

ASSISTANCE TO UKRAINE IN DEVELOPING
A RADIOACTIVE WASTE DISPOSAL PLAN

WATER GLASS-BASED GROUTS FOR
INJECTING ROCK AND BACKFILL MATERIAL

2ND MEETING OF THE CRYSTALLINE CLUB
IN JAPAN

BGE TECHNOLOGY GMBH SUPPORTS BGE'S
REPOSITORY PROJECTS



Saporischschja Nuclear Power Plant, SE Ukraine (source ENERGOATOM)



Dear Readers,

Right or wrong, it is often said that working in the area of geological disposal makes it necessary to adapt to geological timeframes when it comes to developments and decisions of any kind. At least for the current German programme, this statement has been proven wrong. The national programme for radioactive waste management has been put on new grounds. The HLW disposal programme was restarted and the entire national organisation for radioactive waste management has changed. New organisations were founded to allow for a more straightforward implementation of the national radioactive waste programme. A major milestone in this context is the merger of the former national radioactive waste management organisations – a federal authority, a state-owned company, and a utility-owned company – into the new national implementer BGE.

Despite all the changes here, the world keeps on turning. Hence, we stick to the tradition of informing you about news and statuses of our projects and activities by means of our newsletter. So, please enjoy a small trip into our projects and activities.

Happy reading!

Dr. Thilo von Berlepsch
Managing Director
BGE TECHNOLOGY GmbH

At the same time, along with the formation of the new implementer, the shares of DBE TECHNOLOGY GmbH were transferred to BGE, and now our name has been changed to BGE TECHNOLOGY GmbH – a clear sign of appreciation of our expertise. And what is true on the large national scale also holds for us: Our projects are progressing well and we keep working with the same highly motivated and qualified staff as before. We are involved in several interesting and challenging national and international projects, a small excerpt of which you will see in this newsletter.

The success of BGE TECHNOLOGY GmbH is largely based on the work of Dr. Jürgen Krone. With a high degree of patience, tenacity, and competence, he led the company to its current success and reputation. A good leader and expert at the same time, he motivated the team and set the mark for the level of quality of the company's work. His retirement after more than 20 years in the company leaves a gap that will be hard to fill. Dear Jürgen, thanks a lot for all your support and guidance over the last years. I wish you lots of happiness for your retirement and that all your plans will come true.

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Assistance to Ukraine in developing a radioactive waste disposal plan

The European Commission awarded a two-year contract to a consortium led by BGE TECHNOLOGY GmbH to assist Ukraine in developing a viable plan for their radioactive waste geological disposal. The successful tender was jointly realised by the consortium partners Andra, SKB International AB, and BGE TECHNOLOGY GmbH. The strong project team will be supported by external experts from Posiva Solutions Oy, Facilia AB, and from Ukraine: Radioecological Centre of the National Academy of Science.

Nuclear power contributes more than 50% to Ukraine's electricity generation. Fifteen nuclear reactor units are located at four sites around the country. Ukraine has had nuclear power generation since 1981, with the associated amounts of spent nuclear fuel and other types of radioactive waste. The long-term management of such waste calls for a geologic repository based on international best practice. The awarded contract concentrates on assisting Ukraine in developing and establishing a national programme, including knowledge transfer with regard to geologic disposal of radioactive waste.

The consortium has proven experience in cooperating successfully with Ukrainian stakeholders and mastering the known challenges of the project. BGE TECHNOLOGY GmbH will benefit directly from its parent company's expertise, bringing to the project the experience gained in the German repositories, which are at various stages



Crystalline Club

2nd Meeting of the Crystalline Club

of their operating cycle. This is in addition to the recently restarted siting process for a high-level waste repository in Germany. BGE TECHNOLOGY GmbH's very recently retired Managing Director, Jürgen Krone, will be leading the project.

The project starts in September 2018 and is expected to run for two complete years. The key to the success of this project is that all of the consortium members have long-standing and proven experience from past projects in radioactive waste management in Ukraine and other Eastern European countries. This project will add another high-level entry to BGE TECHNOLOGY GmbH's long list of international cooperation projects.

Water glass-based grouts for injecting rock and backfill material

To optimize or restore the barrier function of different host rocks or backfill materials, BGE TECHNOLOGY GmbH developed injection materials and grouting techniques to seal any cavities in rocks or backfill materials.

