NATIONAL EMERGENCY RESPONSE FRAMEWORK IN CANADA

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Outline:

- Canadian National and Organizational Emergency Response Framework
  - Acts and Regulations
  - National Emergency Response Framework
  - Protective Action Strategy in Canada
- CNSC Emergency Operation Centre Response
  - Response Mandate
  - Response Structure and Staffing
  - Concept of Operations for Reactor Accident Response
  - Assessment & Prognosis (A&P) Methodology and Supporting Technical Tools
- National Exercises
- EPREV
- Summary

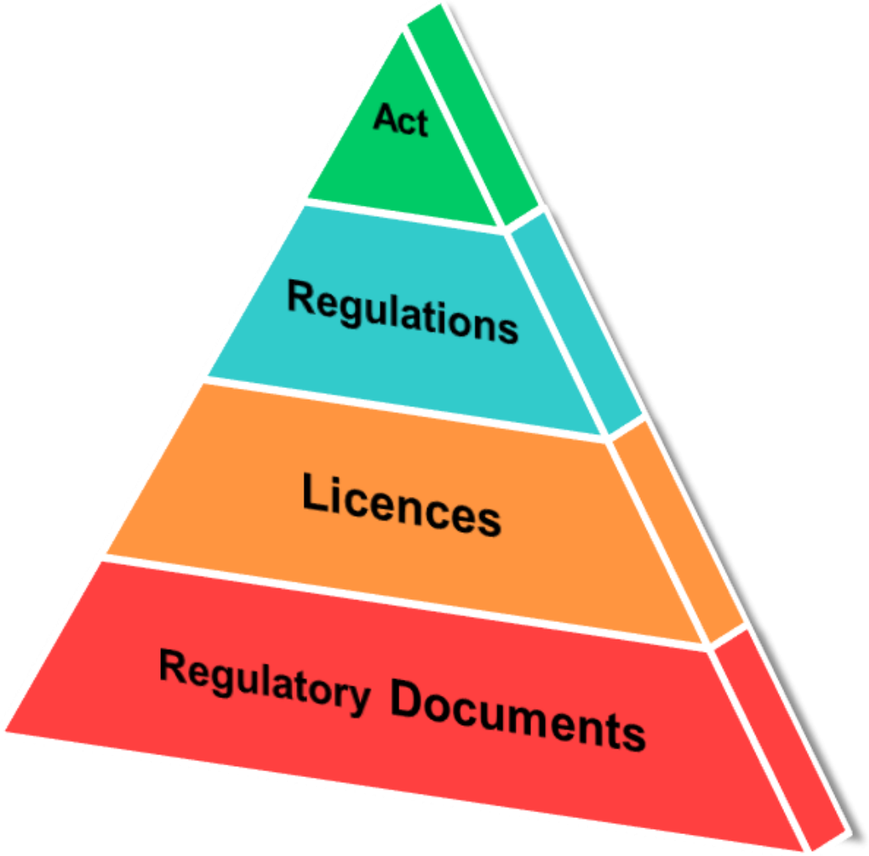
Canadian National and Organizational Emergency Response Framework

Canada: A Constitutional Monarchy

- The ***Constitution Act***:
  - Canada is a federation consisting of 10 provinces and 3 territories.
  - Establishes fundamental principles and division of powers between the federal government and provincial/territorial governments
- The ***Emergency Management and Civil Protection Act***:
  - Responsibilities for emergency management are shared
  - Provinces and territories have the primary authority in an emergency
  - Province to formulate an emergency plan for emergencies arising in connection with nuclear facilities
- The ***Nuclear Safety and Control Act***:
  - Provides the Canadian Nuclear Safety Commission (CNSC) with its regulatory authority
    - ✓ Regulate the use of nuclear energy and materials to protect the health, safety and 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

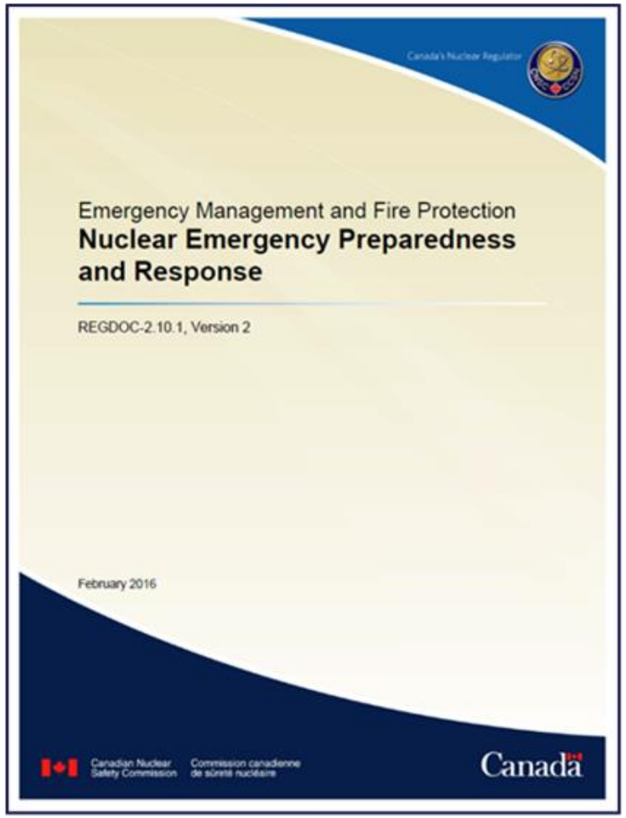
CNSC Regulatory Framework

- ***Nuclear Safety and Control Act*** **(NSCA)**
  - Enabling legislation
- **Regulations**
  - High-level requirements
- **Licences, Licence Conditions Handbooks, Certificates**
  - Facility and/or activity specific requirements
- **Regulatory Documents**
  - Include requirements and guidance



