A Dialogue on the
Transportation and Storage of Used Nuclear Fuel

REGIONAL SESSIONS

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Transportation and Storage
of Used Nuclear Fuel

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Presentation Outline

Part 1: Adaptive Phase Management and the Deep Geological Repository

- What is nuclear waste?
- Canada's plan for used nuclear fuel
- Deep Geological Repository
- Site Selection Process
- Next Steps and Timeline
- Questions and Discussion

Health Break

Presentation Outline

Part 2: Transportation of Used Nuclear Fuel

- Background: Used Nuclear Fuel Bundles
- Transportation Packages and Testing
- Number of fuel bundles being transported by location
- Travel Distance: Ignace and South Bruce
- Transportation Timeline
- Regulations, planning objectives and guiding principles
- Questions and Discussion

Lunch Break

Background: Nuclear Waste Management Organization

- Through the Government of Canada's 2002, *Nuclear Fuel Waste Act*, nuclear utilities were required to establish the Nuclear Waste Management Organization (NWMO)
  - Ontario Power Generation, Hydro Quebec, New Brunswick Power Corporation and AECL
- The NWMO is a non-profit organization and is required to study approaches for the management of nuclear fuel waste and recommend a preferred approach.

Background: Nuclear Waste Management Organization

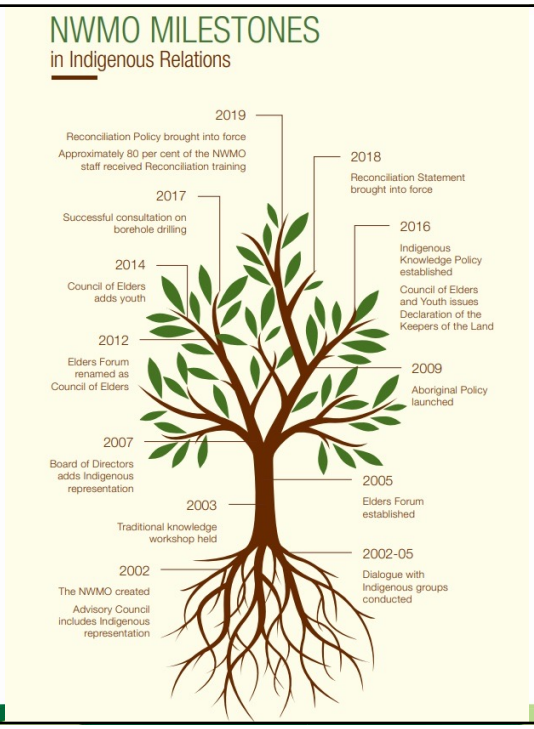
- The purpose of the NWMO is to develop and implement collaboratively with Canadians, a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible.

- The NWMO is also responsible for implementing the plan for Canada's intermediate-level and non-fuel high-level radioactive waste.

Nuclear Waste Management Organization

Recognition and Respect for First Nations Rights

- The NWMO is on a continuous learning pathway toward Reconciliation.
- We recognize both the historic and current injustices Indigenous communities have endured.
- We continue to learn as an organization remaining involved in collaboration and discussion with Indigenous communities toward Reconciliation.
- Working with Indigenous peoples, learning from Indigenous Knowledge and apply learnings to our work are critical to successfully implementing Canada's plan for the long-term management of used nuclear fuel.



