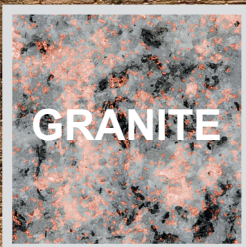


DBE TECHNOLOGY NEWS

2016



METHODOLOGY OF SAFETY DEMONSTRATION FOR
A REPOSITORY IN CRYSTALLINE ROCK

SAFETY INVESTIGATIONS FOR SITING A REPOSITORY
IN A CLAY FORMATION

UK NDA R&D FRAMEWORK CONTRACTS AWARDED

GERMAN-RUSSIAN COLLABORATION REGARDING FINAL
DISPOSAL IN CRYSTALLINE HOST ROCK

Verantwortung
für Generationen

Responsibility
for Generations

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DBE TECHNOLOGY GmbH



7th US-German group 2016, Washington (USA)



Dear readers,

The safe disposal of radioactive waste in rock salt formations is favoured in several countries (United States of America, Germany, the Netherlands and in Poland). While repositories for low- and intermediate-level radioactive waste and non-heat generating defence waste have been implemented decades ago (e.g. ERAM, Asse, WIPP), the disposal of high level radioactive waste and spent fuel in rock salt is still an issue of research and development. German and US researchers have worked together in this field since the 1970s. After more than 20 years of successful cooperation and a period of less intense activities, the contact was refreshed in 2010 with the first joint workshop and a Memorandum of Understanding between US-DOE and the German Ministry for Economic Affairs and Energy (BMWi) was signed in 2011.

Since then, a series of workshops has been held, alternating between the USA and Germany and organized by SANDIA National Laboratories, Project Management Agency at KIT and DBE TECHNOLOGY GmbH. Scientists from the Netherlands and Poland also participate at the workshops. These collaborations help to ensure documentation of the state of the

art in the design, safe operation, and closure of repositories, which is tantamount to creating a knowledge archive. Consequently, the workshop results are always compiled in proceedings. The workshops encourage open discussions in a mentoring atmosphere.

About 60 scientists and engineers attended the last US-German-Workshop in Washington DC, in September this year. This workshop was initiated by welcome addresses from Mr. John Kotak, Acting Assistant Secretary for the Office of Nuclear Energy, and Mr Wirth on behalf of BMWi (Germany). The workshop focused on four main topics: safety case issues, repository design (focus: operational safety), geomechanical issues, and a breakout session on percolation issues. In addition to this, special topics covered the issue of technical approaches on waste package retrieval and investigations on the disposal of specific waste in very deep boreholes.

The group will continue to document and report about elements that have substantial scientific basis. Mature issues will be balanced with elements of arising concerns to render progress on matters of interest on both sides of the Atlantic Ocean. Those who are interested in following the activities of this collaboration are kindly invited to visit the web-site www.energy.sandia.gov or to attend the next US-German-Workshop in 2017, which will be hosted by our Dutch colleagues of COVRA.

This flyer again provides brief information about ongoing activities of our company in different fields of safe radioactive disposal.

Happy reading.

Wilhelm Bollingerfehr
Head of Research &
Development Department

German-Russian Collaboration Regarding Final Disposal in Crystalline Host Rock

In 2001, radioactive waste disposal was integrated into the scientific-technical collaboration between the former Russian Ministry of Atomic Energy (Minatom, now Rosatom) and the German Ministry of Labor (BMWA), now Federal Ministry for Economic Affairs and Energy (BMWi). This collaboration was based on a bilateral agreement regarding R&D on the peaceful utilization of nuclear power (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 perform site-specific work, to test the safety demonstration tools available, and to expand the knowledge to all aspects specific to these host rocks. Another motivation for joining this cooperation was the intent to assist Russian engineers and scientists in their integration into the international scientific community concerned with radioactive waste disposal and to share advanced safety approaches.

Based on the WTZ agreement, a comprehensive and versatile cooperation has been implemented in the past 15 years. Joint R&D activities and projects regarding HLW disposal in crystalline (magmatic) host rocks based on site investigation activities in the Krasnoyarsk region have been a permanent part of this cooperation. The Russian side has been led by VNIPI Promtekhologii (VNIPI PT), while three major R&D organizations, the Fed-

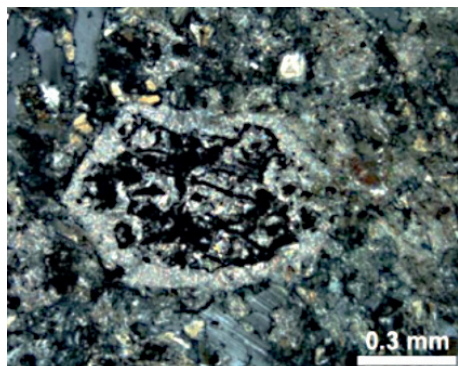
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Main barrier for the KBS-3 concept: the copper canister (Source: SKB)

eral Institute for Geosciences and Natural Resources (BGR) in Hanover, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH in Brunswick, and DBE TECHNOLOGY GmbH (DBETEC) in Peine have been the permanent participants from the German side.



