

PACIFIC BASIN NUCLEAR CONFERENCE

Fulfilling the promise of nuclear energy throughout the world

The 19th Pacific Basin Nuclear Conference (PBNC), held August 24–28 in Vancouver, British Columbia, Canada, provided an opportunity for meeting attendees to hear about the accomplishments of the nuclear industries in several of the leading Pacific Basin nuclear countries.

To open the conference, Tim Gitzel, president and chief executive officer of Cameco and the meeting's honorary chair, introduced the first keynote speaker, Kelly Block, member of Parliament and parliamentary secretary to Canada's minister of natural resources. Welcoming the delegates to Canada on behalf of the government, Block stressed that the Canadian government is



Block

very supportive of the nuclear industry.

Nearly 15 percent of Canada's electricity and over 50 percent of Ontario's, the most populous province, is nuclear generated, which, according to Block, means that Canada's electricity supply is among the cleanest in the world. Block also noted that Canada is the world's second-largest producer of uranium, all of which is mined in her home province of Saskatchewan. Regarding the uranium market, last year marked the first deliveries of yellowcake to China under multiyear, multibillion dollar agreements with Cameco, she said. This was made possible by the supplementary protocol to the

The 19th PBNC provided a forum for Pacific Rim countries to share their experience and help advance nuclear's role worldwide.

nuclear cooperation agreement between the countries that entered into force in January 2013.

The government has also taken steps to reinvigorate Canada's nuclear industry. Among the many benefits of that reinvigoration is a recent agreement—signed by the Canadian vendor Candu Energy and a Chinese engineering company—that calls for the construction of two new CANDU units at the Cernavoda nuclear plant site in Romania. At the same time, Candu Energy's parent company, SNC-Lavalin, signed a memorandum of understanding with China National Nuclear Corporation for cooperation in several areas, including the development of Advanced Fuel CANDU Reactor technology to use recycled uranium and thorium fuel in China, and the pursuit of other international project opportunities. These projects, she said, have the potential to generate billions of dollars.

Other government-led initiatives that Block mentioned include the following:

- In order to bring private sector efficiencies into the management of the nuclear laboratories of Atomic Energy of Canada Limited, the government is introducing a government-owned, contractor-operated model.

- Steps have been taken to encourage investment in Canada through a significant

modernization of the regulatory framework for major resource projects. As a result, potential investors will see a much more predictable permitting process.

- In January, the government introduced the Energy Safety and Security Act. This legislation maintains the key principle of absolute and exclusive liability of operators of nuclear facilities for civil injury and damage. The compensation available to address civil nuclear damage will increase from Can\$75 million (about \$67 million) to Can\$1 billion (about \$900 million), bringing Canada's regime more in line with international standards. The legislation will also permit Canada's ratification of the international Convention on Supplementary Compensation.

- On the important issue of long-term management of radioactive waste, the Nuclear Waste Management Office is working with potential host communities in Ontario and Saskatchewan on the siting of a long-term management facility for spent fuel, while an Ontario Power Generation (OPG) proposal for a deep geological repository for low- and intermediate-level waste is undergoing regulatory review (see page 34, this issue).

These measures, Block noted, are also aimed at reinforcing public confidence in the safety and security of the nuclear in-

dustry, a fundamental requirement for fulfilling the promise of nuclear energy in the Pacific Basin and throughout the world.

Nuclear in the Pacific Rim

The opening plenary session, “Fulfilling the Promise—Developments Within the Pacific Rim,” was chaired by Peter Lyons, U.S. assistant secretary for nuclear energy, who was the first speaker.



Lyons

Lyons described some of the challenges facing the nuclear industry in the United States and actions taken by the Department of Energy to enable nuclear power to make a bigger contribution to meeting the country’s energy supply needs and, at the same time, its environmental and security goals. He referred to President Barack Obama’s energy strategy, which includes nuclear as an important component. The president, he said, knows that a clean energy future is going to require an “all-of-the-above” approach. There is no “silver bullet” clean energy source, Lyons stressed, that is going to address the energy requirements of the present, let alone of the future global economy.

