BGE TECHNOLOGY NEWS

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Draft Layout for the Surface Facilities of the Norwegian Repository

BGE TECHNOLOGY GmbH

IAEA Headquarters Vienna (Austria)

Dear Readers,

as this is my final editorial, I would like to highlight upcoming projects and challenges in one hand and, in the other, to reminisce about the past 30 years of radioactive waste disposal development, which has determined my professional life.

Upcoming projects throughout Europe demonstrate the variety of options to dispose of radioactive waste, which differ significantly depending on the type and amount of waste, as well as on the national regulatory framework. Norway and Australia are investigating the possibilities of disposing small quantities of high level waste (HLW)/spent nuclear fuel (SNF) waste in deep boreholes. In many countries, including France, low and intermediate level waste is disposed of in near surface disposal facilities. In Germany, all radioactive waste types will be disposed of deep geological repositories (DGR). The technical solutions developed for this task, e.g. for the Konrad LILW repository, depict a treasure trove of experience for planning future HLW/SNF repositories in deep geological formations. The German restart of the site selection procedure for a HLW/SNF disposal facility, which now considers crystalline rock and clay rock as potential host rock formations in addition to the previous salt rock option, requires international exchange, especially with countries where repository concepts for these host rock formations are well developed.

As previously mentioned, the former German disposal strategy focussed on salt formations for which safety and demonstration concepts have been established and optimised. The focus of the safety demonstration concept shifted from assessing radionuclide release considering dose constraints to safe confinement of radioactive waste as demanded by national regulations. Consequently, it is important to quantify the containment capability of a barrier system relying on geological and technical barriers. Additionally, dilatancy and fluid pressure criteria are applied to assess salt barrier functionality, and became internationally accepted. By applying the `effective geological barrier thickness,' the influence of uncertainties can be displayed as a function of time and thus systematically reduced. A geological barrier supplemented by an engineered barrier system ensures safe containment of radionuclides. However, construction of such barriers – shaft and drift seals – under mining conditions and their long-term performance present challenges. Each step from the theoretical concept to the finalised underground construction requires adequate testing. Although some assumptions still must be experimentally verified, significant progress has been made by demonstrating the feasibility of safe containment of radioactive waste in salt formations.

After more than three decades of theoretical and practical work – supported by a motivated team of experts from different fields – it is now time for me to say goodbye. I wish you much success in continuing the task to realise the safe confinement of radioactive waste.

Happy Reading!

Nina Müller-Hoeppe

BGE TECHNOLOGY's Involvement in IAEA Activities

For several decades, BGE TECHNOLOGY GmbH (BGE TEC) and its predecessors (the R&D department of DBE and DBE TECHNOLOGY GmbH) have been involved in IAEA networking groups such as Underground Research Facilities Network (URF) and the IAEA International Low Level Waste Disposal Network (DISPONET) and have supported the IAEA in several expert missions.

The URF Network for Geological Disposal (URF Network) was implemented to foster information exchange on practice and learning for geological disposal. In this context, developing safe, sustainable, and effective geological disposal programmes through technology demonstrations is encouraged, training improved, and communications between participating organisations enhanced. To achieve these goals, URF members report their experiences and share and discuss best practices in developing, evaluating, and implementing geological disposal solutions for intermediate and high level waste and spent nuclear fuel. Compiling results of national programmes in the IAEA Nuclear Series reports remains an important tool for knowledge transfer from advanced programmes to starting programmes. BGE TEC

In-situ-test at the Hagerbach Research Tunnel (Switzerland)

contributed to several of those reports, including the recent "DGR Roadmap" and "URL Compendium," which are now being prepared for publication. Furthermore, BGE TEC supports the URF Network by its participation in the steering committee.

DISPONET serves Member States to enhance efficiency in sharing international experiences to ensure application of safe and sustainable solutions in the disposal of low and intermediate level waste. Therefore, experiences and lessons and good practices should be transferred to starting programmes. Furthermore, a forum supporting expert advice and technical guidance in questions related to disposal was implemented and training and practical learning experiences was organised. Those activities are planned in cooperation with advanced waste disposal programmes. Topics considered cover the full scope of disposal issues and respect different national approaches in the management of low and intermediate level waste. BGE TEC supports DISPONET's objectives by participating in the Steering Committee and supporting preparation of technical reports, e.g. Design Principles and Approaches (NW-T-1.27) and Costing Methods and Funding (NW-T-1.25). Furthermore, BGE TEC contributes to the preparation of a report on the closure of surface repositories.

In November 2022, an IAEA Expert Mission took place at Ignalina Nuclear Power Plant (INPP) in Visaginas Municipality, Lithuania, next to the Belarusian border. The mission belongs to the larger IAEA Project: "Enhancing National Capabilities for Decommissioning and Radioactive Waste Management, Safety Assessment, Oversight, Licensing and Emergency Preparedness." The project's objective was to support radioactive waste management and disposal decommissioning activities at INPP. The mission was part of a larger project and focussed on providing expert support on radioactive waste disposal topics. The expert group included an expert from BGE TEC and members from IAEA, United Arab Emirates (UAE), and Serbia. The head of the Radioactive Waste Repositories at INPP served as the local host for the mission, which included technical meetings and site visits at the radioactive waste handling facilities and the VLLW repository. Fruitful discussions took place between the experts and the decommissioning and disposal staff experts at the different sites and at the Vilnius office. Topics ranged from engineering challenges for the VLLW repository to the demonstration mock-up for the surface disposal facility for LILW, and to public opinion and stakeholder engagement for the future DGR for HLW. Among other valuable lessons, mission participants learned international cooperation is very helpful for these complex projects.

