

# BAUER Offshore Drilling Technologies



### BAUER Group

The BAUER Group is an international construction and machinery manufacturing concern based in Schrobenhausen, Bavaria, Germany. The stock-market listed holding company BAUER Aktiengesellschaft is the parent of more than 110 subsidiary businesses in the fields of construction, equipment and resources. Bauer is a leader in the execution of complex excavation pits, foundations and vertical seals, as well as in the development and manufacture of related rigs and equipment for this dynamic market. The Group also deploys its expertise in the exploration, mining and safe-guarding of valuable natural resources.

The operations of the BAUER Group are divided into three future-oriented segments with high synergy potential: Construction, Equipment and Resources. BAUER Spezialtiefbau GmbH is the construction segment and concentrates mainly on the execution of complex specialist foundation works in difficult soil and can present the best references worldwide.

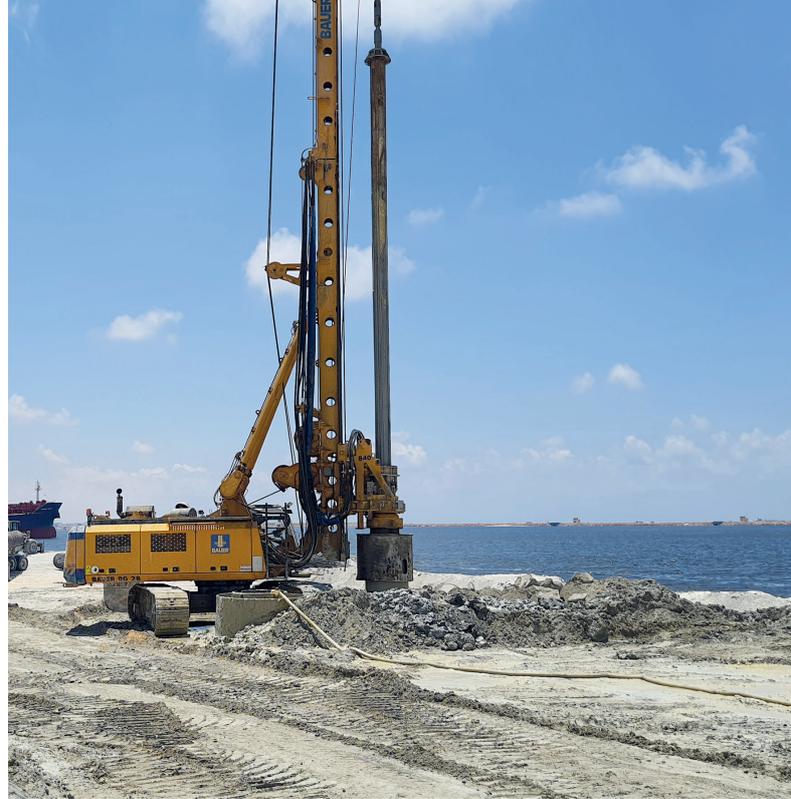
The global industrial drive for clean energy is in the midst of uncovering and tapping into the huge potential for generating renewable energy via wind, wave and tidal devices, being installed around the world oceans. Fresh challenges to tackle, with legislation that never sleeps mean we must look to new ways for improving operations that make everything safer, faster and more efficient than before. No mean feat onshore, but it takes extraordinary vision, patience and commitment to do this in a revolutionary way offshore. To meet this challenge, Bauer has designed and is now offering a range of remotely controlled drilling equipment solutions, operated by Bauer, focusing on safety and operational excellence.

### BAUER Offshore Technologies GmbH

The offshore arm of the BAUER Group located in Schrobenhausen, Germany, that design, manufacture & operate bespoke subsea pile drilling & grouting solutions to the global offshore renewable and oil & gas sectors.



Bauer Dive Drill Seabed Drilling Rig



Bauer BG Rig drilling on location

### BAUER Renewables Ltd.

The BAUER group's UK offshore foundations division is located in Dundee, Scotland. BRL's business is the installation of drilled foundation piles for offshore wind turbines and tidal energy devices.

Key equipment includes the Bauer Dive Drill and BSD 3000 Seabed Drilling equipment which deliver easy and cost effective installation of piles. The revolutionary equipment saves time by drilling & grouting jacket piles simultaneously in all soils & hard rock utilising recoverable casing - eliminating borehole collapse and mitigating project risk. The subsea drilling and grouting equipment operates in aggressive combinations of deep waters and strong currents (12 knots). System scalability allows reduced vessel size for FOW & other mooring pin pile applications. Controlled via flexible umbilicals the system operates from both fixed & floating vessels.

