

# Annual Report 2016



Verantwortung  
für Generationen  
Responsibility  
for Generations

**DBE**TEC  
DBE TECHNOLOGY GmbH

# Balance Sheet as of December 31, 2016

## Assets

	Notes	12/31/2016 T€	12/31/2015 T€
<b>A. Fixed assets</b>	(1)		
I. Intangible assets		8	18
II. Tangible assets		114	43
III. Financial assets		(€ 250.00)	(€ 250.00)
		<b>122</b>	<b>61</b>
<b>B. Current assets</b>			
I. Inventories			
1. Work in progress		4,204	4,538
2. Advance payments		19	1,506
		4,223	6,044
II. Receivables and other assets	(2)		
1. Trade receivables		496	386
2. Receivables from affiliated companies		92	118
3. Other assets		75	44
		663	548
III. Cash on hand, bank balances		2,897	2,978
		<b>7,783</b>	<b>9,570</b>
<b>C. Prepaid expenses and deferred charges</b>		<b>13</b>	<b>26</b>
<b>D. Deferred tax assets</b>	(3)	<b>7</b>	<b>134</b>
		<b>7,925</b>	<b>9,791</b>

## Equity and Liabilities

	Notes	12/31/2016 T€	12/31/2015 T€
<b>A. Equity</b>			
I. Subscribed capital	(4)	511	511
II. Capital reserves	(5)	179	179
III. Revenue reserves	(6)	569	569
IV. Net profit for the year		660	444
		<b>1,919</b>	<b>1,703</b>
<b>B. Provisions</b>			
1. Provisions for pensions	(7)	119	111
2. Tax provisions		0	18
3. Other provisions	(8)	379	748
		<b>498</b>	<b>877</b>
<b>C. Liabilities</b>	(9)		
1. Advance payments received		4,295	6,760
2. Trade payables		890	101
3. Payables to affiliated companies		96	142
4. Other liabilities		227	208
		<b>5,508</b>	<b>7,211</b>
		<b>7,925</b>	<b>9,791</b>



## Income Statement

	Notes	2016 T€	2015 T€
1. Turnover	(10)	9,262	6,324
2. Changes in inventories		-334	275
3. Other operating income	(11)	611	131
		<b>9,539</b>	<b>6,730</b>
4. Cost of purchased services	(12)	3,664	797
5. Personnel expenses	(13)	3,853	4,198
6. Depreciation		38	43
7. Other operating expenses	(14)	1,056	1,057
		<b>8,611</b>	<b>6,095</b>
		928	635
8. Other interest and similar income	(15)	16	28
9. Interest and similar expenses	(16)	-17	-23
10. Taxes on income	(17)	-266	-195
<b>11. Result after taxes</b>		<b>661</b>	<b>445</b>
12. Other taxes		-1	-1
<b>13. Net profit for the year</b>		<b>660</b>	<b>444</b>

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## Editorial

Dear Readers,

This annual report is to give you an idea how DBE TECHNOLOGY GmbH as a small company specialized in radioactive waste disposal that works on the free market both nationally and internationally has prepared itself for the organizational changes regarding radioactive waste disposal in Germany upcoming in 2017. As in the previous 15 business years since its founding, DBE TECHNOLOGY GmbH could again demonstrate its economic stability in 2016 with a strong positive result.

Together with other leading German research institutions, major efforts were directed towards the preparation of the necessary research basis for supporting the upcoming new site selection process for a high-level radioactive waste repository in Germany. In this context, our international collaborative efforts and the participation in international large-scale projects play a major role. These activities give us the opportunity for a direct exchange of experience and an active contribution to the advanced international state of the art in science and technology and prove that German disposal know-how – irrespective of the difficult national political environment – is appreciated at an international scale.

The provision of qualified staff and of selected scientific and technical services to the repository projects of the Federal Government, which are currently operated by Asse-GmbH and DBE, are further good opportunities to make sustainable contributions to the use of synergies between these two companies. We thus welcome their merger with relevant parts of the *Federal Office for Radiation Protection (BfS)* in the *Bundesgesellschaft für Endlagerung mbH (BGE)*, with the hope that the inherent chances for a fast solution of the disposal tasks in Germany are resolutely exploited. DBE TECHNOLOGY GmbH and its staff are well prepared to provide substantial contributions to these tasks.

In this connection, I would like to thank our numerous, mostly long-standing business partners and customers for their cooperation and commitment, and our employees for their dedication and hard work, always following the highest scientific and technical standards. I look forward to continuing our successful collaborations.

Dr. Jürgen Krone  
Managing Director



Dr. Jürgen Krone  
Managing Director DBE TECHNOLOGY GmbH



## Company Profile



From left to right: Dr. Jürgen Krone (Managing Director), Wilhelm Bollingerfehr (Head of Research & Development, Authorised Officer), Dr. Nina Müller-Hoeppe (Head of Repository Safety), Dr. Thilo von Berlepsch (Head of International Projects), and Hartmut Bothe (Head of Asse Projects)

### Expertise and Know-How

DBE TECHNOLOGY GmbH was established in the year 2000 as a 100 per cent subsidiary of Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE, *German Company for the Construction and Operation of Waste Repositories*) in order to focus and further develop the scientific and technical know-how of DBE and to make it available to interested parties both nationally and internationally. Since its founding one and a half decades ago, DBE TECHNOLOGY GmbH has rapidly become a nationally and internationally recognized engineering company in the area of radioactive waste disposal.

Its activities are based on over 35 years of experience gained by its parent company in German nuclear waste repository projects as well as on the know-how gained through over three decades of collaborative efforts in national and international research projects. The company's main fields of activity today include waste disposal strategies and activities,

site characterizations and evaluations, concept, design, safety, and engineering of repositories, and their closure.

On behalf of German research institutions and other public and private customers, DBE TECHNOLOGY GmbH provides services in the field of radioactive waste management, e.g., support in collecting and documenting waste data and demonstrating that the waste packages destined for the Konrad repository meet the corresponding technical acceptance criteria.

In Germany, the legal requirements for licensing a repository stipulate that the technical feasibility of the intended operational processes be demonstrated before a license is granted. DBE TECHNOLOGY GmbH developed the systems and components required for operating a repository in salt, which were subsequently tested until ready for approval.

DBE TECHNOLOGY GmbH develops safety concepts for the operating and post-operating phases of repositories and plans corresponding safety measures. The company was also involved in the development of safety cases for HLW repositories in salt and clay formations and crystalline rock.

Thorough sealing of subsurface repositories is essential for ensuring the long-term safe containment of radioactive waste. In this context, the company develops sealing concepts that are adapted to the site-specific requirements, to the radionuclide inventory destined for disposal, and to the disposal concept.

Throughout the world, DBE TECHNOLOGY GmbH advises and supports public and private energy, waste disposal, and mining companies as well as testing organizations and governmental authorities in all issues concerning the disposal of radioactive waste, mining, and other related technical fields. Furthermore, the company develops and tests new materials, processes, and machinery for their practical application in repositories.

DBE TECHNOLOGY GmbH has gained extensive experience in research projects in underground laboratories in clay and clastone in Mont Terri (Switzerland) and Bure (France), and in crystalline rock in Grimsel (Switzerland) and Äspö (Sweden). Based on the knowledge accumulated in these projects, the company develops and analyses repository concepts for various host rocks (crystalline rock, clay, lime, and salt) and waste types (high-level, intermediate-level, and low-level radioactive waste). Furthermore, the company reviews repository concepts of other waste management organizations and gives recommendations for optimization measures.

Based on its comprehensive know-how, the company supports governmental institutions in the development of national waste management strategies and gives recommendations for corresponding financing strategies and pertinent legislation.

### Evening of Arts and Sciences

Following a long tradition, DBE TECHNOLOGY GmbH hosted its Evening of Arts and Sciences on October 19, 2016. About 140 guests of the business and research communities and of government institutions took up the invitation of Managing Director Dr. Jürgen Krone.

This year's scientific contribution was provided by Dr. Harald Hecking, Managing Director of ewi Energy Research & Scenarios gGmbH. He lectured on "The German fossil fuel phase-out: A multi-billion Euro effort or just peanuts". During his lecture, he made clear that, depending on the approach, both statements can be true.

The arts were represented by jazz pianist Andreas Kipp and magician Maik Paulsen. The event was framed by an exhibition of photos made by Dr. Hans-Joachim Engelhardt during his studies of structural materials. They show microscopic views of different crystals.

### Acknowledgements

The management would like to thank all employees for their extraordinary commitment and cooperation in the business year 2016.

In an environment marked by change and transition, they applied their scientific know-how in numerous international undertakings and various research projects in an exemplary manner and beyond the normal measure, thus showing their high level of expertise and their loyalty to the company.



Evening of Arts...



