BGE TECHNOLOGY NEWS

4
2020

20 Years of BGE TECHNOLOGY GmbH

BGE TECHNOLOGY GmbH

- SUCCESSFUL COMPLETION OF THE ELSA PHASE 2 PROJECT
- SUPPORT OF INTERNATIONAL DEEP BOREHOLE DISPOSAL PROJECTS
- CERTIFICATION ACCOMPLISHED!
- IMPACT OF EARTHQUAKE ON ROCK BOLTS AT KONRAD REPOSITORY

Dear Readers,

Anniversaries always invite us to look back and take stock. This is of course also the case with BGE TECHNOLOGY GmbH, which was spun off 20 years ago from the former research and development department of our parent company. BGE TECHNOLOGY GmbH (at that time still under the name DBE TECHNOLOGY GmbH) was founded with the aim to generate knowledge through research and development projects in the field of radioactive waste disposal, to gain experience by working for national disposal programmes and to make both, knowledge and experience, available to the parent company and to external customers.

And this is exactly what we have been doing for 20 years. We can look back on over 60 R&D projects, more than twice as many projects for customers, and countless tasks for our parent company. The range of tasks and projects includes the performance of safety analyses or construction of sealing structures, the development of new numerical models or tailor-made technologies as well as the development and evaluation of entire repository concepts – and all this for different host rocks, in particular clay, crystalline rock and salt. Armed with this equipment, our employees are frequently requested to participate in national and international working groups or to give lectures at conferences and hold training courses.

Also 20 years ago, the Gorleben moratorium came into force. The then sudden termination of work on and in the Gorleben salt dome marked the beginning of a process that led to an agreement of the main political groups on a complete and intentionally unbiased restart of the programme for a repository for high-level radioactive waste. In the meantime, BGE, our parent company, has been commissioned with the search for a repository site, independent of the host rock and concepts developed so far. Our employees can optimally contribute to the success of the site search based on the largely site-independent work and projects that we have carried out in the 20 years of our existence.

The team of BGE TECHNOLOGY GmbH would like to thank you with this edition of our flyer. This is why we want to give our expertise a face this time in addition to the pictures and graphics from the projects. The articles in this issue reflect the spectrum of our work: from the development of concepts for shaft seals and testing of functional elements in the ELSA project, to looking beyond the horizon of the national waste management programme in the IAEA concerted research project on borehole disposal on the basis of our very extensive expertise in the development and processing of building materials, to the application of our knowledge to geotechnical issues for the future repository for low- and intermediate-level waste at Konrad. In this context, we would also like to demonstrate that we are always striving to produce our work to high quality standards.

But as always ... convince yourselves!
Happy Reading!

