

Swivel and Marine Systems

Swivel stack and fluid transfer systems for multiple applications

Swivel Stack Systems

The swivel stack is the heart of the turret mooring and fluid transfer system (FTS). Reliability, safety, and flexibility are key to securing increased uptime for the floating production, storage and offloading (FPSO) / floating storage and offloading (FSO). The swivels ensure that all fluids (liquids and gas), controls, and power are transferred safely from the geostationary parts (i.e., wells, flowlines, manifolds, and risers) to the rotating vessel and its process plant under any environmental conditions in the field.

OneSubsea is able to engineer, produce, and deliver swivel stacks and fluid transfer systems to FPSOs and FSOs worldwide. We provide a safe and reliable production flow year after year. In addition, the OneSubsea FRIEND* remote surveillance and diagnostic system is offered for the systems.



Total System Supplier

OneSubsea provides the oil industry with products that are engineered, manufactured, tested, installed, and commissioned as turnkey systems and modules.

OneSubsea has the skills and expertise to provide engineering and delivery of complete swivel and marine systems. Our range of products allows our customers to implement complete fluid transfer systems topside and subsea. All of these systems relate to fluid and gas transport, in addition to control and monitoring of the performance. OneSubsea can provide compact and highly integrated solutions.

Topside and subsea

- Multiphase pumps
- Multiphase flow meters
- Multiport selector manifolds
- Wet gas compressors

FPSO/FSO

- Swivel stacks and fluid transfer systems
- Offshore cryogenic transfer (OCT)
- Subsea loading system
- Main contractor role available as required by the project



Swivel stacks and fluid transfer systems for FPSO/FSO

OneSubsea offers reliable and versatile swivels for the transfer of oil and gas production, chemicals, water, electric power, hydraulics, and signals. Our fluid transfer system combines swivel stacks with compact manifolds, valves, quick disconnectable connectors, pig launchers/receivers, etc., in addition to various systems associated with power supply to subsea pumps.

Offshore cryogenic transfer

Our OCT capabilities provide safe and reliable transfer of LNG from ship to ship or from ship to offshore terminals. OneSubsea provides an OCT system that is a complete offtake system for LNG. It consists of a flexible pipe and uses a vacuum to insulate against the environment.

Submerged loading

The OneSubsea submerged loading system has several unique features and benefits:

