ANS ANNUAL MEETING

The right fit, the right time

WELCOMING ATTENDEES TO the opening plenary session of the American Nuclear Society's 2010 Annual Meeting, held June 13–17 in San Diego, ANS President Tom Sanders introduced the meeting's theme, "Nuclear Science and Technology—The right fit. The right time."

Sanders noted that there is a great deal of interest in finding the "right-size" nuclear system, which will vary, depending on the application. During his year as ANS president, Sanders put a special focus on small modular reactors (SMR), and he said that although large reactors will remain the answer to the country's critical need for additional baseload generation, considerable efforts are under way to develop SMRs for use in a variety of applications and locations. He said that the developing world is a particularly appropriate market, not only for electricity generation but also for applications such as desalination, pharmaceutical production, and other vital uses.


Sanders

Sanders then turned the meeting over to the general chair, Ross Ridenoure, senior vice president and chief nuclear officer of Southern California Edison (SCE), who introduced the plenary session speakers, starting with Gregory Jaczko, chairman of the Nuclear Regulatory Commission.

Regulatory issues

Taking his lead from the conference theme, Jaczko stressed the importance of science and technology in coming up with answers that will continue to make the nuclear regulatory infrastructure "one of the most effective regulatory systems that we have in this country."


Jaczko

While reactor licensing and oversight are what the agency is known for, he said, more scientific and technological underpinning is needed to improve and enhance the regulatory program in the area of radioactive and nuclear materials. In this regard, he said, there are thousands of licensees that use materials for medical, industrial, commercial, and research purposes on a daily basis. An important reminder of why more attention must be focused on these, he noted, was provided in May during the NRC's briefing on its annual evaluation of licensee performance, when the only two licensees warranting discussion for performance problems were a medical licensee and a fuel fabrication facility. This was the first time one of these meetings dealt only with materials licensees, he noted, adding that one of the lessons learned from this was that the scientific and technological foundation and tools used by the NRC are not as well developed for materials as they are for reactors.

(Photos in first and second meeting session writeups, except for Sanders on this page, by J. Katarzyna Woronowicz Photography)

Meeting session coverage:

- *The use of "123" agreements for U.S. nuclear trade overseas*
- *ANS involvement in SMRs, Commission on America's Nuclear Future*
- *Establishment of nuclear innovation hub*
- *Decommissioning challenges and developments*
- *Extending power reactor life beyond 60 years*

One of the challenges, Jaczko said, is to take the advanced methods used in the reactor oversight process—such as probabilistic risk assessment—to develop comparable programs in materials oversight.

Of particular concern are activities in areas such as nuclear medicine and security, Jaczko said, where rapid scientific and technological developments are occurring. He said that even though a good security infrastructure is now in place, some serious challenges remain. Cyber security, for one, is an area where the NRC is struggling to keep pace with the kinds of threats that exist, Jaczko said, expressing particular concern about the potential impact that cyber threats may have on digital instrumentation and control systems as their use continues to grow.

Jaczko also touched on regulatory issues tied to advanced reactor concepts as the industry embarks on the development of SMRs. The NRC, he said, is preparing to receive applications for one or two SMR design certifications in the next few years and needs to develop the right kinds of skills and infrastructure to review license applications for these types of facilities. Science and technology will play a very important role, he said, and the issue that comes up most frequently is the need to develop a regulatory infrastructure that can deal with the risk profiles of SMRs in areas such as emergency planning and facility security, for which the infrastructure developed for larger reactors is not well suited.

One of the hallmarks of the NRC's work, and one that Jaczko said he believes makes the NRC such an effective regulator, are the lessons-learned programs, which are crucial to both the industry and the agency itself. Several incidents over the last few years, such as the Davis-Besse vessel head degradation and the sleeping guards incident at the Peach Bottom plant, led to changes in the rules and more effective regulation.

This does not mean that the NRC is not prepared for the unexpected, Jaczko said, as a very robust regulatory system is in place. Nevertheless, he pointed to another area to watch out for, referring to a comment attributed to Mark Twain—it's not what you don't know that gets you into trouble, "it's what you know for sure that just ain't so." Jaczko warned that this is where many challenges could come from in the years ahead.

