



Information Update on CNSC's Early Role in NWMO's Adaptive Phased Management



CNSC Staff Presentation

Commission Meeting

April 27, 2021

CMD 21-M17



Previous Updates to the Commission on CNSC's role in the NWMO's APM

| Commission Meeting Date | CMD number | Title |
|-------------------------|------------|--|
| November 9, 2017 | CMD 17-M50 | Update on CNSC's Early Role in an Initiative for a Deep Geological Repository (DGR) for the Long-term Management of Canada's Used Nuclear Fuel |
| December 14, 2016 | CMD 16-M50 | Regulatory Oversight Report for Waste Management, Storage and Processing in Canada: 2015 |
| February 4, 2015 | CMD 15-M4 | CNSC's Early Role in an Initiative for a Deep Geological Repository for the Long-term Management of Canada's Used Nuclear Fuel |
| December 9, 2010 | CMD 10-M73 | CNSC's Role in the Pre-project Phase of the Nuclear Waste Management Organization (NWMO) Adaptive Phased Management (APM) Project |



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Outline for Today's Information Update

- Background on CNSC's Early Role in NWMO's APM
- Outreach and Engagement
- Scientific and Technical Capacity Building
- Readiness to Regulate for the APM Project
- Early Engagement



BACKGROUND ON CNSC'S EARLY ROLE IN NWMO'S APM



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Timeline: Deep Geological Repository Implementation

Pre-licensing Stage

Licensing Stage



Federal regulatory process triggered
Regulatory Submissions:
Licence to Prepare Site application
Impact Assessment project description

Ongoing CNSC Regulatory Involvement



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Impact Assessment of Nuclear Designated Projects

- A DGR for used nuclear fuel will be subject to an integrated assessment under the *Impact Assessment Act* (IAA)
- NWMO expects to identify a preferred site in 2023 and submit an Impact Assessment project description and licence application in 2024
- **CNSC Readiness for APM under the IAA:**
 - Established MOU with the Impact Assessment Agency of Canada (IAAC) available on CNSC's website ([here](#))
 - Regular discussions between CNSC-IAAC-NWMO on the APM project

**A single process to discharge the requirements
of both the IAA and the NSCA – one project, one review**



OUTREACH AND ENGAGEMENT



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Outreach and Engagement Activities

Objective: Explain regulatory role and build relationships with potential host communities

- Outreach is conducted at the request of communities or Community Liaison Committees (CLCs):
 - Presentations to the community at a public CLC meeting
 - Presentations to local schools and youth groups
- Expanded outreach to neighbouring communities
- Meetings with First Nations and Métis communities
- 30+ events have been held in person and virtually since 2018



CNSC staff presenting to a youth group from Aboriginal Peoples of Wabigoon in 2019

Continue to build and expand relationships



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Indigenous Engagement

- Building relationships with the First Nations and Métis communities who may have an interest in learning more is a priority
- Building strong relationships based on trust and mutual respect takes time; CNSC has initiated engagement early
- Reach out directly to nearby Indigenous groups to offer one-on-one meetings in their communities
- Provide information about our early role in the APM process and learn more about each community



CNSC staff presenting at the Wabigoon Sharing and Learning Gathering

**Structured, formalized,
continuous engagement**



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Highlights of Outreach and Indigenous Engagement 2018-2019

- Presentations and hands-on activities with a youth group from the Aboriginal Peoples of Wabigoon (APOW) in Ottawa
- School visits in the South Bruce and Huron-Kinloss area
- Outreach presentations during two Wabigoon Lake Ojibway Nation Learning and Sharing Gatherings
- Presentations at CLC meetings in South Bruce, Hornepayne, Huron-Kinloss, Constance Lake, Manitouwadge, and Ignace



CNSC staff presenting at the Huron-Kinloss CLC meeting 2019.
Photo: CNSC staff



CNSC staff presenting to an elementary school in the South Bruce area in 2019.
Photo: CNSC staff

