

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.

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

COG's vision is excellence through collaboration.

To achieve its vision, COG and its Members work together with suppliers and other stakeholders to solve the industry's most challenging technical problems, share operating experience and work toward regulatory acceptance. We do this through collaboration to enhance *safety* and *reliability*, strengthen *human performance*, reduce *environmental* impacts and *reduce costs*.

Our members

COG is comprised of Canadian and international nuclear utilities.

Canadian Members:

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

International Members:

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

Hydro Québec, re-joined COG as a participant in the Information Exchange program in 2016.
Nuclear Waste Management Organization (NWMO) joined COG as a NSEA participant in June 2017.

Our supplier participants

COG has a **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.

Acuren	Lakeside Controls
AECOM	MDA Systems
ATS Automation	Nuvia Canada
BWXT Canada	Promation
Cameco	RCM Technologies
Canadian Power Utility Services	Rolls Royce Civil Nuclear
CNPO	SNC-Lavalin
Hatch	Stern Laboratories Inc.
KEPCO E&C	Weir Group
Kinetrics	Westinghouse
	Worley Parsons

Our partners

COG also has several partnership agreements with industry partners as well as strong working relationships with others.

Partners include:

Atomic Energy Canada Limited (AECL)
Canadian Nuclear Association (CNA)
Canadian Standards Association (CSA)
Institute of Nuclear Power Operations (INPO)
International Atomic Energy Agency (IAEA)
Electric Power Research Institute (EPRI)
Organization of Canadian Nuclear Industries (OCNI)
Nuclear Generation II and III Association (NUGENIA)
University Network of Excellence in Nuclear Engineering (UNENE)
World Association of Nuclear Operators (WANO)

What we do

Joint Projects and Services (JP&S) develops solutions to problems and issues common to two or more COG members through shared resources; innovates new approaches for longer, more robust plant life; and provides quality assurance for CANDU systems and components.

Research and Development (R&D) is a mechanism for Members to share the risks, costs and the rewards of R&D projects in six program areas.

Information Exchange (IE) leverages experience across the industry and among CANDU utilities to share experience and best practices.

Nuclear Safety and Environmental Affairs (NSEA) facilitates industry alignment on industry and regulatory standards.



Meet the needs of an evolving industry



Enhance Member value



Engage international Members

YOUR CONTACT AT COG

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For OPEX, Peer Groups,
Events, Reports, R&D, Joint
Projects + more

COGonline.org

JOINT PROJECTS

Joint Projects and Services

develops solutions to problems and issues shared by two or more COG members through shared resources; innovates new approaches for longer, more robust plant life; and provides auditing services towards ensuring quality and reliability of CANDU systems and components.

The JP&S program:

- Identifies common issues and develops and implements solutions through shared resources
- Procures services and equipment on behalf of Members
- Develops IP and maintains custody on behalf of Members
- Provides project management services
- Provides contract administration services
- Consolidates all applicable technical and commercial requirements

What we solve

Common issues include those related to design, operation, maintenance and refurbishment as well as materials-related issues such as acquisition of obsolete parts, sharing of spare parts and obsolescence management.

JP&S Program Areas

Fuel Channel Life Management

The FCLM program has allowed utilities to develop a solid technical basis to regain operating safety margin in aging reactors and to extend the number of years of continued operation.

- The program has resulted in 4-5 years of life extension to Bruce Power's Units 3,4 and 5-8 and Pickering's B-side units
- Buy-in discussions are in progress with C6 utilities
- Annual funding ~\$20M at the current levels
- **Benefit-Cost Analysis: Billions in continued operations**

Joint Projects

Typically 30-50 projects on the go
Annual funding \$5M-\$10M, and growing

CANDU Procurement Audit Committee (CANPAC):

Joint quality assurance audits/assessments of direct (Tier 1) suppliers to COG's utility members (all CANDU utilities except NASA, NPCIL and PAEC)

CANDU Industry Assessment Committee (CANIAC)

Joint quality assurance audits/assessments of sub-suppliers (Tier 2 and 3 suppliers) to nuclear power plants for enhanced quality and consistency of supplier audits, and reduced supply chain related costs through joint audits

CANDU Inspection Qualification Bureau (CIQB)

A service to review and certify inspection procedures
Reviews performed by qualified Subject Matter Experts

Inter-Station Assistance Program

Enables better exchange of knowledge, experience and issue identification through COG joint projects

