

# COGNIZANT

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OPG's Dietmar Reiner  
and the career that led  
him to Darlington's  
mega-project leadership

CANDU Owners Group Inc.



"Excellence Through Collaboration"





CANDU Owners Group  
President Fred Dermakar

# Innovation is more than a word

*Every day, in CANDU nuclear plants, safety and efficiency is improved through new approaches and advancements while new-build technologies consider nuclear uses previously unimagined.*

If you have been watching the industry news over the past year or two, you will have noticed the word innovation creep further into the lexicon. It would be easy to dismiss this as a 'word de jour' if it were not for the rate of change surrounding us. We are in an unprecedented time of technology advancement as computer-assisted, artificial intelligence and virtual-reality tools provide new means to accomplish tasks with greater safety and precision than ever before.

But there is more than just advanced technology at work. We are now benefitting from decades of cumulative research and development (R&D), engineering and continuous learning in our nuclear plants, in research facilities and on big nuclear projects. Years of collaboration and a collective questioning attitude have created a virtuous ripple effect.

This investment has returned billions in dividends by, among other things, helping to confirm life expectancy of components including ever-critical fuel channels. It has also given us predictive models for the most efficient approaches to operations and maintenance for equipment reliability. It has also enlightened us on the value of leadership and human performance effectiveness in this people business.

Innovation was a buzzword back in the mid 20th-century, too, when the industry' pioneers developed nuclear technology for electricity generation and managed the very first new build projects. Today, innovation is focused on gaining years of additional life from existing plants and managing complex refurbishment projects to improve the return on investment for the people who count on the plants for low-carbon, low-cost, reliable electricity.

Innovation is expanding the use of nuclear plants for additional purposes such as harvesting of materials for life-saving medical applications. And, it is going once again into new frontiers with small modular reactors (SMRs) for untapped nuclear applications such as load following, adding incremental baseload or providing off-

grid solutions.

Some innovations, like AI and VR, are shiny objects. Others are less eye-catching, like the work of collaboratively creating new processes that improve human performance, plant longevity and safety, incrementally, year over year. They don't garner headlines but do lay a foundation we continue to build upon.

## Demonstrated performance

Over the past year, I had the opportunity to provide testament to the work of the CANDU industry in Canada at the licence renewal hearings of the three operating utilities and for the Canadian Nuclear Laboratories' site. I was proud to share success stories by these COG members collaboratively and individually. In fact, last year, New Brunswick Power's 35-year old Point Lepreau station celebrated its best performance in more than 20 years. Pickering Nuclear has also recently achieved some of its all-time best performance after almost half a century of service. We now know that age, like many other things, can be managed if we understand plant condition and needs. That is innovation.

Equally, in the past several months, I have been encouraged to view firsthand, the efforts of COG international members as I travelled to sites worldwide, including in Romania, Korea and China. I also participated in the WANO Tokyo Centre-led event, hosted by the Nuclear Power Corporation of India Ltd. (NPCIL), assisted by COG.

Societatea Nationala Nuclearelectrica (SNN), Romania is in the preparatory stages for a mid-life refurbishment on its Unit 1 reactor at Cernavoda, scheduled to begin in 2026. No doubt, innovations developed in current and past CANDU refurbishments will provide an excellent starting point for yet further innovation in project management there.

Innovation, according to the Merriam-Webster dictionary, means a "new idea, method or device." In this issue of COGnizant, you will see many.



*Leadership, innovation, collaboration  
Focus on refurbishment pp. 7-19*

*CANDU operators share their discoveries and lessons from refurbishments past and present through COG workshops and peer groups. Above, workers during restart activities at New Brunswick Power's Point Lepreau refurbishment. Photo: NB Power*

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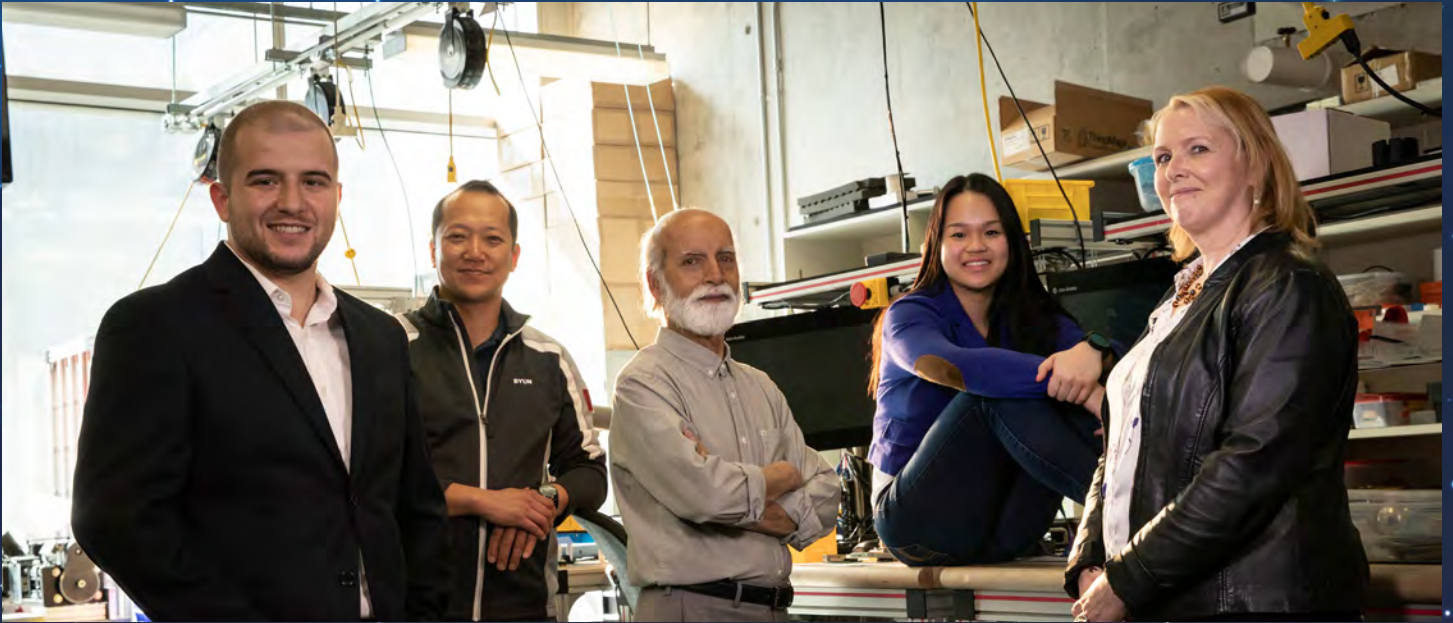
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Cover photo courtesy of OPG





# ***TO GO WHERE NO NUCLEAR DOSIMETRY PROGRAM HAS GONE BEFORE***

*A Bruce Power scientist helps McMaster University launch a project with the Canadian Space Agency*

**A** new Canadian Space Agency (CSA) tool to ensure safe levels of radiation for astronauts during space exploration got its start in technology used in nuclear power plants.

Space explorers can face a number of unknown risks, including one familiar to us here on earth where it is just as difficult to quantify without the proper tools: radiation exposure.

With humans starting to extend their space exploration beyond a low earth orbit – where the International Space Station is located – radiation detection systems that can classify and characterize radiation hazards are more necessary than ever.

A satellite the size of a loaf of bread, conceived by Bruce Power senior scientist, and CANDU Owners Group (COG) Health, Safety and Environment (HS&E) committee member, Andrei Hanu is one of 15 projects chosen by the CSA to be launched into space as part of the Canadian CubeSat Project. The project was developed by Hanu working with a team of McMaster faculty and students.

The satellite, named NEUDOSE — “NEU” for neutrons,

“DOS” for dosimetry (the measurement of radiation dose) and “E” for exploration – is the first device to measure the amount of neutron and charged particle radiation an astronaut receives during a spacewalk. Neutrons, which are produced when galactic cosmic rays interact with the earth’s upper atmosphere, make up about 50 per cent of the radiation dose that humans receive in space. It’s important to track an astronaut’s exposure to neutrons, because they can have serious effects on a body’s DNA – but that hasn’t always been possible.

“Conventionally, the instruments that were required to measure neutrons in space were very heavy – up to 50 kilograms, and using 600 watts of power,” explains Hanu, a graduate of McMaster’s Radiation Sciences program. “You can’t use those instruments for personal dosimetry. So we wanted to develop something that would solve that problem.”

NEUDOSE, which is expected to be deployed from the International Space Station in 2021, will beam data from the International Space Station back to McMaster, where it will be collected and analyzed, helping researchers on the ground understand how long-term exposure to

charged and neutral particles affects the human body.

The project that has been years in the making, started with Hanu, during a fellowship at NASA's Goddard Space Flight Centre from 2013-2017. There, a fifth of his time was dedicated to creating "game-changing" technology.

Hanu was working on developing an instrument to measure radiation exposure in astronauts and reached out to two people he knew could help him: Fiona McNeill, the director of McMaster's Radiation Sciences graduate program, and Soo Hyun Byun, a professor of physics and astronomy.

The project's information meeting attracted almost 100 students across a range of disciplines, from engineering to life sciences to science. Since then, roughly 40 undergraduate and graduate students have worked on the project designing, fabricating and testing the satellite structure as well as its supporting structure.

A group of students tested the satellite through NASA's High Altitude Student Platform (HASP) program in 2017, flying the satellite's radiation detector 100,000 feet above the earth in a high-altitude balloon above the Columbia Scientific Balloon Facility in Palestine, Texas. Another group will return this year to perform further tests.

Collaboration, whether with academia or with industry colleagues, such as through COG, provides an important opportunity to advance ideas and to train Highly Qualified Persons (HQP), says Hanu. That is true for radiation dosimetry and in other fields where innovation is helping us improve safety and advance the quality of life we experience right here on earth.

— Files and photos by McMaster University



At the top of the page and above, members of the McMaster team that launched a Canadian Space Agency project. Top of page, left to right: Bruce Power's Andrei Hanu with McMaster's Soo-Hyun Byun, Ishwar Singh, Erica Dao (student project manager) and Fiona McNeill. Photo above, Hanu and Singh discuss the Neudose project.

