

Anchors ready to reveal their secrets

With holding power over 100 times their own weight as well as clear economic advantages, the first drag embedment anchors made quite a splash in the offshore industry in the 1970s. Yet some project engineers still feel more comfortable with pre-determined fixed mooring points without the possibility of drag. Vryhof is looking to change all that with a system that provides factual data during and post installation and much else besides, as **David Morgan** reports.



A Stevpris Mk6 15t test anchor with transponder mounted between the shanks.

'Stevtrack puts the use of drag anchors ahead of other mooring alternatives, both commercially and technically. It enables faster installation as it shows in real-time where the anchor is, what it does and what load it holds.'

Øyvind Wathne, Vryhof



Nobody really argues that drag anchors are significantly less expensive than any of the alternatives available in the market,' says Øyvind Wathne, managing director of leading anchor design firm Vryhof Anchors. The unit costs are low and due to their relatively small size and weight they are easy to handle from a logistical and installation perspective, so the installation costs are low as well.

'One thing we could improve according to our customer satisfaction survey of 2007/08 was to make the drag embedment process visible, so we immediately went to work on it in our then newly opened research centre,' explains Wathne. 'Although aiming for a tracking device, hence its name Stevtrack, the outcome was a system that also opens applications such as building a base with historical data.'

'That eventually will help our industry to improve mooring designs in general.'

The Stevtrack Anchor Data Acquisition System is designed to provide in real-time a reliable representation of the installation process at hand in the seabed. The system consists of a transponder unit on the anchor, a signal transmission system and a surface data read-out unit, with proprietary Windows-compatible software displaying real-time data for roll, pitch, drag length, penetration depth and pull-in force.

'We developed the software in-house, more or less in parallel with the integration of our anchor designs' geometrics,' notes technical director Roderick Ruinen, who led the Stevtrack R&D team.

'Nothing fancy, just functional. That was our main goal throughout – don't get ahead ourselves, but stay focused on its functionality,' he says.

The biggest challenge was the data transmission through the seabed soil. Initially a trailing wire was used but due to handling difficulties Vryhof opted instead to hire in a wireless communication system. The rented system failed, however, putting the project back and driving the decision to develop that part of the system in-house too. Six months of trial and error later,

the new system was successfully tested in Rotterdam harbour at the end of 2009.

The big difference

According to Ruinen, the principal difference is that with current methodology anchor installation data is commonly inferred from the characteristics of the installation vessel (winch tension, position), sometimes with the help of a marker on the mooring line measured by ROV. 'Although reliable, it is not real time and only serves to determine the anchor position,' says Ruinen.

'That is actually where Stevtrack instantly pays off,' he explains, 'as it generates real-time installation data from parameters measured at the anchor, such as force, inclination and depth, and will therefore warn if an anchor does not arrive at the seabed in the correct position. It thereby simply prevents a whole drag sequence goes lost on an anchor that eventually will have to be reset. This alone can save the cost of a day's installation. It also saves a lot of frustration,' Ruinen adds.

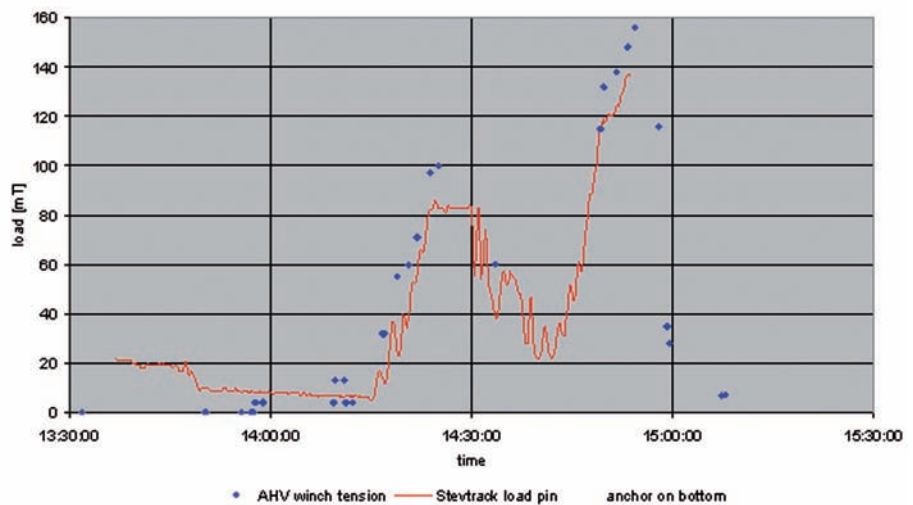
The system was tested under full offshore conditions in March this year using the AHV *Far Shogun* on a 183m deep location in the Gandsfjord in Norway. A 15t Stevpris Mk6 was used as test anchor equipped with the transponder. During this test, the continuous two-way communications

system between the anchor and the vessel was supported by a transmission buoy so as to allow full test focus on the reliability of the subsoil communication transmission. Although it may be used for the same reason on the first project, possibly later this year, the buoy will not be part of the final system configuration.

