Smet Group

Project drilling tunnel with segments Mol
Construction of connecting gallery SCK

Client: ESV EURIDICE
Main contractor: TV Smet-Tunnelling - Wayss & Freytag - Deilmann-Haniel
Execution: 2001-2002
Machine: open shield + Fuchs
Segments: 10 + 2 keystones
ID-OD: 4.000 - 4.800 mm
Length: 80 m

The construction of the connecting gallery is an important phase in the research programme of ESV EURIDICE for the feasibility of underground disposal of nuclear waste in the Boom clay. Beside the realisation of the second shaft (1998-1999), the construction of the connecting gallery was awarded to the same joint venture. This work consists of the design and construction of the TBM and the tunnel lining, and of the excavation of a gallery Ø4000/4800 at a 230 metre depth. The applied excavation technique is based on a well-known tunnelling technique, used in the many underground tunnels in London, yet never before applied at such depth.

Study and preparation

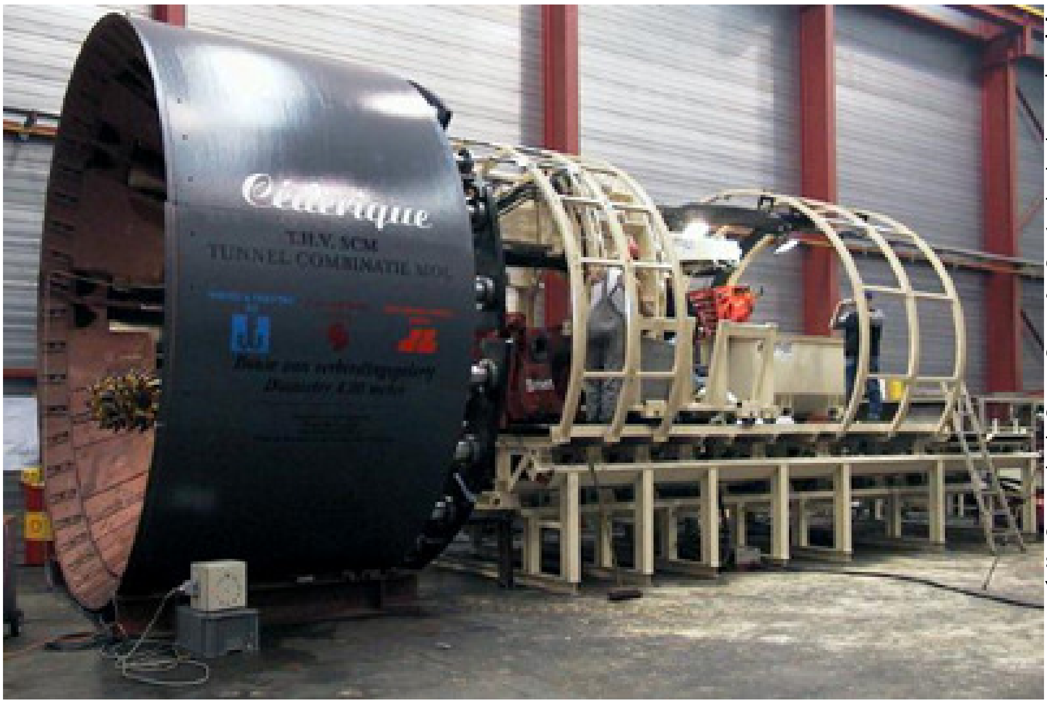
In view of the very specific situation and conditions, a detailed study was carried out: starting from of a Ø 3.00 metre shaft, a gallery has to be built with a 4.80 metre external diameter. Therefore, all components of the TBM have to be designed in such a way that they can be brought in through this shaft. Furthermore, the present lifting installation does not allow for the transport of weights exceeding 3.8 tons. The design and construction of the TBM was entirely executed by Smet-Tunnelling in cooperation with the workshop department of Smet-Boring.

Work phases

We distinguish the following phases: study and design phase, production of the tunnel lining, construction of the assembly chamber, TBM construction and test assembly, tunnel excavation and finishing.

Assembly chamber

The assembly chamber has a useful diameter of 6.3 metre and a useful length of 3.5 metre; this space was enough to assemble the entire TBM (app. 90 tons) manually. The works consist successively in: drilling fibreglass anchors (to prevent the clay mass from breaking up), breaking the existing concrete wall at the northern starting point, excavating the gallery and installing sliding ribs and shotcrete as temporary lining.



TBM and backup trains

The TBM can be split up into 4 large parts. First there is the circular cutting shoe with a 4.82 metre diameter. By pushing the cutting shoe, the section of the tunnel is cut away very accurately. The cutting shoe is equipped with a variable oversize and the necessary measuring equipment to study the response of the clay. Further down, there is the road header, consisting of a rotary cutting head and two conveyer belts to evacuate the muck. The backup train is the actual (mobile) work platform just behind the TBM and enables the supply of muck and segment lorries. Finally there's the 'bird wing' erector for the installation of the tunnel lining.