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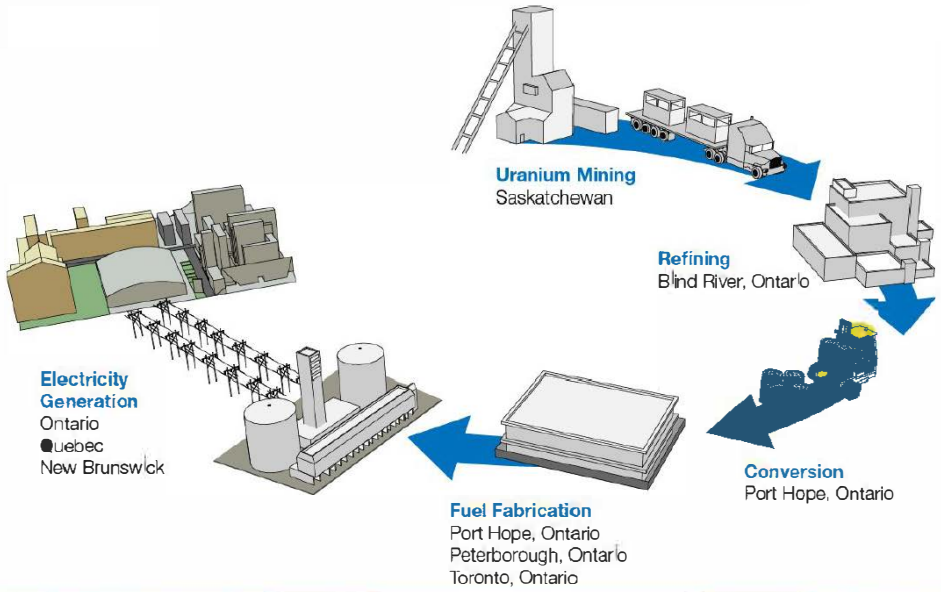
ADAPTIVE PHASE MANAGEMENT AND THE DEEP GEOLOGICAL REPOSITORY

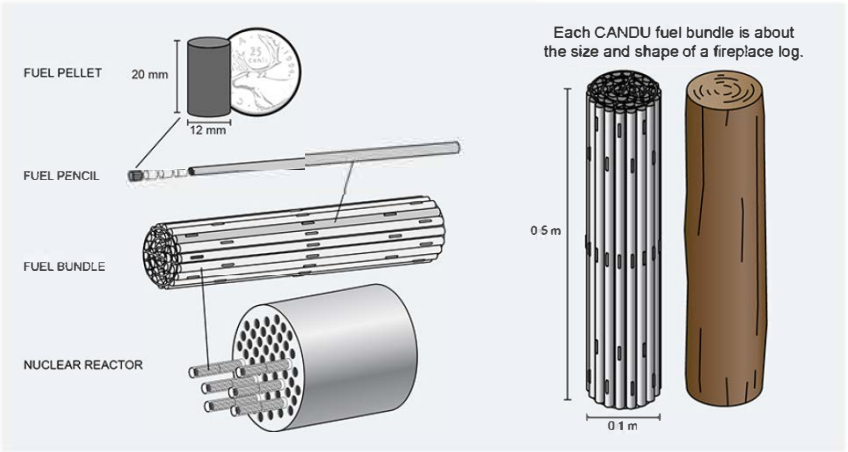
PART 1

The Nuclear Fuel Cycle



Background: What is Used Nuclear Waste?

- Nuclear energy is produced in a nuclear reactor to generate heat.
- When removed from the reactor, it is considered used nuclear fuel, it is radioactive and requires careful management.
- Used fuel radioactivity decreases over time, but chemical toxicity persist, posing a potential health risk for thousands of years.
- Used nuclear fuel is stored on an interim basis at existing reactor sites in Canada.



Background: Types of Nuclear Waste

	Low-level waste	Intermediate-level waste	High-level waste
Source	Power plants, medical, academic, industrial, and other commercial uses of radioactive material (e.g., mop heads, paper towels).	Components such as filters, resins, pumps from powerplants, research reactors, and medical isotope manufacturers.	Used nuclear fuel. A small amount of non-fuel high-level waste comes from other activities such as medical isotope production.
Description	Produces no heat and contain radioactive levels that require containment and isolation up to a few hundred years.	Produces minimal heat but requires a higher level of containment and isolation for longer time periods than low-level.	Generates a significant amount of heat and radioactivity and requires containment and isolation for thousands of years in a deep geological repository.