In order to stabilize the rock and backfill bodies and to seal cracks, fractures, or pores, suspensions and particle-free injection materials are applied. In saline environments, the particle-containing grouts are based on magnesium oxide. In non-saline areas, mixtures with classic cements as well as reactive and non-reactive fillers are used.

Beyond a certain size, particles cannot penetrate into small fractures or pores,

which are potential pathways for fluids. As a result, the range of use of these grouts is limited, and water glass is used to seal finer flow paths. However, experience has shown that the penetration of particles can be improved if water glass is injected first and the grouts are injected immediately afterwards. This effect can be explained by a lubrication of solid surfaces and the effect that water glass dissolves salts before gelation and hardening can start. This finding suggests combining water glass, as carrier fluid, with reactive additives. The development work led to novel grout families that also have many other benefits. At elevated injection pressures, the water glass and non-inert solutions are squeezed out of the mixtures, which themselves act as an independent injection agent. This way, it is possible to fill or seal fractures and pore systems of very different sizes in one injection step for the very first time.

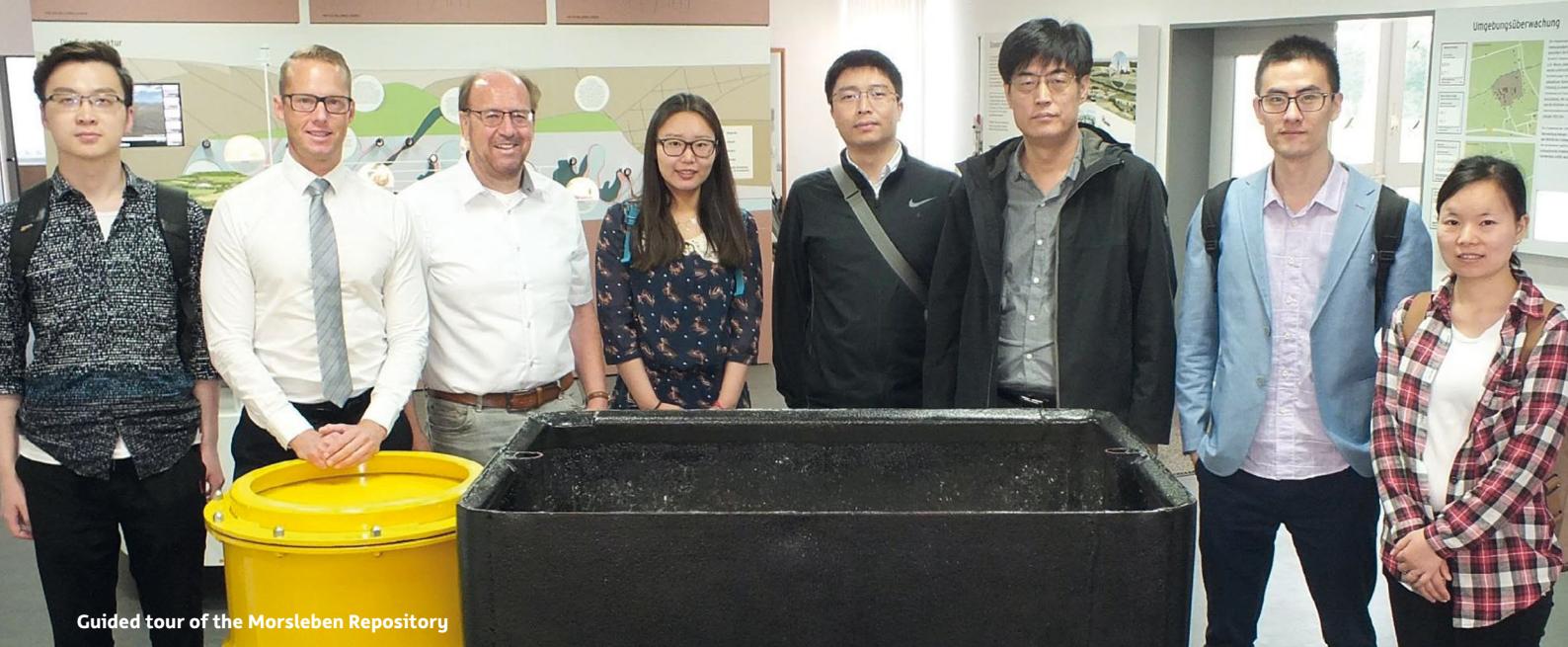


Sample of crushed salt grouted with MgO-water glass mixture (marked in blue)