## CANDU Owners Group shares message of collaboration and innovation at industry licence renewal hearings

COG President and CEO Fred Dermarkar recently spoke at the Ontario Power Generation Pickering Nuclear and Bruce Power licence renewal hearings. In doing so, he highlighted both companies' commitment and achievements in furthering nuclear safety and advancing knowledge of CANDU plant and equipment management as well as human performance.

In his remarks to the Canadian Nuclear Safety Commission on the Pickering station, June 27, Dermarkar highlighted OPG's high safety standards and their leadership role in COG programming.

"OPG is a leader in continuous improvement, innovation through R&D, nuclear safety and emergency preparedness," Dermarkar said. "These efforts have a direct correlation on OPG's ability to safely and predictably manage the Pickering station until end of operation. The quality of the work and the resulting performance is transparent and measurable."

In support of the 10-year licence renewal for Bruce Power's Nuclear Generating Stations A and B in Kincardine, Ont., on May 30, Dermarkar highlighted the important contributions Bruce Power has made to the industry through its R&D activities at the site and through its membership in COG over several decades.

"Through its contributions to the nuclear industry, Bruce Power is advancing health care, is helping Canada achieve its goals for climate change and is helping us provide safe, reliable, affordable electricity with nuclear technology," Dermarkar said.

Dermarkar also appeared at the Canadian Nuclear Laboratories Ltd. hearing earlier in the year and at the New Brunswick Power hearing in 2017.

**Read more on COG's CNSC submissions on the Pickering Nuclear and Bruce Power licences:**

[OPG Pickering Nuclear](#)  
[Bruce Power](#)



# Nuclear Maintenance Managing for the future



Above: OPG's Chief Nuclear Officer Sean Granville presents at the first of COG's new maintenance managers' workshop series.

***A new COG workshop series offers maintenance managers a chance to step back from the day-to-day and prepare for the long game***

**A** lot has happened in the nuclear maintenance field in recent years with artificial intelligence, improved human performance tools and other developments that can take maintenance to a new level of efficiency and add years to the life of the plants.

The challenge is being able to step away from day-to-day urgency to take a strategic approach that will solve today's problem and, as importantly, will help manage for performance excellence tomorrow.

A new CANDU Owners Group (COG) workshop series, "Maintenance Strategic Thinking Workshop," is helping managers get a handle on long-term opportunities and bring them to fruition.

COG kicked off the series with a three-day pilot workshop in early June. Together, COG-member maintenance managers from Canadian Nuclear Laboratories, New Brunswick Power and Ontario



Above: Maintenance managers from Canadian Nuclear Laboratories, New Brunswick Power and Ontario Power Generation participate in one of the workshop's group discussions.

Power Generation, considered how to seize strategic opportunities and gain "buy in" to execute on them.

"Strategic opportunities present themselves at all levels of a company," says George Williams, the COG project manager who facilitates the session. "Examples may include a new and innovative process, a new tool on the market, or refining the way we already do business to make it better."

The course builds on a number of competencies that support thinking and leading strategically. The workshop moves participants through the motions of identifying potential opportunity, assessing the situation, building a case for the proposal and presenting the case to move it forward.

Participants leave the program with personal action plans on how they will apply the learning on the job. In the June session, the managers were able to build from each other's experiences and gain momentum for their own personal objectives, says Williams.

"When I facilitate workshops like this I am always impressed with the talents and insights of our industry's managers. Those in maintenance really understand the need to have the right tool available for the job at hand. Leadership is no different. This workshop simply provides leaders with more tools for the toolbox."

Given the positive feedback from the pilot, COG has scheduled the next workshop for Sept. 26-28. Senior maintenance managers at each utility nominate participants.

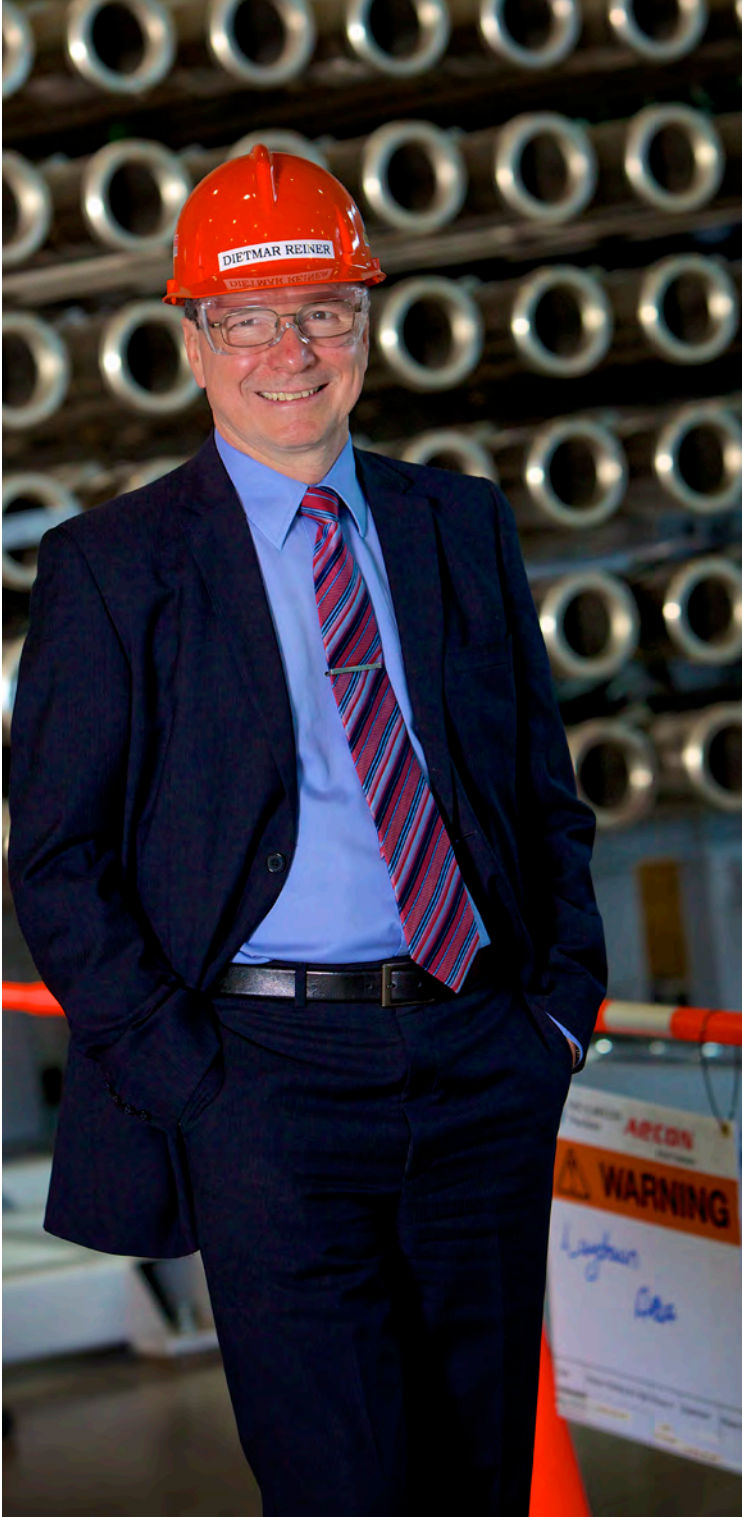
For more information, contact George Williams at [George.Williams@CANDU.org](mailto:George.Williams@CANDU.org).



The  
leader,  
the company and  
the *'it'* project



Just like the methodical lead up to the Darlington refurbishment itself, Ontario Power Generation's Senior Vice President of Nuclear Projects Dietmar Reiner spent much of his career preparing to lead Canada's big show.



Senior Vice President of Nuclear Projects Dietmar Reiner at the Darlington Energy Complex mock up and training facility in May 2008. The facility has innovated the way training and tool testing is performed.

In a 2013 speech to the Clarington Board of Trade, then Ontario Power Generation president and CEO Tom Mitchell explained the company's approach to the Darlington refurbishment. The company had already been working on the project for six years at the time, though it would not begin execution for another three years.

In that time, OPG had been doing feasibility studies including extensive plant condition assessments, benchmarking at other stations, costing the project, procurement and contracts for the work ahead, including selection of their engineer-procure-construct (EPC) partners – SNC-Lavalin and Aecon. It constructed facilities to support the project and was pre-engineering parts in anticipation of execution. It had also built a full-scale mock up for training and tool testing to ensure all systems and people were ready when the day came to enter the first reactor. There was planning - lots and lots of planning.

"But as Abe Lincoln used to say: 'Give me six hours to chop down a tree, and I'll spend the first four sharpening the axe,'" Mitchell told the Clarington business audience that day. "Lincoln knew the value of preparation...and so do we."

It was back in 2007 when the Ontario government gave OPG the go-ahead to study the fate of the Darlington station and to prepare a business case for whether to move forward with a life extension.

In 2010, with sufficient studies completed, the government announced OPG would move forward with the refurbishment project.

The announcement came from the government like a bride on the day of her second wedding: excited but skittish. In one breath the government heralded the project. In the second, it added exit ramps if OPG could not deliver as promised.

In the early 2000s, the first unit of a major overhaul of the Pickering station significantly exceeded budget and schedule. OPG learned important lessons from it, paused and did an extensive lessons learned. As a result, the company successfully brought the next unit, Unit 1, back to the grid on-time and on-budget to a newly constructed cost and schedule based on a much better understanding of plant condition,

*Feature photos provided by OPG*



part availability and activity synchronization for each step of the project. In the next several years, on both nuclear and hydro projects and outages, OPG refined and strengthened its project management skills and built internal bench strength.

Today, the Darlington refurbishment project and the Bruce Power life extension projects sit at the top of Canada's list of top infrastructure projects at about \$13 billion each. Their economic reach spreads across the country, and is especially felt throughout Ontario where they currently account for about 50,000 jobs in construction and manufacturing activities. The projects contribute about \$5 billion annually to the national economy.

