununu suggested.

He provided an insider’s thoughts on how legislative actions may affect the future of nuclear energy, discussing both the opportunities and the challenges that may result from Congressional decisions. All pending or future legislation affecting the nuclear industry

The ANS Annual Meeting, held in Boston in June, surveyed the many opportunities and challenges the nuclear industry will find in the coming years.

can be divided into three areas, he declared: environmental climate concerns and initiatives, the regulatory environment surrounding deregulation, and national security.

Sununu pointed out that the interest groups that 20 years ago raised emotional arguments against nuclear power are now becoming concerned about emissions from fossil fuel electricity production. The ensuing debate over capping or trading emissions creates an opportunity for what Sununu calls “among the cleanest possible technologies.” The challenge, however, he termed the “waste problem”—a problem caused not by technical difficulties but by geographical politics, “an expanded version of the not-in-my-backyard [NIMBY] syndrome.” He emphasized that the technical means exist to create a permanent repository for the waste, and that the federal government has an obligation to take spent fuel.

Deregulation means opportunity to those electricity generators—using nuclear, fossil, or renewable fuels—who are able to reduce costs and remain competitive, Sununu explained. A field that values consistency of performance reliability and environmental performance may give nuclear generation a boost, he said, but challenges in the form of capital costs and decommissioning planning continue to beset the nuclear industry.

Sununu noted that national security concerns could both encourage and hamper nuclear technology’s strength in the coming millennium. The fossil fuel market’s relative stability and low prices, which is keeping the cost of oil down, will not be permanent, and the market may favor nuclear generation,

with its low fuel costs. Nuclear technology can also be used as a foreign policy tool—the U.S. can encourage safe technology, while preventing nuclear weapons proliferation, as was done in North Korea, he pointed out, while at the same time expanding the international market for the U.S. nuclear industry. National security concerns over proliferation and spying, however, could become a challenge and hamper the flow of technical knowledge.

When asked by a member of the audience what is necessary to convince members of Congress that nuclear power is vital to America’s energy supply, Sununu made it clear that the strength of the atom in the next millennium will depend on effort from the industry. Public opinion is the key, he said, and the public must be informed, must witness the steady performance of nuclear reactors, and must be convinced of the value of nuclear energy.

Jeffrey Merrifield, the newest commissioner on the Nuclear Regulatory Commission, spoke about the agency, which he says has been much improved by an all-out effort to address the concerns and criticism from stakeholders regarding regulatory uncertainties, confusion and slowdowns in regulatory processes, regulatory emphasis on non-risk-significant matters, and its size. Merrifield



Merrifield

emphasized several improvements, including a fiscal year 2000 budget that is lower in real dollars than the NRC's budget has ever been, before addressing the four issues that he believes will ultimately determine the future of nuclear power: license renewal, license transfers, certification of next-generation reactor designs, and the disposal of high-level waste. The NRC must adapt to the new business environment under deregulation, he says, because, "with the onset of electric industry deregulation, no factor will have greater influence on this industry than economics."

More than 40 percent of the existing U.S. nuclear plant licenses will expire by 2015, yet utilities have found that well-run nuclear plants can be competitive in a deregulated electric industry, Merrifield said. The NRC has committed to completing the license renewal process for Calvert Cliffs and Oconee in 30–36 months, but, according to Merrifield, those processes are on schedule for completion in a total of 25 months. A realistic future goal for renewal applications that do not involve an adjudicatory hearing is 18–20 months, he said, and the NRC is on the right track for "disciplined and timely" renewals.

Merrifield stated that the NRC expects the volume of license transfer requests to increase as deregulation moves forward; he reports that the NRC has been told by some of its licensees to expect sales of 6 to 12 plants during the next year. The NRC is developing guidance documents and regulations to evaluate the technical, financial, and foreign ownership issues that it expects will arise. Merrifield described the license transfer for the purchase of Three Mile Island-1 by AmerGen Energy Company (a joint venture of PECO Energy Company and British Energy plc) which took four and a half months, and that of Pilgrim to Energy Nuclear, which took a little over four months.

The NRC is ready to issue new nuclear plant licenses in a timely manner, although it doesn't expect utilities to be lining up to purchase new plants right away, Merrifield said. The agency's streamlined licensing procedure allows for early site permits, certified standard designs (two of which are currently on file), and combined construction and operating licenses.

Addressing high-level waste disposal, Merrifield stated that the NRC is prepared to evaluate Yucca Mountain if the site is found suitable, and that the facility could open for disposal in 2010. He spoke with concern, however, over the lack of agreement between the NRC and the Environmental Protection Agency over appropriate radiation protection standards; the NRC supports a 25-millirem all-pathways standard, while the EPA wants a 15-millirem limit, with a separate standard for groundwater.

Merrifield emphasized, as Sununu did, that nuclear energy's future is in the hands of the industry: "The outlook for nuclear power in the U.S. is brighter today than it has been in a very long time. However, you should not lose sight of the fact that this outlook is a fragile

one. The continued safe operation of the existing fleet of nuclear plants remains the foundation upon which this industry will be built."

Representing the Department of Energy was William D. Magwood IV, director of the Office



Magwood

of Nuclear Energy, Science, and Technology, with a speech titled "Looking Toward Generation Four: Considerations for a New Nuclear R&D Agenda." Paraphrasing his philosophy professor in another context, he declared, "Nuclear power will exist if and only if it is necessary."

Federal policies once encouraged nuclear power, and the young nuclear industry was more concerned about ensuring long-term electricity supply than short-term costs. While the electric market and government policy have changed, Magwood believes there is a future for nuclear power—not because of carbon taxes and emission trading (he wouldn't "bet the company" on that possibility), but because of increased electricity demand, in the United States and, more dramatically, in the developing world and Asia.

Major roadblocks stand in the way of domestic and international nuclear development. Magwood praised the third generation of plants that have been designed and are waiting for a buyer, including GE's Advanced Boiling Water Reactor and Westinghouse's AP600, with their enhanced performance, efficiency, and availability, but said that developing countries need plants that are safer and cheaper still. The U.S. nuclear market, whose main competition he called the "legendary" combined-cycle natural gas plant, also needs minimal costs. With 60 percent of current U.S. nuclear plants having operating costs of less than 2¢/kWh in a market with a going rate of 4 to 6¢/kWh, nuclear plants can be operated safely and efficiently in the United States; they just need to be built, Magwood declared. With this in mind, he called for a new fourth generation of nuclear plants.