...and Sciences



## Research and Development



» **WILHELM BOLLINGERFEHR,**  
Civil Engineer, age 60, Head of Research and  
Development; on the calculation of the areal  
requirements for a HLW repository

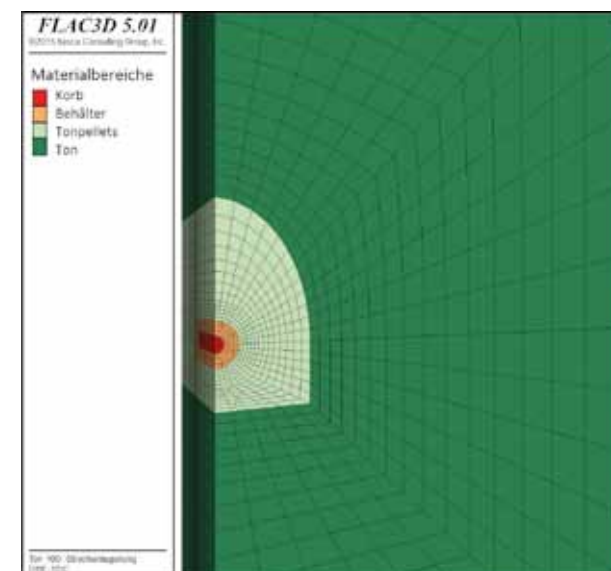
*I am not particularly surprised about the results. No matter whether the design temperature is 200°C or 100°C, heat dissipation is best in rock salt. That mine openings in rock salt are stable has already been shown. We know this from more than 150 years of experience in mining. This is why a HLW repository in rock salt has the smallest footprint.*

### Area Requirements of a Repository for Heat-Generating High-Level Radioactive Waste

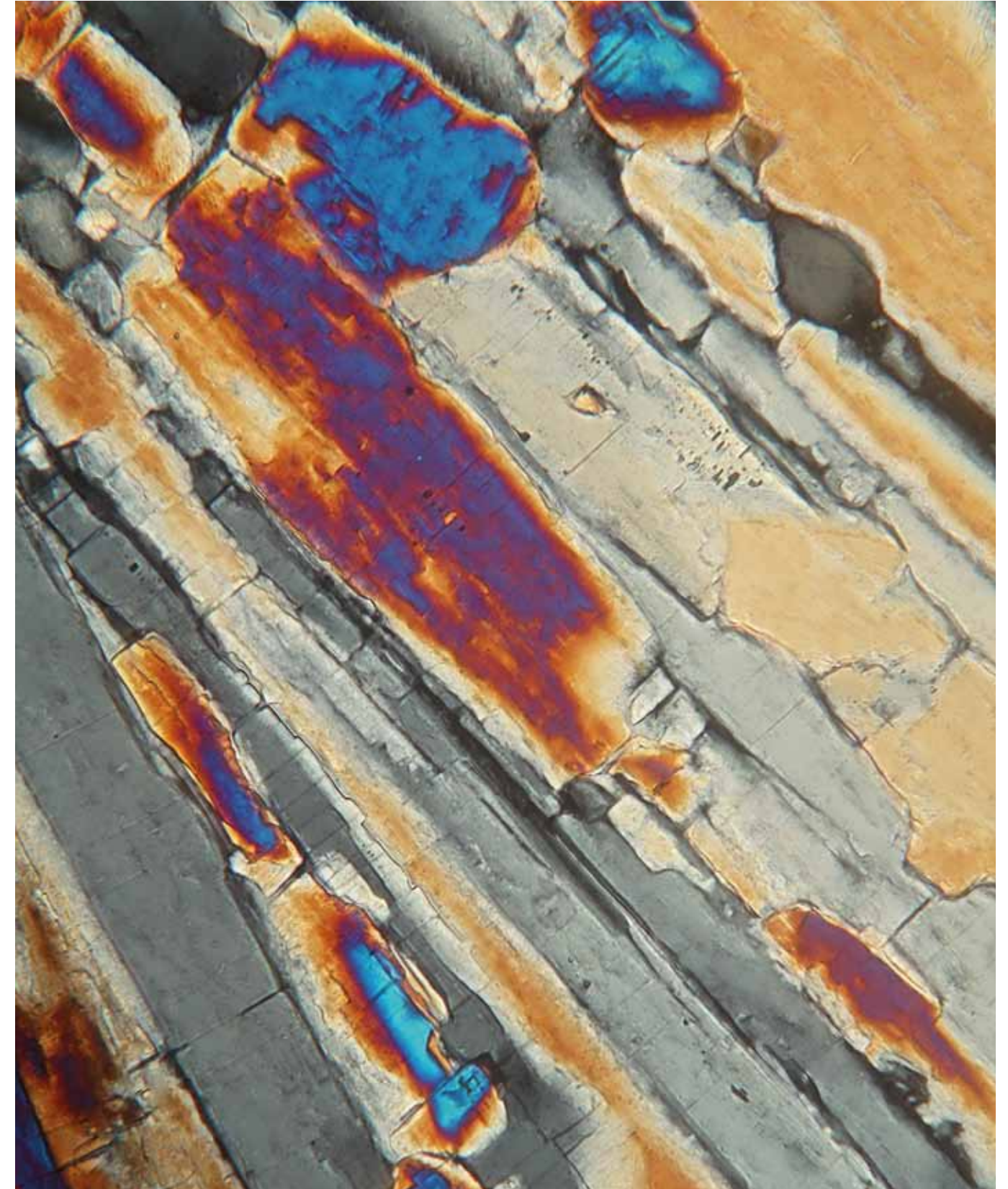
In December 2015, the "Kommission Lagerung hoch radioaktiver Abfallstoffe" (Nuclear Waste Management Commission) assigned the task to prepare an expert assessment and report specific to the area requirements of a repository for heat-generating high-level radioactive waste to DBE TECHNOLOGY GmbH. Based on the specific expertise DBE TECHNOLOGY GmbH possesses through numerous R&D projects conducted on the design of repositories in the three host rocks (salt, clay, and granite), mostly funded through BMWi, it was possible to complete the assessment within the two-month time frame specified. Following the scope of work described, the repository area requirements for three different host rock types in four variants were determined (salt: design temperatures 200°C and 100°C, clay: 100°C and granite: 100°C). The waste volume to be accounted for in the study was taken from the "National waste management program (NaPro)". Following the project specifications, single-level drift disposal was considered for salt and clay rock types, while vertical borehole disposal (KBS-3V-concept) was considered for granite. Further specifications included the use of cylindrical, metallic disposal containers, uniform emplacement over a 30-year period, and an adjustment of the container inventories to the respective design temperatures. To facilitate comparability, a uniform emplacement depth of 600 m for all repository variants was selected. The expert assessment comprised the development of mathematical models, the conduction of temperature calculations, the designs of the respective repository layouts, and the calculation of the areas needed for the different repository variants, including disposal and infrastructure areas. In addition to this, the design basis had to be planned and supplemented, and the material parameters for the host rocks, containers, and the backfill material had to be defined. The results of the assessment showed that rock salt at a design temperature of 200°C has the smallest area requirements.

At similar design temperatures for all host rocks (i.e., 100°C), the smallest area requirement was again achieved for rock salt. The differences are mainly due to the differing thermal conductivities of the selected host rocks and of the backfill material selected.

Repository variant rock salt at 200°C design temperature: 1.28 km<sup>2</sup>  
Repository variant rock salt at 100°C design temperature: 2.28 km<sup>2</sup>  
Repository variant clay at 100°C design temperature: 6.58 km<sup>2</sup>  
Repository variant granite at 100°C design temperature: 3.56 km<sup>2</sup>



3D model concerning drift disposal in claystone



Crystals of anhydrite rock





» MICHAEL JOBMMANN,  
Geophysicist, age 59, Project Manager ANSICHT

*Claystone as host rock – this is an entirely new territory in Germany. Several European countries have been studying this subject for a long time and are well ahead of us in their knowledge. Within the scope of the ANSICHT project, we and our partners BGR and GRS have been able to catch up in the past five years. Based on our results and taking into account the German safety requirements, radioactive waste disposal in German claystones seems to be possible.*

## Final Disposal of High-Level Radioactive Waste in Clay Formations – Project ANSICHT

In addition to their low permeabilities for fluids, claystones have good retention properties for radionuclides, which qualifies them as host rock formations for repositories for radioactive waste.

Within the scope of the ANSICHT project, which was jointly carried out by DBE TECHNOLOGY GmbH, the *Federal Institute for Geosciences and Natural Resources* (BGR), and *Gesellschaft für Reaktorsicherheit* (GRS) gGmbH on behalf of the *Federal Ministry of Economic Affairs and Energy* (BMWi), a first draft of a methodology to demonstrate the safety of a HLW repository in claystone in Germany was prepared, taking into account the regulatory requirements. This method links the geologic and regulatory boundary conditions with the development of a repository concept, especially the development of an emplacement and sealing concept, and of a corresponding demonstration of the barrier integrity. Furthermore, it is based on a complete system description within the scope of a FEP catalogue and a scenario development derived thereof.

In 2010, the *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* (BMU) issued the *Safety Requirements Governing the Final Disposal of Heat-Generating Radioactive Waste*, which include general criteria for demonstrating the integrity of a geologic barrier. In the course of the ANSICHT project, these criteria have been specified in such a way that their compliance can be verified by means of numerical calculations. The key elements of the safety concept are three safety demonstrations that have to be provided independently:

- the demonstration of integrity of the geologic barrier (here: clay)



*Opalinus-Clay – a potential host rock for high-level radioactive waste (quarry of the Holcim GmbH in Dotterhausen, South Germany)*

- the demonstration of integrity of the geotechnical barriers (e.g. sealing constructions)
- the radiological evidence that the radiological release from the containment providing rock zone is below legal limits

For all types of evidence, exemplary calculations have been carried out that illustrate the methodology. The results of the ANSICHT project can be used as a basis for a verification-supported design of repository components and for the construction, operation, and closure of a repository in a clay formation. A number of open issues have been identified that need to be resolved prior to a safety analysis for a future repository site. The methodology developed can be considered as a tool for comparable safety analyses necessary for the future site selection procedure for a repository for high-level radioactive waste in different host rocks.



» WOLFGANG FILBERT,  
Mechanical Engineer, age 62,  
Project Manager BASEL

*Operational safety and long-term safety influence each other. In the past, little attention was paid to how strong this influence is. So far, analyses focused on assessing the long-term safety; studies on safety during the operating phase were rather limited. Now, this aspect is studied in much more detail.*

## Assessment of the Interdependency between Operational Safety and long-term Safety in a Safety Case

Nationally as well as internationally, there is extensive experience on how to demonstrate the long-term safety of a repository for heat-generating radioactive waste and spent fuel. Internationally, it is state of the art to compile all analyses and arguments in a so-called Safety Case. In the past, the discussion about the methodology used to develop a safety case was very much focused on long-term safety. Little attention was paid to safety during the operating phase, although the fundamentals for long-term safety are already laid down during the operating phase. Taking this into account, it is important to analyse the interfaces between operational safety and post-closure safety and to develop tools and methods to minimize or even eliminate unplanned interactions. According to the Safety Requirements stipulated by the *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* (BMU) in 2010, the influences of the operating phase on the post-closure phase are to be documented in a safety case in a clear and transparent manner. In order to identify such influences and to assess possible interactions, the R&D project BASEL (*“Assessment of the influence of sound construction and safe operation of a HLW repository on long-term safety”*) was launched.

