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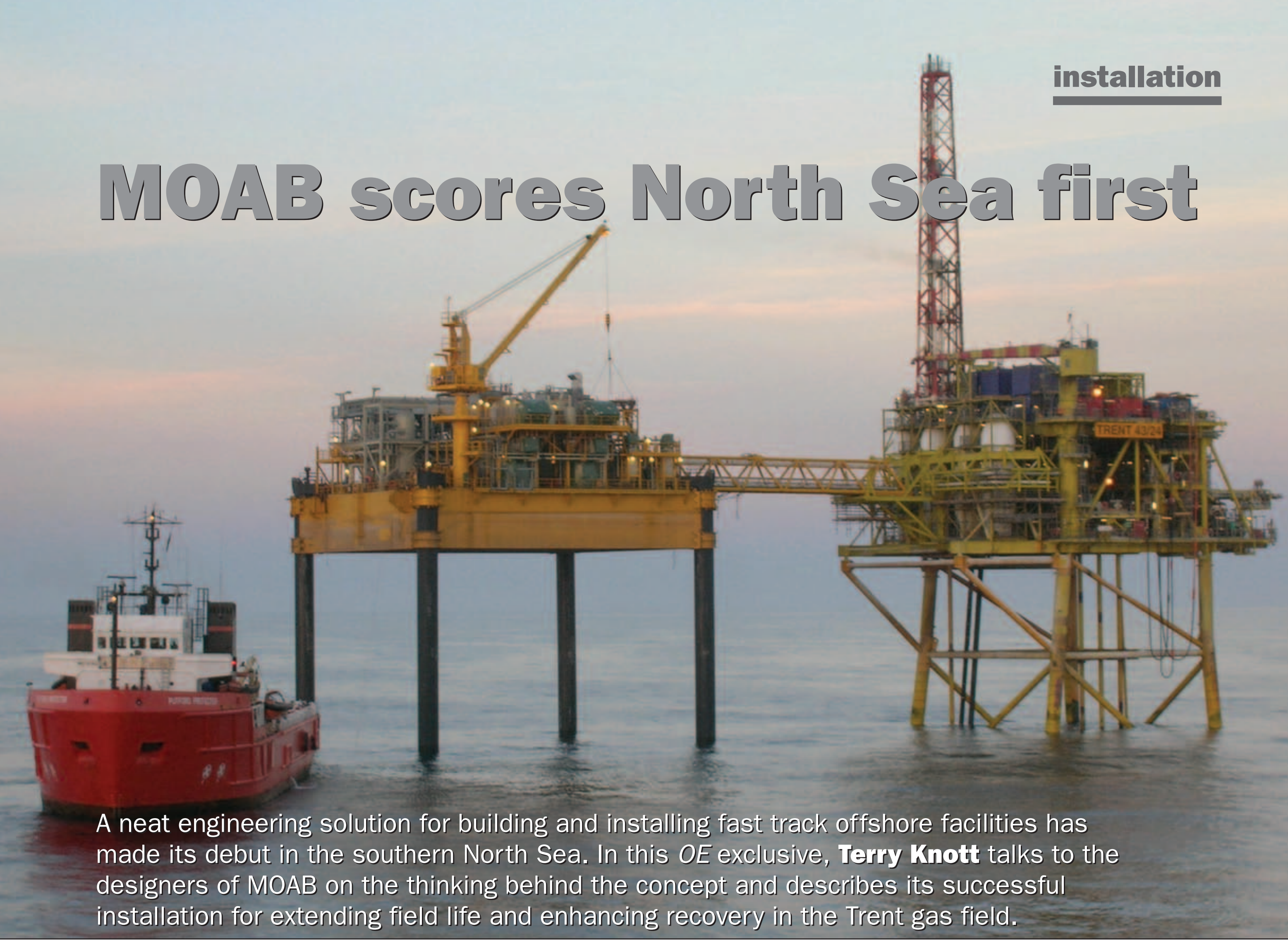


MOAB scores North Sea first

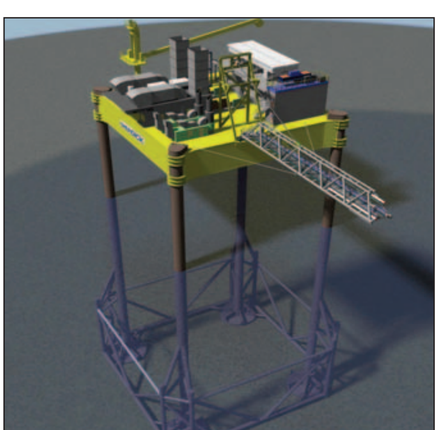
A neat engineering solution for building and installing fast track offshore facilities has made its debut in the southern North Sea. In this *OE* exclusive, **Terry Knott** talks to the designers of MOAB on the thinking behind the concept and describes its successful installation for extending field life and enhancing recovery in the Trent gas field.