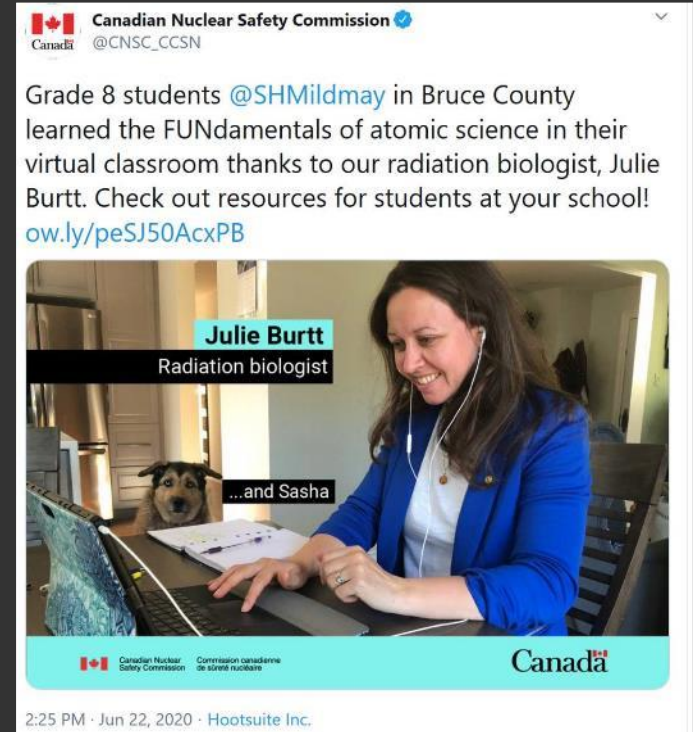
Continuous engagement at the request of community



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Highlights of Outreach and Indigenous Engagement 2020-present

- Virtual school visit in the South Bruce area
- Outreach presentations to South Bruce CLC and Ignace CLC
- South Bruce CLC - *“Meet the Regulator”* webinar and Q&A
- Virtual engagement with First Nations and Métis communities near the Ignace and South Bruce sites



Dialogue and relationship building continue virtually



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CNSC Outreach: Common Topics of Interest

- Role of the CNSC
- Fundamentals of radiation & radiation protection
- Safety - what if something goes wrong
- Indigenous Consultation
- Benchmarking - what are other countries doing?
- Transportation of used nuclear fuel, emergency preparedness and security



CNSC staff presenting at an Ignace CLC meeting 2019



Julia Smith, CNSC project officer using 3D printed models;
continuing to meet with communities in virtual settings



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Challenges in Outreach: some examples

| Challenge | Action |
|---|---|
| Who does what? | Clearly identify CNSC's roles and responsibilities as separate from industry |
| Information is too technical | Develop better science communications tools and presentations |
| Why is CNSC here so early? | Identify benefits of early engagement, before regulatory process is triggered |
| Virtual outreach – no platform for informal one on one discussion | Arrange virtual meetings with technical specialists in a variety of online forums until it is possible to resume in-person meetings |



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Lessons learned from CNSC Outreach and Engagement Activities

- Communities expressed appreciation for a trusted, independent source of scientific information
- Communities like to have the opportunity to talk directly to CNSC technical staff
- Important to
 - Build relationships with communities, First Nations and Métis communities
 - Clarify CNSC's role as the independent nuclear regulator and current pre-licensing involvement
 - Convey technical information that is accessible to all audiences