The safety and health of our employees is our priority. The standards and guidelines for HSE – Health, Safety and Environment – are core elements of our business activities and apply equally for the entire BAUER Group.



**health | safety**  
**environment**

# Bauer Offshore Drilling Systems

safe, environmentally friendly and economical

## Safety

Drilling and where applicable, grouting operations are directed and performed from modular control cabins located on the vessel deck. These cabins incorporate the newest technology, ideas, and features in order to ensure that no work is performed from external drilling platforms or piling gates overboard the vessel. Bauer seabed drilling rigs are connected to the vessel via umbilicals which recover all drill spoil and connect controls, signals and power between the control units and seabed drills. This removes entirely all rigid links from vessel to seabed, removing risk to personnel (manual handling of drill strings/kelly extensions) while speeding up operations. This allows for a considerably safer offshore workplace and environment.



© Fotolia

## Underwater Noise

Bauer's Seabed Drilling Systems keep noise levels below that which can be detrimental to marine mammals and aquatic species. For example, our BSD 3000 drilling equipment produces less noise than the thrusters of a standard offshore construction vessel. And within as little as 300 m, the equipment generates noise drops below general background levels, which falls safely below even the newest European limits.

## Economics

The Bauer Seabed Drilling Systems are economical and versatile:

- Operate from any vessel with suitable deck space and crane capacity.
- Ideal for pre-piling for jacket structures, so that the foundations can be installed independently and in advance of the other work steps.
- Capable of running multiple drilling rigs simultaneously

- Can work in very difficult environmental conditions, such as strong currents, deep water and difficult sea states. Usually, it is the vessel that reaches its limits long before our equipment its operating threshold.

We work closely with project EPCI Contractors/vessel operators to develop the fastest possible LaR (Launch and Recovery) methodology for each project, in order to speed up installation and drive down the serial cost of installation.



Deployed Bauer Dive Drill's. © Picture courtesy of Van Oord

# Subsea Drilling and Grouting

'Uncased' in 'Rock'

## Typical Applications:

### Tidal, Wave & Floating Wind Moorings Equipment: BAUER BSD 3000

Tidal stream devices, Re-arranged which utilise currents, are broadly similar to submerged wind turbines and are used to transform kinetic energy in tidal currents into electrical energy. Due to water having higher density than air, the the turbine blades can be smaller and turn more slowly, but deliver a very significant amount of power.

The BAUER's BSD 3000 Seabed Drilling Rig (left) installs grouted monopiles or pin piles for Tidal current devices into the seabed using fast and safe procedures to de-risk projects in competent rock seabed.

Wave devices use different technology and can be tethered to the seabed in a number of ways. For bottom fixed generators, Bauer can offer fixings similar to those for Tidal arrays. However, other solutions are available especially when we consider that the geology will not be rock all the way, but layers of sand, cobbles, clay and rock of varying hardness. We now change over to a 'Cased' solution to prevent the collapse of the drilled socket. This provides a completely safe way to install a grouted pile in any combination of soils and even very hard rock.



Rock Drilling Uncased with a Template



Seabed Template lowering to seabed

# Tidal Energy



*BAUER BSD 3000 Seabed Drilling Rig Head*

Interaction of the gravitational forces of the sun and the moon causes water levels of the oceans to rise and fall. In places with favorable geomorphologic conditions like natural inlets or narrows, then changes in the water levels can result in rather substantial water flow, caused by strong currents. It is these currents which can be used to generate electricity via energy convertors or tidal turbines. Tidal currents and therefore the energy produced from tidal currents can be predicted with precision, as opposed to energy produced from wind and waves. This makes tidal energy therefore very attractive to utility companies.

Tidal energy is perhaps one of the greenest energy sources available:

- It is from a renewable source
- Environment-friendly
- Predictable and reliable
- Effective at low current speeds
- Low/negligible visual impact

Why has this not been done before now? The answer is simply that the installation of drilled foundation piles for tidal turbines is the most challenging task in offshore construction. The environmental conditions with very strong currents and rocky seabed are unique; working on such a site is extremely difficult, especially using traditional Top Drive equipment, with rigid connections between vessel and seabed. Therefore, Bauer developed our seabed drilling technology, such that the surface connections are via flexible hose and not rigid. Our BSD 3000 Seabed Drill is designed specifically for safe, fast and economic installation of steel pile foundations in deep, fast flowing water and is able to work from any appropriate vessel with sufficient deck space and crane capacity.

