Pumps and Subsea Processing Systems

Increasing efficiencies of subsea developments
Pumps and Subsea Processing Systems

OneSubsea offers unique and field-proven pumps and subsea processing systems. Our aim is to provide comprehensive technical solutions to help increase efficiencies in subsea oil and gas developments worldwide through high-quality pump standardization, as well as tailor-made systems.
Subsea Processing Technology

Subsea processing technology is increasingly playing an important role in spurring offshore developments, both in deepwater greenfield developments and in tying back satellite fields to existing host facilities at conventional water depths. Advanced technology, coupled with the dramatic reduction in development costs, have been the driving force behind the increased use of subsea production systems, enabling operators to access deepwater oil deposits and gas reservoirs.

OneSubsea offers unique and field-proven turnkey solutions to enhanced recovery systems for subsea oil and gas developments worldwide. Drawing on 30 years of experience in subsea processing and boosting, our systems have been developed to meet increasing market requirements to facilitate and enhance oil recovery in deepwater, ultra-deepwater, and long-offset environments.

We have in-house knowledge and expertise of all key elements, from pump design, controls and power system solutions, to subsea stations and topsides power and control modules. Our pump and multiphase compressor systems can be applied as standalone solutions or as part of our total field offering.
Pump Technology

OneSubsea supplies pump systems that incorporate the equipment necessary for integration with seabed production systems. Our boosting technology covers all operating conditions, from single-phase pumps for oil production or water injection, to multiphase pumps and wet gas compressors (WGC). Our modules enable light intervention and simple integration with existing or new infrastructure. We design, develop, and test all our systems under realistic conditions and to full load prior to delivery and installation, thus ensuring reliable systems throughout the life of the field.

OneSubsea pump systems can be operated safely from topside via the variable speed drives and pump control systems located in dedicated power and control modules or in local equipment rooms. We provide total system solutions to ensure all risks have been identified and mitigated at the early stages of the field development-planning phase. These solutions are combined with operational support to provide complete system availability.

Based on the requirements of a given field, OneSubsea designs and builds boosting solutions that include all the equipment needed to operate the pumps during startup, shutdown, and under normal flowing conditions. A controls and power umbilical system transfers the power and utilities from topside to the booster station. This umbilical contains a topside termination unit with hangoff and a subsea termination assembly where all lines are split out and jumped across to the booster station. For long-distance tiebacks, a subsea transformer also can be included with this termination.

The topsides system, which contains the variable speed drive(s), hydraulic power units, and the pump control system, normally is housed in a power and control module, enabling efficient hookup and commissioning on site.

All pumps are configured with an electric motor mounted on top and the pump section at the bottom in a vertical cartridge. The cartridge is fully encapsulated in a pressure housing designed for water depths to 9843 ft (3000 m) and pressures to 15,000 psi. The compact design is optimized, allowing subsea installation and retrieval by light vessels.

OneSubsea is your one resource for field-proven pump systems, providing in-house knowledge of pump internals to electric drive and control systems, from support structure to intervention aids, all backed by operational and aftermarket support.

Depending on how a field develops, any pump type can be fitted into the standardized subsea interface, giving our customers the option to replace one pump with a different type to meet their specific needs during the life of the field.
Complete Range of Subsea Pumps

The initial approach to the OneSubsea multiphase pump systems focused on trial testing of various pump concepts, such as twin-screw and piston pumps, before incorporating the rotodynamic pumping principle known as the helico-axial design. This principle was developed in order to add energy to a fluid mixture of water, oil, and gas (i.e., an unprocessed wellstream), and was arranged in a multistage unit. Today, we offer a complete range of pumps, including the more conventional centrifugal pumps, all of which are designed to meet a variety of market demands.

Multiphase pump

The OneSubsea Multiphase Pump design is inherently robust and is wear-resistant to conditions where particles such as sand may be present, which is the case in most subsea production systems. The technology was developed to handle hydrocarbon flow at high gas volume fractions (GVFs) up to 100% mechanically and to 95% operationally.

The pump can generate a differential pressure of up to 2901 psi (200 bar), depending on the actual GVF at suction conditions. The pump design has been tested and operated on high-viscosity fluids.
**Hybrid pump**
The OneSubsea Hybrid Pump is a combination of helico-axial and centrifugal technologies, ideal for use downstream from a separator where the GVF is kept consistently low. Characteristics of this pump include significant gas-handling capability and increased efficiency.

**High-pressure pumps**
The pressure capabilities of the single-phase design can reach up to 4060 psi (280 bar), or 6525 psi (450 bar) if operated in series. All pumps are driven by an electric motor mounted on top, and the pump section at the bottom, in a vertical configuration. The pump/motor is fully encapsulated in a pressure housing designed for water depths to 9843 ft (3000 m) and pressures to 15,000 psi (1034 bar). The compact design is ideal for subsea installation and retrieval by light vessels.

Wet-mate power connectors are mated during installation of the pumps, and process inlets and outlets feature two clamp connectors operated by standard ROV tooling.

**Single-phase pump**
As with the multiphase pumps, the dynamic pumping principle is used for the OneSubsea Single-phase Pump. The centrifugal design is used for single-phase applications or where the GVF is low.

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OneSubsea has a portfolio of proven, reliable systems that have successfully increased production rates from 30% to 100% for operators.

OneSubsea offers a complete range of pumps designed to meet a variety of market demands.
**Single- and Dual-pump Stations**

OneSubsea pump stations have been developed with an emphasis on achieving a symmetrical, flexible, and compact design. This design simplifies installation, optimizes pump performance, and ensures compatibility with international standards for subsea equipment.

**Life-of-field solution**

The piping within the subsea pump stations can be configured to allow for a variety of pump operations, such as parallel, serial, or individual, according to the client’s needs and the details of the field.