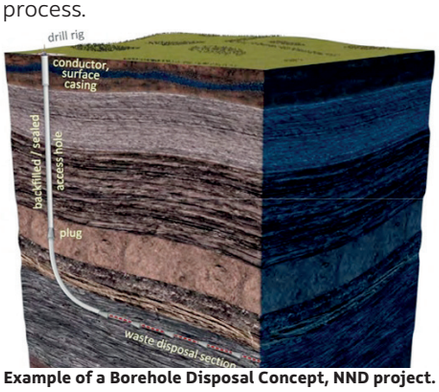
Continuous collaboration with IAEA and other global radioactive waste management agencies forms one of the main pillars in the BGE TEC's suite of services.

Reference Recipe for Shotcrete Walls in the Emplacement Chambers of the Konrad Repository

The former Konrad iron ore mine is currently being converted into a Deep Geological Repository for low and intermediate level radioactive waste in Germany. During operation, the waste packages will be stacked in emplacement chambers up to 1,000 m long. The chambers will be divided into 50 m long emplacement sections separated by shotcrete walls and filled with liquid backfill material to close the remaining cavities. The shotcrete walls have to seal the chamber sections and withstand the fluid pressure of a liquid backfill material. The solid components of the shotcrete are mixed underground in a central mixing station. Truck mixers transport the fresh shotcrete mix to the emplacement chambers where shotcrete manipulators place the shotcrete in the desired thickness at the chamber contour. To facilitate control of the wall shape and thickness, the shotcrete will have a low rebound.

Although shotcrete has already been used in the Konrad repository as support and liner in the underground cavities, the existing recipe had to be adapted to the specific requirements for use as a separating shotcrete wall in the emplacement chambers. This work was carried out in close cooperation between BGE, BGE TECHNOLOGY GmbH (BGE TEC), and DMT GmbH & Co. KG. After completion of the laboratory work, an in-situ test was carried out in the Hagerbach research tunnel (Switzerland) in which a shotcrete wall was constructed under comparable Konrad repository conditions. As a result, the shotcrete processing and placement could be carried out successfully in compliance with all requirements. Additionally, BGE TEC developed a quality assurance concept to verify all installation requirements were met.

This demonstrated another step for the smooth implementation of the placement process.



Example of a Borehole Disposal Concept, NND project.

Exploration Drilling at the Asse Mine (Germany)

BGE TECHOLOGY GmbH Continues to Support the Norwegian Disposal Programme

Norwegian Nuclear Decommissioning (NND) is responsible for the radioactive waste management including disposal in Norway. Since 2020, BGE TECHNOLOGY GmbH (BGE TEC), in collaboration with A-Insinöörit Oy (AINS Group), Mitta Oy, and the VTT Technical Research Centre from Finland, have provided NND with technical consulting services related to radioactive waste disposal. In October 2022, NND signed a significant sole provider framework agreement with the GeoReN (Geological Repositories for Norway) consortium. The consortium consists of AINS Group, BGE TEC, Geological Survey of Finland (GTK), Mitta Oy, Posiva Solutions Oy (PSOY), and VTT from Finland, with subcontracting assistance from Rambøll of Norway.

With more than 40 years of experience in radioactive waste management and developing geological repositories, the consortium's team provides NND with comprehensive international expertise in developing long-term, safe, reliable, and cost-effective radioactive waste management concepts and solutions. Based on its high-level expertise, the team will propose disposal concepts and solutions based on specific experience from several operational and under construction repositories encompassing different geologies and concepts, and covering all waste types and streams, including operational and decommissioning radioactive waste, as well as power and research reactor spent fuel.

BGE TEC will strongly support the GeoReN group by providing high-level expertise in a wide range of geological disposal solutions for the Norwegian client. The contract runs for four years and includes a contract sum of 40 million euro.

Disposal Options Analysis for Australia's Intermediate Level Radioactive Waste

Last year, BGE TECHNOLOGY GmbH (BGE TEC) performed an initial deep borehole disposal study for the Commonwealth Scientific and Industrial Research Organisation (CSIRO) on borehole and waste emplacement design parameters associated with Australia's long-lived intermediate level waste (ILW) requiring geological disposal, potentially in deep boreholes. A follow-up study by an expert team of BGE TEC and Finnish engineering company, AINS, personnel considers other repository options, including shallow silos or an intermediate depth repository for disposal of Australia's short-lived ILW.

BGE TEC has been able to draw on its deep drilling technology expertise, as well as its broad experience with different disposal and emplacement solutions, to develop more detailed aspects of the basic deep borehole disposal concept. As only a small volume of the long-lived ILW is considered for deep geological disposal, other near surface solutions have been considered for the short-lived waste. Solutions discussed include an intermediate-depth mined repository, as well as two different shallow silo options. An important aspect of the disposal options was the flexibility and adaptability of the repositories to accommodate different waste volumes and, if necessary, expand during or after the operating phase.

Preliminary cost calculations considering all surface facilities, as well as different operational times, have been done for all presented concepts. At this early stage of planning, cost differences between the shallow disposal options are small. From the many parameters discussed, the waste production scheme and the resulting operational time are two influential parameters for the planning process and cost calculation.

For further information, visit www.bge-technology.de or scan the QR code below.

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