During the question-and-answer period following Jaczko's presentation, one issue of concern that was brought up was the new study of cancer risk in populations around nuclear facilities that the NRC has asked the National Academy of Sciences to undertake. This study will take advantage of the advances in science and data collection since the 1990 report on this subject by the National Cancer Institute. The new study will look not only at cancer mortality rates, but cancer incidence rates as well. This is a new approach, he said, as the previous study looked only at mortality rates.

Audience members expressed concerns that the study would be an unhelpful distraction while not providing any additional understanding of low-level dose effects. Jaczko explained that the NRC currently uses information from the 1990 study for many purposes, including communicating with the public, but the study is 20 years old, and for an agency that is based on science and technology, it's time for an update. It will take some time, Jaczko said, but it will provide a very good tool for enhancing public confidence in the work of the NRC.

Negotiating agreements

Richard Stratford, director of the Office of Nuclear Energy, Safety, and Security at the U.S. Department of State and the recipient of the 2010 ANS/NEI Henry DeWolf Smyth Nuclear Statesman Award, spoke next. Stratford's responsibilities include leading the negotiations for 123 agreements—the top governmental nuclear cooperation agreements whose requirements are set out in Section 123 of the Atomic Energy Act. He has been heavily involved in negotiating new agreements—for example, with India and Russia—and most recently headed negotiations on an agreement that allows India to reprocess fuel from its civilian facilities.


Stratford

Stratford noted some of the other negotiations he handles. For example, the renewal of the Australia cooperation agreement, which expires next January, almost slipped by the department's notice. Fortunately, a new agreement was negotiated and sent up to Capital Hill by early May, ensuring—as required under congressional procedures—that it would await 90 days of continuous session in order to enter into effect. Had the early May deadline been missed, international uranium trade dependent on U.S. consent could have been severely disrupted, Stratford said.

He noted that the recent United Arab Emirates cooperation agreement with the United States is unique in that it is the only one so far in which the other party accepts a binding legal obligation not to pursue enrichment or reprocessing in its territory. This feature is one of the reasons that the agreement was accepted in Congress, he said, particularly since this was seen as a "gold standard" for how nuclear cooperation agreements should be set up and a model for others in the Middle East to emulate. With this standard established, however, Stratford wondered whether the United States would require all other countries in the region to accept similar agreements. Other states that are expected to seek cooperation agreements, such as Saudi Arabia, may not be willing to accept such a restriction.

The Koreans are also eager to open negotiations now, Stratford noted, well ahead of the expiration of their current agreement, because they are looking for U.S. programmatic approval for reprocessing. Korea's view is that it "should have what Japan has." This is problematic because of the 1992 declaration that no enrichment or reprocessing is to be allowed on the Korean Peninsula, he added.

Stratford also touched on an issue soon to be considered by the Nuclear Suppliers Group (NSG) aimed at strengthening its guidelines to ensure that "any international transfer of enrichment" is done as a "black box" arrangement. This means that a company can build an enrichment facility in another country, but that country gets only the equipment, not the design or technology, and is not allowed access to the machines. This has worked well so far, he said. Russia transferred an enrichment facility to China under such an arrangement, Areva is building the Eagle Rock enrichment facility in Idaho under this condition, and Urenco is providing a centrifuge facility for the Georges Besse II plant in France in the same way. The United States would like to see this arrangement become a global NSG standard.

And last, for the first time in his 29 years at the State Department, Stratford attended the Nuclear Non-Proliferation Treaty Review Conference, held earlier this year in New York. While describing some of the discussions at the meeting as surreal, one

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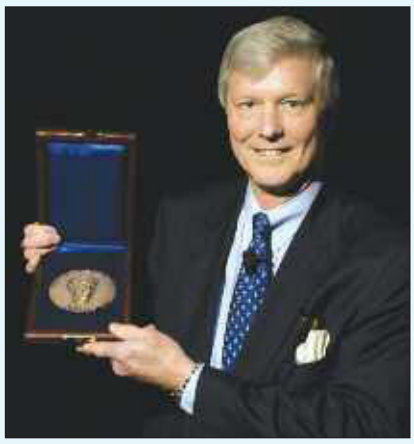
Stratford accepts Smyth Award

At the conclusion of the opening plenary session of the Annual Meeting, Marvin Fertel presented the 2010 Henry DeWolf Smyth Nuclear Statesman Award to Richard Stratford, director of the Office of Nuclear Energy, Safety and Security at the State Department. The award is given jointly by the American Nuclear Society and the Nuclear Energy Institute.