SCIENTIFIC AND TECHNICAL CAPACITY BUILDING

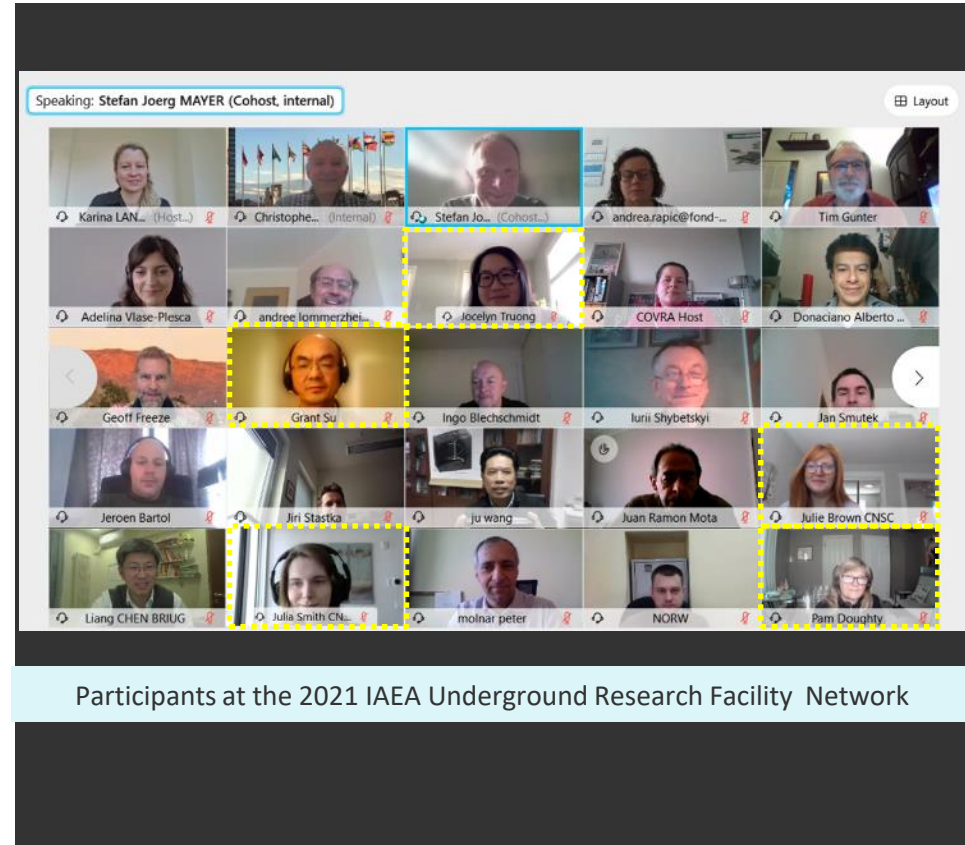


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International Collaboration

International Atomic Energy Agency

- Demonstrating the Safety of Geological Disposal (GEOSAF) – Part III: demonstration of operational and long-term safety of geological disposal facilities for radioactive waste - *chaired by CNSC staff*
- Use of Monitoring Programs in the Safe Development of Geological Disposal Facilities
- Underground Research Facilities Network for Geological Disposal





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International Collaboration

- **OECD-NEA –**
Integration Group for the Safety Case (IGSC)
 - 2019 topical session: paired regulator-operator presentations on updates to the safety case
- **Bilateral Agreements**
 - Swiss Federal Nuclear Safety Inspectorate (ENSI)
 - French Institute for Radiological Protection and Nuclear Safety (IRSN)
- **DE**velopment of **CO**upled models and their **VAL**idation against **EX**periments (**DECOVALEX**)
- Sustainable network for **I**ndependent **T**echnical **EX**pertise on radioactive Waste Management (**SITEX II**)



Two decades of Safety Case Development: An IGSC





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International Collaboration

Regulatory exchange & site visits

Objective: learn from other regulators about their regulatory process, pre-licensing activities, lessons learned, and best practices:

- DGR Regulatory Forum (DGRRF) workshops have been held in Canada (2016), Sweden (2017), Switzerland (2019), and France (2020)
- The next meeting will take place in Finland (2022)



DGRRF workshop site visit, Bure Underground Research Facility, France, January 2020.

Platforms to share knowledge



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DGRRF Countries

Country / DGR – rock type

Status

Canada
– sedimentary or crystalline

Site selection process underway

Finland / Onkalo
– crystalline

Construction licence application submitted
in 2012; granted 2015; expected to begin
operating: 2023

