UNDERGROUND EXPLORATION OF THE GORLEBEN SALT DOME - A STATUS REPORT

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ABSTRACT

The exploration of the Gorleben salt dome for the disposal of all types of radioactive wastes is well in progress. The exploration from the surface is finished. The results of this research and development program have led the German Federal Government to approve the excavation of two exploratory shafts for investigating the salt rock formation of the Gorleben underground.

The shafts will be sunk by the ground freezing method. Drilling operations for the freezing process started in May 1984, and the surface facilities have been under construction since early 1984.

This report gives a review on: 1) the exploratory program site, 2) the status of construction of the surface facilities for the exploratory mine, and 3) the underground exploration program.

The underground exploration will provide the essential information about the interior structure of the salt dome. This is a prerequisite for the licensing procedure for the construction of a repository for radioactive waste.

INTRODUCTION

Under the provisions of a German federal law, the National Institute for Physics and Technology (Physikalisch-Technische Bundesanstalt, PTB) is responsible for the construction and operation of final repositories for radioactive waste in the Federal Republic of Germany. For the implementation of its legal responsibilities, it has the option of commissioning a third party. Under the terms of an operating contract, the Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH, (DBE) has been commissioned by the PTB to execute the planning and construction for the Gorleben project.

Salt formations are being investigated for the purpose of final disposal of weakly, moderately, and highly radioactive wastes in the Federal Republic of Germany. As proposed by the government of the Federal State of Lower Saxony in February 1977, solely the Gorleben salt dome is being investigated for its suitability as site for the final disposal of weakly, moderately, and highly radioactive wastes. The objective of the investigation is the detailed exploration of the geological and hydrogeological conditions prevailing in and around the Gorleben salt dome for

- demonstrating the suitability of the site for the construction of an underground facility for the final disposal of radioactive waste, and
- ascertaining all relevant data for planning and construction of an underground repository, with specific reference to the site, and for demonstrating its safety.

EXPLORATORY PROGRAM ON SITE

In April 1979, the implementation of the exploratory program began on site with the surface exploration of the Gorleben salt dome.

Prior to the end of 1984, a total of 590 wells had been drilled as hydrogeological exploratory boreholes, salt wash surface boreholes, deep boreholes for the exploration of the salt dome, and shaft pilot boreholes. Moreover, 540 geoelectrical surface surveying operations had been conducted, and 156 km of deep seismic profiles have been recorded.

With the exception of concluding operations, the surface exploration of the Gorleben salt dome has been completed. It has provided information and proofs concerning the structure of the overlying rock strata, the geohydrological relationships, and the stratigraphic sequence in the salt dome, including a preliminary interpretation of the structure of the various Zechstein series, which have resulted in the specification of the sites for excavation of the shafts.

The results of the surface exploration, by means of which the suitability of the Gorleben salt dome has been further confirmed as promising, justifies the excavation of two shafts and the subsurface investigation of the internal structure of the salt dome. The data required for the planning of a final underground repository, as referred to the site selected, such as useful salt rock volume for repository units, its local extension, the presence of carnallite and anhydrite, etc., can be obtained only by means of underground exploration. The subsurface exploration, which is scheduled to be conducted from 1988 to 1992, encompasses the driving of about 25 km of exploratory entries, and exploratory coring operations over a total distance of more than 50 km. By means of this program the salt dome is to be explored at a depth of 840 m over a total distance of 10 km within an area of 18 km^2.

On July 13, 1983, the German Federal Government approved the underground exploration of the Gorleben salt dome. The Board of Mines in Celle approved the main operating plan for the subsurface exploration on September 9, 1983. Thus, it has been confirmed that the operations for underground exploration are feasible and worthy of approval in accordance with the Federal Mining Law.

STATUS OF OPERATIONS FOR THE UNDERGROUND EXPLORATION OF THE GORLEBEN SALT DOME

On October 28, 1983, a contract concerning the excavation of the two shafts was signed between DBE and the Gorleben Shafts Joint Venture (Deilman-Haniel GmbH, and Thyssen-Schachtbau GmbH).

The shafts are to be excavated to a final depth of about 940 m (shaft 1) and about 840 m (shaft 2), with a final diameter of 7.5 m.

