GE Oil & Gas
Subsea Systems

Subsea Systems in Norway

Fueling the future with comprehensive technologies and support services for the most extreme conditions

Fueling the future
with subsea systems

Technology

GE Oil & Gas is a world leader in advanced technologies and services with 45,000 employees in more than 100 countries supporting customers across the industry—from extraction to transportation to end use. Our unrelenting commitment to the environment, health and safety, quality and integrity defines us: it's The Way We Work. We develop smart solutions for our customers across the oil and gas value chain delivering the innovation, customized service solutions, training programs and technology that help them to maximize their efficiency, productivity and equipment reliability. We partner with our customers to develop their next generation workforce; help them to fully benefit from the megatrends of natural gas, the growth of subsea and hard-to-reach reserves and the revolution in asset health management. We collaborate with our customers to address today's toughest challenges, push the boundaries of technology and fuel the future.

Each of our GE Oil & Gas Centers of Excellence (COE) around the world is dedicated to delivering the highest quality for its particular technology area. Our COE in Norway, for instance, ensures that subsea manifolds and connection systems provide decades of safe and reliable operation with our subsea tree and wellhead systems, as well as the flexibility for future expansion and integration of emerging technologies.

These widespread petroleum-specific resources have the unique advantage of drawing on GE's strengths in other key transferrable-technology areas like aviation, energy and healthcare. We cast a much wider net than most for identifying and applying solutions to improve performance in subsea applications.

Talent

We cast a similarly wide net for innovative thinkers. In addition to recruiting top graduates in every region where we do business, we also have programs focused on closing the demographic 'talent gap' that the oil and gas industry is currently facing. By attracting trained and experienced engineers and managers from other high-tech industries, and tailoring training to their already advanced levels, their new perspectives and approaches to problem-solving bring tremendous value to all aspects of our business.

Because of these unparalleled training and career development programs, as well as the high integrity through all other aspects of the way we work, GE Oil & Gas is recognized as an employer of choice around the world and, in particular, in the exciting and challenging subsea sector.

At the heart of subsea

Norway has long been a proving ground for offshore drilling and production products and processes, so it's no surprise that many of GE's most advanced subsea technologies have more than 50 years of heritage here too. We pioneered subsea pumping in 1992 at Prezioso, subsea separation and boosting in 1999 at Troll C, and subsea compression in 2006 at Ormen Lange.

Our Subsea Systems business employs around 1,000 employees in Norway. Our teams design, build and maintain industry-leading products, and provide the highest levels of support to offshore oil and gas operations in the North Sea, the Norwegian Sea and around the world.

Our Sandvika head office just outside Oslo combines with the resources at Trondheim to make up GE's global Center of Excellence for Manifolds & Connection Systems. Our state-of-the-art facilities in Dusavik (Stavanger) and Fyllingsdalen (Bergen) focus on comprehensive life-of-field support service.

Evolution & integration

Whether tied back to an offshore facility or as a long step-out from shore, every design is tailored to meet the specific requirements of the reservoir, installation procedures, storage and processing systems.

By continually investing in product research and rigorous testing, and by working closely with our global customers, we deliver practical solutions to the industry's immediate needs, while staying focused on the long-term potential that our evolving technologies will help unlock.

Fundamental to the success of any subsea development is the ability to ensure that mission-critical components will work together when installed and be reliable for the duration of their service life. To do this, we fully evaluate all the diverse components and put effective mitigation programs in place to keep each project on track.

Sandvika

The advanced resources at our Sandvika and Trondheim sites combine to form GE's Global Center of Excellence for the following areas:

- Subsea Systems engineering & project management
- Flow assurance
- Subsea manifolds and connection systems
- Subsea power and processing

The combined size of the sites is 15,485 m^2 and hosts a world class team of around 450 people, including subsea engineering and project control experts, and is our headquarters for state-of-the-art finite element analysis (FEA) and computational fluid dynamics (CFD) design capabilities. The 1,300 m^2 Trondheim engineering office specializes in the development and manufacture of subsea manifolds. Our team is comprised of experts in design, analysis and material properties for subsea construction. They work closely with the Sandvika team to engineer industry-leading equipment for use in some of the most demanding installations around the world.

Sandvika, Billingstad and Drammen Footprint

Total Site	15,485 m^2
Lab/Workshop	1,300 m^2
Crane	6.3 tons
Caterpillars	30 tons
Hook height	5.2 m
Warehouse	1,200 m^2

Significant assets at Drammen

- Hydrostatic pressure test lab
- High voltage test lab
- General assemblies
- Clean room assemblies
- Shallow water testing of assemblies
- Medium scale multi-phase flow loop for separation and flow assurance tests

These locations provide a seamless range of services that enable the most challenging subsea projects around the world. From ground-breaking research and technology development for individual products and integrated systems, to project management, multi-disciplinary engineering and project execution.

Subsea Systems engineering

This team supports subsea delivery projects and performs front-end and concept studies for subsea developments, incorporating new technologies for improved recovery, reliability and performance.