- Provides a fleet approach

Project			PO#	YTD 2017 budget (with HST)	YTD 2017 Spent (Bruce Power's share only)	Life-to-date contract budget (with HST)	Life-to-date Spent (Bruce Power's share only)	2017 cost update
BP #	COG JP #	Title	CN#					

Customized member reports provide up-to-date details on project cost and schedule

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Director JP&S

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AND SERVICES

Joint Project Logistics

Getting involved

Joint Projects can:

- be initiated at any time of the year
- have any combination of two or more COG Members as participants
- be set up to accommodate budget constraints of participating members where possible
- address a wide range of common issues

A successful project step-by-step

INITIATION

Go to COGonline.org and complete a project initiation form
COG creates an Expression of Interest for all Members and notifies suppliers

ACTIVE STAGE

COG manages the program working with a decision-making steering committee:
The COG project manager acts as an advisor to the Committee
Any changes to cost, scope or schedule are put through a transparent review process and approved by the Committee
Customized reports are provided for budget planning and schedule reporting internally within Member organizations

SUCCESSFUL COMPLETION

All deliverables are accepted by the steering committee
COG maintains IP rights on behalf of participants
Buy-ins to completed projects require approval by all of the original participants
Buy-in funds typically flow back to the original funding Members per the funding share formula
Any unspent funds are returned to the participating Members

Are we there yet?

We continually seek to be faster and better through graded internal approvals and enhanced member engagement. Send us your feedback on project completion and we will improve the services we provide to you.



SHARED SUCCESS:
A JP to re-engineer a valve is saving millions of dollars for the JP participants over the life of their plants. And, it has created a template approach for countless other part and equipment requirements. It's one more tool in obsolescence management.



Photo courtesy of Bruce Power

INFORMATION

Information Exchange

leverages experience and best practices across the industry and among CANDU utilities so that each member and supplier participant can make the most of shared operating experience and best practices.



For all your event information, OPEX, news groups, team workspaces and industry data, visit www.COGonline.org

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Director Information Exchange

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Helping members connect for safer, more reliable and cost-effective operations and projects worldwide

Common issues include those related to design, operation, maintenance and refurbishment as well as materials-related issues such as acquisition of obsolete parts, sharing of spare parts and obsolescence management.

Information Exchange Program Areas

An information management tool: COGonline

COGonline is a one-stop collaboration tool and information access portal, which serves as an information hub for more than 40,000 data entries, a calendar of events, peer team and committee virtual workspaces and much more.

In August 2017, COG launched a new, updated version of its publicly-accessible website at www.candu.org. This will be followed in late fall with an updated and revamped version of COGonline. Both sites feature an e-zine version of **COGnizant**, COG's industry magazine with a deeper dive available within the Member site.

Operating Experience (OPEX): Database and screening meetings

With more than 30 years of operating experience in its records, there is a solution waiting to be found in the COG OPEX database. As well, weekly screening teleconferences can keep you up-to-date on the latest issues and resolutions.

Question and Answer Forum:

The Q&A Forum online newsgroup provides an interactive space for COG members to post their questions and draw on the expertise of colleagues from around the world. And, it isn't just for problems. Thinking of implementing something new? Before you re-invent the wheel, see what has been done elsewhere.

Connecting face-to-face: Workshops, peer teams and conferences

COG hosts more than 100 forums, peer groups, technical committee meetings, conferences and workshops, annually. Check the COG online calendar or the downloadable PDF on COGonline under EVENTS to get involved.

News Groups

COG maintains more than 50 topical newsgroups. Subscribers can get the latest information on specific topic areas for selected CANDU and industry activities related to their area of responsibility.

Just-in-time (JIT) briefings and handbooks

JIT briefings and RapidOPEX and work group handbooks contain operating experience information to assist plant personnel to perform activities in the field. Each package concisely describes a significant problem, related industry experience, causes and lessons learned. Find the JIT packages on COGonline.org.

NUCLEAR PROFESSIONALS DEVELOPMENT SEMINAR

The NPDS course is part of COG's overall Leadership Development Program. NPDS provides a framework for high-potential staff as they take on increased accountability.

The program establishes clear and well understood standards for senior plant staff conduct; enhances the ability of senior nuclear plant personnel to identify, analyze and solve leadership problems; strengthens lesson transfer between nuclear sites; and provides ongoing support through mentoring practices.