The 'kick-in' moment, according to one Vryhof team member, was 'when we monitored the anchor arriving on the seabed before the AHV crew did. We were able to show the captain that the anchor was correctly positioned on the seabed, which until now could only be concluded when load in the mooring line has sufficiently built up, so after some time has elapsed'.

During pull-in of the anchor, Stevtrack sent data live to the surface read-out unit installed in the wheel-house, offering a detailed image of the drag embedment. Vryhof says the system performed flawlessly right through the pull-in process and once on target depth, buried 6m as is customary with this type of anchor, the test anchor communicated successfully with the system on board.

The pull-in force measured at the anchor was compared to that measured on the winch. The two curves (*shown below*) follow each other correctly, but Stevtrack proved significantly more accurate, out at some point measured to be well over 20%, Ruinen points out. 'The tests confirmed full operational readiness



Stevtrack test, March 2010.

What they said about Stevtrack

'It is potentially the "missing link" for permanent moorings at deepwater sites. At sites where soil condition and strength profile are known, monitoring the exact depth of the Stevmanta VLA anchor allows us to accurately calculate holding capacity. It makes Stevmanta predictable and thus more reliable for use in deepwater mooring systems. At sites with unknown strength conditions, Stevtrack will show an accurate load versus embedment curve, returning a relatively accurate soil strength profile for that site. It thus works in more than one way.'

Jean-Louis Colliat-Dangus,
Total – TDO/TEC/GEO

'I look forward with great expectations to see the results of Stevtrack measurements when it becomes an integrated option with the Stev-series of anchors. I sincerely hope that the Stevtrack will give us more reliable test data both from full-size commercial offshore anchor installations and from offshore tests with scaled-down anchors. In planning and executing research-oriented onshore instrumented anchor tests it will be natural to benefit from using anchors equipped with the Stevtrack or similar instrumentation packages.'

Rune Dahlberg,
senior principal engineer, DNV Energy/Foundations

'The Stevtrack system will be very valuable in fully optimizing mooring designs with drag embedment anchors as in full operation, we will know that the system can provide real-time data during installation and get confirmation that the anchor will perform according to design condition. The system also allows the load monitoring and actual positioning during the life time of the mooring and provides information on the stability of the mooring during and after a storm.'

Sunnva Hyle,
manager, soil mechanics, BW Offshore:



The Vryhof Stevtrack monitors the anchor installation process in real time. The interface main window visualises the anchor's roll, pitch, penetration depth, drag length and pull in force. Separate windows show actual measured figures and for the anchor's position in the mooring system, location and project details.

to our standards,' he adds. 'From here some improvements will be made to handling and electronic communications will be enhanced to enable sharing real time data through GPS and internet potentially with every PC that has Stevtrack-software installed.'

Øyvind Wathne chips in: 'Stevtrack is a perfect example of how people can excel in an organization given the right tools and opportunity. The pizza bills were considerable but we are truly proud we have arrived at being able to develop such complex, now patented equipment in-house, including the software and hardware.'

As well as accurate verification between design and installed condition and obviating the need for more expensive ROV verification, other direct benefits claimed by Vryhof for Stevtrack include: significant savings on installation time; removing the need for anchor resetting due to the wrong anchor arriving on the seabed; and enabling maximum mooring point performance to be set on projects with poor or insufficient soil data.

And longer term Vryhof sees potential for Stevtrack in replacing the proof loading required by qualification authorities; retrieving historical performance data from an installed mooring (dependent only on battery life), and for continuous mooring line performance monitoring in harsh weather conditions, for example hurricanes.

Time to market

Vryhof initially expects Stevtrack to be available on the company's Stevpris Mk6 anchor, but later also on the Stevmanta VLA.

'Stevtrack will probably see its first application later this year and it will not take long for our customers to recognise the benefits,' believes Wathne. 'In the longer run we hope to see an increasing use of pre-installed moorings because the installation time savings on Stevtrack can make all the difference in the economics of such a project. There is such tremendous interest in this technology that we may have to increase our manufacturing capacity,' he adds. **OE**



The deepwater (soft soil) Stevmanta VLA, of which a full anchor set is shown here, is next in line to be equipped with Stevtrack.