

Subsea 7: depths of expertise

Investing in technology

In the offshore energy industry, Subsea 7 is the leading global contractor in seabed-to-surface engineering, construction, inspection, repair and maintenance (IRM) and other services.

In recent years, this subsea market has entered an era of increasing challenge, with reservoirs at greater depths and in more hostile environments. The company has responded by developing a wide and versatile range of market-driven, enabling technologies and by extending its technical expertise.

“Many of the large subsea developments in recent years are either marginal or extremely technically challenging, and probably wouldn’t have been attempted a decade ago,” says Øyvind Mikaelson, Subsea 7 Senior Vice President, North Sea and Canada.

“Today, Subsea 7 is much more than an installer of subsea infrastructure – we design pipeline systems for clients, develop technologies to support flow assurance in hostile conditions, and invest in world-class high-performance vessels which enable the execution of large, complex projects even in extremely deep waters.”

The catalyst for this accelerated commitment to technology was the successful combination between two complementary predecessor companies, Acergy S.A. and Subsea 7 Inc. in 2011.

“The 2011 merger delivered much more than enhanced volume, capacity and geographical range,” says Steve Wisely, Subsea 7 Executive Vice President Commercial. “It also gave us the widest range of technologies in key sectors in the subsea market, including pipeline riser systems, pipelay techniques, pipeline Bundles, Life-of-Field services and Remotely Operated Vehicles (ROVs).

“As a result, the technologies we use are independent and fit for purpose. We are not committed to using in-house hardware – we meet the challenge of delivering each complex subsea project through selecting the most effective technical solution.”

Subsea 7 operates in every major offshore region worldwide, including the North Sea, the Gulf of Mexico, West Africa, Brazil’s pre-salt fields, West of Shetland, Western Australia and, most recently, the Norwegian Sea.

Well established for decades in the Norwegian offshore market, and listed on the Oslo Børs, Subsea 7 is focused on playing a leading role in delivering technology-rich subsea projects in Norwegian waters.

Safety remains the number one priority in all Subsea 7’s operations, and powerful hazard identification, risk assessment and safety management processes all contribute to the highest levels of safety performance.

In Norway, Subsea 7 has had no Lost Time Incidents in over a year during more than 2,000 vessel days and 12 current projects.

The subsea market

Subsea installation is already a major growth sector of the oil and gas market, as operators explore technological alternatives to conventional offshore drilling and platform production, most notably for deepwater field developments.

Industry analysts forecast that subsea production will match or exceed conventional platform production in the next 15 years, with the subsea processing market in particular estimated to grow from its current annual value of \$500 million to a projected \$8 billion by 2020.

As subsea infrastructure grows in size and complexity to meet the demands of higher pressure deepwater installation, an increasing number of operators are demonstrating a preference for the packaged EPIC (Engineering, Procurement, Installation and Commissioning) contract models, which only a number of large top-tier contractors are able to deliver.

“Innovative subsea technologies and large EPIC contracts represent the future, but cost and reliability remain the two principal drivers in this industry,” says Thomas Sunde, Subsea 7 Vice President Technology and Asset Development. “Operators are prepared to give increased installation responsibilities to their contractors – but they want confidence in the contractors’ track record.”

Subsea 7 is certainly well placed to meet this requirement. The company has extensive global project experience in every element of subsea construction and engineering, from conceptual design through to installation and commissioning.

“We have executed a huge number and diversity of subsea projects on a worldwide basis, and we harness all this technological expertise and know-how into safe, reliable delivery,” says Sunde.

“Many of our areas of technological expertise are not what clients expect from an ‘installer’; flow assurance, Finite Element Analysis (FEA), concept analysis, structural riser design, the development of Autonomous Inspection Vehicles and other cutting-edge areas.”

As a result of this experience, the company is an acknowledged leader in key sectors of the subsea market, including Subsea Umbilicals, Risers and Flowlines (SURF) and Life-of-Field (LOF).

Subsea 7 employs the highest concentration of specialist subsea engineering and project management expertise in the sector, with more than 2,000 engineers deployed globally, including 1,000 on North Sea, Norwegian Sea and West of Shetland projects.

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“One of our greatest assets is our ability to share expertise and know-how from project to project,” says Sunde. “We retain world authorities in many key areas of technology, and we can flow this intellectual property efficiently through the company.

