ENGINEERING TOMORROW

Case story | VACON® NXP Liquid Cooled

Maximum power
for excavating uphill tunnels

The situation

FRANCE: Powerful VACON® NXP drives power the Tunnel Boring Machine (TBM) used in construction of a new hydroelectric power plant in the Alpe d'Huez region. The Italian contractor Cogeis operates this TBM to dig a tunnel with a 22% gradient. It's part of an innovative project which will deliver 100% renewable energy to the grid.

The hydroelectric power plant will integrate perfectly into the landscape, thanks to almost entirely underground systems. Tunnelling in this region requires the use of cutting-edge construction techniques, capable of overcoming the challenges posed by working in the difficult alpine environment, without disrupting the local tourism industry.

"La Sarenne" tunnel
An underground tunnel 2700 m long, with a gradient of 22%, climbs to the water source near the power plant intake.

The challenge

A refurbished TBM
For this project, Cogeis supplied a completely renovated TBM.

Project manager Paolo Bresciano explains:
"In this case, we had to dig uphill, with a considerable slope that significantly impacts the distribution of the forces at work in the 600-ton machine. Not only that, but because of the very limited space available at the access points to the construction site, about 25 m, we also had to invent a suitable way of assembling the 176 m long machine.

There were many challenges to deal with, but in particular the electrical challenges led to a total rebuild of the equipment, which allowed us to obtain performance and flexibility far superior to that possible with the original configuration."

The TBM purchased by Cogeis used a configuration of **5 motors of 225 kW each**, connected to a gearbox through clutches, to drive the rotating head.

Through the local DrivePro® Service Partner, **Gatta Srl**, Cogeis contacted Danfoss to assess a suitable solution for the renewal of the electrical system.

GATTA S.r.l.

Danfoss Drives
DrivePro®
Service Partner

"We wanted to keep the original motors, designed specifically for the size of the TBM. The solution was therefore to think of a new generation solution with drives."

Paolo Bresciano
Technical Manager, Cogeis Spa

The solution

The solution proposed by Gatta Srl and Danfoss is based on the **VACON® NXP Liquid Cooled** drives family, which has a very simple and effective load sharing management capability.
Paolo Bresciano confirms: *"Thanks to the drive control, any discontinuity of load on the motors due to the dynamic variations of the rock conditions no longer generates important mechanical stresses. Instead, electrical stresses are rebalanced autonomously by the Danfoss control system, which is capable of managing the torque differences absorbed by the individual motors.*
Furthermore, ***the drive control allows us to choose the rotation speed of the cutter with maximum flexibility, based on the expected conditions of the rock in the various stages of excavation.***
Last but not least, we are able to reconfigure the system instantly if we need to stop a motor or a drive for maintenance, with no significant impact on the productivity of the machine.

What else?

Specially designed dU/dt filters were integrated in the TBM to optimize operation of the motors, which were not originally designed for use with AC drives.
The construction of the electrical panel was designed by the engineers from Danfoss Drives Italy, who delivered all equipment ready to be installed on the TBM.
In addition, Danfoss provided **DrivePro® Extended Warranty services**, giving a warranty extension of up to 6 years, the longest in the industry.

The 4.2 m diameter underground tunnel has a dual function. The first 800 m section will constitute the water reservoir. A water tank will fill the entire excavated volume of this section. The second section of the tunnel, separated from the first by a bulkhead, will serve to house the penstock or sluice, which will carry the pressurized water downstream.

The underground insertion of both the tank and the penstock will make the system practically "invisible" from the outside, so it is perfectly integrated into the landscape.

