

# LMR Drilling UK Ltd.

**"Nobody Does It Better!!!"**



## Meary Veg Rock Outfall, Isle of Man



Drill Rig Site at Meary Veg

### Introduction

European leaders in Horizontal Directional Drilling, LMR Drilling UK Ltd., have recently completed works surrounding the installation of 400 metres of an 800 mm medium density polyethylene SDR 17.6 outfall pipe in hard rock and the installation of a 28 m long, 8-port diffuser on the seabed. This challenging work was concluded with great satisfaction to all concerned.

### Project Brief

Charles Brand, a Northern Ireland based construction company, were awarded the contract on behalf of the Isle of Man Government to construct a new waste water treatment plant on the east side of the Isle of Man, approximately 10 miles south of Douglas. This new plant required an outfall to be constructed through this stunning, environmentally sensitive coastline. Due to the difficult topography, conventional trenching was going to be extremely difficult and destructive, and Horizontal Directional Drilling (HDD) seemed the only viable option. Due to the reputation of LMR Drilling UK Ltd. in terms of drilling rock outfalls, they were the ideal choice for Charles Brand.

Within the scope of work of the Contract, it was necessary for LMR to not only drill the outfall and install the pipe, but to carry out the marine

engineering works required to install a diffuser securely on the seabed and attached to the end of the pipe. This was carried out from a work barge with a team of professional divers.

### Geology

The rocks along this stretch of coastline are strongly folded and, geologically speaking, are termed pelites and psammities. These are basically metamorphosed mudstones and silt/sandstones respectively. Psammities by definition are quartz rich, and, as such, are generally extremely hard and abrasive. Indeed, the uni-axial compressive strength of the rock was estimated to be upwards of 80 MPa. Due to the nature of the rock and the large hole size that needed to be created for the 800 mm pipe, the project was highly challenging.

### Drilling Engineering

Taking into account the above geological considerations and a designed drilled length of 390 metres, it was decided the drilling and hole opening should be done in four stages, these being 17½", 26", 34" and 40" diameter. The rig to be used was LMR's 100 Tonne drilling rig, which is capable of producing 130 Tonnes

pull/push force and a torque of 120 kNm (88,500 ft lbs).

### Pilot Hole

The pilot hole was drilled with a 17½” tungsten-carbide insert (TCI) tri-cone bit and a 9½” mud motor. Although these are unconventional sizes to use in HDD generally, LMR have used them with great effect for the drilling of previous rock outfalls. Also, due to the necessity for more heavily engineered drilling equipment, heavy-weight drill pipe was used.

Drill bit guidance for the pilot hole was enhanced by using the Tru-Tracker magnetic survey system. Due to this drill being an outfall, the surface coil could only be placed overland to the edge of the cliff. This meant that towards the end of the drill, the surveyor had to “drill blind” based on information gathered prior to going out under the sea.



**Pilot Drilling**

Drilling continued until the bit was out of the rock and onto the seabed.

The typical rate of penetration (ROP) for the pilot hole was 6 metres per hour.

### Hole Opening

After the pilot hole was completed, to avoid losses of bentonite drilling fluid during the hole opening process, a “soft plug” was created at the end of the hole. This was done by pumping granules of an environmentally safe swelling polymer and then following this up with a cement pill. This had the obvious advantage that it would be drilled out easily at a later date, as well as having significant engineering and environmental benefits during the subsequent hole opening operations.

Due to the hard abrasive nature of the rocks encountered during the pilot hole, high torque hole openers fitted with TCI cones had to be used during the hole opening operations. These cones were originally designed for use on tri-cone rock

bits, but were modified for use with hole openers and were mounted to ream the appropriate diameter of hole.

Conventional hole opening involves pulling the hole opener from the exit point towards the drill rig. However, to enable the exit end of the hole to remain sealed, this was impossible. Therefore, each hole opener was pushed and rotated from the drill rig, thus opening the hole up from the entry point downwards. This technique was essential to minimise both environmental impact and engineering risk.

