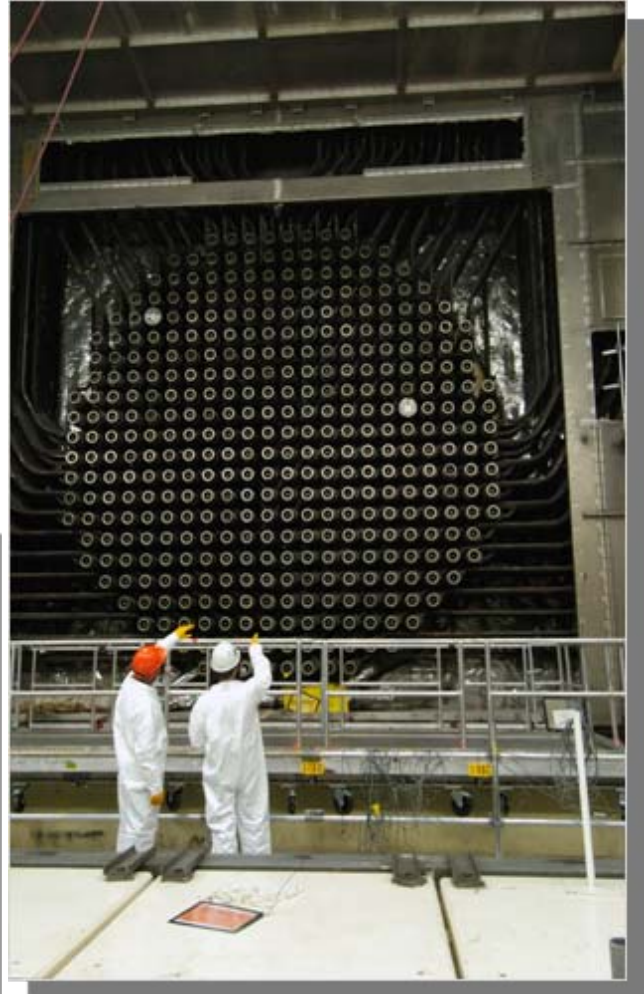


# Canada



# Convention on Nuclear Safety 5<sup>th</sup> Review Meeting

## Canada's Presentation

Country Group 5

April 8, 2011, Vienna



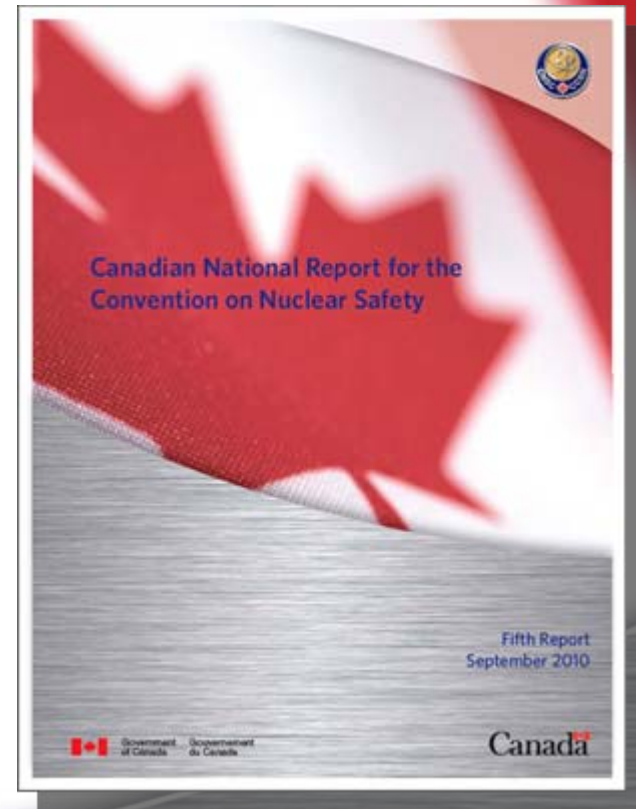
Government  
of Canada

Gouvernement  
du Canada

Canada

# Outline of Canada's Presentation

- ❁ Canada's response to events in Japan
- ❁ Highlights from Canada's 5<sup>th</sup> National Report
- ❁ Peer review of Canada's 5<sup>th</sup> National Report
- ❁ Conclusions



# Canadian Delegation

## Government:

- 🇨🇦 Canadian Nuclear Safety Commission
- 🇨🇦 Natural Resources Canada
- 🇨🇦 Canada's Permanent Mission in Vienna

## Industry:

- 🇨🇦 Atomic Energy of Canada Limited
- 🇨🇦 Ontario Power Generation
- 🇨🇦 Bruce Power
- 🇨🇦 Hydro-Québec
- 🇨🇦 New Brunswick Power Nuclear

# Canadian Nuclear Safety Commission

**Established May 2000**, under the  
*Nuclear Safety and Control Act*

Replaced the AECB,  
**established in 1946** under the  
*Atomic Energy Control Act*