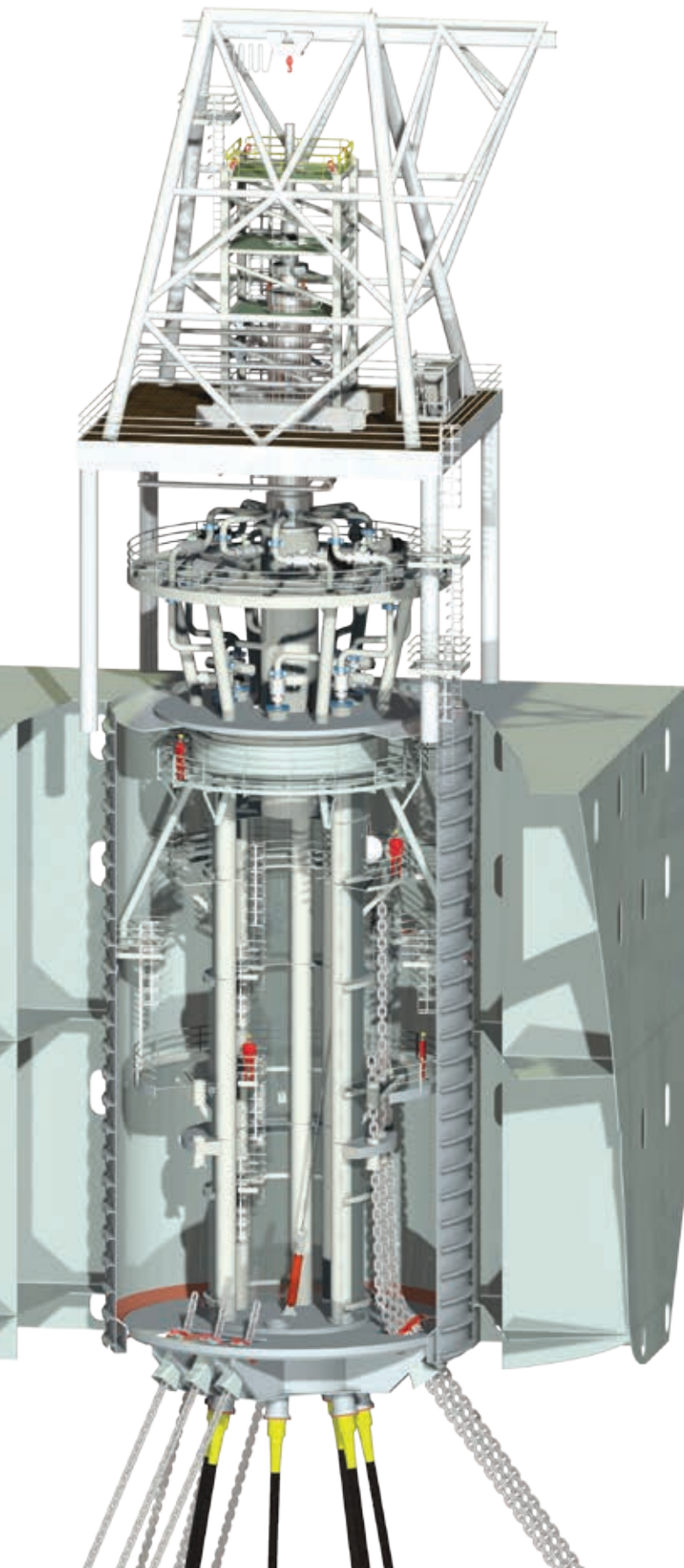
- Robust capabilities with increased weather and operational envelope
- Utilizes proven components throughout the system
- No modification is required for the existing dynamic positioning tanker fleet
- Loading hose is not in contact with the seabed, thus no wear of hose occurs
- Vessel collisions are not an issue due to submersible location
- System is piggable

Integrated and Compact Fluid Transfer System for Oil and Gas Production

Procurement of a complete fluid transfer system will limit the number of interfaces and can secure focus on fluid transfer.

A total system can consist of the following:

- Riser hangoff
- Inlet section
- Swivel stack
- Emergency shutdown (ESD) valves
- Flexible connections
- Pig receivers and launchers
- Compact control and monitoring system integration to hydraulic power unit (HPU)
- HPU
- Integrated multiphase flow meters
- Multiport selector manifold
- Structural connections and torque arms
- Quick connect and disconnect
- Inlet and outlet pigging
- Isolation valves