France / Cigeo
– sedimentary

Expected to begin construction
in 2022

Sweden / Forsmark – sedimentary

Expected to begin construction
in 2020s

Switzerland
– sedimentary

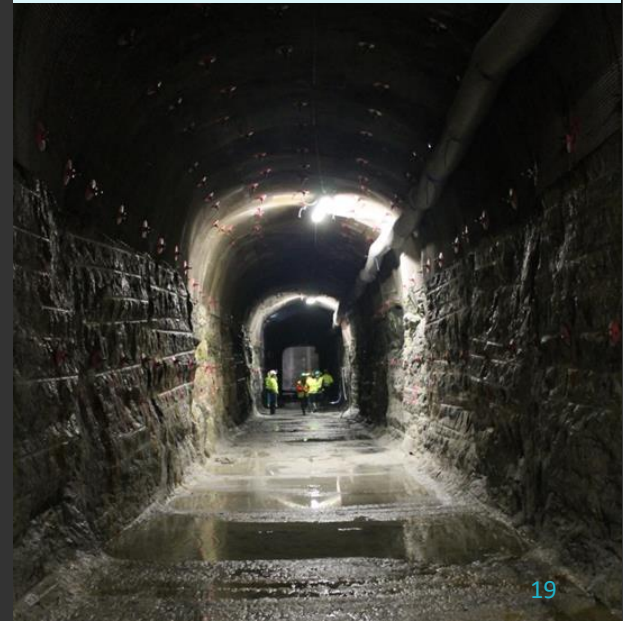
Site selection process underway

U.S.A. / Yucca Mountain
– volcanic

Inactive



On inspection at ONKALO, 2013





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CNSC Research on DGRs

- Since 1978, CNSC has been involved in independent research and assessment on DGRs
- CNSC Strategic Research Agenda for DGRs:
- **Primary objective**, to provide a framework for identifying research needs that:
 - Support CNSC staff's review of the post-closure safety case for disposal, as in **REGDOC 2.11.1** vol. III
 - Inform science-based recommendations made to the Commission
 - Support regulatory oversight activities
- **Secondary objectives**:
 - Builds in-house expertise and promotes knowledge transfer/long-term knowledge management
 - Provides a tool for communicating CNSC's research activities

Goal: protection of people and the environment at all times



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CNSC's Independent Advisory Group (IAG)

Provides objective, independent advice to CNSC staff on geoscience aspects of the initiative for the safe long term management of used nuclear fuel



Dr. Mostafa Fayek
University of Manitoba



Dr. Paul Van Geel
Carleton University



Mr. Peter Flavelle
Consultant



Dr. Vicki Remenda
Queens University



Dr. Stan Pietruszczak
McMaster University



Dr. John Percival
Consultant

Activities include:

- Reviewing documents related to NWMO's research and development program and annual reports
- Reviewing CNSC's DGR research program



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CNSC DGR Research is Focused on Safety

Perturbations



- Excavation
- Heat generation
- Gas generation
- Geological events
- Climate change

Barrier performance




Research results




- Inform CNSC's independent evaluation
- Build knowledge
- Shared with the scientific community and the public

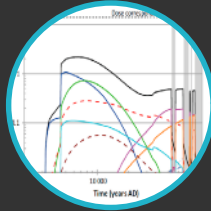
Research Areas

Natural analogues
(**geological barrier**)



Thermal-hydro-mechanical-chemical processes
(**engineered barrier**)



Safety assessment





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Current CNSC Research Activities

- Modelling of Thermal-Hydro-Mechanical-Chemical (THMC) processes:
 - **Gas migration** (multi-phase flow) studies
 - Geomechanics of Cobourg Limestone based on microstructural characterization
 - Fault slip test
 - Hydromechanical and radionuclide transport processes in Cobourg limestone and Canadian Shield rock
- Natural analogues
 - Review of glacial erosion effects
 - **Uranium deposit studies**: 1. Radionuclide transport in the Arctic: quantifying the effects of glaciation; 2. Revisiting Cigar Lake
 - Natural analogues modelling of coupled THMC Processes using paleohydrogeology
- Safety assessment tool development and application
- Performance of buffer and seals under elevated thermal and chemical gradient