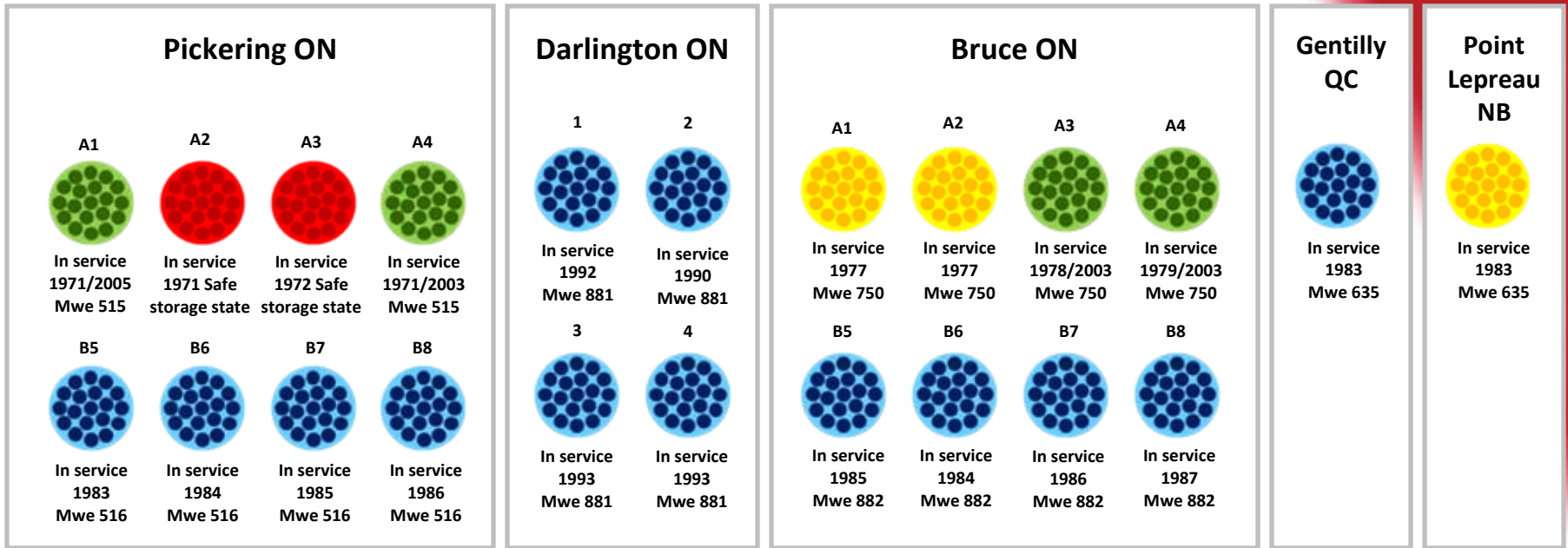
**Canada's independent  
nuclear regulator 65  
years of experience**



# Nuclear Power Plants in Canada



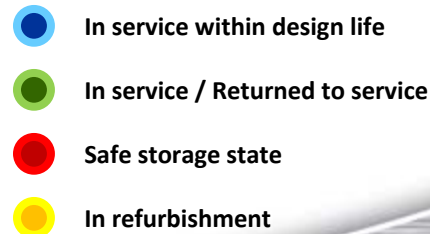
# Canada's Nuclear Energy Profile



## Typical share of nuclear energy in total electricity generation



## Operable status (Average age – 25 Years)



# Canada's Response to Events in Japan

## Overall Government Response

- ❖ Ongoing environmental monitoring on Canadian territory from coast to coast
- ❖ Deployed experts to the IAEA
- ❖ Videoconferencing to answer questions from Canadians in Japan

# Canada's Response to Events in Japan

## Regulatory Response

- ✿ Activated Emergency Operations Centre (EOC) on March 11, 2011
- ✿ Staffed EOC 24 hours a day, 7 days a week
- ✿ Initiated discussions with international peers
- ✿ Held discussions with other Canadian government agencies:
  - Health Canada
  - Foreign Affairs
  - Natural Resources Canada
  - Government Operations Centre
  - Canadian Food Inspection Agency
  - Environment Canada

# Canada's Response to Events in Japan



## Regulatory Response

Issued a request pursuant to the *Nuclear Safety and Control Act* to all major nuclear facilities to:

- 🍁 review initial lessons learned
- 🍁 re-examine safety cases, with focus on:
  - external hazards
  - measures to prevent or mitigate severe accidents
  - emergency preparedness
- 🍁 implement immediate actions
- 🍁 implement long-term measures

# Canada's Response to Events in Japan

## Regulatory Response: Immediate Actions

-  CNSC site staff carried out focused inspection on:
  - seismic qualification
  - fire
  - flooding
  - backup power
  - hydrogen igniters and passive recombiners
-  Ongoing inspection against external hazards

# Canada's Response to Events in Japan

## Regulatory Response: Immediate Actions

- ❖ Inspections of spent fuel bays:
  - components and equipment
  - heat sinks
  - alarms
- ❖ Availability of on-site and off-site resources

