The science behind safe nuclear waste disposal: decades of research

**Used Nuclear Fuel Project**

- The governments of Canada and Ontario announce the Nuclear Fuel Waste Management Program.
- Atomic Energy of Canada Limited (AECL) is directed to develop the Waste Management Program.
- The science behind safe nuclear waste disposal: decades of research.

**Public/Panel Hearings**

- The Seaborn Panel, a federal environmental assessment review panel, is established to independently review AECL’s deep geological disposal concept.
- AECL submits its environmental impact statement (EIS) for the concept to the Seaborn Panel. No specific site is identified.
- The AECB publishes its findings in reports, scientific journals, and conference proceedings.
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- The Seaborn Panel conducts public hearings in the five provinces – Saskatchewan, Manitoba, Ontario, Quebec, and New Brunswick.
- The Seaborn Panel submits its report.

The NWMO is established and is tasked with exploring three options for the long-term management of used nuclear fuel. They will recommend the preferred option and, if accepted by the government of Canada, implement nuclear waste management in Canada.

The Nuclear Waste Management Organization (NWMO) is established in 2000. The CNSC continues with independent regulatory research on geological disposal.

The AECB becomes the Canadian Nuclear Safety Commission (CNSC) in 2001. The CNSC continues with independent regulatory research on geological disposal.

The NWMO recommends an adaptive phased management (APM) approach to manage used nuclear fuel for the long term. The APM approach provides a high degree of flexibility and adaptability, with explicit decision points along each phase.

Under the APM approach, an informed community must volunteer to site a deep geological repository and present a site selection proposal. Both sedimentary and crystalline rock formations in the Canadian Shield will be considered.

The NWMO starts to develop a site selection process among volunteer communities. They will recommend the preferred site for geological disposal.

The NWMO submits a project description for the Deep Geologic Repository (DGR) project be referred to a review panel. The federal Minister of the Environment refers OPG’s DGR project to an environmental assessment by a Joint Review Panel (JRP).

The CNSC begins the Coordinated Assessment and Research Program (CARP) on sedimentary rock to demonstrate the long-term safety of used nuclear waste disposal.

The CNSC begins site selection and be funded by nuclear energy corporations.

OPG’s Deep Geologic Repository Project

The NWMO serves as the project developer and the CNSC will serve as the regulator. OPG will site and construct the DGR.

The CNSC publishes regulatory document G-320, which provides guidance on how to demonstrate the long-term safety of radioactive waste, consistent with international best practices.

G-320 defines the concept of the safety case, an integrated and documented set of arguments to demonstrate the long-term safety of radioactive waste disposal.

Central to the safety case is the safety assessment: a systematic and quantitative analysis of the level of protection provided by the proposed repository. The nuclear safety assessment must be supported by additional arguments and lines of evidence.

Regulatory document G-320 will be used by the NWMO to demonstrate the long-term safety of its project.

The CNSC and CEAA publish the JRP Agreement and the EIS Guidelines.

The CNSC begins the Coordinated Assessment and Research Program (CARP) on sedimentary rock as a candidate host formation for the disposal of used nuclear fuel.

The CNSC publishes regulatory document G-320, which provides guidance on how to demonstrate the long-term safety of radioactive waste disposal.

Regulatory document G-320 will be used by OPG to demonstrate the long-term safety of its project.

The NWMO recommends that the Minister of the Environment refer OPG’s DGR project to an environmental assessment by a Joint Review Panel (JRP).

The CNSC and CEAA publish the JRP Agreement and the EIS Guidelines. The EIS Guidelines identify the information needed for OPG to prepare the EIS, which will provide a detailed analysis of the potential environmental effects of the proposed DGR project. OPG must meet these requirements for a licence to prepare and construct the DGR.

The JRP Agreement establishes how the panel will function and the terms of reference for conducting the environmental assessment, and for considering the licence application to prepare a site and construct OPG’s proposed DGR project.

The draft EIS Guidelines and the JRP Agreement. The CNSC posts a notice of environmental assessment (NEA) for the DGR project. Following a public hearing in Kincardine, ON, the CNSC recommends that the Minister of the Environment refer the DGR project to a review panel.

The CNSC begins the Coordinated Assessment and Research Program (CARP) on sedimentary rock at the Bruce site.

The CNSC begins site selection and be funded by nuclear energy corporations.

Ongoing assessment by a Joint Review Panel (JRP)

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The CNSC begins the Coordinated Assessment and Research Program (CARP) on sedimentary rock at the Bruce site.
OPG submits the EIS for the proposed DGR on the Bruce site. OPG also applies to the CNSC for a licence to prepare the site and construct a DGR, and submits the EIS and a preliminary safety report in support of the application.

**2011**
- The CARP concludes that the many layers of sedimentary rock at the Bruce site would constitute robust barriers for the long-term containment of low- and intermediate-level waste, based on the following findings:
  - Groundwater at depths of more than 500 m has remained isolated from the near-surface waters for hundreds of millions of years.
  - The rock at depths of more than a few hundred metres was unaffected by nine glacial cycles over the last million years.
  - Damage of the rock due to the construction of the repository, and future perturbations such as glaciation and gas generation would be limited.

**2012**
- In 2012, CNSC extended the CARP to include experimental and theoretical research on the long term performance of clay seals and their interaction with sedimentary rocks and brine groundwater. The research included natural analogues, and the development of computer models to perform a long-term safety assessment.

**2013**
- CNSC establishes the Independent Advisory Group (IAG) to provide CNSC with an independent review of both the CNSC’s and NWMO’s research programs.
- IAG’s members are Canadian geoscientists who are internationally recognized for their scientific contributions to geology, hydrogeology, geomechanics and geochemistry.

**2014**
- CNSC research continues in preparation for the review of the NWMO’s APM plan.

The JRP for OPG’s proposed DGR submits its report to the Minister of the Environment with a positive recommendation for the project. The report includes 97 recommendations on proposed environmental and health and safety protection measures over the lifetime of the project. The report is consistent with the CNSC’s conclusions.