Complete stack-up prior to shipment

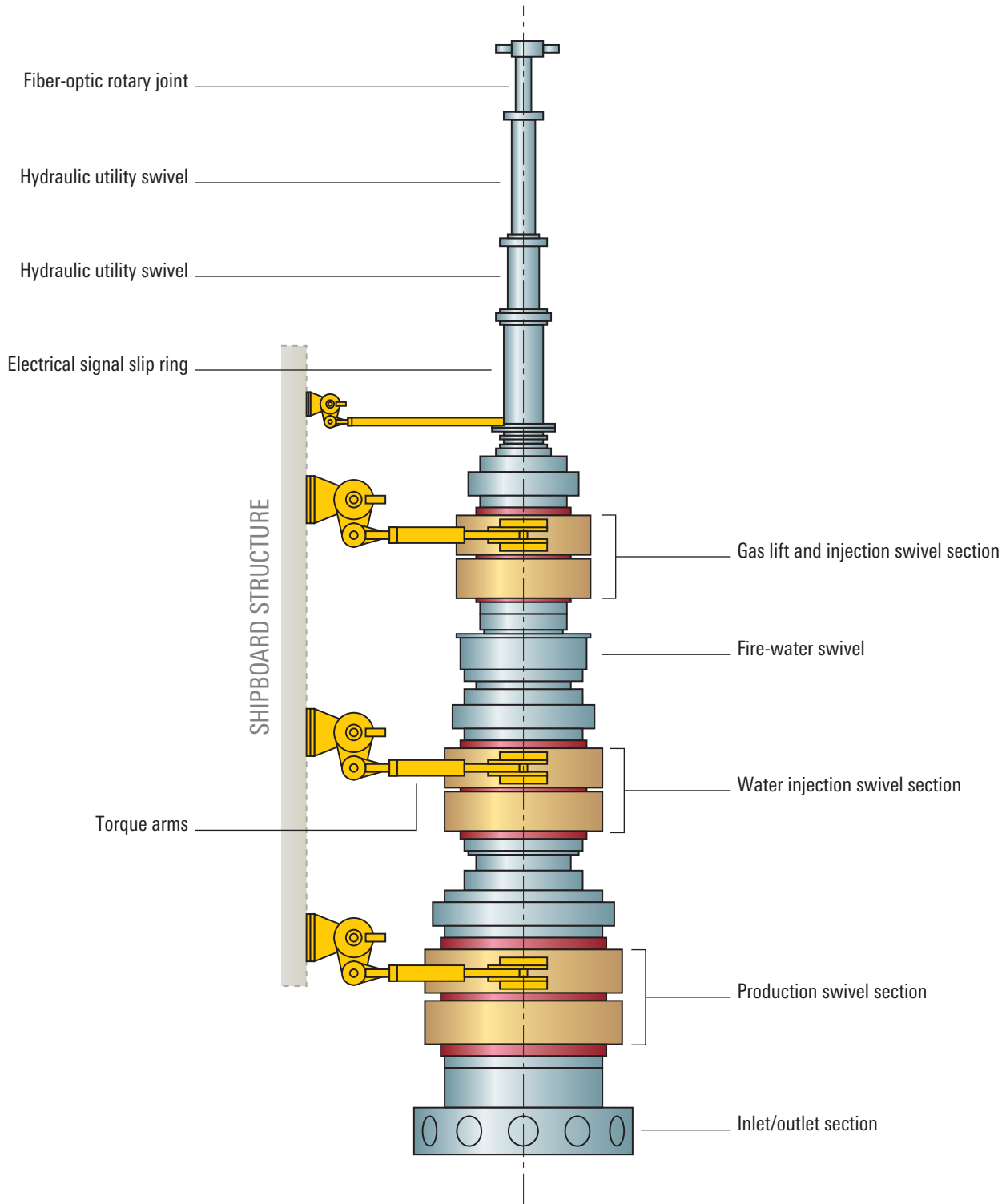
What Makes OneSubsea Swivel Stacks Unique

- Very compact and lightweight, requiring reduced space, and structural support
- Fits any turret and FPSO
- Extremely high pressure capability: to 7,542 psi (520 bar)
- Very large throughput capacity
- High safety and reliability, with continuous condition monitoring of the swivel stack system
- “Green light philosophy,” confirming system availability before startup
- Completely independent of process fluid and operating pressures
- Optimum seal operating conditions independent of pressure and temperature
- Remotely overpressured barrier fluid-activated seals with clean hydraulic fluid
- Modularized and standardized design with flexibility for the operator
- Standardized sealing and bearing system for high availability of spares
- Double sealing between individual swivels and four dynamic seals from the process toward the environment
- Only high-quality duplex materials are utilized in the swivels
- Low torque with continuous lubrication of seals and bearings
- No internal piping or flanges, but use channels in solid core
- Installed in a single lift onto an FPSO