The BAUER BSD 3000 was designed and developed for the specific application of drilling ‘uncased’ through competent rock.



*Seabed Drilling Template © Renewable UK*

# BAUER BSD 3000

The BAUER BSD 3000 is a reverse circulation drilling system with a full face weighted roller-bit drilling head. The rig is launched and positioned on the seabed by the vessel crane into the pre-installed subsea template. Remote control is via Bauer's modular control cabins, positioned on deck. All functions of drilling and monitoring/positioning of pile installation/grouting are performed remotely, with power and signals attached by flexible umbilical, in the same way as a ROV. Subsequent drilling spoil and cuttings are transported to the seabed by airlift. All main functions are monitored through cameras and proximity sensors when visibility is poor. The drilling rig and umbilicals are specifically designed to withstand the huge forces and fatigue caused by exceptional seabed currents and surface waves. The umbilical handling system has to compensate for the unavoidable movements of even the most capable DP vessels and must also ensure that in an emergency all umbilicals can be detached safely and all hoses having failsafe close functionality. All critical parts of the drilling template are designed, constructed and tested by Bauer.

The actual drilling template consists of three main components:

1. The drilling template with legs including leveling system and weight plates and the centerpiece with casing clamp and oscillator.
2. The conductor pipe with drilling shoe and internal brackets and plates to support the drill unit.
3. The drill unit with rotary drive – the climbing mechanism, drill pipe, heavyweights and full-face roller bit – for drilling hard rock.

The following additional components were also utilized for



*BAUER BSD 3000 Seabed Drilling Rig operating the drilling template:*

4. The umbilicals for supplying the template, drilling unit and monopile with hydraulics, air, grout, electricity and electrical signals.
5. The umbilical handling system with quick release mechanism and mooring winches.
6. The command cabin with power unit and signals to the seabed drill.
7. Deck storage frame for conductor casing and drill unit.



*Mobilisation of Seabed Drilling Equipment*

# Relief Drilling

## for 3D (Drive-Drill-Drive) piling

**Typical Applications: Offshore Wind + O&G Platforms, FPSO Moorings – Equipment: BAUER Dive Drill ‘DDC 40’**  
Offshore wind turbines in deeper water with more than 10 MW will most likely be founded on jacket structures. The jackets are fixed to the seabed with pin piles.

Bauer offers seabed drilling solutions for pin piles installed from either floating or fixed offshore vessels. In softer seabed soils, pile driving is the most common way.

Where soils are more challenging, piles are driven to first ‘refusal’ and then have the inside of the pile drilled out to reduce ‘set’ friction and/or blockages at the pile toe which were preventing further progress. This is a common technique used in more demanding soils particularly where ‘Driving Analysis’ has already predicted that driving of piles alone has its limits and may not always be enough.

Bauer offers a new drilling technique that can operate from any construction vessel and reduce the serial cost of installation on projects with multiple foundations, such as OWF arrays. The launch and recovery process is also much faster than with conventional top drills.

Bauer has developed the DD C 40 Dive Drill, which is inserted directly into the casing using the vessel crane. It is controlled via umbilicals and needs no solid drill string connection between vessel and pile. It is quickly lifted into the ‘set’ pile where it clamps itself into place and drills out necessary soil and rock material within the pile and in front of the pile toe.

Upon completion, it is swiftly recovered by the crane, by simply retracting the drill clamps inside the pile. There are no ‘kelly’ extensions to dismantle/re-connect and the vessel only has to maintain a reasonable degree of positioning because of the flexible nature of our umbilical connections.

The Bauer Dive Drill offers distinct advantages in relation to conventional top drills:

- It can be installed directly into the casing when hitting refusal, regardless whether the top of the casing is above or below the water table.
- The switch from pile driving to relief drilling can be accomplished within a very short time period.
- On jacket foundations, pile driving can continue on an adjacent pile, while our DD C 40 simultaneously works on the neighboring pile
- The DD C 40 comes with a range of drilling heads which can drill soil and rock combinations.
- The whole drilling process is much faster than conventional reverse circulation drilling.

To provide flexibility, the DD C 40 can be mounted on its own ‘launch & recovery’ platform – including power packs. Relief drilling operations are now completely independent and leaves the vessel crane free for all other activities, including pile driving.