# Canada's Response to Events in Japan

## Regulatory Response: Long-Term Measures

### Verification of defence-in-depth strategy and measures to:

- ✳ minimize frequency of abnormal operation and failures
- ✳ control abnormal operation and detect failures
- ✳ limit the progression of accident to within the design basis
- ✳ control severe plant conditions (Severe Accident Management Guidelines)
- ✳ mitigate radiological consequences (emergency management)

# Canada's Response to Events in Japan

## Regulatory Response: Public Communication

- CNSC Web site became the site of choice
- Provided daily information updates
- Web site visits increased:
  - more than 10,000 daily visitors to the Japan updates page
- Performed source term assessment in order to advise Canadian citizens in Japan

# Canada's Response to Events in Japan

## Industry Response

- Public engagement and employee involvement
- Established working group under CANDU Owners Group (COG) to exchange information and define response strategies
- Verifying station capability to mitigate:
  - conditions during beyond design basis events
  - station blackout conditions
  - internal and external flooding events
  - other events concurrent with a seismic event

# Canada's Response to Events in Japan

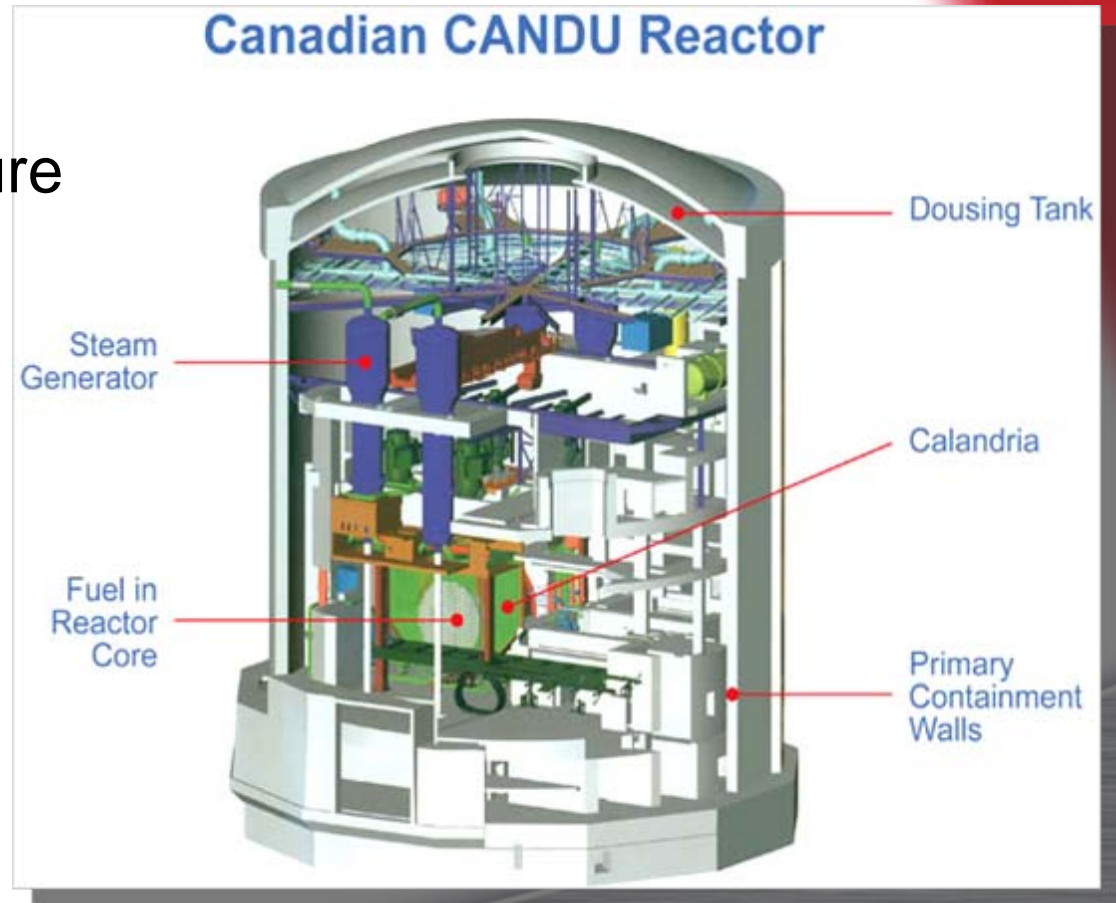
## Industry Response

- 🍁 Timely response by industry to CNSC directive:
  - all licensees responded by April 1, 2011 on short-term actions
- 🍁 Enhanced environmental monitoring and reporting
- 🍁 AECL product development program review:
  - review lessons learned from all reviews and findings
  - incorporate improvements into new build design

# Canada's Response to Events in Japan

## CANDU Safety Features: Review Outcomes

- ❖ Two-group design philosophy against common mode failure
- ❖ Large-volume, low-temperature moderator can act as a reactor core heat sink



# Canada's Response to Events in Japan

## CANDU Safety Features: Review Outcomes

- ❖ Low-temperature shield tank surrounding the moderator to act as a further heat sink
- ❖ Passive convection cooling
- ❖ Gravity-fed dousing tanks
- ❖ Emergency filtered air discharge system