How OneSubsea Swivels Work

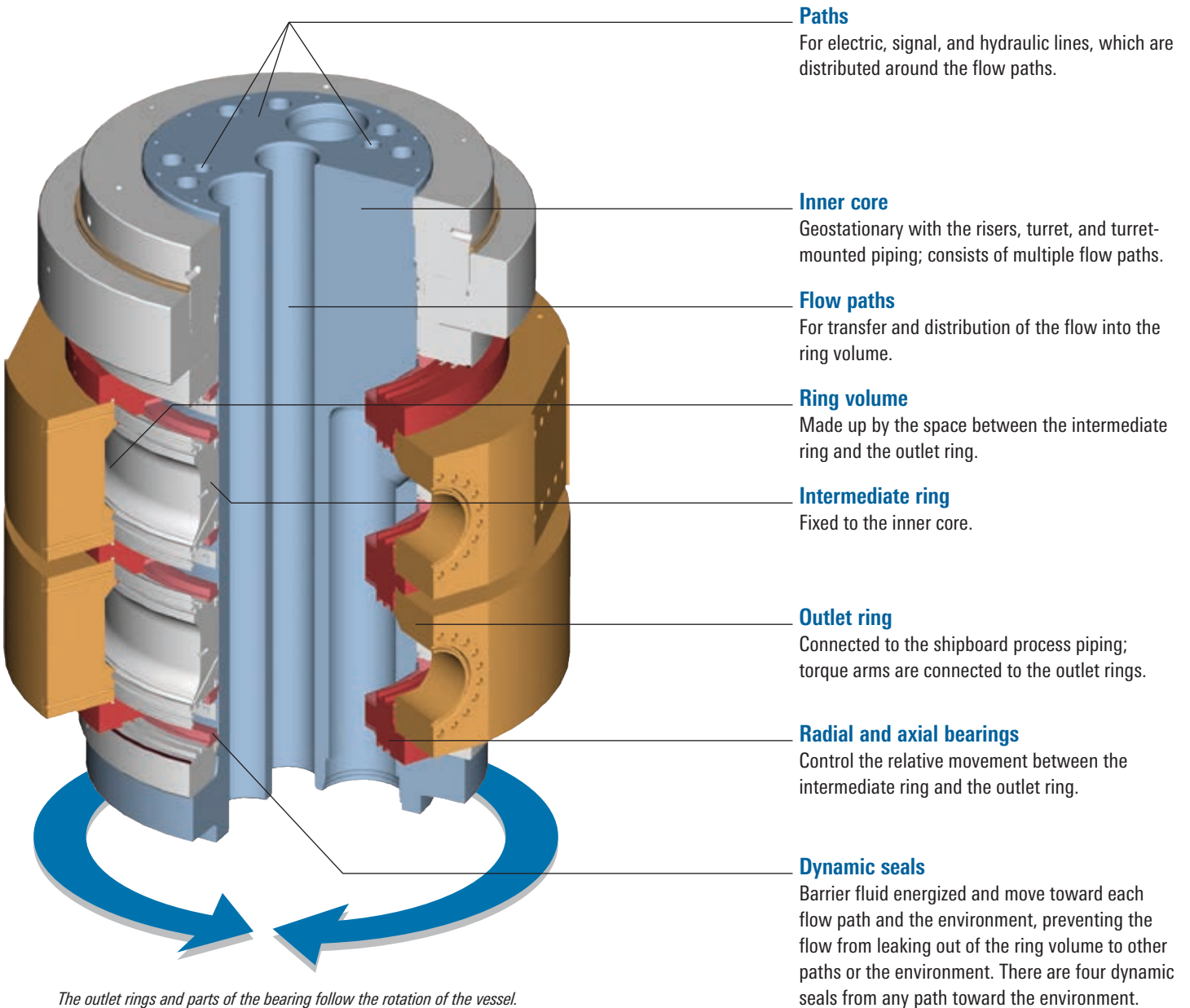
The OneSubsea swivel stack assembly consists of several subassemblies stacked on top of each other. The various combinations of standardized subassemblies provides the flexibility to fit your vessel.





The basic scope of the OneSubsea swivel stack system includes:

- Swivel stack assembly
- Swivel torque arms
- Swivel barrier fluid HPU
- Swivel control cabinet



Flexibility and Versatility

The OneSubsea swivel stack and fluid transfer systems provide flexibility and versatility for customers.

- Each swivel design is independent of the flowing medium
- Duplex material allows for almost all flowing media
- All swivels can handle HPHT applications
- Sealing systems are not in contact with a flowing medium or sand
- Modularized swivel is designed to suit different pressures and capacities
- Modules can be equipped with single or multiple rings
- Each ring can be fitted with one or multiple outlets
- Swivels can be added to existing stacks



Safety and Reliability

OneSubsea swivel stacks utilize proven technology, innovative design and engineering, and communication with customers. Our unique, standardized and compact swivel design is relevant for several applications and meets industry function requirements.

