Responsible Nuclear Waste Management
Nuclear Energy

- Nuclear energy produces 50 percent of the power in Ontario
- Small amount of waste relative to its enormous contribution
  - High-Level Waste – Used Fuel
  - Intermediate-Level Waste – Resins and Filters
  - Low-Level Waste – Industrial items
- Low and Intermediate-level waste shipped safely for more than 40 years to the Bruce Nuclear facility on Lake Huron
Western Waste Management Facility

1. Used Fuel Dry Storage
2. Low Level Storage
3. Intermediate waste
4. Low-level waste Processing
5. Deep Geologic Repository

- Waste for DGR already stored above ground at site
- Located within secure nuclear facility
DGR Project Timelines

- Phase I site investigations initiated (Sept/06)
- Conceptual Design Report (May/08)
- DGR 1-2 complete (Nov/07)
- V1 Safety Case complete (Mar/09)
- Preliminary Design Report (Feb/10)
- V2 Safety Case complete (Oct/10)
- DGR 5-6 complete (Jun/10)
- Submit Preliminary Safety Report (Mar/11)
- Phase IIA initiated (Mar/08)
- Phase IIB initiated (Jan/09)
- DGR 3-4 complete (Dec/08)
- EA Guidelines issued (Jun/08)
- EA Track announced (Jun/07)
- EA Project Description (Dec/05)
- Positive Community Poll (Feb/05)
- Feasibility, Alternative Media studies
- EA Scoping Hearing (Oct/06)
- EA Accepted and Federal Government decision (assumed)
- EIS Submission (Apr/11)

2002-2004
2005
2006
2007
2008
2009
2010
2011
2014
Lake Huron is Protected

- Stable, laterally-extensive sedimentary bedrock
- Low permeability formations above and below the DGR
- Multiple natural barriers isolate and contain the waste

1 km
1.2 km between DGR and Lake Huron

Secure Bruce Nuclear Site

DGR
680 metres deep underground

CN Tower
533 m
DGR: GEOLOGY AT A GLANCE

- Sedimentary Sequence (840 m thick)
  - 34 Bedrock Formations
  - Paleozoic age (390 - 540Ma)
  - Diffusion Dominated

- Repository Horizon 680 m depth
  - Limestone (27 m)
  - Shale cap barrier (200 m)

- Shaft Accessed (main/vent)

- Main shaft 1 km from lake

- Closest point of waste to lake is 1.2 km
Regional Geologic Setting
Michigan Basin Geology - Cross-section
Existing Excavations
Favourable Geologic Site Features

**Predictable**: horizontally layered, undeformed sedimentary shale and limestone formations of large lateral extent.

**Multiple Natural Barriers**: multiple low permeability bedrock formations enclose and overlie the DGR.

**Contaminant Transport Diffusion Dominated**: deep groundwater regime is ancient with low permeabilities and hydraulic conductivities, and shows no evidence of glacial perturbation or cross-formational flow.

**Natural Resource Potential Low**: commercially viable oil and gas, salt, and base metal reserves not present.

**Seismically Quiet**: located in a seismically quiet portion of the craton; comparable to stable Canadian Shield setting.

**Geomechanically Stable**: selected DGR limestone formation will provide stable, virtually dry openings.

**Shallow Groundwater Resources Isolated**: near surface groundwater aquifers isolated.
Geoscience Teamwork

**Geosynthesis**
AECOM Canada Ltd.

**Descriptive Geosphere Site Model**
Geofirma Engineering Ltd.

**Technical Oversight**
- Geoscience Review Group (GRG)
  - Jacques Delay (Andra)
  - Joe Pearson
  - Andreas Gautschi (Nagra)
  - Derek Martin (U. of Alberta)

**Specialists & Consultants**
- **Itasca** – geology, 3DGFM, Geomechanical Stability Analysis
- **Worthington Groundwater** – karst
- **Fracture Systems Ltd.** – EDZ
- **AMEC Geomatrix Inc.** – Seismic Hazard Assessment
- **Hydro Resolutions** – in-situ hydraulic testing

**Canadian and International Universities**
- **University of Toronto** – glacial systems modelling
- **University of Waterloo** – hydrogeological modelling, geology, hydrogeochemistry
- **University of Ottawa** – groundwater and porewater chemistry, porewater extraction techniques
- **University of New Brunswick** – diffusion testing and method development, hydrogeochemistry
- **University of Alberta** – geomechanics
- **University of Bern** – groundwater and porewater geochemistry, porewater extraction techniques
- **University of Washington** – glacial erosion
- **Pennsylvania State University** – cap rock integrity
- **Monash University** – outcrop fracture mapping
Site Characterisation Activities: Summary

• III Phase Site Characterization program (2006-2011)

• Drilled six deep boreholes (4.7 km): 4 vertical, 2 inclined

• 2-Dimensional seismic imaging survey (20 km)

• Installation of micro-seismic (M~1) monitoring system

• Borehole testing: Geophysics/Hydraulic (80+)/Geochemical

• 1000+ Rock Core Samples

• Borehole multi-level instrumentation
Geologic Attributes

- Thick sedimentary bedrock formations undeformed and traceable.
- Multiple thick bedrock formations that possess barrier properties.
- Ancient and stable saline groundwater groundwater system not in contact with surface.
- Host formation geomechanically strong, dry and stable.
- Natural resource potential low.
- Area of low seismic hazard.
- Contaminant transport is diffusion dominated - ground/surface water protected.
Long-Term Safety

- Expected long-term impacts from the DGR are essentially zero
- Analysis of worst-case scenarios demonstrate the robustness of DGR design
- DGR provides for safe long-term management of L&ILW
U.S.A. Review

Environmental Protection Agency

- reviewed submission and provided comments and request for further information

“In comparison to other international programs, the proposed DGR site, at 2,230 feet beneath the Bruce Nuclear site, is the deepest planned facility in the world, is bounded by the thickest assemblage of low permeable cap rocks, and is isolated from surface and drinking water” (July 24, 2012)

Department of Environmental Quality – Lansing

- OPG provided detailed geoscientific data

“In summary, the RMD (Resource Management Division) has reviewed the EIS (Environmental Impact Statement) and supporting radiological and geological studies and has no technical objections to the conclusions reached in the many various studies.” (Aug., 2, 2012)
Next Steps:

- The Joint Review Panel is continuing its detailed review of the information on the record.
- The Public Registry will remain open until all information requests have been answered and JRP convinced it has sufficient information to close the public record.
- Participants allowed final submissions (30 days).
- JRP will prepare a report within 90 days.
- Report submitted to Federal Minister of Environment who will have 120 days to make a final decision.
- Decision from the Panel expected early 2015.
For more information go to opgdgr.com

Tobermory, Ontario