



Radioactive Waste Management in Canada

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Legislative Framework

✿ ***Nuclear Safety and Control Act*** (2000) created the Canadian Nuclear Safety Commission (CNSC), Canada's single nuclear regulator

- CNSC regulates all nuclear-related facilities and activities, from cradle to grave
- Commission makes regulations, continuously updates them
- Independent Commission – reports to Parliament through Minister of Natural Resources; decisions through public hearing process, reviewable only by Federal Court
- includes regulation of safe spent fuel and radioactive waste management
- 4 categories of RW – high level (HL), medium level (ML), low level (LL) and uranium mine/mill tailings

✿ ***Nuclear Fuel Waste Act*** (2002) establishes framework for national long-term management solution respecting Canada's spent fuel

- Created the Nuclear Waste Management Organization (NWMO), a not-for-profit corporation established and funded under the Act by Canada's nuclear energy corporations (waste producers)
- responsible for implementing the Adaptive Phased Management (APM) approach, accepted June 2007
- NWMO does annual and triennial reports on its progress to Minister of Natural Resources

CNSC Principles for Waste Management

Licensees' waste programs encompass:

- 🍁 Reduce, Reuse, Recycle – minimization, volume reduction, compaction
- 🍁 Plan for the complete life of the facility, including financial guarantees
- 🍁 Defence-in-depth – never rely on a single system or process for protection





Government of Canada

Radioactive Waste Policy Framework (1996)

- ✿ **The Federal Government** will ensure that long-term radioactive waste management is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner
- ✿ **The Federal Government** has the responsibility to develop policy, to regulate and to oversee owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved disposal plans
- ✿ **The waste owners** are responsible for the funding, organization and operation of the waste management facilities required for their wastes



Regulatory Oversight of Waste Management in Canada

CNSC
Independent Regulator

Licensed Facilities in Canada

Spent Fuel

Nuclear Waste Management Organization (NWMO)

APM project under *Nuclear Fuel Waste Act*

No licence application to date

Intermediate-Level Radioactive Waste

Ongoing

Ontario Power Generation (OPG)
Hydro-Québec (HQ)
New Brunswick Power (NB Power)
Canadian Nuclear Laboratories (CNL)
Nordion

Legacy

AECL
CNL

Low-Level Radioactive Waste

Ongoing

OPG
HQ
CNL
NB Power
Cameco
Waste Nuclear Substances Licensees

Legacy

AECL
CNL

Historic

Low-Level Radioactive Waste Management Office (LLRWMO)

