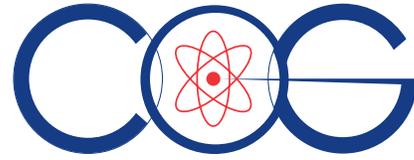


CANDU Owners Group Inc.



"Excellence Through Collaboration"



CANDU OWNERS GROUP YEARBOOK 2020-2021

Helping to build a clean-energy world



CANDU Excellence

Operations & Management

Refurbishment & MCR

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COGonline.org (member site)

CANDU.org (public site)

Produced by Querencia Partners Canada Ltd.

ABOUT COG

EXCELLENCE THROUGH COLLABORATION

Who we are

The CANDU Owners Group (COG) is a private, not-for-profit corporation funded voluntarily by CANDU operating utilities worldwide, Canadian Nuclear Laboratories (CNL) and supplier participants.

Together with its members, suppliers, partners and researchers, COG is continuously strengthening nuclear plant equipment and processes to ensure the highest standard of safety, efficiency and environmental performance.

COG's workshops, events, training programs, peer groups and online resources facilitate industry sharing of operating experience, create the conditions for regulatory acceptance and improved human performance.

Through its collaboration model, COG helps the industry succeed through creation, retention and transfer of knowledge to achieve continuous improvement and develop the nuclear innovations for tomorrow.

COG is a trusted nuclear industry leader comprised of highly-skilled, diverse employees with extensive experience in many facets of CANDU nuclear technology and project management.

We are committed to the principles of equity, diversity, inclusion and collaboration excellence.

COG'S VALUES

Respect

Treat all with dignity
Embrace diverse backgrounds, experiences, perspectives, and talents of all
Demonstrate fair and equitable treatment to all

Integrity

Be truthful and honest
Do the right thing regardless if anyone is watching
Accept responsibility for our actions

Commitment

Do what we say
Our word is our contract

ABOUT COG

Gaining value from the COG collaboration model

COG membership and participation brings a host of benefits including the significant opportunity for exponential research results at a fraction of the cost on common interests amongst COG members. It also creates a shared pool of information, data and human capacity development.

Financial Benefits

- Cost sharing: Customer funding, Strategic Research and Education Development credit, grants
- IP portfolio management and information access: Managing shared data for information exchange and retention more effectively and at a fraction of the cost
- More revenue streams: COG revenue generating strategic initiatives contribute to cost centres, thereby ensuring COG remains a viable collaboration mechanism to sustain CANDU capability

Other Benefits

- Pooled resources
- Shared Intelligence
- Highly Qualified Persons: COG peer groups, forums and training programs contribute to greater human capital
- Group Support: COG members and participants benefit from peer support and the ability to “call a friend”
- Maintains a higher standard of CANDU performance across the fleet through shared knowledge management and peer connection



**CANDU OPERATIONAL
EFFECTIVENESS**



**BEYOND
CANDU**



**HUMAN PERFORMANCE /
DIVERSE WORKFORCE**

ABOUT COG



COG is comprised of Canadian and international nuclear utilities, a strategic advantage for its members.

ABOUT COG

A collaboration model to move forward together

Through collaboration of all CANDU operators, worldwide, with supplier participants, small modular reactor vendors, and COG partners and other participants, COG is an ideal mechanism for pooling of funding, resources and knowledge. It also brings a diversity of perspectives that can lead to exponential results on initiatives and research of common interest to its members.

In addition to its CANDU operating members, COG has a well-established Supplier Participant (SP) program, which provides opportunities for information exchange, training and interaction between operators and SPs to strengthen common understanding of expectations, issues and opportunities.

As well, since 2018, COG has steadily grown its role as an industry facilitator of industry small modular reactor (SMR) collaboration. COG has identified its commitment to SMR development in Canada's SMR Action Plan.

To fully take advantage of COG's collaboration infrastructure, COG has formed several partnership agreements or strong working relationships with industry partners in Canada and around the world.

COG's head office is in Toronto, Canada.



Image: Bruce Power

ABOUT COG



Image: CNNO

Working with partners and stakeholders

COG holds the membership for the CANDU fleet with the Electric Power Research Institute (EPRI) helping members to contribute and derive knowledge from EPRI membership most effectively.

COG facilitates its Canadian members' interactions with the Canadian Nuclear Safety Commission (CNSC) on some regulatory files and the Canadian Standards Association Group (CSA) on standards development where multiple COG members have common objectives.

As well, COG interacts with government organizations and ministries including Natural Resources Canada, Health Canada and Environment and Climate Change Canada, federally, and the Ministry of Energy, provincially in Ontario, where its members have shared objectives on technical policy development.

ABOUT COG



Members

Canadian Members

Ontario Power Generation (OPG)
 Bruce Power
 New Brunswick Power (NB Power)
 Canadian Nuclear Laboratories (CNL)

Program Participants

Atomic Energy of Canada Limited (AECL)
 Hydro Québec
 Nuclear Waste Management Organization (NWMO)
 Sask Power (SMR development program)

International Members

Korea Hydro and Nuclear Power (KHNP)
 Nucleoeléctrica Argentina S.A. (NA-SA)
 China National Nuclear Operations (CNNO)
 Nuclear Power Corporation of India Ltd. (NPCIL)
 Pakistan Atomic Energy Commission (PAEC)
 Societatea Nationala Nuclearelectrica (SNN), Romania



Supplier Participants

Canadian Suppliers

Acuren Nuclear Services
 AECOM
 Aecon
 Alithya Digital Technology Corporation
 ATS Automation Tooling Systems Inc.
 BWXT Canada Ltd.
 Calian Group Ltd.
 Cameco Corporation
 CCNuclear
 Curtis-Wright Nuclear Canada
 Energy Solutions
 Framatome
 Hatch Ltd.