As with the pilot hole, an extended bentonite drilling fluid was pumped to clean out the drilled cuttings. As the soft plug was placed at the end of the hole, fluid returns, complete with cuttings, were directed toward the rig



**Hole Opener Assembly**

site and this reduces overall mud costs and allows site management to gauge the hole cleaning efficiency. The first hole opener created a 26” diameter hole. A 17½” bit was placed in front of the hole opener to act as a centraliser and to clean the original pilot hole. During the 26” hole opening, the typical ROP was 4.5 metres per hour. To prevent mud losses at the end of the 26” ream, the hole opener was pulled back to the rig when it was 20 metres from punching out on to the seabed, at approximately 370 metres from the entry point. This gave the advantage of keeping bentonite returns and thus maintaining the hole’s integrity during subsequent hole opening passes.

The next diameter of hole created was 34”. The assembly used for this consisted of a 34” hole opener, a 25” centraliser and a bullnose. The typical ROP for this ream was 3 metres per hour and was pulled back to the rig 25 metres from the seabed, at approximately 365 metres from the entry point.

The final hole opening reamed a hole to a diameter of 40”. It was deemed that this size was sufficient to install the product pipe. The assembly used for this consisted of a 40” hole

opener, a 33" centraliser and a bullnose. The typical ROP for this ream was 2 metres per hour and was pulled back to the rig 30 metres from the seabed, at approximately 360 metres from the entry point.



**Hole Opener Commencing Run**

To ream the final section of the hole out on to the seabed, the hole opening assemblies mentioned were again used in turn to punch out individually. After the 26" hole opener had punched out on to the seabed, all of the bentonite mud down to sea level, drained away. From this point on, the reaming was carried out with a high volume of fresh water with occasional high viscosity bentonite sweeps. This method ensured that the final section of the hole would be cleaned out whilst ensuring that a minimum amount of bentonite would be pumped out to sea so as to minimise the environmental impact on the coastline.

Once the final ream had been completed, the hole opener was left at the end of the hole to aid in the location of the exit point by the team of divers.



**Diver to Locate Exit Point**

the barge dug down through the sediment to the rockhead, and once the debris had been cleared

from around the exit hole, the hole opener was pulled back to surface.

### **Pullback Procedure**

As this drilling was for an outfall which exited on the seabed, the product pipe which was welded on land had to be pulled in from the sea. The pipe was therefore strung out behind the rig and a steel pulling head was welded on the seaward end and a flange welded to the other. Bolted to the flange was a blank plate with a pulling eye and a 4" valve to control the buoyancy. From this point onward, the pipe installation was dependent upon the weather.

Prior to launching the pipe, the 34" hole opener and pad-eye sub were run back to the seabed, and a 100 Tonne swivel attached by the divers. Once the weather was suitable, the pipe was launched into the sea. In support of the barge, a tug, two work boats and a multi-cat were mobilised and it was these vessels that had the task of pulling the pipe to sea, towing it to the appropriate location, then keeping it in line ready for the pullback. The 4" valve was kept closed during this operation to maintain positive buoyancy of the product pipe, and the rear pulling eye was attached to an on land winch to control the pipe as it went over the edge of the cliff. Once the pipe had been correctly positioned and the pulling head brought to the barge, the swivel was attached behind the pullback assembly on the seabed.



**Launching Pipe**

Just prior to pullback, slots in the product pipe behind the pulling head and the 4" valve on the back end of the pipe were opened. This allowed water to flow into the pipe and reduce its buoyancy during the pullback.

### **Post Pullback Marine Operation**

Following pullback completion, a concrete mattress was placed on the seabed over the end



**Marine Spread**

of the pipe, securing it while further excavation was undertaken. Again, this was executed using the barge and the team of divers. Once excavation was completed, the pre-fabricated diffuser sections, with weight collars assembled in position, were lowered to the seabed, then aligned and bolted to the end of the outfall pipe. On completion of the diffuser attachment, the area surrounding the end of the pipe and diffuser was backfilled to provide further ballast and protection.



**Lowering Diffuser to Seabed**



**Concrete Mattresses Loaded for Placement over Pipe**

## **Summary**

With the coastline left untouched, the work was completed within the programmed timescale and all parties were satisfied with the achievement. As well as showing that drilling in hard rock environments can be testing, this work on the Isle of Man highlighted that innovative solutions to unique situations can not only reduce cost, it can minimise environmental impact within the locale.

Although the geology and the required scope of work increased the complexity of this drill and pipe installation, LMR Drilling UK Ltd. have proved that, with careful planning and the right kind of engineering knowledge, even the most challenging of situations can be overcome.