

DBE TECHNOLOGY NEWS

2017

COOPERATION WITH JAPANESE RADIOACTIVE WASTE
MANAGEMENT ORGANIZATIONS

SAFETY STUDIES FOR SHAFT HOISTING OF HEAVY
LOADS

THE DOPAS PROJECT: FULL-SCALE DEMONSTRATION OF
PLUGS AND SEALS

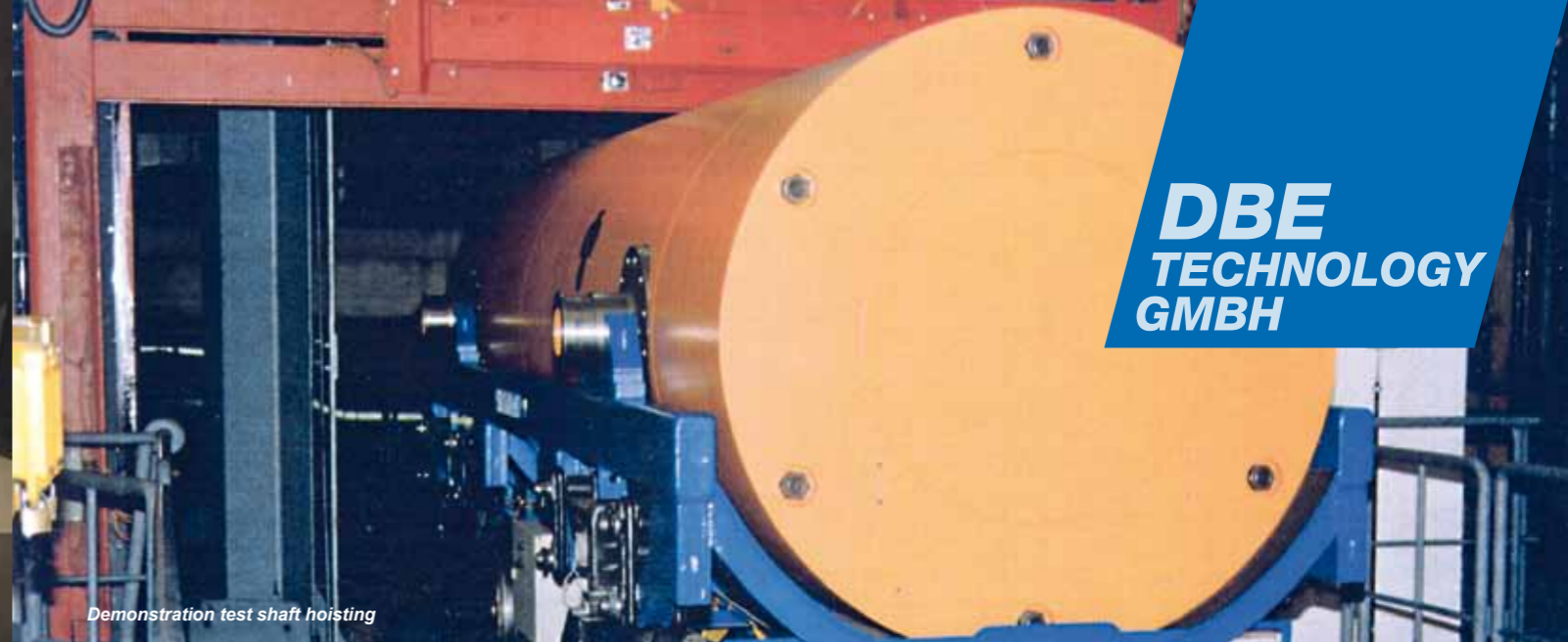
DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTE IN DEEP
BOREHOLES

Verantwortung
für Generationen
Responsibility
for Generations

DBETEC
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Signature of Cooperation Agreement between NUMO (Dr. Kondo to the right) and DBE (Mr. Raapke)



Demonstration test shaft hoisting

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Dear readers,

This leaflet again provides a brief overview of the most recent activities of DBE TECHNOLOGY GmbH. They illustrate the positive results achieved by the company in 2016. These results do not only reflect positive business achievements, but also the intensification of national and international cooperative efforts in supporting the implementation of large-scale industrial projects as well as in the resolution of key technical and scientific issues related to radioactive waste disposal. Together with other German research institutions, major efforts were directed towards the generation of the necessary scientific and technical basis

for supporting the upcoming German site selection process for a repository, especially for high-level waste. This process has to take into account all host rock formations potentially suitable in Germany.

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.

In view of the forthcoming deep-reaching organisational changes in radioactive waste disposal in Germany, the expertise and commitment of our employees as well as the success of our national and international partnerships, developed over many years, assure us that we are well-prepared to meet future demands and to provide significant contributions towards mastering the associated challenges.