# Canada's Response to Events in Japan

## Multi-Unit Stations: Review Outcomes

- ❖ Interconnected containment utilizing negative pressure vacuum building
- ❖ Inter-unit feedwater tie
- ❖ Inter-unit electrical tie



# Canada's Response to Events in Japan

## Station Blackout: Review Outcomes

- ✿ Automatic reactor shutdown
- ✿ Passive convection cooling
- ✿ Two independent and diverse sources of back-up power

# Canada's Response to Events in Japan

## External Hazards: Review Outcomes

- ❖ All sites have been assessed for a range of concurrent hazards, including flooding, severe weather and seismic events
- ❖ Reactors have been designed to withstand external hazards

# Canada's Response to Events in Japan

## Seismic Events: Review Outcomes

- ❖ All sites located in zones of low seismic activity
- ❖ Every site has its own specific seismic hazard assessment
- ❖ Plant designs have been recently re-evaluated and confirmed to be seismically robust

# Canada's Response to Events in Japan

## Spent Fuel Storage Bays: Review Outcomes

- ❖ Seismically qualified double-walled pool
- ❖ Spent fuel is removed routinely into dry storage to minimize bay inventory
- ❖ On-line fuelling minimizes heat load in the fuel bay
- ❖ Several diverse means of adding water to bays

# Canada's Response to Events in Japan

## Emergency Management: Review Outcomes

### On-site response:

- ✦ multi-level response to ensure adequate resources and communication with province and municipality
- ✦ Severe Accident Management Guidelines

### Off-site response:

- ✦ collaboration between municipal, provincial and federal emergency management organizations
- ✦ actions to mitigate impacts

Transparency through communication with the public and media

# Canada's Response to Events in Japan

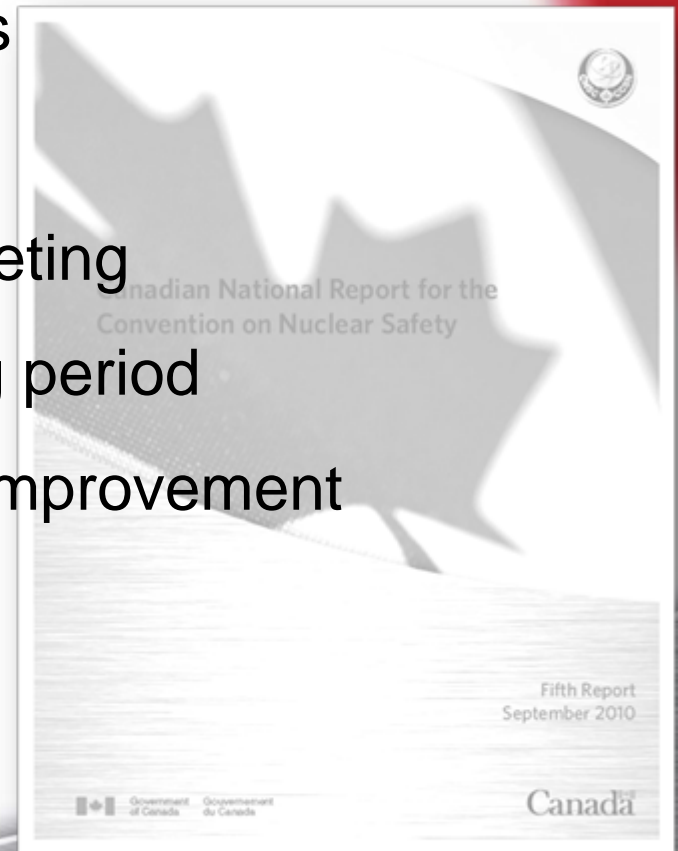
## Summary

- ✿ At all government levels, Canada responded with urgency
- ✿ Canadian nuclear industry collaborated to coordinate a comprehensive review within a very short time frame
- ✿ Ongoing environmental monitoring on Canadian territory and evaluation of readings from outside Canada
- ✿ Follow-up actions to strengthen nuclear safety

**It's time for global mandatory  
minimum safety standards**

# Highlights of Canada's National Report

- ❖ Canada's commitment to safety
- ❖ Increased regulatory effectiveness
- ❖ Long-term operation
- ❖ Follow-up from the 4<sup>th</sup> Review Meeting
- ❖ Significant events during reporting period
- ❖ Planned activities for continuous improvement