As a new connecting bridge to the Perenco-operated Trent platform was lowered into place in mid-September, it marked the conclusion of an impressively compact 11-month design, build and installation programme for the novel offshore structure at the other end of that bridge – a mobile offshore application barge (MOAB).

The unmanned MOAB, elevated some 20m above the sea surface alongside the existing Trent fixed production platform in UK block 43/24, houses compression and process equipment. The new facility can handle 3.4 million m^3/d of gas and will allow independent Perenco to recover an additional 1.4 billion m^3 of gas from its Trent and Tyne fields, in addition to providing flexibility in accommodating third party gas streams in the ETS pipeline system linking Trent to the Bacton terminal. With an overall project price tag of £25 million to achieve these goals, MOAB sits at centre stage in demonstrating its cost effective credentials.

The MOAB concept was developed by naval architect and marine engineering consultancy Overdick of Hamburg in Germany, targeted at fast track small- to medium-sized offshore developments. It can serve as a standalone platform or as an annex as in the case of Trent, and can fulfil a variety of platform roles – compression, production, wellhead, accommodation among them.

'Whatever duty the MOAB performs,' explains Overdick partner Andreas Rosponi, 'the key factors are it allows concurrent engineering and fabrication, it is self-installing, simple to remove and readily deployable. These combine to give a solution that does not require heavy lift vessels and offers significant savings in terms of schedule and capex.'



TOP: MOAB barge (*left*) installed and bridge-linked to Perenco's Trent production platform in UK southern North Sea.

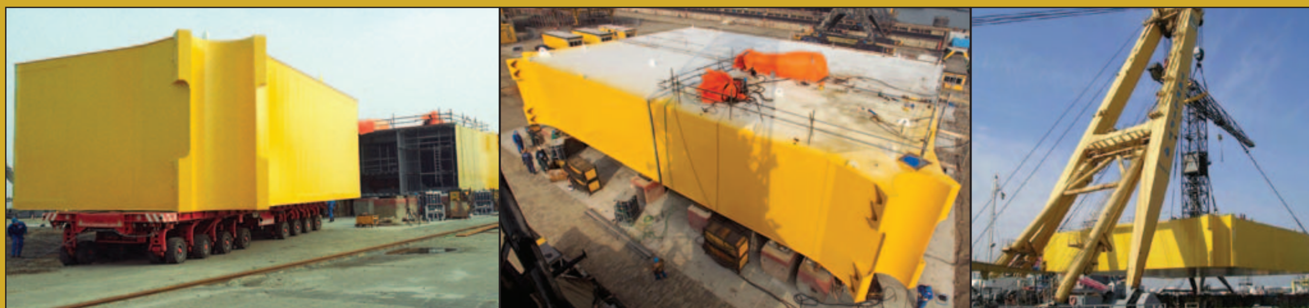
ABOVE: Developed by Germany's Overdick, the MOAB concept was also used in Southeast Asia.

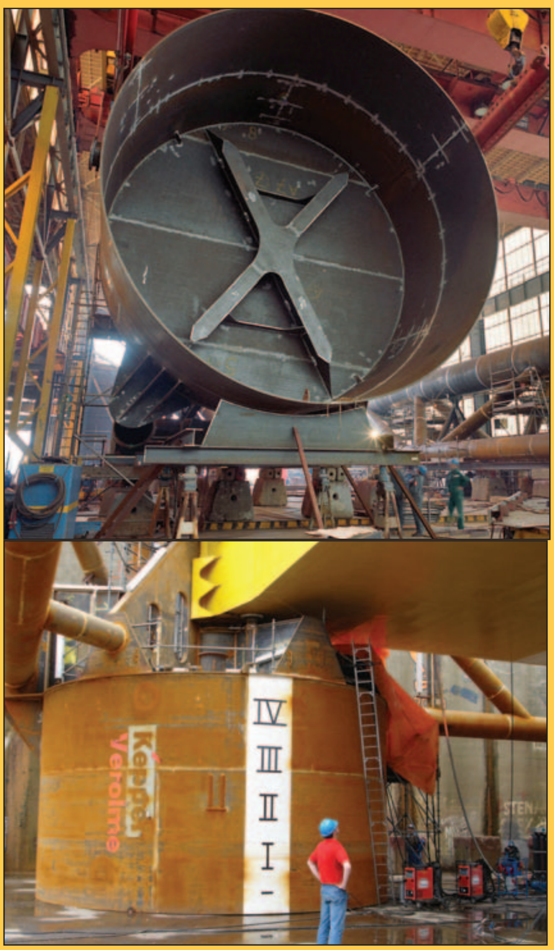
The Trent MOAB is the third of its kind to be designed by Overdick, with its two predecessors having been contracted by operator Talisman in Malaysia. In 2003, a compression and separation annex platform was installed in Talisman's Bunga Raya field in the Malaysia/Vietnam joint development area in 56m of water, while earlier this year a standalone integrated wellhead and production MOAB went on location in 70m of water in the South Angsi field in Malaysia's South China Sea.

