



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
 - $\checkmark\,$ Disseminate objective scientific, technical and regulatory information to the public



CNSC Regulatory Framework



- Nuclear Safety and Control Act (NSCA) Enabling legislation
- Regulations

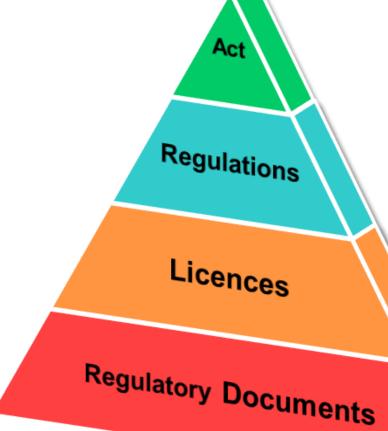
• High-level requirements

 Licences, Licence Conditions Handbooks, **Certificates**

• Facility and/or activity specific requirements

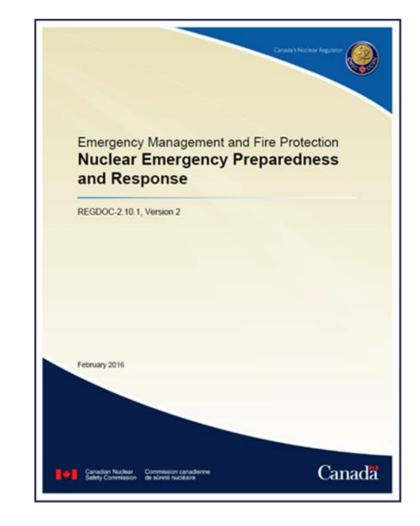
Regulatory Documents

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



| | | FEDERAL GOVERNMENT | Sharad racponcibility: |
|---|--|--|---|
| | LOCAL & PROVINCIAL GOVERNMENT | Support to province National coordination | Shared responsibility: Relies on ongoing cooperation between all levels of government and their partners |
| OPERATOR Prevent Regain control | Protection of residents – Alerting – KI pills – Sheltering | Cross border International matters | |
| Mitigate Provide info to offsite authorities & the regulator | – Evacuation | Local authorities | nazards approach: s and Provincial/Territorial rovide the first response to ties |

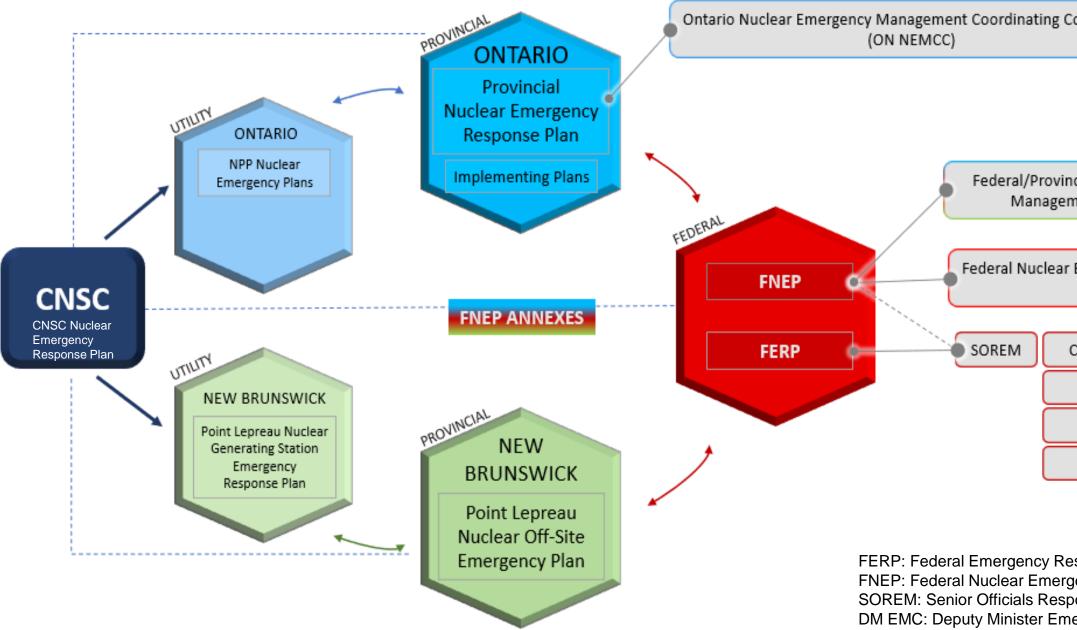
 If an emergency threatens to overwhelm provincial or territorial resources, the federal government may support at the request of the province or territory

