Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CNSC Research Program

Presentation to COG Nuclear Safety Peer Group

Daniel Tello

Senior Research Program Officer

February 17, 2017

e-Doc 5174469

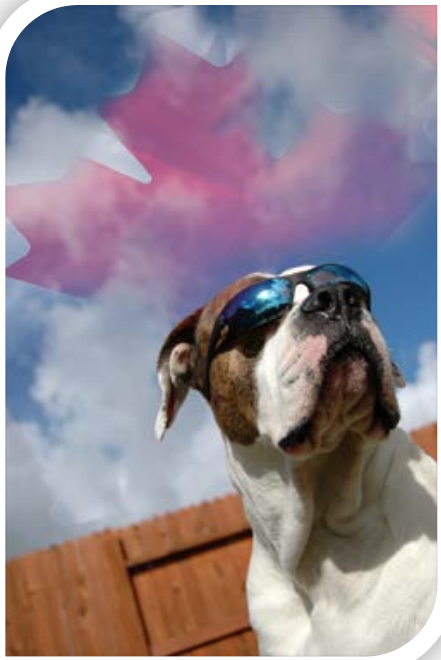
nuclearsafety.gc.ca

CANADA 150

Canada

Canadian Nuclear Safety Commission

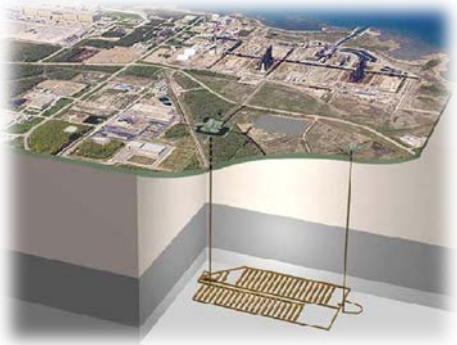
- Regulates the use of nuclear energy and materials to protect health, safety, security and the environment
- Implements Canada's international commitments on the peaceful use of nuclear energy
- Disseminates objective scientific, technical and regulatory information to the public



Regulator for 70 years

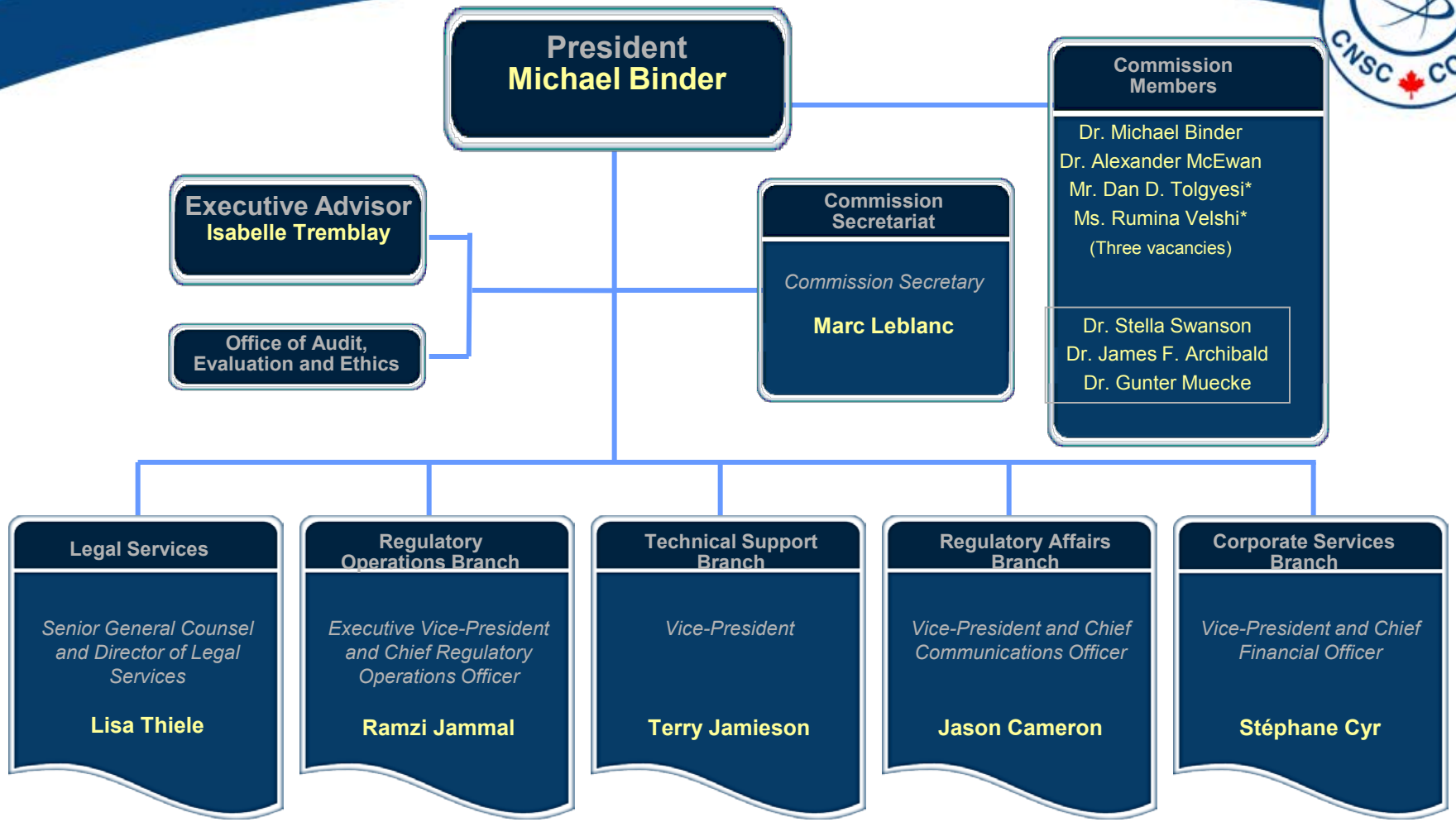
CNSC Regulates All Nuclear-Related Facilities and Activities…