The cap rock is an aquifer consisting of sands, gravels, and clays of the Quarternary and Tertiary, and is not sufficiently stable for mining purposes. It is to be consolidated through the application of the deep-freezing process. For creating the frost zone, so-called freezing wells are drilled around the periphery of the intended shaft. Subsequently, calcium chloride brine cooled to -38 to -40° C is circulated through the formation as refrigerant. The excavation of the shaft cannot begin until a stable frost zone has formed within the cap rock.

The operations for the underground exploration of the salt dome commenced on November 17, 1983 with the installations at the construction sites for the shafts and the infrastructural facilities at the surface.

Comprehensive earth-moving operations, as well as land-filling operations dictated by the high ground water level, had to be conducted. The entire premises around the shaft excavation sites, with an area of 33 ha has been safeguarded against external interference by means of metal security fencing and a concrete wall with a height of 4 m. Within the construction area, about 4.5 km of roads, water supply, sewage disposal, and electric power supply lines, as well as two transformer substations, have been constructed for later operation. Two gatekeepers' stations and a warehouse have been erected. An office and washroom module has been installed, but is to be replaced by a stationary structure in the course of the year. Reservoirs for firefighting and cooling water with the associated pumping stations have been constructed. With the exception of the office building and the dump to be located outside of the plant premises, the infrastructural construction operations will have been completed in the summer of 1985.

In parallel with these infrastructural measures, the preliminary operations have been in progress in preparation for the construction for the excavation of the shafts. For the creation of the frost zone, a total of 43 freezing wells must be drilled over a diameter of 18 m and down to a depth of several meters into the salt formation for shaft 1, and a total of 42 freezing wells must be drilled over a diameter of 17.5 m for shaft 2. For later surveillance of the frost zone, moreover, 4 temperature monitoring wells are to be drilled for each shaft.

For the drilling operations, each shaft site has been reinforced with a concrete drilling platform, and collecting pits for the drilling fluid have been constructed. Temporary access roads have been constructed to the drilling sites. On May 29, 1984, the drilling of the freezing wells at shaft 2 began in accordance with schedule. After the drilling of the first few freezing wells, difficulties were already encountered upon penetration of the Quarternary clay, which is designated as "Lauenburg clay". At a depth of about 90 m, it exhibits a plastic consistency, and the return flow of drilling fluid is impeded in the borehole during operations. Of the total of 42 freezing wells and 4 temperature monitoring wells, only 22 + 2 boreholes have been successfully drilled through the clay and cased with a 7" casing string. The remainder of the boreholes have been redrilled by ramming of 16" casing strings through the clay. As a result of these additional, unforeseen operations, the schedule for shaft 2 has been exceeded by several months.

The drilling operations for creating the freezing and temperature monitoring wells for shaft 1 commenced as scheduled on October 29, 1984 and have hitherto proceeded precisely as planned and without interference.

The constructional measures necessary for the installation of the drilling equipment, such as the construction of the concrete foundation for the hoisting machinery, assembly of the accommodation for the refrigeration machinery, and the installation of the refrigeration units, have proceeded independently of the delays experienced during the drilling of the boreholes, and have been completed on schedule.

Hence, it is anticipated that the refrigerating facilities can begin operation in August/September of this year, for the purpose of creating the frost zone necessary for the excavation of the shaft. The excavation operations can then commence toward the end of the year. The shafts are expected to be completed by 1988.

All of the operations described here for the subterranean exploration of the Gorleben salt dome are being approved and conducted in accordance with the Federal Mining Law. In the Federal Republic of Germany, however, the question of whether or not these operations already encompass the construction of a final repository has been raised by the opponents of nuclear energy. At least the two shafts indicate that a final repository is under construction here. This implies that the operations cannot be executed under the provisions of the Federal Mining Law, but rather must be approved under the terms of the Nuclear Energy Act. With this argument, the opponents of nuclear energy have petitioned for a declarative proceeding on August 1, 1984. The objective is to compel the Ministry for Federal Matters of Lower Saxony (Niederšachsisches Ministerium für Bundesangelegenheiten NMB), which is responsible for approval under the provisions of the Nuclear Energy Act, to prohibit the continuation of operations by the PTB/DBE, and to force the PTB/DBE to submit the application for plan verification under the terms of the Nuclear Energy Act. This lawsuit was filed again on November 16, 1984; this time it was aimed directly against the PTB. The verdict is expected sometime in the summer of 1985. Whether or not the scheduled completion of operations for exploration of the Gorleben salt dome can indeed be realized by 1992 depends on this court decision.