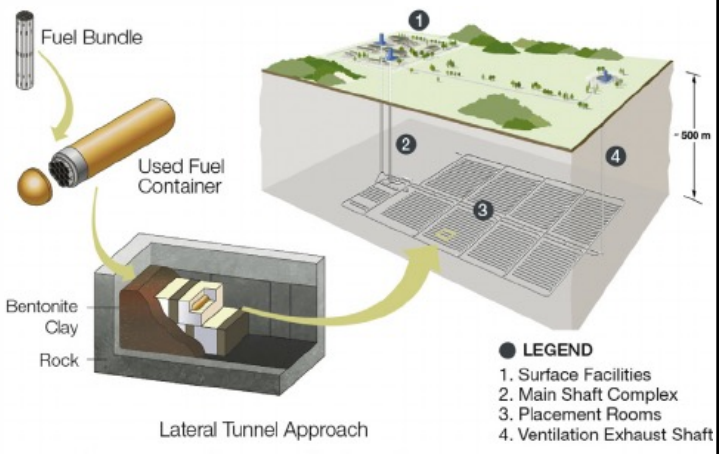
Canada's Plan for Used Nuclear Fuel

- Adaptive Phase Management (APM) has been selected for the long-term management of used nuclear fuel.
- Used nuclear fuel will be contained and isolated in a deep geological repository (DGR)
  - Suitable geology
  - Informed and willing host
- A multi-stage process.

Site Selection	Site Preparation and Construction
Operations	Extended Monitoring
Decommissioning and Closure	Post Closure Monitoring

What is a Deep Geological Repository?

- Combination of natural and engineered barriers to contain and isolate used fuel.
- Used nuclear fuel containers for storage.
- Network of underground tunnels and placement rooms.
- Constructed at a depth of 500 meters (as deep as the CN Tower is tall).
  - Underground footprint of approximately 2 km by 3km
    - Dependent on chosen site characteristics.



Lateral Tunnel Approach

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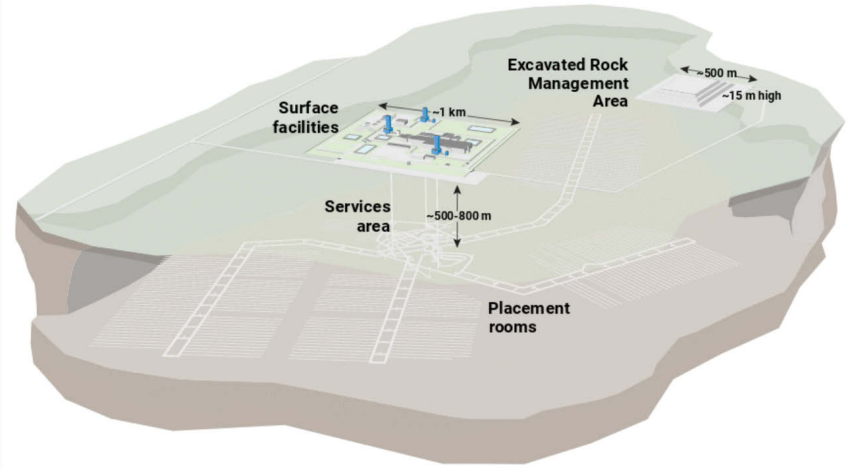


APM: Site Selection Process

- In May 2010, the NWMO began the process for selecting an informed and willing community to host the deep geological repository.
- The safety and appropriateness of any potential site is assessed against several factors, both technical and social in nature.

