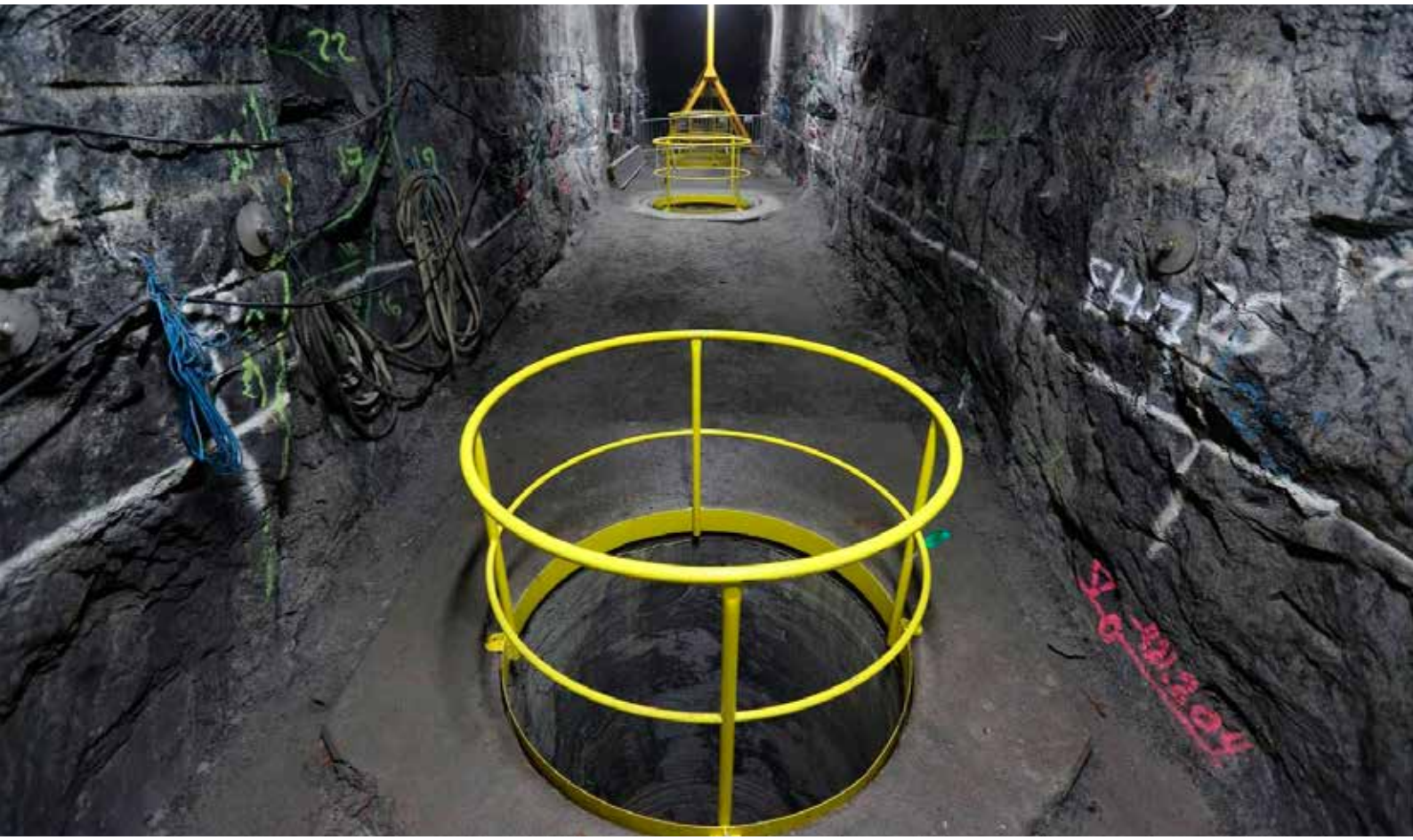
SOLUTIONS FOR WASTE MANAGEMENT



Finland built a large system of underground tunnels in solid rock designed to last for at least 100,000 years. The final repository will be located in Olkiluoto, approximately 300 km northwest of Helsinki. (Photo: Posiva, Finland)

To safely and securely dispose of high-level and long-lived radioactive waste, this material needs to be stored for a period of time that is very long compared to our everyday experience. Underground disposal facilities need to be designed and constructed in suitable geological conditions that can be confidently demonstrated to contain and isolate the hazardous waste from our environment for hundreds of thousands of years.

Over this period of time, during which the safety of an underground waste repository system must be assured, the waste's radioactivity will decay to a level that cannot pose a danger to people or the environment. The archaeological record can help in visualizing such a long period of time. Climates change, oceans rise and vanish, and species evolve in the course of a one hundred millennia. Rocks bear witness to all of these changes. Geologists in their search for safe repositories for the long-term disposal of high level radioactive waste have identified rock formations that have proven stable for millions of years. These geological formations are expected to remain stable for millions of years and can serve as host formations for waste repositories.

