



Natural Resources
Canada

Ressources naturelles
Canada

Canada's Approach to Spent Fuel Disposal: Financial Assurances and Costing

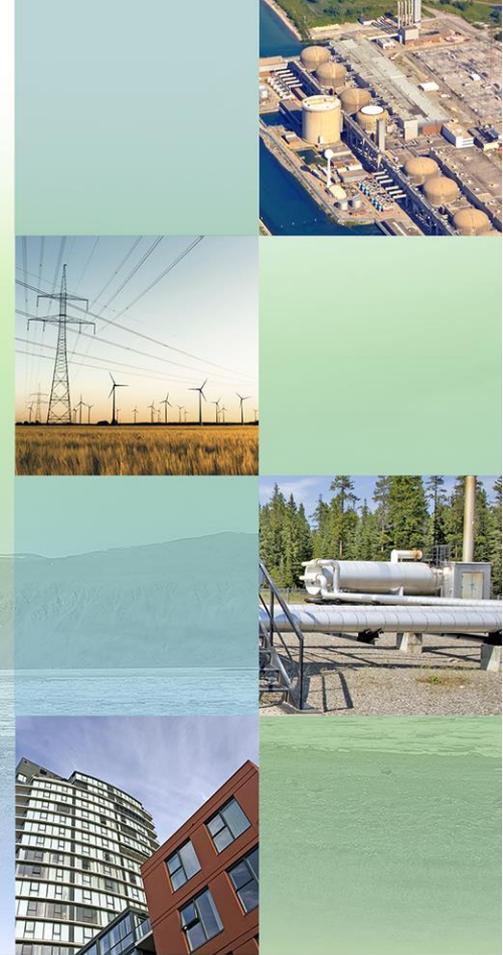
Presentation to:

IFNEC's Reliable Nuclear Fuel Services Working Group
OECD, Paris, France

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December 11, 2018



Canada



Population:
35,150,000 (2016)



Land
9,976,140 sq km

5,514 km from east to west
4,634 km from north to south



Federal Policy Framework for Radioactive Waste Management and Funding are in Place

- Radioactive Waste Policy Framework defines responsibilities based on “polluter pays”:
 - Waste owners are responsible for funding and managing their wastes over the short and long terms;
 - Government develops policy, oversees, regulates
- *Nuclear Safety and Control Act* establishes basis for Canadian Nuclear Safety Commission’s (CNSC) independent regulatory regime:
 - Licenses and regulates all waste management facilities
 - Require financial assurances at the start of project and throughout lifecycle
- *Nuclear Fuel Waste Act* requires Nuclear Waste Management Organization (NWMO) to implement long-term solution for spent fuel
 - Minister of Natural Resources Canada (NRCan) is responsible for Act
 - Require financial assurances from inception of Act



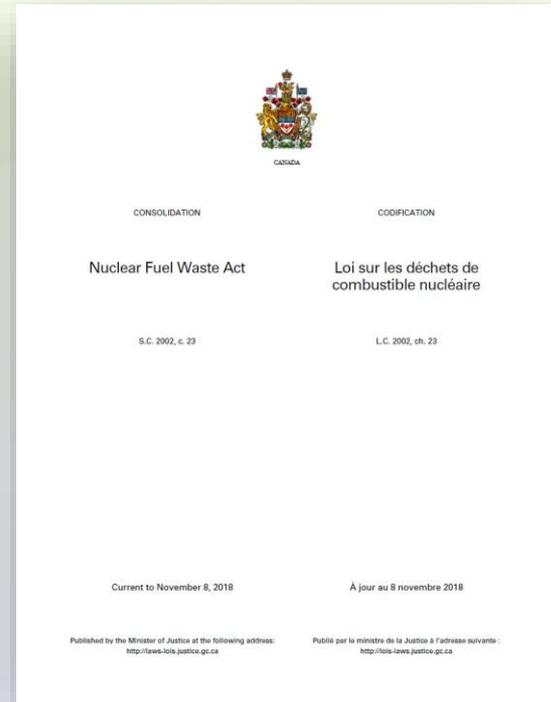
Safe Management of Radioactive Waste in Canada