Stratford was recognized for his outstanding and statesmanlike contributions to nuclear energy activities in the United States and around the world. He has led U.S. teams in negotiating difficult and often controversial nuclear cooperation agreements, such as those with India and Russia, and has contributed to the vital work and reputation of the International Atomic Energy Agency.

Fertel, a member of the ANS board of directors and president and chief executive officer of NEI, described Stratford as fitting the criteria for the award perfectly. Stratford has served under five presidents and has always held basically the same job that he has now, but has taken on more and more responsibilities. This in itself, Fertel said, is a tribute to Stratford's capabilities and commitment. He said that Stratford has also been instrumental in opening global markets to U.S. industry, as well as in improving nonproliferation and safety regimes worldwide.

In accepting the award, Stratford said that it was special for the particular reason that it had also been awarded to his mentor, Richard T. Kennedy, in 1998, although, sadly, posthumously. Along with Kennedy's wife, Stratford had accepted the award on Kennedy's behalf. One of the first five NRC commissioners, Kennedy served for over a decade as ambassador-at-large for nuclear energy and nonproliferation. Stratford said that the reason he was receiving this award could only be due to what he had learned from Kennedy. "I like to say that he taught me everything I know about diplomacy and nuclear affairs. Unfortunately for me, it was only about 10 percent of what he knew."

Finally, Stratford confirmed that he plans to stay around for a few more years. There is still too much left that needs to be accomplished, he said.—*D.K.*

exciting experience was his walkout during Iranian President Mahmoud Ahmadinejad's speech. When he rose from the table, all the television cameras turned on him for a good 15 seconds at least. He said it was not his full "15 minutes of fame," but he found it quite an "enjoyable" experience.

Marvin Fertel, president and chief executive officer of the Nuclear Energy Institute, first wanted to share NEI's perspective on the political transformation over the last 18 months. President Obama's support for building "a new generation of safe, clean nuclear power plants in this country," as he stated in his State of the Union Address in January, was unexpected, Fertel said, and it was also striking for being one of the only times during the speech that the president received a standing ovation from both Democrats and Republicans. Despite the Yucca Mountain decision, he said, "we have seen the administration do things that are very helpful, very appropriate, and very sincere, and I wanted to share that with you."

Fertel

Fertel stressed the importance of the meeting's theme, "the right fit, the right time," suggesting that ANS should see it in terms of a long-term campaign, and not just the theme for this meeting. "Nuclear has been the right fit for a long time," he said, playing an important role in providing people with electricity, as well as in improving agriculture yield, eradicating insects that ravage crops, and in food preservation. In the future, nuclear is also expected to play a major role in providing potable water to areas of the world that now have very little. Fertel also alluded to Jaczko's comments on the need to make sure that medical applications of radionuclides are being regulated properly to ensure that they play an even greater part in improving health around the world.

A particular concern that Fertel noted is the need to transfer knowledge to those coming into the industry. What members of the young generation have told him, he said, is that they want mentoring to be a two-way street. "They want us to mentor them, and want us to listen to them." The knowledge flow can go in both directions, he said, even if the experience may be sitting in only one party. More generally, he said, training and education need to be built up in academia and elsewhere to ensure that there is a pipeline of people not only for industry, but also for government, research facilities, and other areas of nuclear science and technology.

While nuclear science and technology will evolve and improve, Fertel said, long-term issues remain, such as spent fuel disposal. "We don't need the perfect solution now," he said. "We need good solutions that are safe, effective, and reliable. We'll hopefully get smarter and will be able to improve on those."

Fertel also had a warning for the industry about rushing to sell reactors. He suggested more caution and advised going for growth in a "smarter way," with an eye to future needs. Many things need to be put in place, he said, and it is vital to ensure that the pipeline is there to achieve a successful outcome. This must be done internationally, he added, with a sharing of experiences and knowledge.

The next speaker, Masaharu Hanyu, became the first president and representative director of Hitachi-GE Nuclear Energy when the joint venture was formed in 2007. Hanyu set out how its ABWR technology has evolved to overcome past challenges and face new ones. He described the actual experience of building the first Generation III ABWRs, such as the Shika-2 project, which was delivered on time and on budget. He noted that the company is on target to do the same with the three units now under construction in Japan. Hanyu showed numerous photos to illustrate the construction methods the company used to achieve its targets and explained how it will do the same in the United States.