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

| ommittee | |
|----------|--|
|----------|--|

Federal/Provincial/Territorial Nuclear Emergency Management Committee (FTP NEMC)

Federal Nuclear Emergency Management Committee (FNEMC)

CABINET COMMITTEE

DM EMC

ADM EMC

DG EMC

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: ٠
 - **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: ٠
 - 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 | | Basis of Decision-Mak | ing | Protective Actions |
|------------------------------------|---------------------------|------------------------------|-------------------------------------|--------------------------------------|
| Pathways | Early Response | Intermediate Response | Intermediate/Transition Response | |
| External radiation from plume | Based on plant conditions | | | Sheltering |
| | and dose projection | | | Evacuation |
| | models | | | Control of access |
| Inhalation of radioactivity in the | | | | Sheltering |
| plume | | | | • KI |
| | | | | Evacuation |
| | | | | Control of access |
| Contamination of skin and | | Based on actual measurements | | Sheltering |
| clothes | | | | Evacuation |
| | | | | Decontamination of persons |
| External radiation from ground | | | Based on actual measurements | Evacuation |
| deposition | | | and sampling | Temporary Relocation |
| | | | | Decontamination of land and property |
| Inhalation of resuspended | | | | Relocation |
| radioactivity | | | | Resettlement |
| | | | | Decontamination of land and property |
| Ingestion of contaminated food | | | | Food and Water Controls |
| and water | | | | |

Offsite Emergency Planning Zones

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



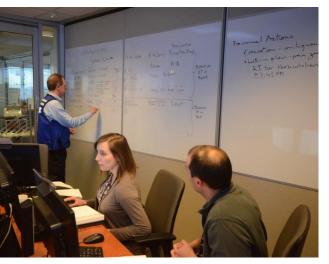


CNSC Emergency Operations Centre (EOC) Response









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 | |
|---------------------------------|---|--|
|---------------------------------|---|--|

Coordinate and cooperate with external organizations Enforce relevant regulatory and licence conditions

Not unlike what we do in "normal" circumstances, only more rapidly...