- All radioactive waste in Canada is safely managed at storage facilities licensed by the CNSC
- Canadian waste owners have a number of long-term initiatives that are advancing:
 - Near-surface engineered facilities for low-level radioactive waste
 - Deep geological repositories (DGR):
 1. NWMO's APM approach for Canada's spent fuel
 2. OPG's DGR for its low- and intermediate-level radioactive waste
- Siting and public/Indigenous acceptance is a key challenge



Nuclear Fuel Waste Act, 2002 (NFWA)

- National strategy for the long-term management of Canada's spent fuel
- Federal legislation defines the process and the Minister of Natural Resources provides oversight
- Natural Resources Canada (NRCan) staff support the Minister in carrying out this function



Requirements of the NFWA

- Canada's Nuclear Energy Corporations to establish and fund a waste management organization as a separate legal entity
 - Nuclear Waste Management Organization (NWMO)
- NWMO to provide recommendations on the long-term management of Canada's nuclear fuel waste
- NWMO to report regularly to the Minister of NRCan
- Minister of NRCan to table NWMO's annual reports in Canada's Parliament and issue public statements on NWMO's progress
- NWMO to propose funding formula for Minister of NRCan approval
- Nuclear Energy Corporations and AECL to contribute to NFWA Trust Funds



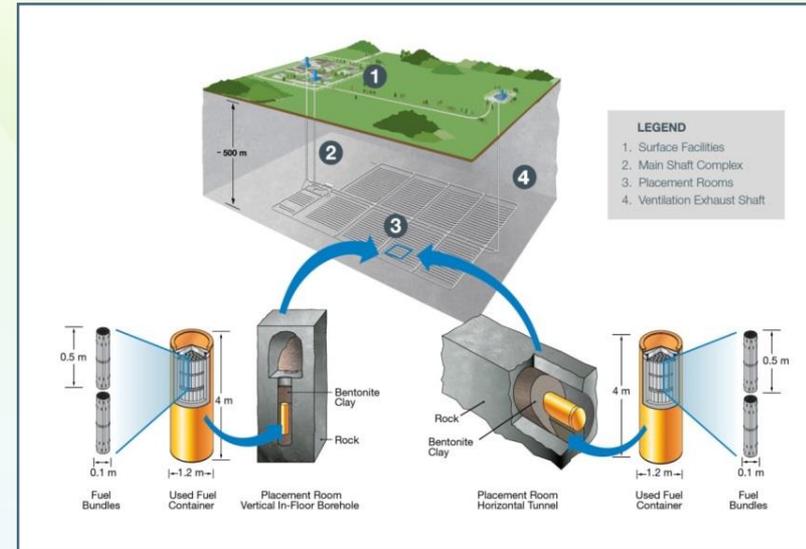
NWMO's APM Approach

- Formed in 2002 by the Nuclear Energy Corporations (OPG, NB Power, Hydro-Québec) to develop and implement a national solution for spent fuel
- From 2002-2005, NWMO studied approaches for the long-term management of Canada's spent fuel, including
 - Extensive input Indigenous Peoples, public, technical specialists
 - 120 public consultations and 18 000 citizens contributed to study
- In 2005 NWMO submitted recommendations to the Government of Canada
- In 2007 Government of Canada selected NWMO's recommended APM approach
 - DGR for Canada's spent fuel in a willing host community in a suitable geological rock formation



NWMO's Siting Selection Process

- NWMO commenced siting process in 2010
- Seeking an informed and willing host community with a suitable geological formation
 - Voluntary siting process
 - 22 communities expressed interest
 - Narrowing down through multi-stage technical and socio-economic and cultural assessments
 - Currently 5 communities
 - Drilled first borehole; more planned
 - Broad involvement of Indigenous Peoples and communities in siting areas



NWMO Estimation of Cost of APM Approach

- Project costs estimated at **\$23B** (2015 \$'s) including the full lifecycle costs – planning, regulatory review, construction, operations, transportation, monitoring, decommissioning and closure
- Key assumptions for cost estimates:
 - Operational 2043
 - Estimate of 5.2M fuel bundles
 - Engineered barrier system (ceramic pellets, fuel bundle, copper-coated steel canister, bentonite clay buffer box, rock itself) and repository conceptual design as a reference design in a hypothetical crystalline site
 - All transportation of spent fuel will be by road 1,000 – 2,500 km's from reactor locations



