

Trenching on Ormen Lange

A purpose designed trenching vehicle was developed to carry out one of the most arduous projects of its type — the sharply undulating sea floor of the Ormen Lange development

Back in 2003, the Storting gave its approval for the NoK 66 billion Ormen Lange development, 120km north west of the Møre coast in Norway. The field had been discovered by Hydro in 1997 and subsequent drilling had put the reservoir at around 40km long and 8km wide, approximately 3000m below the surface of the sea

The development is currently on schedule for coming onstream in October 2007, where it will produce at a rate of

up to: 6000 - 8500m³ per day of condensate and 70Mm³ per day of gas. Ormen Lange will supply the UK alone, with between 20-30% of its gas requirements for the next 20 years

The field is being developed as a subsea completion by 24 subsea wells located in four seabed templates around 800 - 1100m below sea level.

The untreated well stream will be tied back to the onshore facilities in Nyhamna, mid-Norway by two 120km long, 30in multi-phase flowlines. Here it will be processed, before being

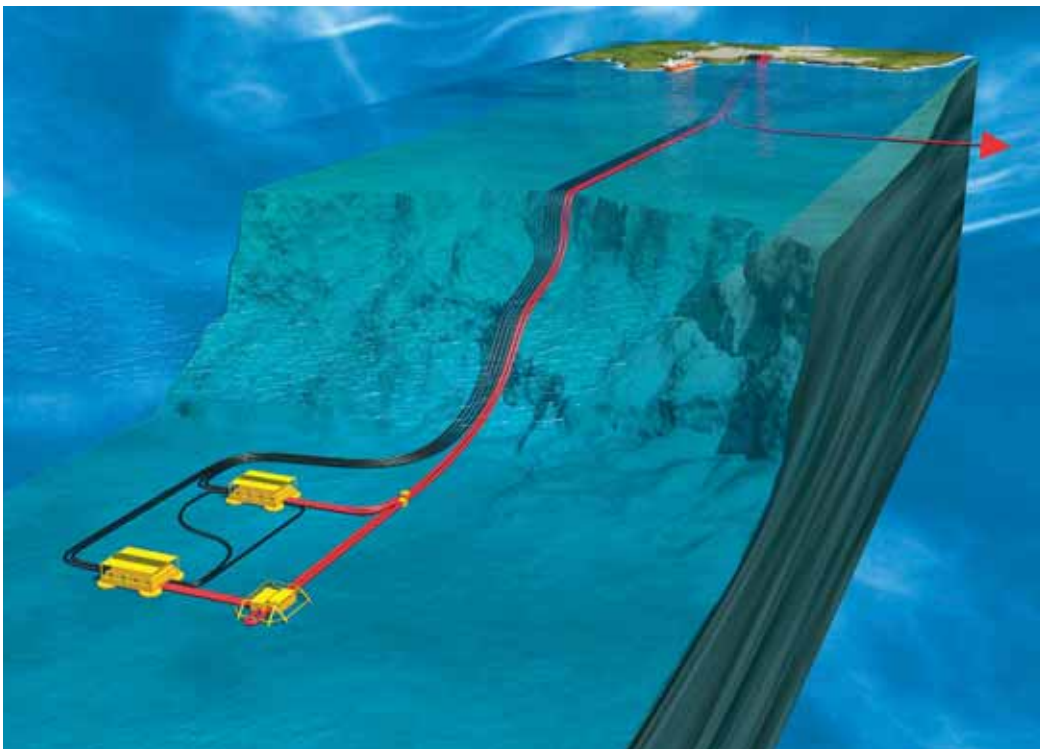
exported in the 1200km long subsea transport pipeline – the worlds longest – to Easington in the UK.

At present, this so-called Langede pipeline has arrived in Easington, while on the field itself, the subsea installations are to be installed using the heavy lift vessel *Thialf*, after being completed at the Grenland Tonsberg in Norway. The subsea installations measure 44m by 33m and stand 15m high.

|| Layout of the Ormen Lange development facilities

LANDSLIDE

A characteristic feature of the project is the seabed above the reservoir on which these subsea installations will sit. Approximately 8100 years ago, one of the largest landslides in the world occurred at Storegga, where an area the size of





■ The Spider Trenching ROV being retrieved back to the mother vessel

Iceland slid into the Norwegian Sea. The mass slid around 800km into the deep sea, with its back edge is around 300km in length. The Ormen Lange field lies in the middle of the depression left behind by the Storegga slide and lies close to the steep slide edge which rises 200-300m up towards the continental shelf.