In Clarington, execution of Darlington Unit 2, the first unit out of the gate, has rounded the halfway mark and with some systems already returned to service, home is clearly in sight. And, while OPG continues the necessary work on Unit 2, it is already taking the lessons learned there and feeding them into the work packages and plans for the next unit to enter execution, Unit 3.

In 2015, Mitchell passed the CEO torch to Jeff Lyash at an ideal hand-off spot as the project began to transition from preparation and moved toward the 2016 start of execution. But at the project face, the steady hand at the wheel remained. Senior Vice President of Nuclear Projects Dietmar Reiner joined the project right when it got the 2010 go-ahead.

Out of the gate, Reiner's job was to get the team built, select the partners, negotiate and manage the multi-million dollar contracts. He brought expertise to the project team through the most complex aspects to get the project infrastructure built, the training done, the people ready and the engineering completed. And since October 2016, Reiner, with SVP of Refurbishment Mike Allen, has seen the project through the first year and a half of project execution. This was accomplished under the intense scrutiny saved for mega-projects of the nuclear kind, and through some of Ontario's most tumultuous provincial elections, without missing a beat.

So far, so good.

"I have a very high degree of confidence we will finish the refurbishment of Unit 2 either on or ahead of schedule and on or ahead of budget," Reiner said, earlier this spring from an interview in his office at the Darlington Energy Complex. "And, we are far enough into the schedule now to be able to say that with some certainty."

### The leader and the company

Reiner is not the kind of leader who speaks from the cuff. He is an engineer by trade and by temperament, much like the company he works for. He defines problems. He develops solutions and executes on them, measuring, course correcting and reporting as he goes. His thinking and his processes are purposefully transparent.

His appearance is equally methodical and consistent: Shirts always crisp. He has a well-scrubbed, affable look that suggests no corners are cut in any area of his life. One would guess his bed is always made, birthdays are not forgotten and despite being the leader of a \$12-billion project, he has figured out work-life balance the way an accountant remembers to put money to the savings account first. If he was a train, he would be Swiss. So, when he says he has confidence something will happen, you take comfort that it will.

If he is the living embodiment of OPG in demeanor, it is equally hard to separate the history of the man from the company. His career trajectory has been instrumental to many Ontario Hydro/OPG milestones of the past 30 years, which is probably how he came to be the right person at the right time to lead the Darlington refurbishment.

A 1985 University of Waterloo engineering grad, Reiner started his career at then Ontario Hydro as a systems engineer at Pickering Nuclear. There, he cut his teeth on CANDU technology, nuclear safety culture and the practical application of any radiation knowledge learned in university.

He says he loved the work and the chance to apply technical skills. But, when he started to use the same honed skills on different projects, it was time to move to a new position where he could learn more.

"I made a conscious choice. I said, 'what business is



Reiner was the recipient of the Ontario Power Generation 2002 Information Productivity Award.



*Darlington Unit 2 (above) is in execution phase. Several of the plant's 58 systems have already been restarted and reassembly has begun.*

this company in? We're actually in the electricity business. I actually don't know a whole lot about the electricity business," he recalls.

Reiner moved into Power Systems Operation (today the separate organization known as the Integrated Electricity System Operator) where he learned about transmission and distribution, eventually becoming involved with the Ontario Energy Board hearings where the company's rates are decided. He got the lay of the land, spending time working with and in the other generation units and eventually moved into supply forecasting and energy trading. As the company and its political direction evolved, he helped restructure the company into standalone business units.

In the late 1990s, he helped the company prepare for self-sufficiency in a deregulated market becoming vice president of commercial systems in 1999. During this time, Reiner was assigned to a government committee working on open market rules as part of the then-government's plan for privatization of the system. He worked with McKinsey to determine the value of the company's assets. While the open market never materialized quite as envisioned, by this point Reiner had received a deep education in business strategy, negotiation and contracts. It made him an ideal

candidate to spin off OPG's IT department and he spent 2000 to 2008 as OPG's chief information officer.

Reiner's attention in the years since he had left nuclear were focused on business transformation. In a way, he was still a systems engineer only on a corporate level using the new set of skills he had hoped to gain.

In 2008, he got the chance to combine his nuclear technical knowledge with these business skills when he was promoted back into the nuclear business as senior vice president of Inspection, Maintenance and Commercial Services to oversee the Bruce site lease, OPG's isotope business and to negotiate the separation of the IMS services between OPG and Bruce Power. The job gave him ample negotiation practice and it also provided a chance to work intimately with tooling and gain familiarity with the large outage activities and resourcing.

Two years later, when the government announced refurbishment would move forward, it must have seemed as if Reiner's entire career had been preparation for the role he would take leading the Darlington project.

### **The project**

The story of the Darlington refurbishment has been well documented. In fact, every quarter, the project



publishes a public update with metrics and detailed reporting on the work, the lessons and the steps to come.

The early jitters have given way to mostly praise. Competence is the new expectation based on consistent and predictable performance and reporting of the project over the last several years. Where there have been challenges, they have been openly reported and addressed.

It has helped that the industry as a whole has been outperforming itself these last several years. Pickering Nuclear, the province's oldest plant, has landed some of its best performance thanks to continued innovation that has helped the industry manage and excel in aging asset management.

Research, such as that conducted through the CANDU Owners Group on fuel channel life management (FCLM), has demonstrated component fitness that allowed OPG to extend planned operation of Pickering to the end of 2024. And, the company was able to push back project execution by a year to a 2016 start, allowing OPG to gain more production from the plant pre-refurbishment. The same research will allow Bruce Power to operate longer before its major component replacement project execution. The innovation of the FCLM project has given the two companies the flexibility to optimize timing of their work to best manage the challenges of resourcing two mega projects simultaneously and to best serve the needs of Ontario's electricity system.

For those close to it, the past 20 months of project execution may have felt like the intense paddling a duck does under water. But, the results have mostly provided the picture of serenity above the surface, especially for a mega-energy project. Execution has gone well.



Which is not to say there is any room to let up on the urgency, the focus or the oversight, Reiner emphasizes. There is the long schedule, and then there is the one right in front of you, every single day. And, there are still many years ahead.

But, with the benefit of having now lived the project day in and day out for eight years, Reiner elaborates the point made that day five years ago by Mitchell to the Clarington business crowd. Planning, he emphasizes, lays the groundwork for success in execution.

"You cannot underestimate the effort it takes to plan, and the amount of detail you need to get into in the planning process to be ready for execution. Industry had to learn the hard way. You need to be able to assess all the risks you're going to run into and not just technical risks. There are your commercial risks with your partners, risks that you face externally with stakeholders who have a key influence on what you do. Also, the technical risks you are going to run into in execution," he says.

"You need to be able to model that and understand it in a way you can quantify it. You can start looking at, 'if I put a plan together what do I need to have in my plan for contingency to deal with potential schedule impacts and potential cost impacts?'. And then, where is the place to draw the line? There are external factors we are not going to put into our plans but we are going to ensure everybody understands they are not in the plan. There needs to be clarity where that line gets drawn and we need to be comfortable to ensure we can manage all those risks."

Reiner says the effort put into the modeling helps guide execution because both the work and the risks have been pre-considered. Solutions are already thought through before the issue arises. And, he adds, in the planning process, the team turned those assumptions and models into timelines, dollars and strategies to manage them.

"You need to ensure the project has the resources to deal with it, and that you have the team and the partners and the access to the experts in the industry to help you through all of that."

### **The road back to restart**

The long-term planning helped the team structure the execution in a way that is paying off now that the Unit 2 refurbishment is heading into the restart phase, says Reiner. With a lot of the non-critical path work frontloaded into the schedule, the team is now able to focus on the

next phase of work, reassembling the reactor, where human performance becomes particularly critical, without the distraction of added scope.

“The work takes on a very significant shift. It’s less hazardous from a radiation protection perspective. The logistics are less impactful. There’s less automated tooling so some of those tooling complexities disappear. But there’s a new thing that emerges. The job is far more dependent on human performance, people performance. The quality with which the work gets done becomes critical.”

At this point, the focus is on quality assurance and the nuclear safety standard of both OPG and the regulator. As systems are brought back on line, they must come back clean without any foreign materials introduced that could create a hazard for future operation.

“It takes a mind-shift for people to understand we are now much more people performance dependent,” says Reiner. “This is going to be the tone from now until we are done reassembling the reactor.”

A key learning from prior projects was the value of a prompt restart. The team has separated the plant into 58 systems, a number of which have already been brought back to avoid the challenges that can come when components sit idle too long. With that come hold points, internally set and those set by the regulator. At each point, the work is validated to confirm the quality of the work and the accuracy of documentation that will provide the blueprint for the future operators and maintainers.

In execution it is all about communication, transparency, tracking, course correcting, problem solving. It is all about people, says Reiner.

“At the end of the day, these projects – it’s people that execute the work. Even where a tool does the job, it’s a person that sets up the tool, it’s a person that operates the tool, it’s a person that sets the parameters of the tool. It does come back to people and it comes back to how effectively these people work. It goes all the way up to the supervision, communication, management, and the oversight. That all becomes a critical element.”

## Dietmar Reiner’s listicle: Tips for project success

### *Words of wisdom from the Darlington refurbishment*

#### **Face time is everything:**

It’s easy to underestimate the effort it takes to communicate effectively especially to a large number of people. Nothing works as effectively as face-to-face dialogue. Managers in the field doing observation and coaching, including one or two levels removed, must happen regularly. In a busy project, it is easy to find reasons you can’t get there and to rely on emails and signs, says Reiner. “These are all good tools but face-to-face is important.”

#### **In partnership, everyone needs to feel the win:**

“You can’t let commercial relationships and commercial requirements stand in the way of creating good productive, collaborative environments,” says Reiner. Project owners have a set of objectives that are not necessarily the same as those of the commercial partners. If one party doesn’t achieve their objectives, things are going to break down. “There need to be victories for everyone. It’s important to align everyone on a set of goals... but then the relationships and the collaborations become important.”