Uranium Mine and Mill Tailings

Operating

Cameco
AREVA

Inactive

Provinces
Former operators

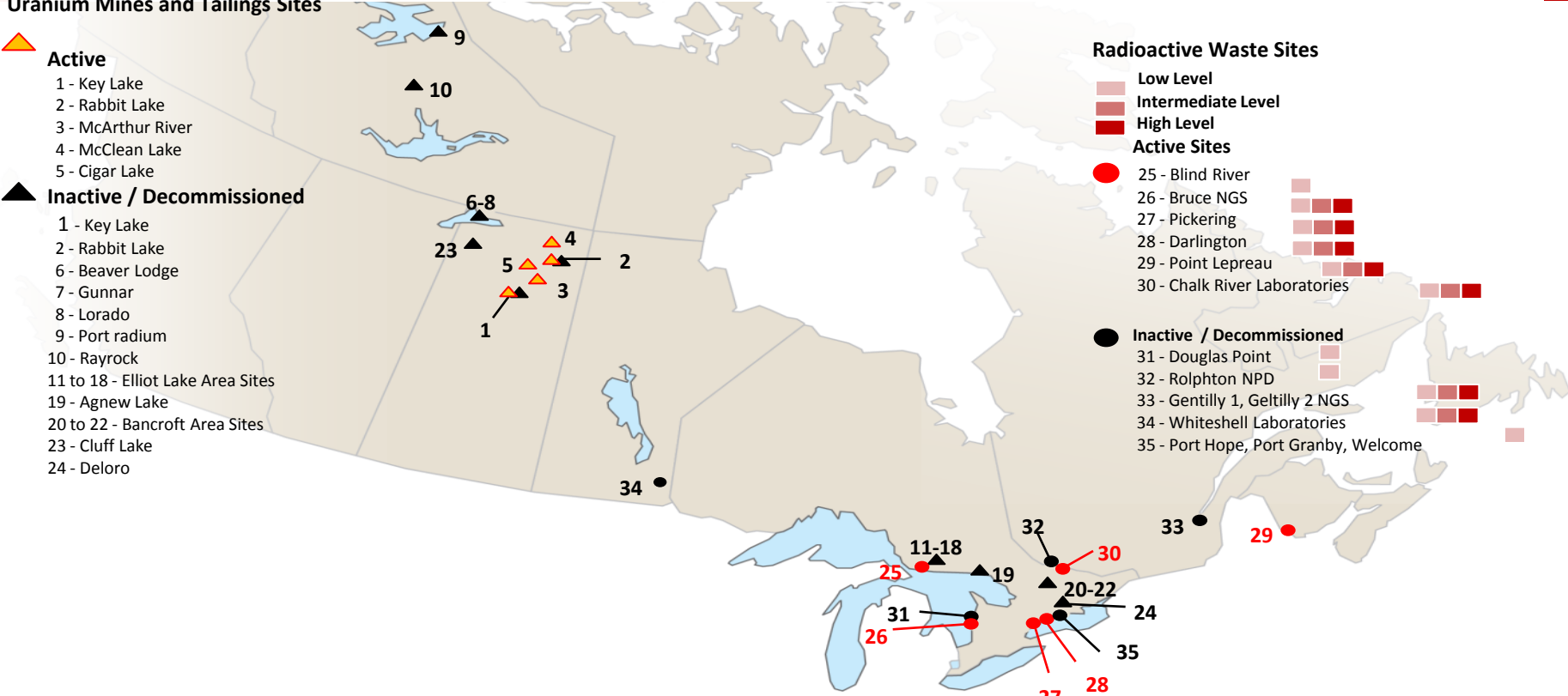
Waste Management Facilities/Areas

Uranium Mines and Tailings Sites

- ▲ **Active**
 - 1 - Key Lake
 - 2 - Rabbit Lake
 - 3 - McArthur River
 - 4 - McClean Lake
 - 5 - Cigar Lake
- ▲ **Inactive / Decommissioned**
 - 1 - Key Lake
 - 2 - Rabbit Lake
 - 6 - Beaver Lodge
 - 7 - Gunnar
 - 8 - Lorado
 - 9 - Port radium
 - 10 - Rayrock
 - 11 to 18 - Elliot Lake Area Sites
 - 19 - Agnew Lake
 - 20 to 22 - Bancroft Area Sites
 - 23 - Cluff Lake
 - 24 - Deloro

Radioactive Waste Sites

- **Low Level**
- **Intermediate Level**
- **High Level**
- **Active Sites**
 - 25 - Blind River
 - 26 - Bruce NGS
 - 27 - Pickering
 - 28 - Darlington
 - 29 - Point Lepreau
 - 30 - Chalk River Laboratories
- **Inactive / Decommissioned**
 - 31 - Douglas Point
 - 32 - Rolphton NPD
 - 33 - Gently 1, Gently 2 NGS
 - 34 - Whiteshell Laboratories
 - 35 - Port Hope, Port Granby, Welcome





Uranium Mine and Mill Waste

- ✿ Mill tailings and mine waste rock must be managed over long term
- ✿ Over 200 M tonnes of tailings generated in Canada since the 1950's
- ✿ Tailings Management Facilities (TMF): designed to isolate tailings from surroundings – 3 operational TMF, 22 inactive sites in Canada
- ✿ TMFs are located in mined-out pits or surface impoundments, using geographical features and barriers to contain tailings; designed to ensure that groundwater and surface water is diverted
- ✿ All operational and inactive tailings sites are the joint regulatory responsibility of the CNSC and the provinces/territories where sites are located



Low- and Intermediate-Level Waste Interim Storage

- ✿ All low- and intermediate-level waste (L&ILW) produced by NPPs in Canada is stored on an interim basis at the nuclear facilities
- ✿ Low-level waste may be reduced through various processing methods

Low-level waste



Low activity radioactive waste stored in warehouse-type buildings

Intermediate-level waste



Higher-activity, longer-lived radioactive waste stored in in-ground containers

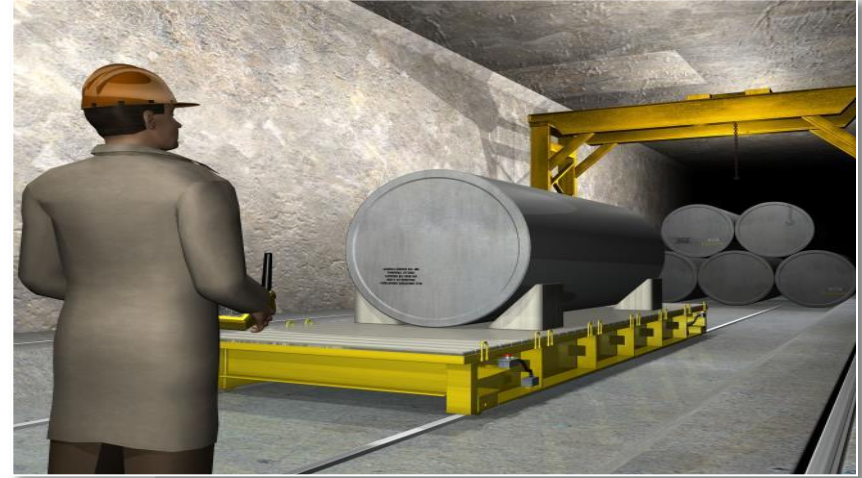


Refurbishment radioactive waste stored in above ground containers



Long-term Management of OPG's Low and Intermediate-Level Waste Deep Geologic Repository