Site Selection (2024)	Site Preparation and Construction
Operations	Extended Monitoring
Decommissioning and Closure	Post Closure Monitoring

APM:
Site Selection Process

- 22 communities voluntarily expressed interest.
- Further delineated through intensive social engagement and technical site evaluations.
- Two communities remain, to be picked in fall of 2024
  - South Bruce: Saugeen Ojibway Nation
  - Ignace Area: Wabigoon Lake Ojibway Nation

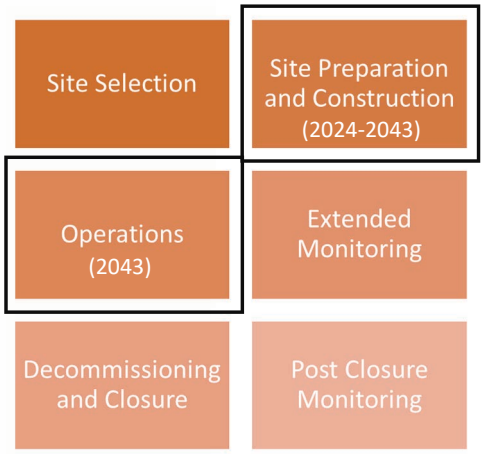
APM:
Site Selection Process

- Several criteria were used in the site selection process, some of which include:

Partnerships	Safety	Transportation

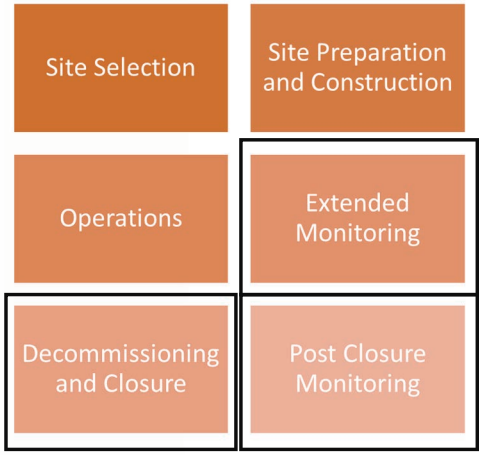
APM:
Site Preparation and Operations

- Repository Design
- Centre of Expertise:
  - Knowledge sharing
  - Site characterization work related to technical safety
  - Engineered test facility
- Surface Facilities:
  - Security, quality control laboratories, sealing materials production plants.
  - Support the repackaging and transfer of used fuel bundles to the underground repository.

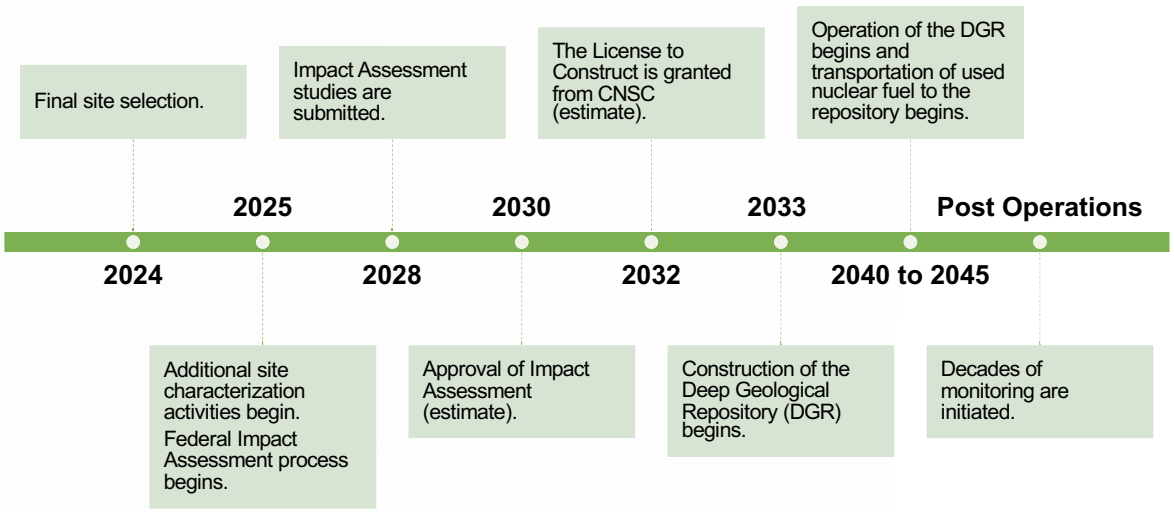


APM:
Monitoring and Closure

- **Extended Monitoring:**
  - Following placement of the used fuel, the facility will continue to be monitored and the used fuel will be retrievable for an extended period.
  - 70 years has been assumed for financial planning purposes.
- **Decommissioning and Closure:**
  - Expected to take 30 years.
- **Post Closure Monitoring:**
  - Nature and duration will be informed by input from the community at that time.