Provide technical advice and support to stakeholders

Communicate on the event response

CNSC Emergency Response Level



Enhanced monitoring

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

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

All EOC functions

MIR3 Notification by CNSC Duty Officer to Activate the EOC

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

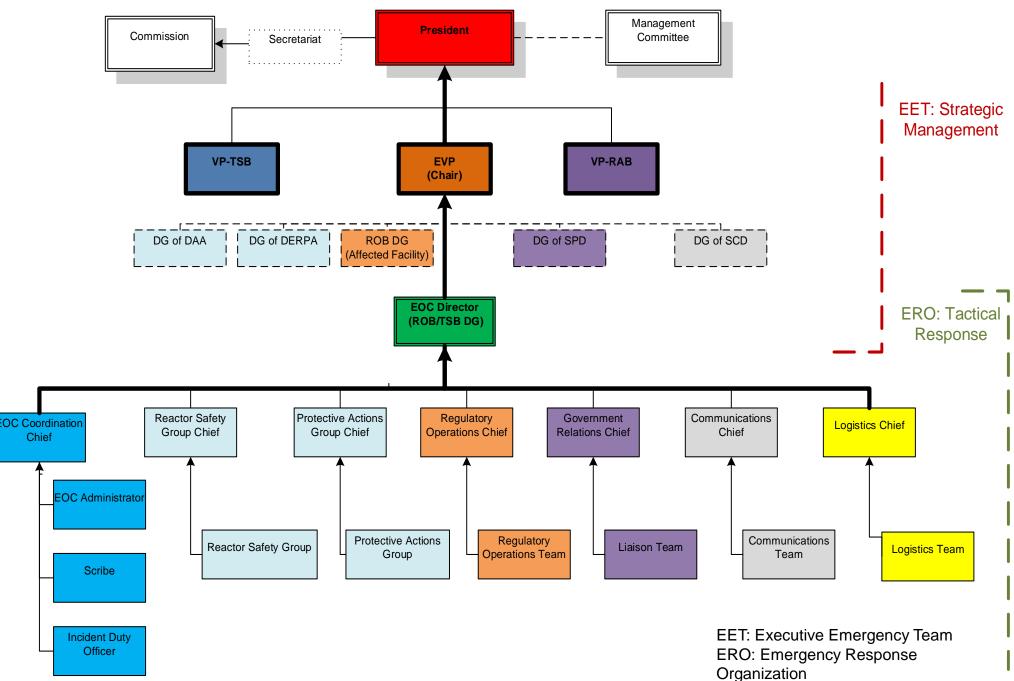
Fully staffed

(30-40 Staff)



CNSC Nuclear Response Organization Structure







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

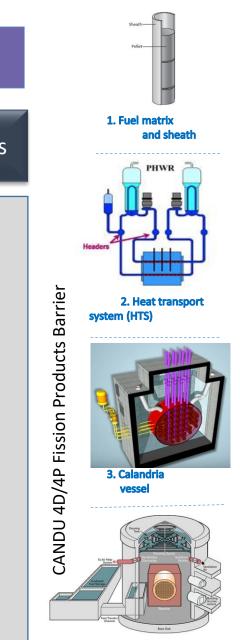
- Activated to perform accident assessment and prognosis for nuclear reactor accidents
- 8–10 Technical subject matter experts in:
 - Severe accident phenomenology
 - Source terms estimation/modelling
 - Safety systems design/analysis
 - Reactor physics and fuel behaviour



CNSC Assessment & Prognosis (A&P)



CNSC WebEOC: CNSC Response Coordination Tool Accident assessment: Diagnosis and Technical info products Onsite info prognosis 4D/4P METHODOLOGY Status of the safety function Availability of systems used for Status of the barriers maintaining barrier integrity safety function control Releases Diagnosis Prognosis Potential safety barrier status Forecast of the safety function Forecast of systems availability for safety function control maintaining barrier integrity Releases



4. Containment

CNSC A&P Toolbox



4D/4P Automated Tool

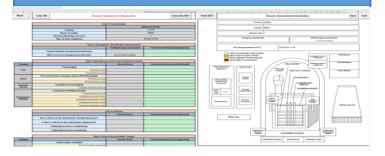
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Plant Data Trending Tool

4D/4P Site-Specific Grids

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IAEA RAT



Source Terms Tools

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| | | When did sprays stop? | Day | , 0 | Hour | 1 | Minute | 0 | |
| Releases from the Containment | | | | | | | | | |
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Source Terms Database

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| Lase 2 SBO CCD-ON | 2018-09-28 11:36 Dossier de fichiers |
| Lase 2.1 SBO CCD-ON | 2019-09-22 17:08 Dossier de fichiers |
| Case 3 580 CCD-ON SAG1 | 2018-10-03 09:11 Dossier de fichiers |
| Lase 4 5BO CCD-ON SAG2 | 2018-09-28 11:42 Dossier de fichiers |
| Case 4.1 SBO CCD-ON SAG2 | 2019-09-22 17:08 Dossier de fichiers |
| Lase 5 SBO CCD-ON SAG3 | 2018-09-28 11:45 Dossier de fichiers |
| Case 5.1 SBO CCD-ON SAG3 | 2018-10-04 18:22 Dossier de fichiers |
| Lase 6 SBLOCA Unmitigated | 2018-10-04 09:23 Dossier de fichiers |
| 👍 Case 6.1 SBLOCA Unmitigated | 2019-09-21 08:33 Dossier de fichiers |
| Case 7 SBLOCA CCD-ON | 2018-09-28 12:30 Dossier de fichiers |
| Case 7.1 SBLOCA CCD-ON | 2018-10-03 09:17 Dossier de fichiers |
| Case 9 SBLOCA CCD-ON SAG2 | 2018-10-03 11:29 Dossier de fichiers |