- ✦ isolated from the surface, 680 m deep at Bruce nuclear facility site
- ✦ Sedimentary Sequence:
 - 34 Bedrock Formations
 - Mechanically strong/dry limestone
 - Shale barrier cap (200m)
- ✦ NOT for spent fuel
- ✦ Joint Review Panel EA Report May 2015 – project not likely to cause significant adverse environmental effects, will not harm Lake Huron
- ✦ Awaiting decision from Environment Minister on EA conclusions
- ✦ Licensing by CNSC would follow Ministerial decision

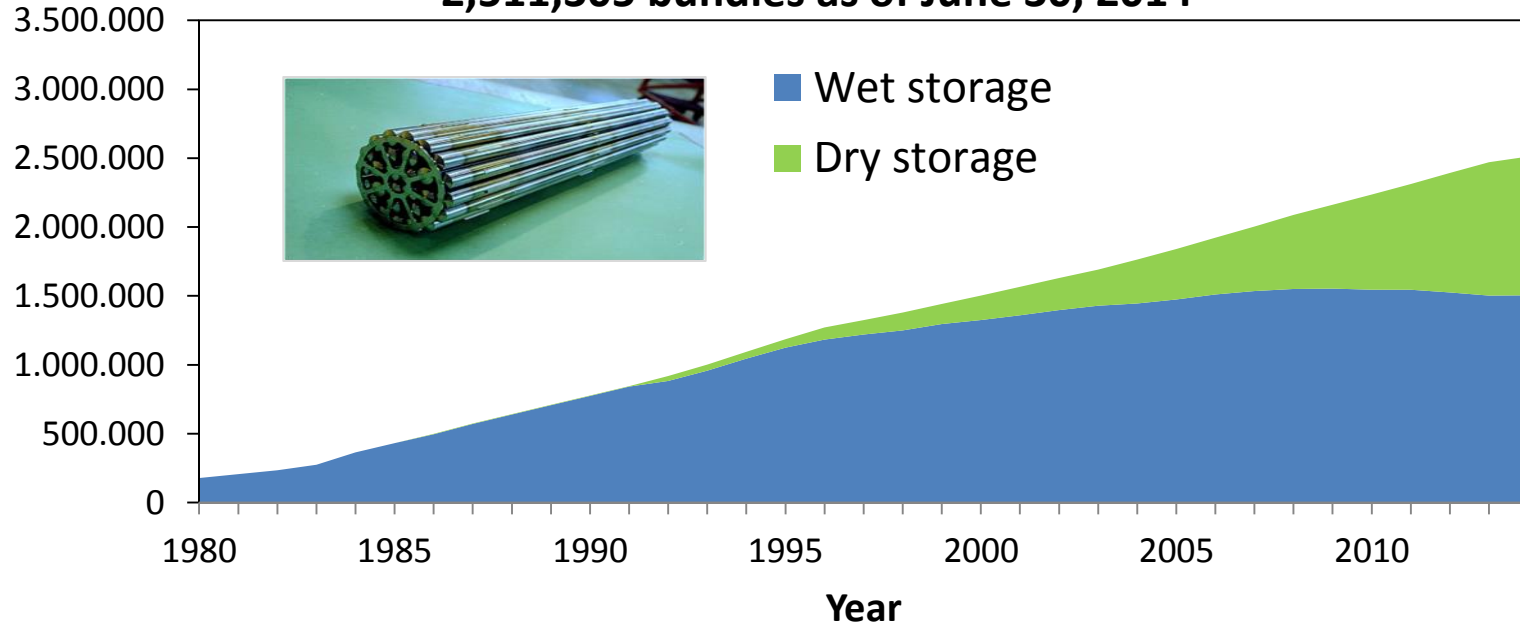


Conceptual emplacement for intermediate-level waste (photo courtesy OPG)



Current Management of Canada's Spent Fuel

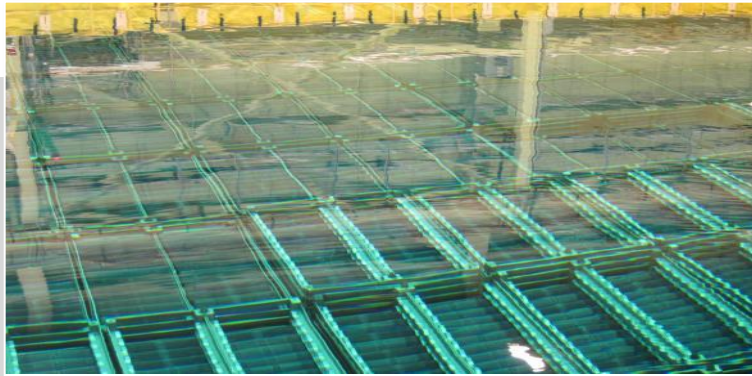
**Canada's Spent Fuel Inventory:
2,511,305 bundles as of June 30, 2014**