Hanyu

In the evolution of the ABWR, a 1350-MWe reactor, Hanyu said that the company has stressed the need to incorporate customer demands, site-specific requirements, and improvements from previous experience and technological advances, with a focus on improving plant operability, maintainability, and constructability.

The main challenges to the successful completion of new-build projects, Hanyu said, are avoiding cost overruns and delays. To achieve "on-time and on-budget" construction, he said, the Hitachi-GE approach concentrates on integrated construction management, front-loaded construction engineering, the application of information technology, and workforce skills development.

The company's construction strategy, he said, has the following objectives: to reduce

the amount of on-site work, to improve on-site work efficiency, and to improve site support work. Some of the construction methods developed to achieve these objectives include modular construction, which is implemented using very-heavy-lift cranes, and maintaining construction activity across the site using open-top techniques and concurrent—or parallel—construction. Hanyu said that the company has also adopted "front-loaded construction engineering," which basically means that unlike construction programs of the past, when construction engineering would be done in parallel with construction work, construction engineering is completed before the work starts, allowing the project to develop and keep to a detailed construction schedule. Substantial use is also made of information technology, applying systems such as radio-frequency identification for warehousing and managing work progress in real time, he added.

For new-build projects in the United States, Hanyu stressed the importance of partnerships with American constructors for establishing module manufacturing facilities, investigating construction methods, and scheduling for realistic project planning.

The California solution

Ross Ridenoure, the general chair of the meeting, wrapped up the session with his take on new construction. As a utility manager in California, which has a moratorium on building new nuclear plants, Ridenoure's discussion focused on alternatives open to SCE. California, he said, has established a renewable portfolio standard (RPS) that calls for 33 percent of electricity capacity to be generated by renewables by 2020. While 29 states have set an RPS, California's is the most aggressive, with an ultimate goal of reducing emissions by 2050 to about 10 percent of what they were in 2000. Meeting the RPS, he said, is challenging and costly to SCE and its customers.

Ridenoure

Currently, about 18 percent of SCE's overall electrical generation is made up of renewables, which do not provide consistent power and have difficult transmission issues, Ridenoure said, particularly for wind generation. SCE is building a 1500-MWe wind farm 250 miles north of Los Angeles in an area called Tehachapi. To get the power to the grid system, SCE has to build a 250-mile transmission line over federal property and other lands. The cost for this, $1.9 billion, might seem excessive, but, he explained, most of the system has had to be built by helicopter because the landowners, including the federal government, will not allow the company to build roads to the transmission tower sites. Furthermore, to ensure that there is power availability, a 4500-MWe combined-cycle gas turbine power plant is being built as a backup. Ridenoure also noted that there are so many issues involved in trying to site a transmission system, he judges that it would be more difficult than siting a nuclear plant—that is, if there were not a moratorium on building nuclear power plants.

At some time in the future, some smart people are going to determine that nuclear power—whether from a large baseload facility or SMRs—will be the way to go.

Another costly special project Ridenoure described is a rooftop solar project that SCE kicked off about a year and a half ago. Solar panels are being placed on warehouses in the Los Angeles area to generate about 250 MWe at a cost of about $800 million and with an estimated capacity factor of 25 percent. "I didn't say it makes sense," Ridenoure said, but these projects are being undertaken to fulfill the requirements of the current laws.

Another potential constraint on SCE is the proposed change in the use of once-through cooling for power stations in California. In early May, the State Water Resources Control Board came out with its interpretation of an Environmental Protection Agency rule on the use of cooling water and decided that any coastal power plant has to stop using the Pacific Ocean for cooling water by a certain date. He noted that while this may seem acceptable to many people, the estimated cost to SCE to install a cooling tower system at San Onofre is about $3 billion. Ridenoure said that SCE is discussing the policy with state officials to see if some other measures can be agreed upon.

Ridenoure ended on a fairly optimistic note, suggesting that at some time in the future, some smart people are going to determine that nuclear power—whether from a large baseload facility or SMRs—will be the way to go.