Cost breakdown of APM Approach by Major Activity

(based on 5.2 million fuel bundles)

Phase	2015 Cost (\$M's)
Pre-Construction	2,014
Construction	4,361
Operations	11,925
Monitoring and Closure	3,708
Total Repository	22,008
Transportation	999
Total	23,007



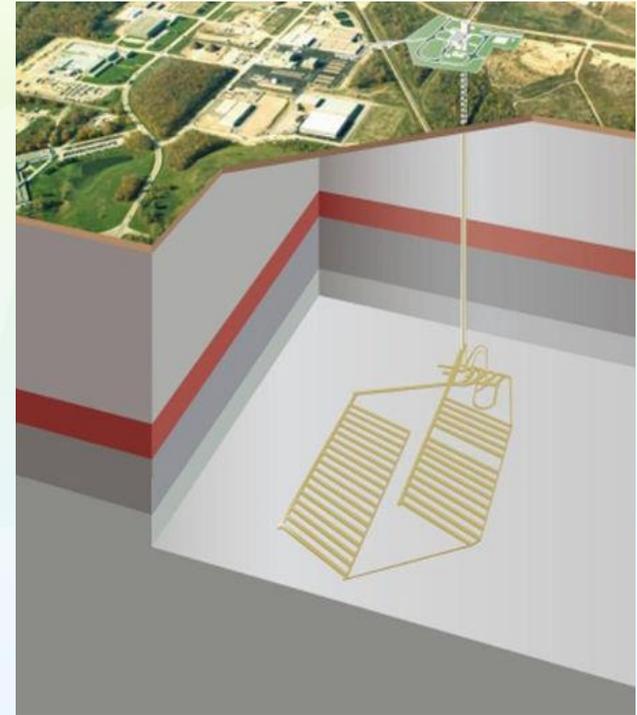
Funding for NWMO's APM Approach

- Waste Owners' Funding
 - Cover day-to-day activities in the pre-construction period
 - Annual deposits by the Nuclear Energy Corporations (OPG, NB Power, Hydro-Québec) and AECL, relative to the number of spent fuel bundles from each corporation
 - The 2018 budget is \$76.5M
- NFWA Trust Funds
 - Cover construction, operation, monitoring, decommissioning and closure.
 - Annual deposits by the Nuclear Energy Corporations and AECL, relative to the number of spent fuel bundles produced.
 - Current NFWA Trust Funds amount to \$4.24 billion
 - Audited annual financial statements of contributions to the NFWA Trust Funds submitted to the Minister of NRCAN for review.
 - NWMO cannot access the NFWA Trust Funds until the NWMO has been issued a licence to construct under the NSCA.



Ontario Power Generation's (OPG DGR) Project

- Repository to be located 680 metres underground on Bruce nuclear site, Kincardine, ON
 - Only accepts OPG's low- and intermediate-level waste, as per community agreement (spent fuel is excluded)
- Project is well advanced – awaiting decision of Federal Environment Minister on whether it may proceed
- Project cost **\$2.4B** including site preparation and construction, operations, decommissioning and long-term monitoring



Funding for OPG's DGR

- The cost of OPG's decommissioning of its facilities and long-term management of radioactive waste is included in the price of power it charges to consumers.
- OPG maintains a Segregated Decommissioning Fund
 - Established to fund expenditures associated with nuclear fixed asset removal and the long-term management of low- and intermediate-level radioactive waste.
 - Segregated fund is part of its Financial Guarantee to the federal regulator
 - Fund is currently considered "over-funded"
- Financial Guarantees are a requirement of the NSCA and independently reviewed by the regulator, the CNSC



Conclusion

- All radioactive waste in Canada is safely managed
- Canada is progressing in developing and implementing a number of solutions for the long-term management of radioactive waste.
- The Government of Canada has a robust set of rules to ensure funding is available for the safe, long-term management of radioactive waste