CNSC Regulatory Document 2.10.1, Nuclear Emergency Preparedness and Response

- Sets out EPR requirements for Class I nuclear facilities and uranium mines and mills
- Aligned with IAEA guidance and incorporated Fukushima lessons learned
- Current version was published in 2016 and is undergoing review and updates as part of the SMR readiness REGDOC
  - Application of the graded approach that is commensurate with risk
  - An alternate approach may be proposed to demonstrate the intent of a requirement is addressed
  - EP Program to be driven/based on the facility's planning basis



Canadian National Emergency Response Framework

OPERATOR

- Prevent
- Regain control
- Mitigate
- Provide info to offsite authorities & the regulator

LOCAL & PROVINCIAL GOVERNMENT

- Protection of residents
  - Alerting
  - KI pills
  - Sheltering
  - Evacuation

FEDERAL GOVERNMENT

- Support to province
- National coordination
- Cross border
- International matters

Shared responsibility:

- Relies on ongoing cooperation between all levels of government and their partners

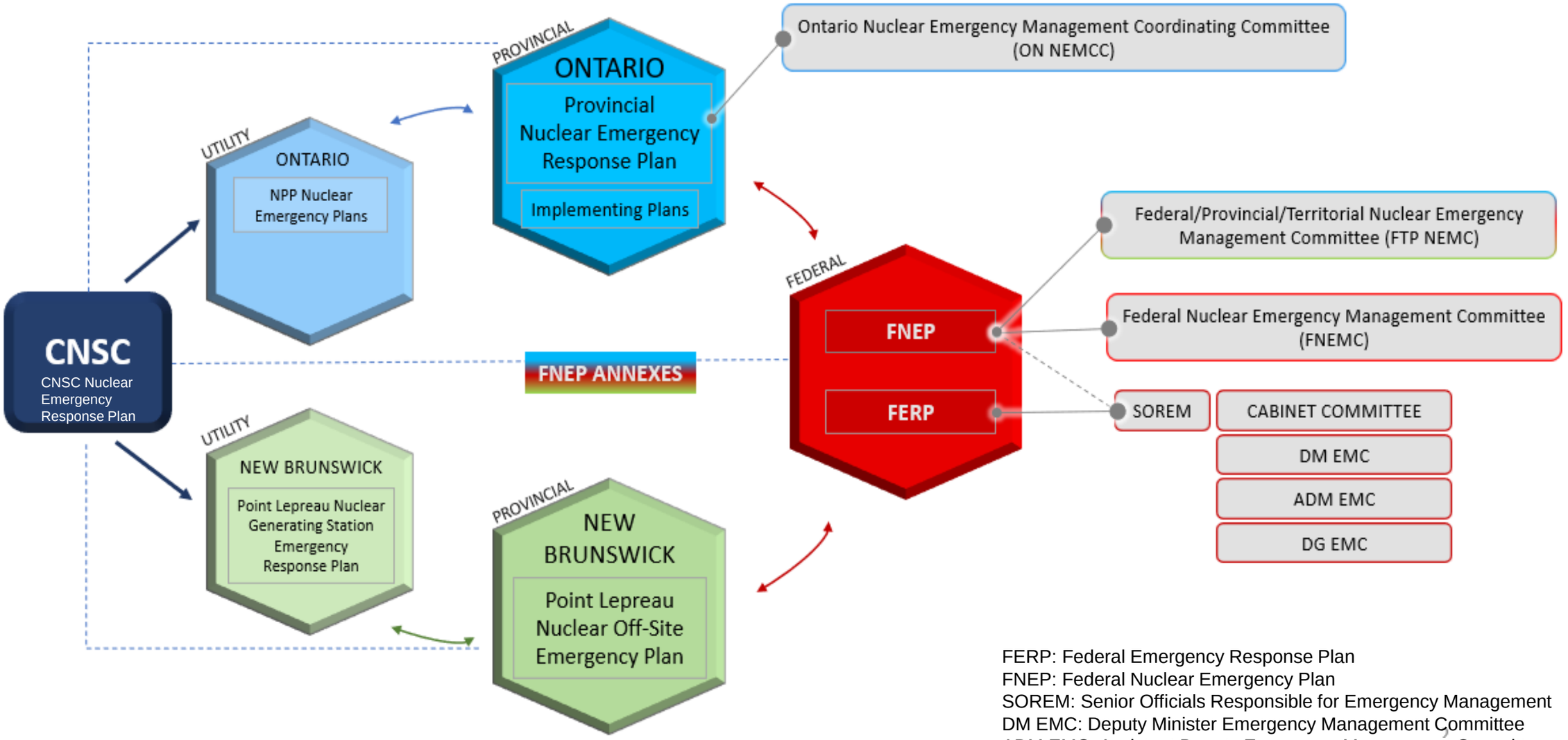
Bottom-up, all-hazards approach:

- Local authorities and Provincial/Territorial governments provide the first response to most emergencies
- If an emergency threatens to overwhelm provincial or territorial resources, the federal government may support at the request of the province or territory

REGULATOR

- Regulatory oversight of operator
- Disseminate information
- Support to Federal and International response
- Domestic Competent Authority (onsite)

Coordination of Emergency Response Plans/Jurisdictions



FERP: Federal Emergency Response Plan
FNEP: Federal Nuclear Emergency Plan
SOREM: Senior Officials Responsible for Emergency Management
DM EMC: Deputy Minister Emergency Management Committee
ADM EMC: Assistant Deputy Emergency Management Committee
DG EMC: Director General Emergency Management Committee

Protective Actions Strategies-Two Different Approaches

Bruce Nuclear Generating Station

Darlington Nuclear Generating Station

Pickering Nuclear Generating Station

Point Lepreau Generating Station

Ontario

- Protection strategy is dependent on the type of the accident:
  - **DBA**: Sufficient time is available to determine the nature of the hazards posed through analysis of the plant status and plant data
  - **BDBA/Severe Accident**: Sufficient time may not be available prior to a radioactive release to undertake analysis, and default protective actions are defined for specific areas in the PNERP Implementing plans
- Protective action decision-making is categorized according to emergency phases:
  - **Early Phase**: Protective measures are based on conservative estimate of the situation. Based on the HC Generic Criteria for actions based on dose projections
  - **Intermediate Phase**: Based on real measurements using OILs

News Brunswick

- Automatic protective actions in the automatic action zone are triggered by emergency action levels
- **Immediate evacuation of Automatic Action Zone at the declaration of a General Emergency**
- During the early stages of an emergency, after urgent protections have been implemented but before measurements are available, GC for exposure control can be compared to projected dose to confirm, that the pre-determined arrangements to protect populations are adequate
- OILs are used to support decision-making post-release to identify the need for or confirming the adequacy of protective actions 9

Protective Actions and Basis of Decision-Making

Potential Exposure Pathways	Basis of Decision-Making			Protective Actions
	Early Response	Intermediate Response	Intermediate/Transition Response	
External radiation from plume	**Based on plant conditions and dose projection models**			• Sheltering • Evacuation • Control of access
Inhalation of radioactivity in the plume				• Sheltering • KI • Evacuation • Control of access
Contamination of skin and clothes		**Based on actual measurements**		• Sheltering • Evacuation • Decontamination of persons
External radiation from ground deposition			**Based on actual measurements and sampling**	• Evacuation • Temporary Relocation • Decontamination of land and property
Inhalation of resuspended radioactivity				• Relocation • Resettlement • Decontamination of land and property
Ingestion of contaminated food and water				• Food and Water Controls

Offsite Emergency Planning Zones

IAEA Planning Zones	HC/CSA Planning Zones	NB EMO Planning Zones (1 Unit station)	Ontario EMO Planning Zones (Multi-units stations)
Precautionary Action Zone	**Automatic Action Zone**	4 km	3 km
Urgent Protective Action Zone	**Detailed Planning Zone**	20 km	10 km
Extended Planning Distance	**Contingency Planning Zone**	50 km	20 km
Ingestion and Commodities Planning Distance	**Ingestion Planning Zone**	57 km	50 km

CNSC Emergency Operations Centre (EOC) Response

CNSC Emergency Response Mandate

Same role before, during and after an emergency

- Provide assurance that appropriate actions are taken to limit the risk to health, safety, security and the environment

Two missions plus one

- Maintain regulatory oversight of licensees' emergency response activities
- Participate in Canada's whole-of-government response
- Provide support to the international response as required
- **Provide reactor accident A&P and source terms prediction for both domestic and international reactor emergencies for Canada**

CNSC Roles and Responsibilities

Manage the CNSC EOC Response

Monitor accident progression, perform forecast/worst case analyses, and assess protective actions and consequences

Provide technical advice and support to stakeholders

Coordinate and cooperate with external organizations

Enforce relevant regulatory and licence conditions

Communicate on the event response

Not unlike what we do in “normal” circumstances, only more rapidly…

CNSC Emergency Response Level

Enhanced monitoring

Enhanced oversight
Key program staff and specialists
(2 to 5 Staff)

Partial activation

Core functions
Limited staff within the EOC
(15-20 Staff)