Isaac Operations
 Jensen Hughes
 Kinectrics
 L3 Harris Technologies
 Lakeside Process Controls Ltd.
 McDonald, Dettwiler and Associates Inc.
 Nuvia Canada
 PCL Industrial Constructors Inc.
 Promation Nuclear Ltd.
 SNC Lavalin (CANDU Energy Inc.)
 Stern Laboratories Inc.
 Tyne Engineering Inc.
 Westinghouse Electric Company LL
 Worley Parsons Canada

International Suppliers

CNPO (China Nuclear Power Operation Technology Corporation, Ltd.)
 KEPCO Engineering and Construction Company Inc.



SMR Vendor Participants

ARC Nuclear Canada
 GE Hitachi Nuclear Energy
 Holtec
 Moltex Energy
 NuScale Power

Terrestrial Energy
 U-Battery
 Ultra Safe Nuclear Corp.
 Westinghouse
 X-energy



COG Partners

Atomic Energy of Canada Ltd. (AECL)
 Canadian Nuclear Association (CNA)
 Canadian Standards Association Group (CSA)
 Institute of Nuclear Power Operations (INPO)
 International Atomic Energy Agency (IAEA)
 Nuclear Energy Institute (NEI)

Nuclear Generation II and III Association (NUGENIA)
 OECD Nuclear Energy Agency (NEA)
 Organization of Canadian Nuclear Industries (OCNI)
 University Network of Excellence in Nuclear Engineering (UNENE)
 World Association of Nuclear Operators (WANO)
 World Nuclear Association (WNA)

MESSAGE FROM THE BOARD CHAIR



Meeting the needs of a brave new world

Gary Newman, Board Chair

In 1984, CANDU reactors held seven of the Top 10 life-time performance records among world reactors. That same year, Pickering Nuclear was shut down due to a two-metre long split in a pressure tube.

The solution that allowed Pickering Nuclear and all the CANDU units to move forward to produce millions more hours of emission-free electricity, was identification and correction of misaligned annulus gas spacer springs. It was a significant lesson learned for the entire CANDU fleet. That work, which assured the future of CANDU operations and growth in Canada and globally, was done through the newly formed CANDU Owners Group.

Today, there are many new areas of nuclear exploration. This includes small modular reactor development, as well as technologies transforming our existing operations. There will be early successes and challenges for each. Some will be part of our future, and some may not. Those that do succeed, will no doubt encounter periodic setbacks requiring the best science and engineering minds to find solutions to not only fix but improve upon the designs and technologies. This is what we have done through COG for almost four decades.

At Bruce Power, the Major Component Replacement (MCR) project is foundational for continued operation to the mid-2060s, and all the benefits for clean energy and nuclear medicine, that come with it. Likewise, people in jurisdictions in Canada and internationally rely on other CANDU members to power their economies and meet their climate change goals.

Today, just as it was in 1984, COG is the heart of CANDU collaboration for building and sharing knowledge to ensure sustained, quality performance. And, when it is time to end operation, through COG, we can build the necessary knowledge for effective, environmentally responsible decommissioning and waste management.

Using COG infrastructure, the industry is working together to develop solutions of common interest on those “beyond CANDU” opportunities.

The Board and the Management Team are cognizant of the need to maintain a focus on CANDU operational excellence even as we develop new areas and identify new funding models in preparation for the end of operation of the Pickering Nuclear and Wolsong plants.

I am proud of the work from the COG team, and the leadership of Stephanie Smith, who began her first term as president, just over a year ago. As in those early years of COG, we have a lot to build on and still, a lot to learn, together.

THE COG BOARD OF DIRECTORS



Carla Carmichael
Ontario Power Generation



Jeffrey Griffin
Canadian Nuclear Laboratories



Jason Nouwens
New Brunswick Power



Dumitru Benchea
Societatea Nationala Nuclearelectrica, Romania

MESSAGE FROM THE PRESIDENT AND CEO



The evolution of *Excellence Through Collaboration*

Stephanie Smith, President and CEO

While I didn't expect the entire fiscal year, and my first year at COG, to take place during a global pandemic, I couldn't be prouder of the results the COG team delivered. Layered on top of global uncertainty, calls for social change, and a focus on the growing impacts of climate change, we've all had to learn how to work together, apart.

While it may not have been the year any of us hoped for, it has reinforced my belief in the power of collaboration to drive innovation in times of challenge and opportunity, and the resilience of the nuclear industry.

Despite the incredible challenges produced for our member operations and projects, we accomplished major project milestones and hit operating performance records this past year. We will emerge from COVID with more knowledge and new ways of thinking about our work and how to work together.

The COVID-19 crisis has highlighted the importance of a reliable, affordable and secure electricity supply that is able to accommodate sudden changes in behavior and economic activity while continuing to support vital health and information services. This need will be compounded by the ongoing desire for electrification of infrastructure, new uses of nuclear for power applications beyond electricity, medical treatments and diagnostics, and hydrogen. It's a lot for the industry to tackle at once.

And amidst all these changes is COG's greatest challenge: how to address the potential loss of funding as certain CANDU units come to the end of their operation. The needs of the operating fleet will not diminish, although they are changing, based on a number of factors, including each facility's lifecycle status, the introduction of new independent collaboration initiatives by some members, and the response to a long-overdue focus on diversity,

equity and inclusion on a global scale. In addition, new industry opportunities "beyond CANDU" such as small modular reactors can benefit from a collaborative approach, leveraging COG's expert staff, well-established infrastructure and processes while supporting the collaboration framework with additional revenue.

To that end, since 2018, COG's business planning efforts have focused on mitigating these potential changes in funding while ensuring our organization continues to evolve so that we can support members' current and future needs. Taking the baton from former CEO Fred Dermarkar, and working closely with COG's management team and Board of Directors, we have a new funding model in development to help ease the transition and maintain sustainability. The approach has been approved by the Board and we plan to run it in parallel in fiscal year 2022 so we are well-prepared in advance of any actual change in funding.