Engaging in the renaissance

The goal of the President's Special Session was to describe the search for a path forward for U.S. engagement in the global nuclear renaissance. To a great extent, however, the session was about ANS and its members becoming involved in this engagement. In introducing the session, President Thomas Sanders said that he also wanted to discuss export capability and fuel cycle support, but in the context of integrating society activities with manufacturers, national laboratories, and other sectors of the nuclear community to help reestablish the preeminence of the United States in worldwide nuclear commerce and discourse.

Sanders

John McGaha, retired senior vice president of Entergy Corporation, said that the role of the United States in the renaissance must be determined soon. He said he believes that the United States can still "field a championship team," but "our bench strength has waned." Citing his role as chair of ANS's special committee on utility integration, he noted that two previous ANS attempts to expand utility membership had had minimal effect. Over the three years he has spent on the committee, he said, a realization has arisen that its scope and strategy should change, and the committee is now aimed at clarifying and pursuing ANS's role in the global nuclear endeavor. In particular, he said, ANS should be more involved with younger professionals, and with women in the industry.

McGaha

Speaking next was Audeen Fentiman, associate dean of engineering for graduate education and professor of nuclear engineering at Purdue University. She is the head of a special ANS committee formed to provide input to the blue ribbon commission established by the Department of Energy to explore fuel cycle and waste management options in light of the Obama administration's decision not to seek a license for a high-level waste repository at Yucca Mountain, in Nevada. She said that ANS can contribute significantly to the commission's deliberations by providing data on spent fuel

Fentiman

options and, in general, unbiased information written for a nontechnical audience. Fentiman is working with Margaret Chu, former director of the DOE's Office of Civilian Radioactive Waste Management, to define goals for a report to be assembled later this year for submission to the commission.

Philip Moor, an engineer with TetraTech EC, reported on his work as cochair of the ANS President's Special Committee on Generic Licensing Issues for SMRs—an acronym often used to mean "small modular reactors," but which in Moor's talk was used for "small and mid-sized reactors." He showed a slide indicating that the committee includes representation from essentially every SMR concept that has been proposed recently. He said that the committee's work is intended to be independent, although the committee is also seeking to collaborate with NEI, the International Atomic Energy Agency, the Electric Power Research Institute (EPRI), and the DOE. The committee intends to be technology-neutral, and so far it has drafted eight white papers addressing various licensing issues for SMRs. He said that every licensing issue that affects conventional light-water reactors also affects SMRs, regardless of the reactor coolant.

Moor

The committee is continuing to study the issues, and Moor said that the goal is to define more prospects for white papers during the summer for completion by the ANS Winter Meeting in November. Moor asserted that SMRs will be useful only if they can compete with other energy sources, adding that current nuclear power regulations are based on LWRs and are incompatible with new technologies. He said that he hoped that the committee's work would lead to demonstration projects, perhaps for more than one type of SMR. In his view, an SMR initiative could be a private or a public-private partnership.

Next to speak was Glenn George, a partner in the energy and finance practices of Bates White Economic Consultants and an advisor to the government of Lithuania on plans to build new reactors and to the DOE on new reactor loan guarantee applications. He cited some potential benefits of SMRs, such as fuel cycle improvements, thermal efficiency, lower life-cycle costs, and reduced proliferation risks, but he also listed a number of challenges, including the generic licensing issues Moor had mentioned. Also, because SMRs are by definition small, their ability to generate revenue and pay themselves off is not as strong as that of large LWRs. At the same time, large LWRs now entail such big capital commitments that a customer has to commit a substantial percentage of the company's book value to build one.

George

"Risk is the vampire that sucks the lifeblood of the renaissance," George said, citing project risk, power market risk, and regulatory risk—at least as much from state rate regulators as from the NRC. He added that the investment community has a long memory, and its memory of nuclear construction is one of delays and cost overruns. The regulatory scheme is different now, he said, but until it has been used and shown to obtain results different from those of nuclear construction in the 1980s, that memory will not be erased. SMRs have their best chance in situations in which the output provided matches demand, and where risks in general can be reduced. At this stage, however, SMRs are "paper reactors" with no practical experience base.

Every licensing issue that affects conventional light-water reactors also affects SMRs, regardless of the reactor coolant.