In April 2016, the *Project Management Agency Karlsruhe* (PTKA) of the *Karlsruhe Institute of Technology* (KIT), on behalf of the *Federal Ministry for Economic Affairs and Energy* (BMWi), assigned *Gesellschaft für Anlagen- und Reaktorsicherheit* (GRS) gGmbH and DBE TECHNOLOGY GmbH with corresponding research. The aim is to illustrate the safety concepts in the operating and post-closure phases of a HLW repository and to develop a methodology to assess the mutual impacts of both. For this purpose, repository concepts for the host rocks salt and clay as well as the related safety concepts for the operating phase are taken into account. The work programme furthermore includes an assessment of the



*Remedial action of an operational disturbance: demonstration of re-railing a derailed transport cart with transfer cask*

operating phase in regard to its impact on long-term safety and vice versa. It will be assessed whether a FEP catalogue is a suitable instrument for this purpose. In the end, methods and approaches to assess the interactions between operating and post-closure phases are to be developed.





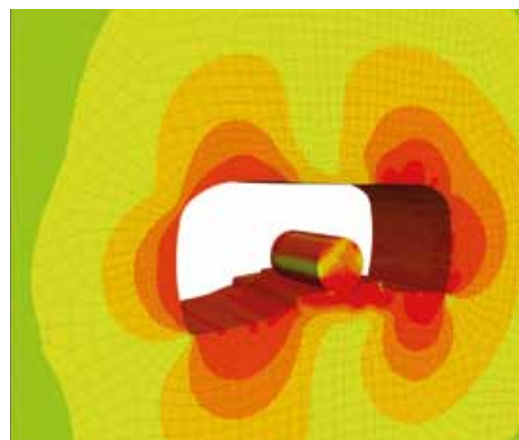
» PHILIPP HEROLD,  
Mining Engineer, age 32, Project Manager ERNESTA

*For the first time, we are concerned with the technical implementation of retrievability. Depending on the disposal concept, various challenges have to be met. Not only do the temperature fields of salt and claystone differ considerably but the boundary conditions during retrieval are distinct as well. Retrievability is a requirement in Germany but when, how, and where is still open.*

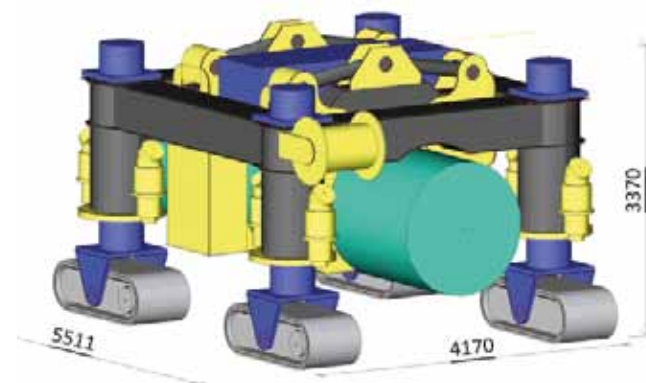
## Development of Technical Concepts for the Retrieval of Waste Containers with Heat-Generating Waste and Spent Fuel from Repositories in Salt and Clay Formations

In 2010, the *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* issued the new "Safety Requirements Governing the Final Disposal of Heat-Generating Radioactive Waste". Since then, retrievability as "... the planned technical option for removing emplaced radioactive waste containers from the repository mine" has been a design criterion and requirement for licensing in Germany. To investigate how retrieval of POLLUX® casks in the horizontal drift disposal concept and spent fuel canisters (BSK) in the vertical borehole disposal concept in salt and clay formations is possible, the R&D project ERNESTA was initiated. The project is funded by the *Project Management Agency Karlsruhe* (PTKA) of the *Karlsruhe Institute of Technology* (KIT) on behalf of the *German Federal Ministry for Economic Affairs and Energy* (BMWi). Within this project, DBE TECHNOLOGY GmbH investigates the expected underground conditions by

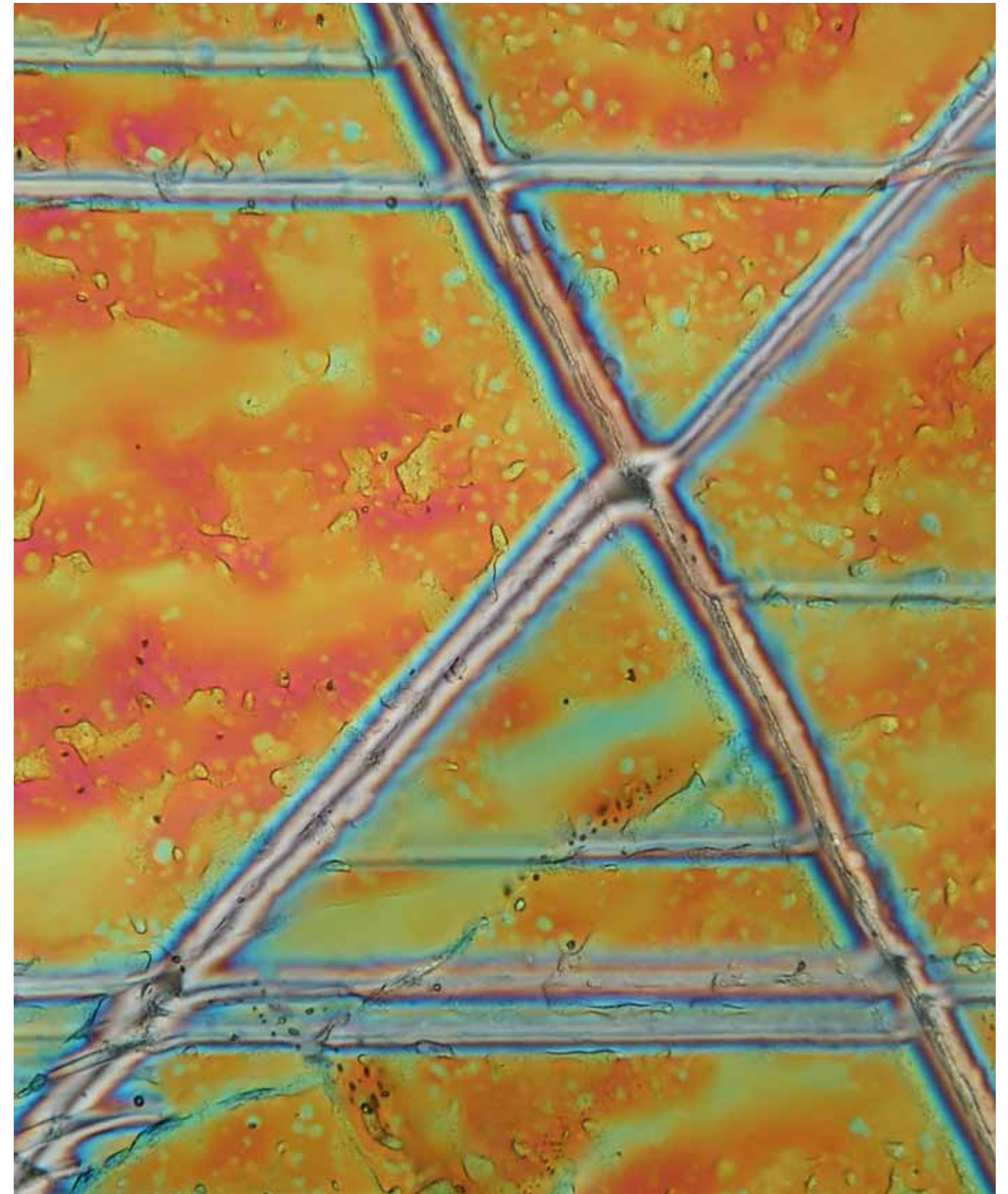
means of numerical simulation of the thermo-mechanics and the ventilation networks, describes the operating processes during retrieval and the technical equipment needed. This also includes the development of new equipment. The so-called "re-mining" strategy is considered as most suitable for the retrieval of waste containers. This strategy comprises the emplacement of the waste containers, followed by backfilling and sealing of the mine openings as designed. For retrieval, the already backfilled and sealed mine openings will be excavated again using state-of-the-art technology, and the waste containers will be removed. The waste containers will then be transferred from the passive safety system of the repository back into human care. For all disposal options, retrieval concepts could be developed that allow flexible retrieval from the operational until the closure phase, depending on the actual emplacement and backfilling progress.



Maximum principal stress around the retrieval drift



Feasibility study for a modified emplacement device for the retrieval of POLLUX® casks



Carnallite crystal with twin lamellae





» **SABINE PRIGNITZ,**  
 Physicist, age 35, Project FORBAS

*In the past, retrievability was not relevant to the safeguards concepts. Today, we think in entirely new technical and temporal dimensions – imagination is needed. In addition to this, new findings, e.g. from satellite transmissions, have to be taken into account. Thus, the existing safeguards concepts have to be adapted to the new conditions.*

## Revision of German Safeguards Concepts taking into account the Requirements for Retrievability and Recovery of Waste Containers

Due to its membership in the European Atomic Energy Community (EURATOM) and the signing of the Treaty on the Non-Proliferation of Nuclear Weapons, Germany is obliged to ensure that nuclear material will only be used for peaceful purposes. This will be accomplished with safeguards measures, which will ensure that nuclear material will not be diverted for non-peaceful usage and that the basic technical characteristics of the facilities for the production, separation, or other applications of nuclear material have to be verified. Spent nuclear fuel elements belong to such nuclear material that has to be monitored for safeguards purposes. For this reason, the disposal concepts for spent fuel have to take into account safeguards measures. In the 1990s, a safeguards concept for the emplacement of POLLUX® casks in horizontal drifts in a repository in host rock was developed; at that time, retrieval was not considered. The Safety Requirements issued by the *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* (BMU) in 2010 stipulate however that retrievability of the casks be possible during the operating phase of a repository and that recovery be possible for 500 years after its closure.

