Vortrag

Freitag, 11. Oktober 2024, 09:30 Uhr

Überwindung geologischer Herausforderungen:
Eine Fallstudie über komplexe HDD‘s im Baskenland, Bermeo

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Lecture

Friday, 11th October 2024, 09:30 am

Overcoming geological challenges:
A case study of complex HDD in the Basque Country, Bermeo

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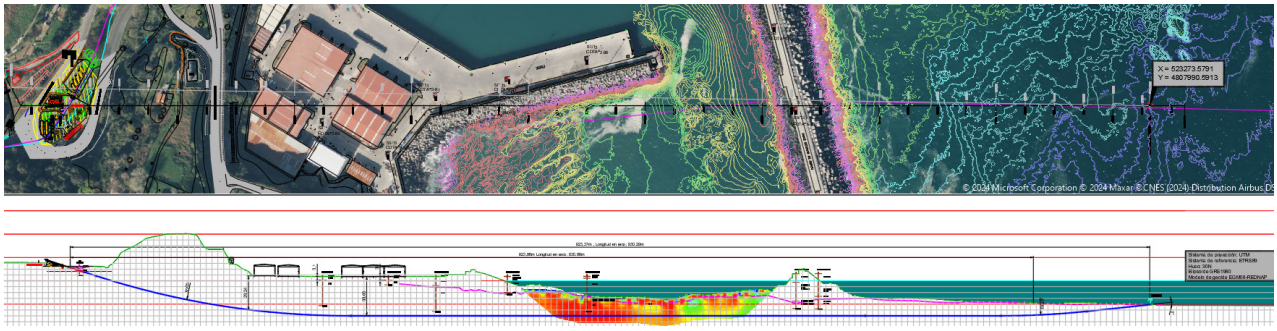
The concept

Construction of the outfall for the Lamiaren Aramburu water treatment plant.	
Drilling	930m Ø710mm.
Location	Basque Country (Northern Spain).
Location	Complex and cramped. Limited by a race.
Geology	Rock with altered sections (ophite), and boulders in the sea exit.

Survey and design

The project already described a drilling in rock, although there was uncertainty about the possible presence of an ophiolite stratum in the middle of the crossing, as well as the presence of large boulders at the sea outlet.
To confirm this uncertainty, a detailed study of the work was planned and carried out via a borehole along the route, together with a geophysical and bathymetric campaign in the marine environment.
Based on this previous research campaign, the definitive route of the outfall was established, avoiding the area of boulders at the outlet to the sea, and delimiting the layer of fractured ophiolites to be drilled, to be considered during the drilling works.
The parameters set during the campaign allowed the drilling to be designed as follows:



Parameter		
Entrance casing	Ø1.220mm (12m)	48“ (39ft)
Pipe diameter	Ø710mm	28“
HDD Length	919m	3.015ft

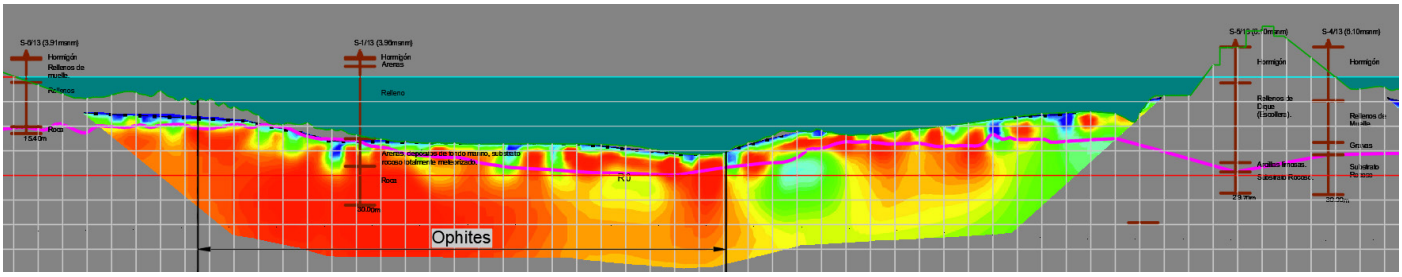
The execution

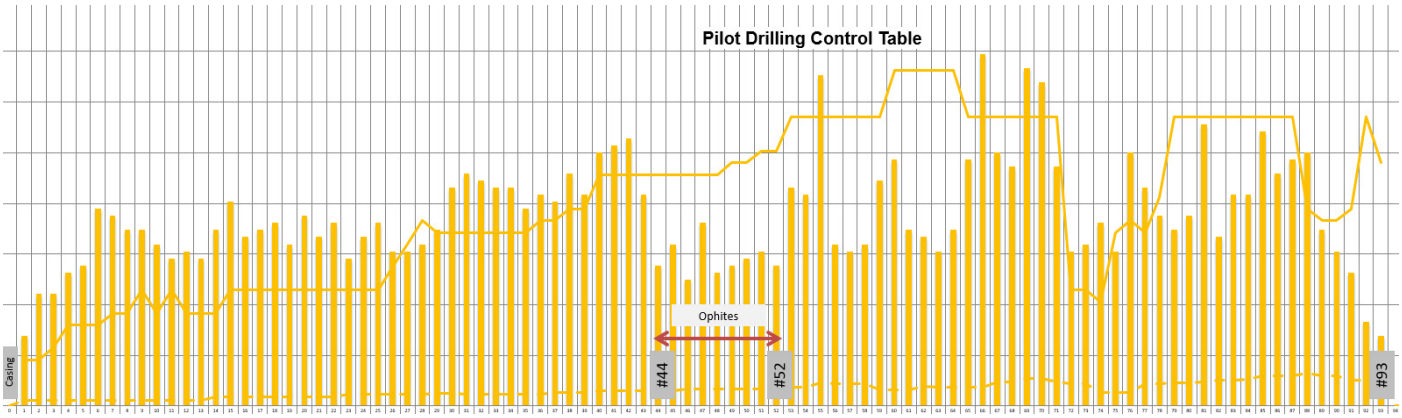
The execution of the landfall started in January 2015, preparing the platforms and immediately proceeding with the set-up of the HHD equipment.