Magwood said fourth-generation plants would have "technologies that alleviate both the proliferation and safety concerns associated with building plants in the developing world while providing U.S. and European utilities with a nuclear option that is competitive with gas." He referred to a recent speech by Stan Hatcher (ANS President 1997–98), in which Hatcher recommended a shift from *constructing* nuclear plants to *manufacturing* them in small, modular units. Building nuclear plants should be more like building aircraft than aircraft carriers, Magwood said. Such plants could have a passive safety design approach, and could even contain enough fuel to run for long periods without the need for the operator to deal with spent fuel. Where do we turn for this advanced technology and research? Well, the recent NERI awards (*NV*, July 1999, p. 70) are a start, Magwood said, and at least two of the

projects being funded are for such fourth-generation reactors.

Charles Pryor, president and chief executive officer of Westinghouse Electric Company, first explained his company's structure resulting from its sale to British Nuclear Fuels plc and Morrison Knudsen, and then took his audience on a whirlwind tour of nuclear power's prospects around the world.

Nuclear's presence in western Europe is shaky, but still holding on with the threat of pending antinuclear policies in Sweden and Germany, but also the possibility of a European pressurized water reactor for France. Central and eastern Europe, where more nuclear power would be welcome, are low on funds, and are concentrating on improving the safety of existing plants.

In Asia, while economic problems have slowed growth in Japan, Korea's economy is recovering and Pryor thinks new plant orders are likely. China's anticipated rate of reactor purchases has slowed, due in part to quicker, and—at least initially—cheaper fossil generation. Pryor stated that China will "probably, in my opinion, halt the activity regarding new orders for another 3–5 years."

Pryor praised the performance and reliability of U.S. nuclear power plants, where in 1998, 70 nuclear units had O&M costs of less than 2¢/kWh. That is not quite good enough,



Pryor

though, he said. Pryor declared that to make nuclear plants truly competitive they must have costs of only 1¢/kWh. "Recognition of the benefits of our energy is at an all-time high," Pryor said. He expressed his dismay over the lack of new construction in the United States, explaining that when he meets with the Chinese in hopes of selling Westinghouse's AP600 design, "they say 'if that product has such good design features and good constructibility and is such an advanced safety product, why isn't your own nation building it?'"

Lee Morin, a commander in the U.S. Navy and a NASA astronaut who holds four advanced degrees, proposed to talk about "New Astronauts and New Rocket Engines." After enlivening the session with a brief discussion and video clips of his two years of astronaut training, completed in 1998, he turned to the topic of the advanced propulsion systems. The Space Shuttle has six fuel pumps, each of which has 90 000 horsepower, or 30 times the horsepower of a commercial airplane, according to Morin, but their power pales in comparison to nuclear fusion or fission rockets, which he said would be necessary for a manned mission to Mars.

The VASIMR system (variable specific impulse magnetoplasma rocket) being developed at NASA's Johnson Space Center in Houston, Tex., shows three compact cells—forward, central, and aft. Neutral hydrogen is ionized and injected. The plasma is then heated, and expelled and shaped in the nozzle. The

VASIMR rocket would allow a 96-day one-way mission trip to Mars, Morin said, and has the added benefit of its aneutronic propellant,



Morin

which would provide the best possible radiation shield to the mission crew. (Morin pointed out that a one-way trip to Mars using a chemical engine would take as long as one year, and would result in a space radiation exposure to the crew exceeding their total allowed lifetime

dose. "That would be your last trip as an astronaut, but it would be a good way to go out," he quipped.)

Morin joined the other plenary speakers in encouraging the industry to take actions toward ensuring the future of nuclear power, suggesting that from the fusion energy propelling spacecraft to the three small, 5-MWe fission reactors supplying electricity to the engines of the VASIMR rocket, space is full of opportunities for nuclear technology. In response to an audience member who asked if Morin, with his knowledge and experience with both submarine and space propulsion reactors, might be able to leverage his experience in support of commercial nuclear power, Morin said, "Actually, we were kind of hoping that you guys would solve those public relations problems in time for us to go to Mars."

Paul Wilson, of the University of Wisconsin-Madison's Fusion Technology Institute, an active member of ANS who spoke as a representative of the North American Young



Wilson

Generation in Nuclear (NA-YGN), inspired confidence that he and his peers possess the enthusiasm and talent that nuclear science will need for its success. He surveyed several opportunities for growth in the industry: license renewal and spent fuel repository development in the short term, and medical applications, fusion energy, space propulsion, and widespread food irradiation in the future. He commented that the Star Trek movies are set in the 25th century, so, "if we meet any of their expectations, we're going to be using a lot of nuclear science and technology."

Wilson emphasized the need to increase the appeal of the industry for the best and brightest young students. These young professionals must not only be recruited but also retained, and given valuable institutional knowledge in trust, he declared. He then presented and elaborated on a mission statement of the NA-YGN: "NA-YGN unites young professionals who believe in nuclear science and technology and are working together throughout North America to share their passion for a field that is alive and kicking."

Women in nuclear

Anyone who chose to attend the President's Special Session titled "Celebration of Women in Nuclear Engineering," commemorating the late Dixy Lee Ray, and sponsored by the Professional Women in ANS Committee, was treated to the insights of an impressive group of women representing many fields of nuclear science and technology. The session was chaired by outgoing ANS president Ted Quinn, and moderated and organized by Carolyn Heising, professor of nuclear engineering at Iowa State University.

Dixy Lee Ray, chairman of the Atomic Energy Commission from 1973-1975, governor of Washington from 1977-1981, and outspoken environmentalist and advocate of nuclear power, was recognized by many of the speakers during the session. Heising, who graduated from high school during Ray's term at the AEC, identified her as a role model. In his introduction of the session, Quinn spoke of his experiences with Ray. He then declared, "I would like to see a position statement on the role of women in nuclear. I would say this isn't so much an issue of sex as an issue of opportunity. We must support equal opportunity."

Keynote speaker Shirley Jackson, then chairman of the Nuclear Regulatory Commission, and now president of Rensselaer Polytechnic Institute, spoke on "Identity, Community, and Responsibility," three "essential components in the formula for continued progress—both for individuals and for women in nuclear as a group." Women in nuclear today still struggle to balance the tasks of Marie Curie, who Jackson once heard described as "an overachiever who cooked, cleaned, discovered radium, won a couple of Nobel Prizes, and raised a Nobel Prize-winning daughter, but who never forgot how to make a good pierogi."

Women in the sciences can build a sense of identity and improve their skills because of their very isolation, Jackson said. She did just that at the Massachusetts Institute of Technology, from which she graduated in 1968 as one of only 10 African-American students in an undergraduate student body of approximately 4000. She encouraged women to foster a sense of community among other female scientists, and make it easier for other young women to follow.