CNSC staff site visit, Ignace ON





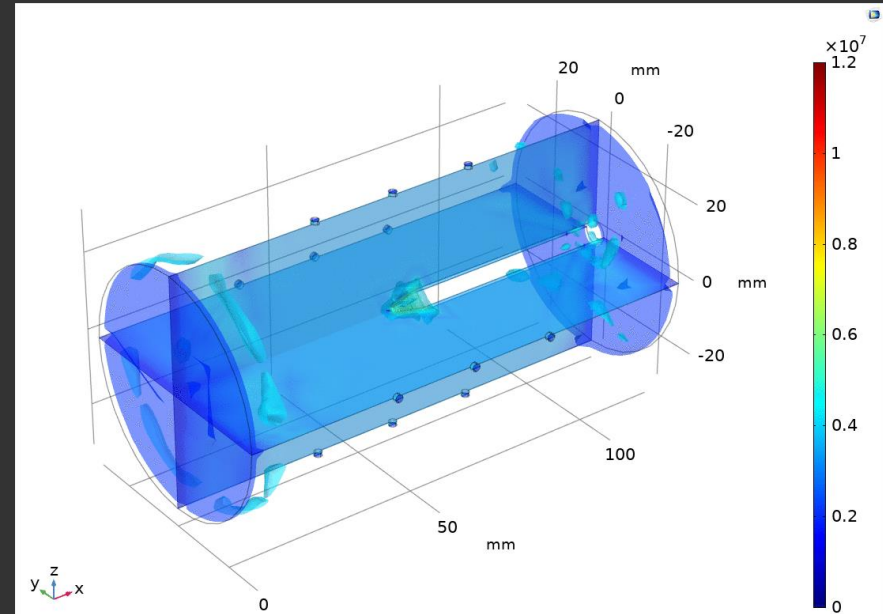
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Research on the Engineered Barrier

Gas Migration studies

- undertaken through an international working group (DECOVALEX)
- Experimental data from facilities in Europe used to inform mathematical models developed by CNSC staff

Objective: to understand gas migration and the formation of flow pathways through the engineered barrier system



3D model of gas migration
(CNSC staff Elias Dagher's PhD thesis, 2020)



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Research on Natural Analogues for DGRs

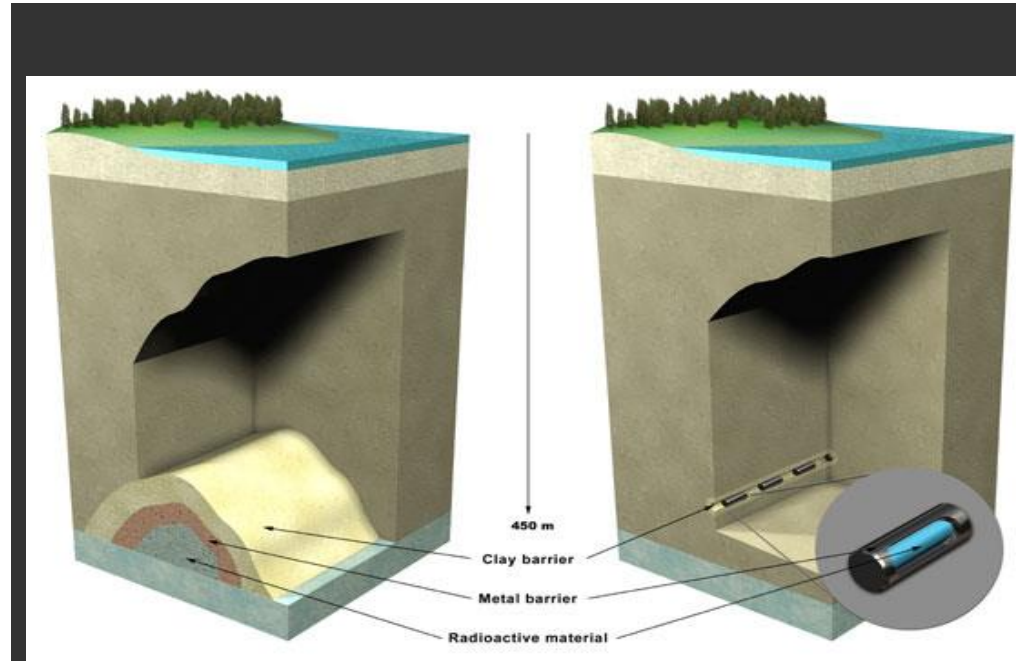
What are they?

A natural feature or process similar to some part of a DGR system.

Why do we need them?