Manifolds & connection systems

We support an extensive portfolio of equipment and technology for subsea infrastructure development – including manifolds, jumpers, connection systems, tooling, pipeline end terminations (PLETs) and specialized pipeline structures. The product portfolio is continually growing, with new and enhanced solutions being developed and qualified.

Subsea power & processing

We are spearheading development of the next generation of subsea processing solutions, building on GE's extensive range of technologies within subsea systems, gas compression and power distribution, and leveraging GE's global research and development capabilities.

Stavanger

Our Stavanger facility is strategically located at the Dusavik supply base, just 15 minutes outside downtown Stavanger. With approximately 500 employees, it is a key resource for the offshore industry since 1984.

It is the largest GE Oil & Gas service facility in the world and our primary location for all engineering, sales and service related to our VetcoGray subsea and surface systems. Significant assets include advanced testing and assembly facilities and a fully equipped service workshop. We provide aftermarket and field life management support to customers operating primarily in the North Sea. Services range from repairs and system testing to expert offshore field support.

As many fields in the North and Norwegian seas are now quite mature, the expertise and advanced technologies at our Dusavik facility become increasingly important – ensuring the highest integrity refurbishment, modifications, upgrades, and life-of-field extensions.

Footprint

Office	5,000 m^2
Workshop	7,500 m^2
Test & assembly	2,200 m^2
Yard storage	32,000 m^2
Warehouse	2,900 m^2

Comprehensive customer support

- Field-life service and management
- Product engineering and sales
- Engineering and project management for tail-end and subsea tie-back projects
- Repair, stack-up and integrated testing
- Support for exploration and drilling campaigns
- Functional and configuration testing
- Operation and maintenance training

Key technologies

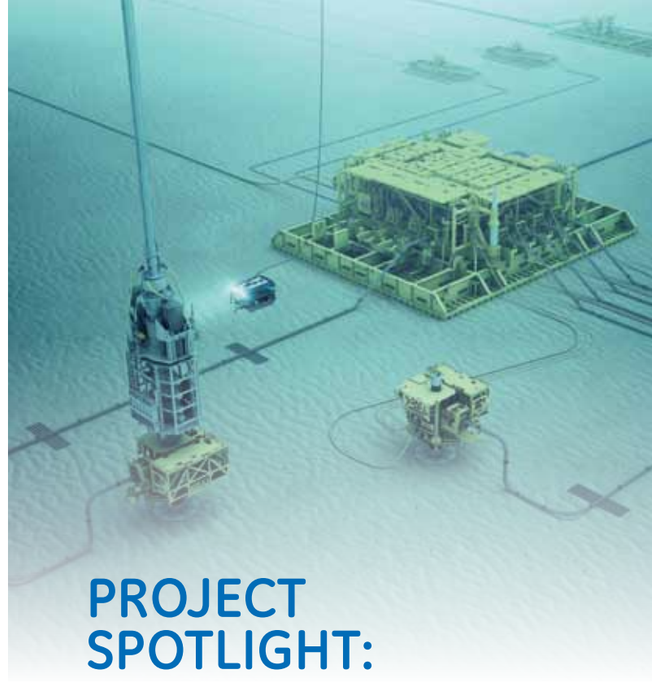
- Surface & subsea wellhead equipment
- Surface & Subsea trees
- Capital Drilling equipment
- Subsea production control systems
- Manifolds and connection systems
- Specialty connectors and pipe
- Connections and tie-Ins
- Exploration equipment
- Valves

INNOVATION & COLLABORATION

Stavanger is also home to GE's Technology Solutions Center (TSC) for oil and gas. Completed in 2014, it is the first facility of its kind in Europe.

With the North Sea's important place in the global offshore industry, the TSC gives visitors deeper insight into the latest and emerging technologies from GE Oil & Gas as well as related solutions from GE Energy Management, GE Power & Water, GE Lighting and GE Transportation.

The TSC features a combination of interactive kiosks, scale models and live demonstrations. One sure highlight is the Industrial Internet area showcasing GE's latest Predictivity™ and Remote Monitoring & Diagnostic solutions. The facility also provides state-of-the-art training and collaboration facilities for our customers and other organizations.



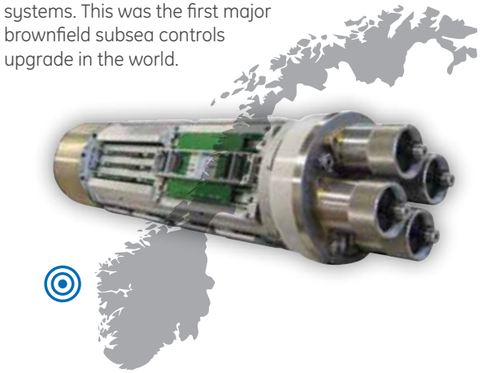
PROJECT SPOTLIGHT:

Tordis & Vigdis

Located in water depths of 200-280 m in the North Sea, the Tordis and Vigdis oil fields tie back to processing platforms 7 and 10 km away, with subsequent links to other fields for gas-reinjection. Tordis came on stream in 1994 and is now 48% depleted. Vigdis came on stream in 1997 and is now 38% depleted. The two fields have produced over 629 million barrels of oil – roughly 300 million more than expected at the beginning. Yet, Statoil plans to extract nearly 400 million more barrels from them over the next 15 years.