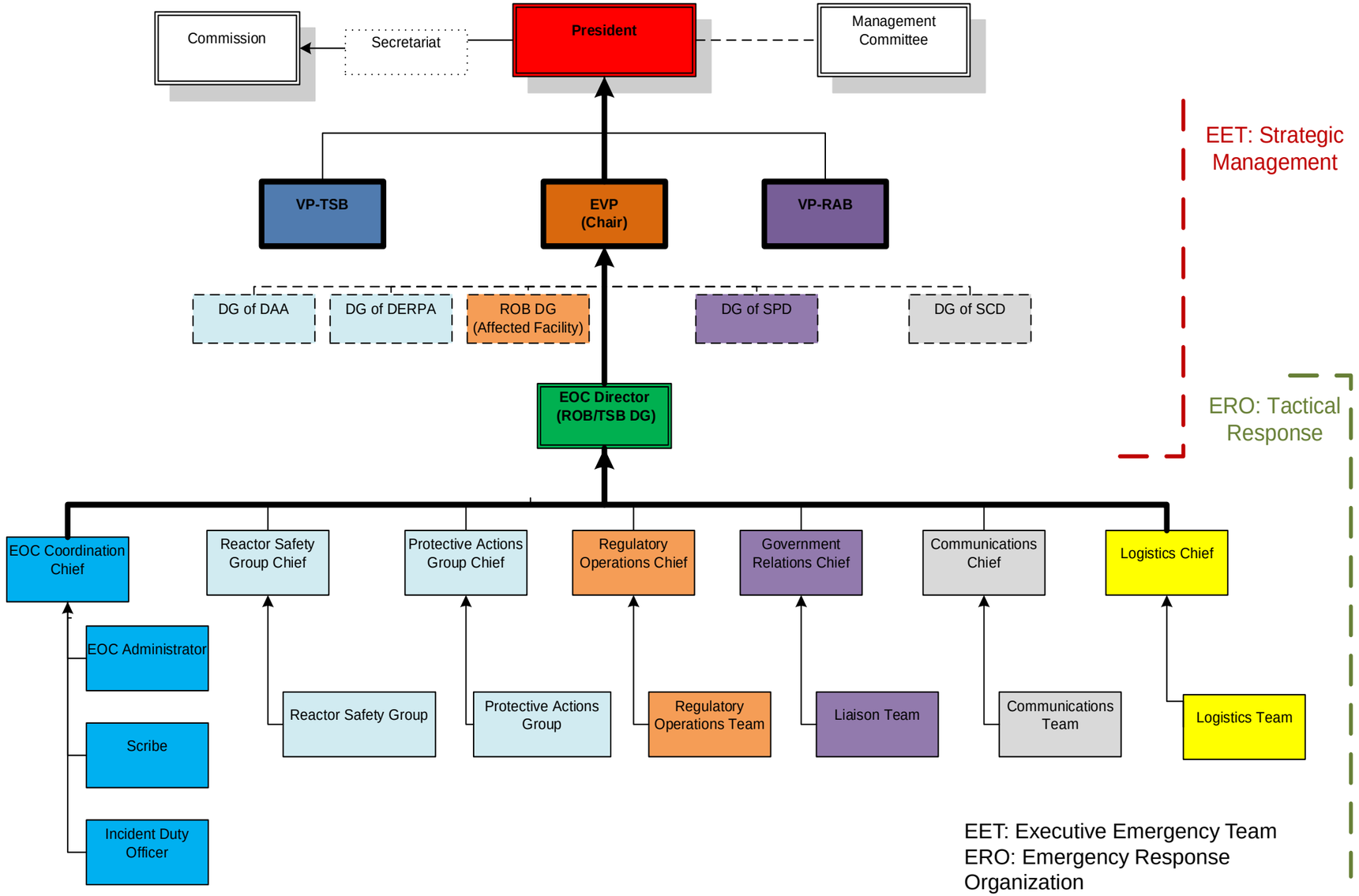
Full activation

All EOC functions
Fully staffed
(30-40 Staff)

MIR3 Notification by CNSC Duty Officer to Activate the EOC

Pre-established EOC activation triggers /
Director general or vice-president decision to activate

CNSC Nuclear Response Organization Structure



EET: Executive Emergency Team
ERO: Emergency Response Organization

In Event of a Reactor Nuclear Emergency

The CNSC Nuclear Emergency Organization will activate in accordance with the CSNC Nuclear Emergency Response Plan

The Reactor Safety Group will be activated to assess the reactor and plant state to:

- predict possible accident progression for key events and timelines
- predict release of fission products
- provide technical info to support the CNSC EOC and offsite response
- liaise with international stakeholders to provide technical information
- forms the FNEP TAG Risk Assessment Group

3 Key Questions

1. What is the onsite situation?

Assess the accident scenario and determine whether the licensee is taking appropriate actions.

2. What is the risk?

Determine if a radiological release would occur and what its magnitude would be.

3. What actions are being taken?

Determine the offsite consequences and provide support to the offsite organizations in order to ensure appropriate actions are taken.

