

OPG'S DEEP GEOLOGIC REPOSITORY FOR LOW AND INTERMEDIATE LEVEL WASTE – RECENT PROGRESS

F.K. KING

*Nuclear Waste Management Division, Ontario Power Generation
700 University Avenue, Toronto, Ontario M5G 1X6 Canada*

ABSTRACT

This paper provides a status report on Canada's first project to build a permanent repository for the long-term management of radioactive waste. Ontario Power Generation has initiated a project to construct a deep geologic repository for low- and intermediate-level waste at the Bruce Nuclear Site, at a depth in the range of 600 to 800 m in an Ordovician-age argillaceous limestone formation. The project is currently undergoing an Environmental Assessment and consulting companies in the areas of environmental assessment, geoscientific site characterization, engineering and safety assessment have been hired and technical studies are underway. Seismic surveys and borehole drilling will be initiated in the fall of 2006. The next major milestone for the project is the submission of the Environmental Assessment report, currently scheduled for December 2008.

1. Introduction

Ontario Power Generation (OPG) is responsible for the safe management of the radioactive wastes arising from the operation of 20 CANDU reactors in the Province of Ontario, Canada. The purpose of this paper is to provide an update on a project to construct a Deep Geologic Repository (DGR) for the long-term management of the low- and intermediate-level wastes (L&ILW) arising from these reactors. The location of the proposed DGR is the Bruce Nuclear Site which is located about 225 km north-west of Toronto, between the towns of Kincardine and Port Elgin, on the east shore of Lake Huron.

In 2002, the Municipality of Kincardine, the host community for the Bruce Nuclear Site, signed a Memorandum of Understanding (MOU) with OPG to jointly study options for the long-term management, at the site, of all L&ILW arising from the operation, refurbishment and decommissioning of OPG-owned reactors in Ontario. All L&ILW generated by these reactors are now in interim storage at OPG's Western Waste Management Facility (WWMF) which is located on the Bruce Nuclear Site, along with the eight reactors currently operated by Bruce Power under a lease agreement.

In the joint study with Kincardine, consultants were hired to identify various options and conduct geotechnical, safety assessment, and environmental and social impact studies. Following completion of the studies Kincardine council indicated a preference for the deep repository option and a Hosting Agreement based on this option was negotiated in late 2004. A community poll was conducted in early 2005 and the Council's position was solidly endorsed.

Documents describing the above processes and studies in more detail can be found on the project website at www.opg.com/dgr.

Following the successful community poll, and a formal decision by OPG to proceed with the DGR project, activities have been progressing on a broad front. Detailed work plans have been developed in the areas of environmental assessment, geoscientific Site Characterization, engineering and safety assessment and supporting contracts have been put in place. As well, extensive stakeholder engagement activities are continuing in order to ensure that all stakeholders are kept aware of project

developments and that any concerns are being addressed. This paper describes these current activities in more detail.

2. Geologic Setting

The Palaeozoic rocks underlying the Bruce Nuclear Site are comprised of a near-horizontally layered, undeformed sequence of carbonates, shales, evaporites and minor sandstones within the Michigan Basin. This sedimentary sequence is approximately 800 m thick resting upon the crystalline Precambrian basement. The repository is currently targeted for a argillaceous limestone formation at a depth of about 660 m below surface. This formation is overlaid by a 200 m layer of low permeability shale. These Ordovician-age shales and limestones are expected to have rock mass hydraulic conductivities between 10^{-13} to 10^{-12} m/s and under these conditions it is expected that solute transport in these media would be diffusion controlled.

3. Design Concept

Figure 1 provides an illustration of the current conceptual design of the facility. In the concept the underground repository would be comprised of a series of horizontal emplacement rooms, some dedicated to low-level waste and some to intermediate-level waste. Access to emplacements rooms would be by shafts and access tunnels. It is currently assumed that the repository would need to be designed for about 160,000 m³ of waste to handle all operational and refurbishment wastes from the 20 OPG-owned reactors. The design assumes that low-level waste containers will be transferred as is from their current above-ground storage locations, while the intermediate-level wastes containers would be placed in sacrificial concrete shields, as required by occupational dose considerations, prior to being transferred underground.