'With deck payloads of 2500t and 4400t respectively, the first two were larger structures than the latest one for Trent, which has a payload of 1200t,' notes Rosponi. 'But the sizes and duties of the three demonstrate the flexibility of the concept.'

The concept he refers to might appear at first to be akin to using a conventional jackup platform – the MOAB consists of a main hull supported by a steel substructure on the seabed and four corner legs extending above the sea surface. The 'barge' is wet-towed under its own buoyancy to the offshore field where its legs are lowered and its hull jacked up above water. > *page 26*

550t hull built in sections by Keppel Verolme, assembled on the dockside, and lifted into the water for tow into dry dock.





Four 9m diameter suction cans provide the seabed foundation for the barge.

1500t barge substructure being built around the hull.

'The main difference between MOAB and a traditional jackup is that you don't have to buy an integral jacking system which then sits idle for 10-15 years offshore, while still requiring maintenance,' Rosponi points out. 'The MOAB design does not include permanently installed jacks – we use temporary strand jacks to lower the legs and raise the hull, and these are hired for the job and then removed. And unlike a jackup which is classified as a seagoing vessel and therefore must be flagged and have a master and crew onboard, the MOAB is classed as a fixed installation which only floats temporarily, and hence does not attract the costs of national flagging.'

Indeed, says the company, when Overdick was first approached in March 2004 by Dixon Marine Consulting, representing Perenco, a jackup solution of some kind was being sought in the revamping of Trent to include a compression and process plant extension. MOAB was selected in August 2004 as a 'self installing' solution for the 50m water depth, capable of 15 years of operation in exacting North Sea conditions.

Building the table top

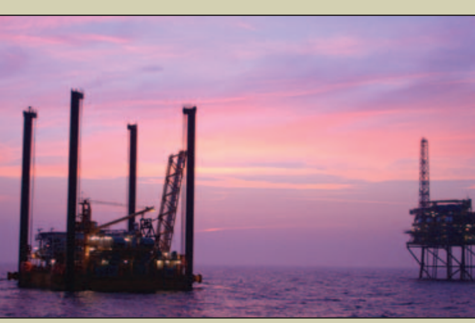
Work on detailed design and fabrication began in earnest two months later with EPC contracts awarded by Perenco to Keppel Verolme in Rotterdam for the barge structure and to Solar Turbines in Houston for the topsides modules – Overdick acted as 'nominated subcontractor' for the engineering of the structure and transport and installation operations.

Keppel Verolme's contract called for delivery of the 'table top' platform – bare of topsides – and the 30m bridge link. The 550t hull, measuring 30m x 30m x 5.5m, was prefabricated in five sections in the shipbuilder's workshops and assembled into the finished hull on the side of the dry dock. To speed up the schedule, the corner sections of the hull, which guide and hold

Competed MOAB floated and towed out to the field.

Hull, substructure and legs completed, followed by topsides modules installation.

MOAB arrives in field, the legs are lowered and deck jacked up. **FAR RIGHT:** Leg in clamp guides.



the legs, were outsourced to a local subcontractor. The hull was completed in six months in May this year and then lifted into the water by sheerleg crane and towed into dry-dock.

Fabrication of the 1500t substructure and legs progressed in parallel. The substructure, which consists of four partially braced leg towers, was built indoors out of prefabricated and pre-shaped tubulars – SIF supplied the bulk of tubulars with some from EEW. The substructure elements were lifted into dry dock and located around the hull. At the base of each corner of the substructure is a 9m diameter, 5m high suction can which provides the seabed foundation for the installed platform – these were also outsourced by Keppel Verolme, as was the bridge, weighing 56t with all interconnecting pipework installed.

