

# Canadian Nuclear Laboratories

## A New Era of Science in Canada

For three quarters of a century, Canada's national nuclear laboratory has been home to new and exciting breakthroughs in nuclear science and technology.

This work has had profound impacts on people all over the world – from the way we power our homes and business, to the technologies we use to fight cancer. As we build on this history of innovation, CNL has developed a plan that charts our path forward for the next decade. Known as Vision 2030, this plan encompasses all-new programs and projects that focus on our competitive advantages, seeks to grow our commercial business, and positions the company as a sustainable, thriving business into the future.

Most importantly, Vision 2030 builds on what we already do best – cleaning up the environment, developing clean energy technologies for today and tomorrow, and improving the health of Canadians.



## Clean Energy for Today and Tomorrow

In clean energy, CNL is working to bring the next-generation of clean energy technologies to Canada – Small Modular Reactors (SMRs). But our work in clean energy extends into other areas as well, including the production of hydrogen, the development of advanced nuclear fuels, the integration of clean energy technologies, and services that support the continued safe and reliable operation of today's nuclear generating stations.

## Restore and Protect the Environment

CNL is managing the largest and most complex environmental clean-up missions in Canada, including the Chalk River and Whiteshell Laboratories sites, and the remediation of historic waste as part of the Port Hope Area Initiative. We are also leading a number of major environmental remediation projects, including the Near Surface Disposal Facility (NSDF) project, the Nuclear Power Demonstration (NPD) Closure Project, and the WR-1 Closure Project.



## Canada's National Nuclear Lab

- » Through AECL, acts as advisor to and agent of the Government of Canada for public policy purposes
- » Sustains unique national capabilities and infrastructure for nuclear safety and security, emergency response and reactor fleet sustainability
- » Conducts research to support science-informed regulation
- » Provides critical technology and services to commercial customers in Canada and abroad
- » Enables business innovation and technology transfer
- » Deploys highly qualified staff to address industry's toughest challenges



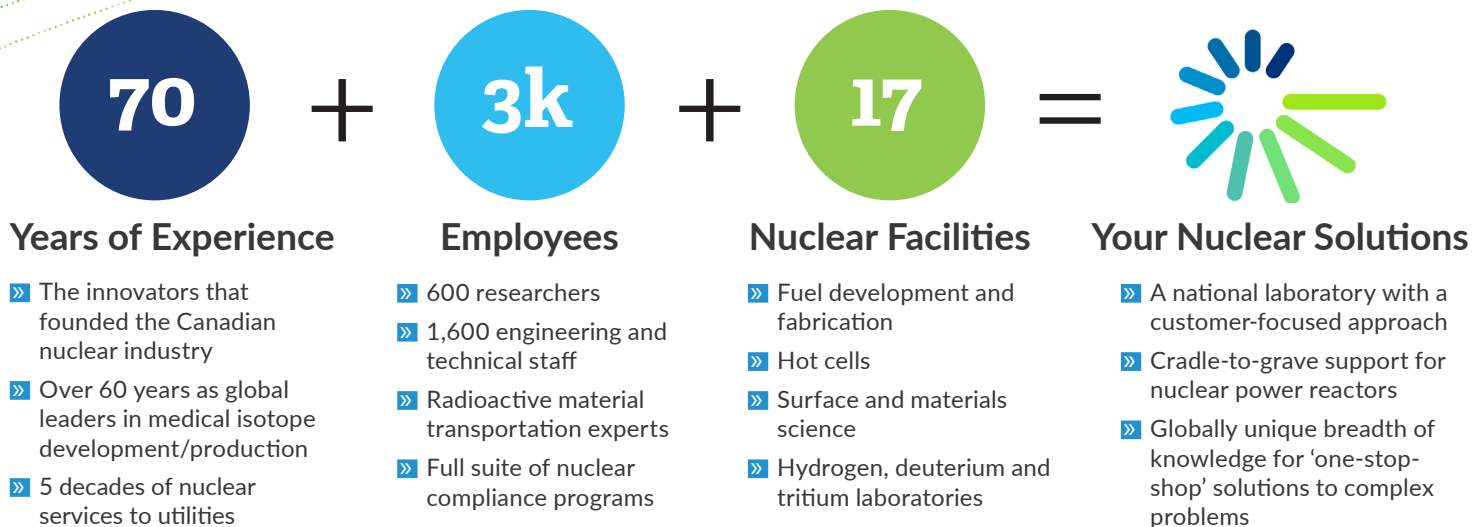
## Contribute to the Health of Canadians

With over one billion medical treatments conducted using isotopes produced at CNL, we have been a world leader in the production of radiopharmaceuticals for decades. We are now leveraging this expertise to become an international hub in the research, development and supply of alpha-emitting isotopes, including Actinium-225, a rare isotope that can be used to create a revolutionary new cancer treatment.