Online swivel condition monitoring is an important safety and reliability issue. Monitoring pressures, oil consumption and torque forces gives the operator indications of possible failure modes. Trending parameters can assist the operator in planned maintenance, resulting in higher uptime. All parameters can be read and controlled from the FPSO's main control center.

Reliability issues are dependent upon the following elements:

- Proven design
- Quality of personnel
- Manufacturing capabilities
- System approach
- Complete system testing

In addition, the safety of personnel and the environment is fundamental to all operators. Selecting the highest quality materials with prolonged service life is a priority for OneSubsea.



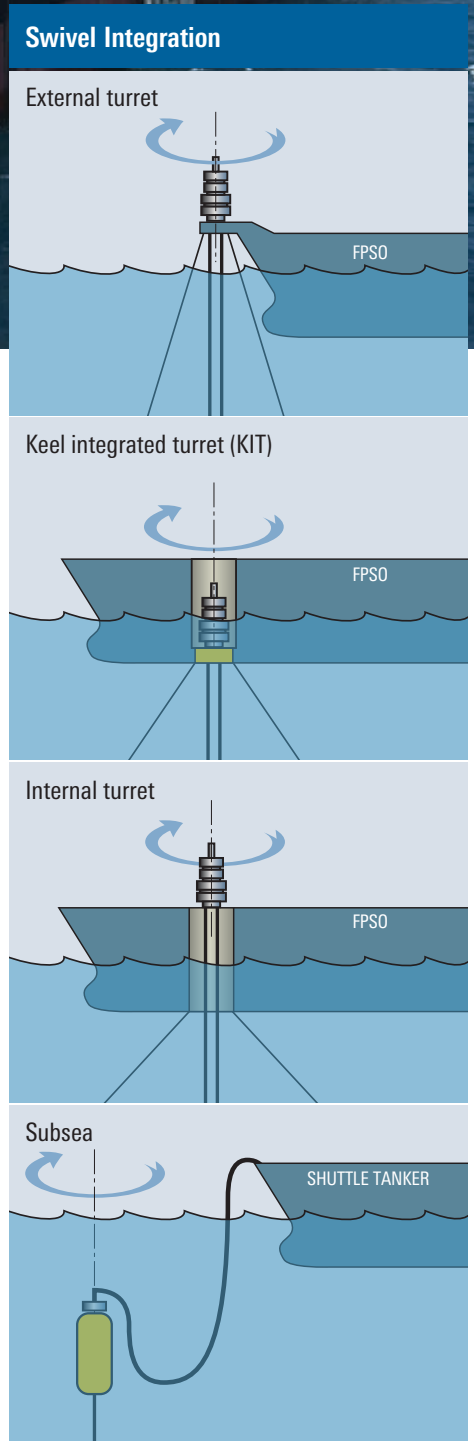
Quality is maintained throughout OneSubsea system engineering and deliveries by performing all critical work within one company, from design to delivery. Our products are thoroughly tested before they are released, providing the required quality. All work is performed in accordance with our ISO 9001-certified quality assurance system.