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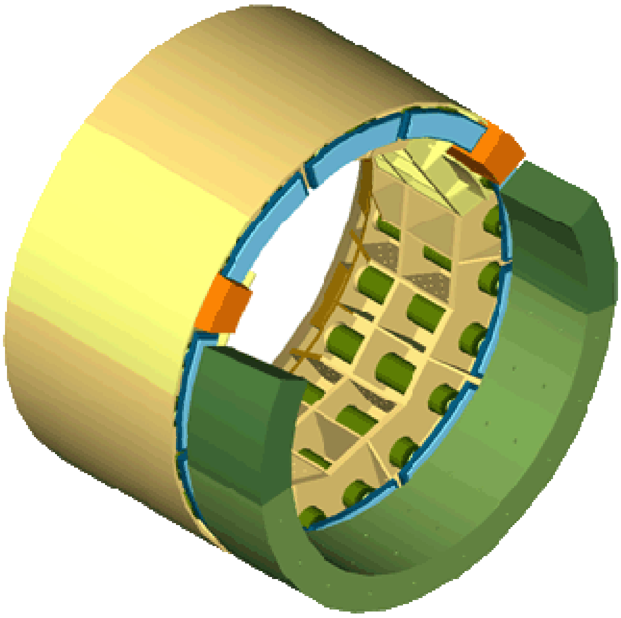
Excavation of the gallery

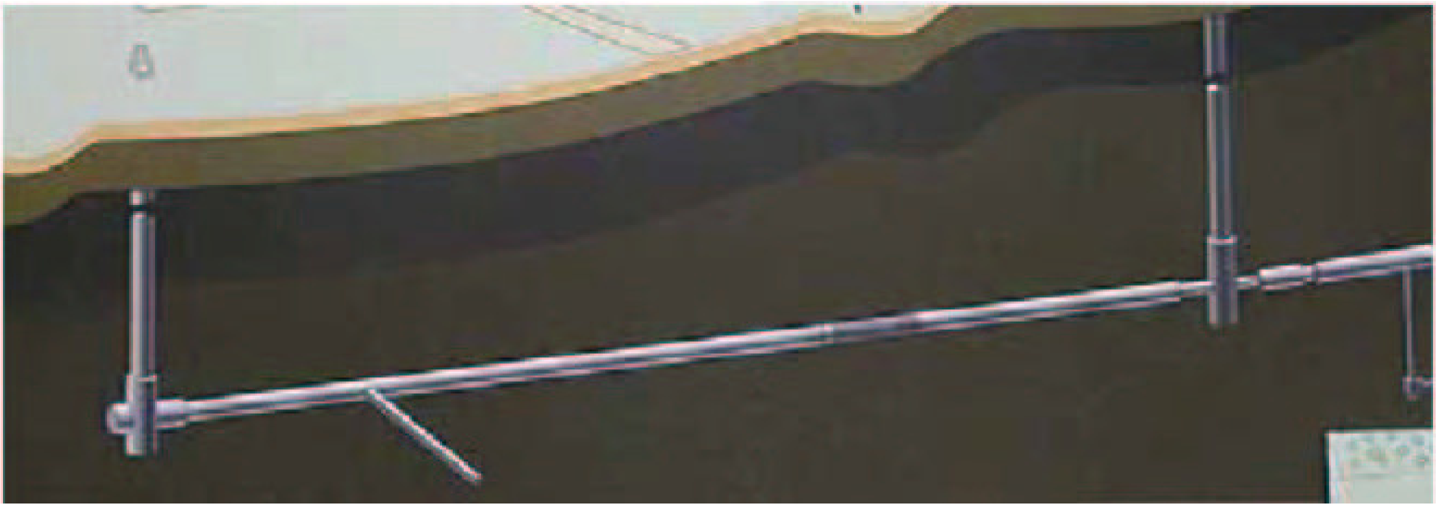
Because of the strong converging behaviour of Boom clay, a minimum progress of 2 metres per 24 hours has to be achieved, otherwise the pressure of the clay on the cutting shoe threatens to increase so much that this gets stuck and it is impossible to continue excavating the tunnel. For these reasons, the cutting shoe is fitted with a low-friction (Tef on) coating, and the necessary spare parts are present on site. For nuclear technical reasons, the soil must be disrupted as little as possible – i.e. the minimum oversize required – and therefore,the finishing of the cutter blade and of the variable oversize must be impeccable. The applied tunnel lining consists of concrete segments with a thickness of 40 cm and a length of 1 metre. Each ring is made up of 10 segments and 2 keystones ("wedges"). After installation of all normal segments, the 2 wedgeshaped keystones are pushed from the cutting shoe into the ring. The ring is expanded against the excavated clay. The maximum achieved progress was 3 metres a day. All deviations in height and direction stayed far below the allowed values. During the complete duration of the excavation, each 30 seconds monitoring and instrumentation of TBM and concrete segments were recorded. These data will, after detailed study, contribute to refining the existing computer models that simulate the behaviour of Boom Clay at great depth.

Conclusions

In addition to the very intense cooperation between client, desig-



ner and contractor, a thorough and detailed design is paramount for such high-risk projects. However, this test project has demonstrated the feasibility of drilling tunnels in highly convergent layers, with minimal disruption of the soil, high quality finishing and a safe work environment for the personnel involved.



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