# Highlights of Canada's National Report Canada's Commitment to Safety

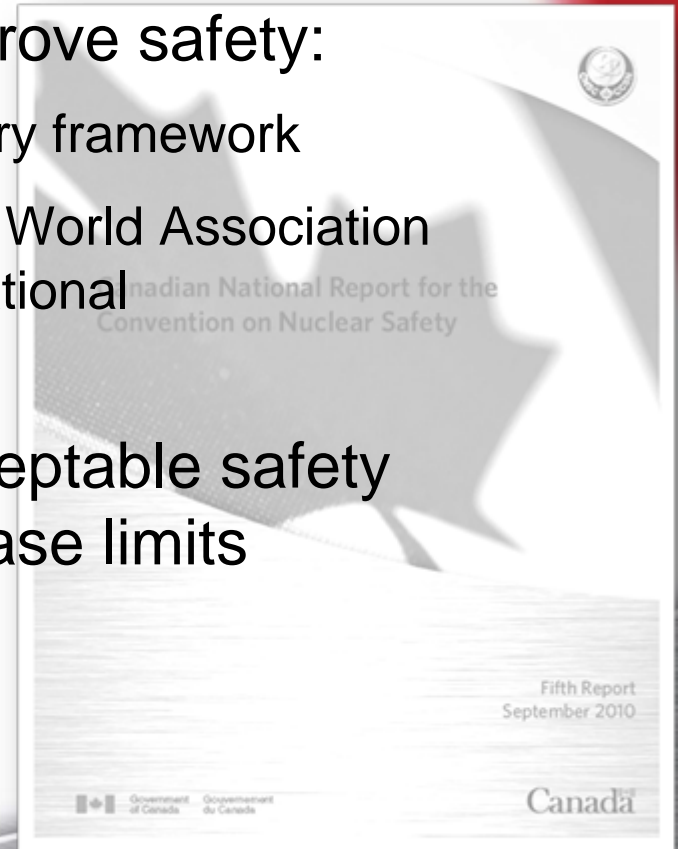
Canada is committed to the objectives of the Convention on Nuclear Safety:

- ❖ achieve and maintain high level of nuclear safety
- ❖ establish and maintain effective defences in nuclear power plants
- ❖ prevent accidents and mitigate their consequences should they occur



# Highlights of Canada's National Report Canada's Commitment to Safety

- ❖ Canada complies with all articles of the Convention
- ❖ Canada seeks to continuously improve safety:
  - IRRS Mission assessment of regulatory framework
  - Independent industry peer reviews by World Association of Nuclear Operators and IAEA Operational Safety Review Team
- ❖ Canadian industry operates at acceptable safety margins, and below dose and release limits



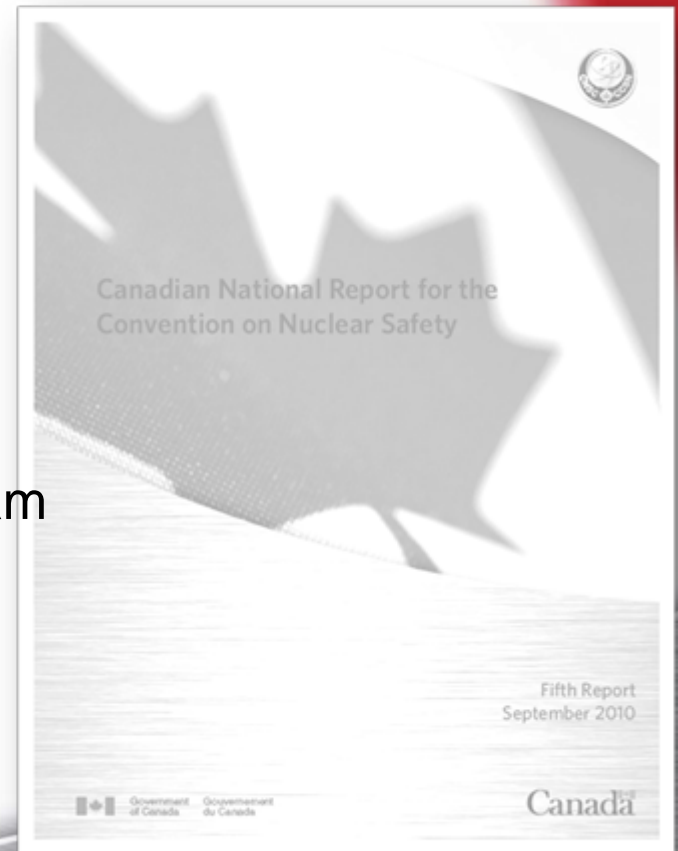
# Highlights of Canada's National Report Increased Regulatory Effectiveness