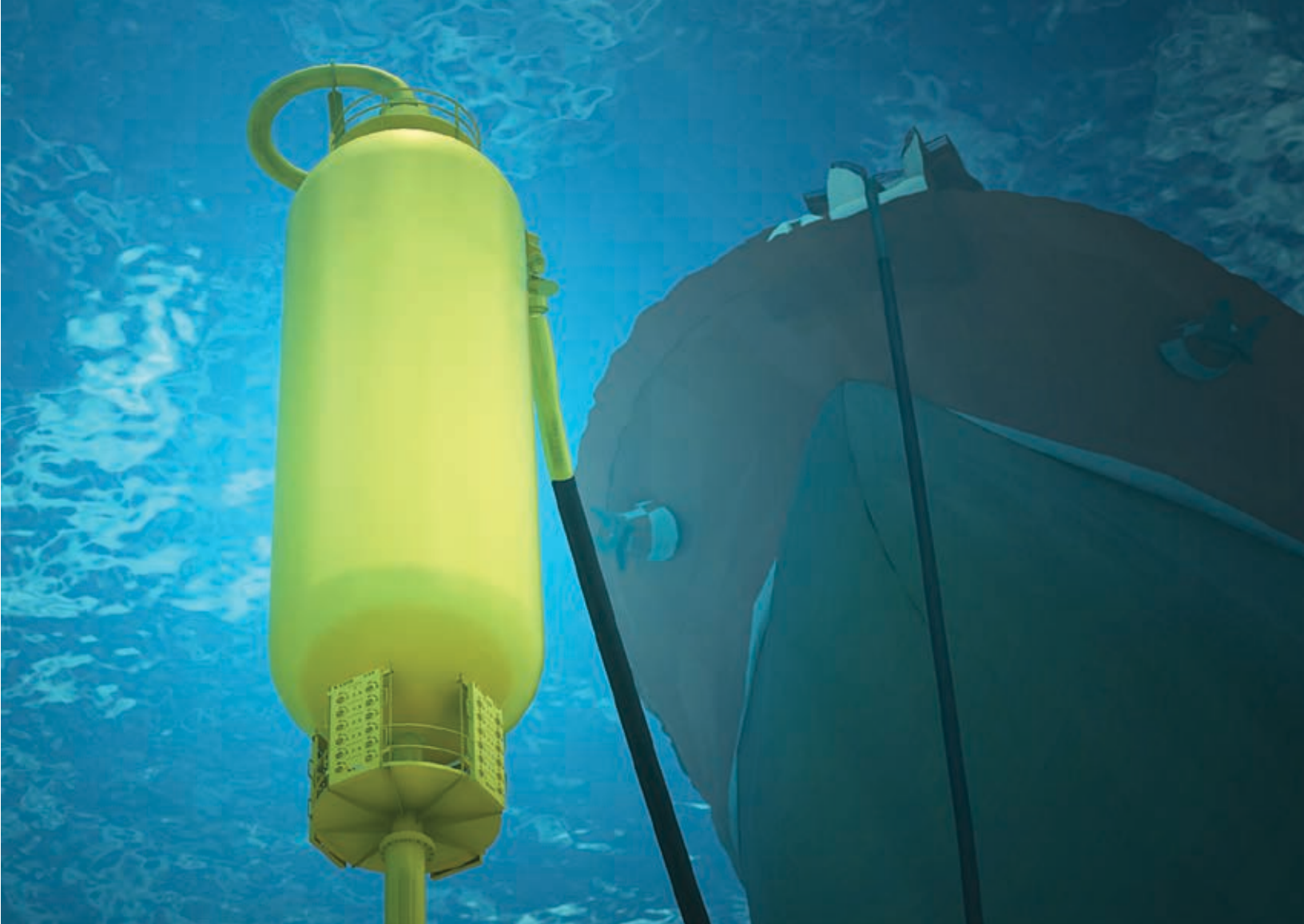


Any Application, Any Turret, and Any FPSO for Any Field

Floating production vessels are flexible and versatile, making them appropriate for use on a variety of field types. These features also apply to the selection and arrangement of fluid transfer and swivel stack systems for FPSOs. FPSO owners and end users can utilize OneSubsea expertise for their swivel and marine systems to increase the value of the vessel in multiple fields. Since there will be an increasing number of vessels available in the marketplace once the FPSOs move from their current fields, the vessels must be flexible in order to stay competitive.

It is expected that vessels will need to be able to easily relocate or be easily converted to suit alternative production, water injection, gas injection, and other requirements. Through utilization and combination of standard swivel sections, OneSubsea is able to provide swivel and marine systems with the features, capacities and flexibility required for such FPSOs.





Submerged Loading System

The OneSubsea submerged loading system consists of a subsea frame, rigid riser, buoyancy tank with swivels and loading hose, and pickup system for the loading hose. The subsea frame contains couplers for two flexible flowlines, valves, and a control system to communicate with the platform. The riser has a flexible joint at the lower end and is held in tension by the buoyancy tank.

A swivel system is placed on top of the buoyancy tank that allows the loading hose and shuttle tanker to weathervane freely. The buoyancy tank typically is located 246 ft (75 m) below the sea surface. The pickup system is attached to the end of the loading hose and connected to a buoy on the surface that can be picked up by the tanker for connection of the loading hose.