The field is at a depth of 800 to 1100m and the slide has made the seabed very hilly, with peaks that suddenly rise 30 to 60m. The development plans envisage dredging and excavating the bottom of the seabed to make way for what will be the world's longest export subsea gas pipeline.

SPIDER

In order to find the appropriate solution for a very demanding seafloor terrain, Hydro, the operator of the Ormen Lange, contacted Nexans in 2002 to discuss possible means of levelling the steep and uneven seabed of the pipeline and flow-line routes. Several different possible modifications of the existing Capjet design were discussed before Nexans came up with a radical new proposal leading to the development of the Spider technology. The principle design of the unit was developed by Nexans engineers in Norway, with support from several specialised vendors and suppliers. It also required close cooperation with the Norwegian company, GTO, which had developed its own subsea ejector-based dredging technology.

This technology was incorporated into the Spider design. The machines were constructed at the Nexans' Halden plant in Norway. The first Spider was constructed and tested on Ormen Lange in 2004 after a period of testing in the Kristiansund area in Norway.

'The novel Spider system is the only technology capable of levelling the seabed in steep areas,' said a

spokesman. 'It combines powered tracks with an articulated walking leg system, enabling it to function in very uneven sub-sea terrain with up to 35deg slope. Much of the technology is derived from the well-proven Capjet trenching vehicle design and benefits from more than 15 years of experience in sub-sea vehicle design and operation,' he said.

The Spider incorporates an advanced control system and will work in water depths of approximately 1000m although it has been designed in principle to operate in 'deep water' at depths of up to 2500m. The Spider's movements are controlled by operators located aboard a support vessel, via its specialised LARS (launch and recovery system). Power and signals

between the mother vessel and Spider are supplied through an umbilical, also designed and supplied by Nexans.

The Spider unit itself measures 7m by 4m by 2.5m and weighs 15 000kg. It is connected to a 20t umbilical winch measuring 4.4m by 3m by 2.8m. The frame is a titanium air filled structure with a pressure rating of 2000m.

The hydraulic system is based on a single software-controlled 170hp hydraulic power unit. The design has separate dirty and main hydraulics system.

The Spider is powered by eight 17in thrusters, each capable of generating 550kgf. It can attain a forward bollard pull of 2000kg, a 1000kg vertical pull and a 500kg lateral pull.

There are two 400kW jetting systems with an output of 14 bar/25 bar and a 130kW dredging system. The unit has a maximum dredging capacity of 14in.

Among the sensors are six colour video cameras, a Mesotech 1000 sonar, a pressure sensor, Mesotech altimeters and Octans fibreoptic survey gyros. There are eight angle sensors, typically six proximity sensors, two speed counters, pressure and temperature units and eight linear sensors.



■ Spider being deployed to the seabed

The data signals are transmitted to the surface using an Ethernet system with a serial to Ethernet drop-down network, giving 'local' control of all sensors and valvepacks. Electronic data is transmitted at 20 Gbaud uplink/175 Mbaud downlink. There are six video channels and two imaging sonar links

During operations, the operators follow the Spider's movements via underwater cameras. However, when material stirred up from the sea bed reduces visibility, an alternative is provided by a virtual three dimensional computer image. This virtual image of the seabed is prepared by the onboard survey operator and loaded into the Spider's data system. Once the operation has started, new terrain surveys are performed as required to confirm the seabed profiles.

'The Standard Capjet trenchers trench cables and pipelines into the seabed and cover them as they travel along the cables/pipelines at speed. Specialised swords with waterjets break up the soil thus creating the trench,' explained the spokesman. 'The Spider has a different task, which is to level or flatten out the seabed in one particular area using a combination of water jetting and suction to remove large volumes of soil. This is done by using a dredging head on an extendable arm to cover the operational area. The telescopic tool arm can also be equipped with purpose designed dredging heads, cutting tools and other intervention tooling.'