“Our ability to deploy technological expertise is a major differentiator in this market.”

Equipped for EPIC

In November 2012, Total E&P Norge AS awarded to Subsea 7 the largest Subsea Umbilicals, Risers and Flowlines (SURF) contract to date on the Norwegian Continental Shelf, for the Martin Linge Development project.

The four-year contract, valued at around \$800 million, comprised engineering, procurement, construction and installation of the complete subsea facilities on the field. The workscope was familiar in scale and complexity to similar recent EPIC projects executed by Subsea 7 in other offshore regions, most notably West Africa.

The Martin Linge Development project consisted of three main elements: the gas export system, based on a 70km x 24-inch pipeline; the infield systems, including three 3km flexible flowlines and risers provided by NOV and the FSO mooring system; and the world’s longest high-voltage power from shore cable, delivered by ABB, extending to 160km.

The contract represented a step-change in the Norwegian subsea sector, calling for the deployment of around 100 engineers and project personnel in Subsea 7’s Stavanger office. The project team is responsible for all planning and design work, as well as the procurement of all pipeline and subsea equipment to be used on the seabed.

The contract also calls for the deployment of ten vessels from Subsea 7’s fleet on diverse pipelay, construction, diving, trenching and survey activities across 34 offshore campaigns.

The main pipelay activities mark the debut in Norwegian waters of Subsea 7’s flagship vessel, the *Seven Borealis*, the world’s largest pipelay vessel, whose construction at approximately \$550 million represents the largest capital investment project undertaken to date by the company.

The *Seven Borealis* is a versatile, high-performance rigid pipelay and heavy construction vessel, capable of laying up to 46-inch diameter pipe in S-lay mode and 24-inch pipe in J-lay mode, and is equipped with the world’s largest offshore mast crane, with a 5,000-tonne capacity.

The vessel is deployed by Subsea 7 on a global basis, and augments Subsea 7’s local fleets when her high-performance capabilities are required to execute projects more quickly, more efficiently and more cost-effectively, as on Martin Linge.

Deepwater challenges in the High North

Subsea 7's Norwegian office was awarded another milestone SURF project in 2013, in this case from Statoil, for the construction of the Aasta Hansteen gas field in the northern Norwegian Sea, north of the Arctic Circle, in water depths of 1,300 metres.

As well as its challenging location, the project is also the deepest field development on the Norwegian Continental Shelf, and calls for the deployment of a number of key enabling technologies developed by Subsea 7.

This is the first Steel Catenary Riser (SCR) system in the North Sea (SCRs are deepwater riser pipelines configured in a catenary shape). SCR's are recognised to have significant benefits, including cost efficiency, ease of installation and a strong international track record in service.

For pipeline protection against the corrosive well fluids, Subsea 7 is also installing BuBi[®] mechanically-lined pipe by the reel-lay method – another North Sea first. BuBi[®] pipe consists of a thin-walled corrosion-resistant liner aligned and expanded inside a carbon steel pipe, and represents a cost-effective alternative to solid corrosion-resistant alloy or metallurgically-clad pipes.

BuBi[®] pipe has been successfully deployed by Subsea 7 on projects for almost 20 years, and Subsea 7 achieved a major technological breakthrough in collaboration with manufacturing partner BUTTING in extending the scope of this key technology for installation by the reel-lay method. Extensive testing and Finite Element Analysis (FEA) confirmed that reel-lay was possible without the liner suffering from local buckling during the spooling process.

The achievement was recognised by Subsea 7 receiving the Pipeline Industries Guild's prestigious Subsea Pipeline Technology Award in 2012, and this specialist capability has been a significant factor in the award of a number of challenging deepwater contracts worldwide.

Local presence

Aasta Hansteen is a strategic, as well as technological, milestone for Subsea 7, since it is the maiden project for Subsea 7's new office in Tromsø, in Norway's 'High North'.

The decision to open the office in 2013 in Norway's new offshore frontier territory was taken with a view to the long-term. "Clients have already welcomed our decision to set up a solid operational platform to service future subsea developments in the region," says Tromsø Managing Director Yngve Vassmyr. "We are, for example, targeting a number of new oil and gas developments, including Johan Castberg, Gotha and Wisting in the Barents Sea.