Our submerged loading system has the following advantages when compared with conventional loading systems:

- Simple and built on standard and proven components
- Requires no modifications on existing tanker fleet
- Loading hose will never be in contact with the seabed
- Robust, with a larger weather window and a wider operational envelope
- Located subsea, it is subjected to low environmental loads and motions
- Possibility of tanker collision is eliminated
- Designed for 25 years of service life and requires a low degree of maintenance
- Fully piggable system
- Allows for diverless replacement of all critical components
- May be located in close vicinity to existing loading system, thus allowing both the existing and new systems to operate in parallel; the oil export is therefore not interrupted during field testing and commissioning



Data Management and Condition Monitoring

OneSubsea FRIEND Remote Surveillance and Diagnostic System

The FRIEND remote surveillance and diagnostic system provides real-time data readings, data management and condition monitoring of OneSubsea supplied systems. A dedicated web portal provides the customer with access to these services and represents the front end to the real-time database containing interactive functionality such as sophisticated trending, data export and tools to enhance and secure system performance. One example of the interactive tools is the Swivel Flow Calculator for production swivels. This interactive application makes it possible for the operator to increase production within the permissible design limits.

The FRIEND system's automated alert feature continuously monitors system performance and provides alerts and/or alarms to OneSubsea personnel on duty when incoming data to the FRIEND system database indicates abnormal process or system conditions. This information enables OneSubsea to provide a proactive service to secure best practices in equipment operation and maintenance.

Many customers subscribe to the FRIEND system and fully utilize the communication functionality offered by the system, i.e., a 24/7 help desk, an inquiry and discussion forum, FAQs, and a document library. Status reports are quality assured by swivel experts and are published on a daily, weekly, and/or monthly basis.

Condition monitoring parameters

- Torque readings from all torque sensors
- Primary and secondary barrier system pressures
- Barrier tank level
- Number of barrier pump starts for both primary and secondary pumps
- FTS – valve movement
- Process parameters (production and gas lift pressure, temperature, flow rates, and sand production)
- Ship motion and movement information, including heading

Main customer benefits

- Customer and application-adapted support
- Proactive failure avoidance and remote expert analysis, as well as online advice
- Improved operation of equipment, extended run life and increased mean time between failures
- Reduced operating costs and increased oil production

Manufacturing and Testing Facilities

OneSubsea has a unique setup with modern manufacturing, assembly and testing facilities for system and integration testing prior to shipment, both dry and wet. Before being delivered, each swivel stack passes through a test program where all subassemblies and subsystems are tested prior to full integration testing in the test dock in a controlled environment.

The complete swivel stack, with all auxiliary systems, is tested at maximum pressures. Rotation tests are conducted as part of a standard swivel test procedure, and the complete integrity of the stack is demonstrated and verified. In addition, heavy in-house lift capability enables fully assembled and tested systems to be lifted onto vessels at the key side.





Maintenance, In-situ Seal Replacement

OneSubsea swivels are manufactured with double dynamic seals. The double sealing arrangement ensures that one seal (secondary seal) is running idle while one seal (primary seal) is performing the active sealing action. If the active seal fails, the secondary seal will take over the sealing function. This gives the operator time to plan for a swivel seal changeout during the next scheduled production shutdown.

Key swivel parameters are continuously monitored and trended in a dedicated swivel control system. A fault development can be observed and corrective actions planned for.

The swivel stack can be disassembled in situ. This requires a special tool package that can be provided to the customer. This sequence is independent of where of the swivel stack is located.

The swivel stack is a modularized unit that can be disassembled by lifting off each section at a time. A special tool package is used for dismantling the failed swivel section. After repairing or changing the seals, the swivel section is assembled and other swivel sections are reinstalled.

Research and Development

OneSubsea is dedicated to quality and reliability of its products and services. Continuous R&D is an important part of the OneSubsea philosophy. Before releasing any new technical solution or product, we ensure that it meets our high quality standards. Extensive and realistic testing is integrated into our R&D programs to continuously improve our products and services.



OneSubsea advanced subsea technologies, such as our multiphase metering, multiphase boosting, subsea processing systems, and power distribution systems offer further flexibility to our customers' field developments and FPSO investments.

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