Speaking of her four-year tenure as chairman of the NRC, Jackson enumerated several of what she believes are her most important accomplishments (see p. 24 for a detailed interview):

- Strategic assessment and rebaselining of all NRC activities and programs, leading to a more business-like planning, budgeting, and performance management process.
- Introduction of risk-informed, performance-based regulation as the "overarching

concept and methodology for carrying out our work."

- Implementation of a new performance-based reactor oversight process.
- Establishment of a license renewal process that is "fair, focused, well-planned, and predictable."
- The formation of the International Nuclear Regulators Association, comprising the heads of regulatory bodies from North American and western European countries.
- Reorganization of major NRC functions and offices, and fostering of a new group of leaders.

Margaret Maxey, professor of Biomedical



Maxey

Engineering at the University of Texas at Austin, stated that "there is no future for women in nuclear if there is no future for nuclear." She urged the audience not to let fear dominate in the minds of the public, and pressed for the abandonment of the

linear no threshold hypothesis (LNT), which she says was "at one time administratively useful in regulating radiation exposures during the infancy of radiation science, [but which now] has become scientifically illegitimate and ethically indefensible."

Beverly Cook, of the Department of Energy, has served in recent years as principal deputy director of the Office of Nuclear Energy and as program director for Space Nuclear Programs, also within the Office of Nuclear Energy. One week prior to her appearance at the Boston meeting she took a new position as the DOE's field manager for the Idaho National Engineering and Environmental Laboratory. Cook encouraged women to fill the positions that will be left open in the nuclear field as many nuclear professionals retire. She strongly encouraged women to take a leading role in communicating information to the public, as she has done by volunteering to speak on science at grade schools, and by honestly addressing the fears of the public.

Cook described an appearance she made on a CBS program in defense of the much-publicized *Cassini* launch in October 1997. An audience member was "ranting and raving, saying 'It's just those government bureaucrats lying to you again.'" Following the program, a reporter approached Cook and said: "They haven't got it yet, have they?—the rules have changed. They say 'those government bureaucrats are lying to you again' and we pan over and there's somebody's mom standing there—you just don't fit the image." To sum it up, Cook said, "if you're a white male in a tie you're at a disadvantage if you want to talk about nuclear right now."

Agneta Rising, vice president and president-elect of the European Nuclear Society, spoke about the activities of Women In Nuclear (WIN), the organization she founded in 1993 with 130 members (the group now has more than 1100 members). WIN's principal

objective is “to emphasize and support the role that women can have in addressing the general public’s concerns about nuclear energy.” Each country that boasts a chapter tailors its programs to the local culture; South Korea, for instance, boasts a corollary group, WIIN (Women Interested In Nuclear), with 8000 nonprofessional members who tour nuclear facilities and attend lectures.

The Nuclear Energy Institute’s vice president, Angie Howard, spoke of the NEI-sponsored WIN meeting held in Washington, D.C., in November 1998. During that meeting, the possibility of establishing a group of professional women in nuclear in the United States was discussed. Such a group would support three basic goals for the nuclear industry, Howard explained: an environment in which women are able to succeed, a network through which women in nuclear fields can expand their professional development, and an organized network through which women inform the public about nuclear energy. This planned women’s organization would be organized geographically, following the NRC’s four regions.



Howard

Only two of the 204 tenured, full professors of nuclear engineering in the United States are women, and both, Carolyn Heising and Kim Kearfott, participated in the session.



Kearfott

Kearfott spoke of her role models and mentors, one of whom, her “earliest and still crucial role model” was Dixy Lee Ray, who possessed “a lovely combination of beliefs, commitment to principles, articulateness, and extraordinary personality.” Kearfott described turning to nuclear engineering as her specialty after witnessing protests against acid rain and the oil crisis in the seventies. In response to a question from Andy Kadak, incoming ANS President, asking what should be done about the glass ceiling that women in nuclear face, Kearfott gave her take on the problem: “You’re in a room and there’s this glass ceiling. You’ve got three options: 1) find a sneaky way around it, 2) go get some tools and some help and break it, or 3) go find another room.”

Gail Marcus, of the NRC, who is currently on sabbatical in Japan at the Tokyo Institute of Technology, spoke of her early years in ANS. She initiated a survey of women in ANS in the mid-seventies, expecting to find that a science boasting Marie Curie and Lise Meitner among its pioneers would be ahead of the game on equal opportunity. She found instead that the nuclear industry shared common problems with the rest of the job market:

salary disparity, few women in management, and a feeling among women that they were discriminated against in subtle ways. Marcus reported that a recent survey of female faculty at MIT, nearly a quarter of a century later, also found that women felt that they were subject to subtle discrimination.

Marcus said she has been asked several times about her treatment in Japan, and offered a few observations. Her very positive experiences are “due to several factors,” she said. “One is the Japanese attach more significance than we do to the school you come from, the degree you have, and the position



Marcus

you hold in your organization. . . . I think the other factor is a foreign woman is [considered to be] not quite a woman.” She equated the environment young Japanese women face today with that in the United States 25 years ago, although she acknowledged that changes are

slowly appearing: “There are a number of women in the pipeline but they have a tough time getting jobs.” Ann Bisconti, president of Bisconti Research, Inc., presented the audience with statistics reinforcing her fellow speakers’ insistence that women must spread the word on nuclear. While women think less favorably of nuclear energy than men (a March 1999 poll of college graduates registered to vote found 50 percent of women and 74 percent of men in favor of nuclear energy), they are “open-minded about nuclear energy and not committed one way or another.” When the polled women were told, “There are more than 100 nuclear energy plants in the United States that generate one-fifth of the electricity we need without emitting any air pollution,” the approval rating increased from 50 to 68 percent (that for men increased from 74 to 81 percent).



Bisconti

Bisconti has found that nuclear scientists and engineers are rated the most credible source of information on nuclear issues by the public, and so urged both male and female engineers to speak out for nuclear power. She related the conclusions of a study by Vincent Covello, of Columbia University, that identified four factors that contribute to audience acceptance of a message: perceived competency and expertise, 15–20 percent; perceived honesty and openness, 15–20 percent; perceived dedication and commitment, 15–20 percent; and perceived empathy and caring, 50 percent. Covello found that men score higher on perceived competency and expertise, but women score higher on the other three factors, indicating an 80–85 percent “credibility edge” for women, according to Bisconti.

Improving human performance

If a plant worker makes a mistake while repairing a motor-operated valve or aligning a pump because he did not self-check—and is reminded of that by his boss—the next time he performs the task he will be sure to self-check. The time after that he will likely self-check also. But maybe the following time he’s feeling some stress—from his family or from his job—so he decides to take a shortcut. And nothing bad happens: The motor-operated valve opens the way it’s supposed to, the pump starts correctly. The next time, even if he’s not under as much stress, he may take the same shortcut—he may even take a shorter one. These actions will continue until—after one shortcut too many—the same mistake is made once again.

