Comments on the Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project December 2025 APM-REP-05000-0211

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1. The project scope of the DRG at the Revell site is for disposal of up to 5.9 million used fuel bundles to cover the expected inventory from Canada's reactors by the end of 2026. However used fuel from ongoing reactor operation in Canada into the far future can be deposited in the DGR pending approval from host communities and applicable regulators. The Project is expected to last over 160 years. It is recognized that a viable disposal method for all nuclear wastes from reactors is necessary for the continuation of the use of nuclear energy in Canada. Thus the disposal of used fuel from Canada's reactors in the DGR into the far future is almost certain.

   What is grossly missing is a comprehensive analysis of the continuation of nuclear energy in comparison to other energy sources particularly the potentially much less costly options of renewable energy. A comprehensive long term lifecycle cost benefit analysis is required for all potential power sources. All life cycle costs for nuclear energy must be comprehensively determined including the cost of new reactor builds, existing reactor refurbishment, all waste management costs into the far future including all existing and future high, intermediate and low level waste management costs plus reactor decommissioning costs. This analysis must include all legacy waste and decommissioning costs such as from Chalk River, Whiteshell, Point Lepreau, and Gentilly as these are embedded costs of the nuclear industry. All past and continuing costs for nuclear research such as at AECL, CNL and any other government funded nuclear research for nuclear power must be included. The cost of operating the DGR for 160 years must be included. These reactor and renewable costs should be expressed in a cost per GW-hour per year. As well, the overall past and future costs including legacy costs must be quantified.

   Renewable energy is often dismissed based on intermittency of wind or solar. It is essential that any cost comparison include a nation wide power grid that can be used to transfer renewable power over large enough distances to secure continuous renewable sources that would diminish the intermittency issue. Large distance transfers of hydro power used as reliable back up should be included in the cost estimates.

   Such a cost benefit analysis must be done by an independent qualified agency and certainly not OPG or advocates of nuclear power. Such a comprehensive study of all costs associated with nuclear power in Canada will almost assuredly demonstrate that nuclear power is not viable in terms of cost comparison to renewable energy. As such the planned DGR must then be restricted only to current nuclear waste and wastes following from closure of all current reactors.

Implicit is the required shut down of nuclear energy in Canada.

An extensive national energy cost benefit analysis is not planned but absolutely essential to determine the scope of the DGR. All plans for the DGR should be suspended until such an analysis is done.

2. For the Seaborn Panel assessment of the disposal of high level nuclear waste in Canada circa 1998, a comprehensive probabilistic risk assessment was completed entailing years of dedicated research and data gathering and computational analysis. Vault, geosphere, and biosphere models were developed based on years of research to quantify the probabilistic dose consequence risk of a generic DGR. No such comprehensive probabilistic risk has been required for the Revell site DRG.

   For the Seaborn assessment, extensive borehole, seismic and geological data and analysis was used to develop a three dimensional geosphere model including all fracture zones for an example site at the underground research laboratory at the Whiteshell research Centre. The groundwater flow in the example geosphere model including the fracture zones and surface discharge was evaluated using detailed computational finite element analysis. Such an analysis is not documented in the description of the Revell site assessment.

   Research is required on the mineralization present and the geochemical conditions at the Revell site to determine site specific data required for radionuclide sorption on fracture surfaces and radionuclide solubility.

   Extensive site specific data is required for an updated biosphere model for the Revell site.

   Detailed research and modeling was done to determine corrosion, pitting and initial defects in for the copper coated waste container design for the Seaborn assessment. The geometry and thickness of the containers has changed for the Revell site requiring an updated container defect analysis. Detailed computational modeling was done for the Seaborn assessment to determine the required vault design to ensure the temperature around the waste containers would not exceed 100 C, the limit for no damage to the clay based buffer around the containers. Changes in container geometry and vault design for the Revell site necessitates new thermal analysis. The copper coating for the Revell design is significantly thinner than for the Seaborn assessment. Comprehensive new research must be documented to determine modes of Revell DRG container failure including size, number, and timing of pinhole defects from failure mechanisms including initial defects. This information must be incorporated into an updated vault model.