I see a bright future for COG and for the industry, and I couldn't be more proud of efforts on matters close to my heart as a leader. Earlier this year I had the privilege of hosting EmPowering Change. The event was developed as part of the Driving the Advancement of Women in Nuclear (DAWN) initiative, created by female senior leaders in Canada's nuclear industry to strengthen equity, diversity and inclusivity. The event brought together nuclear professionals from COG members Bruce Power, New Brunswick Power and Ontario Power Generation for a virtual conversation on how to make the main control room authorization program more accessible.

If we can be certain about anything, it's that the industry will continue to evolve. And that COG will be here to help. While our members' needs will change over time, the benefits of collaboration will endure.

THE COG TEAM

The CANDU Owners Group employs a diversity of people with specialized expertise in nuclear engineering and science, and project management.

COG’s workforce is gender-balanced at all levels of the organization and its multi-cultural team reflects the international flavour of its membership.

COG’s first-ever woman president and CEO, **Stephanie Smith** took the helm in September 2020. Smith, an industry trailblazer who served as a senior executive in OPG’s Pickering and Darlington stations replaced Fred Dermakar, who now serves as President and CEO for Atomic Energy Canada Ltd.

Carlos Lorencez replaced Rachna Clavero as Director, Nuclear Safety and Environmental Affairs in October 2020. COG appointed its first communication senior manager, **Sarah Charuk** in March 2021.

COG was also privileged to welcome other team members, each bringing a unique set of talents to COG, in 2020-2021. These include:

- Hari Nayar**, *Program Manager, CANIAC*
- Andre Dixon**, *Software Developer*
- Virgini Donaldson**, *Program Manager, Strategic R&D*

THE COG MANAGEMENT TEAM



Liette Lemieux
Research & Development



Carlos Lorencez
Nuclear Safety & Environmental Affairs



Sonia Qureshi
Joint Projects & Services



John Sowagi
Information Exchange



Carmen Trandafir
Information Management & Technology



Sarah Charuk
Communications

THE COG TEAM

Healing and inclusion with BiPoc Communities

COG is working with its member partners and employees to identify and address the challenges of systemic racism as a response to #BlackLivesMatter and working with Black, Indigenous and People of Colour (BIPOC).

Over the past year, COG has advanced its own work in understanding and building bridges to address the need for healing and inclusion with Canada's Indigenous communities, in keeping with the tenets of the Truth and Reconciliation report.



Image: Bruce Power

A commitment to Equity, Diversity and Inclusion

Over the past several years, COG has built a strength in the diversity of its workforce with people of diverse gender, ethnic background and competencies, across the organization.

EQUAL by 30
Equal Pay, Equal Leadership, Equal Opportunities

In June 2020, COG signed on to Equal By 30, committing to the organization's goal of gender parity by 2030. In fact, COG has already met the goal of gender balance at all levels of the organization.



THE COG TEAM

Empowering Change



Image: New Brunswick Power

Strengthening gender balance in nuclear

As part of COG's commitment to gender equity, led by COG President and CEO Stephanie Smith, COG hosted 22 women from Ontario Power Generation, Bruce Power, and NB Power for *EmPowering Change: A conversation to drive accessibility in certification*. This event was organized as part of the Driving Advancement of Women in Nuclear (DAWN) initiative created by senior women leaders in Canada's nuclear industry to strengthen equity, diversity and inclusivity within the nuclear industry.

The objective was to bring many voices together for a conversation about making the nuclear certification program more accessible to everyone, including people who may not have considered pursuing the program due to conflicting family commitments or other challenges created by the current certification structure. The findings and recommendations were presented to the CEOs of the participating utilities in June to support input into the Canadian Nuclear Safety Commission (CNSC) certification training program requirement review.

COG LINES OF BUSINESS

INFORMATION EXCHANGE	RESEARCH & DEVELOPMENT	JOINT PROJECTS & SERVICES	NUCLEAR SAFETY & ENVIRONMENTAL AFFAIRS
<p>Learning and Development</p> <p>Operating Experience</p> <p>Technical conferences, workshops and meetings</p> <p>Benchmarking & operational effectiveness</p>	<p>Strategic R&D</p> <p>Fuel Channels</p> <p>Safety and Licensing</p> <p>Chemistry, Materials & Components</p> <p>Industry Standard Toolset</p> <p>Health Safety & Environment</p>	<p>Joint projects (2 or more members) including FCLM</p> <p>Supply chain, obsolescence management and procurement</p> <p>Shared supply chain auditing and inspection services</p> <p>CANDU-6 Fleet</p>	<p>Nuclear Safety</p> <p>Environmental Affairs</p> <p>Common Standards and Regulatory Approach</p> <p>Emergency Preparedness and Response</p> <p>Decommissioning</p> <p>Nuclear Waste Management</p> <p>Small Modular Reactors</p>
			

COG's work is executed through four lines of business, each geared to meet specific objectives within COG's mandate.

COG LINES OF BUSINESS

Information Exchange (IE)

IE leverages experience and best practices across the industry and among CANDU utilities so that each member and supplier participants can make the most of the collective learning through the sharing of operating experience and best practices.

This is accomplished through workshops, peer groups and benchmarking activities. IE also includes Learning and Development (L&D). Through L&D, members have access to high-quality leadership and training programs, as well as education programs. L&D activities are carried out on a cost recoverable basis as joint projects for such things as course development or by user registration fees for specific course deliveries.

Training programs include: Nuclear Professional Development Seminars, Regulatory Affairs Training, Nuclear Safety Culture, Maintenance Strategic Thinking Workshops and Supplier Participant First Line Supervisor Training.