In autumn 2014, Forschungszentrum Jülich on behalf of the *Federal Ministry for Economic Affairs and Energy* (BMWi) commissioned DBE TECHNOLOGY GmbH with the R&D project FORBAS to revise and refine the safeguards reference concept for the disposal of spent fuel for the host rocks salt, clay, and hard rock, taking into account these requirements. Furthermore, the applicability of this concept to other emplacement concepts, e.g., the emplacement of transport and storage casks in horizontal boreholes, was to be considered. So far, the studies show:

- Depending on the emplacement concept, additional conditioning facilities, interim storage casks, and interim storage facilities may be necessary. In this case, the retrieval and recovery requirements can have a major impact on the safeguards concepts.
- It has to be ensured that information about the stored waste casks will be preserved over the period of potential recovery in order to be able to apply safeguards measures to the recovered casks again.
- It has to be established if an underground cask verification for both shielded and non-shielded casks is necessary during retrieval and/or recovery.



*Demonstration test for the emplacement of POLLUX® casks containing the fuel rods of spent fuel elements*



» **NIKLAS JOACHIM BERTRAMS,**  
 Mining Engineer, age 28, Project Manager  
 KONEKD

*In Germany, we still know only little about final disposal in crystalline rock. Other countries are considerably more advanced. The necessary glance abroad, especially into Scandinavia, makes research in this field even more exciting. I am thrilled to take part in this pioneering work.*

## Development of a Repository Concept for Heat-Generating Radioactive Waste in German Crystalline Rock

Within the scope of the KONEKD project, DBE TECHNOLOGY GmbH was commissioned by Projektträger Karlsruhe on behalf of the *Federal Ministry for Economic Affairs and Energy* (BMWi) with the development of a technical concept for a generic repository for heat-generating radioactive waste and spent fuel in German crystalline host rock. The project is based on the results of previous projects, especially R&D project CHRISTA, a study on the development of a safety and safety demonstration concept, where three promising disposal options were identified:

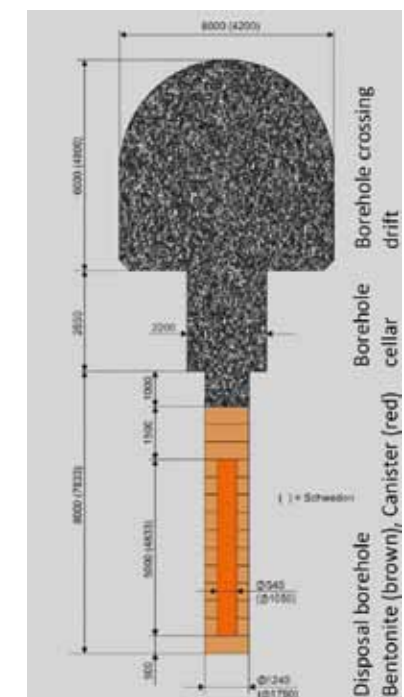
- the Swedish KBS-3 concept (based on copper canisters and buffers)
- a containment providing rock zone (CRZ) that consists of several, separated rock areas
- a CRZ of sedimentary rock that covers the repository located in crystalline rock

Within the scope of the KONEKD project, technical concepts will be developed for all options.

In a first step, the state of the art in hard rock mining in general and in particular the state of the art in science and technology in repository construction and operation in crystalline rock will be determined. At the same time, fundamental data, i.e., assumptions of representative geologic data, waste quantities and respective cask types as well as the legal and technical requirements for a repository concept will be compiled. Given the limited geologic data on German crystalline rock available, such information will be derived from related literature.

In a second step, the repository-specific mining technology, the emplacement technology, and the repository layout will be designed, taking into account the interdependencies of the different tasks.

In a third and final step, the required efforts in time and costs for the planning, licensing, construction, operation, and closure of the repository will be assessed.



*Concept for borehole disposal in crystalline rock (modified KBS-3 concept)*



## International Cooperation



» DR. BERNT HAVERKAMP,  
Geophysicist, age 60, on the safety assessment  
of a repository in Georgia

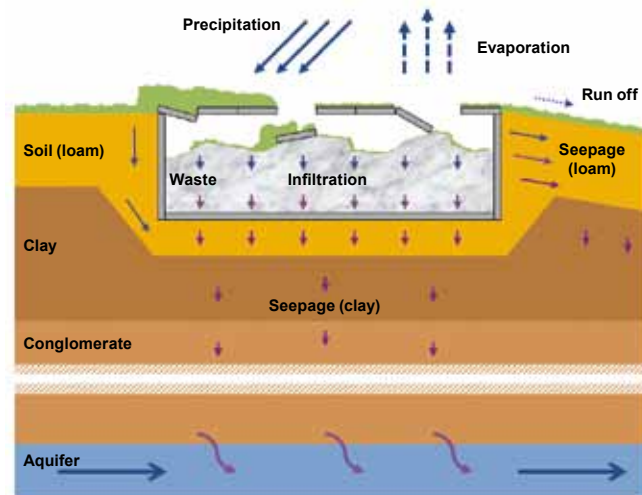
The main purpose was to assess the safety situation and to propose measures for improvements. In this context, it was essential to choose measures that improve the situation but at the same time take into account the financial resources and technical capabilities of the country.

### Safety Assessment for a Repository for Radioactive Waste in Georgia

Within the framework of the EC programme "Instrument of Nuclear Cooperation", a project in the field of radioactive waste management was launched for the Saakadze radioactive waste disposal site and the radioactive waste interim Centralised Storage Facility (CSF) in Georgia. A consortium of two companies, TÜV NORD EnSys Hannover GmbH & Co. KG and DBE TECHNOLOGY GmbH, was awarded the contract for the project, which was successfully completed with the recent submission of the final versions of the Safety Assessment Reports to the European Commission.

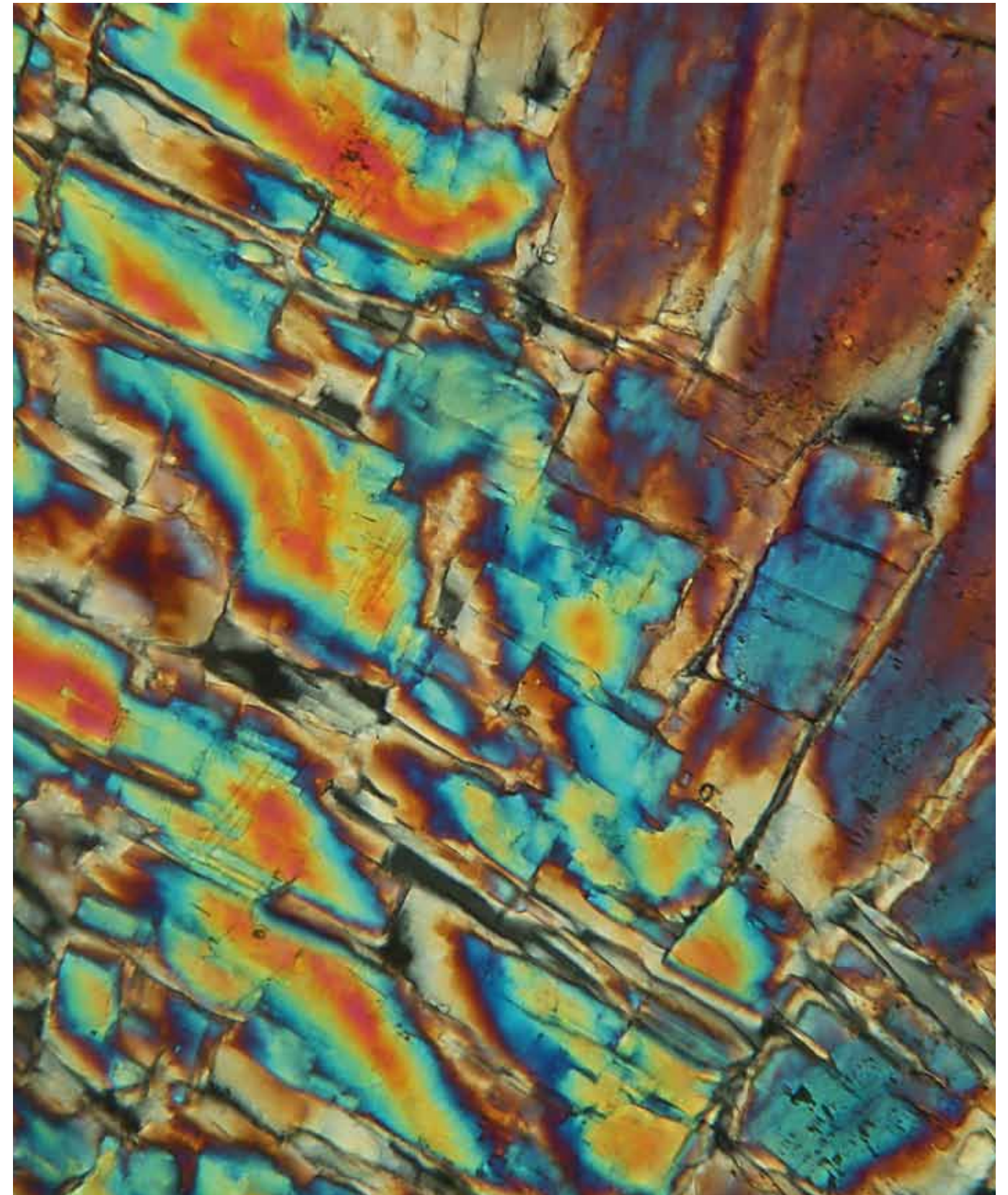
In the framework of the project, DBE TECHNOLOGY GmbH completed the Safety Assessment of the Saakadze disposal facility near Tbilisi in Georgia, a Radon-type near-surface facility designed to accommodate up to 600 m<sup>3</sup> of low and intermediate level radioactive waste. The safety assessment took into account the IAEA recommendations and guidelines. Given the insufficient knowledge about several important parameters for the safety calculations, conservative values and model assumptions were selected and sensitivity analyses were carried out.