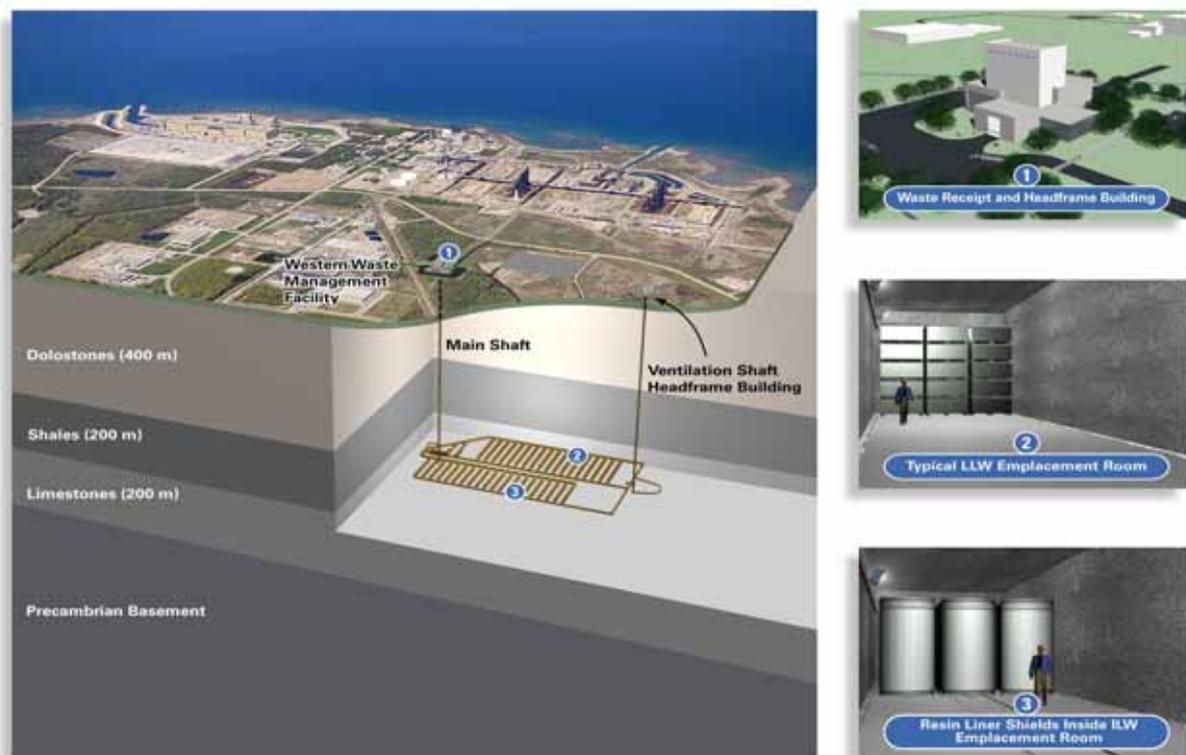


FIG. 1. Proposed Deep Geologic Repository for L&ILW on Bruce Nuclear Site

4. Safety Concept

The essence of the safety case for the repository is being built around the following key arguments:

- The rock is very old and stable,
- The geology and hydrology are predictable at repository depth,
- The deep groundwaters at the site are very old and do not mix with surface waters,
- Post-closure dose estimates are very small because mass transport is diffusion controlled,
- Earthquakes, glaciations or other natural events will not disrupt the repository,
- Gases generated by wastes will remain within the rock,
- The repository is safe from inadvertent human intrusion, and
- The repository can be built and operated safely using proven technologies.

Detailed site characterization and safety assessment studies are expected to support the above arguments through multiple lines of reasoning.

5. Current Activities

5.1 Environmental Assessment

An Environmental Assessment (EA) for the proposed DGR, in accordance with the Canadian Environmental Assessment Act, is currently underway. The Canadian Nuclear Safety Commission (CNSC) is the lead regulatory agency and will be conducting a public hearing, associated with determining the scope of the EA, in Kincardine on October 23, 2006. Subsequent to this hearing, the EA Scoping Document will be finalized. As well, the EA track (Comprehensive Study or Panel) will be determined.

A consulting company has been hired to conduct technical studies and to document the EA with a planned submission date to the CNSC in December 2008.

Following EA approval, a process will be initiated to obtain a Site Preparation/Construction Licence from the CNSC, targeted for receipt in the 2011/2012 timeframe.

5.2 Geoscientific Site Characterization

To date the geologic setting at the site has been predicted through regional geology studies as well as from deep boreholes drilled in the vicinity of the site for other purposes.

A detailed Geoscientific Site Characterization Plan (GSCP) has been prepared with the assistance of a specialized consulting company supported by a number of international experts and an independent, OPG-established Geoscience Review Group with members from Canada, France, Switzerland and United States. The Plan is available on the project website.