## 🍁 Continuous enhancement of regulatory framework:

- licensing process
- compliance program
- regulatory documents and guides

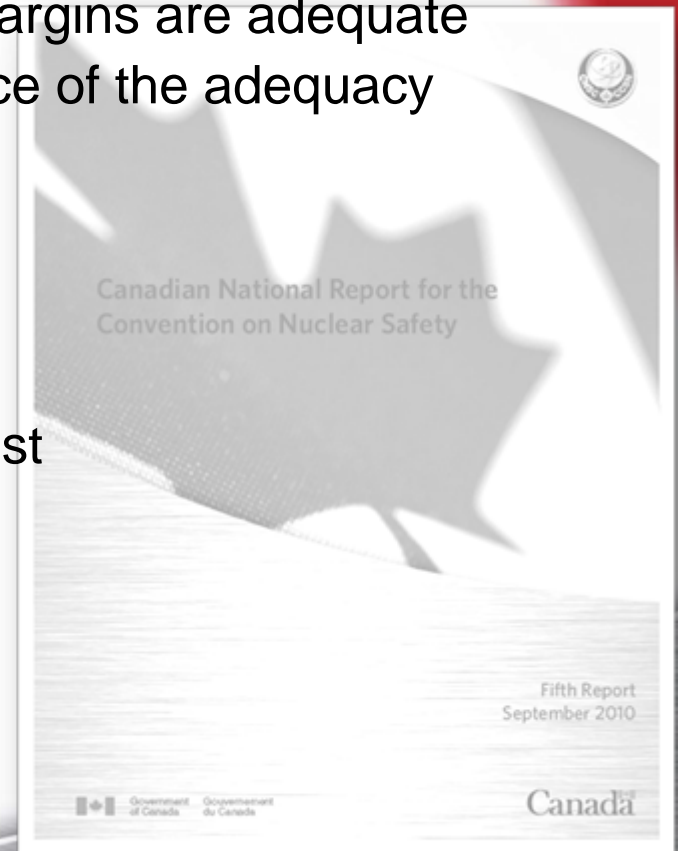
## 🍁 Supporting initiatives:

- Harmonized Plan
- licence reform
- multinational design evaluation program
- vendor pre-project design review



# Highlights of Canada's National Report Long-Term Operation

- ❖ Resolution of safety issues:
  - current safety measures and safety margins are adequate
  - working to provide additional assurance of the adequacy of safety measures and margins
- ❖ Aging management
- ❖ Refurbishments:
  - enhancing robustness of design against external hazards