The 75m long, 2m diameter legs, manufactured from plate up to 40mm thick and 80mm thick at the waterline to resist boat impact, were assembled onto the substructure by two Mammoet crawler cranes, which upended the completed legs on the side of the dock and held them in place for welding. The interconnecting bracings of the substructure were quickly added, followed by seafastenings between hull and substructure.

Next came the 'hired 'equipment' which would make possible the installation of the MOAB in the field. For substructure lowering, four 500t strand jacks were mounted outside the hull on cantilevered platforms, and were connected by steel cables to the substructure.

For deck lifting, eight 300t strand jacks were mounted inside the hull at the corners. Steel cables passed through hull to anchor blocks at the top of each leg. In addition, a single 100t strand jack was placed at the top of an A-frame mounted behind the hinged bridge, which would serve both as seafastening and to lower the bridge to the Trent platform.

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56t bridge being lowered into place to complete the 72 hour installation operation.

'The strand jacks are at heart of the MOAB concept,' Rosponi explains. 'They are readily available for hire, they are compact, and they have very large lift capacity.'

For the Trent MOAB, all jacks and associated power packs and controls were supplied by ALE Lastra.

Other hired equipment included four can-mounted suction pumps, plus one spare on deck, for pumping water from the suction cans as they penetrated the seabed. The pumping system, capable of removing 300m^3/h at 500kPa, was delivered and operated by Norway's NGI and Framo.

Structural assembly of the barge was completed in June.

'The topsides modules arrived in July,' says Rosponi. 'The under-deck of the hull required additional reinforcement of 50t to accommodate the point loads of the topsides modules, which was done while the modules were en route from the USA by adding flanged webs and gussets to stiffen the deck. This activity was always in the plan, as we had only specified to Solar a total weight not to be exceeded of 900t, a horizontal and vertical centre of gravity envelope, and footprint boundary. But addition of only 50t of steel to support a 900t topsides is minimal, and the payoff was in the fact that we did not have to manage detailed design interfaces between hull and topsides.'

The topsides package included two turbo-compressors, two turbo-generators, one slug-catcher for an incoming gas pipeline (with a riser in the north-east leg), a process module for handling liquids in the gas, switchgear and control rooms. Perenco supervised installation of the modules on the deck over a seven week period, preparing the MOAB for sailaway at the end of August.

All in one

The completed MOAB was towed to the Trent field as a self-floating structure from Rotterdam by four Smit tugs over a period of 65 hours in September.

'The design allowed us to tow in sea states with up to 4m significant wave heights, and install with waves up to 1.5m high,' notes Rosponi. 'We were fortunate on the day of installation that the weather was very good and never exceeded 1m waves. Plus the waves were of very short period, which gave us basically no heave at all and very little roll.'

With seafastenings removed, the legs and substructure were lowered to the seabed using the four outboard jacks. As the horizontal bracing of the substructure became submerged, the upper clamp – each corner has a lower and upper clamp for final fixing of the structure's legs – was closed around each leg to act as a guide. Rollers inside the clamps enabled the smooth lowering of the leg. After touch-down, by using the four lifting jacks, the deck was raised to leave around 0.5m of hull remaining in the water, providing 1000t of on-bottom weight. At the seabed, the suction cans self-penetrated through the first 2m of sand. A carefully controlled combination of jacks and suction pumps then pushed the cans down to a depth of 4.5m into the seabed, achieving a preload of 12,000t, after which the deck was elevated to around 20m above water to be level with the Trent platform.

Final fixing of the hull to the legs was made by closing both upper and lower clamps at the four corners for horizontal loads, and installing two giant bolts though the cable eyes in the anchor blocks on top of the legs – which were now down at deck level – into the deck. The 3.5m long, 160mm diameter bolts are manufactured by SuperBolt, says Rosponi, enabling them to be tightened by normal torque wrench. The entire installation operation, plus the bridge link being established, took around 72 hours, excluding standby time.

'Installation of the Trent MOAB as a complete unit was a first,' he adds. 'The two Malaysian platforms were installed in stages – substructure first, hull and legs second, although they could have been competed in one if desired.

'We believe the MOAB concept is very robust economically for payloads in the 700t to 5000t range, and provides a very attractive solution for fast track facilities installation.' OE