Spent Fuel – wet and dry storage

- ❖ Spent fuel remains in wet storage for a limited time (7-10 years) prior to being transferred to dry storage
- ❖ Dry storage containers have been confirmed to be robust and able to withstand an extreme event
- ❖ Included in Probabilistic Safety Assessment of Nuclear Power Plants





Long-term Plan for Spent Fuel: Deep Geological Repository

- ✳️ NWMO Options study results presented to Government in 2005, following extensive dialogue with Canadians
- ✳️ Government selected Adaptive Phased Management (APM) approach in 2007
 - Centralized repository, containment and isolation provided by a suitable rock formation
 - Phased decision-making, collaborative, flexible and adaptive, public engagement, informed and willing host community
 - \$16-24 billion project
- ✳️ No fixed timetable to implement APM
- ✳️ May 2010 - issuance of Site Selection Process
- ✳️ September 2012 – NWMO indicated that no more communities would be accepted
- ✳️ January 22, 2015 – 11 communities in the NWMO's Learn More Process
- ✳️ in-service date of 2035 assumed for financial planning
- ✳️ To date, no licence application has been made to the CNSC

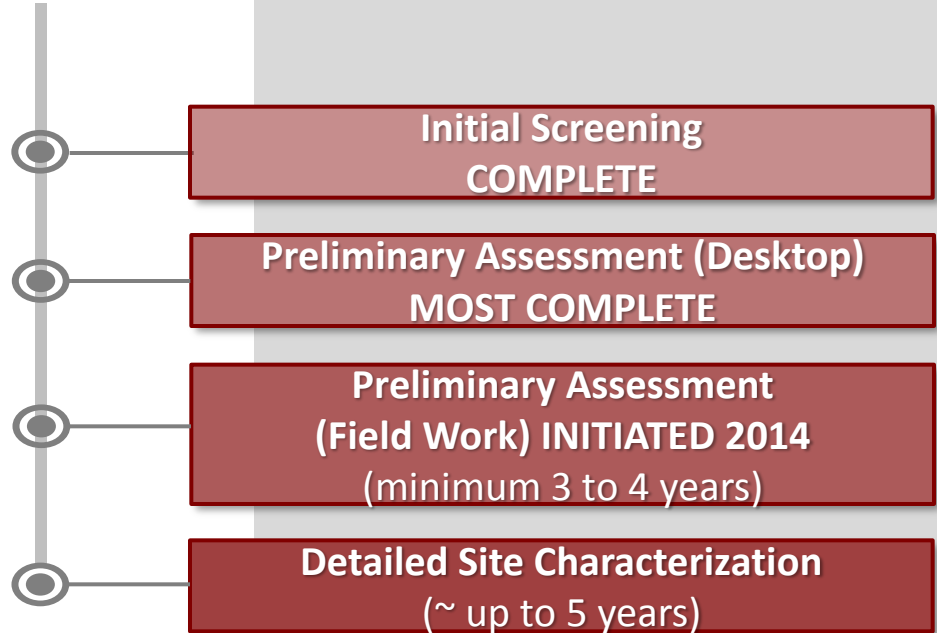




Site Selection Process

Process Goals:

- 🍁 Safety first
- 🍁 Informed and willing host community
- 🍁 Involve surrounding communities, regions and other jurisdictions
- 🍁 Involve First Nations and Métis potentially affected





Early Regulatory Involvement in Long Term Management of Spent Fuel (APM Project)

- ✦ **Independent Advisory Group** – established in February 2015 to provide advice to CNSC staff; composed of geoscientists from several Canadian universities and the Geological Survey of Canada
- ✦ **Independent research program** — Since 1978, the CNSC has been involved in independent research and assessment on geological repositories
- ✦ **International collaboration** — CNSC belongs to six international research groups that exchange information and knowledge on geological repositories
- ✦ Objectives of early involvement in this pre-licensing phase:
 - Build independent knowledge – technical, scientific research, international collaboration
 - Communicate the CNSC’s role and responsibilities as Canada’s nuclear regulator
 - Clarify CNSC regulatory expectations and requirements – provide pre-licensing design review of APM concepts
 - Focus on key safety aspects
 - Maximize national and international collaboration
 - Outreach activities to explain regulatory role, understand concerns
 - Review key research publications from proponents

CNSC role will expand and adapt as initiative progresses





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