#### **Open the lines of communication throughout the organization:**

You need a means for people who execute the work to tell you what’s working and what’s not and it needs to be easy, says Reiner. “Someone welding in the field doesn’t drive their activities around email,” he says. The Project now has boxes with cards that workers can fill out at a break area or on their way out the door. The feedback can be anonymous. The learnings can be huge, says Reiner, who noted that even seemingly obvious things like where cooling stations are located can miss the mark if the feedback loop doesn’t exist. Often, he add, they are so easily resolved once the feedback is received.

#### **Transparent reporting:**

The people of Ontario have a huge stake in the refurbishment project, as do many other external and internal stakeholders. Setting up clearly-defined and reported metrics not only helps the project team track progress, do timely course correction and seek expert oversight; it provides a window into the project for external stakeholders to judge for themselves how the project is tracking. “They don’t have to take my word for it. It is all there.”



# Setting a new pace

*Current refurbishment and life extension projects at three CANDU stations have created a rare convergence of knowledge, talent and a rate of discovery that is exponentially expanding the capacity for innovation within the industry.*

*The implications are better projects and possibly new opportunities that go well beyond the current mid-life refurbishments.*



NA-SA's Embalse plant

## Nucleoelectrica, Argentina

### *Life extension project of Argentina's Embalse Power Plant nears completion*

The refurbishment of NA-SA's nuclear plant in Cordoba is well into its final stage, the reconditioning of the plant. The installation of the upper feeders was completed April 2, and installation of the lower feeders has begun.

The life extension project has been underway since Jan. 1, 2016. Following completion of the project, the plant will enter its second 25-year operating cycle and see a 6% increase in power, reaching 683 MWe.

Innovations have been many throughout the project including the complex task of steam generator replacement.

**Read more here:**

<http://www.na-sa.com.ar/prensa/avanzan-las-ltimas-tareas-del-proyecto-extensi-n-de-vida-de-la-central-nuclear-embalse/>

or follow the project on Nucleoeléctrica's Twitter page: [@nucleoelectrica](https://twitter.com/nucleoelectrica).

## OPG Darlington, Ontario

### Unit 2 moves toward restart

The Darlington Refurbishment Project is on schedule and on budget as Unit 2, the first unit out of the gate, moves into reconstruction and restart mode. The reactor's 58 systems are being reassembled and restarted and the team is now installing new calandria tubes (CTs).

Part of the fuel assembly, replacement of these 480 calandria tubes, signals the start of physically rebuilding the reactor with new components.

Other tasks underway include the refurbishment of fuel handling equipment, the rebuilding and replacing of almost 1,000 valves and the overhauling of turbines and generators. Unit 3's refurbishment has also been given the go-ahead, and execution is set to begin in 2020. Once the refurbishment is complete, the four-unit plant will operate through to 2055.

**Read more** at [www.opg.com](http://www.opg.com) including: [https://www.opg.com/darlington-refurbishment/Pages/20180709\\_Unit\\_2\\_Rebuilding.aspx](https://www.opg.com/darlington-refurbishment/Pages/20180709_Unit_2_Rebuilding.aspx)



OPG Darlington



Bruce Power CEO Mike Rencheck announces contracts in Spring 2018

## Bruce Power, Ontario

### Bruce Power awards \$914-million in contracts for life extension project

Bruce Power continues to invest in its life extension program, which will see the replacement of major components of six of the plant's eight reactors between 2020 and 2033.

In a single day in April, the company announced \$914-million in advanced manufacturing contracts for the MCR project including:

- \$642 million to BWXT Canada Inc. for manufacturing of 32 steam generators to be produced at BWXT's Cambridge facility;
- \$144 million to Laker Energy Products for end fittings, liners and flow elements, which will be manufactured at its Oakville location;
- \$62 million to Cameco Fuel Manufacturing, in Cobourg, for calandria tubes and annulus spacers for all six MCRs; and
- \$66 million for Nu-Tech Precision Metals, in Arnprior, for the production of zirconium alloy pressure tubes for Units 6 and 3.

The company also said Kinetrics will perform fuel channeling inspection, Brotech Precision CNC will supply shield plug assemblies, and Shoreline Power Group will be responsible for the reactor retube.

Read more at [www.brucepower.com](http://www.brucepower.com)

## With lessons from refurbishments already completed...



NB Power's Point Lepreau Station refuelling after refurbishment

## Point Lepreau, New Brunswick

While the companies with the three refurbishment/life extension projects currently underway are gaining significant learnings from each other, they are also learning from peers at other CANDU stations including New Brunswick Power's Point Lepreau station, which completed refurbishment in October 2012 and KHNP, Korea, which returned Wolsong 1 to service in 2015.

New Brunswick's Paul Thompson, a leader on the Lepreau refurbishment and former CANDU Owners Group board member, has been a frequent keynote speaker at refurbishment workshops and forums, including COG's recent **Return to Service Workshop**. Knowledge on restart and what operators can expect in the months and years beyond refurbishment will prove equally valuable.

In its 2017-18 fiscal, Lepreau achieved its best performance since 1994.

Read more at [www.nbpower.com](http://www.nbpower.com)

## COG Return to Service Workshop brings international participants

As NA-SA, Argentina and OPG begin to turn units back toward operation, their minds are turning toward return to service. Others in the industry, including COG international members looking to begin their own mid-life refurbishments, also want to learn what happens after project completion. COG's recent Return to Service workshop, which included a day at the Darlington project site and several expert speakers provided answers for participants from around the globe.





*Macit Cobanoglu manages the Supplier Participant program and the Darlington Refurbishment Forum*

# Ready supply

*CANDU's nuclear suppliers underpin refurbishment and life extension project work through the supply of high-quality parts, tools and talent. And, just like the utilities they work with, this community is using collaboration to strengthen their expertise in nuclear safety and to achieve excellence*

Sometimes, it is a hotel conference room. Other times, it may be a room off a warehouse of the host's facilities. Either way, when the CANDU Owners Group Supplier Participants converge, the talk is singular in purpose: improve the way things are done.

In the world of big projects, it is the client who generally wears the victory flag or accepts defeat for the team, at least to the outside world. But, in the machinery of any big project, especially those on a nuclear scale, a healthy and well-trained supply community is integral to staying on time and on budget with a quality product.

A challenge to this work is the extended period between major projects, especially of the unprecedented size of the concurrent Darlington refurbishment and Bruce Power life extension projects. The type of work and manufacturing required is not only huge in scale but unique. There is a need for parts, tools and people that take advantage of the latest technology advancements and means greenfield investment, new hiring, new practices and a lot of scaling up for even the most seasoned suppliers. There is a strong need for knowledge management capacity to align a large workforce to the values of nuclear safety and the principles of working on a nuclear-grade project.

The COG Supplier Participant program has been running for several years but with the move into execution phase at Darlington and the preparatory work

now underway for the Bruce Power major component replacement project, it has gone into high gear. Regular meetings rotating through the Greater Toronto Area draw participants from the programs 20+ membership as well as executives from the utilities. The result is an opportunity to share perspectives from both sides of the projects and to connect cross-functionally with other suppliers who are working side-by-side either at the workforce or whose products and activities interface with each other.

"The same value gained through collaboration by utilities applies equally for suppliers in terms of OPEX and learning from each other," says Macit Cobanoglu. "And, this forum brings utility executives to the table, as well. So the conversation is not just amongst suppliers but connects all stakeholders on topics that are top of mind in that moment. It is a powerful way to resolve issues and develop competencies with a small investment of time."

## Leaders gain shared vision with New Refurbishment Forum

A COG-facilitated forum led by Bruce Power's Jeff Phelps and OPG's Bill Owen allows industry leaders an opportunity to share approaches, technical information, best practices and OPEX on refurbishment while getting a line of sight on future deliverables.

UPGRADING & UPRATING |



Jacquie Hoornweg

Reporting for CANDU Owners Group

# Building a CANDU future

In Ontario, Canada, more than 60% of the electricity used in 2017 was produced with nuclear power. With successful completion of two huge refurbishment projects, the province can expect four more decades of power from nuclear, **Jacquie Hoornweg** reports



A recent workshop enabled CANDU operators to share lessons from past refurbishment projects

**TOPPING THE LIST ON CANADA'S** Top 100 infrastructure projects for 2017 are two energy projects. This is not surprising in a country known for its oil and gas resources and its large hydro infrastructure. But the projects are neither fossil nor water. They are nuclear refurbishments by Canada's largest province, Ontario, home to 13.6 million people. The projects are part of the provincial government's commitment to eliminate coal use (the province achieved its coal-free goal in 2014) and move to a long-term clean energy mix. In Ontario's most recent long-term energy plan, the province's clean energy future is built on a baseload

supply of nuclear at least into the early-2060s, just as it has been for the past four decades.

### The projects

The first refurbishment project is at Ontario Power Generation's Darlington plant, a four-unit 3500MW station, which is now in execution on its first unit. It is followed closely, with some overlap of execution in the early and mid-2020s, by a life extension project starting in 2020 for six of the eight Bruce Power units at the company's 6300MW station, which includes major component replacement.





Far left: **The Darlington turbine hall. For the first time all turbine blades and rotors were removed and reinstalled to ensure continued operation for another 30 years**

Left: **Turbine casings from Darlington 2 waiting for reinstallation**

Bruce Power returned the first two units to service from refurbishment projects in 2012 and 2013.

Between them, the Darlington refurbishment and Bruce Power life extension account for almost \$26 billion of investment until the final unit returns to service at the Bruce site in the early 2030s and then through continued life extension activities at Bruce. The economic impact of that investment is exponential, multiplied through the supply chain, employment and spin-off spending and development that is rippling through the entire economy.