Basically, the results of the safety calculations demonstrated that the Saakadze site has very favourable environmental conditions for a near-surface disposal facility for radioactive waste. Results from the Normal Evolution Scenario and several Altered Evolution Scenarios show only limited dose rates, which are significantly smaller than the regulatory limits. Contrary to this, the estimated dose rates for the human intrusion scenarios demonstrated values that are at least in part significantly above the limit value of 1 mSv/a. These high dose rates result from the fact that the vaults are currently not backfilled. Furthermore, a properly engineered cover over the vaults has not been constructed. Thus, the Consortium recommended a suitable, engineered backfill to fill the void spaces



Normal Evolution Scenario analysed for the safety assessment of the Saakadze disposal facility

inside the disposal vaults and the design and construction of a suitable cover over the facility. With the implementation of these measures and in conjunction with an effective institutional control over a 300-year monitoring period, it should be possible to expand the disposal capacity at the site by another facility to account for sources and radioactive waste that are presently stored at the CSF.



Anhydrite rock with gypsum-filled cracks





» DR. HANS-JOACHIM ENGELHARDT,  
 Mineralogist, age 53, on the development  
 of a sealing concept for Belgium

*Safe disposal of radioactive waste is a long journey, and a repository is like a large puzzle that consists of many pieces. To get the full picture, we have to fit all the pieces together.*

## Development of a Closure Concept for the Belgian Repository Concept

The concept of the Belgian radioactive waste management agency ONDRAF-NIRAS for a deep geological repository proposes the disposal of long-lived low and intermediate-level radioactive waste (type B) as well as of high-level radioactive, heat generating waste (type C) in deep clay formations. The disposal waste packages will be emplaced separately in accordance with their waste type in the two emplacement fields of the repository. Each emplacement field consists of two access galleries, which are connected by cross drifts, and emplacement galleries branching to the side. The plan is to backfill the emplacement galleries step by step and to seal them with a plug when the last waste package has been positioned in the gallery. These plugs must prevent a release of potentially contaminated liquids until the access gallery seals that will permanently separate the emplacement fields from the shafts have been constructed.

Taking into account these requirements, the in-situ conditions, and the general targets of ONDRAF-NIRAS, DBE TECHNOLOGY GmbH designed respective sealing concepts. In doing so, DBE TECHNOLOGY GmbH could rely on its extensive experience in conventional engineering as well as in the development of construction materials and barrier constructions. Based on well-known technology and new developments, a reference closure concept that is optimally adapted to the repository design has been developed.

It is intended to install identical plugs in both emplacement fields of the repository. The existing gallery lining made of concrete wedge stones is not to be removed. The construction materials for the plugs are refinements of construction materials developed by DBE TECHNOLOGY GmbH in former projects. The plugs will be concreted section by section; the contour surface of the middle section of the seal will be grouted with a circle injection system to avoid bypaths.

The aim of the following project phase is to develop gallery seals that – together with the shaft seals – are to re-establish the integrity of the geologic barrier in order to ensure the long-term protection of man and the environment against ionizing radiation.



Underground Research Laboratory HADES (Source: ONDRAF-NIRAS)



» DR. VICTORIA BURLAKA,  
 Mathematician, age 30, Project SANTOS

*The collaboration with Russia is a real benefit. With the Institute of Geocology in Saint Petersburg, we have found a partner with whom it is possible to intensify the common research work and to exchange experience. This gives us the opportunity to design a sealing concept that effectively seals a near-surface repository in a clay formation.*

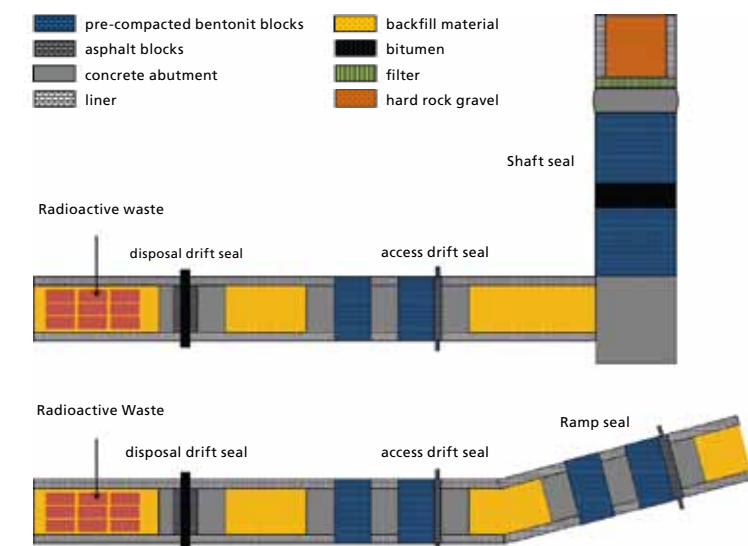
## Safety Studies for the Site Selection for a Repository in a Clay Formation

In Russia, investigations are carried out to check the possibility for siting a repository in a clay formation in the vicinity of St. Petersburg.

Based on the German-Russian bilateral agreement regarding research and development on the peaceful use of nuclear energy (agreement on "Wissenschaftlich-Technische Zusammenarbeit" WTZ), DBE TECHNOLOGY GmbH together with the *Federal Institute for Geosciences and Natural Resources* (BGR) in Hanover and *Gesellschaft für Anlagen- und Reaktorsicherheit* (GRS) gGmbH in Brunswick are carrying out specific safety investigations in collaboration with the Russian partners (NO.RAO, JSC Atomproekt / formerly: VNIPIET, Institute for Geocology). The activities of the German partners are motivated by the possibility to test conceptual approaches and tools for safety analyses developed as part of a safety and safety demonstration concept for siting a repository in German clay formations.

Within the scope of these R&D activities, BGR has developed a 3D geological model. The Russian partners have drilled several boreholes at the site and have identified relevant rock properties of the Vendian clay, which has been selected as host rock. The 3D model is the basis for the flow and transport simulations that have been carried out by GRS in order to identify relevant migration paths and to assess the quality of the radionuclide isolation. At the same time, the model can be used to develop a comprehensive backfilling and sealing concept and to choose suitable locations for individual sealing elements. DBE TECHNOLOGY GmbH has developed a conceptual approach for a backfilling and sealing concept, which has been documented and explained in a technical report.

Finally, a list of FEP (Features, Events and Processes) was compiled, which is a basis for the development of a comprehensive FEP catalogue, which contains all safety-relevant processes in and around the repository that have to be considered in a safety demonstration concept.



Conceptual approach for a backfilling and sealing system (Not drawn to scale. For illustrative purpose only.)

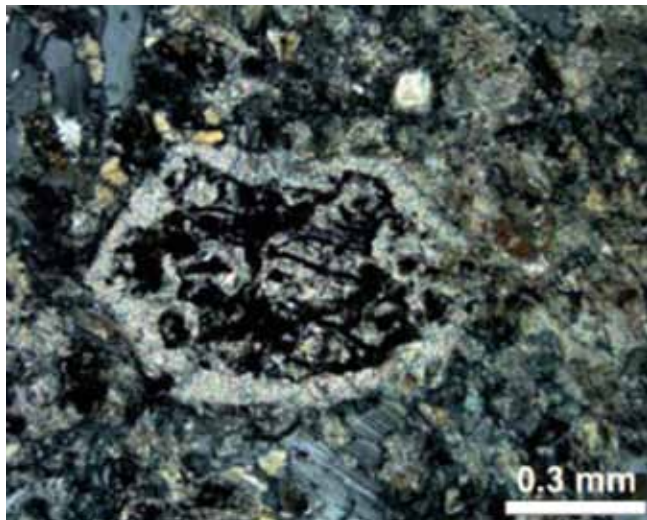




» DR. CHRISTIAN MÜLLER,  
Geoscientist, age 39, Project URSEL

*With a view to the new Repository Site Selection Act, which stipulates that in addition to salt and clay, crystalline rock be investigated as possible host rocks for a repository, the results achieved in the German-Russian research cooperation over the years has gained completely new significance.*