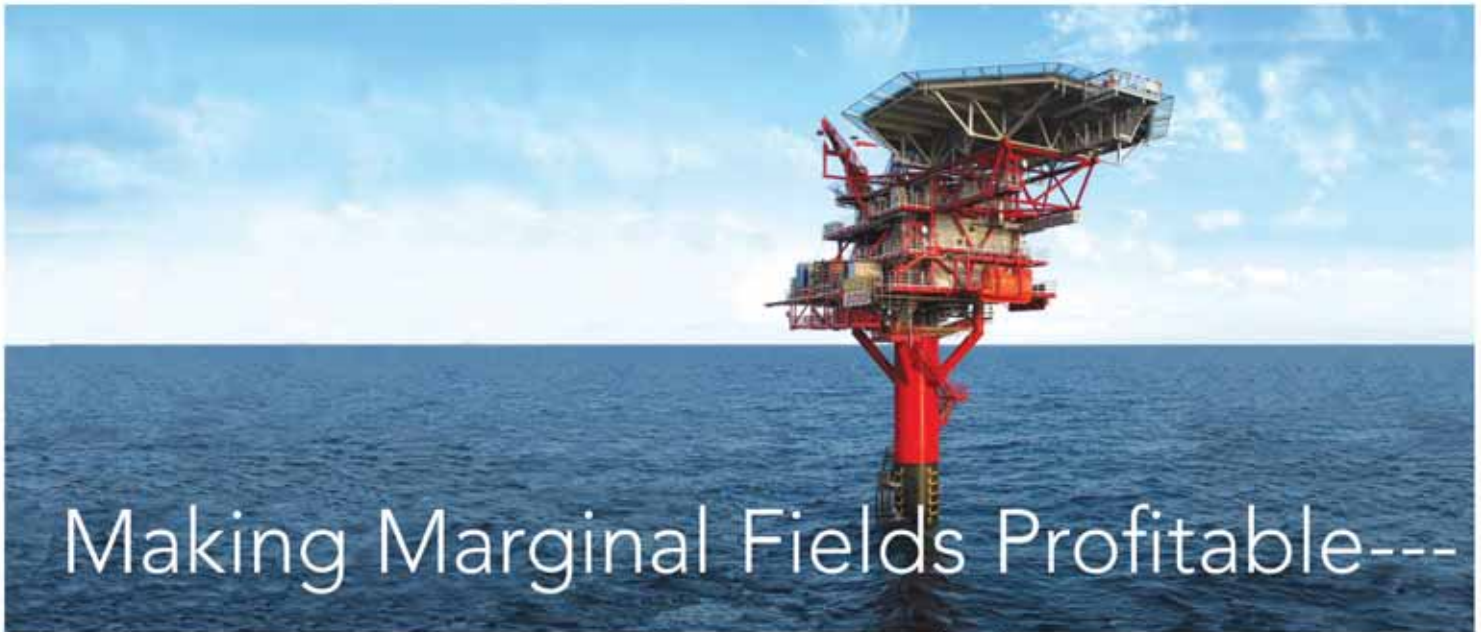
The extensible lightweight arm allows for a 9m reach and

is also equipped with an advanced tool handling capability which allows for a combination of two heavy tools in which can be repositioned subsea. A typical combination is a pipecutter and pipeplug in combination with the ejector system. This allows the system to perform removal of soil, cutting and plugging of the pipe without the need for surface change of tools.

'Many major design elements are derived from the Capjet technology,' said the Nexans spokesman while the Spider wheels/legs, telescopic arm and slewing are further developments of an advanced forest harvester system from Swiss company Menzi Muck, which uses similar technology for cutting trees on steep slopes. Nexans has purchased all offshore rights for subsea use of this system. The unique combination of belt systems and legs allows for operation in terrain with slopes up to 40 deg in both axes.

'In addition to levelling operations, the Spider dredgers can also be used as general sub-sea vehicles for a variety of subsea intervention tasks, and we are developing new markets in these niche areas.

Moreover, since the Spider is based on Capjet technology and equipment, it is possible to convert it to a normal Capjet trenching unit to strengthen the company's future capacity in the trenching market.



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