Already, the effects of the combined projects are being felt in communities that house Canada's nuclear supply chain of more than 200 largely Ontario-based companies. Along with the operators, the supply chain from the largest contractors to the smallest sub-contractors and suppliers are continuously hiring workers and procuring materials and services. In addition to supplying manpower on the project site, they are filling orders for tooling, plant equipment and components. The project has been an opportunity to enter into new advanced-technology manufacturing to meet the need for artificial intelligence and virtual reality (VR) to assist with equipment and software, for applications ranging from supplementary VR training to prepare new workers for a nuclear environment, to robotics that will execute the most invasive work in high radiation areas. For example, laser-scanning technology digitally captures exact shapes and sizes of objects and spaces allowing for replication for tool testing and training. The images are then displayed in a 3D format workers and designers can access through virtual reality holographic headsets that immerse users into the plant environment allowing scenarios and task sequences to be played and replayed without the cost and safety constraints of real-reactor time. Artificial intelligence is also providing interactive and responsive supplemental training for the large number of new workers being on-boarded into a nuclear environment for the first time (see also *NEI December 2017, p27-29*).

### Ontario's refurbishment challenge

It is estimated the projects will create about 60,000 jobs throughout the Canadian nuclear industry. This is a significant economic impact. It is also a logistical challenge. The industry needs to on-board and train numbers of workers and impart safety culture amongst people who come from a construction, project management or administrative background and, in many cases, are entering the nuclear arena for the first time.

Building on lessons from their other mega projects, the companies are taking several steps to smooth the transition from an operations mindset to a project focus including:

- Adjusting to new demands in human performance and development and refinement of high-function project management skills; ●

### Darlington nuclear's refurbishment

**OPG moved into project execution** at Darlington unit 2, the first of its units to enter refurbishment, in October 2016. The unit is now at the halfway mark. Already some areas of Darlington 2 have returned to service and the project is tracking ahead of the promised schedule. The company has received government approval to start preparing to refurbish the next unit, Darlington 3 from 2020.

Work at Darlington was announced in 2010 and started even before that. The plant's operator OPG undertook eight years of planning and preparation while the station continued to operate.

Nevertheless, the announcement was accompanied by a chorus of naysayers who had seen big infrastructure projects go far over budget and past their schedule for reasons that ranged from mid-project government policy changes to a failure of sufficient planning for long-lead and obsolete parts. OPG knew that if the first unit did not go well, there would be no chance for a second unit, says Dietmar Reiner, senior vice president of nuclear projects who emphasises the need to "get it right."

Preparing for the refurbishment included technical assessments of all major components, condition assessments of balance of plant components, initiation of regulatory processes and an integrated safety review and environmental assessment. Planning was followed by several years of preparation for long-lead procurement, engineering, tool testing and worker training.

The project came with an exit clause in the event things did not go as planned. Contractors and suppliers, like the company itself, had to take a leap of faith as they invested to supply that first unit, says Reiner.

The preparation for the Darlington 2 refurbishment included a full-scale

mock reactor. This mockup included not only the reactor face, but also considered the other issues workers would encounter in the plant right down to the overhead clearance on doors where equipment would be brought in – things that had caused delays on past projects.

#### Execution phase and lessons learned

As Darlington progressed through planning and preparation, OPG relied on lessons learned from its own nuclear and hydro projects as well as the CANDU refurbishments that came previously.

There were benchmarking trips and staff were embedded at other stations during projects. In one, new technology calandria tools were loaned to Nucleoeléctrica in Argentina, for Embalse, a one-unit CANDU station refurbishing just ahead of Darlington 2. Embalse got the benefit of using the new tool being developed by OPG, which benefitted from metrics on how the tool performed.

Today, with the Darlington 2 project now through the initial planning and preparation phases and more than 500 days into execution, OPG has lessons for the next unit. These are being documented and analysed for integration into plans, and they are being shared with Bruce Power and with other international CANDU operators starting to think about future mid-life refurbishments.

With each unit it refurbishes, OPG expects to tighten cost and schedule, says Reiner. As Bruce Power does its own analysis of the Darlington work, it passes knowledge back to OPG for use on the later Darlington units.

With the corner turned toward return to service on the first unit at Darlington, Reiner is quick to volunteer his optimism that this refurbishment will be on time and on budget. ■

Right: **Mike Rencheck, Bruce Power's President and CEO announces \$914 million in advanced manufacturing contracts for its major component replacement project in April 2018**



### Bruce Power and the supplier connection

On 23 April, **Mike Rencheck**, Bruce Power's president and CEO was standing on a stage in the middle of a manufacturing facility in Cambridge, Ontario. It was one of its largest, and oldest, suppliers, the Canadian arm of BWXT Technologies, whose predecessor first served the station when it went online with its first unit in 1977. BWXT Canada had recently opened an additional office near the plant. Rencheck has been clear that project success does not start and end with the operator. Suppliers are expected to be physically present on the project and actively engaged in Bruce Power's life extension success.

BWXT supplies Bruce Power with field services to inspect, repair and maintain the plant's critical nuclear components. Many of those components, such as steam generators, are also manufactured by BWXT.

On this day, Rencheck was at BWXT to announce the supplier had been awarded a \$642 million contract. It was the biggest of several, cumulatively worth just under \$1 billion, being announced simultaneously across Ontario at various suppliers. BWXT will

supply 32 new steam generators when Bruce Power begins execution in 2020.

Rencheck told the assembled workers that signing the contracts would extend operation to 2064. "We look forward to growing our already excellent relationships with these supplier partners and unions as we work toward our common goal of continuing to keep Canada's largest infrastructure project on time and on budget," he said.

In December 2015, the company had entered a long-term agreement for the multi-year life-extension programme to continue through 2053, allowing Bruce Power's units to operate to 2064. The company has been doing hundreds of millions of dollars a year in preparation work since 2016, which will continue until the major component replacement gets under way.

The Canadian nuclear industry hopes these projects will be a beginning, not an end, to the Canadian nuclear story. It hopes the rest of Canada will see Ontario's success and move beyond the current programmes that exist in Ontario and New Brunswick to new builds, possibly SMRs. ■

- Familiarising and providing exacting standards of oversight on documentation from all project workers to ensure restart approvals go smoothly on tens of thousands of tasks, even when approvals come months after some of the tasks have been completed;
- Training vendors throughout the supply chain on large-scale nuclear parts procurement to avoid fraudulent and counterfeit parts, which could fail or introduce cyber security risks into the plant;
- Ensuring strong quality control for parts manufacturing and task completions. In projects the wrong work, or poor-quality parts, can have an impact far down the road and mean millions of dollars of rework; and
- Developing a common understanding of the reactor work space, including the variables that will be encountered when taking apart a nuclear reactor that has been operating for decades and putting it back together again.

Once the utilities have done this, they must take the mega-project and complete it in an operating station where several other units continue to produce electricity alongside it. The added challenge for Bruce Power and OPG is to choreograph the human, equipment and parts resources required to complete synchronised and overlapping work across the two stations.

These challenges call for the strongest collaboration and engagement the industry has undertaken to date. Government and regulators will be watching closely each step of the way. With years of preparation already in the rearview, the operators are confident they will succeed.

### An industry collaboration model

In a memorandum of understanding, Ontario Power Generation (OPG) and Bruce Power confirmed their commitment to improve their refurbishment programmes through collaboration. This included sharing lessons learned and best practices in refurbishment and operations, and coordinating efforts to reduce costs and limit execution risk. Specific initiatives include asset management and inspection programmes, procurement, tooling and replacement of major components (including de-tube, re-tube and feeder replacement work). They have collaborated on labour arrangements and logistics.

Through organisations like the CANDU Owners Group (COG), the entire CANDU industry, including other operators worldwide and the supply chain, is working to ensure success of the two projects and innovate to manage human and technical performance. Activities undertaken through COG include:

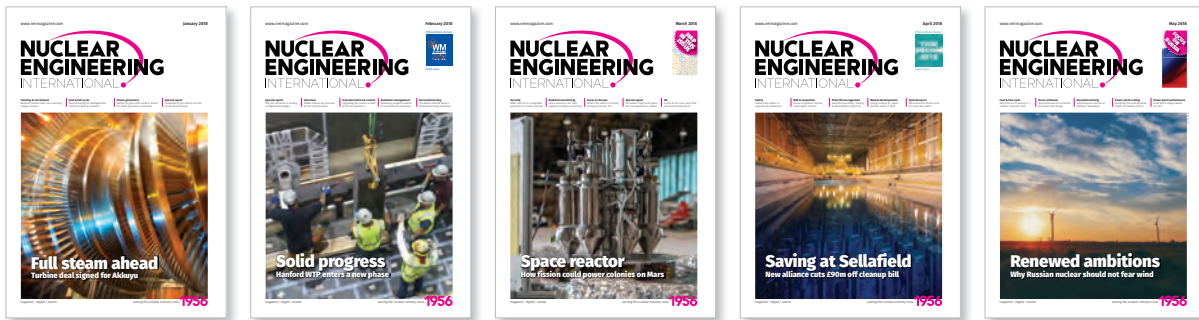
- **A refurbishment forum:** allowing operators to share information, identify needs for the refurbishment projects and develop new initiatives to solve challenges.
- **Supply chain knowledge and training:** COG's supplier participant programme brings together utility and supply chain leaders to discuss challenges, expectations and potential initiatives to develop knowledge. They are building knowledge in nuclear safety, safety culture, leadership and training.
- **Return to service workshop:** A recent COG three-day workshop provided an opportunity for CANDU utilities to talk about lessons learned from past projects. COG is developing an inventory of best practices and operating experience to be applied as future units come back online at Embalse, Darlington, Bruce Power and others. ■

Right: **BWXT Canada Inc. is manufacturing 32 steam generators at its Cambridge facility for Bruce Power's major component replacement**





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## Join COG at upcoming industry events...

*Quality, Leadership and Management in the Nuclear Industry:* July 16-19, Ottawa, ON.

*7th International Workshop on CANDU Safety Association for Sustainability (CANSAS),* Oct. 15-18, Ottawa, ON.

*COG Collaboration Week (CCW):* Dec. 10-14, Niagara Falls, ON.

### *Is your company a COG member?*

Visit [COGonline.org](http://COGonline.org) for more event information and registration using our online calendar or download our member event guide for an at-a-glance look at the year ahead. Also, share and gain operating experience and learn about current research, join peer groups and joint projects.