Annie Caputo, a professional staff member for Sen. James Inhofe (R., Okla.) on the Senate Environment and Public Works Committee and a nuclear professional by training, said that when she began her career, she and her fellow students thought that their careers would be in the decommissioning of nuclear facilities. "How things have changed!" she said, with the pursuit of new power reactors and their endorsement by a Democratic president. Although things are going well and there appears to be public support for nuclear in general and for its encouragement by the federal government, she warned the industry against becoming too dependent on federal subsidies, noting that nuclear power is still a business.

Caputo

Caputo predicted that Congress would not get to the point of voting on legislation to address climate change in the next three years. She called the spent fuel issue "the elephant in the room," speculating that the costs of waste management could prevent nuclear power from being competitive with natural gas–fired generation. Despite all of this, she said, there is currently great enthusiasm for nuclear power in the federal sphere.

Craig Piercy, ANS Washington representative, said that nuclear power is having something of "a second honeymoon" in Washington these days, but he warned that a renaissance is not inevitable. There is, however, a likelihood of substantial nuclear power expansion in the rest of the world, he noted, and the United States does not have veto power over it, so the federal government needs to be realistic about its expectations. He said that for a number of reasons, the United States needs to be a major nuclear supplier worldwide. If the United States doesn't act now, he declared, "other countries will beat us to the punch," putting energy and nuclear security in the hands of other nations.

Piercy

Virtual reactor

The DOE in May announced the creation of an "energy innovation hub" for modeling and simulation of nuclear reactors (*NN,* July 2010, p. 71). A team of researchers led by Oak Ridge National Laboratory (ORNL) will establish and operate the hub, which will be called the Consortium for Advanced Simulation of Light Water Reactors (CASL).

A special session was held at which CASL was introduced by its director, Doug Kothe, its deputy director, Ronaldo Szilard, and its chief scientist, Paul Turinsky. A standing-room-only crowd filled the meeting room to hear about the DOE's plan to develop a complex virtual reactor (VR) that will be used to answer important questions about reactor operations and safety.

CASL will be funded at up to $22 million this fiscal year, and at an estimated $25 million per year for the next four years, subject to congressional appropriations. In addition to ORNL, the core members of the CASL team are EPRI, Idaho National Laboratory (INL), Los Alamos National Laboratory, the Massachusetts Institute of Technology, North Carolina State University (NC State), Sandia National Laboratories, the Tennessee Valley Authority, the Univer-

sity of Michigan, and Westinghouse Electric Company.

Individual contributors to CASL are ASCOMP GmbH, CD-adapco, the City University of New York, Florida State University, Imperial College London, Rensselaer Polytechnic Institute, the Southern States Energy Board, Texas A&M University, the University of Florida, the University of Tennessee, the University of Wisconsin, and Worcester Polytechnic Institute.

CASL is one of three recently launched energy innovation hubs that, according to the DOE, will be modeled after research entities such as the Manhattan Project (to develop the atomic bomb), the MIT Lincoln Laboratory (to develop radar), and AT&T Bell Labs (to develop transistors).

Kothe, the director of science at ORNL's Oak Ridge Leadership Computing Facility, said that the CASL team's vision is to create a VR for the predictive simulation of current and future LWRs. "Our goal is to deliver an unprecedented simulation tool," he said, adding that CASL's mission is to develop and apply the VR to address three critical performance goals: reduce capital and operating costs through power uprates and lifetime extensions, reduce the volume of nuclear waste by enabling higher fuel burn-ups, and enhance nuclear safety.

Kothe

In structuring CASL, 10 challenges involving plant operations and safety have been identified. "For each one of these challenges, we developed a fairly detailed plan in terms of the simulation development that we need to go after and the applications, as well as the validation," Kothe said. The challenges have been distilled into six categories: crud-induced corrosion, grid-to-rod fretting and fuel assembly distortion, operational reactor, safety, lifetime extension, and advanced fuels.

If the project is successful over its initial five-year term, Kothe said, funding for a second five-year term will be applied for in order to expand to other reactor types. While he couldn't guarantee the success of the project, Kothe said, "we do have the key elements here. We have the Westinghouse PWRs as physical reactors against which to validate. We have a plan for NRC engagement. We have an education, training, and outreach program [led by NC State] that is focused on higher-end computational nuclear science and being able to interact not only with our industry partners but also our extended community."

