Smet Group

# Project microtunnelling Easington (UK) Langeled outfall

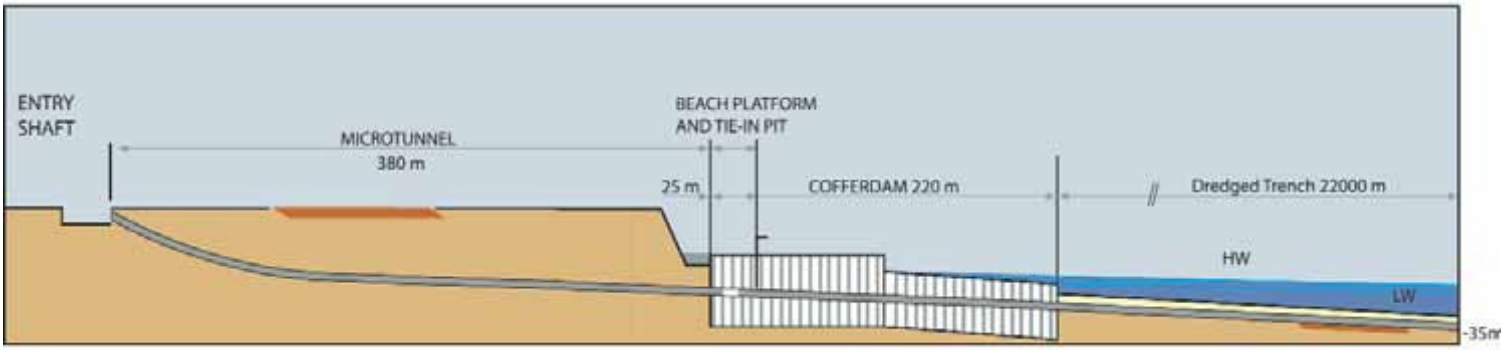
**Client:** Statoil
**Main contractor:** Jan De Nul
**Machine: AVN**
**ID-OD:** 2.100 - 2.410 mm
**Length:** 381 m
**Excecution:** 2005



**Preparations for the landfall of the world's longest offshore pipeline are well advanced at Easington on the East Coast of the UK. Hydro's 1200 km 44 in. diameter Langeled pipeline from Nyhamna in Norway is scheduled to be pulled ashore this month and will begin providing up to 20% of the UK's gas requirement from October 2006. Statoil ASA are executing the work on behalf of Hydro and Jan De Nul (UK) Ltd are the principal contractor for the landfall works. The European Dredging Company (EDC) is responsible for the offshore dredging and stone dumping, while pipeline engineering is being carried out by Snamprogetti.**

The installation of pipelines from offshore through shallow water to a beach always poses challenges, but the rapidly eroding clay cliffs along this section of the UK coastline makes the Langeled a special case. Each year around 1 to 2 m of cliff disappears into the seas. This has been going on for thousands of years, removing numerous villages from the map. In Roman times the coast was 3 miles further offshore. Protecting the Langeled landfall section of pipeline from this erosion called for extra measures. Another challenge at Easington is the presence of several marine pipelines making landfall along the beach and land pipelines that feed gas from the terminals into the UK transmission grid.

Engineering studies of the erosion required that the pipeline be installed deep within the cliff. With minimum environmental impact being a prerequisite, open excavation was not an option. The solution was to install a tunnel to carry the pipeline from the new gas terminal sited 380 m safely inshore of the eroding cliff, to a tie-in pit on the beach passing under existing pipelines, roads and other land features. A sheet piled cofferdam extends the pipeline trench from the tie-in pit through the tidal zone of the beach to 60 m beyond the low water level. Another option that was considered but rejected included extending the tunnel offshore so the pipeline could be pulled directly from the laybarge. However, the combined risk of constructing a longer tunnel with the marine challenges was considered to be unacceptable. To ensure there would be no delay, both the tunnelling and cofferdam were scheduled to be completed in advance of the laybarge arrival.