MAAP-CANDU



CNSC In-House Tools



cident Handbook

evere Accidents Handbook Point Lepreau



BAYLOCA: For Irradiated Fuel Bay Accident

Other Tools

REPRESS: For multi-unit CANDU NPPs

RASCAL and Unified RASCAL Interface

CNSC A&P Products

X > B



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Hourly Plant Transmittals



CNSC A&P Products Pre-Severe Accident Grid Country: Canada Facility: PBNGS Reactor unit: Unit 5 Gerlangekorta Salaringenariskatören Autoringenariskatören Salaringenariskortak Incompany of the set of the -----Ξ This was generated at (UTC): 2023-09-28 15:05 Incording of a bargebbi bargebbi bargebbi bargebbi bargebbi bargebbi bargebbi bargebbi bargebbi Conservations Conservations Conservations Conservations More hang again been at Al Argunition discuss (M - Kang Mil Berning den Terring d Selamat ann anta Garlinny fan La - Antar Suyann Aind Starr - Antar Suyann Aind Starr - Antar Suyan Aind Dedicated Natur Electors Tank IIIII IIIII SPENT FUEL IIII -H IIIIII III III = - 1000 -Reactor Assessment Tool Product (IAEA RAT) Post-Severe Accident Grid

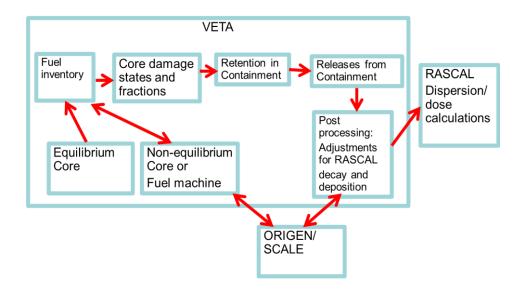


VETA-CNSC CANDU Source term Software



- Visual EOC Source Term Assessment
- 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**

| | | | | OK. |
|--|---|---------------------|-------------------|----------------------------|
| | | | | Cancel |
| Was Reactor Shutdown? | | | | |
| | | Day 1 | Here The | Martin Tar |
| Specify when reactor was shutdown or is expected to be shutdown. | \longrightarrow | Day 0 | Hour |) Minute 0 |
| □ Was Accident Initiated by LOCA? | | | | |
| Check all applicable Core Damage States, specify whether full core or only a part of | I the care is involved in the event (ex | anple: LOCA - in ha | if core, other hi | alf is still being cooled) |
| Is fuel damaged inside intact fuel channes! (PT/CT)? | | | | |
| | | . — | | |
| Specify fraction of full core involved in event> 2500000 | When did this CDS begin? | Day 0 | Hour 2 | 90 Minute 28 |
| Did Fuel Channels (PT/CT) Start to Fai? | | | | |
| Specily fraction of full core involved in event> 2,000000 | When did this CDS begin? | Day 0 | Hour | 20 Minute 52 |
| Did Calandiia Vessel and/or Shield Tank Fail? | | | | |
| ✓ Specily fraction of full core involved in eventi> 1.000000 | When did this CDS begin? | Day _ 1 | Hour 1 | 12 Minute 52 |
| Did Floor of Calendiai Vault Fail? | | | | |
| □ Specily fraction of full core involved in event > 1,000000 | When did this CDS begin? | Day _ 5 | Hour 1 | 16 Minute 30 |
| | | | | |



VETA Tools Suite:

- SCALE (Standardized Computer Analyses for Licensing **E**valuation)
 - Calculates Initial inventory for 'Non-Standard Core' or for Fuel Machine
 - Calculates decay of nuclides included in the source term
- RASCAL (Radiological Assessment System for Consequence AnaLysis)
- **VETA Source term is imported into RASCAL for** ٠ **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