Reactor Safety Group

- Activated to perform accident assessment and prognosis for nuclear reactor accidents
- 8–10 Technical subject matter experts in:
  - Severe accident phenomenology
  - Source terms estimation/modelling
  - Safety systems design/analysis
  - Reactor physics and fuel behaviour

CNSC Assessment & Prognosis (A&P)

CNSC WebEOC: CNSC Response Coordination Tool

Onsite info → Accident assessment: Diagnosis and prognosis → Technical info products

4D/4P METHODOLOGY

Status of the barriers

Releases

Status of the safety function maintaining barrier integrity

Availability of systems used for safety function control

Diagnosis

Prognosis

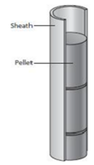
Potential safety barrier status

Releases

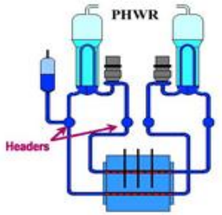
Forecast of the safety function maintaining barrier integrity

Forecast of systems availability for safety function control

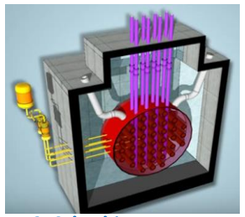
CANDU 4D/4P Fission Products Barrier



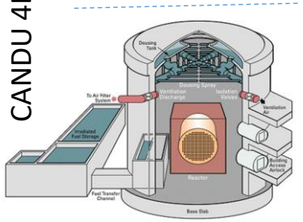
1. Fuel matrix and sheath



2. Heat transport system (HTS)



3. Calandria vessel



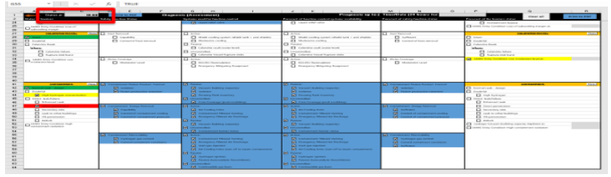
4. Containment

CNSC A&P Toolbox

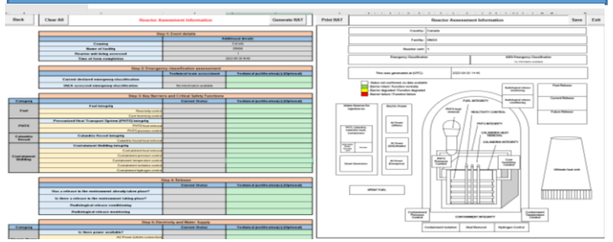
4D/4P Automated Tool

Plant Data Trending Tool

4D/4P Site-Specific Grids

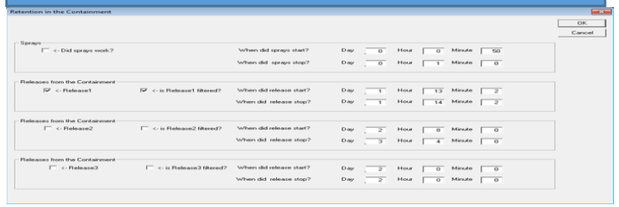


IAEA RAT

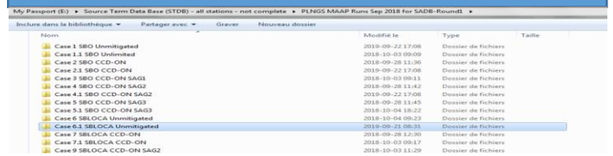


Source Terms Tools

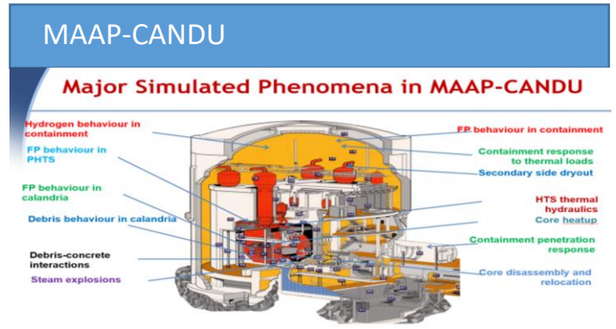
VETA



Source Terms Database

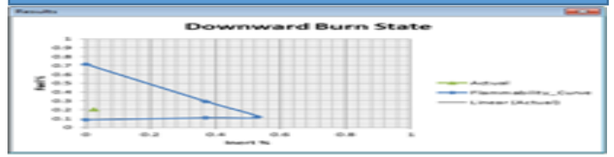


