Since the middle of the last decade, there has been an increasing focus on the need for more cost-effective mooring systems for permanently installed production systems at extreme water depths. The need for improvements is clearly demonstrated in design changes in conventional catenary systems (CMS) of heavy wires and chains and in the taut elastic mooring systems (TMS) of lightweight synthetic ropes.

In TMS systems using fibre ropes as the main element – where the anchor points are both horizontally and vertically loaded – anchor technology also needs to be improved in respect to anchor efficiency. Installation risks must also be reduced.

The operations of anchoring into the seabed by drag-in, impact or suction, have a small effect on the overall costs of heavy CMS systems. Installation costs are primarily governed by the required vessel support and the time needed for handling long lengths of large diameter wire and chain.

However, inadequate application and planning of seabed anchoring can lead to an accelerating overrun of the installation budget, even at moderate water depths.

Switching to lightweight systems
For lightweight TMS systems in deep water, the incentives for improving the anchoring techniques are related to the expected cost savings of using high-capacity uplift resisting anchors in combination with significantly shortened elastic mooring lines.

The combination of lightweight mooring lines and lightweight anchors – as found using drag-in plates, plates driven-in by a suction follower or drilled-in – has a great potential. The anchor efficiency of deeply embedded anchor plates is more than 10 times that of piles and suction anchors.

For anchors in soft soils, exposed to constant tension and sustained dynamics, typical for TMS systems, raises delicate geotechnical issues regarding the durability, such as creep effects and so on. The margin of safety, or the usage of the calculated capacity, will always be questioned, despite the conclusions of previous successful projects.

Improvements of proven anchoring techniques rather than strong promotion of new technology alone may appear to be the best way to meet the requirements of safe anchoring and precise installation. For instance, a conventional suction anchor (inverse buckets) installed with a closed top, may mobilise the weight of the inside soil plug and thus cope safely with the large uplift forces.

A suction anchor configured in combination with an integrated impact pile may provide high anchor efficiency for all load inclinations and safe penetration, especially where hard soil layers underlying soft surface soils are encountered. It is a myth that deep-water areas only consist of soft and homogeneous soil deposits in which any type of anchor can penetrate efficiently to the target.

Working for change
As a supplier of synthetic mooring tethers, Selantic approaches the market step by step in respect to the magnitude and complexity of projects. For three years, the company has delivered tethers to FPSOs to keep flexible riser systems in place. These systems are usually based on individual anchoring of each riser.

Selantic is currently participating in an EU project with an overall technical objective to develop optical fibre strain transducers (OFSTs) for in situ monitoring of the tensile properties of mooring and lifting rope systems. These OFSTs are integrated into the ropes/tethers. It is hoped that this type of monitoring will make it easier to determine the use of synthetic fibres for permanent heavy moorings in harsh environments, without requiring the expense needed for the current standards.

While the mooring projects off-shore Brazil are impressive, are the conditions there really testing the potential of synthetic mooring materials? Will this be the breakthrough for fibre use in mooring?

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