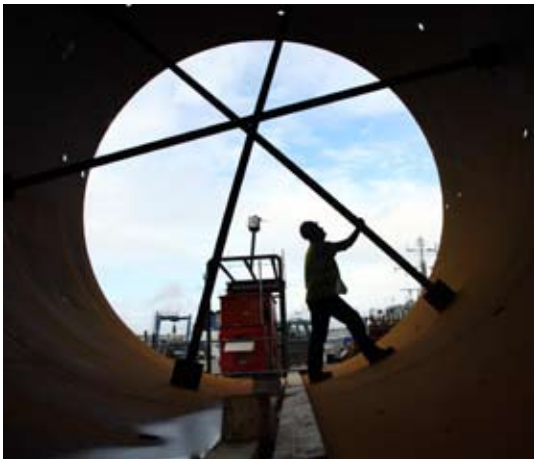
FUGRO SEACORE

Flamanville Epr 3 Marine Outfall Shaft



As part of EDF's new European Pressure Reactor (EPR) Flamanville 3 off the Normandy coast, Soletanche Bachy France (SBF) was contracted by EDF to construct the underground water cooling outlet works, consisting of 160m x 5m diameter land shaft, 63m x 5.85m diameter marine shaft and interconnecting tunnel. Fugro Seacore Ltd (FSCL) was sub-contracted by SBF to construct the marine element, consisting of drilled shaft, installation of 300t internal steel liner and 450t top reinforced concrete diffuser.

FSCL's campaign spanned a period of 3 years; in 2007 3 additional site investigation boreholes were drilled through the strong to very strong locally fractured hornfels (indurated limestone). The exposed surfaces in each borehole were logged with a televiewer from which a 3D model of the rock mass and interconnecting joint patterns was created. This enabled further analysis to assess the potential for sidewall wedge failure and confirm the requirement for any shaft stabilisation during the drilling operations. During 2008 the main shaft drilling and liner installation were undertaken and in 2009 the diffuser was installed.

A new drill rig was required to drill a shaft of this size so a brand new 90 tonne metres torque, reverse circulation drill rig (T90) with 400t pull back capability was designed and built with all new down-hole equipment. The total drill string weight was over 235Te including the 62Te bit which was dressed with tungsten carbide roller cutters. The build process from concept to commissioning took 8 months.

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The analysis from the 2007 SI campaign concluded that casings were required to support the upper 18m of shaft, therefore the drill bit was adapted to under-ream from 5.85m out to 6.45m and two casings were installed using a telescoping technique.

The rest of the shaft was drilled unsupported, however in order to cater for potential shaft wall instability a shuttering device was designed and fabricated and ROV surveys undertaken at key intervals to confirm wall integrity.

The shaft was drilled to a depth of 63m. In total nearly 1750m^3 (4900Te) of hard rock was excavated.

Following completion of drilling operations and final checks for verticality and straightness the 300t steel liner was floated to Excalibur from St Malo and the onboard Demag crane lifted it to vertical via a semi-buoyant assisted lift. The liner was then connected to 4 No. Fagioli strand jacks, mounted on the reconfigured T90 base and the liner was then flooded before lowering it to its submerged final elevation. Once divers had confirmed the final position and elevation of the liner the cable strands were severed.

Excalibur was remobilised with SBF concreting equipment and the FSCL team assisted with concreting the liner annulus, the majority of which was delivered in 1.5m^3 skips by helicopter from a shore-based mixing plant.

In May 2009 Excalibur returned to install the 450Te diffuser. This was lifted from a supply barge in Dielette Harbour using strand jacks mounted on adjustable beams over the 17m x 17m moonpool at the stern and suspended/sea fastened for the short tow across the bay to the shaft site.

Excalibur was positioned over the open shaft and then the diffuser was positioned accurately to align with the shaft opening and subsequently lowered into position on the strand jacks and the interface connection grouted to complete the watertight joint.

All site works were successfully completed in June 2009.