MAAP-CANDU



CNSC In-House Tools

CHAT



Severe Accident Handbook

BAYLOCA: For Irradiated Fuel Bay Accident

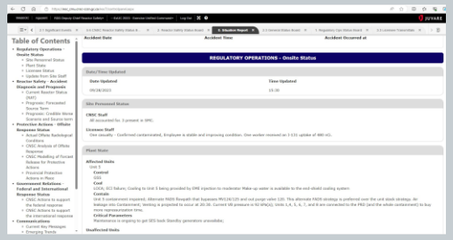
Other Tools

REPRESS: For multi-unit CANDU NPPs

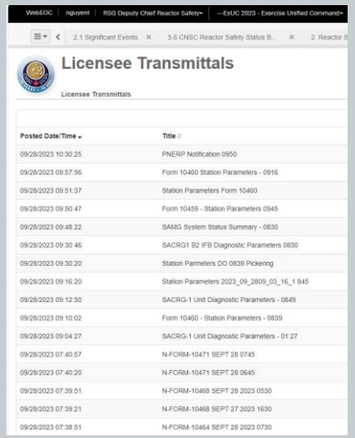
RASCAL and Unified RASCAL Interface

CNSC A&P Products

Onsite Information/Plant Data



CNSC Site Staff



Hourly Plant Transmittals

CNSC A&P Technical Tools

Plant Data Trending Tool

4D/4P Site-Specific Grids

CNSC In-House Tools

CHAT

Severe Accident Handbook

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Licensee Tools

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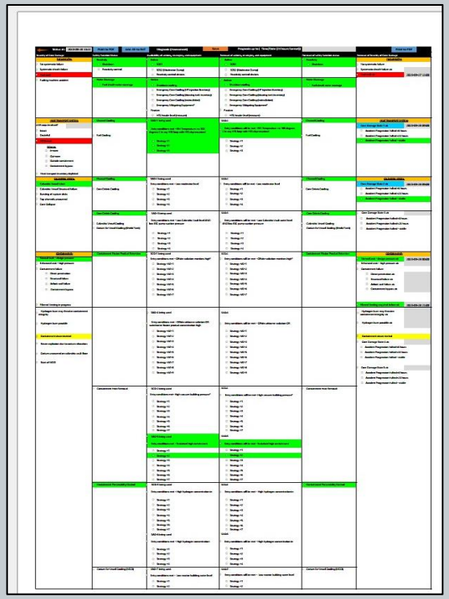
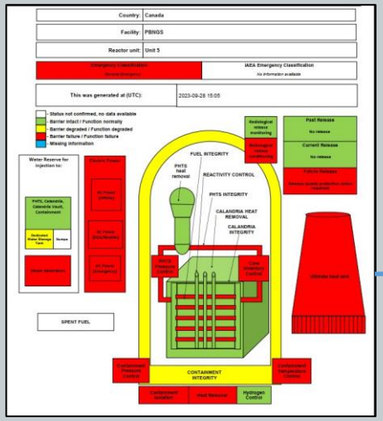
CNSC A&P Products

Pre-Severe Accident Grid



Post-Severe Accident Grid

Source Terms Determination

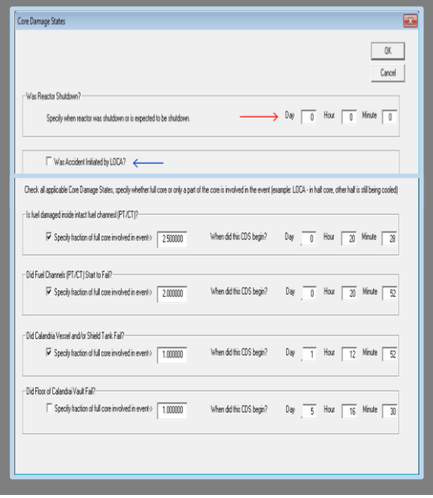


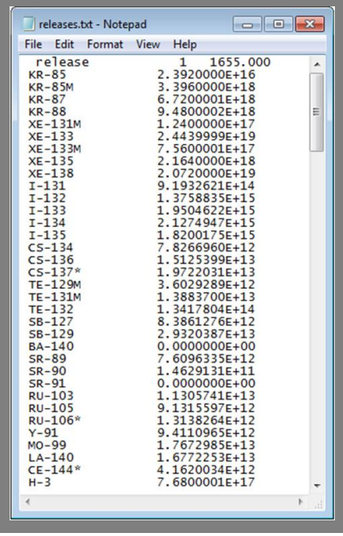
Reactor Assessment Tool Product (IAEA RAT)

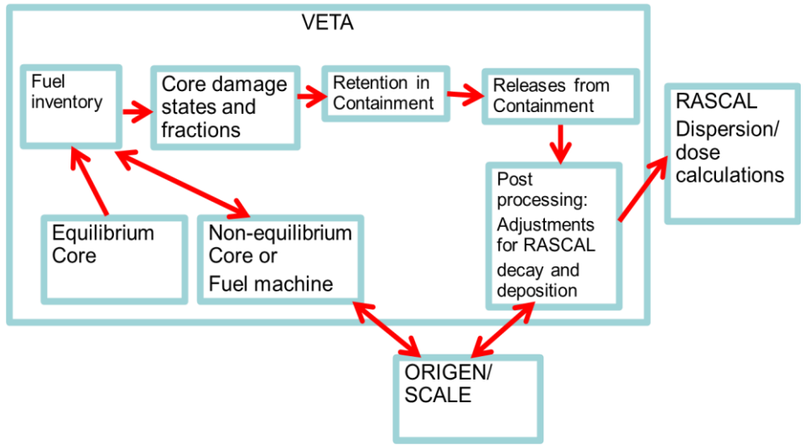
CNSC Technical Product to External Stakeholders

VETA-CNSC CANDU Source term Software

- **V**isual **E**OC Source **T**erm **A**ssessment
- Developed in 2011 by CNSC specialists
- Symptoms-based and designed to reproduce results of MAAP-CANDU
- Aligns with CNSC 4D/4P A&P (based on the CANDU's 4 core damage states)
- Predicts accident releases for both design basis accidents and beyond design basis accidents
- Participated in the International Benchmarking of Fast-Running Software Tools Used to Model Releases During Nuclear Accidents