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Work started in the Autumn of 2004 with the clearance of the site and the installation of the tunnel shafts. The tunnel, with a 2.4 m outside diameter, was installed by Smet-Tunnelling nv using a tunnel boring machine (TBM) affectionately called 'Amy'. 2.5 m long concrete pipes were lowered into the entry shaft where powerful jacks pushed the pipes and the TBM forward to form the tunnel. The TBM was able to steer its way and a vertical curved alignment was followed that avoided the need for a deep entry shaft. The soil conditions were stiff day with occasional boulders. The forward face of the TBM's earth balanced shield was set up with picks and water jets to cut the clay and cutting discs to break up the boulders. Seawater was pumped down to the face of the TBM that flushed out the spoil as a slurry, which was collected in purpose built settlement lagoons. The clay and crushed rock was removed from the seawater by a combination of natural settlement and flocculents, the remaining water was returned to the sea with less than 5 g/L of sediment. The settled clay was treated with a centrifuge and reused at the beach site while the remaining slurry was transported to licensed landfill sites. Jan De Nul's environmental branch company, Envisan, was subcontracted to design, build and operate the tunnel spoil treatment plant.

On completing the installation of the 380 m long tunnel, a 60 m long, 6 " ramp with a rail track was constructed from the terminal end leading into the tunnel. At the far end of the tunnel a winch system was set up in the tie-in pit on the beach. Four 12.2 m long pipe sections could be positioned on the ramp and with a cycle time of 24 hours for the welding, non-destructive testing and coating, the pipeline was progressively pulled into the tunnel. A rubber neoprene coating was specified for this section of the pipeline to give added corrosion protection in the tunnel, polyurethane collars were factory fitted to the pipeline to protect the coating as the pipeline was pulled through the tunnel. The landfall scope of work also included a section of trenched pipeline that extends approximately 300 m from the tunnel into the main terminal. The pipeline works were sub-contracted to Visser & Smit Hanab (UK) Ltd.

With the tunnel activities progressing, a separate team formed an access from the cliff top to the beach where a platform was established to give a safe working area above the high tide level. Within this platform the 13 m deep tie-in pit was sheet piled ready for the arrival of the TBM. Extending 220 m from the beach platform a sheet piled cofferdam was installed by land based equipment working at low tides from a causeway constructed alongside the cofferdam.

Beyond the cofferdam the pipeline trench is being formed by dredging and, in fitting with the size of the project, the world's largest and most powerful cutter suction dredger 'JFJ De Nul' is carrying out the work. The 27 240 kW 'JFJ De Nul' is capable of excavating the trench even in very hard clay with boulders in weeks rather than months, contributing to a lower environmental impact of the project. The 'JFJ De Nul' will be connected to a 500 m long floating hose that will deposit the soil to one side of the trench to be used later for backfilling. To stabilise and protect the nearshore pipeline the trench will be extended 22 km offshore from the cofferdam. For the first kilometre, gravel will be placed by a side stone dump vessel to provide added stability and to protect against low temperatures. Gravel will also be placed in the cofferdam section of the pipeline trench. The marine trench will be backfilled with the dredged clay from the stockpile using the 'JFJ De Nul' for the first 1.5 km and the 11 300 $m^3$ capacity


trailer suction hopper dredger 'Filippo Brunelleschi' for the remaining trench. The 'Filippo Brunelleschi' will also be used offshore to level sand waves to prepare the seabed in order for the pipeline to be installed within allowable stresses and free-spans.

The works are being executed in between two existing live pipelines, one of which has to be crossed approxi-mately 6 km from the beach. At the crossing mattresses will be installed to separate the pipelines and following the laying of the Langeled pipeline, rock will be placed to pro-vide protection.

The 15 km near shore section of the landfall pipeline will be installed by Allseas laybarge 'Tog Mor', this vessel will enter the floatation channel prepared by the 'JFJ De Nul' and anchor at the end of the cofferdam. A 500 t winch will be set up behind the beach platform and the pipeline will be pulled from the 'Tog Mor' along the cofferdam and into the tie-in pit. A seal will be made around the pipeline at the entrance to the tie-in pit so it can be pumped dry and the onshore pipeline can be tied into the offshore pipeline. Following the tie-in the tunnel will be grouted to seal the pipeline.

Unlike other forms of engineering projects where the finished product can be proudly shown to friends and colleagues, once the Langeled site has been reinstated there will no visible presence and no environmental impact to the shoreline of the landfall that will safely feed the UK with energy.

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