# Highlights of Canada's National Report

## Follow-Up From 4<sup>th</sup> Review Meeting: Challenges for Canada

1. Continue refurbishment activities

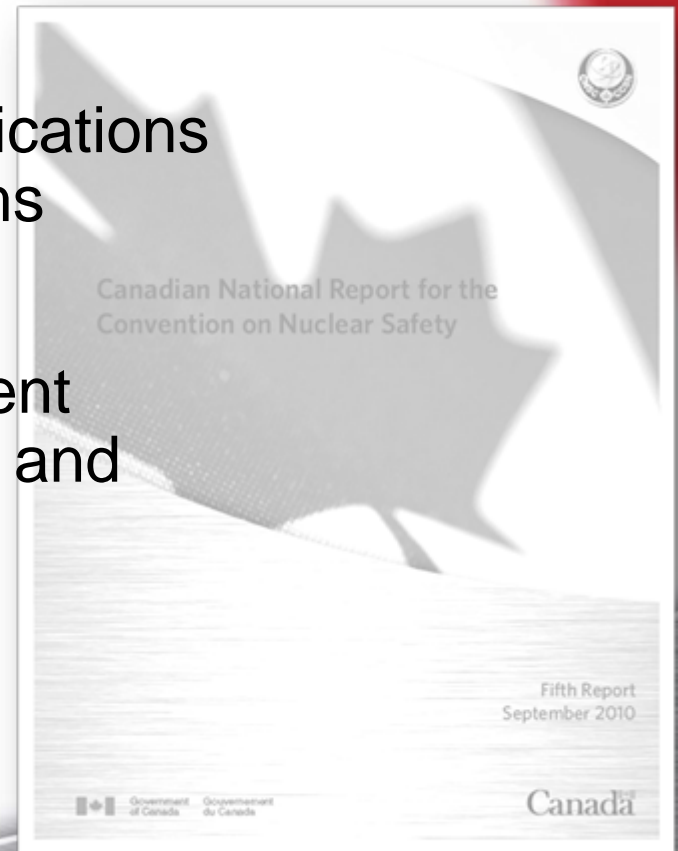
**Addressed**

2. Reassure the environmental qualifications of safety and safety-related systems

**Addressed**

3. Plan and implement Severe Accident Management Guidelines, and plan and conduct validation exercises

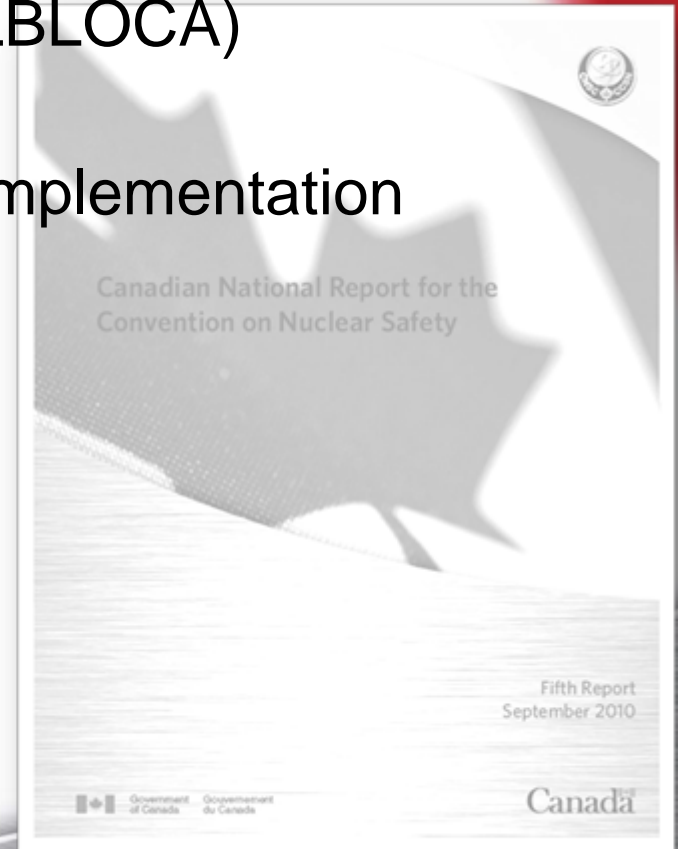
**Addressed**



# Highlights of Canada's National Report

## Follow-Up From 4<sup>th</sup> Review Meeting: Challenges for Canada

4. Establish and pursue a success path for Large Break Loss of Coolant Accident (LBLOCA)  
**Addressed**
5. Continue discussion on possible implementation of Periodic Safety Review (PSR)  
**Addressed**



# Highlights of Canada's National Report

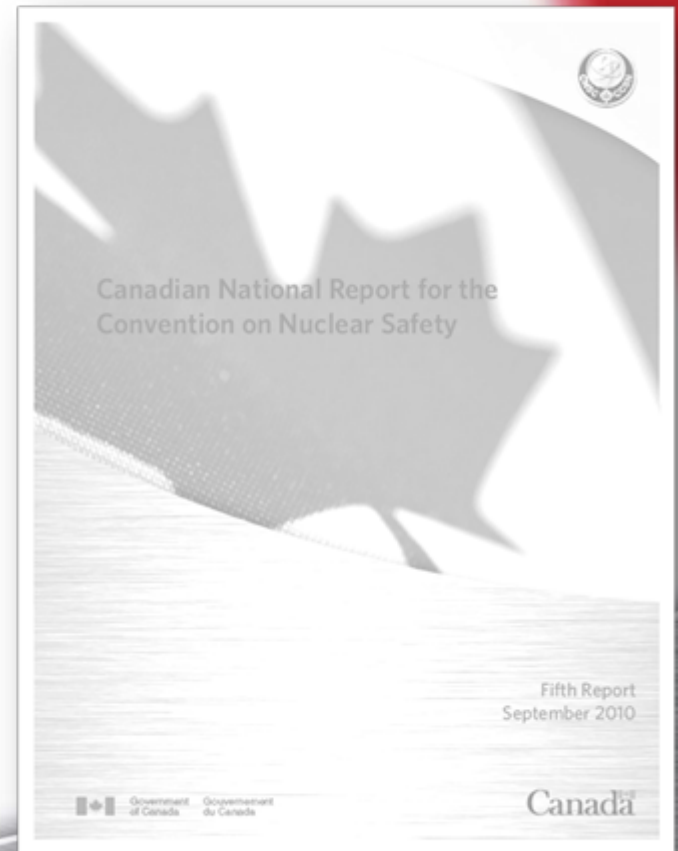
## Follow-up From 4<sup>th</sup> Review Meeting: Challenges for Canada

6. Implement the risk-informed decision making process more fully

**Addressed**

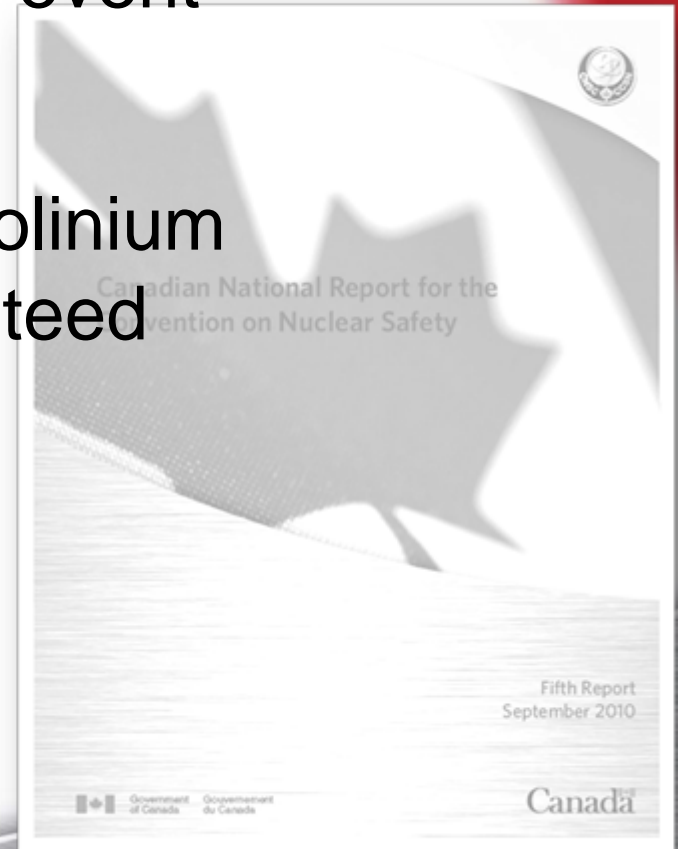
7. Plan for an IRRS mission with an expanded scope