- Geological systems are complex
- Mathematical models of long-term DGR safety use experimental data to simulate expected DGR evolution for many millennia to millions of years

Objective: obtain data on how DGR systems perform, over geologically long timescales associated with safety of geological disposal



Cigar Lake Uranium Deposit as a Natural Analogue



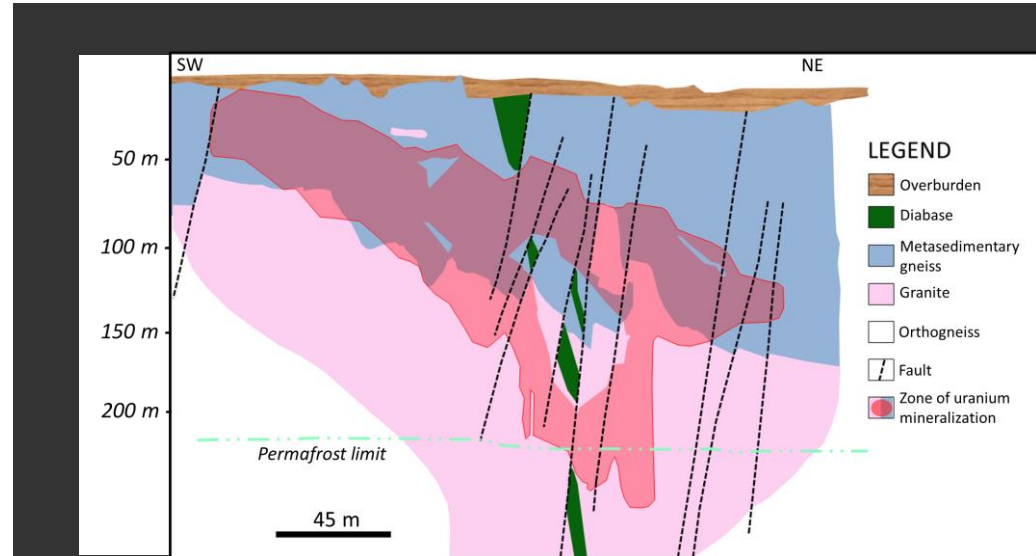
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Natural Analogue Study of Uranium Deposits in the Arctic

Project Overview:

- Natural analogue study of the Kiggavik uranium deposits, Nunavut
- Study uraninite oxidation and migration of uranium and other radionuclides over large spatial and temporal scales in fractured metasedimentary host rock
- Initial work focused on hundreds of archived core samples and thin sections, and 100+ additional thin and thick sections to identify main types and generations of U mineralization

Objective: Quantifying the effects of glaciation on geological disposal projects



Simplified geological cross section of the Kiggavik main zone deposit.
Modified from Areva (2014).



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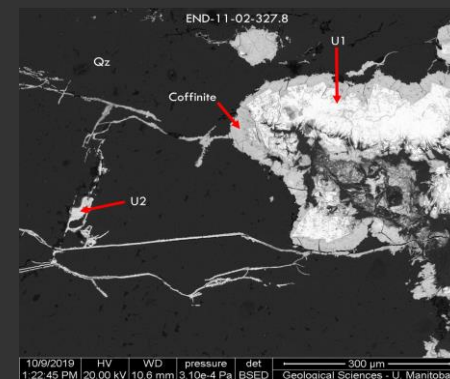
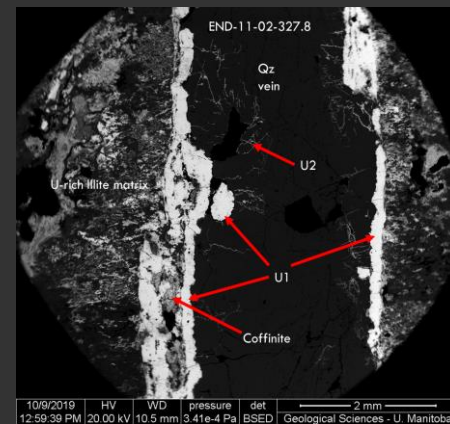
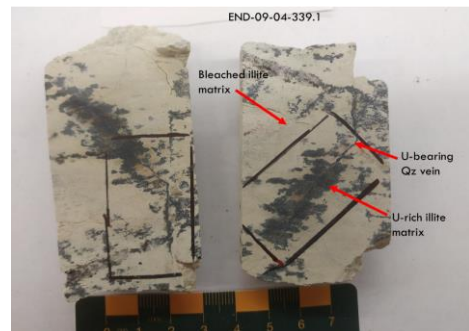
Natural Analogue Study of Uranium Deposits in the Arctic

Research is ongoing, early results show:

- Uraninite is classified into 3 types: vein-hosted, chemical fronts, disseminated
- Multiple generations of U mineralization identified based on mineral chemistry, textures
- Multiple fluid events with different redox conditions