APM:
Next Steps and Timeline



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Questions and Discussion

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TRANSPORTATION OF USED NUCLEAR FUEL

PART 2

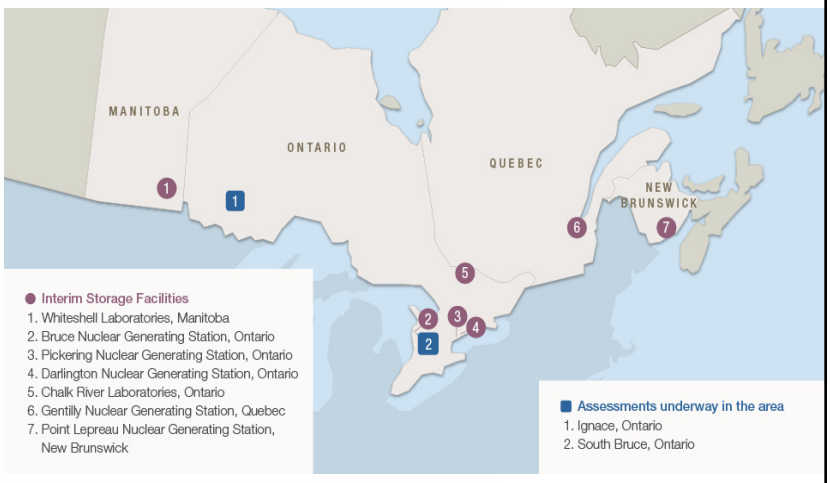
Background: The Used Nuclear Fuel Bundles

- As of 2022, Canada's existing inventory is about **3.2 million** used nuclear fuel bundles.
  - If stacked, the used nuclear fuel could fit into approximately nine NHL hockey rinks, from the surface to the top of the boards.
- At the end of the planned operations of Canada's existing nuclear reactors, the number of fuel bundles will reach **5.5 million**.

These used nuclear fuel bundles will need to be transported to the Deep Geological Repository upon opening.

Background

- Set to begin in 2040 (estimate)
- Transportation of used nuclear fuel from the seven interim storage facilities, where it is currently stored.
- Used nuclear fuel will be loaded into specially designed and certified containers and transported to the repository site.



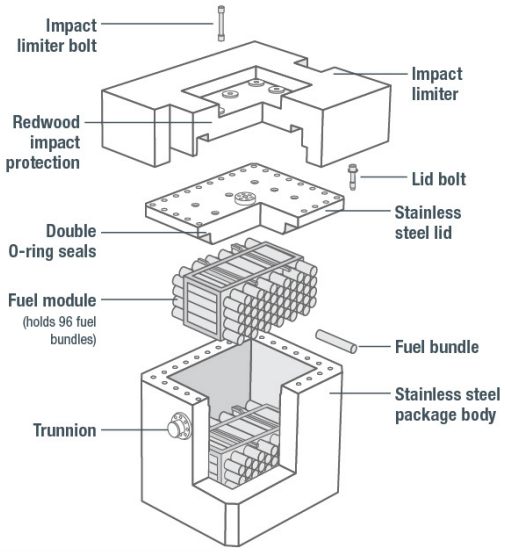
Background

Background: Transportation Containers

- Before used fuel bundles are moved, they are placed in steel assemblies called fuel modules.
  - These are then placed in massive containers for transportation.
- Currently, three types of containers are being considered for the transportation of used nuclear fuel:
  - Used Fuel Transportation Package (UFTP)
  - Dry Storage Container Transportation Package (DSC-TP)
  - Basket Storage Container Transportation Package (BST)