Research and Development (R&D)

R&D enables COG members to share the risks, the costs and the rewards of R&D projects that support innovation and continuous improvement in CANDU operations, decommissioning and waste management. As well, COG's R&D program supports small modular reactor development and other advanced nuclear technologies.

Core areas of research: Nuclear Safety and Licensing (S&L), Chemistry, Materials and Components (CMC), Fuel Channels (FC), Health, Safety and the Environment (HS&E) and Industry Standard Toolset (IST) of safety analysis codes.

The Strategic Research and Development (SRD) program

COG's Strategic R&D (SRD) program addresses the long-term objectives of extending reactor operating life beyond the next round of refurbishments (60-90 years).

Strategic R&D focus areas: Reduced Outages, Enhanced Computer Codes (IIST), Advanced Reactor Materials, Decommissioning and Long-Term Waste Management, Climate Adaptation, Reduction of Environmental Impacts, Knowledge and Public Acceptance of Low-Level Radiation and Human Performance and Organizational Aspects of Nuclear Generation.

COG R&D funders

The R&D Program is funded by OPG, Bruce Power, NB Power, Canadian Nuclear Laboratories and SNN Romania*. As well, CNNO, China and KHNP, South Korea and SNC-Lavalin are partial funders.

*SNN rejoined the Fuel Channels and Chemistry, Materials and Components R&D programs in FY 2020-2021.

COG LINES OF BUSINESS

Joint Projects and Services (JP&S)

JP&S develops solutions to problems and issues shared by two or more COG members. Joint projects leverage proven solutions from the industry to expand the pool of shared OPEX and allows members to scale the learning curve faster. Joint projects also minimize costs to individual members through the shared cost structure and work-in-kind initiatives.

In addition, JP&S provides cost-effective and robust services for QA audits for both utilities (i.e. CANPAC) and suppliers (i.e. CANIAC), inspection procedure review and certification (i.e. CIQB), Supply Chain Obsolescence and Procurement (SCOP) Program and Inter-Station Assistance (ISA) to COG members. JP&S also manages the CANDU 6 (C6) Fleet Forum promoting exchange of OPEX and development of common solutions to the unique technical challenges faced by C6 utilities.

Joint projects areas include: Fuel channel life management, decommissioning, equipment reliability, safety analysis, waste management, procurement, operational improvements, and maintenance.

Nuclear Safety and Environmental Affairs (NSEA)

COG's NSEA group facilitates alignment on industry and regulatory standards, including provincial and federal regulation, CSA and IAEA standards. NSEA facilitates leadership forums and aggregates collective wisdom across the industry to solve complex nuclear safety and licensing issues and to steer industry direction on emerging areas of interest including nuclear waste and decommissioning. It also plays a strong facilitation role in the Canadian efforts for small modular reactor (SMR) development.

Program areas include: Nuclear Safety, Regulatory Affairs, Nuclear Environmental Affairs, Radioactive Waste Management, Decommissioning, Small Modular Reactors, Human and Organizational Factors and Emergency Preparedness and Response.

COG's corporate functions support the foundations of excellence through collaboration. COG's Information Management and Technology (IMT) develops and maintains infrastructure to organize and protect COG's wealth of intellectual assets. They ensure cyber security, requirements are met and contribute to industry best practice development.

COG MEMBER TEAM STRUCTURE

COG has a fully developed collaboration model that ensures COG members and participants provide oversight, input and feedback on COG's programs and services at all levels of our member organizations. Our structure of forums, peer groups and committees ensures our knowledge management (creation, retention and transfer of knowledge) is relevant and effective. Through this collaborative model, we are able to continually input the most up-to-date information across the industry for innovation and continuous improvement.

See full details of our teams structure [here](#).

PERFORMANCE HIGHLIGHTS 2020-2021

A year in pandemic

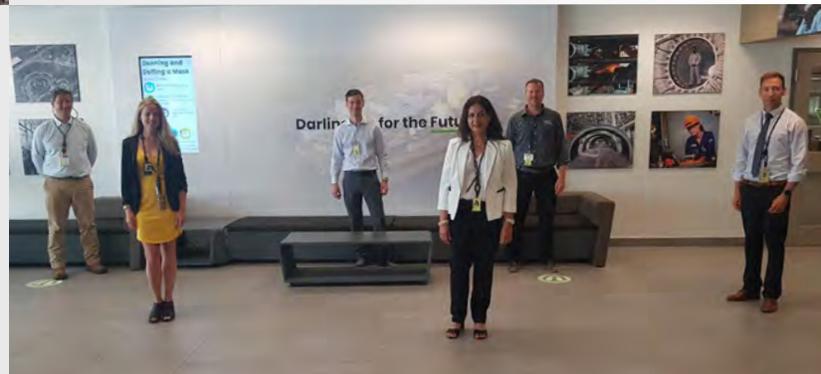
Bruce Power



New Brunswick Power



OPG Darlington Nuclear



OPG Pickering Nuclear



PERFORMANCE HIGHLIGHTS 2020-2021



Clockwise from top left: Nucleoeléctrica Embalse Nuclear Plant, Argentina, COG Covid O&M virtual peer group, and Ontario Power Generation food bank initiative.

Rising to the occasion

In March 2020, COG closed its offices and worked with its team to set everyone up to work from home, for what was thought to be a few weeks to months. Of course, the months stretched to more than a year as the pandemic continues.

But the COG team adjusted and thrived. A Wellness Committee was formed and bi-weekly virtual town halls and water cooler events helped staff stay informed and connected. COG employees demonstrated resilience in the face of challenge.

Through it all, the COG team helped its members and participants stay informed and connected. In those early weeks, COG responded to the need for real-time information sharing with an operational team of utilities that developed responses to COVID in-plant logistics. Working with communicators from across the membership, COG created a repository for analysis and communications resources.