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



…from cradle to grave

Organizational Structure



Regulatory Operations Branch

The Regulatory Operations Branch (ROB) supports the CNSC mission and mandate by making final regulatory decisions, or by making recommendations to the Commission in the areas of licensing, certification and regulation

Ramzi Jammal
Executive Vice-President and Chief Regulatory Operations Officer

- Directorate of Power Reactor Regulation — **Gerry Frappier**, Director General
- Directorate of Nuclear Cycle and Facilities Regulation — **Haidy Tadros**, Director General
- Directorate of Nuclear Substances Regulation — **Colin Moses**, Director General
- Directorate of Regulatory Improvement and Major Projects Management — **Raoul Awad**, Director General

Technical Support Branch

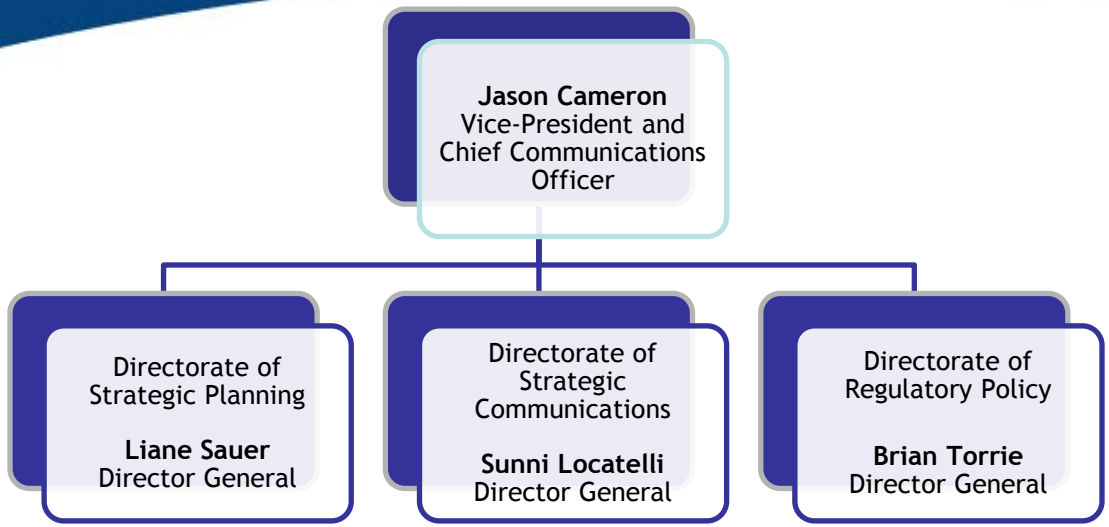
Terry Jamieson
Vice-President

- Directorate of Assessment and Analysis — **Dave Newland**, Director General
- Directorate of Environmental and Radiation Protection and Assessment — **Mike Rinker**, Director General
- Directorate of Safety Management — **Greg Lamarre**, Director General
- Directorate of Security and Safeguard — **Kathleen Heppell-Masys**, Director General