Defeating such faulty human behaviors was the subject of the Utility Forum titled “Human Performance in a Competitive Environment.” Human performance, along with equipment reliability, are the two factors that most affect plant performance—and the equipment is already quite reliable.

“I am a believer that it is important to think about the people as you try to operate a nuclear power plant,” said William Diproffio, station director at North Atlantic Energy Service Corp.’s Seabrook plant. “And unless you can improve the performance of your people, you’re going to run into a wall when you find



Diproffio

the equipment continues to run but the people continue to make errors.” The panel—which consisted of Diproffio in addition to a representative from the Institute of Nuclear Power Operations and a performance psychologist—cited developing more extensive performance monitoring techniques, encouraging greater communication among plant workers, identifying and treating hidden mental illness, and cultivating better stress-handling skills as ways to improve human performance within the nuclear industry.

Earlier in the decade, Seabrook station was mired in the bottom end of INPO’s plant rankings according to the number of events caused by human error. And in 1993, the plant experienced three inadvertent trips that were caused by human error. “It was pretty clear to everyone,” Diproffio said, “that human performance at the plant was not improving. In fact, it was declining.”

This year, Seabrook station has experienced only one INPO event caused by human error.

Rigorously monitoring human performance has been the key to the plant’s steady progress, according to Diproffio, who outlined a few of the monitoring programs Seabrook has implemented to reduce human error. One monitoring technique is to have supervisors and managers perform “observations,” Diproffio said. After certain activities, such as a pre-job briefing, turnover meeting, or field activity, managers and supervisors respond to

a series of generic questions about the activity by filling out a card. The benefit of such a program is that it gets managers and supervisors out into the field more often, Diproffio said, which means they will communicate with the workers more often.

The plant staff at Seabrook has also been reporting smaller and smaller problems as a way to sharpen procedural efficiency and prevent errors from recurring. When a procedure does not unfold as expected—due to either an operational misstep or an error in the written procedure—an adverse condition report is filed. In 1995, approximately 1200 adverse condition reports were filed; this year, Diproffio said he expects more than 5000 adverse condition reports to be filed. The increase in the number of reports indicates that the staff has lowered the threshold of what constitutes an adverse condition and it indicates that the staff is paying closer attention to their work.

The adverse condition reports are then used in a system of “real-time trending” of human performance at Seabrook, Diproffio said. A task team meets each week to study the adverse condition reports and identify emerging trends. They pick 20 issues to monitor closely, which are usually issues that have been troublesome in the past. And “any [trend] turning to the wrong direction, we broadcast to the staff,” Diproffio said. “We did that in 20 areas and the results were really good.”

INPO cannot prevent human error, said Bob Link, manager of the Department of Or-

ganization and Administration at INPO, “but we feel we can prevent events.”

INPO is continually trying to improve human performance, Link said, by instilling an uneasiness with respect to human fallibility and vulnerability to mistakes. “As we start to do a task and it becomes repetitive—and we have a lot of repetitive tasks in our power plants—we become overconfident once we start to get the desired results.” It is also providing the industry with a set of error prevention tools, such as the “Excellence in Human Performance” document that INPO published last year. And the organization is trying to encourage communication. “One of the questions we’re asking ourselves in this industry is, ‘How often do the managers get out into the field?’” Link said. “And when they’re out in the field, what are they asking for? Do they ever sit down with the workers at the job site and ask them, ‘What’s frustrating you? What’s bothering you? What’s unsafe about this situation?’”

Even the best people will make mistakes, Link said. He told the story of an instrumentation and control technician—one of the best performers in the work group—who had caused an inadvertent plant trip. When asked by his manager why the trip had occurred, the I&C tech replied, “Boss, I just made a mistake.” The plant manager accepted that response. But as he talked to other workers in the group, he found out that the technician’s mother had gone to the hospital, and that the results of her biopsy were not back yet. The

manager went back to the I&C tech to discuss the situation, and the tech said he was having trouble concentrating since his mother had gone to the hospital.

Work environment greatly influences behavior, Link said. An organization has “core values,” which will dictate what happens when, for example, a worker approaches his supervisor with a question. During an outage, a work group was working on a control rod drive system. There was confusion over which way a stack of concave washers was to be inserted. They checked the prints and still could not come to any conclusions, so one of the workers approached the supervisor—even though he appeared to be busy. “Hey, if you don’t know how to put those washers in after reading the prints, then maybe you shouldn’t be working here,” the supervisor replied. So, the worker went back to the group and said, “The boss said it doesn’t make a difference.” Link said when the system was started up “it literally was a rainforest” because of the leaking control rods. To prevent this kind of situation from occurring, the plant can strive to enforce a core value dictating that a supervisor who is asked a question must always stop to answer it.

Link said the downward trend of INPO events over the last 10 years has been significant. “Eight to 10 years ago, at INPO it was big news when one of our plants in the U.S. industry had no significant events. Last year, we had only four significant events.”

Continued

"I continue to be amazed, in this particular industry, at how far behind we are in human behavior, in human behavioral technology," said Jack Stark, a performance psychologist who has been practicing for nearly 25 years. Stark said that 20 percent of people cause 80 percent of the problems. The reason for this, he said, is that nearly one in five people have a mental illness. This person can often function day to day, Stark said, but when stress becomes overbearing, the mental disorder begins to cause problems. Stark sees a real opportunity for human performance improvement if plants would accept this fact and treat the disorders.

Stark pointed out that many of the programs the industry uses to reduce human error—self checking, STAR (Stop, Think, Act, and Review), and others—are useful, but only to an extent. A mental disorder can derail even the best intentions.

He told the story of a man who had made a mistake that caused his plant to be fined by the Nuclear Regulatory Commission. He interviewed the man and determined that he had a mild learning disability and mild personality disorder—he was shy and was afraid to ask for help at the time of the incident because he wasn't working with his usual crew. Both conditions—which are treatable—contributed to the problem.

Two other psychologists were then brought to the plant to test the rest of the operators, Stark said. They performed personality, stress, and neural-psychological tests to identify problems that may lead to potentially avoidable operational errors. "I said, 'Look, we want to help you. We want to find out if there are some things going on that you're not aware of,'" Stark said. Some of the operators objected, but about 95 percent complied. Stark said there was a 60 percent improvement in attitude, morale, and performance of the operators during this process.

"If you look at 40-, 45-year-old operators, when they were going through school nobody identified [these] disabilities," Stark said. "No one identified attention deficit disorder. No one identified medication [for treatment]."