Examples of different types of mineralization identified to date (*Ian Burron, PhD Candidate*)

Outcome: new analogue that will help to elucidate the possible impact of glaciation on a Canadian DGR





READINESS TO REGULATE THE APM PROJECT

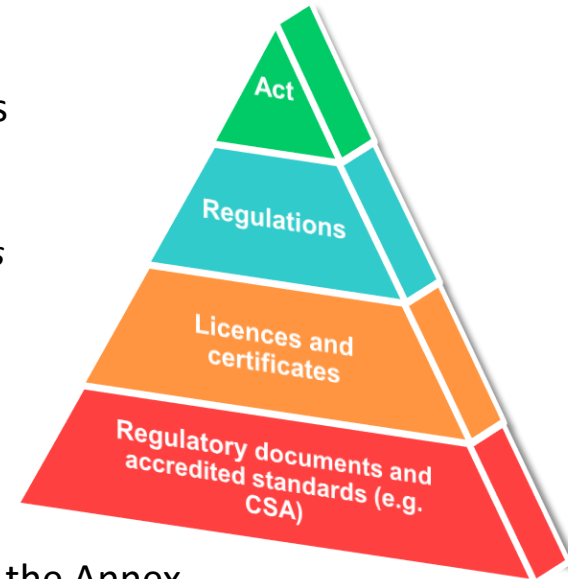


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Regulatory Framework for Waste Management

Waste management within this framework:

- *Nuclear Safety and Control Act*
- Waste and decommissioning addressed in multiple regulations
 - **Examples:** *General Nuclear Safety and Control Regulations, Class I Nuclear Facilities Regulations, Uranium Mines and Mills Regulations, Nuclear Substances and Radiation Devices Regulations*
- Licence conditions to implement and maintain waste management programs
 - The safety and control area (SCA) of waste management: *Waste characterization, waste minimization, waste management practices, decommissioning plans*
- Regulatory documents on waste management are provided in the Annex





EARLY ENGAGEMENT WITH THE NWMO

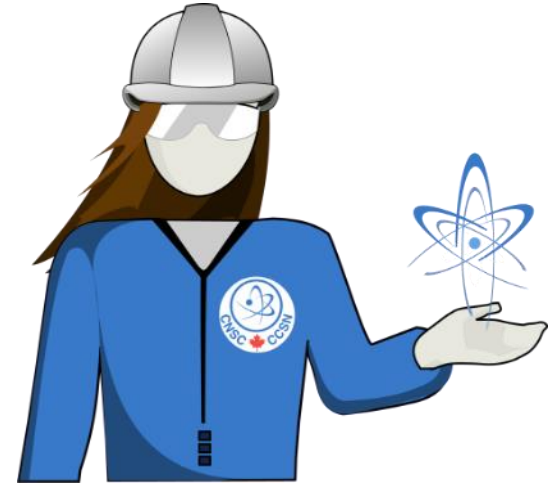


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CNSC – Licensing Authority

Objectives of pre-licensing involvement:

- Start a dialogue with future applicant (NWMO)
- Communicate the CNSC's role and responsibilities as Canada's nuclear regulator
- Build independent knowledge and regulatory research
- Focus on key safety aspects
- Maximize national and international collaboration
- Review key research publications from proponent
- Clarify CNSC regulatory expectations and requirements



**International best
practice for early
regulatory involvement**



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CNSC/NWMO Special Project Service Arrangement

- Provides for regulatory guidance prior to submission of a licence application
- Posted on CNSC's website ([here](#))
- Conducting outreach activities provide information on CNSC's role
- Allows CNSC to cost recover for pre-licensing activities



March 2019 renewed Special Project Service Arrangement signed by President Velshi and President of NWMO

Mechanism for conducting pre-licensing activities



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Technical Reviews

Recent Technical Reviews and Discussions

- Analysis of licence application requirements for site preparation (ongoing)
- Review of NWMO's environmental baseline monitoring program for Northwest Ontario (2021)
- **Hybrid vendor design review of NWMO's Mark II Used Fuel Container (2020)**