**Addressed**



# Highlights of Canada's National Report Significant Events During Reporting Period

- ❖ Bruce A: alpha contamination event at unit under refurbishment
- ❖ Pickering B: decrease in Gadolinium concentration when in guaranteed shutdown state



# Highlights of Canada's National Report Plans for Continuous Improvement: Industry

- ❖ Continue life extension activities in accordance with regulatory document *Life Extension of Nuclear Power Plants*
- ❖ Augment existing hydrogen mitigation capability with installation of passive autocatalytic hydrogen recombiners
- ❖ Complete the implementation of Severe Accident Management Guidelines



# Highlights of Canada's National Report Plans for Continuous Improvement: Regulatory

## 🍁 Clarity of regulatory requirements:

- complete licence reform project
- complete staff review procedures

## 🍁 Enhanced monitoring of safety culture

## 🍁 Integrated management system




# Peer Review of Canada's Report

## Questions to Canada

- ❖ Preparations for new builds (Articles 7, 17, 18)
- ❖ Safety culture assessment (Articles 10, 12)
- ❖ Regulatory independence (Article 8)
- ❖ Human resources strategies (Articles 8, 11)
- ❖ Severe Accident Management Guidelines (Articles 14, 19)

# Peer Review of Canada's Report Response to Questions

## Preparations for new builds?

-  Stakeholder engagement:
  - public participation in hearing process
  - all public hearings are webcast
  - all documents available for public viewing and comment
  - Participant Funding Program

# Peer Review of Canada's Report Response to Questions

## Preparations for new builds?

- 🍁 Site evaluation/Environmental Assessment:
  - bounding factors
  - probabilistic safety goals

# Peer Review of Canada's Report Response to Questions


## Preparations for new builds?

### 🍁 Basis for new quantitative safety goals:

- dose acceptance criteria
- achieved by three safety goals:
  - large release frequency: limit accidents requiring permanent relocation
  - severe core damage frequency: limit likelihood of severe accident
  - small release frequency: limit accidents requiring temporary evacuation

# Peer Review of Canada's Report Response to Questions

## Preparations for new builds?

-  Features of design qualification program:
  - defined by licensee, consistent with Canadian standards, and reviewed by regulator for acceptability

# Peer Review of Canada's Report Response to Questions

## Preparations for new builds?

- ❖ Vendor pre-project design reviews:
  - vendor-optional process to assess the design
  - three phases at vendor discretion
- ❖ Human factors considerations in new builds:
  - must be factored into design, construction, commissioning and operations

# Peer Review of Canada's Report Response to Questions

## Safety culture self-assessments?

- ❖ CNSC organization and management review method:
  - comprehensive approach to assess organization and management issues
- ❖ Safety culture performance indicators:
  - qualitative in nature
  - refer to observable performance of people at different levels

# Peer Review of Canada's Report Response to Questions

## Regulatory independence?



- ✿ Quasi-judicial administrative tribunal
- ✿ Commission members are independent
- ✿ Decision can only be reviewed by the Federal Court
- ✿ Independent Legal Services
- ✿ Public hearings are webcast



**Transparent, science-based  
decision-making**

# Peer Review of Canada's Report Response to Questions

## Human resources strategies?

-  Recruiting and retention strategies:
  - alliance of universities, nuclear power utilities, research and regulatory agencies
  - CNSC alumni program and succession planning
-  Assessing competence needs and training:
  - management competency profile
  - individual learning plans
  - support professional development

# Peer Review of Canada's Report Response to Questions

## Severe accident management?

- ✳ Guidelines are based on reactor design
- ✳ Off-site emergency response may differ depending on:
  - location
  - nature of the event
  - population density

# Conclusions: Good Practices

- ❖ Dedicated CNSC resources for new builds
- ❖ Systematic approach to long term operation
- ❖ Integration of all improvement initiatives into one plan (CNSC Harmonized Plan)
- ❖ Integration of regulatory document framework with independent standards associations

# Conclusions: Good Practices

- ❖ Comprehensive preparation for and follow-up on the 2009 IRRS mission
- ❖ Actions levels to trigger an early response
- ❖ Mandatory reporting and proactive disclosure
- ❖ Openness and transparency

# Conclusions

- ❖ Canada has demonstrated:
  - its commitment to the Convention's objectives
  - its compliance with the Articles of the Convention
- ❖ Canada benefited from peer review
- ❖ Canada recognizes and acts upon improvement opportunities

# Conclusions

**The CNSC has cast its organizational priorities under the heading “Core + Four”:**

- ❖ **core:** licensing and compliance activities, regulatory framework
- ❖ **commitment** to ongoing improvement
- ❖ **clarity** of regulatory requirement
- ❖ **capacity** for action
- ❖ **communications**

A close-up, slightly blurred photograph of the Canadian flag, focusing on the red maple leaf. The leaf is the central element, with its white and red colors and serrated edges clearly visible. The background consists of the red and white stripes of the flag, also slightly out of focus.

**Thank you**

Canada



Canada 