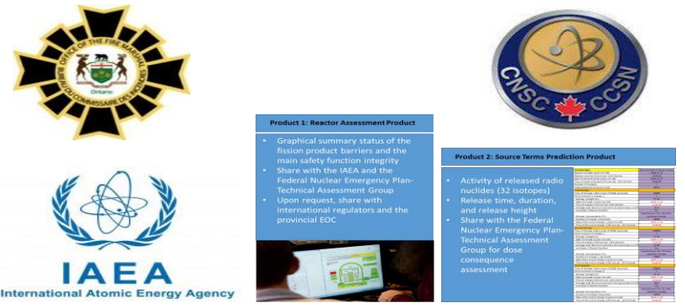
VETA Tools Suite:

- SCALE (**S**tandardized **C**omputer **A**nalyses for **L**icensing **E**valuation)
  - Calculates Initial inventory for 'Non-Standard Core' or for Fuel Machine
  - Calculates decay of nuclides included in the source term
- RASCAL (**R**adiological **A**ssessment **S**ystem for **C**onsequence **A**na**L**ysis)

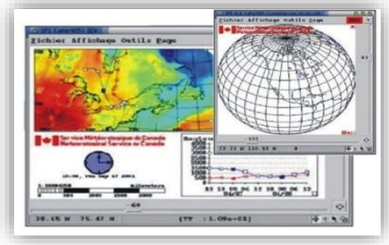
- **VETA Source term is imported into RASCAL for CNSC dose assessment**
- **VETA Source term provided to FNEP for dose assessment**

FNEP TAG Response

- **Source term characterisation – based on information provided by the CNSC**
  - How much radioactive material could be/has been released?
  - How might this change over time?
- **Hazard prediction – modelling**
  - Where might a radioactive release go?
  - What are the potential pathways and exposures?
- **Hazard assessment – measurements / modelling**
  - Where has the radiation actually gone?
  - What are the potential pathways and exposures?
- **Hazard impact**
  - What is the impact on population and environment?
  - What are recommended protective actions?
- **Information sharing/Situational awareness/Common Operating Picture**
  - Mapping & situational awareness reports
  - Shared with other EOCs and Global Affairs Canada



Accident and Source term Information

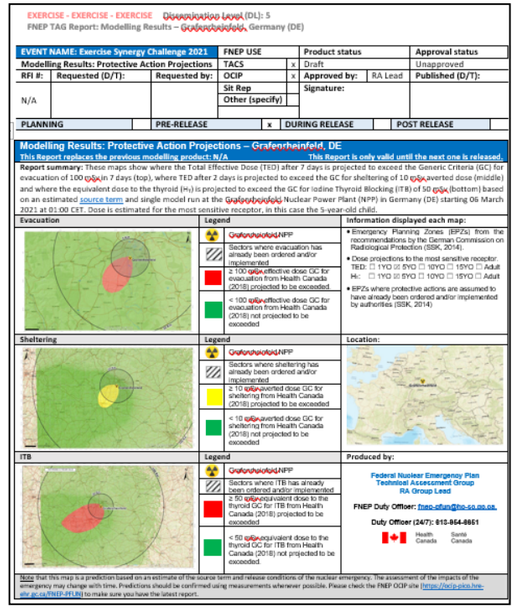


Modelling

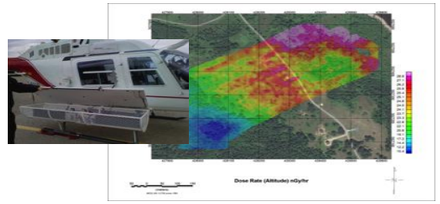
Radiation Monitoring Networks

Ground Surveys and Population Monitoring

FNEP TAG Product



Aerial Surveys



International Accident Support

- Under IAEA RANET agreement, Canada provides the following support:
  - PHWR Nuclear Power Reactor Accident Analysis, Radiation Survey, Source Search and Recovery, and Dose Assessment
- MOUs with other regulators for collaboration and support, including:
  - US NRC, UK ONR, FRA ASN/IRSN, KOR NNSC/KINS, JAP NSA

National Exercises

National Exercises

- REGDOC 2.10.1 requires Nuclear Power Plants to conduct a full-scale exercise every 3 years
  - Participation to include the operator, offsite organizations/province, FNEP, and the regulator
  - Usually takes 1 year to prepare and develop a full-scale exercise
  - Number of participating response organization could range from 20-50
- Canada routinely exercise with our international counterparts and participate in the ConvEx and INEX exercise series

Recent National Exercises since 2017

- **2017**: Darlington, Pickering NPPs
- **2018**: Pt. Lepreau NPP
- **2019**: Bruce, Darlington NPPs
- **2020**: Darlington, Pickering, Bruce NPPs
- **2021**: Pt. Lepreau NPP
- **2022**: Darlington, Bruce NPPs
- **2023**: Bruce, Pickering NPPs