The Technical Support Branch (TSB) provides leadership and specialized expertise in the areas of:

- safety analysis, nuclear science and engineering
- environmental and radiation protection
- safety management, human factors, personnel training and certification
- security, nuclear emergency management, safeguards, and nuclear non-proliferation

Regulatory Affairs Branch



The Regulatory Affairs Branch (RAB):

- coordinates and supports policies with central agencies, key departments and other levels of government
- manages the development of CNSC's regulatory framework
- manages internal and external communications
- supports the strategic planning framework, research and evaluation plan
- coordinates Aboriginal engagement and international relations

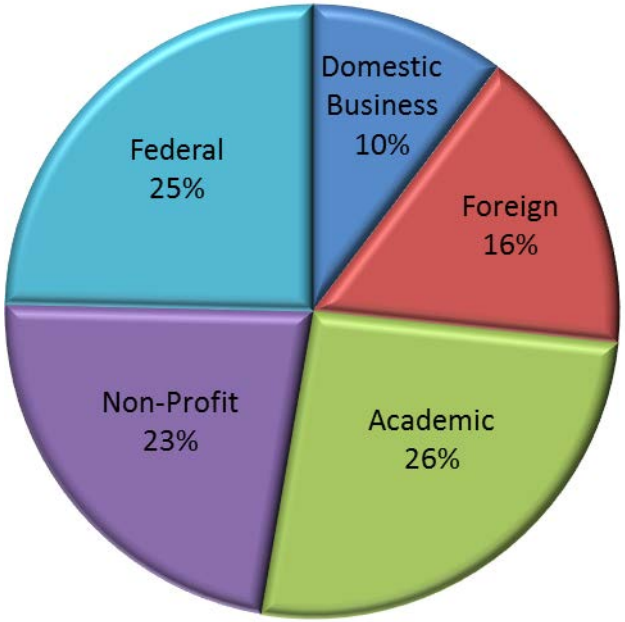
Regulatory Research

Regulatory research generates knowledge and information to support CNSC staff's 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 regarding health, safety, security and environmental issues

Research Universe

- Annual research budget is $3.8M
- Approximately half of this budget is used for collaborative agreements (Contribution Agreements), while the other half is used for contracted research
- A large share of the CNSC's research is conducted by academic institutions
- AECL/CNL is currently the highest single vendor to CNSC research (captured under federal)



FY16/17 research spending distribution by vendor category

Research Program Areas

- Research aligned with CNSC safety and control area (SCA) framework
- Currently only 8 of 14 active Research Program areas vs. SCA
- CNSC research is planned on a multi-year basis
- Top currently funded program areas: safety analysis, fitness for service and safeguards

Current Research Program areas

- *Fitness for service*
- *Physical design*
- *Safety analysis*
- *Radiation protection*
- *Environmental protection*
- *Waste management*
- *Human performance management*
- *Safeguards and non-proliferation*

Research Goals Developed With Linkages to Research Program Areas

Why use a goal-based approach?

- To help articulate the importance of research work to senior management by providing a clear link to the CNSC's mandate and needs
- To help select the right "suite" of funded projects and demonstrate clear priorities
- To use linkages for strategic effect (i.e., sourcing strategy)
- To help communicate CNSC research needs to internal and external groups
- To provide a framework for assessing the value of the research that has been accomplished (performance)

Research Goals

1. Strengthen the CNSC's licensing, compliance, and regulatory framework in preparation for long-term operation/post-refurbishment operation of Canadian nuclear power plants
2. Enhance the CNSC's capability to independently assess hazards (particularly natural hazards) and to analyze/respond to severe reactor accidents
3. Support CNSC staff in the preparation and conduct of vendor design reviews
4. Enhance the CNSC's understanding of the environmental transport and behaviour of hazardous nuclear substances and associated environmental exposures
5. Inform the CNSC's radiation protection knowledge base to reflect the best available science on the protection of workers and the public

Research Goals (cont'd)

6. Support CNSC staff in their evaluation of licensing or other submissions related to waste repositories
7. Further our understanding of the long-term behaviour of both uranium mining and milling waste
8. Support the update of the CNSC's regulatory framework to reflect modern human performance approaches
9. Support Canadian Safeguards commitments and influence international safeguards efforts
10. Strengthen Canadian nuclear forensics capability