The interfaces between the pump and the pump station are standardized so that any pump type can be fitted into the same slot. This allows the operator to replace the pump with a different type (e.g., multiphase, centrifugal, or hybrid) if necessary during the life of the field.

The pump station can be installed on mud mats or on a suction pile/anchor; it can be integrated in new field developments (i.e., greenfields), and can be easily retrofitted and adapted to existing production systems (i.e., brownfields). A dedicated umbilical connects directly to the module and includes:

**Standard**
- Power
- Barrier fluid supply
- Pump control lines

**Optional**
- Methanol lines
- Fiber-optic cables
- Chemical inhibitor lines

To ensure the correct and safe operation of the pumps and production systems, the pump stations are equipped with the following features:
- Production bypass
- Recirculation of flow from pump outlet (for start-up and minimum flow conditions)
- Mixing/slug suppression of inlet flow (for multiphase flow only)
- Isolation of pumps for intervention
- Monitoring of process pressure and temperature

**Retrievable items include:**
- Pumps
- Choke insert
- Control modules
- Electrical and hydraulic jumpers
Raw Seawater Injection System for Reservoir Pressure Support

The OneSubsea raw seawater injection (RSWI) system provides a water injection system for installation in fields where topside facilities face challenges with respect to space and weight. The RSWI system reduces the amount of equipment needed to be installed topside. The seawater is filtered to the required level of cleanliness upstream the pump. The RSWI pump uses the same design as the OneSubsea single-phase pump; however, different materials can be selected to ensure compatibility with the seawater.

Main components:
- Single-phase water injection pump
- Seawater filter (when required)
- Process system
- Subsea power system
- Variable speed drive for pump
- Connections
- Umbilical system
- Subsea pump control system (SPCS)
- Operator stations
Multimanifold

The Multimanifold has been developed using the OneSubsea patented Multiport Selector, which provides a more compact test and production system for subsea developments. The Multimanifold applies the OneSubsea PhaseWatcher fixed multiphase well production monitoring equipment utilizing Vx technology for testing of individual wells, and can also include pumps, a control system, and gas lift distribution. The subsea control system is capable of monitoring all components of the Multimanifold, and for some applications, also provides control of the wellheads that are tied into the module.

These features and capabilities help to provide a comprehensive subsea manifold arrangement, allowing operators to reduce contractual interfaces, in addition to offering a structure with an overall installation weight of up to 50% less than conventional manifolds.

The Multimanifold provides a more compact test and production system.
Multiphase Sampling for Subsea Applications

By reducing uncertainties associated with variations in fluid behavior relationships and fluid composition versus time, OneSubsea multiphase fluid sampling and analysis systems take samples at the seabed and provide powerful solutions for improving the understanding of the fluid behavior and maintaining the lowest uncertainty of the flow rate measurements.
The compressor has three main parts: upper electric motor, compressor section, and lower electric motor. As in the case of the pumps, a barrier fluid system is used to provide overpressure protection, lubrication, and cooling of the compressor’s critical parts on a continuous basis during all modes of operation. All process, electrical power, auxiliary, and instrumentation connections have been utilized in more than 25 subsea pumping projects.

**Main features:**

- The subsea multiphase wet gas compressor can handle 100% liquid without any mechanical issues.
- A simple upstream flow conditioner for slug suppression and provision of homogenous feed to the compressor is included; i.e., no complex and costly preprocessing equipment is required.
- The subsea multiphase wet gas compressor has 85% polytrophic efficiency and high wet gas polytrophic efficiency over a wide operating range (GVF and flow rates).
- High-reliability design features no surge or minimum flow limitations.
- High pressure ratio is possible due to the positive density effect.
- High efficiency and low discharge temperature are due to interstage mixing and cooling.
- The subsea multiphase wet gas compressor concept is ideal for subsea applications with a compact design without any need for an auxiliary anti-surge control system, intercooler, or inlet scrubber.
The SPCS has been developed in order to provide:

- Fast-acting monitoring, control, and safeguarding of subsea pumps and compressors.
- Provision of a high data rate communication link for subsea instruments.
- Performance of traditional production system operations.
- Operation of subsea satellite and full field developments as part of the subsea production control system.

In addition to the primary goal of ensuring the safe operation of the subsea equipment, two other objectives have helped drive the development of the OneSubsea SPCS. The first objective is to provide an open architecture that enables the inclusion of various instruments subsea for improved control and condition monitoring. This design offers local data storage with trend tools and the option to interface with the OneSubsea FRIEND® Remote Surveillance and Diagnostic System through Ethernet IP for remote monitoring and control.

The second objective is the ability to provide a high-capacity communication link with bandwidth control to take advantage of subsea instruments such as our multiphase flow meters and other data-intensive instruments. Backup communication also is possible through the use of high-speed power line modems superimposing the communication on the power supply lines.

Our SPCS was designed to operate as part of a wide range of systems, including:

- Subsea multiphase pump systems
- Subsea multiphase compression systems
- Subsea multimanifold systems (including production trees control)
- Subsea RSWI systems (including water injection trees control)

The OneSubsea SPCS provides a fully integrated control system solution, enabling the signal paths to become short and robust for the system controller. A fast system response becomes increasingly important when operating high-power rotating equipment such as subsea pumps and compressors.

Service and Support

The OneSubsea subsea pump control system (SPCS) is an electro-hydraulic subsea control system with high-speed fiber-optic communications. It offers seamless integration of subsea and topside control equipment and is tailor-made for monitoring, control, and safeguarding of subsea boosting applications. The SPCS also ensures optimum operation of the subsea system with both high reliability and high availability, as well as expandability through industry-standard interfaces for other subsea or subsurface equipment.
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