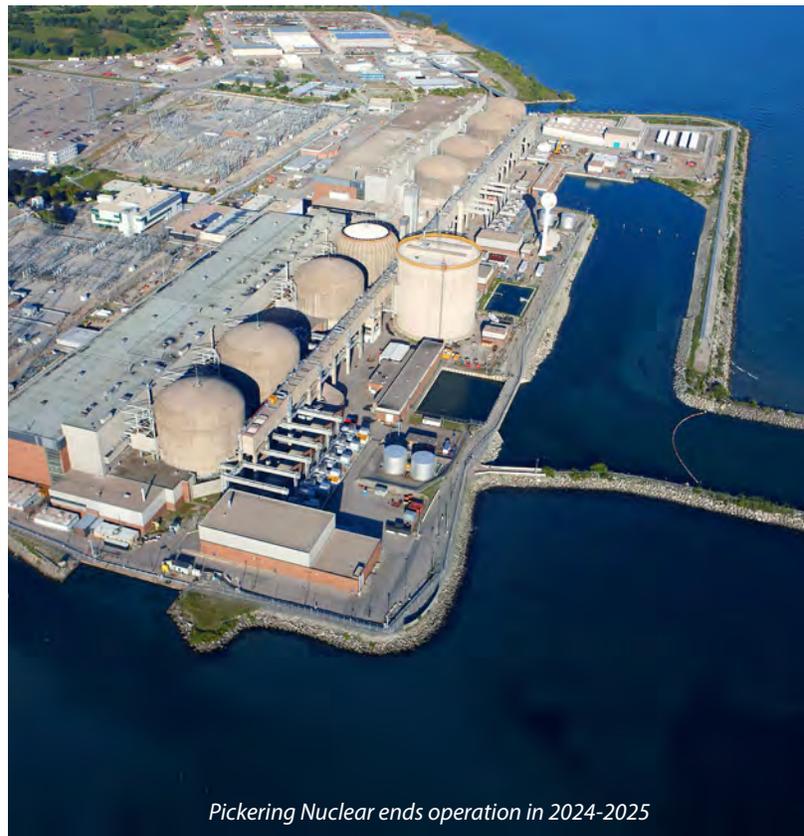
These efforts were supported by COG's Information Technology Management infrastructure, which allowed for a seamless move to a work-from-home environment and supported online meetings with COG's Canadian and international members and partners.

Together, we proved that there is no challenge that cannot be solved through a spirit of collaboration.

PERFORMANCE HIGHLIGHTS 2020-2021



There is a key role for nuclear in the fight against climate change



Pickering Nuclear ends operation in 2024-2025

Meeting today's challenges

The pandemic is not the only issue facing the industry or the world. A global commitment to urgently address climate change with low-carbon energy sources has created renewed interest in the potential of nuclear technologies. The imperative to reach a net zero carbon emission target is changing how we think about our energy future.

Closer to home for the Canadian nuclear industry and the CANDU community, the end of operation of the six-unit CANDU complex at Pickering Nuclear after more than 50 years of operation has implications for pooled resources across COG's membership. This is exacerbated by limited prospects for immediate CANDU new build. And, for the first time, there is an identifiable divergence in members' interests as some operators focus on decommissioning while others progress through refurbishments and yet others focus on asset management pre-refurbishment.

However, there remain some clear areas of common interest. Over the past few years, and moving forward into 2022, the COG management team has been focused on crystallizing and building on these areas. Our projects and services, delivered in the 2020-2021 fiscal year reflect that focus, as does our 2022-2025 business plan.

PERFORMANCE HIGHLIGHTS 2020-2021

Delivered 2020-2021

Joint Projects Technical Program Initiatives

The Technical Joint Projects program saw progress in a number of areas that will deliver results in increased reliability, improved best practices, time and cost savings.

In 2020-2021 the Technical JP program progressed key initiatives in the C6 fleet. Starting with JP-4295 Reactor Building Integrated Leak Rate Test Frequency Reduction; with the C6 fleet now on common ground, this JP is progressing and well-positioned to complete the regulatory safety case by the end of the year to have a 10-year or more test frequency. This will result in significant outage savings time and cost.

A C6 HTS Aging workshop has laid out a roadmap on what can be done to avoid CANDU de-rates as plant age. All of the tools, analysis and other suggested modifications have now been communicated. JP-4486 NOP/ROP enhancements is a key aspect to this and is progressing well and on schedule.

A common C6 Preventive Maintenance (PM) program has established common definitions for critical categorizations of components amongst the participating C6 fleet. The impact of this is that future Equipment Reliability (ER) initiatives and sharing or developing of ER programs, ER related data and OPEX will now be much easier with this common basis and understanding of the significance/importance of individual plant components. This is also key to establishing a solid and common life cycle management and asset management program.



Continued Focus on Fuel Channels and Pressure Tubes

In the past year, the Fuel Channel Life Management / Spacer Life Management projects achieved several critical milestones and refined the strategic objectives of the project for the next several years. One such achievement was the completion and successful closeout of the project's third phase (JP4491). Phase 3 was closed under budget by \$1.2M while completing its objectives. Phase 4 of the project was realigned to mitigate any identified EFPH target gaps specific to OPG and Bruce Power.

A Pressure Tube (PT) surveillance project for KHNP Wolsong Unit 2 is coming to a successful conclusion. Two PTs were surveyed with results that are consistent with tubes from other units of the similar operating life. The project should be wrapping up by mid-2021 as the final Comprehensive Report has been issued by Kinectrics for R&C.