Contact: John Sowagi at John.Sowagi@CANDU.org for more information

EXCHANGE

COG Collaboration Week

In 2016, COG began planning for its first week-long conference filled with workshops, an R&D expo and an opening plenary featuring leaders from across the industry. The week included evening network events and concluded with COG's Annual General Meeting. The sold out event, June 2017, hosted more than 200 participants. It provided COG's international partners an opportunity to make the most of their travel budget and provided all participants an opportunity for cross-functional collaboration and a chance to better understand all the opportunities COG offers for research, joint projects, information exchange and nuclear safety and environmental affairs support. The event received contributions from member and supplier participant sponsors who generously joined in the effort to make this possible.



40,000+

COG's OPEX database of more than 40,000 entries provides members searchable information to help solve problems today based on past experience from COG Members.

800

COG holds weekly OPEX screening meetings where members agree on significance and discuss follow-up actions. Approximately 800 events are reviewed annually.

100+

COG hosts more than 100 forums / peer groups / technical committee meetings and workshops each year for members and supplier participants. **New in 2017:** SMR technology and radioactive waste management forums.

Knowledge Transfer: From one generation to the next

COG delivers the *Nuclear Professional Development Seminar*, a three-week leadership program that takes place in the classroom and in the plant providing an opportunity to examine leadership, management practices and performance.

In 2017, the University Network of Excellence in Nuclear Engineering (UNENE) and CANDU Owners Group, with the help of sponsors, published *The Essential CANDU*, which provides a full and detailed briefing on the CANDU system. A limited number of print copies have been distributed to members and it is available in a free PDF format: www.nuceng.ca/CANDU (Copyright UNENE)

The Essential CANDU

Ch 1 Introduction to Nuclear Reactors
Ch 2 Genealogy of CANDU Reactors
Ch 3 Nuclear Processes & Neutron Physics
Ch 4 Reactor Statics
Ch 5 Reactor Dynamics
Ch 6 Thermalhydraulic Design
Ch 7 Thermalhydraulic Analysis
Ch 8 Plant Systems
Ch 9 Plant Operations
Ch 10 Instrumentation and Control

Ch 11 Electrical Systems
Ch 12 Rad Protection & Environmental Safety
Ch 13 Reactor Safety / Safety Analysis
Ch 14 Nuclear Reactor Materials
Ch 15 Nuc Process Systems Chemistry & Corrosion
Ch 16 Regulatory Requirements and Licensing
Ch 17 Fuel
Ch 18 Fuel Cycles
Ch 19 Storage and Disposal of Irradiated Fuel
Ch 20 Fuel Handling and Storage
Ch 21 Incore Fuel Management

RESEARCH AND

Research and Development

enables COG members to share the risks, costs and the rewards of R&D projects in six research areas.

Five of these research areas support the Members' base program needs.

A sixth area, Strategic R&D was developed to set a long-term vision and create research that will help the CANDU industry remain sustainable and strong for future operations over the next several decades.

Developing innovative solutions to create new opportunities and to solve the most complex challenges

Research and Development Program Areas

Each year, COG's R&D program teams collectively manage hundreds of work packages in six program areas. New R&D programs are considered annually and member company employees are invited to nominate projects.

1. Safety and Licensing

The Safety and Licensing program operates in six 'centres of excellence':

- Containment and severe accidents
- Physics
- Fuel and fuel channels
- Probabilistic Safety Assessment
- Thermal-hydraulics
- Fuel normal operating conditions

2. Fuel Channels

The Fuel Channel program develops predictive models for fuel channel aging. Its overarching goal is to reduce the conservatism in operating margin models so the margins can be increased. CSA standards are used to establish fuel channel fitness for service. One objective is to maintain expertise and facility availability.

3. Industry Standard Toolset (IST)

The IST program increases regulatory confidence, reduces costs and improves quality by consolidating the qualification, development and maintenance activities on computer codes used for design, safety analysis and operational support of CANDU reactors. The program administers 16 codes in four categories:

- Containment and severe accident
- Thermal-hydraulics
- Physics and
- Fuel and fuel channels

Get involved...

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As a member

- Participate in the R&D Technical Programs and Projects
- Attend technical committee meetings, workshops and conferences
- Participate in the R&D planning meetings and receive project proposals
- Receive indexes, abstracts of R&D reports and reports contributed by Members
- Access the COG website (COGonline.org) for OPEX, R&D products, technical bulletins and more
- Share expertise and resources (national / international) more effectively
- Minimize cost

DEVELOPMENT

4. Chemistry, Materials and Components (CM&C)

The continued safe operation of CANDU nuclear facilities, coupled with reliable electricity production are the overarching goals of the CM&C program.