The countries surrounding the Pacific Basin are among the most active in developing nuclear power, Lyons noted, but the picture in the United States is currently mixed due to lower demand and the availability of cheap shale gas. While five nuclear power plants are under construction, since 2012, five reactors have either been closed or have been announced as closing soon. For an administration that is deeply concerned about carbon emissions, he said, the closure of any zero-carbon energy resource is a serious issue.

The DOE is providing support to the industry to address some of these challenges, Lyons said, such as a \$6.5-billion loan guarantee for the Vogtle new-build project, as well as funding for small modular reactor (SMR) development through its SMR Licensing Technical Support Program. Among the potential benefits of SMRs, he said, are enhanced safety and security, shorter construction schedules, and reduced capital costs, which may make nuclear power feasible for more utilities. In general, he added, the DOE sees SMRs as possibly presenting a new paradigm as to how we think about nuclear plants. There will still be a need for the very large class of plant, Lyons declared, particularly where utilities have the capital to finance them, but SMRs may provide opportunities for smaller utilities to use nuclear.

Other DOE programs Lyons highlighted are the Light Water Reactor Sustainability Program (*NN*, May 2013, p. 47), whose goals include developing a scientific basis

for the operation of existing LWRs beyond 60 years and their long-term economic viability, and the program for developing accident-tolerant fuels, which is looking at cladding materials that have a much lower probability of generating hydrogen in an accident scenario (*NN*, Sept. 2014, p. 43).

Regarding climate concerns, Obama announced in June another initiative for cutting carbon pollution by some 30 percent on a state-by-state basis. There will be a comment period on this proposal, and critics are challenging the plan. “At least we have started,” Lyons noted. “We have asked each state for a plan to achieve this.”

The next speaker was Pierre Tremblay, president of Canadian Nuclear Partners, a subsidiary of OPG, where he spent most of his career. Besides speaking as an operator, Tremblay also wanted to provide a Canadian perspective to the meeting. He noted that the nuclear industry’s willingness to share experience, including personal and organizational failings, serves to strengthen it. This can be seen in the institutions that serve the industry, such as the CANDU Owners Group, the World Association of Nuclear Operators, and the International Atomic Energy Agency, and is also apparent when significant events occur.



Tremblay

Tremblay also remarked that within Canada, industry leaders are committed to working collaboratively for the whole sector and the country. He said that over the next decade, he expects that Canadians will demand nuclear energy as a low-carbon technology. In the meantime, the industry must continue to “deliver value safely, efficiently, and transparently” to ratepayers and the public, and, he added, to deliver “our projects on time and on budget. . . . It is all about performance.”

Nuclear will remain the backbone of the power supply of Ontario, Tremblay said, and the provincial government is committed to refurbishing its CANDU reactors, starting with the four units at OPG’s Darlington station. This project, which will take more than a decade, is scheduled to begin in 2016, when the first unit goes off line. The benefits associated with these refurbishments are significant, he said: 30 more years of baseload generation, along with

jobs, new business activities, and tax contributions, as well as other benefits to the region. A lot is riding on this refurbishment, Tremblay said, and OPG is making extensive preparations for it. The project—one of the biggest of its kind in the world—cannot be rushed, he added, “because we know we will not get a second chance to do a project of this scope, and we simply have to get it right the first time.”

Tremblay also described OPG’s development of a culture that is designed to maintain high levels of performance through the use of methods such as a continuous improvement approach; the implementation of practical measures, including a corrective action program; peer reviews; and extensive benchmarking. The culture incorporates the lessons learned from operating experience at OPG and around the world and makes use of industry best management practices.

Looking to the future, Tremblay said, OPG considers its programs for knowledge retention and management as vital. It has also developed an emerging leaders program and offers the opportunity for its college and university graduates to train as plant operators and engineers. These programs attract thousands of qualified applicants each year, he said, and have proven to be an effective means of keeping OPG’s talent pipeline flowing.

The company also builds relationships with the community, local colleges, and secondary schools and provides support for supplier companies, Tremblay said, noting how important the success of the Darlington

The nuclear industry’s willingness to share experience, including personal and organizational failings, serves to strengthen it. This can be seen in the institutions that serve the industry.

refurbishment will be for enhancing Canada’s reputation and driving the province’s supply chain forward for decades to come. “But we have more to offer,” he said, which is why OPG created Canadian Nuclear Partners to market the company’s nuclear expertise. This, he added, is the type of innovation that can drive nuclear’s growth.