The outcome

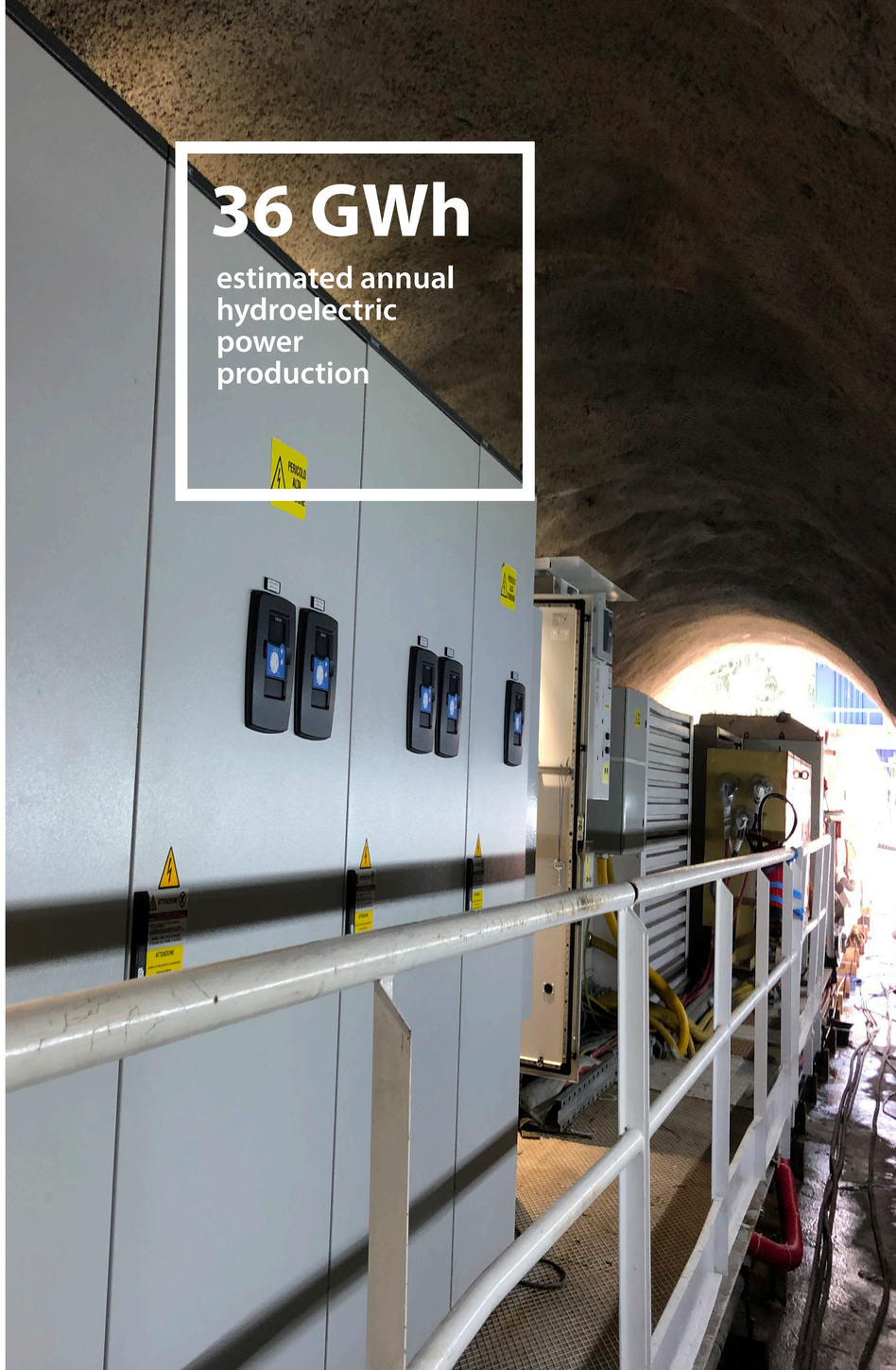
Renewable energy at the end of the tunnel

The complex La Sarenne project is currently in full swing and excavation of the tunnel has started under the best conditions. The Cogeis TBM runs under the thrust of Danfoss drives. Upon completion of the tunnel, it will be extracted from the top and disassembled, ready to face new challenges. Thanks to the flexibility of the drive solution, it can be quickly prepared for transport to a new excavation site.
In 2024, with this 11 MW hydroelectric plant, the Compagnie Nationale du Rhone will be ready to feed 36 GWh 100% renewable energy into the grid annually. This is equivalent to the energy consumption of 16,000 households.

This project is a good example of how Danfoss and its customers translate the concept of sustainable transformation into action, using the newest technology and skills based on long experience.

“It was a very satisfying job, because we were working together, each in our own role, ‘speaking the same language’, which also allowed us to respect the very stringent execution times for the realization of this project.”

Paolo Bresciano
Technical Manager, Cogeis Spa



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