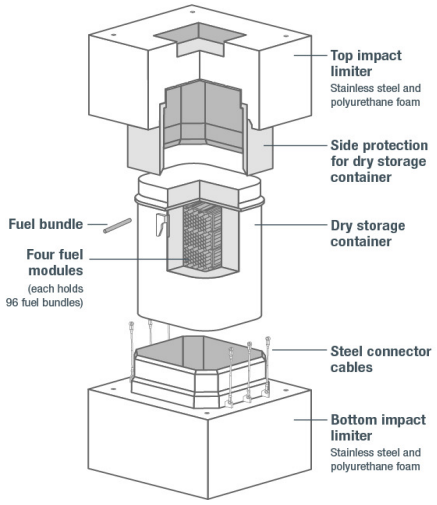
Used Fuel Transportation Package

- Three main components:
  - The body
  - Lid
  - Impact Limiter
- The stainless-steel body and lid provide containment, shielding and impact resistance.
- Can carry 192 used fuel bundles



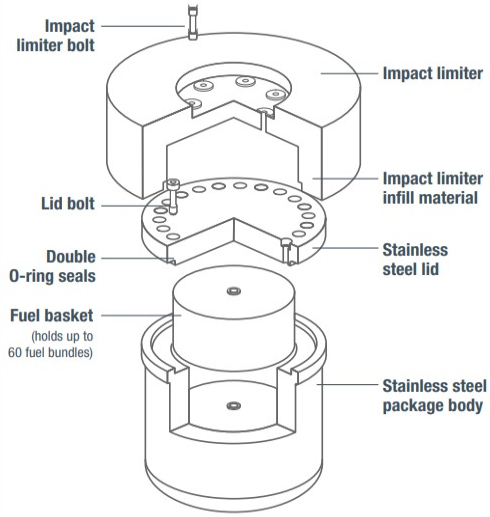
Dry Storage Container Transportation Package

- Consist of a dry storage container (DSC) with Impact limiters on each end.
- DSC provides containment and shielding, while the impact limiter's goal is to protect it in the event of an accident.
- Can carry 384 used fuel bundles.



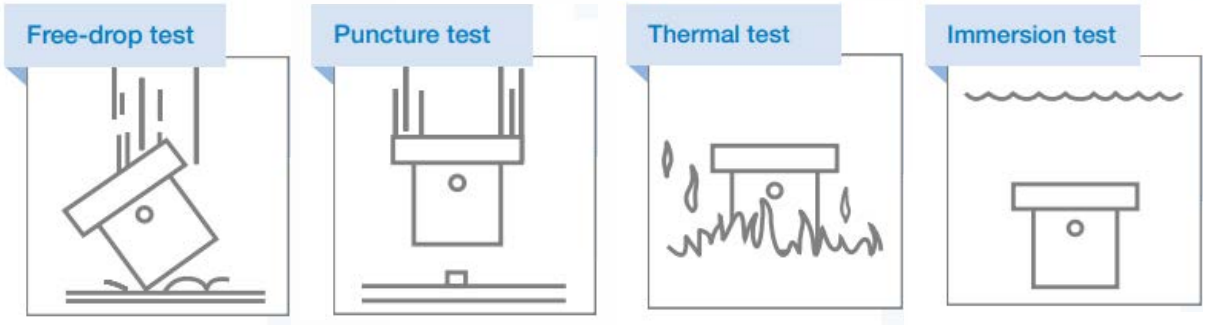
Basket Storage Container Transportation Package

- Consists of the following main components:
  - body,
  - lid, and
  - one or two impact limiter(s).
- Can carry 120 used fuel bundles.



Transportation Package Testing

- All packages are designed to withstand severe accident conditions. Tests include:



Transportation Details

- Used fuel transportation, handling and placement operations in the repository will occur over a period of approximately 50 years.
- Used nuclear fuel bundles will be delivered at a rate that allows it to be placed in the repository as it is received.
- The NWMO will need to demonstrate the safety and security of any transportation system to the satisfaction of regulatory authorities, and citizens before transportation of used nuclear fuel to the repository can begin.