Phase 1 of the Plan has been developed to support the project EA. In Phase 1, 18 km of 2-D seismic lines will be shot. Two boreholes will also be drilled and tested. One will be about 400 m in depth and will be used to investigate the upper stratigraphy. The second will be drilled through to the Precambrian basement at about 800 m depth and will be used to investigate the lower Ordovician-age shales and limestones. The seismic survey field work is expected to start in late September 2006, and the borehole drilling is expected to start in early November 2006.

The same consulting company that led the preparation of the GSCP has been hired to coordinate the execution of all GSCP field and laboratory activities. A descriptive geosphere model report based on the results of these investigations is expected to be available in late 2007.

Phases 2 and 3 of the GSCP will include additional boreholes and will support the process to obtain a Site Preparation/Construction Licence for the facility.

5.3 Geosynthesis

A second geoscientific consultant is being hired to lead the preparation of a Geosynthesis report. This report will integrate the results of the geoscientific site characterization program, as well as studies in the areas of long-term climate modeling, geologic framework studies, regional hydrogeochemical and geomechanics assessments, regional hydrogeologic modeling; and site-specific geochemical, geomechanical and hydrogeologic modeling. The Geosynthesis report will provide a multi-faceted, reasoned argument why the geologic conditions at the Bruce Nuclear Site will ensure the safe containment and isolation of the L&ILW to be emplaced in the repository. This report is expected to be available in mid-2008.

5.4 Engineering

The current conceptual design was developed in 2003/2004 to support the joint options study conducted with the Kincardine Municipality. A consulting company has recently been hired to further study and develop the concept. Particular areas of review will be:

- shaft access versus ramp access,
- concept for shielding of intermediate-level wastes,
- waste room design,
- underground waste handling, and
- room seal and shaft seal design.

Rock stress conditions and geomechanical properties of the host rock obtained from the geoscientific site characterization activities will be an important input into the design activities.

An updated conceptual design is expected to be available in late 2007.

5.5 Safety Assessment

The potential dose consequences of the DGR were estimated in preliminary safety assessments conducted in support of the joint options study with the Municipality of Kincardine. These results predicted very low public doses due to the expected diffusion-controlled deep geologic setting.

The planned site characterization activities will provide more detailed information on which to verify the assumptions made in the preliminary safety assessment studies, and to conduct more detailed modelling of the safety of the proposed DGR.

Two separate consulting companies have been hired to conduct the pre-closure and post-closure safety assessments.

The pre-closure safety assessment will cover normal operations and accident conditions. Impacts to workers, public and biota will be considered. The post-closure safety assessment will cover potential future impacts to people and to biota after the repository is closed. The assessment will generally follow the IAEA Integrated Safety Assessment Methodology (ISAM). Two iterations of these assessments are anticipated during the Environmental Assessment stage, to allow for inclusion of more detailed information from other work programs.

The safety of the DGR will be assessed in accordance with the CNSC regulatory guide G-320. The safety case will include both quantitative safety assessments as well as complementary evidence for long-term safety, including in particular evidence from the site geology. Scenarios will be developed that account for normal (or expected) evolution of the site and facility with time (groundwater and gas scenarios), disruptive events such as human intrusion, and hypothetical "what if" scenarios to test the robustness of the repository system.

Pre- and post-closure safety assessment study reports are expected to be available in early and mid-2008, respectively.

Following completion of Phases 2 and 3 of the GSCP and further preliminary design work, the safety assessment studies will be updated to support the Site Preparation/Construction Licence process.

5.6 Community Communications

OPG, and its predecessor Ontario Hydro, have a long history of working in partnership with the Bruce Community. The community relationship has been built on trust and transparency and channels of information exchange are well established.

Within this context, communications on the DGR proposal have been extensive over the last four years and the plan is to continue this throughout the regulatory approvals phase. A multi-tactical communication plan has been designed to engage all stakeholders in support of the environmental assessment process. The plan includes displays at community events, advertising, media events, newsletters, key stakeholder briefings, open houses, speaking engagements and public attitude research.

6. Summary

The regulatory approvals phase for OPG's Deep Geologic Repository project is fully underway with a number of specialist consulting companies hired and technical studies are in progress. Key to the approvals phase is the successful execution of the Geoscientific Site Characterization Plan to confirm our belief that the Bruce Nuclear Site is an ideal location for a deep geologic repository for low- and intermediate-level radioactive waste.

The next major milestone in the project is the submission of the Environmental Assessment report, scheduled for late 2008. Earliest predicted in-service date for the repository is 2017.