Kothe added that working with EPRI on a structured technical transfer would be a way to get information about CASL's development out to the general nuclear community.

"The anchor facility for CASL is at Oak Ridge, but we have a number of partners," Kothe said. "Work will certainly be done at those locations as well. We've got what we think are some pretty good ideas for how to virtually collaborate in more effective ways."

Szilard, director of the DOE's LWR Sustainability Program and director of the Nuclear Science and Engineering Division at INL, noted that CASL's challenges are based on real-world industry experience. "Industry goals will challenge performance and lack of performance," he said. "This industry has made some extraordinary efforts in the last 30 years in how it performs."

Szilard

But, he said, although nuclear power plants in the United States have performed well over the past three decades, some in the industry feel that their current performance has "hit a wall."

How can the industry evolve further and be more efficient without compromising safety? he wondered. "Modeling simulation plays an important role here," he said. "Modeling simulation can predict situations and can aid in advancing design and equipment within those existing plants."

Szilard stressed that CASL is not a science exercise. "There is a product at the end of the tunnel," he said. "We fully intend to deliver tools that will be used by the industry."

Turinsky, a professor of nuclear engineering at NC State, gave an overview of CASL's three science focus areas: materials performance and optimization, modeling and numerical methods, and validation and uncertainty quantification (UQ).

Turinsky

"The drivers for defining the project's science program," he said, "are the industry-defined challenges to establish the capabilities required of the VR; the sensitivity and UQ contributors that limit system, structure, or component performance, which help guide the areas of emphasis; and the consideration of the ability to validate the modeling and simulation capability being developed."

A 20-page executive summary to be issued by the CASL team will be available online at <www.casl.ornl.gov> when that site goes live.

D&D challenges

During the "Hot Topics and Emerging Issues" session, the challenges of remote-handled deactivation and decommissioning of solid wastes at the DOE's ORNL were addressed by Bradley Patton, group leader of Radiochemical Process and Facility Design at the lab.

Patton explained that since the days of the Manhattan Project, ORNL has been engaged in operating production facilities and producing radioisotopes for medical and industrial applications. "These activities have resulted in a large variety of unique remote-handled legacy waste and contaminated hot cell facilities," he said.

Patton

The DOE has established a project to dispose of this legacy waste and to deactivate, decontaminate, and decommission facilities that are no longer needed for the mission. Capabilities are needed to characterize, treat, package, and dispose of various remote-handled solid waste streams for which no treatment capability currently exists at ORNL.

The remote-handled materials that require treatment prior to disposal at the Nevada Test Site and the Waste Isolation Pilot Plant in New Mexico, Patton said, include transuranic high-efficiency particulate air filters, contaminated equipment removed from facilities prior to decontamination and decommissioning (D&D), legacy materials stored in hot cells, activated reactor components in reactors slated for D&D, legacy activated reactor components currently stored on site or in reactor pools, legacy radioisotope thermoelectric generators, waste from the D&D of facilities that requires additional treatment and processing, high-alpha legacy material and waste, and spent fuel and activated metals.

Patton said that the legacy waste materials are expected to reach the limits of the treatment and facility design requirements based on physical size, radionuclide content, and dose rates. Material handling capabilities will be required to receive shielded containers of radioactive materials, open the containers, and then examine, characterize, segregate, reduce, and process the materials before packaging them for disposal.

Patton said that alternatives for addressing these wastes are being evaluated, including the packaging and direct shipment of waste from the D&D site, off-site treatment options, and the use of a combination of new and existing on-site facilities for waste treatment and packaging.

Continued

A computer program is being developed to evaluate evolving waste generation and treatment options, he said. The program will have characteristics of each waste stream input into it, along with waste treatment option capability, availability, and cost information. "The computer model will be rerun as waste generation changes or treatment options availability changes," he said. The simulations should provide the most cost-effective alternative for any given set of waste streams and available resources, Patton concluded.

Research is aimed at providing a scientific basis for understanding and predicting aging and degradation in reactor metals, concrete, buried piping, and cabling.

Sharon Robinson, manager of Waste Management Systems and Technology in ORNL's Nuclear Science and Technology Division, focused her talk on liquid waste management that supports D&D activities at DOE sites.