This is a critical time for the industry, Tremblay said, which is why it is necessary to continue the safe, reliable, and cost-effective operation of existing plants and to

execute new nuclear projects with environmental sensitivity, thereby building public trust.

Wei Suo, senior vice president of China's State Nuclear Power Technology Corporation (SNPTC), discussed China's nuclear power development program, providing a brief history (very similar to one provided by China's Jiang Mianheng at the opening plenary session of the ANS Annual Meeting held in Reno, Nev., in June; see *NN*, Aug. 2014, p. 149) and describing the program's current status.

Wei noted that in 2006, China introduced Westinghouse AP1000s into its plans as "supporting projects" while the country developed a third-generation capability, with Chinese and American companies working



Wei

together. Currently, the construction of Sanmen-1, the lead of four AP1000 units, is over 99 percent complete, with 74 of 226 nuclear island system packages having been turned over to operational staff for testing. The main control room has also been put into service. Sanmen-1 and Haiyang-1 are expected to be connected to the grid at the end of 2015, and their twin units at the end of 2016.

According to Wei, the construction of the AP1000 supporting projects has allowed China to establish a third-generation nuclear power industrial system, develop the complete equipment supply chain, complete the standard design of a localized AP1000, and prepare for large-scale construction of the localized design.

At the time of the PBNC meeting, China had 21 reactors connected to the grid and 27 units under construction. Under the latest national development plan, a number of AP1000s and CAP1400s are to be constructed while research is carried out on future technologies, including sodium-cooled fast reactors, high-temperature reactors, and advanced fuel cycles.

Currently, Wei said, the government has approved eight AP1000 follow-up projects, and the sites have been prepared to start construction, including second-phase projects at Sanmen and Haiyang. Three additional two-unit sites have completed their "technical" preparation and are awaiting approvals.

The goal of China's CAP1400 project, Wei said, is to develop the technology with independent intellectual property rights and to undertake a two-unit demonstration project at Rongcheng, in Shandong Province. The CAP1400 draws on 30 years of experience in pressurized water reactor research and development, design, construction, and operation and absorbs the ad-

vanced technology of the AP1000 and the experience and lessons learned from building the first units. It also adopts measures to enhance plant safety margins based on lessons learned from the accident at Fukushima Daiichi.

The basic design of the CAP1400, a large-scale advanced pressurized water reactor, was completed in 2011 and was approved by the Chinese government in January 2014, Wei said. Contracts for 25 of 29 long-lead-time items for the first demonstration plant have been signed, and site preparation is being carried out as planned.

Wei also provided a brief description of SNPTC, which, he said, was established in 2007 to create a self-reliant nuclear power technology capability. Its initial tasks included introducing the AP1000 technology to the country, leading the development of the CAP1400, and forming a national proprietary brand of nuclear power technology. The company is now working on the preliminary R&D for a CAP1700 reactor and for SMRs.

SNPTC's vision, Wei said, is to build an innovative, modern, state-owned enterprise with leading-edge core technology capability. The company also upholds the idea of open cooperation, with mutual benefits for partners at home and abroad, and achieving "win-win" results.

SMRs for the future

Small modular reactors were a main topic of a session on advanced reactor technologies. The session was chaired by John



Kelly

Kelly, U.S. deputy assistant secretary for nuclear reactor technologies, who is responsible for reactor research and development programs, including new reactor concepts, such as SMRs and Generation IV systems. Kelly referred to President Obama's commitment to developing the use of clean energy sources and the challenge he set for the DOE: for the United States to generate 80 percent of its electricity from clean sources by 2035. Furthermore, Kelly said, the president's "all-of-the-above" energy strategy, in which nuclear energy is a major component, is not a

slogan but a strategy to develop clean energy and at the same time develop the new technologies and high-quality jobs that go with it.