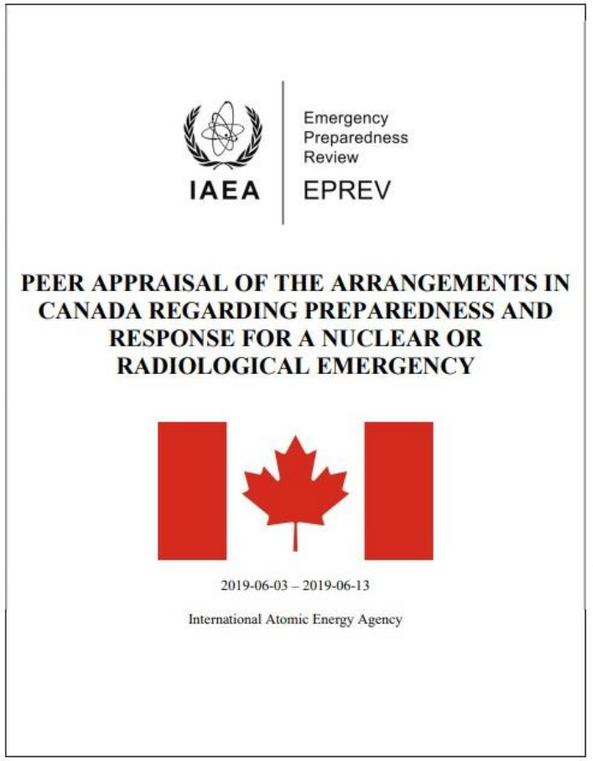
Exercise Unified Response, May 2014

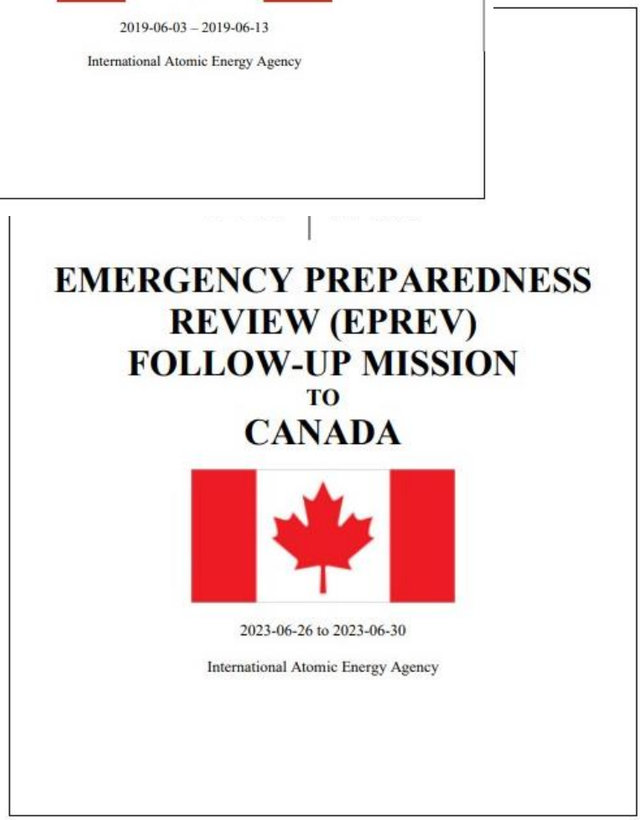
- A national exercise at the Darlington Nuclear Generating Station
  - 3 Days full-scale exercise
  - A severe accident that required a coordinated response from 50 Canadian government agencies and regional organizations
- The IAEA IEC fully participated
  - Tested its assessment of situation and prognosis
  - Conclusions were discussed with the official counterparts at the CNSC
  - First time the IEC tested its A&P in a Member State national level exercise

"Taking part in this large-scale Canadian national exercise helped us sharpen our skills by testing our ability to provide an assessment and prognosis in a real-time scenario," said Elena Buglova, Head of the IEC. **"This was the first time the IEC was given an opportunity to test its capabilities to perform assessment and prognosis in a Member State national-level exercise, and we found it to be a useful complement to our own exercises**."

EPREV-Canada 2019 & Follow-up 2023

- Canada hosted an **E**mergency **P**reparedness **Rev**iew Mission in June 2019
  - First G7 country to host an EPREV mission
  - A peer review conducted by an international team of experts under the coordination of the IAEA
  - Based on IAEA Safety Standards and guidance in EPR
  - Findings included: 6 recommendations, 6 suggestions and 5 good practices
- A Follow-Up Mission was conducted in June 2023 with the focus
  - Focused on the outcome of the Action Plan to address the EPREV findings
  - All recommendations and suggestions from 2019 are closed





Summary

- Nuclear emergency management in Canada:
  - A shared responsibility between the different levels of government
  - Established and maintained through a mature regulatory and EPR regime, that is fully aligned with IAEA safety standards and associated international conventions
  - A&P is an important component to support protective actions recommendations for the federal response
  - EPREV and Follow-Up missions found that Canada EPR system is well-developed and mature across all levels of government
  - Continuous improvement based on lessons learned from national and international exercises, and from real event response

Thank you