2nd Meeting of the Crystalline Club in Japan

From June 13–14, the 2nd Meeting of the Crystalline Club (CRC), hosted by the Nuclear Waste Management Organization of Japan (NUMO) and Japan Atomic Energy Agency (JAEA), took place at the JAEA Mizunami Underground Research Laboratory (URL) in Japan. In 2016, the Integration Group for the Safety Case (IGSC), the main technical advisory body to the OECD Nuclear Energy Agency Radioactive Waste Management Committee (NEA RWMC), approved the launching of the CRC. Many countries are developing or plan to develop geological disposal facilities for radioactive waste in crystalline rock. Although an advanced scientific and geotechnical understanding of crystalline rock has been accumulated through the dedicated research carried out by these countries, there are research areas in which member countries may benefit from joint R&D efforts. The first work activities of the CRC consist of two steps. The CRC will develop a state-of-the-art report on the characterization of crystalline rock as a first step. Following this report, the CRC will define the needs for further research of common interest.

The 2nd meeting was supplemented by a topical session on the role of URL in the development of a safety case for a deep geological repository. Special focus was on the determination and handling of discontinuities and fracture networks in crystalline rock within the framework of safety analytical investigations. The meeting was a very valuable event, especially with regard to ongoing and future R&D work for radioactive waste



disposal in crystalline rock in Germany. As a meeting highlight, the attendees visited the surface facility of the Mizunami URL in the Tono area in central Japan. The URL consists of two 1000-m-deep shafts and several drifts and is used to carry out geoscientific research in crystalline rock.

BGE TECHNOLOGY GmbH supports BGE's repository projects

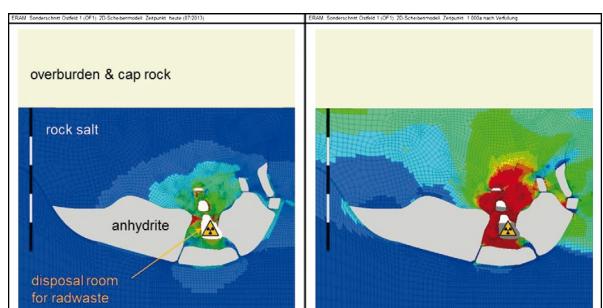
For BGE's repository sites, numerical calculations are carried out, which are used to evaluate the stability of the mine openings and to assess the integrity of the surrounding host rock barrier. The numerical calculations are carried out by either BGE TECHNOLOGY GmbH or by subcontractors of BGE, in which case BGE TECHNOLOGY GmbH technically supports and supervises the project.

For the Morsleben repository, geo-mechanical calculations are carried out to evaluate the integrity of the geologic barrier of the different mining panels of the Bartensleben and Marie mines. Following concerns of the Nuclear Waste Management Commission

(ESK), supplementary calculations are carried out on simplified but typical models to investigate geomechanically-induced uncertainties. In addition to data and parameter uncertainties, model uncertainties are taken into account as geomechanical modelling uses several, consecutive models; e.g. mine opening model, geological/geotechnical model, backfilling plan, calculation model, numerical model, modelling approach, constitutive models including their parameters. All models are restricted by their specific uncertainties. The calculations carried out by BGE TECHNOLOGY GmbH are to investigate and assess the relevance of the geomechanically-induced uncertainties (sensitivities) to the integrity of the salt barrier. This takes into account one of the recommendations of the ESK.

The Konrad mine is currently being converted into a repository in accordance with the license requirements. The corresponding work includes extensive excavation work and the installation of support systems, some of them designed to cover the whole

operating phase of the repository. To dimension the support systems, numerical calculations are carried out, which take into account the mine excavations, the excavation process, and the installation of the support system. Such calculations have been carried out by BGE TECHNOLOGY GmbH for the conventional workshop at the 3rd mine level. The numerical calculations for the extension of shaft 2 and the excavation/support of the shaft landing station at the 2nd mine level are carried out by BGE's subcontractor ARGE CIC, while BGE TECHNOLOGY GmbH supervises and evaluates the calculations and provides technical support. This also includes reviewing the interpretations of the results before they are taken into account in the design work.



Morsleben repository: Eastern field after 1,000 yrs. – dilatancy (left) & fluid pressure criterion (right)

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

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