In 2020, an update to the fuel channel (FC) inspection specification began to provide sufficient information to develop FC inspection equipment and procedures that meet the needs of FC engineering. In addition, it will support all fitness-for-service evaluations and compliance with CSA N285.4 Standard Clauses 12 and 4. The updates are intended to become a common inspection specification that addresses common fuel channel inspection needs across industry.

PERFORMANCE HIGHLIGHTS 2020-2021

Supply Chain, Obsolescence and Procurement

The Supply Chain, Obsolescence and Procurement (SCOP) program initiated a number of new joint projects, increased C6 utilities participation and pursued bulk procurement, with positive results despite the challenges of the COVID-19 pandemic. About 87 per cent of projects had full C6 Fleet member participation. Approximately \$3.8M work was approved in new joint projects under the SCOP program, resulting in the total program portfolio of \$11.7M in FY 2020-21.

Bulk procurement worth \$5.5M was carried out under SCOP projects in the last two years offering ~10-25% price discounts to participating members. Rotary and rectilinear potentiometers, 48V fuses, ion chamber amplifier spares, bladder accumulators, and pooled training are some examples of recent bulk procurements.

Focus on Decommissioning: As COG members gain interest in decommissioning projects, COG has increased research in this area. The first-of-a-kind equipment to encapsulate defective or damaged fuel bundles was manufactured and delivered to Hydro-Québec. The tooling is used to provide an additional barrier to fuel bundles before fuel bundles are placed in long-term repository. This ~\$2M schedule critical project was a success despite the challenges of global pandemic in 2020. HQ successfully removed 36 defective fuel bundles by early December 2020.



Research to Solve Challenges Today and Create Opportunities for Tomorrow

The 2020-21 COG R&D program achieved its objectives despite very challenging conditions related to the pandemic on laboratories. The majority of the work packages were completed as planned. There was some underspend in some of the R&D program areas, as a result of the operational impacts due to the pandemic. However, across all of the program areas, the Cost Performance Index was 1.00 and the Schedule Performance Index was .90. By comparison, performance at the end of 2019-2020 was CPI of 0.98 and SPI of 0.93. It appears that program performance has stabilized, following corrective actions that were put in place over the past two fiscal years.

The R&D team published more than 110 full COG reports, along with many other products, technical notes and IST documents. A value assessment tool has been developed that is based on the EPRI Plant Modernization work, and the use of the tool is being piloted in the HS&E program area in 2021-2022 to help COG members better understand the value of research through COG.

Strengthening Regulatory Effectiveness

COG's Regulatory Affairs issued a number of reports to governing bodies, facilitated meetings and reviewed regulatory documents and procedures to support continued industry regulatory alignment and effectiveness on both CANDU and small modular reactor files. The Nuclear Safety Peer Group reviewed CNSC's NOP-Evaluator code based on a Bayesian statistical approach. The key takeaway from the review is that the Bayesian approach is coded correctly and effectively into the NOP-Evaluator code, and, as expected, the outputs of the code are sensitive to the nature of the prior distribution that is used as an input. As a follow-up activity to the joint project, the industry is undertaking a COG R&D project to develop a more informed prior distribution.



PERFORMANCE HIGHLIGHTS 2020-2021

Partnerships

During the 2020-2021 business period, COG created or enhanced several new partnerships including with the OECD-Nuclear Energy Agency (new), the International Atomic Energy Agency (enhanced), the University Network of Excellence in Nuclear Engineering (UNENE) (enhanced) and the Electrical Power Research Institute (extended to 2025). In each case, these partnerships, like the several other partnership agreements held between COG and other industry organizations in Canada and internationally, they are used to enhance and streamline the services and products available to our members through COG and from other organizations members rely on to extend their network and pool costs and information.



Improved peer group effectiveness

The Chief Nuclear Officer (CNO) and Chief Engineering Officer (CNE) forums provide the highest level of oversight and direction with a series of other leadership forums, peer groups and technical committees that direct COG work programs. In the past fiscal year, the CNOF and CNEF strengthened oversight of peer groups through several initiatives.

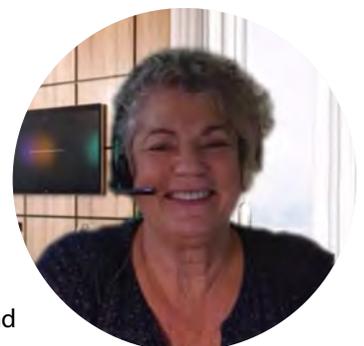
These included effectiveness evaluations and metrics reports to CNO and CNE Forums, increased involvement of CNO/CNE peer group sponsors and use of an evaluation reporting tool. Sponsors also report performance of peer groups to CNO and CNE Forums.

Continuing to inform, even through a pandemic

COG's Information Exchange program continued to support members with on-going peer group meetings, plant calls and other forums, workshops and training activities despite the COVID-19 pandemic. With its international membership, COG is working to identify opportunities to integrate new online capabilities alongside its in-person meetings, post-pandemic to provide a hybrid model that will offer the best of both worlds to save time and money while still ensuring the best meeting experiences.

Since March 2020 when the COG office shutdown for the pandemic, the Learning and Development team has invested in new staff knowledge and infrastructure to strengthen program delivery in both online and physical classroom settings.

COG is ready to support the best in hybrid programming in the new business plan period.



MOVING FORWARD: BUSINESS PLAN 2022-2025

COG Business Plan 2022-2025

Building on the work of the last year and recognizing the changes in its business environment, the COG team has developed a business plan for 2022-2025 that will contribute to its members’ goals and priorities today while remaining sustainable as the industry evolves.

The plan includes:

- Three key objectives that reflect the focus areas our members have said will meet their interests;
- Strategic initiatives to ensure the organization remains sustainable to serve its members today and in the future; and
- Program focus areas aligned to members’ needs for continuous improvement and innovation in CANDU operations and beyond.