## German-Russian Cooperation concerning Research on Final Disposal in Crystalline Host Rock

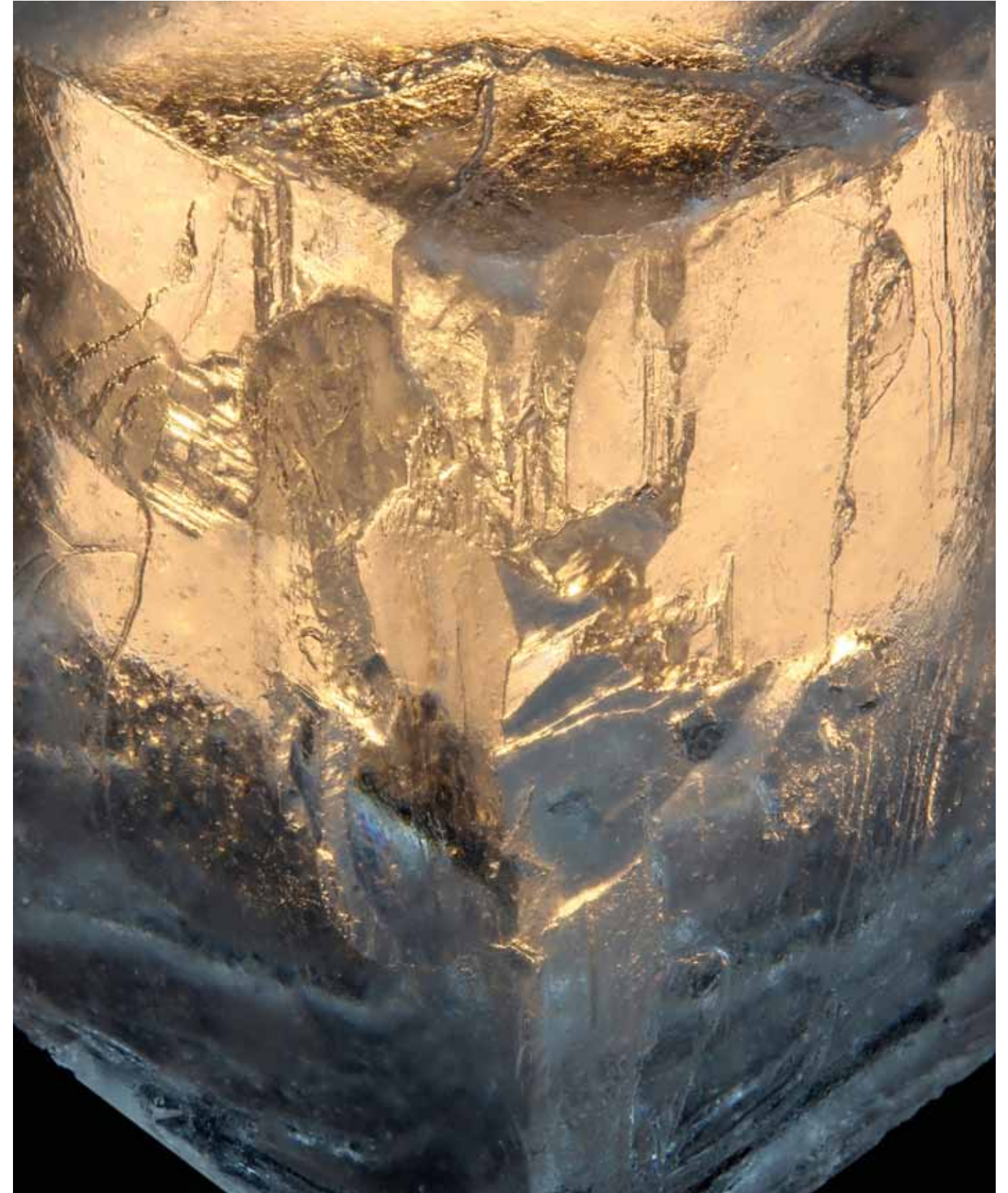


*Thin section of a crystalline rock sample from the Yeniseysky site (Russian Federation)*

In 2001, radioactive waste disposal was integrated into the scientific cooperation between the former Russian Ministry of Atomic Energy (Minatom, now Rosatom) and the German Federal Ministry of Labor, now Federal Ministry for Economic Affairs and Energy (BMWi). This cooperation is based on a bilateral agreement regarding R&D on the peaceful use of nuclear energy (agreement on "Wissenschaftlich-Technische Zusammenarbeit" WTZ). The intention was to have a new and interesting opportunity for international R&D cooperation regarding HLW disposal in crystalline rock, and the unique possibility to carry out site-specific work, to test the safety demonstration tools available, and to expand the knowledge about all aspects specific to this kind of host rock.

Based on the WTZ agreement, comprehensive and versatile cooperation has been implemented in the past 15 years. Joint R&D activities and projects regarding HLW disposal in crystalline host rock, which are based on investigations of the Yeniseysky site near Zheleznogorsk in the Krasnoyarsk region, have been a permanent part of this cooperation. The Russian side has been led by VNIPI Promtehnologii (VNIPI PT), while three major R&D institutes – the Federal Institute for Geosciences and Natural Resources (BGR) in Hanover, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH in Brunswick, and DBE TECHNOLOGY GmbH in Peine – have been the permanent partners from the German side.

The results of the German-Russian Cooperation are documented in a report that provides an overview of the manifold site-specific safety investigations regarding HLW disposal in crystalline host rock.



*Halite cube*



# Management Report



Gypsum crystals with inclusions

## Sphere of Activities

The main business area of DBE TECHNOLOGY GmbH, a highly specialized engineering company operating at both national and international level, continues to be engineering and consulting services for the disposal of radioactive waste. This includes national and international research and development projects for the safe final disposal of these wastes, in particular of high-level waste and spent fuel. Furthermore, mention must be made regarding our international projects that deal with the various aspects of radioactive waste disposal in near-surface repositories as well as in deep geologic formations in different host rocks (claystone in Belgium and France, rock salt in Poland and the USA as well as crystalline host rocks in Russia and Ukraine).

Furthermore, DBE TECHNOLOGY GmbH is involved in international consortia – in some as leader – that on behalf of the European Commission advise the competent national ministries and authorities on radioactive waste management needs and the development of repository concepts for various types of radioactive waste. In France, the Company is involved in the planning of the French repository for high-level radioactive waste and spent fuel while in Bulgaria, the design for a low-level radioactive waste repository near the Kozloduy Nuclear Power Plant has been completed and is ready for licensing

Of particular importance for developing know-how and in support of future tasks in Germany are the management of and participation in joint cooperation projects with other leading research institutes involved in radioactive waste disposal, e.g., concerning safety and safety demonstration concepts for repositories in various deep rock formations, retrievability, sealing of excavation damaged zones, as well as the compaction of crushed salt.

Furthermore, the Company provided services for Asse-GmbH on several major tasks related to hazard prevention and emergency planning activities. In addition to various typical mining engineering services and the provision of highly qualified specialist personnel, key activities were the planning and drilling of injection boreholes, performing the injection work, and developing measures to increase the strength of crushed salt backfill material.

The requirements of environmentally responsible action are taken into account by the Company's activities, which specifically focus on protecting the environment.

## RESEARCH & DEVELOPMENT

Research and development projects continue to be of major importance. In conjunction with its parent company DBE, DBE TECHNOLOGY GmbH thus ensures that the know-how for the exploration, planning, construction, operation, and closure of radioactive waste repositories is preserved and further developed based on the state of the art in science and technology. In the reporting period, the Company was involved in a total of 15 national and international research and development projects.

## Financial Report

### BUSINESS DEVELOPMENT

The Company continued its successful development over the past financial year. Turnover amounted to € 9.3 million. The net profit for the year amounted to € 0.7 million €.

As of December 31, 2016, the Company had orders on hand amounting to € 10.5 million. Because of the extremely specialist nature of the Company's activities, the macro-economic situation does not have any major impact on the development of business and the volume of incoming orders.

### RESULTS OF OPERATIONS

Turnover increased by € 2.9 million to € 9.3 million compared with the previous year. The increase is primarily due to the final settlement of two major contracts with foreign business partners.

Other operating income amounted to € 0.6 million, with the main item being the income from the release of provisions for revenue risks.

Personnel expenses decreased by € 0.3 million to € 3.9 million compared with the previous year. This was mainly due to the reduction in the number of employees.

The cost of purchased services mainly consists of assistance in the two major international contracts and amount to € 3.7 million.

Other operating expenses remained virtually unchanged at € 1.1 million.

Due to the increase in turnover before interest and taxes, the tax expense has increased and now amounts to € 0.3 million. This includes not only taxes on income but also expenses due to the decrease in deferred taxes resulting from the release of provisions.

Compared with the previous year, net income increased by € 0.3 million to € 0.7 million.

### NET ASSETS AND FINANCIAL POSITION

The balance sheet total decreased by € 1.9 million compared with the previous year and amounts to € 7.9 million.

On the assets side of the balance sheet, inventories decreased by a total of € 1.8 million as a result of a decrease in work in progress and in prepayments. Work in progress has been valued at directly attributable cost of production in accordance with the lower valuation threshold under Commercial Law.

Receivables and other assets increased by € 0.1 million compared with the previous year and amount to € 0.7 million. Receivables include entitlements from DBE as part of inter-company performance accounting as well as other supplies and services.

The item "Cash on hand and bank balances" has decreased by € 0.1 million to € 2.9 million compared with the closing date of the previous year.

On the liabilities side of the balance sheet, shareholders' equity amounts to € 1.9 million due to the higher annual net profit.

Due to the release of provisions for revenue risks, provisions decreased by € 0.4 million to € 0.5 million. They mainly comprise personnel-related provisions.

Compared with the previous year, liabilities have fallen by € 1.7 million to € 5.5 million. The largest individual item at € 4.3 million relates to customer advances received in the form of financial advances for orders which have not yet been completed and not yet invoiced.

At 24.2 % (previous year: 17.4 %), the equity ratio of DBE TECHNOLOGY GmbH has risen due to the decrease in advance payments received. On the balance sheet date, equity financed not only fixed assets but also 42.6 % of inventories (previous year: 27.2 %).

The Company was solvent at all times during the past financial year and remained so thereafter.

The fundamental objective of company management is to ensure sustained economic stability, which can be measured by the two indicators of the forward order book over several years and positive net income. Positive proof of this can be seen in the net income for the year of € 0.7 million, the average forward order book range of more than one year with an order volume of € 10.5 million as of December 31, 2016 (previous year: € 17.9 million), and the level of total output at € 8.9 million.



## Personnel and Social Report

As of December 31, 2016, the Company's workforce consisted of 37 employees. Support for handling the tasks of the Company is provided by employees of DBE under the terms of an agency and service agreement that has been concluded with DBE. This primarily involves the provision of commercial services. The Company is integrated into the industrial safety concept and compliance organization of DBE.

## Forecast, Risk and Opportunity Report

Reporting and risk management are conducted in line with the systems that exist at DBE. Risks from order processing are controlled on a timely basis by way of checks carried out in the course of an order. There is adequate insurance cover for risks which the Company can usually expect to encounter. This is primarily achieved through contractual integration into the insurance cover of DBE. There are no risks which pose a threat to the going concern assumption.

The order volume as of December 31, 2016, amounting to € 10.5 million, continues to be at a high level. Utilization of employee capacity is fully assured for 2017 and to about 50% for 2018. The Company's activities continue to focus on developing and expanding the unique know-how of the DBE/DBE TECHNOLOGY GmbH group and accordingly in the future in the Bundesgesellschaft für Endlagerung mbH in order to be able to offer high-quality services on a national and international level. In 2017, it is intended to expand and intensify activities to further attractive and interesting markets.