With this in mind, we look forward to continuing our successful collaborations and wish you a happy New Year, success, and personal welfare.

Happy reading.

Dr. Jürgen Krone
Managing Director
DBE TECHNOLOGY GmbH

Cooperation with Japanese Radioactive Waste Management Organizations

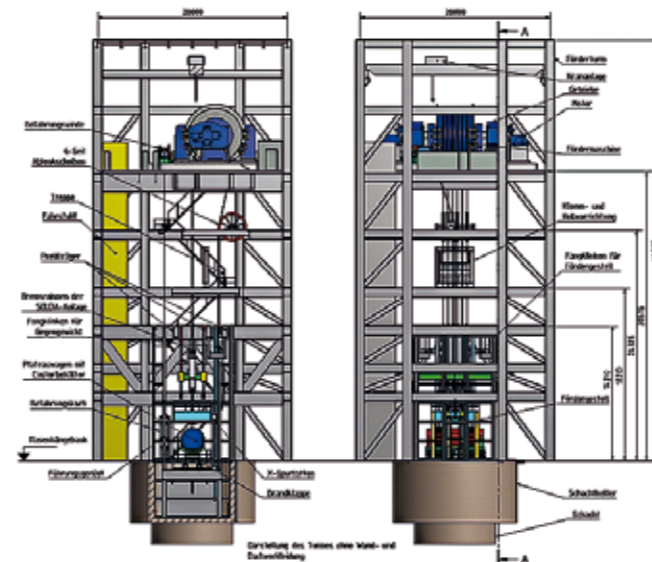
DBE TECHNOLOGY GmbH and DBE have maintained very good relationships with Japanese organizations in the area of Radioactive Waste Management for many years. In 2016, two major events occurred that underpinned these bonds.

Already in July, the cooperation agreement between the Japanese Radioactive Waste Management Funding and Research Center (RWMC), responsible for research on radioactive waste and managing radioactive waste funds, on the one hand and DBE as well as DBE TECHNOLOGY GmbH on the other hand was extended for another five years. All parties emphasised the fruitful and trustful relationship that has developed over the 15 years of existence of the cooperation. In December, the already long-lasting relationship with the Nuclear Waste Management Organization of Japan (NUMO) was formalised, and a new Cooperation Agreement was signed between NUMO and DBE, with DBE TECHNOLOGY GmbH as the executing organization. NUMO manages the Japanese HLW repository programme and currently conducts the site selection process for a HLW repository.

The above mentioned relations as well as the cooperation with the industrial company IHI Corporation facilitate a comprehensive insight into the Japanese radioactive waste management activities. Especially in the current situation in Germany, which is characterised by a re-start of the search for a suitable site for a HLW repository, the collaborations are very valuable for all sides

Safety Studies for Shaft Hoisting of Heavy Loads

The main concern related to the shaft hoisting of payloads associated with underground transport of radioactive waste for disposal is a failure of the hoisting system, which could result in a fall of a waste package down the shaft and the associated potential for release of radioactive materials. For this reason and to ensure that all relevant operational safety requirements are met by the



Conceptual design of a shaft hoisting system for payloads of 175 t

design of the facility, operational safety assessments for shaft hoisting systems have been carried out in Germany for more than twenty years.

In order to provide the basis for demonstrating the technical feasibility of a shaft hoisting system with a payload of 175 t, the Project Management Agency Karlsruhe (PTKA) on behalf of the Federal Ministry for Economic Affairs and Energy (BMWi) assigned the R&D project

“Safety studies on the shaft transport of heavy loads up to 175 t” (acronym SULA) to DBE TECHNOLOGY GmbH. The 3-year-project started in 2013 and has recently been completed.

Due to the limited existing experience in operating underground repositories, the methodology used to assess the operational safety of these nuclear facilities is nowadays in continuous development. In the framework of the project, DBE TECHNOLOGY GmbH analyzed the potential applicability of probabilistic and deterministic safety assessment methods used to evaluate the safety of nuclear facilities (e.g. nuclear power plants) to the methodology used to assess the operational safety of shaft hoisting systems in underground repositories projects in Belgium, Finland, and USA has been evaluated.

The results of the project SULA show that deterministic methods can generally be used to qualitatively analyze the sequence of operations to load/unload and transport the waste packages, to identify potential safety-relevant events and to quantify their consequences. Probabilistic methods are to complement the deterministic methods and can be used to determine the probability of failure of the components and the frequency of occurrence of the undesired end-states of the facility. The starting point of a safety assessment for shaft

hoisting systems is the identification of potential safety-relevant events that can lead to an undesired end-state of the facility (i.e. events leading to release of radioactive material and to radiation exposures). These undesired end-states can occur in the event of loss of waste package integrity (e.g. damage of the waste package) or when operating personnel is required to remain in the vicinity of a waste package for periods longer than required under normal operating conditions (e.g. to carry out repair work).