Transportation: Number of Used Fuel Bundles by Location

Interim Storage	Expected number of fuel bundles to be transported	Expected number of transport packages to be transported (road transport only)	Expected number of transport packages to be transported (road and rail transport)
Bruce	2,907,650	15,147	7,573
Pickering	902,148	4,699	2,350
Darlington	1,268,801	6,610	3,305
Chalk River	7,187	90	90
Douglas Point	22,256	207	207
Gentilly – 1	3,213	43	43
Gentilly – 2	129,925	1,083	1,083
Point Lepreau	258,820	2,157	2,157
Total	**5,500,000**	**30,036**	**16,808**

Travel Distance: Ignace Area

Interim Storage Facility	Fully Highway Scenario	Road/ Rail Scenario	
	Distance (km)	Distance per truck (km)	Distance by train (km)
Bruce	1,775	125	1,750
Pickering	1,725	-	1,600
Darlington	1,725	-	1,625
Point Lepreau	2,900	2,900	-
Chalk River	1,600	1,600	-
Gentilly – 1	2,150	2,150	-
Gentilly – 2	2,150	2,150	-
Douglas Point	1,775	1,775	-

Travel Distance: South Bruce

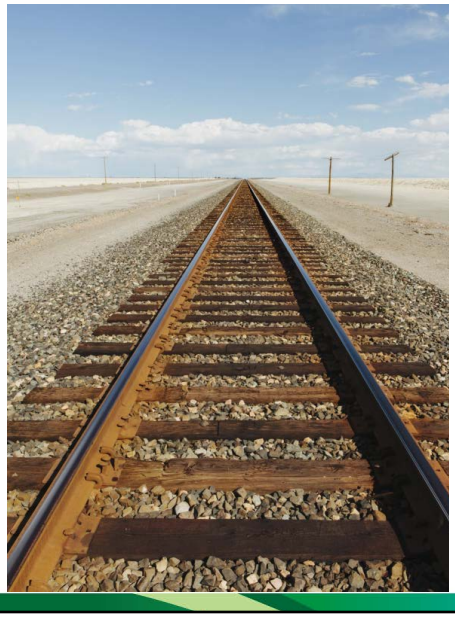
Interim Storage Facility	Fully Highway Scenario	Road/ Rail Scenario	
	Distance (km)	Distance per truck (km)	Distance by train (km)
Bruce	50	50	-
Pickering	275	75	225
Darlington	300	75	250
Point Lepreau	1,725	1,725	-
Chalk River	900	600	-
Gentilly – 1	950	950	-
Gentilly – 2	950	950	-
Douglas Point	50	50	-

Transportation Timeline

Interim Storage Facility	Timelines (approximate number of years)
Bruce	35 – 50
Pickering	5 – 20
Darlington	20 – 45
Point Lepreau	10 – 15
Chalk River	1
Gentilly – 1	1
Gentilly – 2	1 – 5
Douglas Point	1 – 5

Transportation Details

- May involve the use of roadways, railways or a combination depending on the site selected to host the repository.
- All-road approach: 620 truck shipments a year, approximately 1 to 2 shipments per day.
- All-rail approach: 60 train shipments each year, approximately one shipment every 6 days.



Transportation Regulations

Transportation of this material will need to meet the stringent requirements laid out by Transport Canada and the Canadian Nuclear Safety Commission prior to an operating licence being issued and will be the subject of ongoing compliance monitoring once the licence is issued.

Government of Canada

CNSC CCSN

Transportation: Planning Objectives

Protect the public and workers	Security	Protect the environment
• Mitigate hazards associated with the transportation of used nuclear fuel.	• Ensure the security of facilities, materials and infrastructure.	• Mitigate any potential impact on the environment.

Respectful relationships	Project finances
• Build respectful relationships with First Nations.	• Financial surety to ensure the full transportation program will be completed.

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Questions and Discussion

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