### *Non-members:*

There is lots of information on industry events and activities on COG's public website. Check us out at [www.CANDU.org](http://www.CANDU.org)

# A new Canadian nuclear solution



## Canada looks to lead in small modular reactor technology with initiatives and investment in research

**T**he CANDU Owners Group, its members and the supply community along with other industry partners are using their existing nuclear expertise to lead the next wave of nuclear generation — small modular reactors (SMRs), that offer the potential for new uses of nuclear energy while at the same time offering the benefits of existing nuclear in combatting climate change while providing reliable, low-cost electricity.

SMRs, a smaller, scalable model of nuclear plant can be used in on or off-grid applications including as a load-following generation and as a combined heat and power source for resource extraction or heavy industry. They also offer potential as an off-grid, regional electricity source for remote communities, including as a diesel replacement.

“As an industry, we have been highly engaged in exploring and developing opportunities for SMRs,” says COG President and CEO Fred Dermakar. “This includes helping to shape the regulatory and technical framework that can support that development,” he says.

### An SMR Technology Forum

In 2017, COG created an SMR Technology Forum (SMRTF), which provides an opportunity for members to discuss SMR-related issues and developments. The SMRTF members include Canada’s three current nuclear operators

– Bruce Power, New Brunswick Power and Ontario Power Generation -- as well as Canadian Nuclear Laboratories. Observers to the forum include other Canadian utilities with a potential interest in SMRs as well as the Canadian government through the involvement of Natural Resources Canada (NRCan). The Canadian Standards Association and industry associations such as the Canadian Nuclear Association and the Canadian Nuclear Society are also observers.

### A Canadian SMR Roadmap

A parallel and coordinated effort is supported by the Canadian Nuclear Association, as part of NRCan’s Energy Innovation program, to develop a Canadian SMR Roadmap. This stakeholder-driven process encompasses the Canadian Nuclear Association’s Vision 2050 – a vision for the industry’s next 30 years of development, as well as CNL’s SMR strategy and is currently gathering input from across Canada to identify the interests and applications of SMRs for Canadians.

### Announcements on SMR development

**Bruce Power:** Bruce Power, MIRARCO Mining Innovation and Laurentian University have signed a Memorandum of Understanding that will enhance strategic research opportunities, including the long-term potential for Small Modular Reactors (SMRs) to generate clean, low-cost and reliable electricity in rural/remote regions. The five-year, \$1 million research agreement will create an Industrial Chair position at MIRARCO Mining Innovation, focused on clean energy solutions in Ontario’s north.

**CNL:** On April 17, CNL issued an invitation to small modular reactor (SMR) project proponents who wish to participate in the evaluation process for the





## SMRs continued...

### New Brunswick government commits \$10 million and attracts private sector funding for SMR development

construction and operation of an SMR demonstration project at a CNL-managed site. The invitation represents the launch of CNL's SMR review process, including the pre-qualification stage, which allows CNL to evaluate technical and business merits of proposed designs, assess the financial viability of the projects, and review the necessary national security and integrity requirements.

**New Brunswick Power:** In June, the New Brunswick government announced a \$10-million investment toward creation of a nuclear research cluster including exploration of SMR development. In July, additional private investment was announced.

"Canada and New Brunswick have an opportunity to become world leaders in SMR technology and to bring a clean, new and reliable source of ultra-low carbon power to the forefront of global climate change," Rick Doucet, the province's energy minister said.



From left: Energy and Resource Development Minister Rick Doucet; Gaëtan Thomas, president and CEO of NB Power; GE Healthcare president Heather Chalmers; and Don Wolf, CEO and chairman of Advanced Research Concepts at a July 9 announcement related to New Brunswick's nuclear research cluster.



### COG gets a new Board member

Carla Carmichael joined the COG Board of Directors replacing Steve Woods as Ontario Power Generation's representative, recently. Carmichael (second from right with the rest of the COG Board, above) holds both CPA and MBA designations. She came to the nuclear industry with years of prior experience in various industries, joining OPG in 2009 as Director of Nuclear Business Planning. Currently serving as Vice President of Project Assurance and Contract Management, she oversees the commercial management of major nuclear projects. Prior to this role, Carmichael led OPG's Canadian Nuclear Partners and Isotopes businesses. She has been an expert witness for OPG at its rate hearings focused on nuclear generation planning, nuclear operational benchmarking and overall performance of OPG's nuclear fleet. Beyond her core responsibilities, Carmichael has distinguished herself as an effective advocate working to empower women in the workplace. In 2017, Carmichael was awarded the OPG President's Leadership Award, leadership skills.

### Joint project on whole-site PSA provides new insights on risk assessment

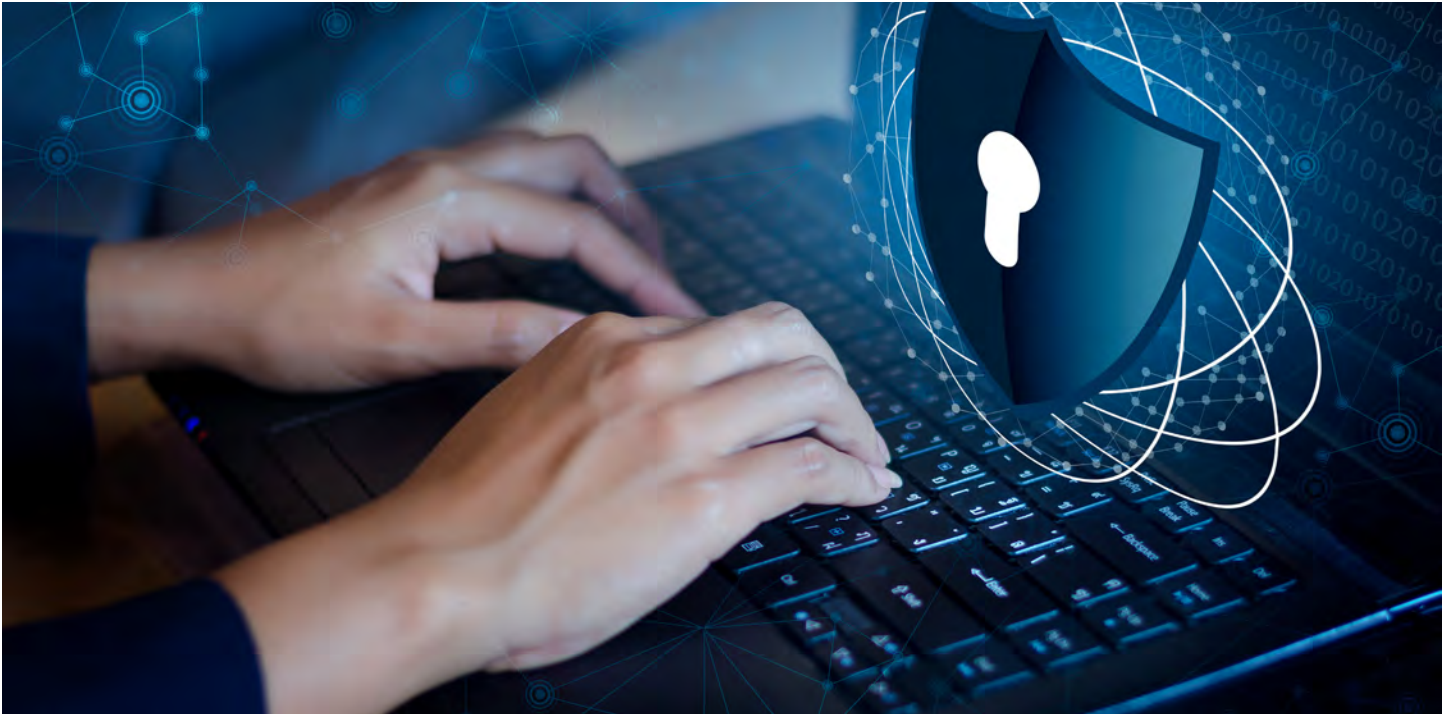
The outcome of a COG joint project (JP) provided an important approach to addressing whole-site probabilistic safety assessment ahead of the Pickering Nuclear hearing and with benefits for other operators, worldwide.

The JP participants: OPG, Bruce Power, New Brunswick Power, Canadian Nuclear Laboratories as well later participants, SNN Romania and KHNP Korea, worked with researchers from Kinectrics and Amec Foster Wheeler (now part of Kinectrics) to develop a methodology for multi-unit probabilistic safety assessment (MUPSA), which was applied to the Pickering Nuclear site in response to a 2013 request by the Canadian Nuclear Safety Commission (CNSC).

In its acceptance of the work, the CNSC said the "substantial" research effort provided a "good characterization of whole site risk" and in some aspects, such as risk aggregation at the site level, the work provided is "first of a kind."

Through the efforts of the COG team, OPG was able to break ground on this issue.

Committee chair, OPG's Jack Vecchiarelli noted, "Our lengthy deliberations and novel technical work led to a high-quality set of reports used to support that the Pickering whole-site risk is low."



# Cyber Safe

***Global cyber security experts meet to discuss a coordinated approach on enhanced cyber safety in nuclear power plants***

**A**n international contingent of cyber security experts gathered at the CANDU Owners Group (COG) offices and at the Bruce Power nuclear plant, March 19-23, to share knowledge and collaborate on standards and processes to ensure cyber safety and security at nuclear plants worldwide.

The event, co-ordinated by the International Atomic Energy Agency (IAEA) and Bruce Power, was held, in part, to review cyber security initiatives undertaken through the IAEA by the Canadian utilities, Canadian Nuclear Laboratories, the Canadian Nuclear Safety Commission and Global Affairs Canada. It is the second meeting for research coordination on enhancing security incidence response and planning at nuclear facilities. Detailed discussions focus on research activities of each participating institution and the possible harmonization of their approaches to computer security.

“Dealing with cyber threats in isolation is not enough,” said Sarah Shortreed, Bruce Power’s Chief Information Officer. “It requires a strategy and a long-term investment in our capabilities and that’s why the IAEA Coordinated Research Project is so important. Some of the best minds in the industry have come together with a common goal to protect and enhance computer security at nuclear facilities. Through their collective experience and ingenuity we will continue to predict, detect and defeat cyber threats, while using cyberspace to further the interests of the worldwide nuclear industry.”

