



# BGE TECHNOLOGY NEWS



The DBE TECHNOLOGY GmbH Team in 2005



BGE TECHNOLOGY GmbH

- SEALING AND BACKFILLING MEASURES FOR HLW REPOSITORIES
- LICENSE TO DESIGN SUPPORT STRUCTURES
- THE FIRST SIX YEARS OF DBE TECHNOLOGY GMBH (2000–2006)

For 25 years, BGE TEC has been supporting repository programmes worldwide and contributing to the international state of science and technology through its research. This milestone serves as an opportunity for us to reflect in this year's editions of our newsletter.

In this edition, you will find the highlights of our formative years from 2000 to 2006 both on this page as well as in the image scroll bar.



## 2000

Construction supervision for the Elbe tunnel north ramp

## 2001

Dismantling of the large-scale test as part of the BAMBUS project



## Congratulations DBE/BGE TECHNOLOGY GmbH on Your 25<sup>th</sup> Anniversary

BGE TECHNOLOGY GmbH (BGE TEC – then still DBE TECHNOLOGY GmbH (DBE TEC)) was founded in 2000 as a wholly owned subsidiary of Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE) in order to maintain and systematically develop its specific expertise and leverage it both in Germany and abroad.

DBE, which was founded in 1979, was not able to operate in the market due to its special legal structure as a non-profit adminis-

trative assistant to the Federal Government. As a result, its activities were limited to the tasks for the national repository projects as specified by the Federal Government. Since then, DBE has focused exclusively on the German repository projects, while DBE TEC is responsible for all other activities.

In the following, I would like to share with you a few DBE TEC activities from my active time, which I remember with pleasure:

- The successful participation of DBE TEC in numerous international waste management projects and in almost all relevant international working groups and committees on the disposal of radioactive waste. This has led to a very positive perception of the company as a whole far beyond national borders. This has ensured that DBE TEC is familiar in detail with the international state of the art in science and technology, which it also plays a key role in shaping.
- As part of national and international R&D projects, DBE TEC has developed the necessary expertise for many of DBE's tasks. One example of an outstanding R&D project is the heater test that simulated and investigated the disposal of spent fuel canisters in drifts at the Asse mine over a period of more than 10 years. This large-scale test demonstrated the feasibility of the disposal of heat-generating, high-level waste in salt formations.
- A prominent example of engineering services for solving tasks in nuclear waste

disposal outside of DBE projects is DBE TEC's involvement in the decommissioning of the Asse mine. Furthermore, for the Richard repository (Czech Republic), a closure concept for a disposal facility for low- and intermediate-level radioactive waste was developed.

- DBE TEC has trained junior staff to highly qualified levels so that they are able to master the technical challenges involved in solving this complex and demanding topic – the disposal of radioactive waste, which generally involves breaking new scientific and technical ground, in close interdisciplinary cooperation with experts from the fields of engineering, geology, and nuclear technology/radiation protection.

The founding of DBE TEC was and is a complete success. DBE TEC has developed into a highly competent, internationally renowned partner. As a small company, they were able to act quickly and efficiently. Their work has advanced the solution of the problems surrounding the management of radioactive waste. I am always happy to receive news from BGE TEC and like to think back to my active days. I wish the current management and the entire team all the best; I am sure that we will continue to hear about BGE TEC's outstanding successes in the future.

A warm Glückauf to you all!

*Yours sincerely, Michael Ripkens  
Managing Director  
DBE TECHNOLOGY GmbH  
from 2001 – 2013*

The first phase of the project was to assess advanced sealing measures and their direct applicability to an HLW repository in Germany. Due to the enormous range of geological characteristics of the sites under consideration in the German Site Selection Procedure, questions about the feasibility of repository closure remained open.