The first 12m Start-Casing was excavated and placed, to ensure the stability of the first few metres of the borehole and the road to be drilled underneath.

The drilling work was carried out using the Paratrack II Navigation system, combining both the surface ring and the Beacon Tracker to guide the head to the exit point. Borehole enlarging work was then carried out using push reaming to reduce marine work and increase fluid return onshore.

The ophite area was drilled without further complications. The planned position in the investigation was between MD410 and MD430. During the pilot drilling phase, this section was reached down between MD422 (#44) and MD499 (#52), as it was undetected in the boreholes and was sensed in the electrical tomography model. (The borehole indicated in the ophite section is projected information).





As can be seen in the graph above, the last 20m of drilling was very soft, and it was necessary to consider this when deciding on the operations to be carried out.

Drilling continued with the Ø508mm [20“] and 711mm [28“] reaming to reach the final planned size of 1,066mm [42“]. The reaming work to 1,066mm was executed on push reaming as planned, with a break of a drill pipe string at position #36 (MD 345m). The recovery of the drilling tool by means of the Overshoot 150 Series fishing tool was quick, and the reaming of the HDD continued. During the progress of the last reaming on rod #55 (MD 549.7m), it was decided to withdraw the reamer and finish the last 373m of drilling by pulling the tool from seaside to landside due to progressively increasing of torque values.

So, the drill string was run from land to sea, and a new 1016mm [40“] reamer was mounted on the exit side, and the reaming of the last few metres was started. Drilling progressed smoothly, unfortunately at 34.92m (MD 584.01) to reach the 1066mm [42”] section a drill shaft failure changed the normal course of the project.

A complex situation for the project, with a 549m section reamed at 42“ from the ground, an intermediate section of 34.92m with a reaming diameter of 28“, and a 40“ drill bit, with a broken shaft, stopped at 584.01m.
Given the state of progress of the project, it was decided to organise a phased rescue plan to recover the reamer from the ground:

- Verification of the reamer position and exact position inside the tunnel.
- Mobility check for subsequent fishing design.
- Push reaming of the soil section up to the reamer in such a way as to allow its recovery.
- Design and manufacture of the fishing tool for reamer recovery
- Fishing and recover of the 1.016mm [40“] reamer.

At this point in the project, an engineering team dedicated an in-shop fabrication line to provide material and accelerate the recovery work.
The duration of the recovery work was as follows:

Duration [Days].	Work carried out on site	Engineering works
3 days	To reach the point and ream from the ground to the point of the drill tool (without contact)	Options analysis and operations to follow
9 days	Position test and verification of lost tool mobility	Designing the necessary tools for recovery
4 days	Standby to finish the manufacturing of the final reaming and fishing tool.	Manufacturing support
8 days	Reaming out the section where the drill bit was and fishing it out.	Monitoring of field operations

The duration of the rescue operation lasted a total of 17 days with 4 days of standby.

As can be seen in the picture, once the recovery of the tool was finished, a new surprise appeared, the rear axle had also broken, and it was inside the tunnel.
This second fishing was extremely simple, in comparison to the previous one and once the first had been achieved, it was only needed to enter with a gasket to pick up the lost section of shaft inside the hole and pull it out on the seaward side.
Once the reamer and the shaft removed, drilling continued by cleaning the tunnel and organising the pipe launching.
The pipe welding area was prepared and carried out on the breakwater in the port of Bermeo itself, a flat area with sufficient length for the preparation of the pipe. From this breakwater, the pipe was launched into the sea so that it could be towed, connected and installed in the borehole.

Conclusions

The execution of the drilling:

Drilling Phase	Duration [Days].	Working shifts
Implementation	10	Double shift
Initial casing	5	Double shift
Pilot hole - 10 5/8“ - 10 5/8	9	Double shift
Extension 1 - 20	14	Double shift
Widening 2 - 28	10	Double shift
Widening 3 - 42	19	Double shift
Rescue work	20	Single & Double shift
Pipe installation - 28	2	Double shift
Demobilisation	7	Double shift

- The rescue represented an increase of 20% over the planned execution time.
- The ability to have an engineering and manufacturing team available immediately after reamer failure dedicated to the preparation of specific tools was vital to stay within a reasonable time frame.
- The learnings acquired during the rescue and afterwards, allows us nowadays to make sound decisions in the design of new projects, especially landfalls.

When it comes to drilling, you should always expect the unexpected, although with a committed team, it‘s possible to overcome challenging situations.