Cyber security measures in nuclear plants include processes, procedures and technical measures. Combined, these steps can be effective in combatting cyber threats in nuclear plants of all ages and technology generations, says Fred Dermarkar, COG President and CEO.



“The information sharing taking place will enhance the knowledge and awareness of all gathered, and by extension, their organizations and our industry,” he says.

“The collaboration taking place is one of the best ways to mitigate the time and money constraints on all of our organizations in order to continue the important work being done, globally on this issue. We’re all in this together.”

Universities and research institutes from Brazil, Austria, Germany, Hungary, Korea, China and the United States presented at the conference.

Focus for the week includes operator support for computer security incident recognition and response, analysis and technology response support, computer security information exchange and cyber crime investigation.

The meeting also showcased the constructed hardware-in-the-loop test beds, plant simulation models and IAEA yearly progress reports.

— Originally published March 2018

## Safe and Secure

Canadian nuclear plants are prepared for cyber security

Like other countries worldwide, the Canadian nuclear industry has a number of initiatives on cyber security including:

- A COG peer group to share best practices, operating experience and to develop a common approach to meeting the requirements of CSA N290.7, which is a standard for security implementation at Canadian nuclear power plants;
- The Canadian Nuclear Laboratory (CNL) has set up an R&D facility in Fredericton devoted to cyber security; and,
- Canadian utilities, CNL and the Canadian Nuclear Safety Commission are viewed as world leaders in this area through their extensive contribution towards the development of IAEA Cyber Security guidance documents.



An international contingent of cyber security experts met in Toronto and visited Bruce Power, March 19-23, to share knowledge and collaborate on standards and processes to ensure cyber safety and security at nuclear plants worldwide.



*Kathy Charette stands in the CANDU Owners Group lobby where a fuel channel model represents the significant contribution to innovation in CANDU operation achieved through COG member collaboration.*

# New Frontiers

## ***OPG's Kathy Charette is leading COG's Fuel Channel Life Management program into the future***

In almost 30 years at Ontario Power Generation (OPG), Kathy Charette worked for one company but experienced several careers. To the good fortune of the CANDU Owners Group, the same 'itch' that drove Charette to try her hand at several things at the utility also inspired a secondment at COG, managing the fuel channel life management (FCLM) program.

At OPG, Charette, a mechanical engineering graduate from Waterloo, began her career as a systems engineer. She worked as a pressure boundary specialist and then moved into management roles within Nuclear Oversight, Procurement Engineering and Major Components Engineering. From there, Charette was appointed to the Fuel Channel Life Confirmation Project, where she was responsible for providing OPG project management and technical oversight of COG FCLM joint projects.

FCLM research has succeeded in improving confidence in the fitness-for-service of CANDU pressure tubes and developed industry standards used worldwide to confirm pressure tube integrity. The work includes accelerated aging of actual reactor components removed from service and then tested to evaluate material properties.

It has increased understanding of fuel channel material properties and provided experimental

evidence to support risk-informed decision-making. This is accomplished through the development of new probabilistic methodologies and predictive models that are used in the evaluation of fuel channel fitness for service.

Charette says the program is a "game changer" for the industry.

In fact, one significant outcome of the program is pre-refurbishment extended operation at both OPG's Darlington plant and at Bruce Power. It means more low-carbon electricity to Ontarians from the original capital investment into the plants. It also gives the operators the needed flexibility to better coordinate their refurbishment / life extension programs. FCLM results have also factored significantly into OPG's application to operate Pickering Nuclear until 2024. The regulator is expected to make a determination on the renewed licence later this year.

"The work that we are doing is really valuable to the industry," says Charette. "We never thought that we'd be running our (nuclear) units as long as we have. This project gives us the confidence to say Bruce Power can safely operate up to 300,000 equivalent full power hours. That would have been unheard of 10 years ago."

In speaking at the recent Pickering relicence hearing



to the Canadian Nuclear Safety Commission, Dermarkar noted, the FCLM program in conjunction with other COG fuel channel research, “represents the most significant evolution of CANDU technology in the past 30, or more, years.”

FCLM has been equally exciting on a personal level, says Charette.

“I always tell people I love my job,” she says. “Genuinely, I love my job. It’s both technical and strategic. I call it a spotlight position because it is the place people turn to when want to understand how long they can run their plants.”

During her one-year secondment at COG, Charette hopes she can improve the synergies between the FCLM and Fuel Channel R&D programs. She points out the industry has a strong, collaborative team that can take the ball further along to new innovations in this area.

“There are people who have spent their entire career in fuel channels so everybody knows everybody,” says Kathy. “Everyone works well as a team. On calls, there is great collaboration to help solve problems. I’ve seen collaboration and teamwork with the entire community working on this program.”

Collaborative project partners include both utilities and supplier participants. In addition to OPG and Bruce Power, the project team also includes companies like Canadian Nuclear Laboratories, Kinectrics and CANDU Energy. The vendor community brings valuable input and innovation to solve the problems faced by operators, says Charette.

COG’s vision is excellence through collaboration and in the case of fuel channels; excellence means nothing less than life extensions that will take today’s CANDU plants further than they have ever gone before.

## Creating value for international members



Above, Carmen Trandafir, SNN Senior Advisor Teodor Chirica, Fred Dermarkar, SNN General Director & CEO Cosmin Ghita, Mike Brett, and Sonia Qureshi (left to right) at the SNN head office.

### COG visits SNN, Romania on expedition of learning and collaboration

In April, CANDU Owners Group’s President and CEO Fred Dermarkar and several COG management team members visited Societatea Nationala Nuclearelectrica (SNN), Romania at the Cernavoda nuclear plant and at SNN’s head office in Bucharest to meet with utility executives including SNN CEO Cosmin Ghita.

Amongst the topics discussed were opportunities for international collaborative research and development and COG’s R&D streams, including the most significant work underway in safety and licensing, health safety and environment, chemistry, materials and compounds, industry standard toolset as well as fuel channels research and the joint projects on fuel channel life management. SNN is planning a mid-life refurbishment for its Cernavoda plant to begin in 2026 and is also interested to learn from the refurbishments of other CANDU stations. Asset management, balance of plant and obsolescence management are also areas of interest for the utility.



Above, the COG Team with SNN representatives visited with CITON executives at CITON (Centrul de Inginerie Technologica Obiective Nucleare – The Technical Engineering Centre for Nuclear Objectives).



Centre photo, a puzzle display in the SNN lobby in Bucharest celebrates their 20th anniversary.

# Societatea Nationala Nuclearelectrica celebrates 20-year anniversary



## ***Romanian CANDU operator sees a bright future building on strong past performance at Cernavoda CANDU plant***

**O**n July 2, Societatea Nationala Nuclearelectrica (SNN) celebrated two decades of company success, including safe, clean and reliable operation of its Cernavoda two-unit CANDU nuclear power plant and FCN Pitesti, a nuclear fuel facility.

The company was formed after a reorganization of the former state-owned company RENEL in 1998, just two years after commissioning of Cernavoda, Unit 1. In 2014, SNN became sole owner of Energonuclear, the project company responsible for development of the Cernavoda Units 3 and 4 project implementation.

Since the commissioning of Cernavoda's two units, SNN has produced and delivered 168 649 752 MWh of electricity. As a result, the company says, Romania has avoided the release of 150 million tons of CO<sub>2</sub> into the atmosphere, compared to generation types with significant CO<sub>2</sub> emissions.

In a press release on the anniversary, the company said, Cernavoda NPP has had excellent performance based on factors that include: investments in nuclear safety, extensive pro-active maintenance programs, and highly-qualified nuclear specialist including industry experts recognized internationally. Cernavoda's CANDU 6 units are both 700 MW installed power output.

Together they provide about 20% of Romania's energy needs. Unit 1 went into operation on Dec. 2, 1996 and Unit 2 on Sept. 28, 2007.

*SNN's achievements over the past 20 years has resulted in performance which, "at present (is) a worldwide benchmark for professionalism and high level of nuclear safety"*

The FCN Nuclear Fuel Plant was authorized in 1994 by Atomic Energy Canada Ltd. (AECL) and Zircatec Precision Industries Inc. (Canada) as a CANDU 6-type nuclear fuel producer.

### ***Looking to the future***

Building from the strong performance, a planned refurbishment of Cernavoda NPP Unit 1 -- scheduled to move forward in 2026 -- will allow the safe operation of the unit for another 30 years. The refurbishment will produce a significant savings compared to new generation and will strengthen the return on the original investment in the plant, making it even more economical for electricity users.

SNN's achievements over the past 20 years has resulted in performance which, "at present (is) a worldwide benchmark for professionalism and high level of nuclear safety," said SNN CEO Cosmin Ghita.

The performance of the past two decades has provided the foundation for further nuclear development. The company plans to move forward with two additional units, to further support a low-carbon electricity system for decades to come.



# Around the industry...

## Canada:

- Canadian regulator welcomes a new president
- Bruce Power announces an innovation centre
- OPG partners to produce medical isotopes and NB Power achieves decades-high performance

## International:

- NPCIL hosts seminar for COG members at WANO Tokyo Centre
- SNN Romania completes maintenance outage
- KHNP Korea announces early closure of Wolsong 1 plant



## Rumina Velshi appointed as new President and CEO of the CNSC

### Long-time member chosen to lead the Commission for a five-year term

Rumina Velshi will start as president and CEO of the Canadian Nuclear Safety Commission, Aug. 22, replacing Dr. Michael Binder, who has served as president for the past decade. Velshi has served as a permanent, part-time member of the Commission, since 2011.

Velshi brings significant experience and expertise, having served as OPG's Director of Planning and Control for the Darlington New Nuclear Project in her last role. She also holds a Bachelor's degree in Civil Engineering, a Master's degree in Chemical Engineering, and a Master's of Business Administration, all from the University of Toronto.