A few of the operators came back to Stark and said they wanted to work with him. "I never thought about this. I do have some learning problems," Stark said they told him.

"You have to remember that a lot of your people are very stressed out today," Stark said. "I've been in the stress business a long time. I used to work next to a physician, and one day he came out of his room and said, 'Jack, I saw 40 people today. Thirty-eight of them need to see you.' [There is] a lot of stress, in terms of what's wrong with people."

And stress begins to take a physical and mental toll, Stark said, particularly on those who have been in the industry for a few decades. "You don't sleep very well if you do get sleep. You've got bad knees. . . . Your posture's not good. [You've got] high blood pressure, cholesterol, weight gain, irritable bowel syndrome.

"Now, it's getting to you. You don't talk about it, but I see a lot—a lot—of mild depression. You've got so much going on in

your mind: worry, guilt—'Guilt about my family, my kids. What I'm doing, I'm not doing. What's my future direction?'"

Responding to a question in the audience asking what is the best way to reduce stress in a nuclear plant work force, Stark replied, "What do people want today? The number one thing they want—and I've [seen] this in sports, I've [seen] it with companies—they want someone to care about them. The world has become more and more impersonal. . . . 'Hey, I'm under a lot of stress, but at least I know that guy cares about me.' That makes all the difference in the world."

The next generation

A group of young people in the nuclear industry formally banded together during a special session inaugurating the North America Young Generation in Nuclear (NA-YGN). The organization is a spin-off of the European Nuclear Society Young Generation Network (ENS-YGN), a program that began in 1995 and has since been growing steadily.

"We're all here today because we care about this industry and we want to see it survive," declared Paul Wilson, a postdoctoral researcher at the University of Wisconsin-Madison Fusion Technology Institute and founding member of the NA-YGN.



Wilson

Wilson and technology and are working together throughout North America to share their passion for a field that is alive and kicking," Wilson said. The NA-YGN's members are individuals under the age of 35 who are working in the nuclear sciences. Wilson said they share the conviction that nuclear science makes valuable contributions to society, and that it will continue to do so. The group brings together the different sectors of nuclear to speak with a united voice and to provide professional development opportunities for its members, Wilson said.

During the session, titled "Young Generation: The ENS Experience and Progress in North America," a panelist from the ENS-YGN briefed session attendees on the organization's history, two leaders within the NA-YGN discussed the need for such an organization, and two industry veterans pledged their support. At one point the attendees were split into four groups to brainstorm on how the NA-YGN can accomplish what it is setting out to do: ease the transfer of knowledge between generations, cultivate both technical and nontechnical professional development, and increase public outreach.

The ENS-YGN currently has members in students and young professionals in over 21 countries, according to Gaston Meskens, the network's chair and a nuclear engineer at the Belgium Nuclear Research Center. The group meets at least twice a year, and elects its own

chair and cochair to two-year terms (the same procedure as ENS). The ENS-YGN chair has a seat on the ENS steering committee, which Meskens said is significant because it shows that ENS takes the network seriously.

In 1997, the group outlined five principles that are representative of the group's goals. The first, Meskens described as "turning young into know-how." Young people, Meskens said, need to gain the knowledge of the generation that is nearing retirement.

The second principle Meskens described as "acting nationally." The network seeks to bring together young people working in nuclear fields at a local and national level. "It's very important to have local, active, young generation groups. That's why we stand for active participation of young people in the national nuclear societies," Meskens said.

Networking internationally is the third principle of the ENS-YGN, Meskens said. The nuclear industry is global, and tomorrow's nuclear professionals need to begin meeting their colleagues in other countries and continents. The ENS-YGN will be present at a number of international meetings during the next year: GLOBAL '99 in Wyoming; a meeting of the Australian Nuclear Society; an OECD workshop in Budapest, Hungary; TOPSEAL '99 in Antwerp, Belgium; and the annual conference of the Spanish Nuclear Society.

The fourth and fifth principles of the ENS-YGN—thinking environmentally and communicating with empathy—were evident in the group's activities during last November's environmental conference in Buenos Aires, Argentina (formally known as the Fourth Conference of the Parties of the United Nations Framework Convention on Climate Change). The group released a statement that surprised some people at the meeting, Meskens said. Although nuclear power must be a part of a balanced energy mix on an international level, every country doesn't need nuclear power, they stated; all available energy sources, including renewables, are needed. Meskens observed, "This seems very obvious to all of us, but not for them. . . . This is a very important message for [environmental groups] and also politicians, especially for the Kyoto protocol."

The group's contacts with the press during the Buenos Aires meeting were also productive, Meskens said. They learned that journalists don't have prejudices when they are talking to young people. Meskens said the journalists were curious about what affects young people's views and about what drives them to be involved in the nuclear industry. "They are surprised when you tell them, 'We are the first to say that nuclear has inherent risks, but that they are manageable,'" Meskens said. "They are surprised when we say that we need all available energy sources. . . . They are surprised when we communicate our message without a defensive—nor an offensive—attitude."

The group sponsored a round-table discussion during the meeting in Buenos Aires and invited representatives from antinuclear groups. "Both sides, for the first time," Meskens said, "had a feeling that although we may never agree in principle, a constructive

dialogue is possible. They said they appreciated the new approach of the young generation—finally leaving the ivory tower and opening the doors of industry to an open dialogue.” Meskens then displayed a photograph taken during the Buenos Aires conference that showed three members of ENS-YGN standing next to a wide-smiling man from Greenpeace International.

“Young people in nuclear are different,” said Meskens, who was dressed in black pants and a shimmering silver shirt. “But, I must state one thing very clearly: Young in nuclear doesn’t mean we have the intention to start all over again and go our own way. That’s not our intention. It is a synergy between young and old ideas and beliefs that will make a difference.”

The void in networking opportunities for young people starting their careers in the nuclear industry led to the formation of the NA-YGN, said Undine Shoop, a reactor systems engineer for the Nuclear Regulatory Commission and founding NA-YGN member. Both students and established professionals have groups that meet their development needs,



Shoop

Shoop said. “But what about when you’re just starting your career? Our networking opportunities are fewer. . . . We’re not always aware of the professional development opportunities that are out there—because [we’re] low-level, [our] company doesn’t have a lot of money to spend on new development.”

The young people in the room chose careers in nuclear when it wasn’t fashionable to do so, Shoop said. “We got into this field when everyone in the public said, ‘Why do you want to do that? That’s bad. That’s nuclear. You know your hair is going to fall out.’”

