

STATUS OF THE MINE FOR THE INVESTIGATION OF THE GORLEBEN SALT DOME

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ABSTRACT

In the Federal Republic of Germany the GORLEBEN salt dome is under investigation for its suitability as a site for the final disposal of all categories of radioactive waste. The objective of the investigation is the detailed exploration of the geological and hydrogeological conditions prevailing in and around the GORLEBEN salt dome. In the period 1979 to 1983 a surface investigative program was performed. Since then the underground exploration program is in progress. Shaft excavation is to start in February 1986. Actual underground exploration entailing 26 km of drifting and 120 km of core drilling will proceed from 1989 to 1992. If suitability can be proven, the GORLEBEN repository will be in a position to accept nuclear waste at the earliest in the year 2000.

INTRODUCTION

Under provisions of German Nuclear Legislation (Atomgesetz) the Federal Government is responsible for the disposal of nuclear waste materials.

The PTB (Physikalisch-Technische Bundesanstalt, National Institute for Physics and Technology) has been allotted the management of the disposal on behalf of the government.

The PTB thus shows responsible for the planning, construction and operation of facilities for safe-guarding as well as for final disposal of spent radioactive fuel and reprocessing waste.

The PTB has involved as "Third Party" the DBE (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH, German Corporation for construction and operation of repositories for waste materials, Inc.) under an operating agreement to execute the planning and all investigations required for the GORLEBEN-Project (Fig. 1).

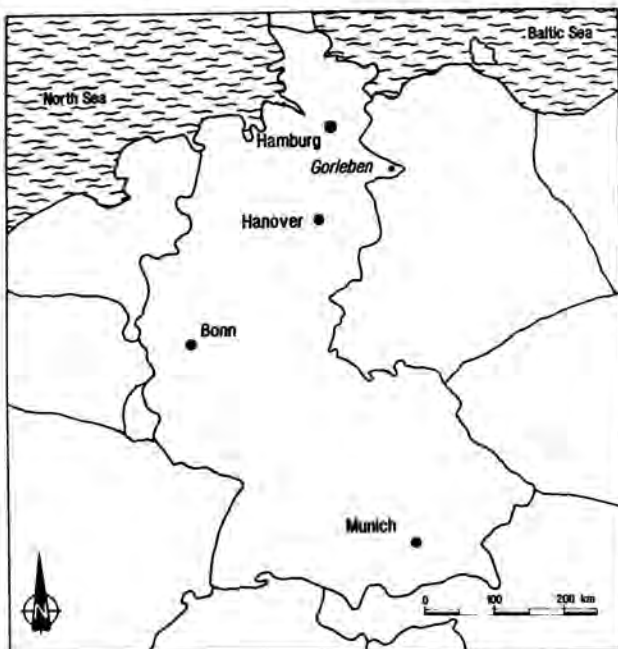


Fig. 1. Location Map.

The GORLEBEN salt dome is under investigation for its suitability as a site for the final disposal of all categories of radioactive waste. The objective of these investigations is the detailed exploration of the geological and hydrogeological conditions prevailing in and around the GORLEBEN salt dome.

The exploratory program began on site in April 1979 with the surface exploration of the GORLEBEN salt dome. The program executed in an area of about 300 km² comprised of 590 drill holes and 540 geoelectrical measurements. In addition about 156 km of deep seismic profiles were recorded. Four deep holes and two shaft pilot holes were drilled. The surface exploration of the GORLEBEN salt dome was completed in 1983.

The results of the surface exploration program confirmed the potential suitability of the GORLEBEN salt dome and justify the excavation of shafts to proceed with subsurface investigations of the internal structure of the salt dome. Only by means of underground exploration can the data be obtained which are required for the planning of a final underground repository.

Details on this program have been presented in prior years.

PREPARATORY STAGES FOR UNDERGROUND INVESTIGATIONS

Based on the positive outcome of the surface exploration phase which fully confirmed the assumptions regarding the GORLEBEN salt dome, the Federal Government approved the underground exploration phase of investigations at the GORLEBEN site in July 1983.

The Board of Mines in Celle, Lower Saxony, consented to the main operating plan submitted for the underground exploration in September 1983 indicating the acceptability of the planned operations in accordance with the Federal Mining Law.

In October 1983 a contract in regard to the sinking of two shafts was signed between DBE and a joint venture consisting of two major German shaft sinking companies (Deilmann-Haniel GmbH and Thyssen-Schachtbau GmbH).

The provisions for the underground program started in November 1983 with the preparation of the construction site for the shafts including all surface facilities required. Extensive earth moving and land-fill operations to safeguard the shafts against possible high ground water levels were undertaken. An area of 33 hectares around the shafts was secured against the possibility of external interference by metal fencing and a concrete wall 4 m in height. Roads, water and power supplies and sewage disposal were installed. The facilities will be complete, when an office - dry house complex becomes operational in March 1986.