"Several trenchless installation technologies have been developed over the last 20 years for a range of pipeline installation applications," she said. She explained that the general requirements used for screening trenchless installation technologies for piping in radioactively contaminated environments typical of DOE sites include the following: Worker entry inside the pipeline must not be required; the technology must be applicable to pipelines in the 2-in.- to 6-in.-diameter size often used within the DOE complex for transporting radioactive wastewater; and the technology must be applicable for installing significant lengths of piping.

Robinson

Robinson said that the technologies that meet these requirements include cured-in-place pipe, thermoformed pipe, sliplining, pipe bursting, pilot-tube microtunneling, and horizontal directional drilling.

She noted that the results of an ORNL study indicated that trenchless installation technologies have the potential for use in contaminated environments and could reduce the amount of D&D waste involved in upgrading or replacing underground pipelines, but that these systems have had limited use in DOE applications to date. "So, the impact of installation method is unknown, particularly with respect to pipeline integrity and design life," she said.

LWR sustainability

During the past year, the fifth decade of commercial operation began at two power reactors in the United States, and preparations for life beyond 40 are being made for most, if not all, of the other reactors now in service. Meeting sessions on taking the fleet even farther—beyond the 60 years allowed by license renewal to as many as 80 years through a second renewal—have become common. This meeting's session on light-water reactor sustainability went beyond the topics of earlier sessions (the motivation for and feasibility of keeping a reactor operating that long) to a nuts-and-bolts discussion of the work that might be required to make this longevity happen.

To a great extent, the post-60-year effort is centered on the Department of Energy's Light Water Reactor Sustainability Program. Richard Reister, who manages the program, outlined the work being done and areas that could be explored. Among the recent developments he cited was the announcement, two weeks earlier, that a modeling and simulation hub was being established under the leadership of ORNL, with funding of up to $122 million over the next five years.

Reister

Reister said that research is aimed at providing a scientific basis for understanding and predicting aging and degradation in reactor metals, concrete, buried piping, and cabling, and that a working group has been formed to integrate the efforts of the DOE, EPRI, and the NRC. There is also work to be done in advanced fuel and cladding design, he said. Not only are reactors expected to stay in service longer, but fuel may spend more time inside the core for extended burnup.

In at least one respect, the DOE program may be preparing to address influences from outside the plant as well as inside. Reister, acknowledging the growing criticism of once-through cooling in future climate conditions that might make a reactor's thermal discharge more of an environmental issue, noted an effort within the program to explore alternative cooling systems for once-through plants to determine whether there are options other than the addition of cooling towers where none had been planned.

EPRI's Long-Term Operations (LTO) Program was described by John Gaertner, technical executive at EPRI. He said that EPRI is participating in collaborative testing, inspection, analysis, and technology demonstrations at two power reactors that are effectively in the vanguard of aging management: Constellation Energy's Nine Mile Point-1 and Ginna, the second- and third-oldest operating units. Nine Mile Point-1 began its fifth decade of commercial operation last December, and Ginna crossed that threshold in July.

The LTO projects for this year, Gaertner said, are to extend the materials degradation matrix for primary metal failure mechanisms to 80 years; to characterize intergranular stress corrosion cracking in nickel alloys; to characterize and mitigate irradiation-assisted stress corrosion cracking in stainless steel; to develop underwater welding techniques for the repair and replacement of reactor internals; to evaluate concrete and containment aging issues; to test and model silicon carbide fuel cladding; to assist in the development of risk-informed safety model characterization and advanced probabilistic risk assessment methods; to carry out some pilot work in instrumentation and controls; to develop a database and assessment tools for life-cycle management; and to scope the adequacy of cable testing technology.

Gaertner

Dan Naus, of the Materials Science and Technology Division at ORNL, addressed aging management of concrete structures. Much of the research in this area is not yet conclusive as far as long-term reactor operation is concerned, he said, but he provided some potentially good news: that long-term results generally show an increase in concrete compressive strength over time. This does not mean, however, that there will never be problems with nuclear plant concrete, he added, noting that existing reactors may ultimately be subjected to temperatures above current code limits.

As candidate research areas are examined and sources of data are explored, there may be an interesting shift in the long-standing tendency to project the behavior of new reactors based on experience with old ones: Naus said that the Advanced Materials Property Information Management System intended for the Generation IV reactor development effort will form the basis of the nuclear concrete materials database.

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