

CANDU OWNERS GROUP

10 things we're celebrating about 2018

It was a year of innovation and progress for CANDU Owners Group and its members. As we jump into 2019 and say goodbye to 2018, we look back at 10 of the year's many achievements for COG and its members.

1. Regulatory approval for extended fuel channel life

COG's FCLM project continues to contribute significant value to the CANDU industry

In 2018, both OPG Pickering and Bruce Power received the green light to extend reactor operation by thousands of hours, providing Ontario with years of additional non-carbon electricity. The utilities gain billions of dollars on additional revenue and service from the capital investment while providing a continuity of service through Ontario's nuclear refurbishment period. This was possible through a multi-year COG joint project that demonstrated safety margin and the technical basis for continued operation. The project has resulted in extension of fuel channel life to 295K and 300K EFPH, respectively for the two plants following an earlier milestone of 235K at Darlington.



Top: COG's fuel channel life management program has meant billions of dollars of increased revenue as a key contributor to life extension at all three Ontario nuclear plants. OPG's Kathy Charette joined COG in early 2018 to manage the project she has been closely involved with as a member of OPG's engineering team.

Lower: John Sowagi, COG's director of Knowledge Management is pictured delivering one of the many training programs his team offers COG members here in Canada and internationally.

2. New ways to connect to CANDU colleagues and share information

There is not enough room to capture all the ways COG evolved its Information Exchange program in 2018 to better serve its members but below are a few:

- The second COG Collaboration Week, five days of plenaries and technical workshops, was attended by participants from nine countries including Austria, Canada, China, India, Japan, Korea, Pakistan, Romania, and the US and included COG members, COG supplier participant program members and other suppliers as well as industry organizations including: EPRI, IAEA, OCNi and WANO-TC (Tokyo Centre).
- In 2018, COG implemented the Continuous Collaborative Improvement Visit (CCIV) Pilot, a program that combines benchmarking visits with follow up lessons-learned activities at participating plants. The first focus area of the program is outage performance, specifically on scheduling.
- Return to Service Refurbishment Workshop: This workshop was cited by several utilities, including Argentina's NA-SA, as providing important insights to support a successful return-to-service post-refurbishment.



Above from top: 1- COG at the Foratom-IAEA QLM conference, 2- The COG Return to Service Workshop, 3- An international supplier participates in the New Supplier Introductions at COG's October GBM (GBM) and 4- An industry cyber security expert shares insights at the same GBM.

COG-member employees: See all the information exchange opportunities through COG's 140+ events and workshops: Visit www.COGonline.org.

3. Quantifying risk to gain regulatory acceptance

COG's work on whole-site PSA helping demonstrate safety at the successful Pickering Nuclear relicense hearing in 2018

A Canadian industry collaborative effort, facilitated by COG over several years, helped Ontario Power Generation successfully demonstrate safety of continued operation at the Pickering Nuclear site and achieve its 10-year operating licence renewal in 2018. The work to demonstrate the whole-site probabilistic safety assessment (PSA) for Pickering included a COG international workshop, and other Canadian and international initiatives. The scope of the project included assessment of risk for multiple reactor units, internal and external hazards, different reactor operating modes and other on-site sources of radioactivity. The project demonstrated the site could meet the Nuclear Safety Control Act expectations to prevent unreasonable risk to the environment and to the health and safety of persons. It also demonstrated it could adhere to the IAEA Fundamental Safety Principle: ***Protect people and the environment from harmful effects of radiation.***

4. Preparing a new generation of leaders

COG's Knowledge Management program grows to help members prepare for the future of nuclear

As the nuclear industry manages retirements and, in some countries, growth, COG's Knowledge Management program has expanded to help bring the necessary skills to leadership teams throughout nuclear plants, worldwide. The leadership training includes the well-established Nuclear Professional Development Seminar. As well, in 2018, new initiatives included:

- Launch in spring 2018 of the Maintenance Strategic Thinking Workshops, and
- Design and development of the Supplier Participant Front-line Supervisor Course in collaboration with the Canadian Nuclear Society. A pilot is scheduled for March 2019.



Above: COG's Supplier Participant program has grown to include more than two dozen suppliers from Canada and internationally. Many of the representatives gather several times a year to connect with utility representatives and to share OPEX, lessons learned and to further develop programs to strengthen the nuclear supply chain.

5. New Fueling Machine Ram Seal reduces outages and costs

A more reliable ram seal and less forced outages

A history of seal failures in fueling machine rams were causing forced outages and related financial costs for the operators. In some cases, the failures resulted in several day outages due to complications in recovery operations.