   No comprehensive detailed data gathering and analysis requiring years of dedicated research comparable to the Seaborn assessment has been done for the Revell site. Why should detailed analysis have been required for a generic analysis but not for an actual site that will be implemented? It is likely that the cost and time frame for a comprehensive probabilistic risk assessment of radionuclide dose consequence would be beyond the level the government and industry is willing to expend. Instead mainly generic arguments will be used which are basically expert-opinion and hand-waving without the comprehensive site specific expensive time consuming data and analysis required to do a meaningful impact assessment. A multi-year detailed comprehensive data gathering, model development and probabilistic risk assessment similar to the Seaborn assessment is required for a meaningful impact assessment of the Revell site. Instead the Revell site development has degenerated into mainly an engineering and design exercise with vague, poorly supported claims and tables about minimal effects to the environment.

3. A neglected issue is neutron activation in used fuel nuclear waste containers. The OPG reactor site used fuel containers are helium filled preventing neutron activation of nitrogen in air to carbon 14. However activation of chlorine in structural components would create highly mobile and difficult to detect long lived chlorine 36. Other radionuclides such as cobalt 60 would also be neutron activated.

   Used fuel waste containers in concrete silos such as at Whiteshell are air filled. Thus carbon 14 would be activated from neutron radiation emanating from used fuel in such storage containers.

   Neutron activation both from short lived spontaneous fission of curium isotopes and long term alpha-n reactions must be considered.

   Carbon 14, chlorine 36 and other activation products would be transferred from waste storage and transport containers to the DRG waste containers.

   The long term DGR waste container would be air filled. Significant amount of carbon 14, chlorine 36 and other activation products would accumulate in these containers over thousands of years in the DGR despite the gradual decrease in the long term alpha-n neutron radiation from used fuel. Activation products would be rapidly released following DGR container failure. This potential risk from neutron activation has been neglected and must be adequately quantified and reported.

4. Transfer of used fuel from transportation containers to the DGR container in hot cells at Used Fuel Packaging Plant at the DGR site could result in significant surface contamination of the DRG container assemblage. The DRG container assemblage is to include an exterior clay based buffer layer that would be impossible to decontaminate. Surface contamination of carbon 14, tritium, and other volatile radionuclides such as cesium 137 and iodine 129 present in large amounts in used fuel are known to occur from off gassing deposition. Both airborne and surface contamination is liable to spread to DGR container assemblages and throughout the DGR during the required remote transport of the

container assemblages.

Carbon 14, tritium, and iodine 129 are difficult to detect beta emitters. There is no documented contamination measurement and control measures in the documentation for the DGR.

Measurements have been made of significant amounts of airborne tritium and carbon 14 of gassing in low and intermediate level waste storage buildings at OPG reactor sites. Ventilation stack measurements at NPD and Whiteshell detect significant emissions of carbon 14, tritium and beta/gamma particulate long after reactor shutdown and removal of used fuel. Such measurements establish that extensive surface contamination and off gassing from used fuel occur, and would be expected at the DGR.

Ventilation stack measurements from the DGR hot cells and general areas are liable to record stack releases. Such stack releases are usually neglected as being far below derived release limits based on very large environmental air dilution of the stack releases. It must be realized that such stack releases of radionuclides are measures of wide spread significant contamination throughout all ventilated areas.

The operational hazard from such widespread contamination that could endanger DGR workers has been neglected. Contamination would continually accumulate over impossible to clean DRG surfaces over the 160 or more operational lifetime. Contamination of the buffer material and exterior of DGR containers would lead to direct unquantified release of radionuclides outside the copper coated containers upon emplacement. Operational measures to adequately control and measure such airborne and surface contamination in the DGR may not be possible rendering the entire DGR operation unfeasible.

The waste container assemblage within the DGR will require remote handling and emplacement due to the high radiation fields around the containers. Any failure of the remote emplacement system would likely require manual intervention exposing workers to potentially unacceptably high radiation dose.

A realistic full scale hot cell transfer and contamination measurement is required to quantify operational hazard and determine adequate contamination control measures if at all feasible. This test must be made over many container transfers to measure accumulation of contamination.

Decontamination of the interior of hot cells following each transport container transfer is not possible for the millions of used fuel bundles that must be transferred. This consideration alone indicates that widespread contamination spread throughout the DGR is unavoidable. Determination must be made for radiation protection during of recovery from failed remote emplacement. The full scale test should include a mock up of recovery from failed waste container emplacement in a disposal environment with actual dose exposure measurements.

A comprehensive operational test including testing of feasibility of recovery from failed remote disposal and determination of accumulation of surface and airborne contamination must be done before any site approval and further site development and characterization.