Velshi is an advocate of STEM (science, technology, engineering and mathematics) careers, especially for young women. She received the Women in Nuclear (WiN) Canada Leadership Award in 2011. She is also a founding member of Canada's Women in Science in Engineering, as well as Focus Humanitarian Assistance Canada.



## OPG and BWXT to partner to produce medical isotopes

### New technology will allow for CANDU reactors to produce molybdenum-99 while operating normally

Canadian Nuclear Partners (CNP), a subsidiary of Ontario Power Generation (OPG), has been selected by BWX Technologies (BWXT) to provide irradiation services for new medical isotope manufacturing technology. BWXT has recently devised an innovative new technique for synthesizing molybdenum-99 (Mo-99), an isotope used for diagnostic imaging in nuclear medicine. They plan to use the new technology to manufacture a steady supply of this radionuclide by inserting and removing medical isotope targets into OPG's CANDU reactors as they operate regularly. The irradiation services will be provided at Darlington Nuclear Generating Station and are expected to begin by the end of 2019.

# Around the industry



## Bruce Power to build Ontario Nuclear Innovation Institute

*An applied research and training centre has been announced to further advance the region's nuclear industry*

Bruce Power and the County of Bruce have announced they will be collaborating to establish the Ontario Nuclear Innovation Institute. This project will aim for increase nuclear innovation and excellence through applied research and training.

"Ontario's Nuclear Innovation Institute will bring together technological leaders to share collective expertise and knowledge, while identifying opportunities to advance nuclear applications and technologies, as well as people skills through training," said Mike Rencheck, Bruce Power's President and CEO.

Main areas of focus will include artificial intelligence and cyber security, medical and industrial isotopes, health and environmental excellence in the Lake Huron and Georgian Bay area, indigenous economic development, and nuclear sector operational excellence. They are hoping to break ground on the project in Southampton no later than 2020.



## WANO Tokyo Centre COG members meet at NPCIL for collaborative learning

CANDU Owners Group (COG)-member operators participated in a six-day seminar in April hosted by the Nuclear Power Corporation of India Limited (NPCIL) to exchange experience on various aspects of operation with a view to sharing best practices and lessons learned. The workshop was organized through the WANO Tokyo Centre with the assistance of COG. COG's Krish Krishnan, who facilitated the meetings with WANO-TC's Iwaki Katsuhiko, says it was a collaborative opportunity to explore OPEX and gain insights for continuous improvement. Those in attendance included representation from WANO-TC, TEPCO, KHNP, NPCIL, OPG and COG President and CEO Fred Dermarck. This is the second event in the past year where COG has collaborated with WANO and NPCIL in hosting a very successful OPEX seminar in India.



## SNN Romania completed bi-annual outage in June

*SN Nuclearelectrica SA ("SNN") completed a planned outage of Cernavoda NPP Unit 1, June 4.*

Unit 1 entered the planned outage program to perform scheduled maintenance works, performed once every two years for each unit. During the planned outage, over 10,500 activities were performed from the following programs:

- The preventive and corrective maintenance program;
- The inspections program;
- The mandatory testing program during planned outages, as per the requirements of the National Commission for the Control of Nuclear Activities, which can be performed with the power plant in shutdown mode; and
- The design modification implementation program for some systems, equipment and components.

## Korea Hydro and Nuclear Power announces shutdown of Wolsong Unit 1

Korea Hydro and Nuclear Power (KHNP) announced in June it will prematurely end operation at its Wolsong Unit 1 reactor. In a board announcement, June 15, the company said it has decided to shut down the reactor ahead of its expected end of operation date and will also cancel plans for new reactors.

The Korean Times newspaper reported that KHNP officials referenced changing government policy and regulations as contributors to the decision. Wolsong Unit 1 started operation in 1983. It returned to service following a mid-life refurbishment in 2015.





## Point Lepreau Nuclear Generating Station reports performance excellence

For the 2017/18 Fiscal Year, ending March 31, 2018, Point Lepreau Nuclear Generating Station (PLNGS) has recorded its best operational and performance results since 1994.

Beginning in Fiscal Year 2015/16, the Station extensively restructured its performance improvement program to concentrate a specific focus on safety, equipment reliability, training and building

a culture of prevention. This shift brought the Station's program more closely in line with the industry's proven formula for plant improvement, and involved PLNGS staff modelling and adopting industry best practices across a broad cross section of plant activities. The assistance and knowledge transfer of operational experience from the global nuclear industry related to these best practices has been a defining feature and backbone of this effort. Taken together these advances have put PLNGS on a defined roadmap of continuous and sustained improvement.

NB Power also completed a scheduled maintenance outage in May. To improve equipment reliability, approximately 10,000 technical maintenance activities were performed on equipment and systems over the month-long outage. Maintenance outages are regularly scheduled to coincide with lower seasonal electricity demands and increased water flow in New Brunswick's hydro system.

"We know that the best plants in the world are the safest plants in the world," said Gaëtan Thomas, NB Power President and CEO. "This year's impressive performance numbers at PLNGS are evidence of a talented team, and their commitment to safety, nuclear excellence, the community and this province. Our PLNGS Team knows how important they are to efficiently and effectively meeting the province's energy needs."

## Proven performance: NB Power's Point Lepreau — Success by the numbers

### Key Performance Indicators:

- 7.8 million person hours without a Loss Time Accident (LTA)
- 89.27% Net Capacity Factor exceeds target of 88.8%, and is best result since 2007
- 2.24% Forced Loss Rate (FLR) is well below the 5% target, and represents the best FLR for the Station since 2006. (FLR is the ratio of all power reductions compared to reference generation, which were not scheduled 28 days in advance.)
- At 91% on the nuclear industry's Equipment Reliability Index (ERI), the Station has achieved its best score since it started tracking this industry measure in 1995. (ERI is a 100 point cross-functional index that assesses the health and status of Station's operations and equipment reliability through 18 sub-indicators.)
- Annual net electrical production of 5.16TWh (Terawatt Hours) of low carbon electrical production is the best production performance of the Station since 1994. PLNGS production represents approximately 47 per cent of the total net generation from NB Power generating stations in FY 2017/18.

# COG welcomes new faces



**John de Grosbois**  
**Program Manager, Research and Development**

John de Grosbois joins COG to manage the Strategic R&D program. The SRD program ensures a long-term outlook on industry innovation with development of R&D projects in the five to 25-year range. John has had a distinguished and varied career within the nuclear industry, most recently spending five years with the IAEA in Vienna as section head of Nuclear Knowledge Management. He also worked for Atomic Energy Canada Ltd. in several senior roles, with projects including instrumental & control R&D technology development in relation to COG-funded projects. John has a Bachelor of Applied Science in Engineering, a Master of Business Administration and a PhD in Production and Operations Management. He is a member of the Professional Engineers of Ontario, Ontario Society of Professional Engineers and the American Society of Mechanical Engineers.



**Ron Hamann**  
**Project Manager, Information Exchange**

Ron Hamann leads a new COG initiative: Collaborative Continuous Improvement Visit (CCIV), which entails conducting visits at COG member plants to provide insights and development of roadmaps to industry excellence in specific areas. In addition, he is providing support, along with Rick Manners, in the operations-related working groups and workshops. Ron has had a 30-year career in Nuclear Operations at OPG Pickering Nuclear. He has in-depth knowledge of CANDU design and operation through extensive nuclear operations experience, senior licensed positions, operations management, operations support management, and operations training. As a shift manager, he was an integral member of the plant management team with production and maintenance oversight at Pickering Nuclear. Ron has a Bachelor of Science degree from the University of Toronto.



**Esther Sun-Lee**  
**Event Co-ordinator**

Esther Sun-Lee has stepped in as COG's new event co-ordinator. She has extensive experience in event planning and project management. In addition to a Bachelor's degree in Sociology and Architectural History and Criticism from the University of Toronto, Esther has also obtained a certificate in project management. She is fluent in both English and Mandarin.

*And we say goodbye to Suneeta Kupur  
Suneeta was well-known to many of our COG  
members as the person who ensured the  
smooth delivery of many COG events. We will  
miss her sunny smile at the registration desk  
and in planning committee meetings. We wish  
her well in her retirement!*







**Ryan Cao**  
**Operations Accountant**

In March, COG hired Ryan Cao to the role of Business Services Operations Accountant. He brings a wide range of experience from accounting and auditing roles within various companies. Ryan holds a Bachelor of Management in Accounting from Jilin University in China. He spent four years as an auditor for PricewaterhouseCoopers and Ruihua Certified Public Accountants, respectively. In these roles he participated in auditing projects for the financial and manufacturing industries.



**Kelsey Rodger**  
**Administrative Assistant**

Kelsey Rodger is working in Knowledge Management and will also work across a number of COG lines of business. Prior to joining the COG team, she worked in administration as well as event planning and execution. Kelsey has a Bachelor's degree in sociology from Brock University, and a graduate certificate in event management from Durham College.



**Steve Choi**  
**Administrative Assistant**

Steve Choi is helping to address a backlog of financial records that need processing, as well as other support duties within COG. He has worked in bookkeeping and graphic design. Steve comes to COG with a Bachelor's degree from the Ontario College of Arts and Design, and a diploma from Centennial College.

**Denise Bilsland**  
**Consultant, Human Resources**

Denise Bilsland joins COG as a part-time HR Leadership Consultant. She has deep-rooted and far-reaching HR experience, having worked in dozens of organizations and their leadership teams with strategic HR initiatives and programs for over 10 years. Prior to that, she held positions as a VP HR in the technology sector and as an HR Director in retail. Denise has expertise in compensation strategies, recruiting, employee engagement, performance management and leadership development, all of which are tools that allow her to build performance capacity within teams. Denise attended the University of Western Ontario and has her Certified Human Resources Executive (CHRP/CHRE) designation through the Human Resources Professionals Association of Ontario.

**Jonathan Tjong**  
**Information Services Support (Co-op Student), I.T.**

Jonathan Tjong is a mechatronics student from Waterloo University who regards himself as a "jack of all trades" engineer with a multi-disciplinary skill set, spanning across software, electrical, computer and mechanical industries.

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