BAUER Dive Drill DDC 40 & Skid. © Picture courtesy of Seaway 7

# Subsea Drilling and Grouting

## Cased with Under-Reaming - Grouted Steel Pile Installation

**Typical Applications: Foundations for Offshore Wind Jackets, Floating Moorings & O&G Installations**

**Equipment: BAUER Dive Drill 'DDCU 40'**

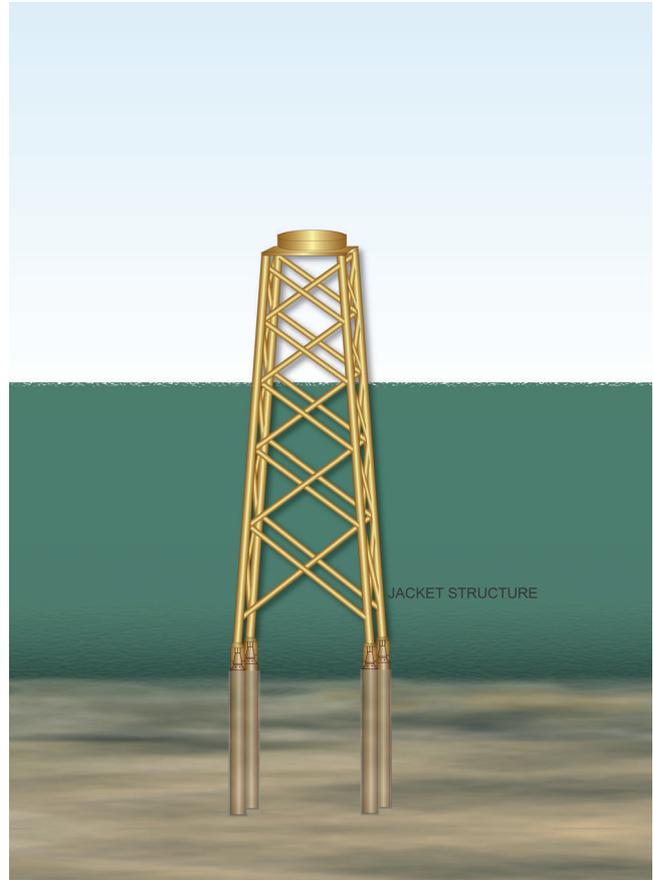
As jacket foundations steadily increases in market share, it brings the challenge of working through deeper water and into stronger soils and rock.

This increased rock to soil ratio means a transition away from 3D pile installation, towards drilled and grouted installation of foundation piles.

There are two keyways in which to drill rock sockets – 'Uncased' and 'Cased'.

Traditional offshore drilled and grouted techniques for steel piles have centered around technology that drills some or all of the socket 'uncased'. This is a proven way of working in competent rock or very hard/compressed soil. Bauer uses this way for our work in rock locations where tidal generators are ideally suited.

However, when the seabed is too hard to drive, but cannot be trusted to 'self-support' when drilled, the only safe way to guarantee clean pile installation and precision grouting of the pile, is to ensure there is 'Casing' protection to hold back the material of the drilled socket wall, to prevent material falling in or even collapsing.



*Pile Post & Jacket Structure for Offshore Wind Turbine Generator*



*BAUER Dive Drill DDCU 40*

# The BAUER Dive Drill

## Drilling Cased with Underreamer DD CU 40

To overcome these challenges, Bauer developed the next generation Dive Drill – the BAUER Dive Drill CU 40. Using this equipment, a drilled and grouted pile can be installed quickly and from a range of offshore construction vessels – we are not limited to self-elevating platforms.

The system will be set up according to specific vessel specification and project schedule but will always be fully optimized for fastest possible drilling speeds. Launch and recovery systems (LARS) are likewise optimized to speed up the program and keep costs low.

### Further Application:

#### Mooring Foundations for 'Floating Wind'

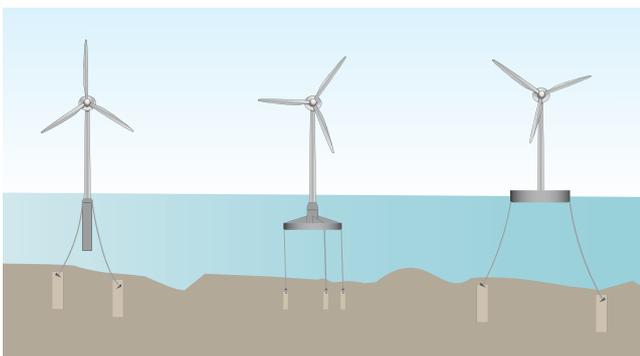
Floating wind is an emerging market, originally conceived for locations/soils where traditional techniques (drag anchor) would first be considered, such as used in O&G for FPSO terminal moorings. The offshore wind industry is now coming to terms with installing floating devices and in much deeper water than with fixed wind platforms.