Together with a sustained business development, the focus is on consolidating the Company's ability to continue as a going concern – also in view of the impending changes in the organizational framework conditions for final disposal in Germany. It can be assumed that a continuation and expansion of the Company's business areas will be possible with the reorganization of the radioactive waste management sector.

With a consistent level of orders on hand but without taking into account extraordinary incidents, the Company expects a constant, positive level of earnings both in 2017 and in the medium term.



*Bitumen emulsion in ultraviolet light*



## Annual Financial Statements/Notes

### General Information

DBE TECHNOLOGY GmbH has its registered office in 31224 Peine, Eschenstraße 55, and is registered with the commercial register at the Local Court of Hildesheim, HRB no. 101385.

The Company is a small corporation within the meaning of Section 267 (1) HGB. The annual financial statements of DBE TECHNOLOGY GmbH are prepared voluntarily in accordance with the regulations applicable for large corporations.

For the first time, the directives of the *German Accounting Directive Implementation Act* (Bilanzrichtlinie-Umsetzungsgesetz / BilRUG), which came into force on July 23, 2015, were applied. The presentation and disclosure methods in the income statement have changed such that the items "Result from ordinary operations" and "Extraordinary result" are deleted. The income statement is supplemented with the item "Result after taxes", which is inserted between the items "Taxes on income" and "Other taxes". The results of the previous year are reclassified in accordance with Art. 75 (2) of EGHGB.

Changes in presentation due to the redefinition of the revenues were not necessary.

In order to improve the overall clarity of presentation, individual items in the balance sheet and income statement have been combined and are shown separately in the notes to the financial statements.

The other accounting and valuation methods – except for the valuation of the pension provisions – have remained unchanged as against the previous year.

The type of expenditure format was used for the preparation of the income statement.

### Accounting and Valuation Methods

Figures shown in the balance sheet for intangible assets and tangible assets are based on the cost of purchase. Intangible assets – consisting exclusively of software – are written off by straight-line method over a period of three to five years, and tangible assets are written off by straight-line method over their probable useful life. Minor value assets with acquisition or production costs of more than € 150 but not more than € 1,000 are combined into an annual collective item and written off uniformly over a period of five years.

Orders that have been commenced (work in progress) are valued at the directly attributable production costs in accordance with the minimum valuation threshold under commercial law.

Advance payments are recognized at nominal value.

Receivables, other assets and cash and cash equivalents are reported at nominal value.

Under receivables, recognizable individual risks are taken into account in the form of allowances. Other assets are reported at nominal value.

Prepaid expenses and deferred charges consist of payments made before the balance sheet date insofar as they relate to a specific period after that point in time.

Subscribed capital is reported in the balance sheet at nominal value.

Provisions are reported at the amount deemed necessary for the fulfilment thereof according to sound business judgment.

Other provisions with a term of more than one year are discounted at the average market interest rate prevailing over the past seven financial years corresponding to their remaining term.

Provisions for pensions were calculated on the basis of actuarial calculations using the projected unit credit method taking into account the "Mortality Tables 2005 G" of Prof. Dr. Klaus Heubeck, Cologne. The reported pension obligations for individual commitments are governed exclusively by the benefit regulations and the contribution-based pension plan of Bochumer Verband (Bochum Association). Contrary to the

previous years (discounting at the average market interest rate of the past seven financial years as published by Deutsche Bundesbank), provisions for pensions are discounted at the new interest rate changed in accordance with Section 253 (2) HGB based on the past 10 years, i.e. 4.01 % (previous year 3.89 %). A salary trend of 2.5 % and a pension trend of 1.0 % are taken into account. In accordance with Section 253 (6) Clause 2 HGB, the difference determined between the different rates of interest amounting to T€ 14 is blocked from disbursement.

Provisions for archiving costs serve to fulfill legal and contractual archiving obligations for business documents and records. The provisions were calculated based on average archiving periods of ten years and an estimated increase in costs of 2.5 % p.a. The provisions are discounted at the average market rate of 2.84 %. For documents and records not archived at the balance sheet date, further provisions are recognized. These are not discounted due to their short durations.

The other provisions also take into account all identifiable risks and contingent liabilities.

Liabilities are reported at the settlement amount.

Deferred taxes are created in relation to the differences between the amounts shown in the commercial accounts and the tax accounts if such differences will probably be reversed in subsequent years. Deferred tax assets and deferred tax liabilities are shown without being netted.

The Company has exercised the capitalization option of Section 274 (1) Clause 2 HGB and reports deferred tax assets.

Deferred taxes are calculated on the basis of an effective tax rate of 30.0 % (15.82 % for corporation tax incl. solidarity surcharge and 14.18 % for trade tax), which will probably be applicable at the time when differences are reversed. The trade tax rate is based on the trade tax assessment rate of 405 %.



Halite salt crystal



## Notes to the Balance Sheet

### Assets

#### 1. FIXED ASSETS

The financial assets consist of a cooperative share acquired in 2012.

Movements of individual items of fixed assets are shown in the fixed assets movement schedule.

#### 2. RECEIVABLES AND OTHER ASSETS

All receivables have a remaining term of less than one year.

Receivables consist primarily of entitlements from the billing of two major contracts as well as from charging the parent company with services provided within the Group.

Other assets relate primarily to tax refund entitlements.

#### 3. DEFERRED TAX ASSETS

Deferred tax assets are shown separately in the balance sheet without being netted and consist of the following balance sheet item:

	31.12.2016 Difference between commercial and tax accounts	31.12.2016 Deferred tax assets
	T€	T€
Pension provisions	22	7
	<b>22</b>	<b>7</b>

### Equity and Liabilities

#### 4. SUBSCRIBED CAPITAL

Subscribed capital remains unchanged at € 511 million. It is fully paid up and is held to 100 % by Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mit beschränkter Haftung (DBE), Peine.

#### 5. CAPITAL RESERVES

Capital reserves originate from other contributions made by the shareholder in previous years.

#### 6. REVENUE RESERVES

Revenue reserves amount to T€ 569. Of this, T€ 440 consist of retained earnings from previous financial years and T€ 129 from a conversion in compliance with the *German Accounting Law Modernization Act* (Bilanzrechtsmodernisierungsgesetz / BilMoG) as of January 1, 2010.

The net profit for the year 2015 amounting to T€ 444 was paid out as dividend to the sole shareholder.

#### 7. PROVISIONS FOR PENSIONS

Provisions for pensions relate to pension obligations to the management.

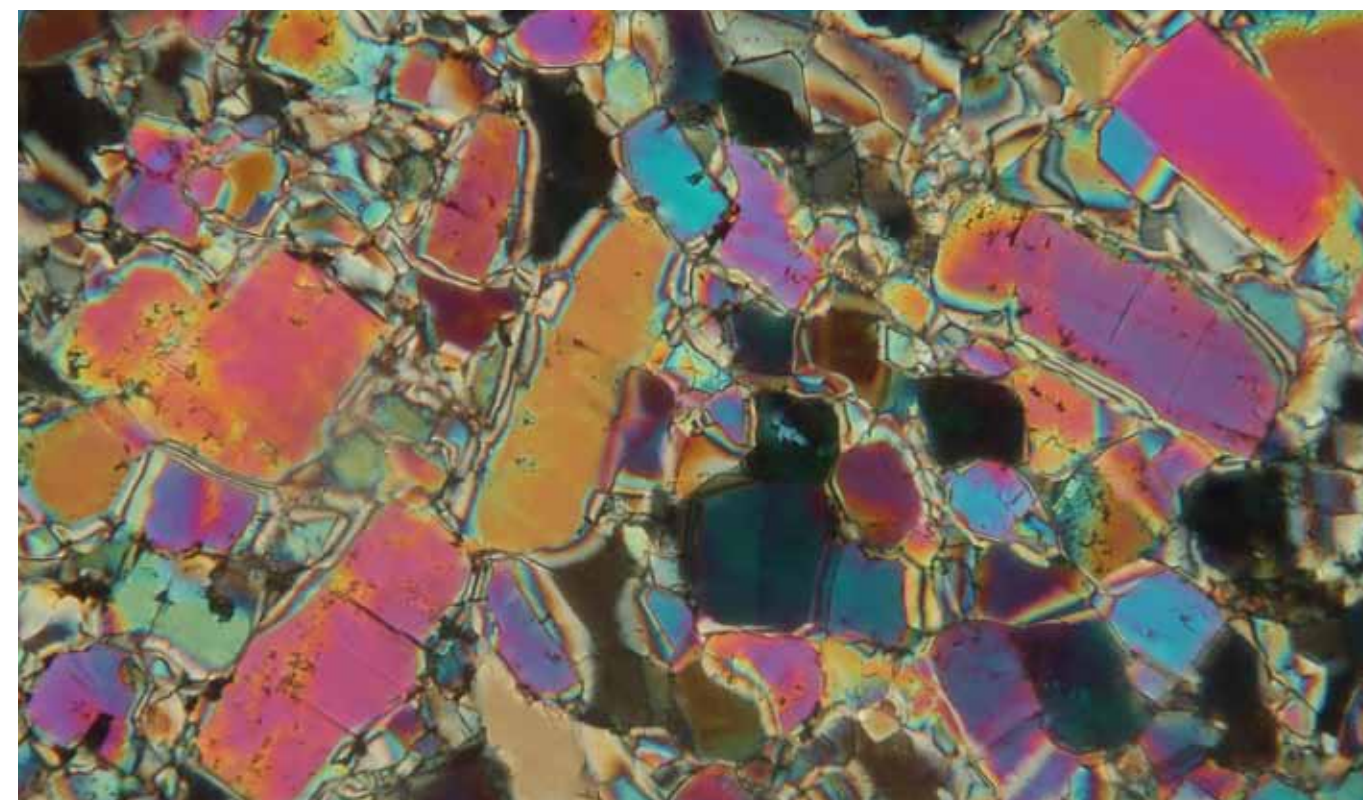
#### 8. OTHER PROVISIONS

Other provisions amounted to T€ 379 on the balance sheet date. They consist in particular of employee-related provisions.