COG Business Objectives, Strategic Initiatives and Program Areas

CANDU Performance Excellence and Capability

Strategic Initiatives

- Decommissioning
- Enhanced International Engagement
- Leveraging COG information to provide high value products and services
- Nuclear Waste

Program Areas

- Operational Effectiveness
- Engineering Excellence
- Inspection and Maintenance
- Cyber Security
- Emergency Preparedness and Response
- Learning and Development
- Supplier Participant (Development) Program
- Refurbishment
- Inter-organizational Collaboration
- Decommissioning and Waste Management

New Areas of Collaboration

Beyond CANDU: Collaboration in SMRs, new technologies and new areas of the value chain

Strategic Initiatives

- Expanding Learning and Development
- SMR Deployment
- Innovative Technologies and New Value Chain Collaboration

Program Areas

- New technologies and value chain
- Small and Medium Size Reactor Technology Forum

COG Operational Effectiveness

To provide the best products and services

Strategic Initiatives

- Creating a Collaboration Culture
- Data Management and Search Technologies

Program Areas

- Internal Process and Program Efficiency
- COG IT Infrastructure Effectiveness
- Workforce Planning
- Communications to support business and reputation goals

MOVING FORWARD: BUSINESS PLAN 2022-2025

About COG's Strategic Initiatives (SI)

Objective 1: CANDU performance excellence

Decommissioning

The decommissioning Strategic Initiative (SI) supports a unified approach to decommissioning CANDU reactors and supports work of common interest amongst some COG members through joint project funding. It is highlighted as an SI because it is an area of growth that until recent years was not a key focus area for COG members. Today, CNL, OPG, Hydro Québec, KHNP and other international members have a common interest in decommissioning best practices, technology and tool development, regulatory management, and supply chain.

Enhanced International Engagement

COG has always worked internationally with its CANDU fleet members. Enhanced engagement builds on this inherent strength to gain maximum value of COG's recognized international presence and network to further cost-effective ways to strengthen knowledge management and increase research and project cost pooling.

This COG SI focuses on the opportunity to develop best practice training that supports inter-generational knowledge transfer in traditional areas and provides qualified personnel for new areas of industry pursuits. COG will seek deeper collaboration and cost sharing in research and regulatory harmonization, internationally, working with other industry organizations like EPRI, WANO, NEA and IAEA and Canadian organizations (UNENE, OCNi and CNA) on international opportunities.

Leveraging COG information to provide high value products and services

Leveraging COG information to provide high value products and services will allow COG to maintain its CANDU fleet capability and also offers opportunity to leverage COG's model as a cost-effective way to further COG member's interests. This SI will contribute revenue and economies of scale that will be an important contributor to sustain COG so it can continue to act as a mechanism for CANDU fleet operators for future years.

This SI includes development of excellence in virtual communications, remote learning methodologies and peer team effectiveness measures.

Nuclear Waste

The nuclear waste management initiative provides members a forum to develop a unified approach to waste management and to collaborate on areas of common interest on strategies for ILLW, management of streams and minimization of long-term disposal costs and risks.

Through the Radioactive Waste Leadership Forum, Waste Management Peer Group, NWMO position papers, workshops and OPEX and trending reports, this SI will provide significant opportunities for savings through cost sharing and pooled resourcing on shared areas of technology and process development. The collaboration model offers an opportunity to strengthen social aspects like Indigenous and community engagement and use expert resources, collectively versus competing for resources.

MOVING FORWARD: BUSINESS PLAN 2022-2025**Objective 2: New areas of collaboration**

Beyond CANDU: Collaboration in SMRs, new technologies and new areas of the value chain

Expanding Learning and Development

Expansion of our current offerings will allow COG to provide enhanced partnerships for collaborative valued training services to our members, including through the enhanced international engagement model SI.

The expansion of our current L&D offerings builds on COG's strong relationship and trust with the utilities to provide training and services that ensure utilities and suppliers will have trained and qualified staff to meet current and future operational challenges. The current JP process results in continued savings through cost sharing and pooled resourcing.

Additionally, this SI will promote further learning and development and alignment of standards and performance across the CANDU fleet using shared lessons learned.

Competency and area specific workshops like the maintenance strategic thinking workshops will be expanded to operations and engineering. Other existing program areas will be expanded and COG will strengthen its capabilities in hybrid and online training.

SMR Deployment

COG has been the collaboration mechanism for COG members and SMR vendors interested in areas of common interest on SMR development and deployment. The cost is limited to human resource of COG's role as a facilitator and remains a low burden on COG and is financed through the participants but the value of leveraging COG's collaboration model for SMR development can be very high.

Through this SI, in the business period, COG will continue to serve as a secretariat for collaborative work through forums and groups, will facilitate position papers and a preliminary safety analysis report. It will also work with other organizations, like the University Network of Excellence in Nuclear Engineering, to facilitate development of education and training infrastructure in Canada.

Innovative Technologies and New Value Chain Collaboration

Building on existing Strategic R&D, COG will facilitate collaboration in areas of common interest on technologies that support CANDU and other nuclear advancement (i.e. SMRs). COG will investigate value of collaboration in areas further up the value chain like hydrogen and nuclear medicine where members identify value to collaborate.

Development of new technologies feeds plant modernization and continual performance improvement in current operations and improves outcomes for decommissioning & nuclear waste management critical to nuclear social license. By increasing integration and connection of generation with other aspects of energy systems, including beyond electricity offer opportunities: COG members can leverage existing investment in COG infrastructure for collaboration further up value chain like hydrogen and medical isotopes. This initiative can also expand the collaboration base, further supporting COG infrastructure for its core program areas.

A needs assessment will be conducted to validate the opportunities and challenges of expansion into these areas.