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“In addition to our own local presence, our clients expect our expansion to accelerate a positive ripple effect with other suppliers. We are committed to introducing, training and qualifying local businesses into the subsea supply chain, and estimate we will spend in the region of NOK 200m with regional suppliers. We are also recruiting around 50 engineers and support personnel for the new office.”

This northern expansion parallels Subsea 7’s expansion in north-east Canada, where our office in St. John’s, Newfoundland, now employs around 80 personnel and, working in collaboration with Tromsø, puts the company in a strong strategic position for anticipated Arctic subsea development.

Subsea 7 has invested strongly in expanding its local Norwegian presence in recent years, and now employs over 1,000 onshore personnel in its project execution offices in Stavanger, Oslo and Tromsø, support bases in Kristiansund and Dusavik, and a vessel management and support base in Grimstad.

“In 2008, we opened our \$30 million state-of-the-art spoolbase at Vigra, in north-west Norway, which is the most sophisticated of its type in the world,” says Stuart Fitzgerald, Subsea 7 Vice President Norway.

Vigra’s 2,000m-long spool-lines reduce vessel spooling time by around 25%, and the facility incorporates world-leading automatic welding, inspection and field joint coating technologies designed by Subsea 7’s Global Pipeline Welding Development Centre in Glasgow, UK.

Since its opening, Vigra has demonstrated its advanced automatic welding capabilities on an extensive range of linepipe sizes, types and materials, including high-performance Pipe-in-Pipe (PIP), BuBi® mechanically lined pipe, Corrosion Resistant Alloy (CRA), high-strength and stainless steel pipe.

Applied technologies - Pipeline Bundles and Pipe-in-Pipe

Subsea 7 has also pioneered and established two technologies with particular significance for subsea developments in the northern seas: pipeline Bundles and high-performance Pipe-in-Pipe (PIP).

The unique pipeline Bundles are produced at the company’s fabrication base at Wick, in northern Scotland, which recently underwent an \$8.8 million refurbishment, and where the company has established world-leading expertise in the technology.

A successful Bundles case study has been carried out for Statoil exploring the use of the concept in the Barents Sea, and Subsea 7 is currently installing its deepest Bundle to date, a 4.5km product for BG’s Knarr Norwegian North Sea project in water depths of 410 metres. This

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Bundle also features the largest and heaviest towhead launched to date from Wick, at around 575 tonnes.

The company has designed, fabricated and installed 70 North Sea Bundles in the last 30 years, and the prefabricated concept is widely recognised as a technically and commercially attractive alternative to field-laid flowlines.

Pipeline Bundles are fully fabricated and tested onshore in lengths of up to 7.6km and diameters up to 56 inches, and are towed to their offshore location at a controlled depth below the sea surface to minimise wave-induced fatigue implications.

The product therefore requires no specialist pipelay vessels for installation, and has many potential benefits for new subsea installations, including excellent thermal performance, fibre-optic "health monitoring" and the potential for re-use.

In particular, the large towheads which terminate one end of the Bundle are being increasingly viewed as a cost-effective housing for subsea processing equipment.

"Bundles offer clients both technical and cost benefits, and we anticipate their deployment in fields beyond their North Sea origins," says Thomas Sunde.

Working in collaboration with manufacturer ITP InTerPipe, Subsea 7 has also designed and manufactured the most thermally-efficient pipeline on the market today – high-performance Pipe-in-Pipe (PIP).

To date, the company has installed PIP in over 40 projects worldwide, including Statoil's Svalin development, where the PIP was fabricated at Vigra and installed by reel-lay in 2013 by the *Seven Navica*.

Subsea 7 has also developed and qualified Electrical Trace Heated Flowlines (ETHFs), a unique game-changing enhancement of PIP with low-voltage electrical heating elements incorporated to offer an active temperature control capability to the product's high-performance insulation.

Trace heating is a low-power consumption element which gives operators an optional capability to ensure that the residual fluid in a pipeline never cools down to a critical level, for example during maintenance shutdowns.

ETHF has been received with great interest in the market, and has been qualified by independent authorities such as DNV and clients including Total, Statoil, ExxonMobil and Noble Energy.