Consequently, 'Cased' drilled and grouted technology able to operate economically at great depth and through a wide range of seabed geology.

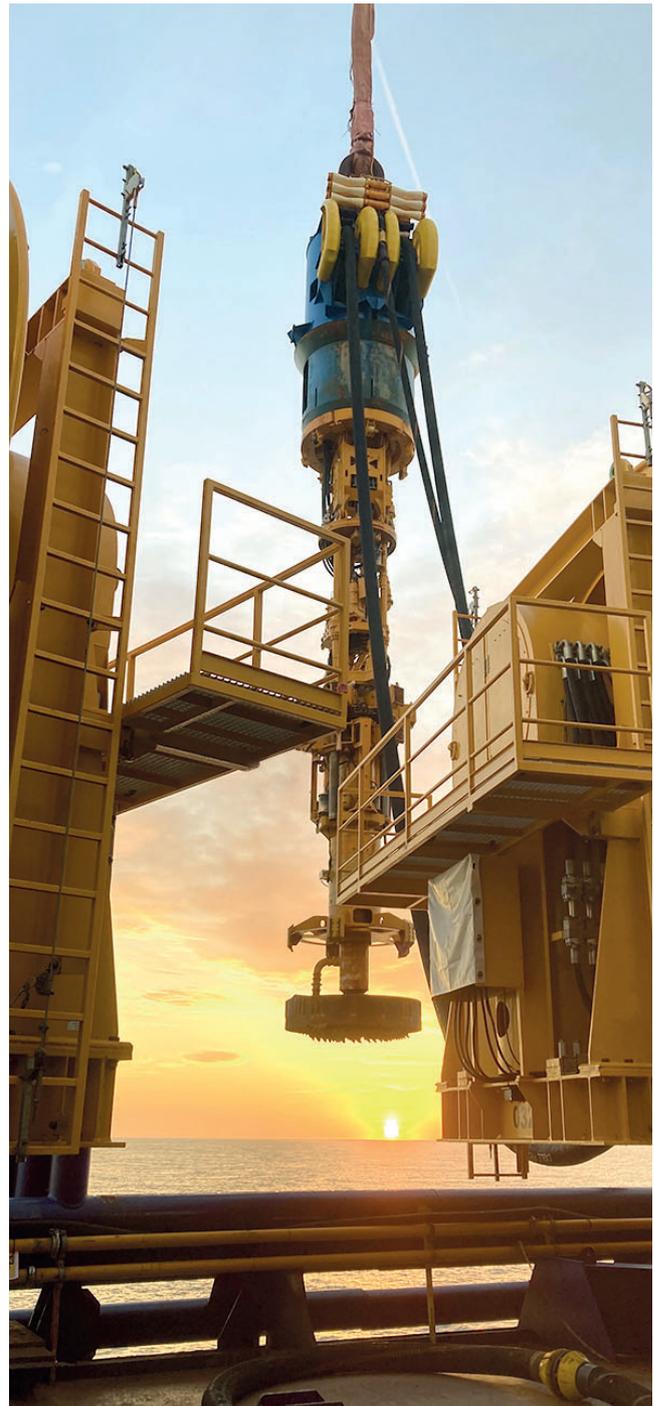
The grouted mooring pile offers technically superior performance. In the past, it was considered uneconomical, however that has now changed with Bauer's new DD CU 40 equipment where the increased capacity/redundancy of a grouted mooring pile and fast installation is proving to be an attractive choice for developers, platform manufacturers and EPCI Contractors alike.

The solution provides the same safety and the security during installation as the jacket pin pile – but in shorter 'mooring pile' configuration. Our techniques provide many advantages to developers, e.g.:

- Boosts RoI – optimized moorings with condensed platform layout,
- Reduce risk – superior redundancy of drilled and grouted mooring piles
- Increased profit: Pile design eliminates need for pile maintenance



