

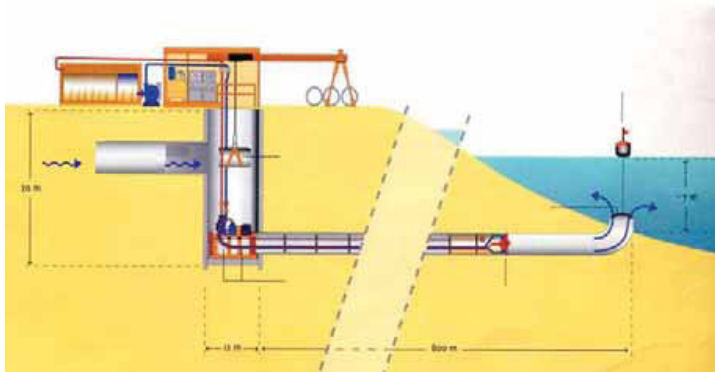


**Client:** SAFEGE  
**Main contractor:** Smet-Tunnelling  
**Execution:** september 2002- june 2003  
**Machine:** AVN  
**Pipes:** reinforced concrete pipes  
**ID-OD:** 1.600 - 1.870 mm  
**Length:** 775 m

The sea outfall built by Smet-Tunnelling is part of a larger seawater clarification program. The purpose of this program is to improve the seawater quality near the world's famous beaches of Biarritz. A brand new treatment plant is built in the southern suburbs of Biarritz. The treated sewer waters and the nearby brook are then flowing through this 1.6 m diameter concrete outfall up to 780 m away from the seaside.

### Pipe jacking

At Marbella beach, a 12 m diameter shaft, 19 m depth, was built by means of slurry walls. Smet launched a micro-tunnelling machine from this shaft towards the ocean. Hydraulic jacks of 300 tonnes each push prefabricated concrete pipes behind the TBM. The jacking forces are transmitted to the shaft wall by means of a steel reaction wall. The layout of the pipe-jacking was defined after a thorough geological and stream study of the area. The pipe jacking crosses mainly marl and limestone layers with gravel and cobbles. The use of adequate polymers was necessary to cope with the sticky marls and to improve the performances of the bentonite lubrication.



### Guiding system

The guiding system for the first half of the pipe jacking is a laser beam and an electronic levelling system. This system was implemented to compensate the well-known refraction problem of the laser beam caused by the temperature differences between entry and TBM zone. For the second half of the pipejacking, we used a fully automated system of computer guided theodolites. This patented system computes and saves continuously the accurate position of the TBM and compares the actual TBM position with the design layout of the pipe jacking and displays the differences on a monitor. The TBM pilot steers the drilling part of the machine to correct the direction and level deviations. The TUMA



system is extremely accurate and particularly adapted for long and curved pipe jackings where laser beams are not sufficient and manual measurements too expensive.

### Jacking pipes

The reinforced concrete jacking pipes have an internal diameter of 1.6m and an outside diameter of 1.87 m. The jacking capacity of the pipes is app. 700 tonnes. Each jacking pipe is 3.30 m long and is provided with three Ø 1" grouting holes. We installed 9 reinforced steel core concrete pipes at the very beginning of the tunnel to guarantee its stability during the TBM removal operations.

### Shield and equipment

Smet-Tunnelling owns a large number of shields of our own brand purchased from external suppliers. For this project, Smet-Tunnelling used an earth pressure balanced (EPB) shield with a cutting wheel adapted for both marl and soft rock. A conical Stone crusher coped with the gravel/cobble in the outfall area. The TBM weighs 25 tonnes, is 6.5 m long and the installed electrical power is 140 kW. A steering unit, a 32 tonnes gantry crane, de-sanding unit and a decantation basin were installed on the site surface.

### TBM recovering and diffuser installation

Last but not least, we use a self-elevating platform to dig a 7 m long trench and recover the TBM from the sea bed. Based on the experience of the Smet-Boring Group in various geotechnical fields, Smet-Tunnelling achieved this project as general contractor within the allowed timetable and budget.