The DOPAS Project: Full-scale Demonstration of Plugs and Seals

The European DOPAS Project was implemented by 14 partners (including DBE TECHNOLOGY GmbH) from 8 European countries. The Project was carried out from 2012 to 2016 with a focus on research, development and demonstration activities related to full-scale drift and shaft sealing experiments conducted in various underground research laboratories in Europe.

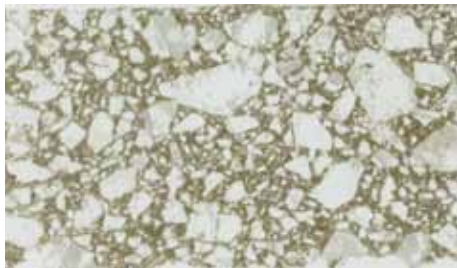
For all types of host rocks, geological disposal concepts include engineered barrier systems (EBS) made from specific technical structures, e.g. plugs and seals, consisting of engineered and natural materials that are designed to provide a range of isolation and containment functions. Within the IGD-TP (Implementing Geological Disposal - Technical Platform), a common need to study plugs and seals was raised. For organizations focused on the licensing and implementation phase of repository development, the driver was to support the further refinement of reference designs or provide alternative plug/seal designs. For organizations

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Chinese delegation at Konrad repository

where licensing is still seen as a future activity, the goal for involvement in the DOPAS Project was to support research and development (R&D) on the feasibility of geological disposal solutions.



Thin section of compacted crushed salt

The DOPAS Project succeeded in improving the industrial feasibility of full-scale plugs and seals, the measurement of their characteristics, the control of their function under repository conditions, and their performance with respect to achieving safety objectives. Appropriate experiments and work allow the waste management programs to proceed to the next level of technical maturity. In addition, the lessons learned will provide valuable input for waste management programs needing further information to develop their own plugging and sealing solutions.

The results of the modelling work performed by DBE TECHNOLOGY GmbH yield a sound basis for the improvement of modelling capabilities regarding the

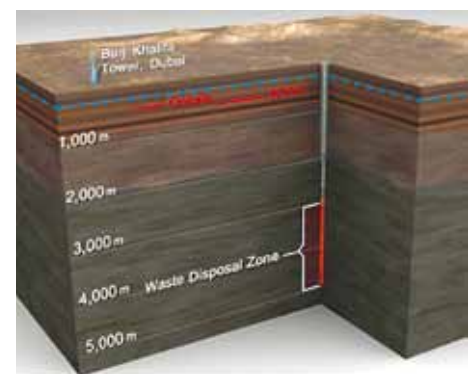
constitutive laws of material compaction to be applied in analytical proofs, which are stipulated for engineered barriers in the German Safety Requirements.

Disposal of High Level Radioactive Waste in Deep Boreholes

In the past, the idea of radioactive material disposal in very deep boreholes was analyzed several times on an international level, mainly with the purpose of investigating the possibilities of disposing of radiation sources. The idea is to drill up to 5000-m-deep boreholes into the crystalline bedrock, to emplace radioactive materials from the bottom of the borehole up to a depth of 3000 m, and to seal the rest of the borehole up to the surface. Recently, the US Department of Energy (DOE) decided to launch a 5-year-program to demonstrate the technical feasibility and safety of this approach for small sized waste.

As a consequence, the German Commission "Storage of high level radioactive waste" recommended observing the evolution/development of this technical approach and launching suitable R&D activities. In this context, the Federal Ministry for Economic Affairs and Energy wants to investigate the chances and risks of applying such a disposal option in Germany. Thus, in December

2016, a 15-month-long R&D project was launched, where DBE TECHNOLOGY GmbH in cooperation with the Technical University Bergakademie Freiberg will analyze in detail the state of the art in such a technology, particularly the associated boundary conditions and assumptions. Compliance with national safety requirements will be analyzed and possible deficits will be identified from a technical point of view. Furthermore, approaches to improve the concept will be developed. In this regard, the focus will be on safety aspects; e.g. the drilling and casing of a borehole, the emplacement process (waste package handling and lowering down into the borehole), the durability of waste packages in a borehole completely filled with fluid, the retrieval process, and the quality of the borehole seal.



Sketch of a 5-km-deep borehole in crystalline bedrock, well below fresh groundwater resources; (source: Sandia National Laboratories)

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

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