Recognizing the advanced technologies needed to achieve this goal, Statoil was the first company in the world to use GE's award-winning SemStar5 subsea electronics module, which greatly simplified the field by eliminating many of the original control modules from multiple vendors. SemStar5 enables complete operation from shore, including real-time monitoring and diagnostics of all seabed equipment. It also enhances safety and productivity with advanced sand-monitoring and leak-detection capabilities, and has the flexibility to integrate more features in the future.

A total of 27 wells were upgraded including subsea control module retrofits, installation of new electrical distribution system, and replacement of topside control systems. This was the first major brownfield subsea controls upgrade in the world.



Bergen

Our primary Stavanger service center is supported to the north by a smaller yet equally capable facility in Fyllingsdalen, just outside Bergen. With a fully equipped workshop facility and warehouse, the Bergen site provides a wide range of aftermarket and field-life management services, including repair, testing and offshore service support.

The Bergen facility is our prime Pressure Control facility in Norway specializing in surface wellhead and tree technologies.

Footprint

Office	250 m^2
Workshop	750 m^2
Yard storage	800 m^2
Warehouse	550 m^2

Primary capabilities

- Aftermarket support and field-life management
- New product and aftermarket sales and engineering
- Project management and engineering for tail-end and subsea tie-back projects
- Refurbishment, repair and testing
- Project management and engineering for field life managements systems

PROJECT SPOTLIGHT:

Balder Phase 3

The Balder field is located about 190 km off the coast of Stavanger in water depths averaging 125 m. With estimated recoverable reserves of 170 million barrels of oil and 0.8 billion m^3 of gas, Balder is a problematic reservoir because of highly viscous oil. It has 12 production wells, three water injection wells, one gas injection well and a water source well. All are equipped with independent guidebase, wellhead system and subsea tree, while some of the production wells are commingled with shared flowline and riser. Balder is one of the first Norwegian fields developed with a permanent FPSO vessel. It began producing in 1999.

We are providing a wide range of products and services for the refurbishment and upgrade of Balder's legacy systems as well as integration of our latest technologies, including subsea trees, controls, connectors and subsea flexible pipelines. GE's VetcoGray SemStar5 subsea electronics module is a key enabler of this life extension project. A key benefit of our technology is backwards compatibility that will avoid costly modification of existing topside facilities and mitigate future obsolescence issues.

Balder currently produces about 135,000 barrels a day and, although in the decline phase, the upgrade and expansion work we're doing now is expected to keep the field producing until 2025.

Workshops

Subsea solutions

Our subsea workshops are staffed by highly trained and experienced technicians, supported by our most advanced test equipment and tools for new build, repair and maintenance of offshore equipment. We provide 24/7 contingency service, training and education, excellent quayside access, and adhere to various rigorous safety programs.

Key assets and capabilities

- 50-ton overhead cranes
- Test pits with 22.5 KPSI capabilities
- Clean rooms
- New building of subsea trees & completion tools
- Re-certification, modification, repair, refurbishment and maintenance
- EFAT/SIT and commissioning support
- Mobilizations and demobilization
- Instrumentation services
- Preservation, logistics and storage

Surface solutions

This workshop's support capabilities span the entire product range and lifecycle – from building new surface trees and capital drilling equipment, to installation and ongoing maintenance, repairs and upgrades.

- EFAT/SIT and commissioning support for EPC projects
- Re-certification
- Mobilization and demobilization activities
- Customer property management, spare parts and storage
- Field installation and maintenance
- Engineering and technical support
- Customer product training

Tool pool and rental supply

- MS-700 wellhead system tooling
- SG5 wellhead system tooling
- SG6 wellhead system tooling
- Container management service
- ICARUS tie-in system
- Vertical connection system
- RCR component replacement system
- Ve-Mec tie-in system
- LIRT level indicator replacement tool
- MECON high-power electrical connector system
- ROV torque tools
- Workshop/control/transport containers
- Hydraulic power units

Welding

Our well-established Dusavik welding facility is ISO 3834-2 certified and contains all necessary fabrication and welding equipment. Layout includes separate halls for production of structural steel and segregation of carbon steel piping and other exotic materials. All handling, welding and fabrication procedures are conducted to the highest qualified specifications and quality standards. A variety of surface protection, NDE, machining and other services are available in the Dusavik base area.

Control systems

Providing full service for maintenance, refurbishment and repair of Subsea Control Modules; as well as testing of directional control valves (DCV) with various subsea control fluids.

Tie-in operations

This workshop has floor area of 1,200 m^2 with a 12 m height to crane, a 6 x 8 m test bay and two 20 ton cranes. Complete service capabilities cover stripping, cleaning and inspection, repair, mobilizations, demobilizations, assembly, testing and FAT/SIT for the following manifold and connection system equipment:

- Horizontal and vertical tie-in tools
- Subsea separation tooling
- ROV tooling
- Tree and manifold control modules
- Choke running tools
- Hydraulic power units
- Torque tools

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