A joint project was created to resolve the challenge to develop, design and qualify a reliable seal to replace the current seal (OEM 'Type 3' FM Ram seal) and supply sufficient quantities of the new seal (Type 4).

Station OPEX shows that failure of Type 3 seals occur typically after 500 fueling cycles. During project development, the project was able to demonstrate the new Type 4 seal could hit its mission target of 3,000 fueling cycles without failure.

Following the completion of the qualification tests, COG members authorized COG to procure the Type 4 seals for deployment at Pickering and Point Lepreau.

Below: A new fueling machine ram seal is delivering a big payoff to reduce forced outages and the resulting financial costs, which also brings a greater quality of worklife for nuclear plant teams.



6. The road to innovation

Collaboration through COG helps chart the path ahead for CANDU reactors

The Strategic R&D (SRD) program focuses on developing technologies and other solutions for the current and refurbished fleet of CANDU reactors to keep units operating safely, reliably and competitively for an extended plant life of 60 to 90 years. In 2018, six roadmaps were developed to support SRD focus areas of:

- Technology to reduce maintenance efforts during outages;
- Material properties of reactor core components to provide longer reactor life;
- Technology and infrastructure to support decommissioning and long-term waste including minimization of dose and radioactive waste; and
- Assessment of potential impacts of climate change on current and planned facilities, operations and nuclear activities.

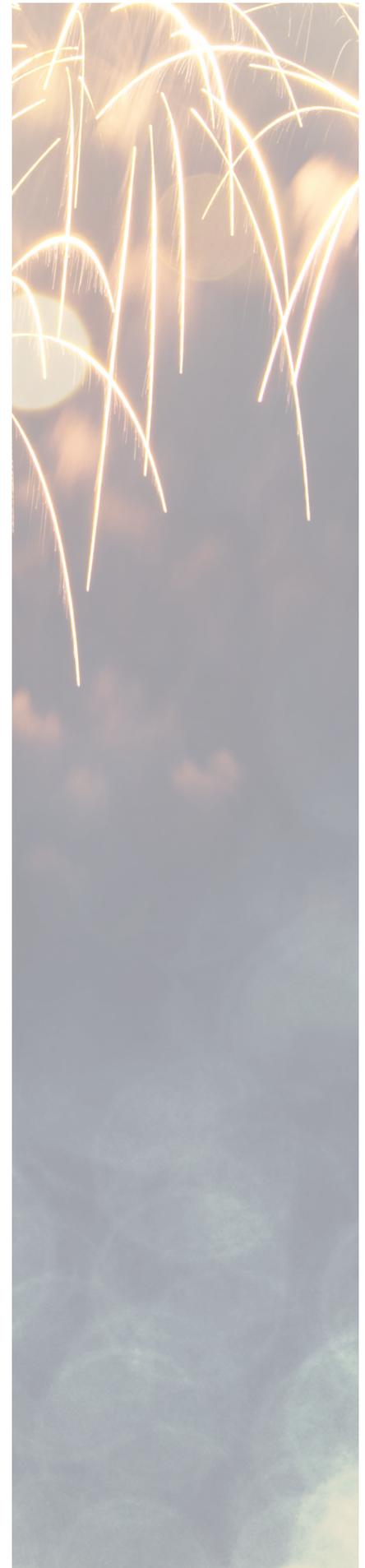
As part of the effort to chart the industry's work for the next several decades, the SRD program also completed an updated Fuel Channel Technical Strategic Plan in 2018.

7. Critical Heat Flux research demonstrates safety in aging CANDU pressure tubes

Demonstration of critical heat flux to 6.8% creep confirms safe continued operation of existing channels

A significant factor in continued operation of CANDU plants is demonstrated longevity and safety margin of key reactor components. COG research on behalf of its members on critical heat flux (CHF) in reactors has been instrumental in validating fitness for continued service.