Developing Roadmaps

- The CNSC is currently developing research roadmaps to visually show linkages between CNSC research needs (gaps) and CNSC research goals
- Roadmaps will:
  - facilitate communication of CNSC research priorities within the CNSC
  - serve as a mechanism for sharing research needs with external stakeholders (i.e., AECL/federal nuclear S&T stakeholders, UNENE, COG, licensees and the general public)
  - **potentially** show linkages between CNSC activities to meet research goals and the activities of external groups

Federal Nuclear Science & Technology

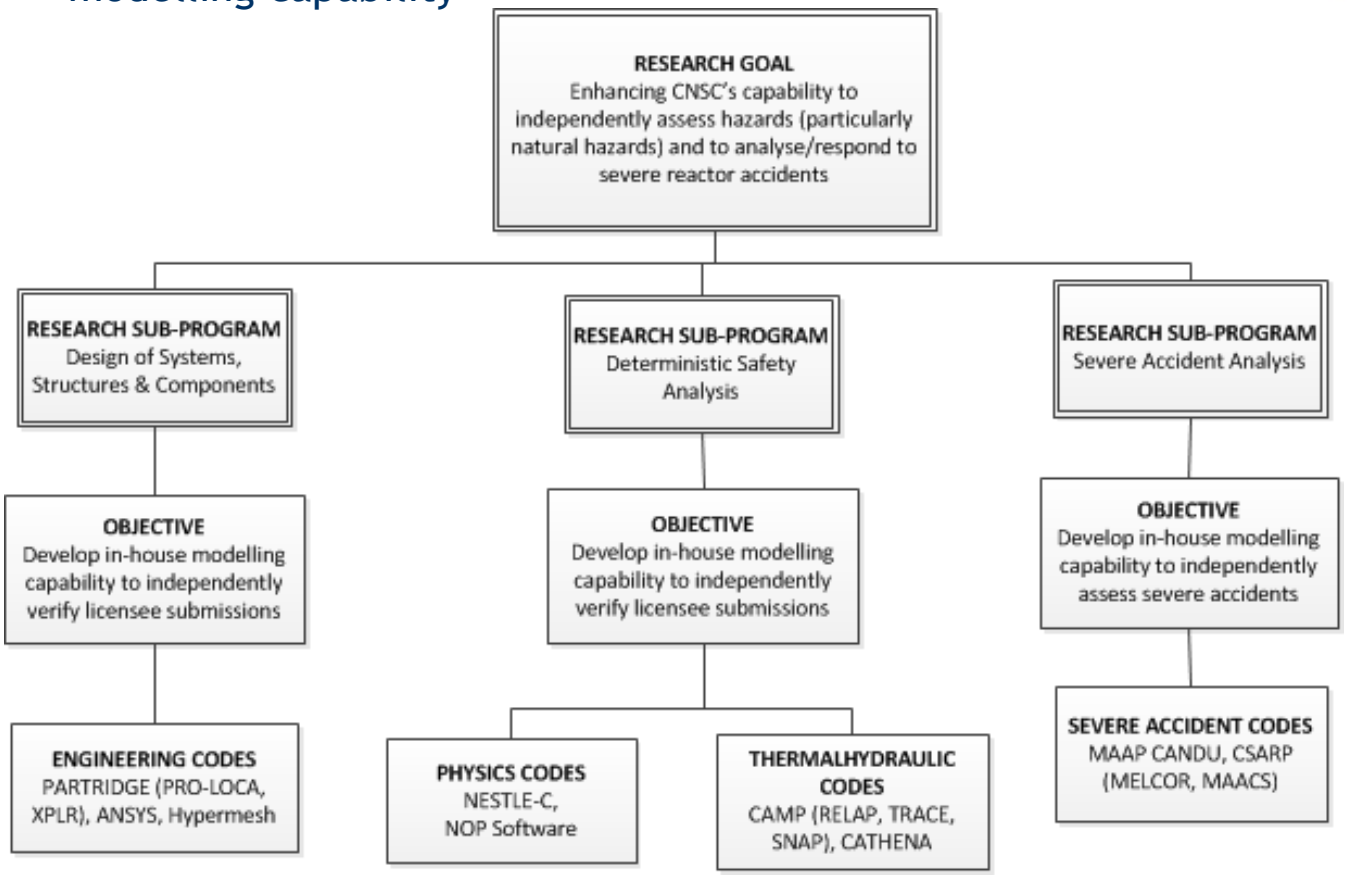
The CNSC is in the process of mapping CNSC research goals to the five Federal Nuclear Science & Technology (FNST) Program theme areas:

