

Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

CNSC Perspective on Nuclear Research

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Outline

- Canadian Nuclear Safety Commission (CNSC)
- Research needs from CNSC (Research Areas)
- Domestic Nuclear Power Landscape and Major Changes to Nuclear Infrastructure
- International Research Collaboration

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Canadian Nuclear Safety Commission

- Established in May 2000, under the **Nuclear Safety and Control Act**
- Replaced the Atomic Energy and Control Board (AECB) under the 1946 **Atomic Energy Control Act**

Mandate

- Regulates the use of nuclear energy and materials to protect the **health, safety and security** of Canadians and the **environment**
- Implements Canada's **international commitments** on the peaceful use of nuclear energy
- Disseminates objective **scientific, technical and regulatory information** to the public



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CNSC Regulates All Nuclear-Related Facilities and Activities

- Uranium mines and mills
 - 5 uranium mines
- Uranium fuel fabricators and processing
 - 8 processing and fuel fabrication facilities
- Nuclear power plants
 - 4 sites, 19 operating reactors
- Waste management facilities
- Nuclear substance processing
- Industrial and medical applications
- Nuclear research and educational
- Export/import control



... From cradle to grave

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Research Needs of the CNSC


1. Physical Design
 - New designs of nuclear technologies introduce innovative aspects which require research in support of establishing regulatory positions
2. Fitness for Service
 - Due to ageing of CANDU reactors in Canada, comprehensive research is required to ensure fitness for service for safe continued operation of the reactors
 - Refurbishment of current fleet to provide Long Term Operation will be a major program over the next 15 years resulting in research opportunities.
3. Safety Analysis
 - Due to the aging reactors, safety margins are being challenged and independent verification is required
 - Research capabilities for code validation need to be maintained
 - Probabilistic Analysis is also playing a more prominent role using advanced statistical approaches to analyze risk and uncertainty

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Research Needs of the CNSC (cont'd)

4. Safeguards and Security
 - Protecting nuclear facilities and nuclear materials from malevolent acts and to review the effect that these threats have on design requirements & physical protection of nuclear material
5. Waste Safety
 - Assessing long-term performance of in-pit uranium tailings management facilities
 - Evaluating long-term safety issues related to the long-term management of radioactive waste in crystalline and sedimentary rocks
 - Address uncertainties related to the long term performance of natural and engineered barriers
6. Environmental Protection
 - Incorporate latest science into human and ecological risk assessment modelling
 - Ensuring adequate understanding of effects (nuclear and hazardous substances, physical impacts) on biological and ecological systems

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 **Research Needs of the CNSC (cont'd)**

7. Radiation Protection (RP)

- Operational RP: identifying best practices and new science that may influence the CNSC RP framework
- Dosimetry: behaviour of nuclear substances with respect to the human body and its consequences on dose
- Human Health Effects: Assessing risk and conducting disease surveillance of exposed populations

8. Human Performance Management


- Research is needed in Human & Organizational Factors
- A better understanding of Human Performance in Emergency & Accident Response

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 **Domestic Nuclear Power Landscape & Major Changes to Research Infrastructure**



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 **Nuclear Power in Canada**


- **The Province of Ontario's Long-Term Energy Plan**
 - Maintains Nuclear power as a significant contributor to the electricity needs of Ontario (currently 60%)
 - Plans refurbishments of existing Nuclear Power Plants (Darlington & Bruce), beginning in 2016
 - increases contribution from solar, wind and conservation and maintains the elimination of coal
- **The Province of New Brunswick**
 - NB Power recently completed refurbishment of Point Lepreau Nuclear Power Plant
 - Represents 35% of electricity needs

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 **Key Activities in the coming years affecting Research**

- Decommissioning
 - NRU Reactor, Pickering units and Gentilly-2
 - Demonstration reactors and aged infrastructure at Chalk River Laboratories
- CNSC benchmarking international best practices on decommissioning activity
- Expanding CNSC Independent Research Program for Deep Geological Repositories (DGR)
 - Nuclear Waste Management Organization's Adaptive Phase Management initiative for a DGR for Canada's spent fuel – site not known – crystalline or sedimentary
 - OPG's DGR for its low and intermediate-level radioactive waste

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 **Major Change in Domestic Landscape**


- Restructuring of Atomic Energy Canada Limited (AECL)
 - With AECL's restructuring, the Federal Government has established a "national nuclear laboratory" with mandates that can support the needs of government, industry and society
 - On November 4, 2014 Canadian Nuclear Laboratories (CNL) was created in preparation for switching to a Government Owned Contractor Operated (GoCo) model
 - New relationships between governments, utilities, industry and international research organizations are being established