Seabed Mooring Pile

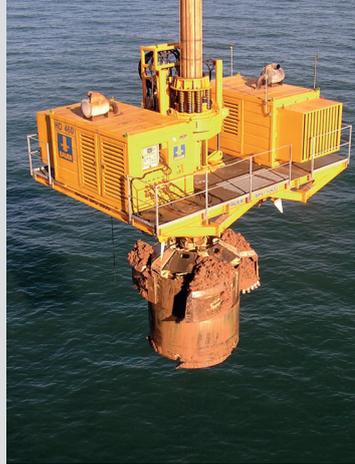


BAUER Dive Drill DDCU 40

# Offshore-References

## 2005 – Barrow Offshore Windpark, UK

Monopile foundations for the 90 MW windpark in the East Irish Sea were installed via the 3D (Drive-Drill-Drive) technique. Bauer performed necessary relief drilling using our Flydrill: BFD 5500 to reduce friction resistance of the 4.75 m diameter foundation pieces in the harder soil layers. Main contractor: MPI Ltd. on installation vessel 'MPI Resolution' where the Monopile was driven by Hydrohammer to refusal then BAUER BFD 5500 launched by vessel crane for relief drilling activities.



## 2011 – EMEC Monopile for Tidal Turbine, Orkney, UK

Bauer was the principal contractor for installing the monopile foundation for Voith Hydro's latest Tidal Stream Device. Working in fast flowing (10 knots) currents and in 37 m or 120 feet water depth.

The 23 m long monopile of 2 m diameter was quickly installed into the 11 m deep rock socket, then fixed in place by high-strength grout.

The BSD 3000 drilling equipment used, was designed, built and operated by Bauer.

## 2017 – Beatrice Offshore Wind Farm-Relief Drilling, UK

Bauer undertook the task of developing the first of a new generation of 'remotely operated' Dive Drill equipment – the DD C 40. This technique is designed for the speed of operation. Built and operated by Bauer, to allow pile driving to continue on Jacket piles while we relieve adjacent pile friction build up (or blockage). This new technology is safer, faster and more versatile than ever before and is ideally suited to the continuous use and repetitive nature of modern offshore wind farm requirements. Commissioned Beatrice OWF 2017 for Seaway 7 (formerly Seaway Heavy Lift) from the vessel Seaway Yudin (Crane ship) as much as 4 m into the rock.



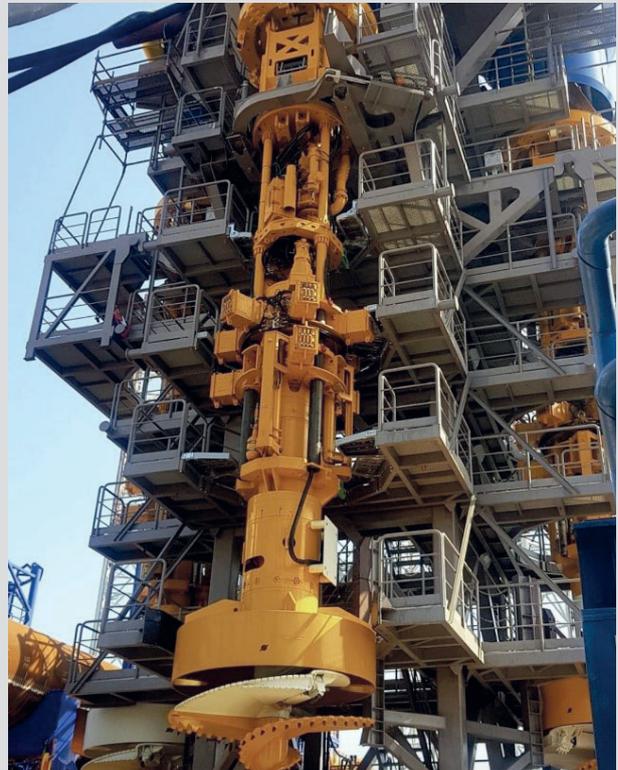


### 2021 – European Waters-Drill and Grouting Operations

Multiple DD CU 40 devices are deployed in 25-50 m water depth, to perform simultaneously pile drilling and grouting operations. All activities are coordinated/controlled from modular deck mounted Command cabins which can fit any appropriate vessel – DP, JuV, Crane Ship etc.

The drilling machines are launched by the vessel crane and inserted in sequence into the previously deployed subsea template. This revolutionary technique is the first commercial and combined drilling and grouting equipment that uses fully cased protection to completely protect the grouted annulus against soil contamination and/or rock socket collapse.

Typically used where soils and rock do not permit driven or 3D pile installation, the DD CU 40 drills quickly in soil, with each equipped with ‘underreamers’ when encountering rock. Installation is fast, with simultaneous Lar, drilling and grouting operations available for 3 and 4 leg Jackets.





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