But being young in the nuclear industry in the late 1990s has its advantages, as young people engender many of the qualities the industry needs, Shoop said. Young people can be more effective spokespersons for the industry because they are not seen as members of the establishment. Young people also tend to be more open to change and to new ideas, and are generally more optimistic than their elders. “My boss keeps telling me that I will run into enough doors that I will have that [optimism] beaten out of me. And I hope to prove him wrong,” Shoop said.

After the attendees were randomly divided into four groups to each discuss ways to transfer knowledge between generations, to improve their professional development opportunities and to increase public outreach, the session reconvened and a representative from each group presented ideas from the brainstorming session.

All four groups showed a strong desire to be mentored as a way to learn from their elders. One group suggested bringing in contracted retirees to serve as mentors to reduce the threat to older workers at a plant, who may regard

training a young engineer as a step toward being replaced. Another group suggested developing a Web site and to list people who are willing to mentor and to provide an opportunity for senior professionals to respond to questions posed by younger engineers. Creating a junior NA-YGN membership for high school students was suggested by another group, because it would provide network members an opportunity to practice mentoring. Getting ideas from other societies’ mentoring programs was also suggested, as was the need to develop a standard method to sell the benefits of mentoring to their employers.

Ideas for professional development included developing networking skills, learning how to communicate better with the public and with each other, and learning how to make a presentation—especially since a company is more likely to fund a trip to a NA-YGN session if attendees return with a new skill. One group suggested training members on how to overcome resistance to new ideas. Another suggested establishing an electronic job listing that is searchable by criteria such as experience level; jobs requiring not more than five years of experience could be highlighted, for example. Scheduling a question-and-answer session around a successful NA-YGN member—someone who was named vice president by the age of 30, for example—was also suggested.

Learning from the environmental groups’ success in selling their message was one suggestion on what NA-YGN can do to reach out better to the public. Also, learning the real reasons why people in countries such as France and Spain are more open to nuclear power than in North America was suggested. In addition, reaching the public through television commercials, letters to the editor, and white papers produced by the group was suggested. Another noted the need to form a voice—not their employer’s voice, not the industry’s voice, not ANS’s voice—but their own distinct and unified voice.

Angelina Howard, senior vice president of industry for the Nuclear Energy Institute, said that NEI will work to communicate its support of the NA-YGN to senior executives within the industry, and will offer the assistance of a staff person. Howard also said she would help the industry “effect a proper relationship and distance, so that we don’t tell you what to do—but we do hope you take some of the advice that I know we’ll offer.”

Ted Quinn, 1998–99 outgoing ANS president and vice president of utility services at MDM Engineering Corporation, pledged to do three things if the Young Generation in Nuclear would accept the challenges ahead of them. First, Quinn said he would work the rest of his career to clean up “the sins of the past.” Second, he pledged to continue working to manage the existing industry infrastructures. And, third, Quinn said “I’ll try hard to stay out of your way. I think that’s what you want.”

Health effects regulation

The ANS President’s Special Session, “Low-Level Radiation Health Effects—Regu-



Quinn

lation & Science,” one of five at the annual meeting on low-level radiation health effects, focused on regulatory policy-making. Ted Quinn, then ANS President, moderated the session (which was organized by Kim Kearfott, professor of nuclear engineering at the University of Michigan) and opened it with some comments of his own. Quinn said that he organized the session, together with outgoing Health Physics Society (HPS) president Keith Dinger, because “there is no subject more important to the future of nuclear science. It is critical that we place emphasis on this subject both on scientific and on policy issues.”

Dinger responded in kind before the meeting was turned over to presentations from the six panelists, stating that “both the application of nuclear technology and the practice of radiation safety are being impacted by our current inability to provide consistent and reasonable regulations for public exposure to radiation.” He outlined the position of the HPS on the linear



Dinger

no threshold hypothesis (LNTH), explaining that the HPS has resolved that “there is no known threshold dose, and thus, by inference LNTH must be accommodated in the regulatory framework.” Dinger said that “HPS members have been actively involved in the debate on LNTH, but the Society has only taken positions related to the implementation of reasonable regulations in light of the uncertainty of low dose/dose rate health effects.”

He ventured to make some personal observations, speaking about three possible nonbiological thresholds, which he said are being supported by some as an alternative to the LNTH. A regulatory threshold would designate a point below which any dose is considered negligible (the Nuclear Regulatory Commission has attempted and failed to institute such a policy, termed “Below Regulatory Concern” [BRC]). A practical threshold would take advantage of research that says that the time necessary for a cancer to appear gets longer as dose and dose rate decrease: A person simply does not live long enough to get cancer when exposed to very low doses or dose rates. A third threshold he termed a statistical threshold, marking a point below which a study could not statistically detect a negative effect if it occurred. He suggested that practical or statistical thresholds may succeed where BRC did not. Reliance on an agreed-upon nonbiological threshold may make it unnecessary to expend money and effort on fixing a biological threshold, Dinger said.

Continued

Greta Dicus, then a commissioner of the Nuclear Regulatory Commission (and now NRC chairman), addressed the LNTH controversy, urging further research and saying that in the long run, the controversy will be eliminated only by reducing radiation health effects uncertainties. The NRC is moving toward a risk-informed, performance-based regulatory approach, but has a challenge when applying the approach to radiation protection standards, because it must ensure both that the standards are protective and that costs for complying with the standards



Dicus

“are justified by the risks that would result if the standards were not met.”

The current regulatory status in the United States, she said, “does not engender public and political confidence in our scientists and in our policy makers.” Multiple agencies and regulations are confusing, and sometimes regulation enforcement and the role of agencies are determined by court cases, which has created a “patchwork quilt of radiological protection requirements,” she declared.

The solution? According to Dicus, “there is a need for the U.S. to more closely follow the radiation protection *system* recommended by the International Commission on Radiological Protection.” Those recommendations constitute a coherent system, she says, that helps “guard against slavish application of radiation protection recommendations independent of the origin and purpose of the radiation source, the assumed risk of the radiation relative to that from background radiation, and the costs to mitigate the assumed risks.” When asked during the panel discussion whether she believed that the NRC would change its regulations if the BEIR VII report (from the Biological Effects of Ionizing Radiation VII committee, led by the National Academies’ Board on Radiation Effects Research) found a biological threshold effect, or evidence of hormesis, she said, “If we have a study that goes through the [peer review and open dialogue with the public] that BEIR VII will go through, then I think the NRC would have an obligation to look at that and take some action.”