# Canadian Nuclear Laboratories - Chalk River

## By the Numbers:



## Our Quality Program:

CNL maintains a robust management system and quality program in compliance with national and international nuclear standards such as ISO 9001, ISO 17025, CSA N286, CSA Z299/N299, 10 CFR-50 Appendix B and ASME NQA-1

## Solutions for:

### Utility Services

Aging Studies & Asset Management

Component & Tooling Development

Materials Investigation and Post-Irradiation Examination

Chemistry Services

Tritium Management

### Fuel Vendors

In-reactor and Ex-reactor Testing

Physics Modeling and Testing

Fission Product Release

Spent Fuel Management

Prototype and Experimental Fuel Fabrication

### Advanced Reactors

Material/Component Selection and Qualification

Safety & Licensing Program Development

Remote Monitoring, Cyber Security, and Safeguards

Irradiation Program Preparation and Execution



# We Offer

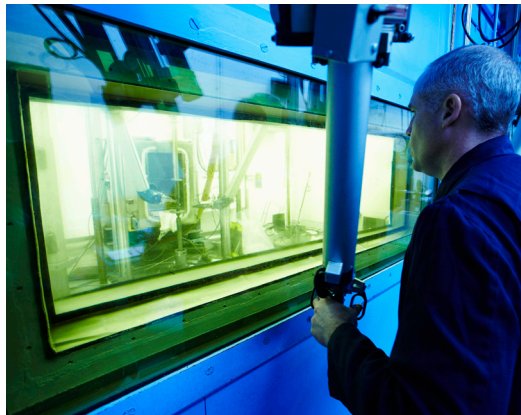


## Chemistry Control, Monitoring and Optimization

- » Whole system view of plant chemistry
- » Plant chemistry support and consulting
- » Laboratory services
- » Component and steam generator corrosion expertise

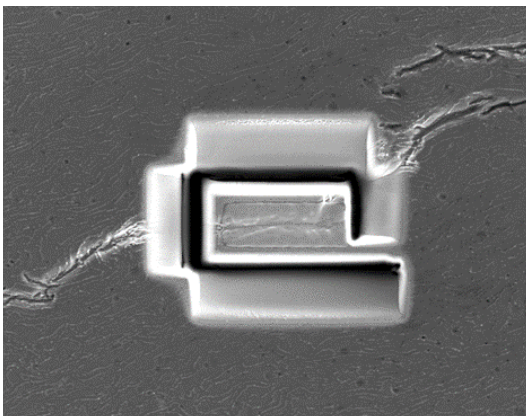
## Aging Management and Post Irradiation Examination

- » Hot cell facilities and in-cell examination capabilities
- » Mechanical and metallurgical testing from full components down to nano-scale samples
- » Aging assessments for irradiated concrete and cables



## Operational Support and Failure Response

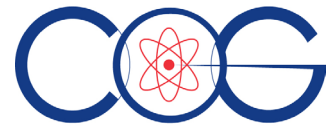
- » Effective, timely support for reactor components
- » Full post-irradiation examination services and facilities for large and small highly contaminated components
- » Examination and decontamination of large contaminated components on outage critical path
- » Expertise and consulting services in seals, valves and cables, and steam generator condition monitoring and operations



## Key Relationships

- » 1,100 diverse suppliers in Canada and around the world
- » Member, supplier and technical leader within CANDU Owner's group (COG)
- » Interface with EPRI committees and expert panels, supplier to EPRI
- » Key contacts and relationships that can be utilized when performing work for clients
- » Broad range of academic and commercial partners

CANDU Owners Group Inc.



"Excellence Through Collaboration"

**EPRI**  
ELECTRIC POWER  
RESEARCH INSTITUTE

ORGANIZATION OF CANADIAN  
NUCLEAR INDUSTRIES



Clean Energy for a Low Carbon Economy

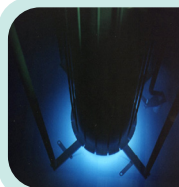


Canadian Nuclear  
Laboratories

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# Case Studies

Hydrogen ingress in pressure tubes is one of the life limiting conditions facing CANDU operators. Working with partners under the COG Fuel Channel Life Management program, CNL deployed proprietary technology to add hydrogen to ex-service pressure tubes to replicate material properties representative of a future state. The tubes were tested in a hot cell to demonstrate their performance. The results from this program have helped inform regulation, and have enabled the life extension of CANDU reactors beyond the original design life of these tubes, enabling ~\$25B of incremental revenue generation in Ontario.