Kelly cited a 2010 survey that found that about 40 percent of U.S. electricity was generated by clean sources. The business-as-usual scenario could take that figure up to 43 percent in 2035. To improve on that, Kelly said, progress will have to be made in a number of clean technologies, such as carbon sequestration, nuclear generation, and renewables. In 2010, these were not seen as having much potential to displace coal by

The CAP1400 draws on 30 years of experience in pressurized water reactor research and development, design, construction, and operation and absorbs the advanced technology of the AP1000 and the experience and lessons learned from building the first units.

2035. The mission was then set to move the technologies forward so that by the early 2020s, they could be deployed to help meet the 2035 goal.

Interestingly, Kelly said, SMRs were not given any credit at all in the 2010 projections, largely because no designs had yet been finalized. To change that, the promotion of SMR design certification became one of the DOE's objectives.

Kelly said that it is clear that new nuclear development has many challenges: Capital costs are very high, natural gas prices are currently very low, some uncertainty still exists about what rules and regulations will come about as a result of Fukushima, and a question mark still hangs over waste disposal.

For these reasons, the United States is looking at SMRs as a potential game changer, as they have many potential benefits, including the possibility of generating a whole new line of business. First and foremost, Kelly said, SMRs can provide improved safety beyond the Generation III+ designs, largely because of the relatively greater volume of water available to remove decay heat. In addition, not only is the capital cost of small reactors lower, but the project risk is less, which in turn will reduce the interest rate at which a utility will have to borrow.

The DOE sees an opportunity for the

United States to take the technical leadership in this area, Kelly said. Also, he noted, the United States is committed to promoting this technology internationally, as it can provide a real breakthrough in terms of clean energy production.

The DOE's support for SMRs, Kelly said, is focused on helping to take designs through the Nuclear Regulatory Commission's reactor design certification process, which is the gold standard for licensing. Through a structured cost-share program with industry, the department will provide financial assistance for engineering, cost estimating, design certification, and other activities to help accelerate the deployment of these technologies.

Two vendors, NuScale and mPower, were the first to be selected for this program, but, Kelly explained, the aim is more ambitious than just ensuring that a few units are built. The DOE is also looking at additional mechanisms to help deploy SMRs with the greater goal of creating a factory fabrication situation to allow for the deployment of a fleet of SMRs.

In summary, Kelly said that the DOE is committed to its SMR program, aiming for the deployment of the technology in the 2022–2025 time frame. “We are going to continue our efforts to create a market for the SMRs through various incentives for our utility industry,” he said.

Global challenge of SMRs

Adi Paterson, chief executive officer of the Australian Nuclear Science and Technology Organization (ANSTO), said that he wants to start a discourse on how to bring SMRs to new nuclear adopter nations. While Paterson is now leading Australia's nuclear research activities, he was previously general manager of business development and operations at Pebble Bed Modular Reactor (Pty) Ltd. in South Africa. Over the years, he has considered some of the real challenges facing the adoption of this technology, particularly in the emerging world.



Paterson

“We need to dream bigger” about the future of these reactors, Paterson said. SMRs can make a big contribution to the global expansion of clean energy production by allowing emerging nations—where the greatest expansion in electricity demand is expected—to embrace nuclear energy. He said he would like to see real plans put in place for these and other countries to replace their old coal-fired plants with SMRs.

In particular, Paterson looked at the large and densely populated countries where the

vast majority of people live. There is a compelling logic, he said, for those countries to adopt the highest density energy sources to ensure that they can get reliable, assured supplies of electricity. “Dilute sources do not really play well in high-density countries,” Paterson said, referring to countries such as Bangladesh, Indonesia, Pakistan, and Vietnam. They will need to build their energy architecture around low-carbon sources, he said, and the only known reliable way to do that is with hydropower or nuclear baseload.

Paterson also considered communities that would particularly benefit from SMRs—for example, the 52 small island states, such as Papua New Guinea, which typically pay seven to 10 times more for their electricity than advanced countries. These states could benefit from ship-based SMRs, but, he noted, most of them are very antinuclear.