The second phase of the project therefore analysed the international state of scientific and technical knowledge in underground backfilling and sealing measures with a much broader scope in order to answer the question: Do we have deficiencies in conceptual knowledge about the closure of an HLW repository under geological conditions that we can reasonably expect



## 2003

Construction of flow barriers for the closure of the Asse mine

Experiments on the technical feasibility of emplacing POLLUX® canisters

Repository concept implemented for LILW repository Richard, Czech Republic

for a site in Germany? Some deficiencies were perceived. For example, as the German site selection considers repository depths of up to 1,400 m in certain host rocks, challenges in terms of constructability and/or hydraulic tightness of plugs and seals can be expected due to the high hydraulic and rock mechanical stresses in the deep underground. Challenges differ from host rock to host rock.

The third and last phase of the project aims at generating a conceptual understanding of feasibility, if possible. Laboratory or modelling work might be needed to achieve this. If feasibility cannot be demonstrated, the project can deliver arguments to narrow down the range of parameters considered in the search for a site.

## License to Design Support Structures

As part of the AGEnT002 R&D project (German acronym for "support structures in underground excavations for high-level radioactive waste repositories in claystone"), BGE TECHNOLOGY GmbH (BGE TEC) is collaborating with DMT GmbH & Co. KG to develop a suitable support system for underground openings in claystone. The project focuses on ensuring both operational safety during the emplacement phase and long-term stability by improving the tunnel lining system and designing support structures for tunnel intersections.

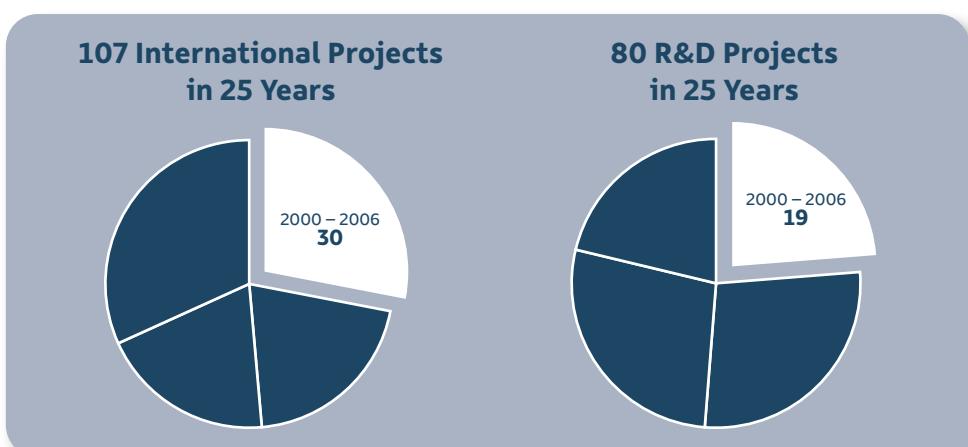
To examine the short- and long-term behaviour of the support system, a multi-stage approach is used. The initial dimensioning is conducted using the software FLAC3D, where the rock mass, tunnel intersections, and support

structure are modelled as a monolithic shell. The rock is assigned a suitable material model and parameters, while the support structure is initially represented with a Mohr-Coulomb model. After excavation, stress distributions and displacements are analysed. A controlled stress relief is permitted until 80% of the expected deformation have occurred, at which point the installation of the support structure is assumed.

As FLAC3D cannot explicitly model reinforcement in concrete linings, a workflow for coupling with structural analysis software has been developed. Nodal forces from FLAC3D are transferred directly to SOFISTIK and ATENA, which

enables a detailed load-bearing assessment. A consistent mesh across all models ensures seamless force transfer. The final design optimisation and stability verification of the support structure are carried out with the structural analysis software.

By integrating these methods, BGE TEC established a robust workflow for the design of long-term stable support concepts, addressing the specific challenges of a high-level radioactive waste repository in claystone. The findings will contribute to the development of durable, adaptable solutions that meet both safety and geomechanical requirements.



For further information, visit [www.bge-technology.de](http://www.bge-technology.de) or scan the QR code below.