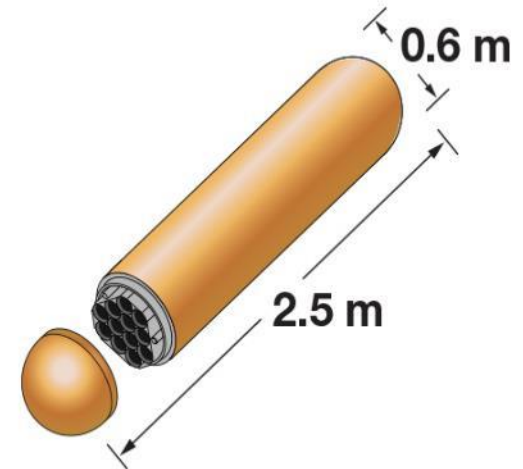
CNSC staff have the technical and scientific capacity to carry out technical reviews



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Design review of NWMO's Mark II Used Fuel Container

- CNSC pre-licensing design review based on process in REGDOC-3.5.4 *Pre-Licensing Review of Vendor Reactor Design*
- Needed to adapt Vendor Design Review process
 - “Hybrid” review, retaining only relevant elements of REGDOC-3.5.4 process for [Phase 1 VDR](#)
- Completed January 2020
- Summary report is posted on CNSC's website ([here](#))





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Conclusion

CNSC staff's preparedness for the APM project is built on:

1. Outreach and engagement – building trust with communities
2. Participation in international initiatives – sharing international best practices and standards
3. Regulatory research – maintain and disseminate objective scientific information and support science-based recommendations
4. Regulatory framework: clarifying regulatory expectations
5. Prepared to carry out technical reviews – dialogue with proponent initiated at an early stage

Early involvement activities prepare CNSC
to regulate the NWMO's APM initiative



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada

Thank You Questions?





ANNEX

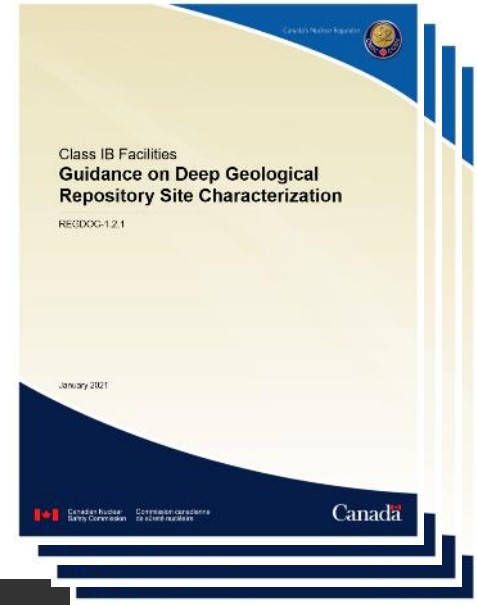


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Regulatory Framework for Waste Management (2)

Regulatory Framework: Waste and Decommissioning regulatory documents

- REGDOC-1.2.1, Deep Geological Repository Site Characterization
- REGDOC-2.11, Framework for Radioactive Waste Management and Decommissioning in Canada
- REGDOC-2.11.1, Waste Management, Volume I: Management of Radioactive Waste
- REGDOC 2.11.1, Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings
- REGDOC-2.11.1, Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste
- REGDOC-2.11.2, Decommissioning
- REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities



Safety case is the driver for regulatory decision-making



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Regulatory Framework for Waste Management (3)

- The CSA Group is a not-for-profit organization composed of representatives from the government, industry and consumer groups
- Radioactive waste management and decommissioning CSA Group standards:
 - N292.0-19, *General principles for the management of radioactive waste and irradiated fuel*
 - N292.1-16, *Wet storage of irradiated fuel and other radioactive materials*
 - N292.2-13, *Interim dry storage of irradiated fuel*
 - N292.3-14, *Management of low- and intermediate-level radioactive waste*
 - N292.5-11, *Guidelines for the exemption or clearance from regulatory control of materials that contain or potentially contain, nuclear substances*
 - N292.6-18, *Long-term management of radioactive waste and irradiated fuel*
 - N294-19, *Decommissioning of facilities containing nuclear substances*
- Under development:
 - **CSA N292.7, *Deep geological disposal of radioactive waste and irradiated fuel***
 - *CSA N292.8, Characterization of radioactive waste and irradiated fuel*