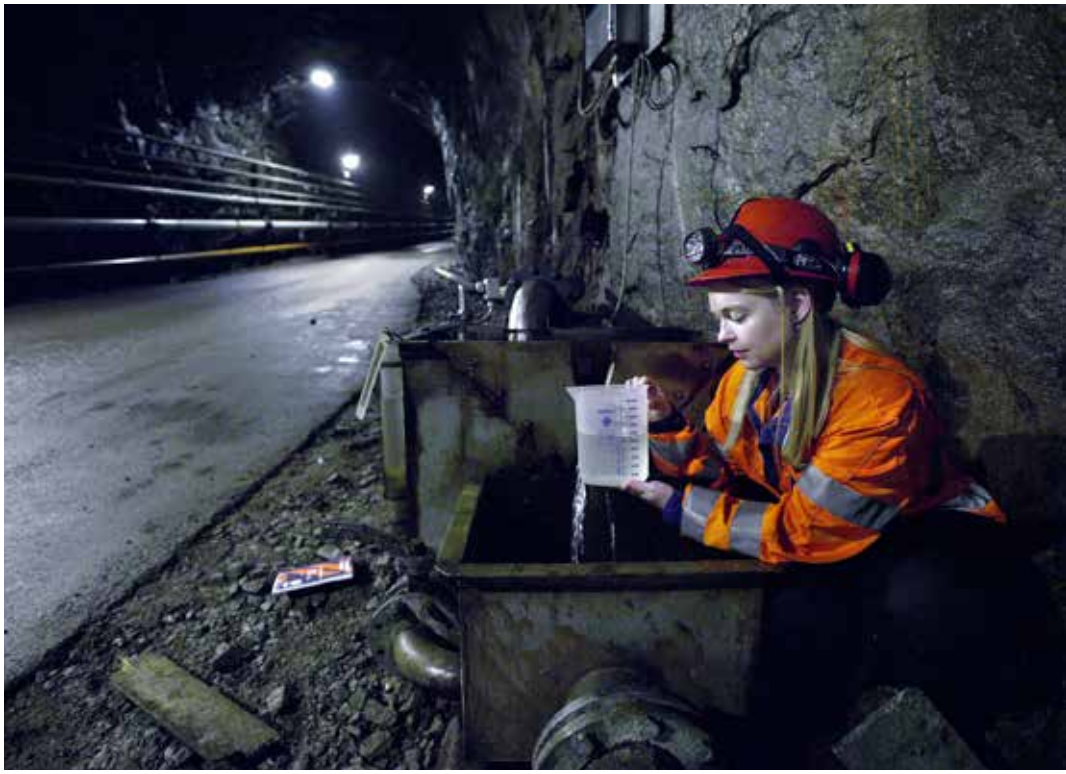
The waste with the highest radioactive content includes spent nuclear fuel, when declared as waste, and by-products of fuel reprocessing activities. This type of high-level radioactive waste must be carefully isolated from the biosphere. In the consensus opinion of international experts, deep geological formations should be used to host final repositories for the safe disposal of this waste. Currently, a number of countries are pursuing the geological disposal of high-level waste. Geological facilities already exist in Germany and the USA for the disposal of low- and intermediate-level waste.

Other sites, in Finland, France and Sweden are being developed for the disposal of high level radioactive waste and spent nuclear fuel and, subject to regulatory approvals, are due to begin waste emplacement operations in the 2020s.

In several countries, scientists are testing disposal techniques and investigating geological conditions in specially built

underground laboratories to be certain that the waste in a repository will remain isolated from people and the environment for the next 10,000 generations. Typically, safety experts assess repository safety over a period of up to, and in some cases, beyond a million years.

Research performed in these underground laboratories has demonstrated the viability of disposal in salt (Germany), crystalline rock (Canada, Japan, Switzerland, and Sweden), plastic clay (Belgium), and claystone (France and Switzerland). Russia is planning to construct an underground research laboratory in the Krasnoyarsk region in central Siberia from 2015. China is planning an underground research laboratory, which would be operational before 2020.



A worker in the underground tunnel in Forsmark, a village on the east coast of Uppland in Sweden. (Photo: SKB Sweden)

In Belgium, the High-Activity Disposal Experimental Site Underground Research Facility, or HADES, is situated in a clay formation at a depth of over 220 metres. It is the leading research facility in Belgium for experimental research on the deep geological disposal of radioactive waste.

The Czech Republic is researching geological repository options that will result in the emplacement of high-level waste in a granite rock mass or a similar environment, a concept comparable to Sweden's and Finland's designs.

In Finland, scientists started the research for a final waste repository in the 1970s. In December 2012, Posiva, the Finnish company in charge of siting and implementing a spent fuel repository, submitted a licence application to build the repository at Olkiluoto, located approximately 300 km northwest of Helsinki. Waste emplacement, provided a licence is granted by the regulator, is scheduled to start in 2020.

In an underground laboratory located outside Bure in northeast France, the French National Radioactive Waste Management Agency (Andra) is testing the capacity of the rocks to contain and isolate high-level radioactive waste for several hundreds of thousands of years.

In Japan, the Mizunami Underground Research Laboratory Project investigates, analyses and assesses the deep geological environment and develops engineering technologies for application deep underground. A second laboratory situated at Horonobe, on the island of Hokkaido, studies the deep geological environment in sedimentary rocks.

In Sweden, the Swedish Nuclear Fuel and Waste Management Company (SKB) selected a disposal facility site close to Forsmark on the east coast of Uppland and submitted a licence application to build the spent fuel repository in March 2011, which is currently undergoing regulatory review.

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Switzerland has two underground research laboratories — in the Swiss Alps, lies the Grimsel Test Site and a second research facility is located at Mont Terri — which provide environments to realistically test geological conditions, equipment and disposal options for high-level radioactive waste disposal.