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 **Canadian Nuclear Laboratories (CNL)**

- The experience, expertise and facilities long associated with AECL will now be offered through a new organization
- CNL is Canada's premier nuclear science and technology organization. CNL has been a world leader in developing peaceful and innovative applications from nuclear technology through its expertise in physics, metallurgy, chemistry, biology and engineering

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Canadian Nuclear Laboratories (CNL)

3 (+1) Mandates

1. Support government in its obligation to manage historic and legacy liabilities at AECL sites and other locations
2. Provide nuclear science and technology (S&T) capabilities and services to federal government departments and agencies
3. Support the nuclear industry's need for in-depth research and development and test and evaluation expertise

4. Participate in an industry-driven, cost-shared nuclear innovation agenda (following further evaluation by Government)

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Canadian Nuclear Laboratories (CNL)

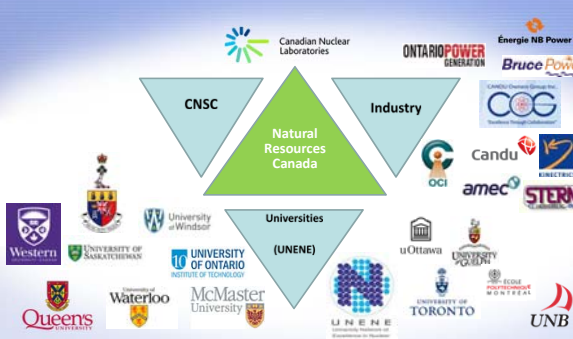
- In response to the 2nd mandate, a federal committee now exists to assess S&T (research) needs of the federal government for CNL
- Research would fall under the following areas:

	Theme Area
1	Supporting the development of biological applications and understanding the implications of radiation on living things
2	Enhancing national and global security by supporting non-proliferation and counter-terrorism
3	Nuclear preparedness and emergency response
4	Supporting safe, secure and responsible use and development of nuclear technologies
5	Supporting environmental stewardship and radioactive waste management

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NPP Research Stakeholders – Canada



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 **CANDU Owner's Group (COG) Research**

- COG undertakes research on behalf of its members in order to improve performance of CANDU Stations worldwide
- Areas include:
 - Fuel Channel Life Management
 - Support to safety and licensing assessments
 - Health, safety and environment
 - Chemistry, materials and components
 - Industry Standard Tool Set

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International Research Collaboration



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 **International Research Collaboration**

- CNSC is reviewing common international research needs to ensure leveraging of resources
- Working on enhanced collaboration with other CANDU countries
- Working with other regulators to:
 - Identify key research needs
 - Ensure common research needs are shared
 - Ensure knowledge generated can be used in a harmonized approach

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International Research Collaboration (cont'd)

- Agreement between the US Department of Energy and Natural Resources Canada including Atomic Energy of Canada Limited (AECL) for Collaboration in the Area of Nuclear Energy Research and Development

U.S. DEPARTMENT OF ENERGY | Natural Resources Canada | AECL EACL

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IAEA Research Collaboration

- Examples of IAEA collaboration
 - Coordinated Research Program (CRP) on Evaluation of Materials from Decommissioned Reactors
 - International Generic Aging Lessons Learned (IGALL)
 - International Seismic Safety Centre (ISSC)

IAEA International Atomic Energy Agency


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OECD/NEA Research Collaboration

- Examples of OECD/NEA collaborations
 - Hazards: Fire Incident Records Exchange and PRISM Project
 - Ageing: Component Operational Experience Degradation and Ageing Programme and Cable Ageing Data and Knowledge
 - New Designs & Standard Harmonization: Multinational Design Evaluation Program
 - Committee on Safety of Nuclear Installations

NEA Nuclear Energy Agency

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 **Bilateral Research Collaboration**

- Examples of bilateral collaborations
 - Modelling: US NRC Thermal-hydraulic Code Applications & Maintenance Program (CAMP) and US NRC Radiation Protection Code Analysis & Maintenance Program (RAMP)
 - CNSC collaborates with the IRSN to model two experiments: SEALEX (Tournemire) and HE-E (Mont Terri)
 - CNSC participates in DECOVALEX: international collaborative project for the modelling of Thermo-Hydro-Mechanical-Chemical experiments in rocks and seals

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 **Summary**

- CNSC continues to have research needs to maintain the current reactor fleet and address emerging issues
- CNSC will continue to provide input to Natural Resources Canada on the restructuring of AECL to the new GoCo model for CNL
- CNSC views international collaboration as a key to success and will continue to work with international partners on common research

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