SMRs are attractive because the initial capital outlay is smaller and more easily obtained than that for large units. Furthermore, Paterson said, because units can be constructed in a predictable way as the baseload increases, the capital outlay can be arranged more easily and cheaply, as the early units constructed can generate income as new ones are added. That fundamentally changes the capital structure in a very attractive way, allowing access to larger-scale banking systems and country-to-country

agreements that would support that type of build. Paterson said that this valuable benefit is not very well appreciated.

Paterson also stressed the benefit of a fleet concept. He said that at a meeting of stakeholders in Jordan, he was amazed to find that the financial community sees the first SMRs as having the usual risk of a first-of-a-kind reactor. He wants to change the thinking about SMRs from first-of-a-kind reactor to first-of-a-fleet of reactors.

There are many barriers to introducing nuclear power and maintaining a program, Paterson said, and emerging countries may be put off by the journey to adopt even an SMR. Issues such as the establishment of the regulatory architecture and other infrastructure can be quite daunting, he noted, which led him to mention solutions that have not had much traction in the past, such as developing a shared global approach to licensing.

An important issue relates to the fuel cycle, particularly fuel provision and disposal for nonnuclear countries, Paterson said, and this is why “buy-burn-return” fuel concepts look very attractive. He said that he believes that a conversation about creating a different type of fuel supply is needed.

Paterson also explained why nuclear safety is not a crucial selling point in the sense that today, the assumption is that any reactor being offered will meet international safety standards. The safety benefits of SMRs over large units, therefore, are not going to be a determining factor. What it does, he said, is “get you to the table.” What utilities want is a reliable electricity supply at a predictable cost. Similarly, other stakeholders, such as banks, credit agencies, and sovereign risk guarantors, are not exercised by the safety question, but by reliability and availability. The sooner SMRs are built and their capabilities demonstrated, he said, the quicker they can be sold.

Generally, Paterson said, the critical elements of the case to sell to new adopter countries are really issues such as regulation, public engagement, workforce, financing, sovereign risk, credit, and risk mitigation. It is important, he said, to gain the support of the population, which means engaging with people in a real debate about energy.

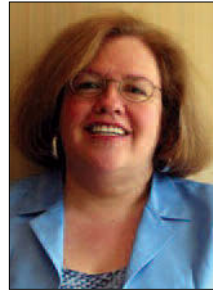
Finally, Paterson said that he dreams of seeing many of these “elegant” machines built in the future, and he hopes that his vision is realized in this generation.

Telling nuclear’s story

The final plenary session of the meeting, “Telling Our Story,” was cochaired by Mimi Limbach, managing partner of Potomac Communications Group (PCG), and Kune Y. Suh, professor of nuclear engineering at Seoul National University. Limbach is the new president of the Pacific Nuclear Council (PNC), and Suh is president-elect.

Limbach presented the PNC-PCG Benchmarking Survey that was conducted

in 2012 by the PNC Communications Working Group, which she chairs. The survey focused on the perceptions of nuclear



Limbach

energy communicators from the Pacific Rim in order to understand the support nuclear gets from policy makers and the public in these countries. The aim was to assess what people think about nuclear energy and how much they know, and to determine what the most effective communication tactics are. The survey found several trends, and while at that time there was a growing use of social media, most communicators were still focused on print media.

In 2012, the general public was considered the top audience for communicators, with news media second and government officials third. In 2014, this shifted slightly, with media at the top and the general public behind by just one percentage point. A surprising result was that regulators were no longer high on the list.

There has been a shift in the topics that communicators are interested in, Limbach said, and while safety remains the top concern, more focus is being placed on the health effects of nuclear energy, pollution, and emergency preparedness. No doubt, she said, this is all because of the way the news media have covered the Fukushima Daiichi story. Radiation continues to be a very important topic.

There has also been a shift in tactics over the past two years. In 2012, a large number of respondents viewed counteracting misleading information as the most important tactic. Today, crisis communications, including developing a crisis communications plan and being able to carry it out in an emergency, is at the top of communicators’ agenda, although counteracting misinformation is still very high.

In 2014, Limbach noted, there is more interest in digital communications than traditional print, with greater interest in social media and significant effort being spent on updating and improving websites.

