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The World's First Power Plant to Produce 400 Billion Kilowatt Hours

Quo Vadis, Grid Stability? Challenges Increase as Generation Portfolio Changes

The Other End of the Rainbow: Nuclear Plant End-of-Life Strategies

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Cover:
View of the Grohnde power plant site, taken by a drone.

Deep Isolation

Future of Nuclear Industry Brighter if Nuclear Waste Issue Can Be Solved

Governments worldwide are considering alternatives to fossil fuel energy sources and taking a fresh look at nuclear energy. Even while some countries, including Germany, Belgium and Spain, are contemplating the permanent shutdown of their existing nuclear fleets, others such as the United Kingdom, France, Finland, Estonia and the Netherlands are exploring advanced reactors.

Cost can be a significant barrier to new nuclear power, but in the minds of many there is an even bigger concern: the lack of a nuclear waste disposal solution. The public is demanding a safe and equitable solution to the disposal of spent nuclear fuel, and is increasingly wary of "temporary" solutions when there is no plan in place for permanent disposal.

The good news is that innovation in nuclear waste disposal has opened up new disposal options. Meet Deep Isolation, an emerging nuclear waste disposal company aiming to break through the nuclear waste disposal stalemate.

Deep Isolation Offers New Path Forward for Nuclear Waste

Since the first nuclear power plant was opened in the Soviet city of Obnisk in 1954, more than 500 nuclear power plants have followed, contributing more than 10 percent of the world's electrical power. While nuclear power plants are considered low-carbon, they create radioactive waste that can remain hazardous to the environment and human health for tens of thousands of years.

For decades, it has been universally accepted across continents, governments, regulators, academics, scientists and the nuclear industry that the preferred solution for the long-term disposal of high-level nuclear waste (HLW) is through deep geological disposal.

Yet the primary route for deep geologic disposal has been via mined repositories — an expensive and often unpopular option.

Founded in 2016 in Berkeley, Calif., by environmentalist Elizabeth Muller and University of California, Berkeley, physicist Richard Muller, Deep Isolation uses an innovative approach to deep geologic disposal. The founders believe that we have a responsibility to find a disposal solution that can be implemented in reasonable timeframes, rather than passing on the problem to future generations.

With core values of **environmental stewardship, scientific ingenuity, and social license**, Deep Isolation believes early community engagement can help alleviate some of the obstacles previous nuclear waste disposal efforts have faced.

"Communities know what is best for them, and we are here to support that process," said CEO Elizabeth Muller. She added, "By working together we can improve the quality of the solutions we are considering. Everyone needs a seat at the table and a reasonable expectation that their input will be incorporated."

Deep Isolation is leveraging existing drilling technologies to put waste into boreholes deep underground. This method means no humans are working underground, making it safer and less expensive.

While vertical boreholes were previously considered for nuclear waste in the United States, Deep Isolation's design takes advantage of innovations in directional drilling to enable additional cost and safety benefits. The Deep Isolation design builds upon the vertical option, by adding a gradual curve at the terminus of the vertical path and extending in a horizontal direction. This design allows the waste corrosion-resistant canisters to be emplaced under rock that has been isolated from the biosphere for a million years or more.

This method means there's no direct path for the movement of radionuclides to the surface. Independently peer reviewed safety calculations published by Deep Isolation in March of 2020 examined 400 modeled scenarios and concluded that the risk of radiation exposure to humans is significantly lower than the U.S. standard.

The waste can then be retrieved during a set time period, if needed, or left permanently with the borehole safely sealed.

One advantage of an on-site borehole repository is that it eliminates the need to transport waste from the reactor site to a centralized mined repository. While transportation has proven very safe, there can be considerable concern from communities located along transportation paths, and this has delayed previous efforts that rely on long-haul transportation.

Solving a problem that has existed for decades in the nuclear industry has had its challenges as some have expressed skepticism about new disposal methods.

But on Jan. 16, 2019, Deep Isolation did something many thought was impossible: It became the first private company to successfully demonstrate to an invited cross-section of community, industry, government officials, and investors the emplacement and retrieval of a prototype nuclear waste canister in a test borehole about half a mile underground.

The success of this demonstration in Cameron, Texas, helped lead to important collaborations with industry leaders, including Bechtel and NAC International, which is working with Deep Isolation to design its waste disposal canisters, and Schlumberger, a leader worldwide in the oilfield industry that provided the test facility.

Deep Isolation recently opened a London-based office to better serve countries in Europe and Asia and began work on its first contracts to assess the feasibility of its solution in specific locations and for specific waste inventories.

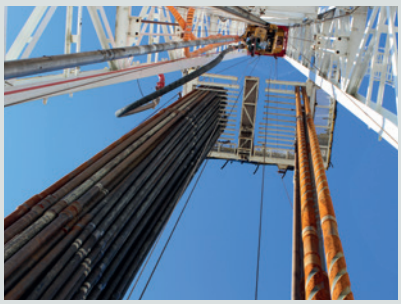
A recent study published by the Electric Power Research Institute (EPRI) indicates that locating a deep borehole repository at the site of a hypothetical advanced reactor in the southeastern United States could be both safe and cost-effective.

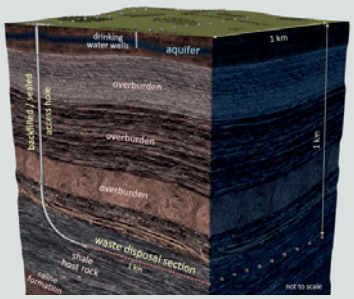
Estonia Project Sets Example for Advanced Nuclear in European Union

On Feb. 1 Deep Isolation and advanced reactor developer Fermi Energia announced the results of a deep borehole geology study — the first such study between a European company and Deep Isolation.

While countries such as Finland, Sweden and France are building mined repositories for nuclear waste, a deep horizontal borehole solution in Estonia would locate the waste much deeper, would cost considerably less than a mined repository and could be deployed in a shorter timeframe.

A cost analysis by Deep Isolation showed the planned expenditure on mined geological disposal in the U.S., Canada, Sweden and the U.K. alone amounts to $172 billion in 2020 prices — not including the costs of interim storage.





While many advanced reactor companies have yet to explain how they plan to dispose of their spent nuclear fuel, Fermie Energia, which aims to bring the first small modular reactor (SMR) to the European Union by the 2030s, took the proactive step of partnering with Deep Isolation on a qualitative geological readiness assessment of Estonia's crystalline basement rock.

The study evaluates geological conditions and potential risk factors for each of Estonia's 15 counties, screening their potential suitability for hosting a deep borehole repository. Such a repository would isolate radioactive elements from the Earth's surface for 1.3 million years. At that point, any elements that might reach the surface would be three orders of magnitude below the levels deemed safe and allowable by international safety standards.

"As Estonia considers the role that advanced nuclear power generation can play in delivering a low-carbon future for the country, citizens and policymakers can feel confident there is a safe and affordable way to dispose of the resulting spent nuclear fuel," said Chris Parker, Managing Director, Deep Isolation EMEA Limited.

Company Seeking to be Part of the Solution

Deep Isolation's success in demonstrating its technology and engaging in recent studies with governments and nuclear energy companies such as Fermi Energia illustrate the types of opportunities for the nuclear industry to solve the massive problem of nuclear waste disposal.

The company's 2021 goals include securing additional contracts with governments and the nuclear industry to study whether its disposal solution meets their needs.

To further help interested parties and organizations worldwide better understand how this solution could work for them, the company hopes to embark upon further drillhole demonstration projects so its nuclear waste solution can be ready to support the fight against climate change via the next generation of nuclear reactors.

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