



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada

Opportunities for Canadian Nuclear Laboratories in Support of Nuclear Safety and Regulation

Peter Elder, Vice-President and Chief Science Officer
Technical Support Branch
Canadian Nuclear Safety Commission

Presentation at
Canadian Nuclear Laboratories' "CNL Federal Lab Day"
Ottawa, ON
February 15, 2018



nuclearsafety.gc.ca

e-Doc: 5450567

Canada

Canadian Nuclear Safety Commission



- Established May 2000, under the *Nuclear Safety and Control Act*
- Replaced the Atomic Energy Control Board, which was established in 1946 under the *Atomic Energy Control Act*
- Regulates all nuclear-related facilities and activities



Over 70 years of experience



Our Mandate

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



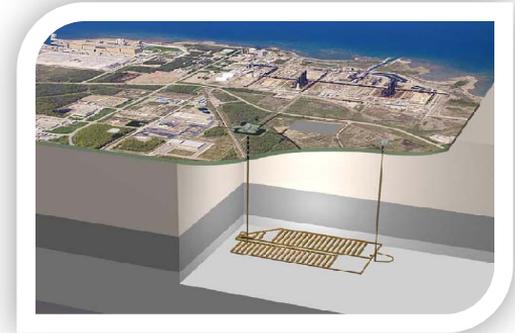
Canada's nuclear regulator

CNSC Regulates All Nuclear-Related Facilities and Activities in Canada



- Uranium mines and mills
- Uranium fuel fabrication and processing
- Nuclear power plants
- Nuclear substance processing
- Industrial and medical applications
- Nuclear research and educational
- Export/import control
- Waste management facilities

...From cradle to grave





Why Is Regulatory Research Needed?

Regulatory research generates knowledge and information to support CNSC staff in their regulatory mission

- Supports regulatory positions and decisions
- Identifies and assesses the significance of emerging issues
- Supplements staff assessment capabilities
- Contributes to the independence of the regulator
- Reduces uncertainties about health, safety, security and environmental issues



Current Areas of Support From Canadian Nuclear Laboratories (CNL)



Current CNSC Engagement With CNL

- The CNSC research program funds a number of projects at CNL through memorandums of understanding with Atomic Energy of Canada Limited (AECL)
- The CNSC collaborates in research at CNL, funded through other federal programs
 - Defence Research and Development Canada's Canadian Safety and Security Program
 - participation in AECL's Federal Nuclear Science and Technology Program



Research Related to CANDU Reactors

- Comprehensive research is required to ensure fitness for service for safe continued long-term and post refurbishment reactor operation
 - includes extensive pressure tube knowledge and expertise on material degradation
- Safety margins are being reassessed and independent verification is required
 - includes code validation and accident progression modelling

CNL's expertise in this area is a valuable resource

Examples of Research Related to Existing Nuclear Power Plants



- Material properties for safety-significant components (e.g., validation of fracture toughness predictive model for zirconium alloy pressure tube)
- Enhanced understanding of cable degradation
- Improved fracture mechanics engineering methodologies for assessment of structural integrity
- Cyber security of industrial control systems
- Mitigation of hydrogen risk to support severe accident management
- Effects and benefits of filtered containment venting for CANDU reactors to reduce source term release



Environmental and Radiation Protection

- Health effects of radiation on living organisms
 - Health effects of low dose radiation
 - Multi-generational exposure of small mammals to environmentally relevant levels of radionuclides
 - Evaluating and improving the efficacy of decorporation agents
 - Effects of fuel burn-up on solubility of radioactive particles in the lung
 - Bioavailability and dosimetry of spent UO₂ fuel particles in the alimentary tract



Nuclear Forensics

- CNL is supporting the Government of Canada through three CNSC-led nuclear forensics initiatives
- Key area of strength is radioactive/nuclear material metrology and characterization
- CNL has supported the Government of Canada/CNSC in international missions abroad related to nuclear forensics
- Opportunities for infrastructure investments (e.g., hot cells) that can support the nuclear forensics capability while also addressing other areas of work within CNL will come to bear as nuclear forensics capability evolves



Areas of Growth



Small Modular Reactors (SMRs)

- Over the past few years interest in small modular reactors (SMRs) has increased significantly. Consequently, in May 2016, the CNSC published a discussion paper (DIS-16-04) outlining its regulatory strategy, approaches and challenges related to SMRs.
- In September 2017, the CNSC published the [What We Heard Report – DIS-16-04](#), which summarizes the results of the CNSC’s consultation on DIS-16-04 and outlines some of the next steps the CNSC plans to undertake regarding the regulatory framework for SMRs.
- Currently, many different SMR technologies are being explored around the world. As such, the CNSC has seen an increase in interest in pre-licensing vendor design reviews (VDRs). The VDRs involve several different reactor technologies, including molten salt, high-temperature gas, liquid sodium and pressurized light water.



Vendor Design Reviews (VDRs)

Reviewing a variety of technologies

VDR No.	Country of origin	Company	Reactor type / output per unit	VDR Status
1	Canada/U.S.	Terrestrial Energy	Molten salt integral / 200 MWe	PHASE 1 COMPLETED, PHASE 2 PENDING
2	U.S./Korea/China	UltraSafe Nuclear/Global First Power	High-temperature gas prismatic block / 5 MWe	PHASE 1 IN PROGRESS completion date 2018 PHASE 2 Service Agreement under development
3	Sweden/Canada	LeadCold	Molten lead pool fast spectrum / 3 – 10 MWe	PHASE 1 ON HOLD AT VENDOR REQUEST
4	U.S.	Advanced Reactor Concepts	Sodium pool fast spectrum /100 MWe	PHASE 1 IN PROGRESS
5	U.K.	U-Battery	High temperature gas prismatic block / 4 MWe	PHASE 1 Service Agreement under development
6	U.K.	Moltex Energy	Molten salt fast spectrum / ~300 MWe	PHASE 1 IN PROGRESS
7	Canada/U.S.	StarCore Nuclear	High-temperature gas prismatic block / 10 MWe	PHASE 1 and 2 Service Agreement under development
8	U.S.	SMR, LLC. (A Holtec International Company)	Pressurized Water / 160 MWe	PHASE 1 Service Agreement under development
9	U.S.	NuScale Power	Integral Pressurized Water / 50 MWe	PHASE 2* Service Agreement under development
10	U.S.	Westinghouse Electric Co.	eVinci Micro Reactor / < 25 MWe	PHASE 2* Service Agreement under development

* Phase 1 objectives will be addressed within the Phase 2 scope of work



Other areas of growth

- Research is needed to support the ongoing development and improvement of the CNSC's regulatory framework related to Human and Organizational Factors, including fitness for duty
- A better understanding of Human Performance in emergency and accident response is beneficial in helping to ensure sufficient regulatory oversight
- Animal care facility capable of supporting multi-generational experiments
- Relevance of biomarker responses to individual (humans) and population level effects (environment).



Summary

- The CNSC has research needs in a number of areas to support its mandate
- CNL should continue to provide expertise related to CANDU reactors
- There is potential for growth in areas related to new technologies



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Questions?

Thank You!

Canada 

Participate and Contribute!



Visit us online



Like us on Facebook



Follow us on Twitter



View us on YouTube



Subscribe to updates



Contact us