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 emergency preparedness and response
4. supporting safe, secure and responsible use and development of nuclear technologies
5. supporting environmental stewardship and radioactive waste management

CNSC is an active member of the FNST Program led by AECL

Roadmap Example

- **Identified gap:** The CNSC would like to enhance in-house modelling capability



Note: This roadmap is for discussion purposes only (not a complete roadmap)

Potential Areas of Collaboration

Safety analysis projects

- **Code Applications and Maintenance Program (CAMP):** The CNSC is exploring how to best facilitate providing access to U.S. NRC CAMP codes (i.e., RELAP)
- **Cooperative Severe Accident Research Program (CSARP):** The CNSC can facilitate providing access to U.S. NRC CSARP codes (i.e., Melcor and MACCS)
- **Two phase flow in reactor headers:** The CNSC is exploring a research project with the University of Ottawa and is looking for industry collaboration
- **Fuel and reactor physics:** Several projects are being explored

Early thoughts for potential collaboration

Summary

- High-level goals have been developed with clear links to Research Program areas
- CNSC is developing research roadmaps to more clearly articulate research needs
- Areas for collaboration exist and can be explored

Annex A: Current CNSC Safety Analysis Research Projects

Sub-program area	Title	Status	Division	Years left
Deterministic safety analysis	Investigation of two-phase flow phenomena in reactor headers	Not started	RTD	2 of 2
	Analysis of severe irradiated fuel bay accident PKPIRT package	Active	PFD	1 of 2
	Continued support for the U.S. NRC Cooperative Agreement of Thermalhydraulic Code Applications and Maintenance Program (CAMP)	Contracting	RTD	3 of 3
	Assessment of RELAP5 for natural circulation	Active	RBD	1 of 2
	Application of Bayes method in evaluation of ROP/NOP trip setpoint (Phase 2)	Active	PFD	1 of 2
	Integrated framework for propagation of uncertainties	Pre-Contracting	PFD	3 of 3
Hazard analysis	Support for the OECD High Energy Arcing Fault (HEAF) events project	Active	EDAD	1 of 2
	Support for the OECD Fire Incident Records Exchange (FIRE) project (Phase V)	Contracting	EDAD	3 of 3
	Site response analysis at nuclear power plants: high-frequency ground motion characteristics for rock sites	Not Started	EDAD	3 of 3
Probabilistic safety analysis	Support for the International Common-Cause Data Exchange (ICDE) Project - Phase VII	Active	PSARD	1 of 3
	Radioactive material transport risk assessment	Contracting	TLSD and PSARD	2 of 2
	Cost-free expert (CFE) to IAEA - Multi-Unit PSA Working Group	Not Started	PSARD	2 of 2

Annex A: Current CNSC Safety Analysis Research Projects (cont'd)

Sub-program Area	Title	Status	Division	Years left
Severe accident analysis	Analytical simulation to gain insights into the effectiveness of severe accident management actions	Active	RBD	1 of 3
	Participation in Nugenia (for SARNET)	Active	RBD	1 of 3
	FASTNET - Participation in EU Project	Active	RBD	1 of 3
	Development of MAAP Grape	Active	RBD	2 of 3
	Participation in the Cooperative Severe Accident Research Program (CSARP) – renewal	Pre-Contracting	RBD	3 of 3
	Simfuel Leaching Experiments	Not Started	RBD	1 of 1
	Containment hydrogen measurement technologies: their applicability and efficiency for monitoring severe accidents	Not Started	RBD	1 of 1
	Effects and benefits of filtered containment venting (FCV) for CANDU reactors to reduce source term release	Not Started	RBD	1 of 1
	Validation and verification of industry's computational aid for hydrogen prediction during severe accident management	Not Started	RBD	1 of 1
	Studies of molten metal solidification in internal pipe flows	Not Started	RBD	2 of 2
	Study impact of calandria-vessel horizontal and vertical penetrations on in-vessel debris retention during severe accident	Not Started	RBD	1 of 1
	Development of empirical correlation models for hydrogen production due to steel oxidation in CANDU feeder and end-fitting materials	Not Started	RBD	1 of 1
	Hydrogen/CO combustion and passive autocatalytic recombiner (PAR) behaviour	Not Started	RBD	1 of 1

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

nuclearsafety.gc.ca

facebook.com/CanadianNuclearSafetyCommission

youtube.ca/cnscccsn

twitter.com @CNSC_CCSN

CANADA 150

Canada