CONCEPT

The conceptual design of the repository at the GORLEBEN site calls for the construction of galleries and drill holes for disposal in the depth range between 850 to 1200 m. Shafts are projected to reach final depths of 940 m (shaft 1) and 840 m, respectively. The top of the salt dome lies at approximately 250 m depth in the area of the shafts. Rock formations above the salt dome and its cap consist of unconsolidated Pleistocene gravel, sand, silt and clay and Tertiary silt and clay. Overburden and overlying rocks are waterbearing and contain three main groundwater horizons. The sedimentary rocks are not sufficiently stable and represent a considerable obstacle to shaft sinking. Shaft sinking will require the deep freeze shaft sinking technique.

SHAFT 1

Shaft 1 will be utilized for the down-cast ventilation of the mine and is to serve for men access, transportation of materials and for the hoisting of salt. It will be furnished from the beginning with the final headframe but will be initially equipped only with hoisting machinery for shaft sinking operations.

The decision had been taken to lay out the two shafts in their final dimensions from the very beginning as a cost and time saving measure. To generate a frost body allowing construction of a shaft with a final diameter of 7,5 m, 43 directionally controlled drill holes were planned along the circumference of a circle with 18 m diameter. To permit control of the frost formation and permit proper surveillance of frost body maintenance additional 4 temperature monitoring holes are required.

Drilling operations for freeze holes and temperature monitoring holes commenced in October 1984 and were successfully completed according to schedule in May 1985. Installation of freezing equipment and machinery followed. 6 Units with a freeze capacity of 7 million KJoule/h are in operation since October 1985. As of mid January 1986 temperatures over the entire depth interval to 250 m - as monitored by a control hole at a distance of 1 m from the freeze holes - registered below 0 °C. Lowest temperatures achieved are minus 14 °C.

Excavation of the preshaft is projected to start in late February 1986 and will probably proceed to a depth of 50 m. It is anticipated that this phase will require three to four months.

Total freeze time will be in the order of 26 months. The critical zone consists of a thick horizon of Tertiary clays at a depth of approximately 170 to 210 m. Freeze time for this zone will be in the order of 16 month.

At the shaft 1 site a 62 m high headframe is presently under construction. Workplatform hoisting and other shaft sinking equipment and machinery are being installed.

Projections are for shaft 1 to reach final depth in 1989. Prior to this foundations for the final lining of the shaft will be emplaced. The connecting drift between the shafts will be driven from shaft 1.

Due to specific safety requirements in the operational and also post-operational phase of a repository an absolutely water-tight shaft lining is mandatory. The shaft lining required to meet these objectives is presented in figure 2. As soon as both shafts become operational construction and equipping of underground infrastructure facilities will proceed.

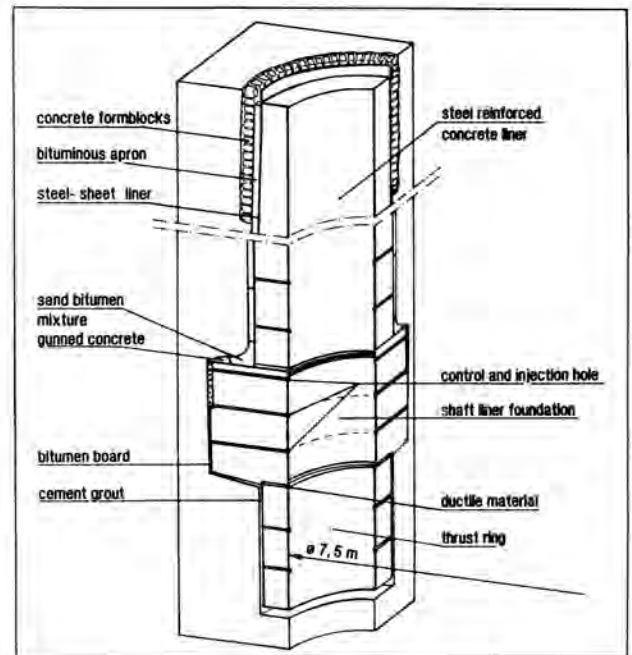


Fig. 2. Final Shaft Lining.

SHAFT 2

In the operational phase of the planned future repository this shaft will be utilized for the transportation of the nuclear waste containers. It will carry the upcast ventilation.

Drill operations at shaft 2 commenced in May 1984. Difficulties were encountered upon penetration of a 50 m thick bed of Pleistocene clay which exhibited plastic consistency and impeded circulation of drill fluids. A number of holes then had to be re-drilled by first ramming 16" casing strings through the clay and resuming directional drilling from the base of the clay. Due to these unexpected problems the schedule for shaft 2 suffered a delay of several months.

Drilling of the freeze holes was terminated in August 1985. All freezing machinery - except one to be used for peak operation and as back-up - are now installed, tested and approved for operation. Start-up of chilled brine circulation is presently expected in February or March 1986. Total duration of the freeze-period envisaged amounts to 31 months.

