

Qualitative Geological Readiness Assessment of Deep Isolation’s bore-hole solution in Estonia

Deep Isolation EMEA, Ltd., assessed the potential suitability of a horizontal borehole disposal solution for the spent nuclear fuel from Estonia’s proposed small modular reactor (SMR). The study was undertaken with local support from engineering bureau Steiger LLC, and sponsored by Fermi Energia, a private sector company established to support the development of an SMR to increase national clean electricity production to meet Estonia’s climate goals. The study concluded that there are no fundamental geologic limitations to disposing of spent nuclear fuel safely in deep horizontal boreholes in Estonia.

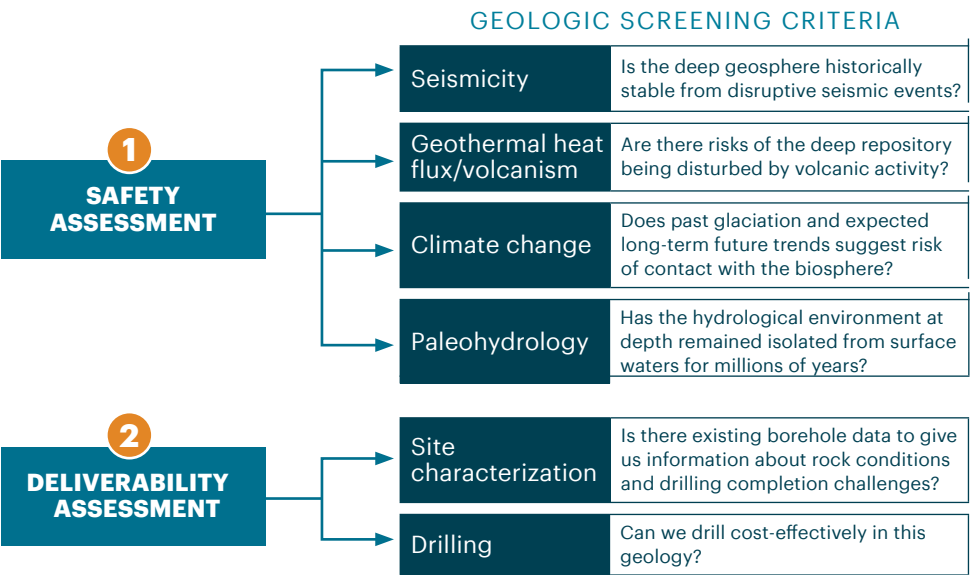
CHALLENGES AND OBJECTIVES

As Estonia considers the role that advanced nuclear power generation can play in delivering a low-carbon future for the country, policymakers and citizens need to ensure there is a safe and affordable way to dispose of the resulting spent nuclear fuel. To inform these considerations, Deep Isolation was engaged for an initial study on the suitability of a horizontal borehole disposal solution for advanced reactor spent nuclear fuel within Estonian geology.

Scientific global consensus concludes that the safest solution for the disposal of high-level radioactive waste is with deep geological disposal. The traditional, centralized, mined repository approach to geologic disposal has yet to be implemented. The identification of a technically credible and socially acceptable solution is instrumental for the adoption and deployment of advanced reactors by providing a much-needed pathway on the management of commercial spent nuclear fuel.

CONTINUED

FIGURE 1: SCREENING CRITERIA BREAKDOWN



EXECUTIVE BRIEF

An initial screening was performed to assess the availability of suitable host geology for a Deep Isolation horizontal borehole repository in Estonia. The assessment used criteria aligned with requirements for geological disposal set out in the IAEA Safety Standards No. SSG-14, Geological Disposal Facilities for Radioactive Waste. Key findings include:

- Deep borehole disposal is a safe, affordable, and flexible disposal option for spent nuclear fuel if the Estonian government decides to move forward with small modular reactors as part of its future energy strategy.
- There are potential geological host environments across Estonia, particularly in the northeast portion of the country.

More work is needed to identify and characterize specific potential sites.

ABOUT FERMI ENERGIA

Fermi Energia is an Estonian energy company that focuses on the development and deployment of Small Modular Reactors (SMRs). The company’s goal is to provide an opportunity to reach carbon neutrality with improved reliability and affordability to Baltic consumers. The SMR designs that Fermi Energia are considering are being developed and licensed with government funding from the USA, UK and Canada.

METHODOLOGY

This work was performed by Deep Isolation and engineering bureau Steiger LLC. Estonia's geology was screened using two main criteria categories: safety and deliverability. The safety assessment examined the extent to which the geologic and hydrologic conditions anticipated at depth support the isolation of radionuclides from the biosphere. The IAEA Safety Standard requires careful examination of seismicity, geothermal heat flux/volcanism, climate change, and paleohydrology. Figure 1 shows the breakdown of the screening criteria.

The deliverability assessment was performed to understand the extent to which the geology is conducive to cost-effective drilling and construction of a Deep Isolation horizontal borehole repository. Regions of Estonia (shown in Figure 2) were rated on their suitability.

RESULTS

The study concludes that deep horizontal boreholes for nuclear waste disposal would be a safe, flexible, and affordable option for Estonia.

- The location options in Estonia would all be in crystalline basement geology. A high level of safety can be achieved.
- The costs of nuclear waste disposal of advanced nuclear spent fuel in a borehole is expected to be between 24% to 31% of the cost of disposal in a traditional mined repository.
- All regions of Estonia are likely to contain potential host rock formations.
- The estimated peak dose at surface from preliminary modelling is three orders of magnitude below expected regulatory requirements.

FIGURE 2: ESTONIA BY REGIONS



ABOUT DEEP ISOLATION

Deep Isolation is a leading innovator in nuclear waste storage and disposal, offering a solution that places corrosion-resistant canisters containing spent fuel in deep boreholes 1-5 kilometers underground. These repositories would be constructed using directional drilling technology within sedimentary, igneous or metamorphic host rocks – rocks that can be demonstrated to have been isolated from the biosphere for a million years or more. Deep Isolation's solution offers a practical option backed by:

- Scientific research on the long-term environmental safety performance;
- Extensive supply-chain partnerships with leading companies from the global drilling and radioactive waste management sectors

FUTURE PLANS

These preliminary conclusions are based on existing data, desk research, and dialogue and review with experts in Estonian geology; no site-specific work or new field research has been undertaken. Significant further technical work will be needed to refine this initial analysis, and to identify and characterize specific locations that would in practice provide suitable rock formations.

Deep Isolation is committed to engagement and collaboration with local communities and governments to determine if deep geological disposal is not only right for that location but supportive of the community's vision. Our model of community partnership is built around a shared understanding of what comprises the safest practices for nuclear waste management.