Charles Meinhold spoke as president of the National Council on Radiation Protection (NCRP), a group he says is “today’s favorite target.” As he sees it, “The DOE has a problem, the NRC has a problem, and the licensees have a problem, and they’re hoping with all their heart that we can prove there’s a threshold.” He emphasized the extent of the controversy with the help of a bell curve. At one end, he put those individuals who are fighting for an end to the use of the LNTH, including the organization Radiation, Science & Health, Inc. At the other end stand people who think that today’s regulations do not guarantee safety. And in the middle are those agencies that make recommendations on radiation protection:

NCRP, ICRP, BEIR, and UNSCEAR (the United Nations Scientific Committee on the Effects of Atomic Radiation). The two ends of the



Meinhold

curve are so at odds that while one group states that there is evidence of hormesis in data on Japanese atomic bomb survivors, the other claims that individuals who were prone to cancer were immediately killed, skewing the results of any study. Meinhold is particularly skeptical

of using epidemiological studies to determine the risk of low-level radiation.

Eleanor Blakely, a senior staff biophysicist at Lawrence Berkeley National Laboratory, spoke not on policy but on science, with a talk titled “Basic Research on Mechanisms of Radiation-Induced Damage and Repair.” Her research attempts to answer questions, such as: What are the radiation targets for radiation damage at low dose rates? Can the low-dose sensitivity of organisms be modified with physical, biological, or chemical means? The answers to these and other questions are becoming more important as the number of low-dose radiation exposures to humans are increasing, through medical procedures and the cosmic radiation that flight crews, for example, are exposed to on the job, according to Blakely.

Blakely is studying variability in the radiation-induced response for normal and radiosensitive cell populations. Among those phenomena she indicates have potential relevance to low-dose effects are hormesis, adaptive response (i.e., biologically induced repair), gene induction, and a bystander effect (on cells from radiation-exposed neighboring cells). Above all, she suggests, many questions remain.

Evan Douple, director of the Board on Radiation Effects Research at the National Academies (formerly known as the National Academy of Sciences), was present to “summarize the current state of research on ionizing radiation health effects” with a talk titled “BEIR has a new look: BEIR VII.” Two years ago, the NAS was asked to conduct a scoping study, examining new data available since BEIR V, in 1990. The resultant study is BEIR VII, which Douple says will take approximately 36 months to complete. (BEIR VI, released in 1998, focused specifically on radon). The goal behind BEIR VII, he said, was “to put together a committee of fresh new people who are not going to be identified as the same people that have been doing all of the recommendations.” He stated that all information gathering will be done in public, and every document will be available via e-mail to interested persons. The Environmental Protection Agency, the NRC, and to a lesser degree the DOE have all contributed funds for BEIR VII.

A major goal of the BEIR VII committee, Douple reported, “is to determine the best estimate of risks for all health effects as a re-

sponse to ionizing radiation. It’s not going to start with the LNTH, it’s going to try to develop a model that best represents that data.” A second goal is to reduce the number of uncertainties about low-level radiation dose response. Douple emphasized that the committee is not responsible for recommending regulations.

Marvin Frazier, director of the life sciences division at the DOE, began his discussion of the DOE’s studies of low-dose radiation effects. Both his division’s Biological and Environmental Research Office and the Office of Environmental Management will conduct research under a new program, with funding of \$3 million and \$5 million, respectively. This program is distinct from previous research, Frazier says, because all work must be relevant to risk assessment: “If it’s going to stay in this program it’s got to be at low dose and low dose rates.”

Key research elements for the program are:

- Are the damage responses the same for low dose radiation and endogenous oxidation? That is a critical question, Frazier says, “because the mechanisms that our bodies have devised to protect against radiation, to repair damage and so forth, really developed due to endogenous oxidation.”
- Are there thresholds for low-dose radiation that can be generalized to provide a basis for regulation?
- Are there genetic factors that can affect individual risk susceptibility?
- How should the program’s results be communicated to other scientific and regulatory agencies?

Ralph Andersen, a certified health physicist



Andersen

and senior project manager of the Nuclear Energy Institute’s Nuclear Generation Group, spoke up as an advocate of radiation, and reminded the audience of radiation’s ubiquity and numerous benefits, including uses in industry and medicine, ensuring safe food and air, and in research. If those numerous and important benefits, including countless lives saved, did not exist, no risk from radiation would be acceptable, Andersen said. As it is, he declared, the “benefits from the use of radiation are large, the potential risks are small, maybe zero, and the negative impacts [of not using radiation] in my mind are enormous.”

Andersen emphasized that actual doses to the public from nuclear technology are “well below established radiation safety limits: Maximum doses to a few individuals are 1–10 mrem per year, average doses to some individuals are 0.1–1 mrem per year, and doses to most of the general population are (arguably) zero.” He offered a “to-do list” for the industry: Improve the scientific basis for regulation, reform the federal regulatory process, and move the focus of communication with the public from risk to benefits.—Susan Bailey and Patrick Sinco

EMBEDDED TOPICAL

Life after 40

A PLANT FILING for license renewal is going “up for grabs,” in the words of one utility executive at the plenary session of the Embedded Topical Meeting on Nuclear Station License Renewal. He was joking, but the joke hints at the wariness with which nuclear power plant licensees regard the process to extend a plant’s life beyond its original 40-year term. Concerns with ratcheting regulations, lengthy and costly public interventions, and inconsistent regulatory practices were expressed by the panel, which included representatives from three utilities involved in varying stages of license renewal, as well as a commissioner from the Nuclear Regulatory Commission.

“The process works,” was the good news from Barth Doroshuk, project director and general supervisor of the life cycle management program for Baltimore Gas & Electric Co.’s (BG&E) Calvert Cliffs plant, which is set to become the first to receive a 20-year operating extension (see *NN*, July 1999, p. 24, for an interview



Doroshuk

with Doroshuk).

He immediately added, however, “It can be improved.”

The process is likely to improve as more plants go through the process and the NRC settles on what NRC commissioner Jeffrey Merrifield calls “the right regulatory touch—not asking for too much information, but [asking for] a sufficient amount so we can feel confident.” Merrifield said the NRC needs to be disciplined to ensure that the requirements of the second wave of license renewal applicants are the same as the first, and that the agency needs to continually strive to operate “more efficiently, better, faster, and less expensively.” These goals become even more critical as the NRC operates on its lowest-ever budget in real dollars.

But the NRC still has a job to do.

“This industry is judged by its weakest link,” Merrifield said. “As a commissioner, I want to be able to go up in front of Congress . . . and say with confidence, ‘We’ve done what we needed to do. We stand behind our recommendation that these plants can perform for an additional 20 years.’”

Southern Nuclear Operating Company (SNOC) decided early—in 1996, with 18

years left on the Hatch plant’s operating license—to move forward with plans to file for license renewal, according to Louis Long, SNOC’s vice president of technical services.



Long

That would put the plant amid the first wave of applicants, and that worries Long.