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Site characterisation at Shezkazgan mine in Kazakhstan



**2005**

Celebration of the first 5 years of DBE TECHNOLOGY GmbH



Meeting of the Club of Agencies (CoA), hosted by DBE TECHNOLOGY GmbH

**J**uly 13, 2000 marks the official founding date of DBE TECHNOLOGY GmbH (BGE TEC – then still DBE TECHNOLOGY GmbH (DBE TEC)) under the managing directors Hartmut Meyer and Dr. Jürgen Lempert, who was succeeded after one year by Michael Ripkens.

DBE TEC has been involved in all aspects of radioactive waste from an early stage and has, for example, supported licensing procedures for interim storage facilities at nuclear power plant sites. DBE TEC also provided construction supervision services for the interim storage facilities. DBE TEC has supported international waste management programmes, for example in Belgium, France, Japan, Romania, and the Czech Republic. For site characterisation, too, DBE TEC was in demand internationally and carried out projects in Argentina and Kazakhstan.

Early on, DBE TEC supported work on sealing dam structures in saliniferous formations, based on a systematic research and analysis of historical dam structures. Grouting of the excavation-damaged zone with sodium silicate was later qualified for use in the Asse mine. In underground preliminary tests, the penetration behaviour was investigated and both the suitability and processability were evaluated. As part of the quality assurance of the Sorel concrete used for the construction of flow barriers, a method suitable for construction sites was implemented to investigate the temperature development, which allows conclusions to be drawn about the setting behaviour and processing times.

The building material salt concrete played a central role for the Morsleben repository (ERAM), as it was used as supporting backfill for cavities, in the planning of drift seals, and in a large-scale test.

During the backfilling of parts of the mine between 2003 and 2011, DBE TEC supported its parent company DBE with the recipe adjustments, the building material analyses, and ultimately with the use of the building material as part of the mining hazard prevention measure, where approx. 1 million m<sup>3</sup> of material were placed in the central section of the ERAM.

As an alternative to the then existing backfill materials, DBE TEC, in collaboration with GRS gGmbH, developed a self-healing backfill material as part of the AISKRISTALL R&D project from 2002 to 2004 – a material that meets the requirements for processability, impermeability and strength, as well as the availability of its components.

A large proportion of the tasks dealt with in the early years involved planning work and numerical verifications for backfilling and sealing measures in mines. The above-mentioned backfilling measures in the ERAM were implemented not least because – based on numerical calculations – employees of DBE TEC correctly predicted that rock would break from the roof of its central part.

In order to be able to mathematically describe the thermo-mechanical effects of the backfilling measures on the mine, a constitutive model was developed and adapted. This was used in large-scale numerical models to analyse the effects of the backfilling measures on the stability of the mine workings. During the mining hazard prevention measures, this was done using the observation method by comparing numerical forecast calculations with daily measurement data.

In addition to AISKRISTALL, ASTER, GEIST and GENESIS were among the first R&D projects carried out by DBE TEC on be-

half of the Federal Government via the Project Management Agency Karlsruhe, which established a very good relationship with the latter. These initial projects already show the breadth of the work spectrum and also laid the foundations for successful collaborations.

ASTER refers to site investigation requirements for HLW repositories in hard rock. As part of a German-Russian scientific and technical cooperation, this project not only intensified the cooperation with the Russian colleagues, but also the cooperation with GRS and BGR. This co-operation between GRS, BGR, and DBE TEC was to develop into many very successful joint R&D projects.

With GEIST and GENESIS, DBE TEC focused on another potential host rock for a future HLW repository: claystone. While GEIST initially focused on comparing repository concepts in salt and claystone, GENESIS already carried out initial investigations into the safety design of such a repository in claystone. Even though the details of the repository concepts changed over time, DBE TEC was already concentrating on technical feasibility studies and numerical calculations at generic sites in northern and southern Germany at that time.

DBE TEC had the opportunity to participate in heater experiments and mine-by tests at the Mt Terri and Bure URLs and to accompany these with THM-coupled calculations. The tests were also used to test fibre optic measuring systems, which were co-developed by DBE TEC. The knowledge gained on the mechanical behaviour of claystones could later be used for targeted measures at the KONRAD mine.