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Oseberg eyes far horizons

Polyester suits Gulf's Gomez

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The **$400,000** question

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The *Rowan Midland* semisubmersible is being converted to a production facility to develop ATP's Gomez field in the deepwater Gulf of Mexico.

Preparing a polyester producer

Rather than build a new floating production facility to develop its Gomez field in the deepwater Gulf of Mexico, ATP Oil & Gas is making plans to instead upgrade the *Rowan Midland* semisubmersible drilling rig and moor it on location as a production facility. InterMoor's **Todd Veselis** and ATP's **Robert Shivers** discuss the station-keeping details involved in what will be the region's third application of permanent polyester system.

As Gomez is a small US Gulf of Mexico field located in approximately 3000ft of water on Mississippi Canyon block 311 with an expected life of three to 10 years, one key aspect of the project is the use of an existing mobile offshore drilling unit (MODU), the *Rowan Midland* semisubmersible, as the production facility in an effort to minimize costs and make development more economical. However, regarding the mooring system of the unit, this entailed several challenges.

For this portion of the job, ATP selected Acteon mooring company, InterMoor, to develop, procure and install a twelve, taut-leg polyester mooring system for the *Rowan Midland* using InterMoor's suction embedded plate anchor (SEPLA) technology.

One of the challenges in the mooring design was to develop an efficient system which utilized as much of the *Rowan Midland*'s existing mooring equipment as possible including the rig's eight mooring winches which are limited to $3^{1}/_{4}$in diameter wire. Due to this restriction, it was necessary to increase the number of mooring lines from eight to twelve whereby the additional four lines will utilize a chain segment at the fairlead as opposed to wire and tensioned with a chain jack and terminated in a chain stopper.

Poly's promise

During the design phase of the project, it was quickly realized that rising steel costs would play a major role in the final configuration of the mooring system. A cost analysis showed that a polyester taut leg mooring system with SEPLAs and subsea connectors was less expensive than a comparable steel catenary mooring with chain, six-strand wire and drag embedment anchors in 3000ft of water.

Previously, polyester taut leg systems have shown to be cost-effective in ultra-deepwater developments, but usually not in this water depth. However, the cost of the components in the steel catenary system was greater than the cost of the polyester taut system, in spite of higher installation costs.

The polyester mooring system also offers other key advantages over the steel catenary system. One such advantage was increased system performance and a reduced mooring vertical deck load on the *Midland*. The reduced cost coupled with the increased performance and reduced deck load of the polyester taut-leg system pushed the design in that direction.

In turn, when combined with the use of a subsea connector, the system is even further enhanced in that it allows for a more flexible mooring installation by allowing it to be performed in phases, making the installation more efficient. These connectors also provide flexibility in the selection of installation vessels and allow the mooring line to be repaired or replaced without removing the anchor.

Vertically challenged

Another effect of the polyester taut leg system is that a vertically loaded anchor is required. For this application, the SEPLA anchor was chosen because they offer several important advantages not the least of which is making the polyester taut leg system more cost effective.

The mooring system for the *Rowan Midland* is to be the third permanent polyester taut-leg system in the Gulf of Mexico and while the SEPLA has been used in a variety of MODU applications in the Gulf of Mexico and West Africa; it will mark its first use for a permanent production facility.

The SEPLA concept combines the plate anchor and suction anchor technology to create an efficient and cost effective solution. The suction follower is an installation tool which is essentially a modified suction pile and is used to embed the SEPLA to an optimal depth where stiffer soils provide greater holding capacity. Once the anchor has

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been embedded to the desired depth, the follower is recovered and reused to install the remaining anchors.

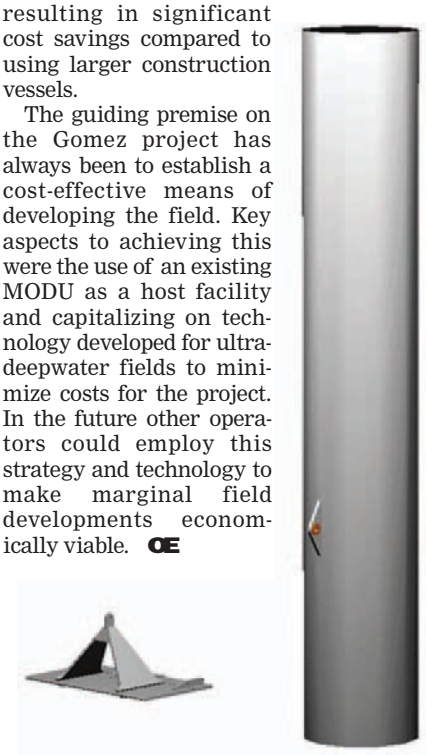
Due to its geometrically efficient shape and the depth at which the anchor is embedded, the SEPLA utilizes a quarter to a third of the steel of a comparable suction pile which in this project resulted in significant cost savings. The smaller footprint of the SEPLA also reduces the number of trips required to install the anchors while using smaller less expensive vessels.