MOVING FORWARD: BUSINESS PLAN 2022-2025

Objective 3: COG operational effectiveness to provide the best services and products

Creating a Collaboration Culture

Building on the strength of the COG model, this SI will further develop a rich collaboration culture and competencies in COG employees and member participants to improve deliverable timeliness and further strengthen performance outcomes. This initiative supports COG's objective to strengthen COG's organizational effectiveness.

The outcomes of this SI will include more effective/efficient stakeholder management, improved deliverable timeliness and new opportunities to increase COG efficiency and enhance its value proposition.

Data Management and Search Technologies

COG will continue work begun in the last several years to modernize COG's data management and search technologies to support information exchange, knowledge management and collaboration through digital technologies.

Through this SI, COG will improve the management of data and the search function, enhance capabilities to track trends to help COG get ahead of industry needs, capitalize on new technologies such as AI/machine learning, strengthen data search capabilities through metadata tagging and will improve the ways it stores and publishes data.

MOVING FORWARD: BUSINESS PLAN 2022-2025

COG Program Areas

The COG program areas identified on page 24 support COG's three business objectives and the strategic initiatives outlined.

Below are initiatives that support each program area. Specifics of these initiatives are detailed in the COG business plan, available on COG's member website at www.COGonline.org.

Objective 1: CANDU Performance Excellence

Operational Effectiveness

- Fuel Channel Life Management (FCLM) and Fuel Channels (FC) Surveillance Program Working Groups and Surveillance
- Research and Development Operational Effectiveness Research Programs
- Operationally focused Peer Groups, Workshops and Information Sharing
- CANPAC: Audits, Staffing and Membership
- CANIAC: Audits, Staffing and Membership
- Supply Chain, Obsolescence and Procurement Program: Programs, contracts and shared solutions
- Technical Operational Excellence Projects
- Technical – Chemistry: Procedures
- Technical – Equipment Reliability: Programs and Sharing Solutions
- Nuclear Safety and Environmental Affairs, Peer Groups and Forums

Engineering Excellence

- Information Exchange Peer Groups and Workshops
- Engineering Research

Inspection and Maintenance

- Peer Groups and Workshops
- CANDU Inspection Qualification Bureau (CIQB): Governance, Compliance and Certification
- Technical - Inspection and Maintenance Management: Procedures
- Inspection and Maintenance Research Programs

Cyber Security

- Information Exchange: Cyber Security Peer Group
- Cyber Security Project

Emergency Preparedness and Response

- Peer Groups, Task Teams and Information Exchange
- Research Programs in emergency preparedness and response

Learning and Development

- Peer Groups and Information Exchange Programs
- Training workshops

Supplier Participant (Development) Program

- Supplier Participant Program meetings, workshops and training

Refurbishment

- Refurbishment Forums

Inter-Organizational Collaboration

- Information Exchange: Programs and Meetings

Decommissioning and Waste Management

- Decommissioning and Waste Management Research Programs
- Nuclear Safety and Environmental Affairs Forums, Peer Groups, Task Teams, Workshops and Information Exchange



MOVING FORWARD: BUSINESS PLAN 2022-2025

Objective 2: New Areas of Collaboration

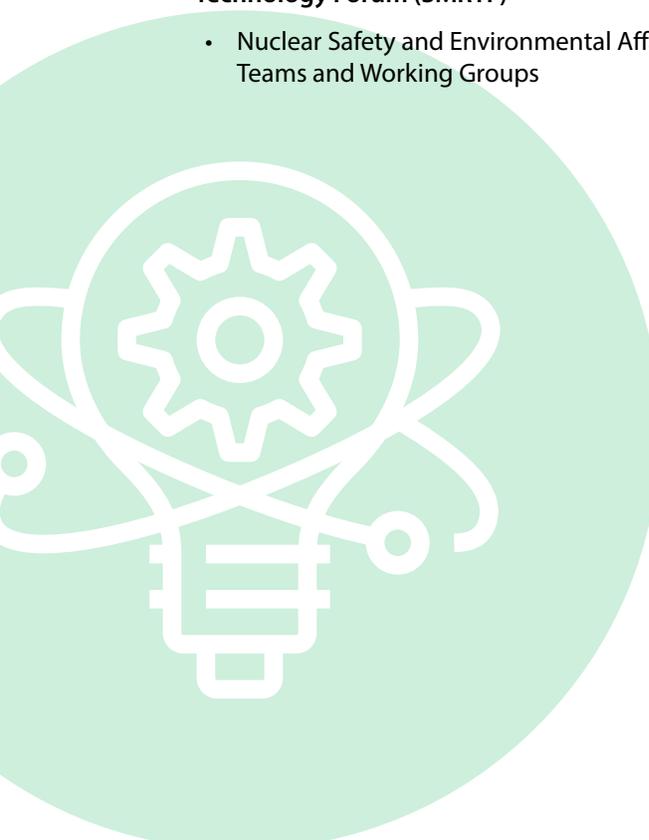
Beyond CANDU: Collaboration in SMRs, new technologies and new areas of the value chain

New Technologies and Value Chain

- Research and development in SMR and New Technology Programs

Small and Medium Size Modular Reactor Technology Forum (SMRTF)

- Nuclear Safety and Environmental Affairs, Task Teams and Working Groups



Objective 3: COG Operational Effectiveness

R&D Internal Process and Program Efficiency

- Reorganization of R&D Team
- R&D process efficiency improvement

COG IT Infrastructure Effectiveness

- Information Technology: Information and Records Management
- Information Technology modernization and capabilities development
- Information Technology cyber security management

Workforce Management

- Corporate Services: Human Resource Planning

Communications to Meet Business and Reputation Goals

- Communications to support business plan goals and reputation management

**Beyond
CANDU**



**Small
Modular
Reactors**



**Advanced
Nuclear
Technologies**





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"Excellence Through Collaboration"