CM&C work includes:

- Chemistry
- Fields and dose reduction
- Non-destructive equipment tools for Steam Generators (SG) & Heat Exchangers (HX)
- Containment boundary degradation
- Improved components, materials, maintenance & processes
- Reactor vessel & piping degradation and
- SG & HX integrity & cleaning

5. Health Safety and Environment (HS&E)

The HS&E program addresses issues related to radiation monitoring and protection as well as dosimetry, including the establishment of the risks of radiation exposure to workers, the public and the environment. Both radiological and conventional contaminants are studied.

6. Strategic R&D

The Strategic R&D program focuses on developing the 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. Focus areas include:

- 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
- Assessment of potential impacts of climate change on current and planned facilities, operations and nuclear activities



Download a program-specific R&D brochure from COGonline.org or contact us for a printed copy.

As a supplier*

- Contribute to COG research efforts
- Join COG's Supplier Participant program
- Participate upon invitation in COG R&D Technical Committee and working group meetings pursuant to COG Policies and Procedures
- Access COG's member website (COGonline) for R&D projects opportunities

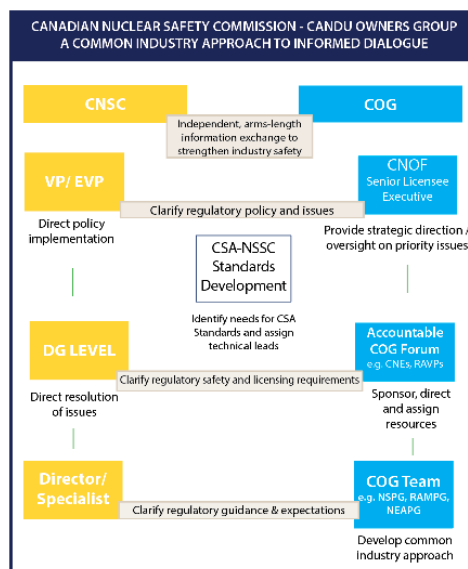
Nuclear Safety and Environmental Affairs

Nuclear Safety and Environmental Affairs (NSEA), working on behalf of members, promotes the adoption of common strategies and plans for the resolution of issues related to nuclear safety, regulatory affairs and the environment.

This is accomplished through:

- The Nuclear Safety Peer Group
- Regulatory Affairs Managers Peer Group
- Nuclear Environmental Affairs Peer Group

Task teams have been formed in these three areas to address specific issues. As well, COG has recently formed a Radioactive Waste Leadership Forum, a SMR Technology Forum, a Human and Organizational Factors Peer Group and an Emergency Preparedness and Response Peer Group.



NSEA works on behalf of both Canadian and International members to achieve common industry approaches and informed dialogue and decisions by CANDU nuclear regulators worldwide.

NSEA at COG

International Collaboration

COG reviews and coordinates the interface with the IAEA for Canadian utilities while maintaining strong links with SNC-Lavalin and CNL. This includes participation on the IAEA Nuclear Safety Standards Committee (NUSSC) and the Nuclear Energy Institute (NEI, Washington) Integration Committee.

Support to the CNO Forum

NSEA provides operational support to the Chief Nuclear Officer Forum (CNOF). This includes regularly scheduled meetings with executive and Director-General level staff in the Canadian Nuclear Safety Commission (CNSC).

Working with the regulator

All COG teams in the NSEA program are sponsored under the *Chief Nuclear Officers Forum*, *Chief Nuclear Engineers Forum* or the *Regulatory Affairs VPs Forum*. In several cases, the teams interface with their counterparts in the CNSC to clarify regulatory expectations and discuss progress on resolution of safety/licensing issues. Some teams collaborate with other organizations such as the CNA and CSA. These activities also have potential to inform international Member regulations.

Safety, security and access...

Information Management & Technology

SECURE INFORMATION SHARING

COG continually upgrades its systems and evolves with technology to ensure a safe and secure online workspace and repository of CANDU IP and information.

EXTENSIVE DATA AND INFORMATION

COG will launch a new COGonline platform this fall for an improved user experience with easy access to databases, peer team and workshop sites, events, performance tracking and industry information.

VIDEO CONFERENCING

COG offers video conferencing from each of our five in-house conference rooms and WebEx conferencing that includes content sharing, video calls and audio-only telecon bridges. Remote participants can join from their own computer or mobile device.

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