"Pipeline flow assurance is the key issue in subsea field development," says Sunde. "PIP and ETHFs give clients the predictability that they need, especially for seabed processing.

Life of Field

In addition to its field development capabilities, Subsea 7 is also one of the largest and most successful global contracting partners in the Life-of-Field market, which includes survey, inspection, repair, maintenance (IRM), and field support and field extension services.

Subsea 7 optimises engineering solutions through its multi-disciplined team of engineers, technicians and programmers, complemented by experts in bespoke tooling and equipment such as Autonomous Inspection Vehicle, pipeline repair equipment, data management and map-based Geographical Information Systems (GIS) support.

The company estimates that it has inspected more than 300,000km of subsea pipelines, and at any one time may have around 1,200 people onshore and offshore engaged on LOF contracts.

The North Sea LOF market has two main sectors – diving-based LOF and Remotely Operated Vehicle (ROV)- based. Over many years, the UK sector has seen an increasing deployment of innovative ROV and remote intervention technologies, many of which have been pioneered by Subsea 7.

But, with the growing emphasis on subsea processing, the Norwegian sector is no longer so reliant on diving support services, and there is a growing demand for dedicated, dual-purpose support vessels with both ROV and diving capabilities.

Subsea 7 has invested in a number of new world-leading support vessels for the Norwegian market, and, as a consequence, is now experiencing an increasing client preference for long-term IRM frame agreements based on the deployment of these dedicated multi-purpose vessels.

“Through our North Sea frame agreement contracts with majors like Statoil, Shell and BP, we have already demonstrated that the partnership approach is particularly cost-effective in LOF, where we can base our service activities on long-term knowledge and understanding of the existing subsea infrastructure,” says Stuart Fitzgerald.

“This approach is also increasingly of interest to smaller independents who can pool their requirements to enjoy the benefits of dedicated LOF vessels on long-term contracts.

“Our Life-of-Field capability benefits from the versatility of our fleet, and positively complements our EPIC project management activities.”

World-class vessels

Subsea 7 has its roots in the early days of North Sea diving, and, despite its fleet of over 175 advanced Remotely Operated Vehicles (ROVs) and the widespread growth in diver-less remote intervention, it remains a market leader in the provision and support of diving-related subsea activities.

The company operates the largest and most versatile fleet of Dive Support Vessels (DSVs) in the industry, including the *Seven Falcon*, one of the largest and most advanced DSVs in the world, which features a state-of-the-art 24-man saturation diving system rated to 400 metres.

Along with DSVs the *Seven Atlantic* and *Seven Pelican*, the *Seven Falcon* was deployed in 2013 on ConocoPhillips' Norwegian Eldfisk and B11 projects, the world's first subsea projects to feature three simultaneous hyperbaric welding habitats.

Subsea 7 also continues to invest in its high-end construction and pipelay vessel capability, building on the introduction to service in 2012 of the flagship *Seven Borealis* with a second new high-performance heavy construction vessel, the *Seven Arctic*, which is currently under construction in South Korea for delivery in 2016.

Despite her name and winterisation features, the *Seven Arctic* will be deployed on a global basis. The vessel's high-performance capabilities represent a game-changing technological advance: her 900 tonne heavy lift crane, high-tension Vertical Pipelay System (VLS) and 7,000 tonne underdeck storage basket will extend the operating limits for architects of the next generation of subsea structures.

"To meet the challenges of more complex field developments in deeper waters calls for heavier structures, longer umbilicals, more complex spoolpieces and a greater diversity of equipment to be installed," says Øyvind Mikaelson.

"The advanced capabilities of the *Seven Arctic* will meet these demands, and allow even the most technically challenging projects to be executed more quickly, safely, reliably and cost-effectively."

Subsea 7's world-class fleet is based on a wide range of modern, high-performance vessels which are, both individually and collectively, capable of operations beyond the scope of other vessels in the market.

The successful strategy has been to develop a versatile global fleet designed to meet market needs in wide-ranging worksopes, including high-performance pipelay in all four modes - J-lay, S-lay, flex-lay and reel-lay.

Subsea 7 is committed to maintaining its competitive advantage in fleet capability through its in-house design expertise, collaborations with leading vessel construction and equipment partners, and ability to sustain investment in these critical assets.