#### 9. LIABILITIES

Advance payments received consist primarily of contractually agreed prepayments for work in progress from Asse-GmbH and from foreign customers.

Payables to affiliated companies are due in full to the sole shareholder and are the result of current business operations.



Crystals of anhydrite rock

Other liabilities consist primarily of value-added tax and wage tax obligations, which are still outstanding to an amount of T€ 220.

All liabilities are unsecured and have remaining terms of less than one year.

### Contingencies

Due to the end of the maturity period of a prepayment guarantee (T€ 501), contingencies have decreased to a liability amount of T€ 10 for a contract fulfillment guarantee (T€ 10). Based on past experience, utilization of the contingencies is not expected.



## Notes to the Income Statement

### 10. TURNOVER

	2016 T€	2015 T€
Project assistance and engineering services for industrial companies	3,614	4,115
Revenues from billing domestic research and development contracts	1,294	1,287
Revenues from international contracts	4,354	922
	<b>9,262</b>	<b>6,324</b>

Revenues from project assistance and engineering services for industrial companies were generated exclusively in Germany.

### 11. OTHER OPERATING INCOME

Other operating income has increased significantly and includes in particular off-period income from the release of provisions for revenue risks amounting to 476 T€. Furthermore, it includes a contribution refund from the *German Social Accident Insurance Institution for the raw materials and chemical industry* (BG RCI) for the financial year 2015 (T€ 76).

### 12. COST OF PURCHASED SERVICES

The cost of purchased services includes third party costs for project assistance activities.

### 13. PERSONNEL EXPENSES

	2016 T€	2015 T€
Wages and salaries	3,096	3,381
Social security and pension benefit costs (thereof for pensions)	757 (7)	817 (19)
	<b>3,853</b>	<b>4,198</b>

### 14. OTHER OPERATING EXPENSES

This item is mainly made up of costs of services in connection with the agency and service agreement with the parent company, rent, travel expenses, and general administration costs. As in previous years, they do not include any off-period expenses.

### 15. OTHER INTEREST AND SIMILAR INCOME

Interest income primarily results from the reimbursement of paid interest on arrears in connection with the annual audit.

### 16. INTEREST AND SIMILAR EXPENSES

Interest expenses include expenses amounting to 12 T€ resulting from the tax audit. Furthermore, it includes expenses from the accrued interest of pension provisions amounting to 4 T€.

### 17. TAXES ON INCOME

Taxes on income relate primarily to corporation tax (incl. solidarity surcharge) at T€ 72 and trade tax for the current financial year at T€ 65.

The release of provisions for revenue risks results in a deferred tax expenditure amounting to T€ 127.

## Other disclosures

### ANNUAL AVERAGE NUMBER OF EMPLOYEES

On average, the Company had 38 employees over the year (previous year: 41 employees).

### REMUNERATION OF CORPORATE BODIES

Details concerning total remuneration of management have been omitted with reference to Section 286 (4) HGB.

### AUDITOR'S FEES

The total auditor's fees charged for the financial year are shown in the consolidated financial statements of DBE.

### AMOUNTS SUBJECT TO DISTRIBUTION RESTRICTION PURSUANT TO SECTION 268 (8) CLAUSE 2 HGB

Deferred tax assets T€ 7

### AMOUNTS SUBJECT TO DISTRIBUTION RESTRICTION PURSUANT TO SECTION 253 (6) CLAUSE 2 HGB

Difference interest on pensions T€ 14

As there are sufficient free reserves, above distribution restrictions do not apply.

## Group affiliation

DBE TECHNOLOGY GmbH, Peine, is under the uniform management of DBE. In its capacity as parent company, the latter prepares consolidated financial statements for the smallest and largest group of companies in which the annual financial statements of the Company are included. The consolidated financial statements are submitted to the operator of the *Electronic Federal Gazette* (Bundesanzeiger) and are published in the *Electronic Federal Gazette*.

## Auditor's Report

The auditor, PricewaterhouseCoopers GmbH Wirtschaftsprüfungsgesellschaft, Hanover, provided the annual financial statements of the Company as of December 31, 2016, with an unqualified auditor's report dated May, 24, 2017.



## Fixed Assets Movement Schedule

### AT COST

	As of 01/01/2016	Additions	Disposals	Retransfers	As of 12/31/2016
	T€	T€	T€	T€	T€
<b>I. Intangible assets</b>					
1. Purchased concessions, industrial, property and similar rights and assets, and licenses in such rights and assets	156	4	16	0	144
	<b>156</b>	<b>4</b>	<b>16</b>	<b>0</b>	<b>144</b>
<b>II. Tangible assets</b>					
1. Other equipment, factory and office equipment	258	95	28	0	325
	<b>258</b>	<b>95</b>	<b>28</b>	<b>0</b>	<b>325</b>
<b>Sub-total</b>	<b>414</b>	<b>99</b>	<b>44</b>	<b>0</b>	<b>469</b>
<b>III. Financial assets</b>					
1. Other loans	(250 €)	0	0	0	(250 €)
	<b>(250 €)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>(250 €)</b>
<b>Total fixed assets</b>	<b>414</b>	<b>99</b>	<b>44</b>	<b>0</b>	<b>469</b>

### IMPAIRMENTS

Accumulated depreciation 01/01/2016	Additions	Disposals	Retransfers	Accumulated depreciation 12/31/2016	As of 12/31/2016	As of 12/31/2015
T€	T€	T€	T€	T€	T€	T€
138	14	16	0	136	8	18
<b>138</b>	<b>14</b>	<b>16</b>	<b>0</b>	<b>136</b>	<b>8</b>	<b>18</b>
215	24	28	0	211	114	43
<b>215</b>	<b>24</b>	<b>28</b>	<b>0</b>	<b>211</b>	<b>114</b>	<b>43</b>
<b>353</b>	<b>38</b>	<b>44</b>	<b>0</b>	<b>347</b>	<b>122</b>	<b>61</b>
0	0	0	0	0	(250 €)	(250 €)
<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>(250 €)</b>	<b>(250 €)</b>
<b>353</b>	<b>38</b>	<b>44</b>	<b>0</b>	<b>347</b>	<b>122</b>	<b>61</b>

### NET BOOK VALUES



# Imprint

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International Projects Department,  
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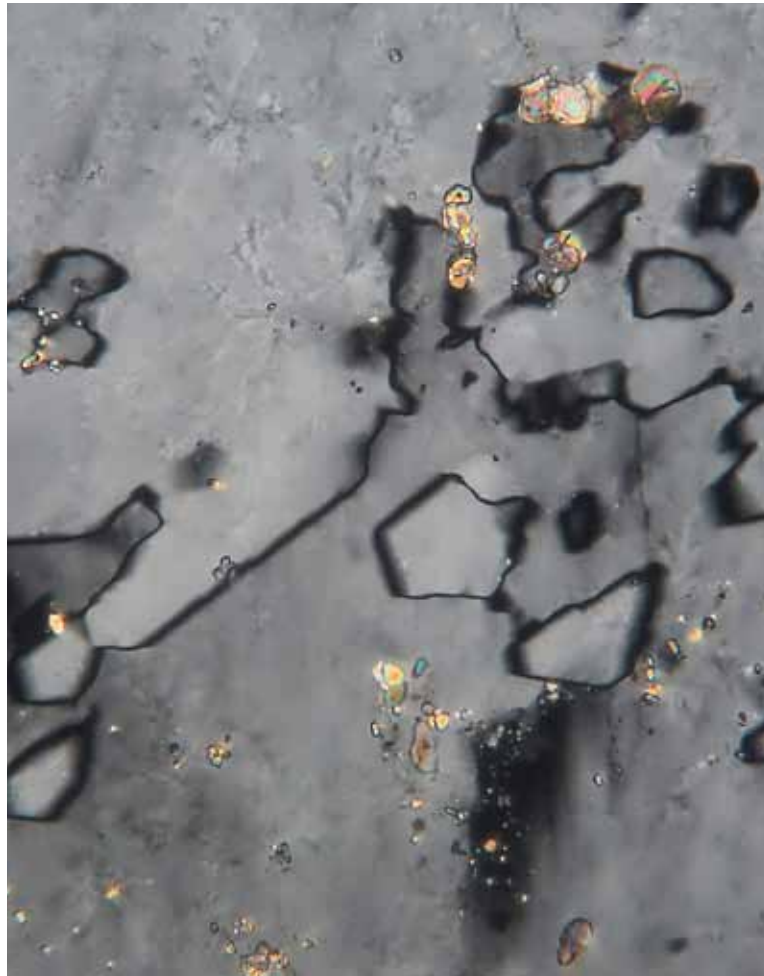
Martina Schwaldat,  
Ursula Ahlers,  
Corporate Communications, DBE

## DESIGN AND CONCEPT

Agentur Spezial, Braunschweig,  
www.spezial-kommunikation.de

## PHOTOS

Christian Bierwagen, Peine,  
and others



*Gypsum crystals as transformation products of anhydrite*



## SAFE IS BEAUTIFUL

**Natural beauties – discovered while investigating materials that were developed to safely seal repositories.**

In order to safely contain radionuclides in the host rock in the long term, the mine openings need to be backfilled and potential pathways for fluids need to be sealed. For these operations to be successful, some groundwork needs to be made. Among others, this includes analyzing the state of the host rock, developing construction and sealing materials adjusted to their various applications, and testing their suitability. Within the scope of these activities, visual examination methods are applied, too. They not only help in providing the necessary diagnostics but also open up a complete new world of crystal sculptures – works of art designed by mineral growth.

**Dr. Hans-Joachim Engelhardt / DBE TECHNOLOGY GmbH**





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