Subsea trenching – more than just spade work

Global Marine Systems Limited has a strong track record in the installation of subsea cables that dates back to 1850. Since then, the company has installed more than 300,000 km of cable – approximately 23% of the world’s total. We take a look at the technology and the techniques behind the process.

The installing of subsea power cables has been a core business activity since the late 1980s. Indeed, Global Marine’s capability is diverse, installing fibre optic, power (from HVDC to HVAC requirements) and composite cables, in both very shallow water depths (less than 10m) through to very deep (over 6000 m).

Clearly, one of the key capabilities with installing any cable is trenching, primarily to ensure protection from the dangers posed by the sea bed terrain itself in certain areas, as well as trawlers, anchors, icebergs or any large objects, such as shipping containers that occasionally fall from vessels. Typically, trenching is performed by ploughing, jetting or cutting the seabed material, and can take place pre- or post-cable laying.

Ploughing forward

The trenching technique of ploughing is a good, general purpose method, as it’s suited to a wide variety of soil types found on the seabed, including granular, sand, clays and fractured rock. As a technique, it can produce deep trenches with high quality, straight walls in a single pass. Furthermore, high speeds are possible in softer seabed types, thus reducing the time and costs incurred.

Global Marine can offer the latest in ploughing technologies, operating to depths of circa 2000m. Each rugged and reliable Hi Plough, as they are known, offers 500 kW of forward and under-head jetting power to reduce active tow tensions. In addition, they can be fitted with a rock ripping tool, as well as a 2m plough share or a 3.25m injector share. Of course, there may be some applications where ploughing is not suitable. For example, the large size of Hi Ploughs means launches can be complex, while there are also some deep water limitations. In such situations, jetting is an extremely viable and cost effective alternative, typically using Remotely Operated Vehicles (ROVs).

The jet set

ROV jet trenching are self-propelled, mobile devices that are easily deployed, deep water capable and particularly suited to granular type seabed materials. Global Marine has dedicated cable trenchers to provide such services, including the company’s Atlas 1 and Atlas 2 ROVs for cable maintenance, post lay and inspection roles; and its ST200 free-swimming ROVs – the benchmark for modern cable working ROVs – which are depth rated to 2,500m with a 1m burial tool.

Multi-purpose ROV jetting trenchers, however, are an increasingly popular option for the power cable market. At Global Marine, these include the XT601 and Excalibur, as well as the recently acquired SMD Q1000. The major advantage of devices, such as the Q1000, is that they are designed for both pre- and post-lay trenching, as well as simultaneous cable lay and burial. With 1000 hp of total installed and variable jetting power, the Q1000 ROV can be easily mobilised on to vessels, and is suitable for trenching cables of up to 508 mm (20”) in diameter to a burial depth of 3m at speeds of up to 400 metres per hour. Moreover, jet flow can be optimised to meet the numerous variables that maybe encountered during trenching operations, while a range of eductors (jetting swords) for trench clearance are easily interchangeable with backfill tools. The principal jetting tool is a twin leg implement of adjustable width. Jet leg lengths of 1, 2 and 3m are available, and can be deployed as stand-alone devices or in conjunction with eductor or rear backwash capability in both cohesive and non-cohesive seabed materials.

The rear mounted eductors are designed primarily for use in conjunction with 2m jet legs to lift and discharge spoil beyond the trench footprint in cohesive seabed soils, thus leaving an open trench. When deployed in non-cohesive soils, the discharged spoil from the eductors serves to extend the envelopule of the fluidised material and aid the lowering of the product into the trench as it is cut.

Versatile performer

Operationally rated to a depth of 1000m, the Q1000 is easily configured for use with either tracks or skids to suit the application and can be deployed for trenching operations in all seabed conditions, from fine sand to firm clay. Its state-of-the-art cable detection and tracking system results in time-saving, precision burial for the customer.

Furthermore, the Q1000’s high specification enables the submersible to operate in extreme environments and in challenging weather conditions. For this purpose, it offers heavy latch beam LARS (launch and recovery systems) designed for Sea State 6.

The Q1000 was acquired by Global Marine in May 2015 and the ROV has an impressive track record in the power cable market. For instance, in 2012, it completed remedial operations for Centrica at the Lincs Wind Farm in the North Sea.

More recently it has completed 10.6 km of trenching (to 0.6 m depth) and backfill operations in the Dutch sector of the North Sea. Here, the seabed ranged from clay to fine silts to fragmented shell. Jet legs of 2m length were deployed to create a 500mm wide trench in a single pass at speeds of 250 to 350 metres per hour.

A further notable project saw the Q1000 produce 30.5km of trenching (to 0.6 m depth) and backfill (in 120 m water depth) at Norge Bøyla, 225km west of Stavanger, Norway. The seabed at this location proved extremely variable, including soft, stiff, hard and gravelly clay, from loose granular to dense. The trench was produced in a single pass at speeds ranging from 50 to 350 metres per hour.

There are conditions where jetting may not be suitable, including those where there are exceptionally strong currents, or where seabed materials are encountered such as clays above 100 Kpa, or cemented materials.

At the cutting edge

For hard seabed materials, self-propelled mechanical cutters are the favoured option. Such devices can produce slot or V-type trenches, depending on whether cable protection or stability is the main priority. They typically deploy chain, claw or scoop type slot cutters to mechanically remove spoil, and can be used in both shallow and deep water for post-lay or simultaneous operations.

Of course, the trenching of more demanding seabed terrain brings certain additional factors into play. For instance, extended deck space will be required to accommodate a mechanical trencher. Also, due to equipment complexity, such devices are typically more expensive to maintain. A large turning circle is also required if a mechanical trencher is to be deployed successfully.

In general, asset selection comes down to the specific properties of seabed material, such as the shear strength of clays and relative density of sands. Experts at Global Marine use geophysical and geotechnical analyses that help select the optimum asset – plough, jetter or mechanical cutter. Vessels also play a key part in any subsea power cable project. Global Marine has an extensive fleet, including the CS Sovereign, which has a pair of 2,300 ton powered turntables installed below deck to ensure the company is prepared for almost any challenge.

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The Q1000 Jet Trenching ROV embodies the latest technologies in jet trenching and ROV design and is the latest addition to Global Marine’s extensive subsea equipment fleet.

About the company

Global Marine Systems Limited is a leading provider of engineering and underwater services, responding to the subsea cable installation, maintenance and burial requirements of its customers around the world.

With a fleet of vessels and specialised subsea trenching and burial equipment, the company has a 165-year legacy in deep and shallow water cable operations. Global Marine’s primary markets are oil & gas, renewable energy & power, telecommunications and deep sea research.

Global Marine holds the RoSPA Order of Distinction in recognition of 16 consecutive years of outstanding occupational health and safety results.

Key facts

• Global Marine has installed enough cable to circumnavigate the globe 7.5 times.
• C.S. Sovereign, the multi-role DPS-2 vessel, has an exemplary track record working in wind farms and has installed in excess of 20% of all inter array cables globally.