Modelling



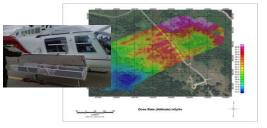




FNEP TAG Product

| EVENT NAME: Exercise Synergy Challenge 20 | | | | | | Product s | tatus | | | Approval status | | |
|--|--|-----------------------|--|---|--|------------|----------------------|--|--|----------------------------------|------------------|------|
| Modelling Results: Protective Action Project | | | TACS | | | Draft | | | | Unapproved | | |
| RFI #: Requested (D/T): Requeste | | Requeste | d by: | | | х | Approve Signature | | | Publish | Published (D/T): | |
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| Evacuation | | | | Legend | | | | | Information displayed each map: | | | |
| | | | - | Colorbioloid.NPP Sectors where evacuation has already been ordered and/or implemented | | | | | Emergency Planning Zones (EPZs) from te recommendations by the German Commission (Radiological Protection (SSK, 2014). Dose projections to the most sensitive receptor TED: 11YO 05 5YO 110YO 115YO Add H: 11YO 05 5YO 110YO 115YO Add H: EPZs where protective actions are assumed to | | | |
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| | | | 1 | | | | | | | | | |
| | | | | ≥ 100 gr6x effective dose GC for | | | | | | | | |
| | | | | evacuation from Health Canada (2018) projected to be exceeded. | | | | | | | | |
| | | | | < 100 geneficative dose GC for | | | | | | ective actions in ordered and | | |
| | | | | evacuation from Health Canada (2018) not projected to be | | | | | by authorities (SSK, 2014) | | | |
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| Challend. | | 10 -1 | Lege | | | | | Locatio | | | | |
| Shothering | | | - Lege | | | | | E alter | | | | 10 |
| | | | - | Sectors where sheltering has already been ordered and/or | | | | | | | | |
| | | | 11 | | | | | | | | | |
| | | | | 2:10 pgp, averted dose GC for sheltering from Health Canada (2018) projected to be exceeded | | | | | | | | |
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| | | | | | | | | the second | | | | 5 |
| | | | | | < 10 www.averted.dose.GC1 sheltering from Health Cana | | | 100 | | C = - | The seal of | |
| LA STATISTICS | | | | (2018) not projected to be exceeded | | | | | | | | |
| 100 | | | Legend | | | | | | 100 | | 1.000 | |
| ITB | And the second second second | | | Graforuhoioloid.NPP | | | | Produced by: Federal Nuclear Emergency Plan Technical Assessment Group | | | | |
| | | i i | * | | here ITB has already | | | | | | | |
| | | 11 | been ordered and/or implemented ≥ 50 gRaveguivalent dose to the | | | | | R | A Group Lea | d | | |
| | | | | thyroid GC for | | | Health | FNEP | Duty Off | oer: fneo-ofu | n@ho-so.co | 2.02 |
| | | | | Canada (2018) projected to be exceeded | | | | Duty Officer (24/7); 613-854-8851 | | | | |
| | | YAN ST | | | | | | 1 ' | July Unit | Health | Santé | |
| EA. | | | | < 50 glovequivalent dose to the thyroid GC for ITB from Health | | | | Canada Canada | | | | |
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| | this map is a prediction bases | | | | | | | | | | | |

Aerial Surveys



International Accident Support





Under IAEA RANET agreement, Canada provides the following support:

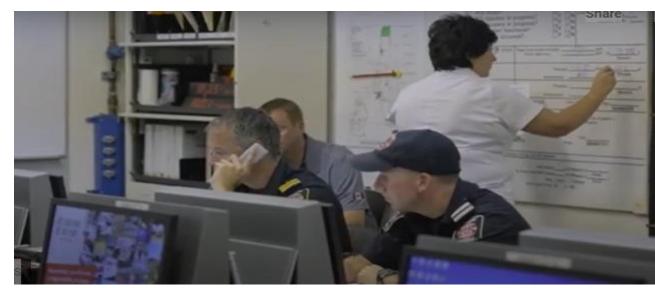
- PHWR Nuclear Power Reactor Accident Analysis, Radiation Survey, Source Search and Recovery, and Dose Assessment
- MOUs with other regulators for collaboration and support, including:
 - US NRC, UK ONR, FRA ASN/IRSN, KOR NNSC/KINS, JAP NSA



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

- NPPs

- **Bruce NPPs**



Recent National Exercises since 2017

• **2017**: Darlington, Pickering

• 2018: Pt. Lepreau NPP

• **2019**: Bruce, Darlington NPPs

• 2020: Darlington, Pickering,

• 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 Emergency Preparedness **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





Emergency Preparedness





PEER APPRAISAL OF THE ARRANGEMENTS IN CANADA REGARDING PREPAREDNESS AND RESPONSE FOR A NUCLEAR OR RADIOLOGICAL EMERGENCY

International Atomic Energy Agency

EMERGENCY PREPAREDNESS **REVIEW (EPREV)** FOLLOW-UP MISSION TO

CANADA



2023-06-26 to 2023-06-30

International Atomic Energy Agency



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