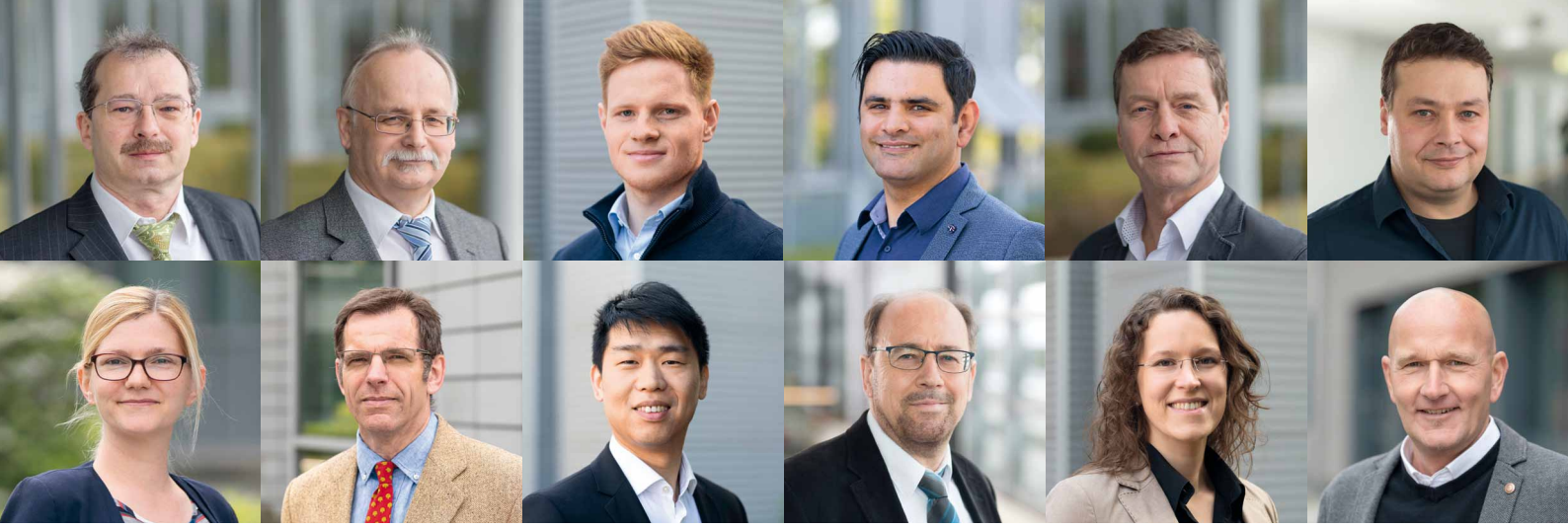
Yours sincerely,
Thilo Berlepsch

Successful Completion of the ELSA Phase 2 Project

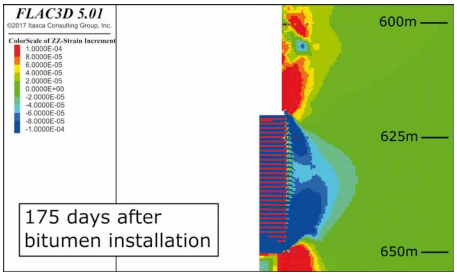
After seven years, the R&D project ELSA 2 as a collaboration between Technical University Bergakademie Freiberg and BGE TECHNOLOGY GmbH (BGE TEC) has successfully been completed. The two general objectives to develop shaft sealing concepts as site-independent basic concepts for salt and claystone formations and to test individual functional elements in the laboratory and in large-scale experiments with development, testing, and calibration of material models for the description of the material behaviour for the mathematical verification were fully achieved.

While TU Bergakedemie Freiberg focused on lab and in-situ experiments, BGE TEC focused on the numerical investigation or in-situ experiments of relevant processes for shaft sealing, especially in clay formations. One objective was to determine to what extent the settling of a gravel column due to an earthquake can be estimated. To simulate the mechanical properties of gravel particles, the general-purpose DEM framework PFC3D was used and additionally coupled with the continuum code FLAC3D. The results show that the expected earthquake impulse is too low to cause a critical settlement of the gravel column.

Further open questions dealt with the technical need of a partial removal of the EDZ at the shaft contour or the risk of an additional damage related to the hot installation of bitumen. A quantitative analysis of the permeability changes inside the EDZ shows that the shaft sinking changes the main characteristics of the permeation significantly. The thermal impacts based on bitumen installation are marginal. More significant impacts are observed during



the removal of rock, which is related to an additional reorientation of the stress field. Bitumen as a mixture of various hydrocarbons can always be assigned a fluid character. Additionally temperature and stress dependencies have to be taken into account. Based on a comparison of different approaches and on calibration with lab tests, the material behaviour was numerically discretized and provides now a useful tool for the further investigation of bitumen-based sealing elements.



Thermomechanical interaction between the shaft contour and a gravel column backfilled with hot bitumen

Support of International Deep Borehole Disposal Projects

Deep boreholes have been drilled for many years in order to explore the structure and composition of rock formations or to extract raw materials or thermal energy. During drilling, well logs and investigations of the drilling mud or cores provide geological information. This way, it is possible to adapt the borehole trajectory according to the respective requirements using directional drilling technology. The boreholes reach depths far below the biosphere, where no fluid transport took place during geological time periods, and their small cross-sections are favourable prerequisites for the sealing of flow paths. These facts suggest that deep boreholes could also be used to isolate radionuclides, especially if the waste quantities do not justify the construction of a mine. Deep boreholes are also drilled prior to the construction of geological repositories, where boreholes and small scale tunnels are considered as one disposal option. Accordingly, extensive knowledge about nuclear safety issues, the development of waste packages, transport and emplacement technologies as well as about the design and sealing of disposal boreholes is available from the planning and technical implementation of the German deep geological disposal projects.

BGE TECHNOLOGY GmbH (BGE TEC) bundles this knowledge and supports countries, for which deep borehole disposal could be an optimal disposal solution due to their small quantities of long-lived radioactive waste. Examples to be highlighted are the cooperation with Norwegian Nuclear Decommissioning (NND) and with the International Atomic Energy Agency (IAEA). The work of BGE TEC for NND is part of technical assistance in the development of possible disposal solutions, which was already a topic of our newsletter issue 2/2020. Cooperation with IAEA in this area mainly takes place in the framework of working groups, whose aim is to exchange the knowledge gained from ongoing projects and research.

At the invitation of NND, BGE TEC also participates in workshops of the European Repository Development Organisation (ERDO). This organisation was founded in order to promote the concept of shared repository development as a complement to the national disposal programmes. This way, BGE TEC contributes to the long-term radiation protection of man and the environment in many countries that have low waste volumes.