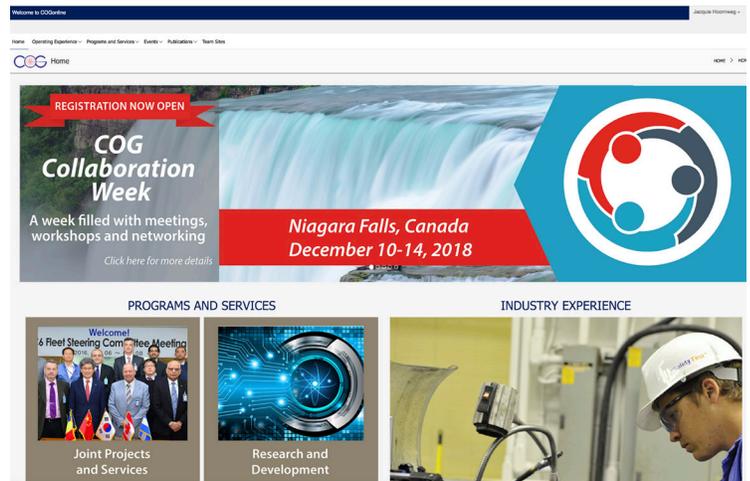
Over the past several years, experimental work has been performed at Stern Laboratories on COG's behalf, investigating critical heat flux (CHF) up to pressure tube diametral creep (PTDC) of 5.1%. With continuous reactor aging some pressure tubes for some CANDU reactors, are approaching the 5.1% PTDC limit. To address this, additional CHF experiments for the higher creep channels were undertaken. In 2018, a series of full-scale experiments were performed to measure CHF performance of the modified 37-element (37M) fuel simulation with a downstream skewed axial flux profile using a 6.8% crept flow channel. The experiment data sets were self-consistent, repeatable and follow established trends with sub-cooling, flow rate, pressure and PTDC. The project results demonstrated the safe extension of the current safety analysis basis for CANDU reactors to the 6.8% limit thus avoiding the need for retubing or defueling. Together with the work done through FCLM, this COG R&D project is a key enabler for extended operation of fuel channels.



8. Information Technology that supports secure and effective collaboration

Infrastructure Improvements for a safer and more effective IT system

COG's IT department spent 2018 strengthening IT-system infrastructure to meet COG members' needs for years to come. The Unified Communications architecture and the email system were upgraded to ensure COG can enable communication amongst all members, supplier participants, and other organizations, in a modern and efficient way. A new backup solution was also deployed for business continuity. The new architecture will provide scalability, long-term cost savings and faster recovery in the event of unplanned outages.



Above: In December 2017, COG introduced an upgraded platform for COGonline users. Throughout 2018, COG's IT department has been working to ensure it is both effective and secure for COG members and supplier participants. The website serves as a portal to more than 45,000 pieces of searchable OPEX as well as stories, calendars and team forums.

9. Simplifying and streamlining collaboration amongst COG members

New general and nuclear liability standard creates clarity for shared projects

In December, COG finalized a new COG Standard for General and Nuclear Liability Terms and Conditions. The standard establishes the general liability and nuclear liability provisions that will apply to agreements for COG Projects and will be referenced in all such agreements (subject to exceptions agreed to between COG, member participants and third-party participants in any individual case). The updated standard will help facilitate clarity for COG R&D-related agreements, program agreements and for COG joint projects.

Below: Since taking on the role of COG's Corporate Services director, John Moore (left) has been instrumental in leading a number of process and governance changes that have helped further improve the consistency and flow of services for COG members. *At right:* COG's John de Grosbois has been fostering development of greater collaboration between academia and industry.



10. COG connects members to international R&D

New initiatives widen the circle of shared knowledge internationally to support COG-member innovation efforts

Nuclear research germinating independently in national labs internationally could be brought into a collective pool to further stimulate innovation globally through a COG - Nuclear Energy Agency (NEA) initiative.

On Sept. 19, 2018 in Vienna, the NEA and COG co-hosted a high-level workshop on international collaboration in R&D of CANDU pressurized heavy-water reactors. The event brought together representatives from governments, national laboratories and utilities of most of the countries using the PHWR technology, including Argentina, Canada, India, Korea and Romania. Participants evaluated the benefits of the working relationship between national laboratories and nuclear utilities under the COG umbrella. They discussed potential opportunities for working together through the NEA, as well as technical areas of interest for cooperation and potential barriers to be explored through future meetings and collaboration.



The NEA-COG initiative was one of several international activities undertaken by COG staff on behalf of its members, worldwide.

In 2018, COG also visited national labs, including on a visit to Romania (*pictured above*). COG also represents its members through active participation on issues and activities through international organizations including the IAEA and keeps abreast of developments through member visits such as the one at Embalse (*right*), where the COG team joined international colleagues for a plant tour. *Below*, COG routinely brings industry from across the international CANDU fleet together at its office in Toronto, Canada for collaborative industry development.



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Is your company a COG member?

Log in to www.COGonline.org to stay up-to-date on the opportunities for research, joint projects, regulatory collaboration, information exchange and professional development: Read **COG's Quarterly Report to Members** from the COGonline.org homepage slider.