Thin section of crystalline rock from Yeniseysky (Russian Federation)

Methodology of Safety Demonstration for a Repository in Crystalline Rock

Due to the restart of the siting process for a repository for heat-generating radioactive waste in Germany, an adequate knowledge base has to be developed for crystalline rock. Therefore the R&D project CHRISTA, led by DBE TECHNOLOGY GmbH, has been initiated to discuss fundamental issues of disposal, safety, and safety demonstration strategies for a repository in German crystalline rock formations. The Federal Institute for Geosciences and Natural Resources (BGR) in Hanover as well as the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH in Brunswick are project partners. The Safety Requirements for the Final Disposal of Heat-Generating

Radioactive Waste defined the safe enclosure of radionuclides in a so-called Containment Providing Rock-Zone (CRZ) as a fundamental safety strategy for sedimentary rock with containment capacity. Crystalline rock is intensively fractured and its containment capacity may therefore be limited. Hence, a modification of the CRZ concept is necessary to consider crystalline rocks as potential host rocks. If the crystalline host rock is covered with a sedimentary rock with good containment properties, this rock may be considered to be the CRZ. In this case the CRZ does not include the crystalline host rock (= CRZ type Bb). As an alternative, homogenous rock blocks with mineralized and thus closed fractures may be defined as multiple CRZs separated by hydraulically efficient fractures (= CRZ type M). SKB (Sweden) and POSIVA (Finland) developed the KBS-3 disposal concept, which consists of a combination of copper containers and bentonite barriers. This concept of "Containment Providing Barriers" (CPB) defines different requirements for the host rock than the CRZ concept. In the final report of the German Repository Siting Commission, the criteria for the suitability assessment of German crystalline formations accept the CPB concept as an alternative for long-term containment of radionuclides.

Current evaluations in the CHRISTA project show that the demonstration of integrity according to the safety requirements can be done for both CRZ concepts. For the CRZ type Bb, integrity has to be proven for the overburden formation. For the CRZ type M, special attention has to be paid to the specific properties of fractured crystalline host rock. The results of indicative model cal-

culations show that both CRZ types may be consistent with the current safety requirements.

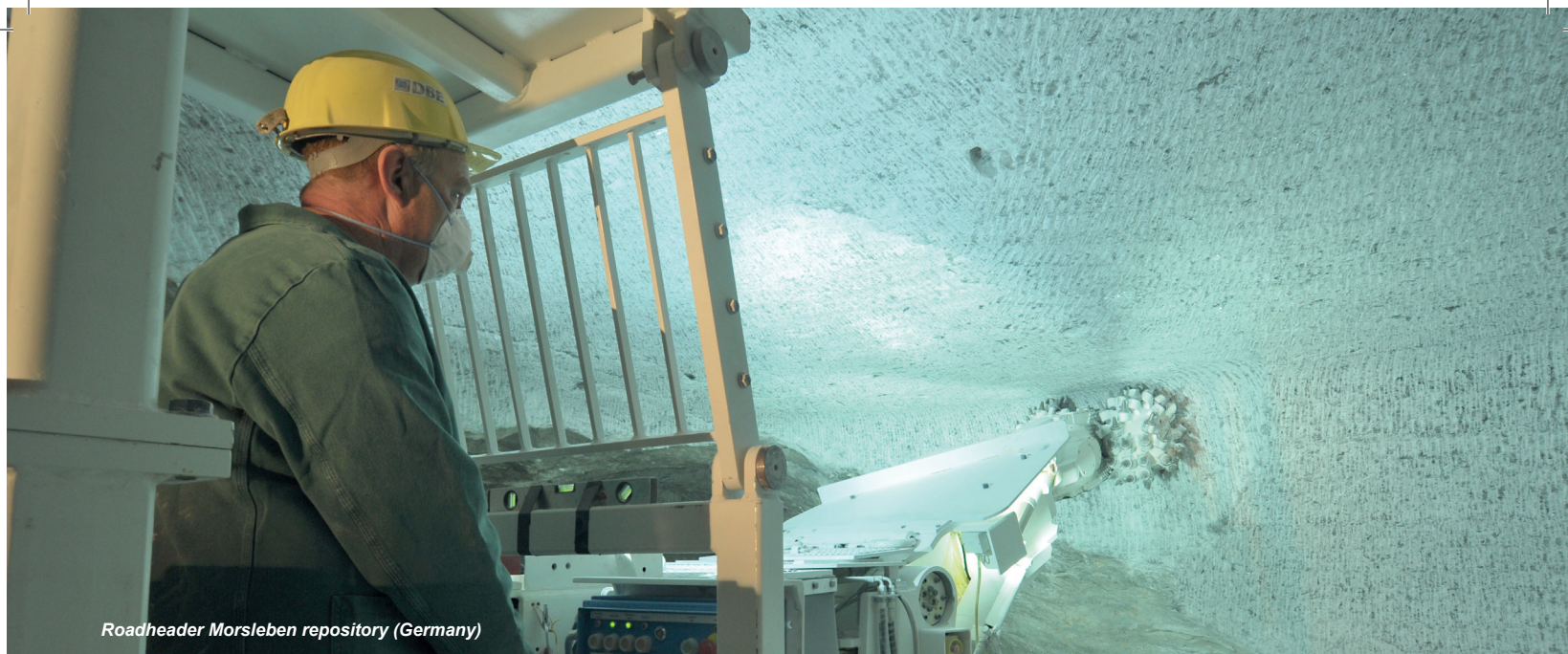
The Scandinavian KBS-3 concept and the corresponding repository and closure concept can in principle be taken as a basis for the development of a generic repository and closure concept and for discussions of the safety and safety demonstration strategies for HLW disposal in German crystalline rock. Specific adaptations of the canister concept will be necessary considering the amount of MOX spent fuel to be disposed of in Germany.