Certification Accomplished!

After a year of extensive work, our new quality management system (QMS) was up and running in June this year, allowing us to get recertified. An independent QMS tailored to the special needs of BGE TECHNOLOGY GmbH (BGE TEC) became necessary after the merger of our former parent company into BGE, which developed its own QMS strategy.

First, the QMS was completely revised. A new QM manual, various new QM instructions, and a new organisation manual had to be prepared. The quick realisation was made possible by the fact that we could build on a proven QMS already lived by all employees of BGE TEC and that we were always supported by our colleagues from the QM department of our parent company. We were thus prepared to re-initiate the certification process that had been suspended in 2018 and 2019 due to the restructuring of our parent company.

Needless to say that in the time between certifications, we were able to ensure our high quality standards for our work at all times, as we were audited at regular intervals by the QM auditors of our parent company. These internal audits ensured a regular independent review of our processes.

The 2020 certification of our QMS was carried out by auditors of TÜV NORD CERT GmbH. Due to the corona restrictions, a virtual pre-audit took place in March. The main audit, however, could take place in our premises in July. First, the entire QMS was audited. This included discussions about the interfaces to our current parent company, BGE, as well as the training and integration of new employees and the acquisition and preservation of knowledge.

Based on one project of the International Projects Department (project "Stocamine") and one of the R&D Department (project "SUSE"), we were able to credibly show the TÜV auditors that we have implemented a QMS that is part of our daily working life. From contract application and processing to the entire project management and documentation, everything could be documented and reproduced in an exemplary manner.

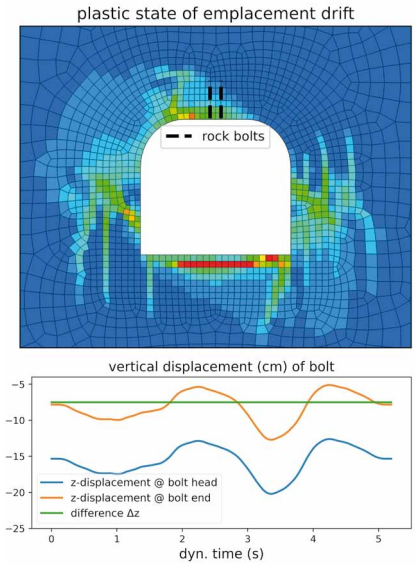
As a result, no non-conformities could be determined, and only a small potential for improvement was identified. A good feedback for our daily work and also a good sign for our partners and clients!

With our certificate for the scope "Planning of repositories, nuclear and conventional facilities and their closure and disposal, remediation of mines and contaminated sites" according to DIN EN ISO 9001:2015 we have been certified to have a functioning quality management system.

This does not mean, however, that we have achieved our final goal. We will constantly optimise our processes, adapt them to current conditions, and train the quality awareness of our employees so that we can continue to provide our partners and clients with our expert know-how at a high level of quality.

Impact of Earthquake on Rock Bolts at Konrad Repository

Considering the operational phase of the Konrad repository, earthquake resistivity of safety-relevant technical components – e.g. pipes for hydraulically transported cementitious backfill for the emplacement drifts – has to be demonstrated according to the technical safety guidelines of the Nuclear Safety Standards Commission (KTA). Some of the technical components are fixed to the drift contour by rock bolts. Therefore, it was investigated numerically whether rock bolts are additionally strained by an earthquake impact due to bedrock fluctuation.



Analysis of seismic impact on rock bolts at Konrad repository

The model area is at a depth of 858.5 m to 935 m and covers the cross-section of one emplacement drift as well as an axial section. At the Konrad emplacement level, the sedimentary rock has an inclination angle of about 25°, and as a consequence, the bedrock shows an anisotropic behaviour. To verify the suitability of the rock mechanical parameters, the history of the emplacement drift from its excavation to the present time was modelled, and the calculated convergence behaviour was compared with convergence measurements. As the agreement between calculated and measured values was adequate, the simulated plastic state of the calculation model was used as initial state for the earthquake calculation.

The calculation results were evaluated at two rock bolt positions in the roof of the emplacement drift. As the length of the individual rock bolts is 1.80 m, the displacement difference between the drift contour and 1.80 m depth in direction of rock bolting was determined, because a displacement difference causes additional strain in the rock bolts. The calculation results showed that the rock bolts are subjected to fluctuations in displacement. The additionally induced strain is negligible. Thus, the empirical experience that earthquakes do not cause significant damage in the deep underground is confirmed by the numerical results.

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

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