In the case of Gomez, the number of trips required for the anchor installation is reduced by half as compared to suction piles.

Another significant advantage of the mooring system designed for the *Rowan Midland* is that it can be installed and connected using only anchor handling tug supply vessels and installed in three phases.

The first phase is the installation of the SEPLA anchors along with the forerunner chain and the lower half of the subsea connector. The second phase is the installation of the upper half of the subsea connector, anchor chain and the preset polyester section which is held off the seabed with a buoy. The third phase is the combination of the installation of the insert polyester section and connection of the moorings to the *Rowan Midland*. All three phases can be performed with existing anchor handling tug supply vessels in the Gulf of Mexico and most of it off of the critical path. This allows for improved flexibility during installation, resulting in significant cost savings compared to using larger construction vessels.

The guiding premise on the Gomez project has always been to establish a cost-effective means of developing the field. Key aspects to achieving this were the use of an existing MODU as a host facility and capitalizing on technology developed for ultra-deepwater fields to minimize costs for the project. In the future other operators could employ this strategy and technology to make marginal field developments economically viable. OE



Size comparison between a SEPLA (*shown on the left*) and suction anchor.

Near normal load anchor wins its deepwater spurs

The vertical load anchor or VLA was developed to maximise the holding capacity of a high-efficiency drag embedment anchor. This was achieved by arranging for the anchor to be triggered after embedment so that it then keyed on further dragging to achieve a final fluke centroid angle of 90°. Once keyed, the VLA's holding capacity is more than doubled.

However, when keyed the VLA is also at its maximum embedment depth and subsequently can only pull towards the seabed surface with loss of holding capacity. To avoid such pullout, Bruce Anchor developed the near normal load anchor (NNLA) concept embodied in the Dennla (pictured).

The NNLA exploits the finding that if a drag embedment anchor is embedded to a depth greater than twice the square root of its fluke area and is then keyed so that its fluke centroid angle is constrained to approximately 80° (near normal), its holding capacity is increased to about 95% of that of a keyed VLA. In return for this small trade off in keyed holding capacity, the NNLA retains the ability to embed deeper, or drag horizontally at constant load, without pulling out.

Bruce Anchor's David Ledgerwood explains: 'The NNLA is, in effect, an ultra-high-holding power drag embedment anchor with the advantage that it can operate at very high uplift angles at the seabed because it has a high component of loading normal to its fluke.'

Over the past three-and-a-half years NNLAs, in the form of the Bruce Dennla, have been in routine use for preset moorings for Transocean's *Sedco 601* and Diamond's *Ocean Baroness* in drilling operations for Unocal in water depths of between 1000m and 2400m in the Makassar Strait, offshore Borneo.

'The experience gained during these operations has led to deck handling procedures that have reduced anchor turnaround time on deck to less than half-an-hour and complete preset moorings have been installed in a single day with two boats each installing four legs,' reports Ledgerwood.

'This experience makes NNLAs an attractive proposition for deepwater applications,' he adds.

Safer anchor handling

Norwegian hydraulics specialist Odim has launched an innovative system aimed at improving anchor handling operations on offshore vessels. Unveiled during an Ulsteinvik seminar last month, the Odim SAHS (safe anchor handling system) has been developed in response to Statoil's challenge to offshore players a year ago to identify and eliminate the most hazardous aspects of anchor handling.

The first such system, developed in partnership with Bourbon Offshore Norway and Ulstein Design, will be delivered by Odim under a NKr45 million contract for deployment towards the end of 2005 on an Ulstein AX104 vessel being built by Ulstein Verft for shipping company Bourbon Offshore Norway. Odim also has an option for a second vessel.

'We have many sailors at work onboard anchor handling vessels around the world and we know how hazardous this type of operation can be,' notes Bourbon Offshore Norway's marketing director, Trond Myklebust. 'In partnership with Odim, a recognised supplier of hydraulic solutions, and the vessel design company Ulstein Design, we have come up with a total concept in which we have great faith. Our contribution to the solution has been to identify hazardous operations and be a prime mover in the project. For each of the hazardous anchor handling operations that were identified, Odim developed a safer alternative.'