A BWR fuel manufacturer wanted to qualify a new lead fuel assembly that was undergoing a demonstration irradiation at a U.S. power plant. CNL was contracted to ship and receive 9 fuel rods from the power plant, and to perform various post-irradiation examinations (PIE) on the fuel to demonstrate its integrity. Successful execution of this PIE campaign will diversify the North American supply chain for fuel qualification services, and set the stage for further innovation in advanced fuels for the existing reactor fleet.

CNL worked with Ontario Power Generation, MIRARCO, and a northern mining company to perform a feasibility assessment on SMR technologies in support of remote mining operations. The study compared the levelized cost of electricity from an SMR to diesel power and other renewables, and demonstrated that the most economical energy mix involved power from SMRs. CNL has provided similar services for Governments and major industrial clients.



CNL worked with Terrestrial Energy (TEI) to develop and experimentally verify a safeguards methodology for molten salt reactors that would meet Canadian and International Atomic Agency (IAEA) requirements. CNL identified promising technologies, established material balance areas and key measurement points for the TEI plant, and down-selected the most promising techniques for experimental verification. In the second phase, CNL successfully demonstrated the efficacy of the chosen approach, establishing a global precedent for the safeguarding of molten salt reactors.

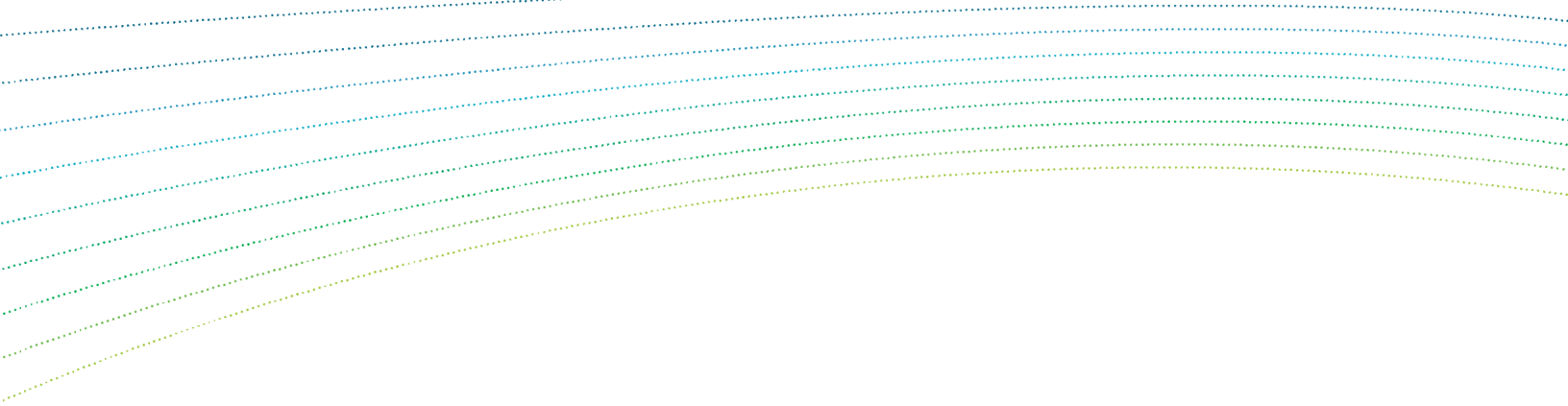
To be successful, it will be essential for micro reactor developers to demonstrate that their designs can be operated remotely in a safe, secure, and reliable fashion. CNL recently developed, constructed, and demonstrated a control system architecture for the safe and secure monitoring of an SMR. This architecture includes defense-in-depth features and supports both local and remote monitoring, control and maintenance of a reactor through a secure augmented reality feed. This work was performed under AECL's Federal Nuclear Science and Technology program, and will inform both vendor design and regulatory requirements.



CNL Chalk River is the host site for the Global First Power (GFP) SMR siting project. CNL is actively engaged with GFP to provide whatever support is necessary for the success of the project. In preparation for the siting project, CNL's environmental team performed an extensive baseline environmental assessment of 4 proposed reactor sites at Chalk River. This data was collected, analyzed, and compiled in a report that was provided to GFP in 2020. The environmental baseline report has provided substantial value to GFP, significantly reducing the time and effort required by them to submit environmental data to the regulator.

With the transition to net-zero carbon emissions in Canada, the Canadian Coast Guard contracted CNL to perform a feasibility study to provide an assessment of alternative fuels for its multi-purpose vessels. Using proprietary models developed by CNL, a report was prepared that compared the benefits of transitioning to alternative fuels and outlined a fuel-switching program.





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