The results of the CHRISTA project are compiled in a final report that will soon be available for download on the DBE TECHNOLOGY GmbH website.

Safety Investigations for Siting a Repository in a Clay Formation

In Russia, investigations are being performed to check the possibility for siting a repository in a clay formation in the region near St. Petersburg.

Based on the German-Russian bilateral agreement regarding R&D on the peaceful utilization of nuclear power (agreement on "Wissenschaftlich-Technische Zusammenarbeit", WTZ), DBE TECHNOLOGY GmbH together with the Federal Institute for Geosciences and Natural Resources (BGR) in Hanover and the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH in Brunswick are performing specific safety investigations in collaboration with the Russian partners (NO.RAO, VNIPIET, Institute for Geoecology). The activities of the German



Roadheader Morsleben repository (Germany)

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.

In the framework of these R&D activities a 3D geological model has been developed by BGR. Several boreholes have been drilled at the site and relevant rock properties of the Vendian clay, being selected as the host rock, have been determined by the Russian partners. This 3D model can be taken as a sound basis for flow and transport simulations performed by GRS to identify relevant flow paths and to evaluate the quality of the radionuclide enclosure. At the same time the model can be used to develop a comprehensive backfilling and sealing system and to select suitable locations for individual sealing modules. A conceptual approach of a backfilling and sealing concept developed by DBE TECHNOLOGY GmbH is currently being documented and described in a technical report.

Finally, a list of FEP (Features, Events and Processes) will be compiled containing all safety-relevant processes in and around the repository that are to be considered in a safety demonstration concept. This FEP list ensures a comprehensive system description and an overview of the over-

all repository behavior.

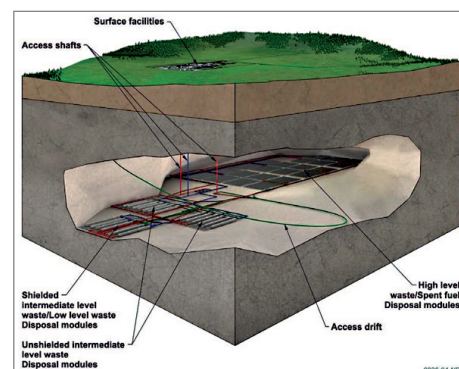
UK NDA R&D Framework Contracts Awarded

UK's Nuclear Decommissioning Authority (NDA) is responsible for ensuring that UK's most complex decommissioning challenges are resolved. R&D plays a critical role in solving the wide range of complex, often unique, challenges that have accumulated over the decades and now need to be addressed. With the aim to solve these problems more effectively, more efficiently and, where possible, less costly NDA channels R&D funds through two main routes: as a portion of the main budget allocated to its sites that seek support for specific projects; and directly, through work commissioned by NDA.

The Direct Research Portfolio (DRP) is the main mechanism through which the NDA directly funds R&D. The DRP is delivered through framework contracts, which were awarded through a competitive process to various consortia. The contract will be let for an initial period of 24 months, with the option to extend by further increments of 12 months up to a maximum contract duration of 48 months. The estimated value is 6 Million GBP per annum over the 3 lots. The framework contracts cover 3 lots, where Lot A supports NDA's University

Research Strategy, while Lot B and C support NDA's strategic themes:

- Lot A – University Interactions
- Lot B – Integrated Waste Management and Site Decommissioning and Remediation
- Lot C – Spent Fuels and Nuclear Materials



British concept for a deep geological repository for radioactive waste (Source: NDA)

As member of a Consortium led by Eden LE Ltd, DBE TECHNOLOGY GmbH was awarded a contract under Lot B. Thus, DBE TECHNOLOGY GmbH provides its comprehensive expertise on the planning, construction, and operation of geological repositories and the related R&D-activities to the NDA programme. The other members of the Consortium are Cavendish Nuclear, Golder Associates Limited, Tradebe Inutec, and Project Time and Cost International Limited.

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