One of the requests in the survey was that respondents share a best practice, she said. Number 1 of the many provided was using

infographics and shareables, which are small infographics that can be used on Twitter and Facebook. Respondents also agreed that their biggest challenge is making technical information understandable, and, Limbach said, there are real opportunities for the PNC and those in attendance at the conference to help them do that. “We all have a lot of work to do,” she said.

Next to speak was Suh, who emphasized that without public acceptance, moving forward is very difficult. Korea embarked late in seeking public acceptance, he said, and is now paying a high price.

Suh said he thought it would be useful to relate his conversion from teaching nuclear engineering to preaching the nuclear gospel. In 2006, when North Korea set off its first nuclear test, the Korean Broadcasting Sys-

Fukushima dealt a hard blow to the Korean nuclear industry, leading the government to reduce nuclear’s capacity target from a 41 percent share of the total in 2030 down to 29 percent. Nonetheless, that is still nearly twice the current capacity level.

tem (KBS) asked Suh to talk about what was taking place. He soon realized how difficult but important it is to speak to people in plain language. On the use of figures, Suh remarked that while “10⁶” is a valid expression when talking about risk, it is better to say “once in a million years.”

When the Fukushima accident occurred,



Suh

Suh was again on KBS talking about what happened over the course of the first 72 hours. No one was really sure what was happening, he said, but having previously been involved in developing core melt propagation calculations, Suh did some back-of-the-envelope calculations and came up with the notion that Units 1–3 probably had gone to core melt. Suh said that it was very simple; more important, he said, was that the government of Japan and the Tokyo Electric Power Company didn’t admit it for

six months.

That was the beginning of his career as a nuclear preacher, he said.

Fukushima dealt a hard blow to the Korean nuclear industry, Suh said, leading the government to reduce nuclear's capacity target from a 41 percent share of the total in 2030 down to 29 percent. Nonetheless, that is still nearly twice the current capacity level. In the meantime, the nuclear industry experienced a major setback when a large number of counterfeit quality certificates and other fraudulent documents were found at nuclear plants. Furthermore, due to the number of plant shutdowns forced by the scandal, Korea was on the brink of a national blackout for a time.

The industry, however, is recovering from this, Suh said, by choosing not to hide, being open about bad practices at the plants, and moving forward. As far as he is concerned, Korean nuclear power is coming back: "It is slow but it is happening," he said.

Changing the conversation

In introducing Michael "Mikey" Brady Raap, president of the American Nuclear Society, Limbach remarked that her agenda for ANS has a focus on improving communications.

Brady Raap said that what is important to her and for the industry is for ANS to take on the responsibility of telling the story

about the promise of nuclear energy to the public. For this, she said, remarkable resources are available, including ANS's network of local and student sections across the United States, as well as nine local sections in other countries (four of them in Asia).

This year is the 60th anniversary of ANS, she said, and a lot has changed over the years regarding communications. Besides technical innovations, the questions that the public asks are different, as are the messages once considered most important.



Brady Raap

members must be more focused and able to present the intended messages in a way that is "digestible and understandable." She declared that ANS must improve on the way it has been doing this work.

So, what is different? In the past, considerable effort was spent on *reacting* to events, which Brady Raap said is very different from *responding* to events. The focus has been on trying to correct misunderstandings; the goal now is to move forward and to be proactive.

This new approach called for developing a communications strategic plan based on ANS industry surveys, on the experience that communicators brought to the society, and on the objectives and goals set by ANS.

The question of how to promote its message led ANS to launch the Center for Nuclear Science and Technology Information website (<nuclearconnect.org>). Studies were organized to get a better idea of what the content of the website should be, and to ensure that the responses are coordinated. The idea is not just to inform, but to engage in conversation. The website allows users to ask questions, with expert answers provided, she said.

To improve "our messaging," Brady Raap said, the main message was broken down into three parts:

■ *Radioactivity is a natural part of our world:* There is no difference between naturally occurring radioactivity and that produced by nuclear power or as a by-product of isotope production. It is the same radioactivity in the ground that is absorbed into the plants and fruit we eat, and that is in coal and is released when the coal is burned.

■ *Nuclear technology works, and works safely:* Safety is a fundamental part of our profession and a basic tenet in regulation and design.

Continued