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

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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)

<table>
<thead>
<tr>
<th>Phase</th>
<th>2015 Cost ($M’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Construction</td>
<td>2,014</td>
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<tr>
<td>Construction</td>
<td>4,361</td>
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<tr>
<td>Operations</td>
<td>11,925</td>
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<tr>
<td>Monitoring and Closure</td>
<td>3,708</td>
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<tr>
<td><strong>Total Repository</strong></td>
<td><strong>22,008</strong></td>
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<tr>
<td>Transportation</td>
<td>999</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23,007</strong></td>
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</tbody>
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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