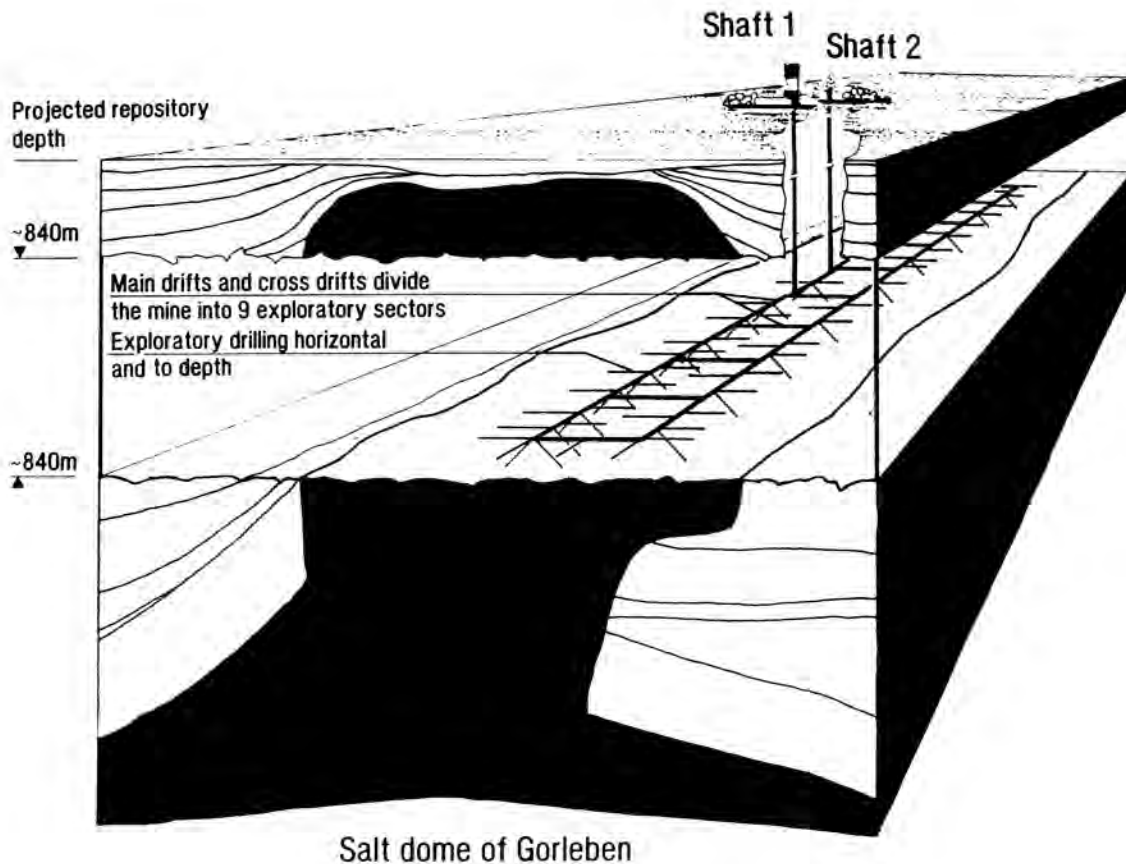


Fig. 3. Underground Investigations - Concept.

OUTLOOK

The critical freeze period for clay horizons at a depth of approximately 110 m is to 20 months. Excavation of the preshaft is expected to begin in June or July 1986.

EXPLORATORY PHASE

During the period 1989 to 1992 the actual underground exploration will then proceed (Fig. 3). It will consist of driving more than 25 km of exploratory drifts and drilling of 100 to 120 km of core. Investigations will be supplemented by geomechanical observations and tests and geophysical sounding techniques. Extensive mineralogical and geochemical work is scheduled.

The underground exploration will attempt a thorough investigation of the GORLEBEN salt dome over a total length of more than 10 km, covering an area of about 18 km² along the central part of the salt structure. Nine potential repository fields will be closely examined. In areas with favorable repository conditions the depth range from 850 to 1150 m will be investigated in greater detail.

Main objectives of the underground exploration are

- to obtain all data required to prove the suitability of the site
- to optimize stability versus repository requirements

Following the extensive exploratory program all relevant data will be compiled and reviewed. In the event of a positive assessment, the PTB then will proceed with the applicable licensing procedure and regulatory requirements (Planfeststellungsverfahren) called for in the Federal Republic for this type of major industrial project in the nuclear sector. A time span of a minimum of 2 years is presently expected to obtain permission for operations.

Construction of waste handling facilities on surface and of the underground galleries then could begin in 1995. Waste disposal will start in the outermost parts of the repository and retreat in the direction of the shafts.

It is forecast that nuclear waste can be accepted by the repository at the earliest in the year 2000.