“What we’re looking for is certainty in that licensing process,” Long said, “for the first [plant] and for the last [plant]. . . . That’s an issue that’s still floating around among people like me who are a bit paranoid.”

Long is troubled by the NRC’s position on the existing programs of a plant seeking license renewal. Under the license renewal rule, the NRC mandates that existing programs be evaluated for adequacy, Long said. But he believes that, because the NRC has already determined the adequacy of existing programs, the programs do not need to be reevaluated. If a plant is taking credit for a program that is managing aging in the current term, Long asked, what’s different about the renewal term? “The NRC would say to you, ‘Look, we need to go back and look at that program and make sure that we still think it’s good.’ I think that adds uncertainty into the overall program in that if they have judged [Calvert Cliffs’] EQ program to be adequate and see that mine differs, now do I have to go back and change mine? Man, that’s a game we used to play when we were licensing plants back at the beginning.”

Further, Long said, the NRC states explicitly that it believes complying with the IWE/IWL subsections of the ASME Boiler and Pressure Vessel Code is adequate for managing containment aging for the current term, as well as for the license renewal term. “The license renewal director then came and said, ‘Eh, I don’t really think that’s right. There’s a few things we’d like to add over and above that initial rule.’

“And the question is, What’s different in year 39 than it is in year 41 in terms of managing aging? I’ve got a real problem with that

The many unknowns of the process—how long it would take to prepare the application, how long it would take for the NRC to review it—led to the decision to begin work early. Pending a final decision later this year, SNOC plans to file its application in early 2000.

kind of approach. . . . That leaves the NRC with a list that they can keep in their pocket. They can pull it out again and add [to it].”

The advantages of renewing the license of Hatch, however, were clear. For one, evaluating the economies of a major—and perhaps unexpected—capital addition late in the term of the current license is easier if the plant is going to operate for another 20 years.

The average age of a Hatch plant employee is 44–45 years old, according to Long, and operating for an additional 20 years will also help the utility attract younger workers as the current workers retire. “We clearly have a lump of people that are about to go out of the organization,” Long said, “and we’re really trying to bring in some people to replace those folks. And it’s hard to make that case [to bring in new people] if you’re going to be shut down within 15 years.”

Virginia Power is also accelerating its process for renewing the licenses of its Surry and North Anna plants because it doesn’t want to fall behind in the license renewal queue, according to Bill Corbin, license renewal project manager for both sites. As it stands, the utility plans to file its application in 2002, which should land the plant seventh or eighth in line, Corbin estimates.



Corbin

The utility also decided to hurry the renewal of its plant licenses because of Virginia’s deregulation act, which passed earlier in the year. Virginia Power indicated it would freeze rates through 2007, and, with a license to operate Surry and North Anna for 20 more years, it could begin to defer some costs and expenditures into the additional 20 years. “And that will help our earnings picture in the critical period of time up until the year 2007,” Corbin said. The utility would also be able to reduce payments to its decommissioning fund.

Virginia Power hopes to take advantage of the similarities between the Surry and North Anna plants by relicensing both stations in one process, Corbin said. Both plants have three-loop, Westinghouse pressurized water reactors, and both have the same nuclear steam supply systems. Even though there are differences—the service water systems are completely different at the two plants, and

Surry has three diesel generators compared to four at North Anna—Corbin said they plan to file two applications on the same day. The utility is also working with Florida Power and Light Co., whose two-unit Turkey Point plant—also a three-loop, Westinghouse PWR—is nearing a decision on filing for license renewal.

Corbin also worries about the stability of the relicensing process. He's concerned about the NRC's asking questions simply because the questions are available to be asked. "We've got to get stable," he said. "We've got to get it down to where we understand exactly what's required. . . . [The process] needs to gel, and gel fairly quickly."

Corbin is most worried about public intervention during the relicensing process because North Anna is one of six power plants scheduled to burn mixed oxide fuel as part of the Clinton administration's agreement with Russia to dispose of 50 tons of plutonium. Some national organizations have already made clear to Virginia Power that they don't want MOX fuel to be used in its reactors, Corbin said. The public hearing processes for the two plants that have submitted license renewal applications—Calvert Cliffs and Duke Power Company's Oconee station—have gone smoothly, but that's doing little to ease Corbin's concerns. "Sooner or later someone's going to have to go through some hearings and some intervention," he said. "I'd prefer that not to be us. I believe we're seeing the interveners getting warmed up, getting their

act together. Sooner or later one of them is going to hit us right between the eyes."

More than 60 public meetings have been held so far in the process to renew the license of Calvert Cliffs, according to BG&E's Doroshuk. There has been ample opportunity for the public to file concerns, he said, and the renewal process has not yet been derailed because the NRC has been able to dispose of meritless contentions. "We have seen two bookends. We have seen, in my opinion, a truckload of attorneys try to abuse the process as we have seen historically through nuclear licensing." But, on the other end, Doroshuk said he saw that ordinary citizens were able to submit genuine concerns. He cited one woman who rose at a public hearing to say, "I've got a report that says there's such a thing as extremophiles, and they can get into your concrete and then dissolve the concrete. Is this an issue?" The NRC staff allowed that to be entered into the scope of the Environmental Impact Statement, "as strange as it may have sounded," Doroshuk said.

"But to me, it was significant in that it did allow the average citizen—the layman—to come in and voice a concern. And the process allowed that concern to be heard. I think that's a real testament to the openness [of the public hearing process]."

One improvement Doroshuk suggested was allowing for electronic submittal of the license renewal application—on CD-ROM, for example. As it stands, the application is filed on paper only, and the NRC divides it among var-

ious disciplines for review, according to Doroshuk. Some departments are given the entire application, others are not. Doroshuk said that more than 100 of the NRC's approximately 400 total requests for engineering investigations had asked questions whose answers could be found elsewhere in the application. Publishing the application on CD-ROM would help reduce needless questions.

"That will save, I think, the licensees and the NRC a significant amount of resources it needs to search and do their reviews. I think there is a lot of mileage we can get out of a move to electronic [submission]."

When Calvert Cliffs receives its 20-year license extension by the end of this year, as Doroshuk expects will happen, it will end a process that began 10 years ago when the plant was shut down because of a pressurizer defect. In response to that 1989 event, a high-ranking board member established the life-cycle management organization for the purpose of ensuring the long-term physical and financial viability of the plant.

Doroshuk attributes the success of their bid for license renewal to the project's well-placed sponsorship. "This has been supported by the board of directors at BG&E since the beginning," he said. "It's been critical. Resources at everyone's site are scarce. And when you have an optional group—and license renewal is an optional task—you do need a significant amount of sponsorship to protect your resources. . . . It wouldn't have survived without it."—Patrick Sinco ■