OVERVIEW OF SOLUTIONS

Framo offshore pumping system

FRAMO
an Alfa Laval brand

Rethink simplicity

The simplest way to do things is not necessarily the way they've always been done. As technology develops, old truths give way to new and smarter possibilities.

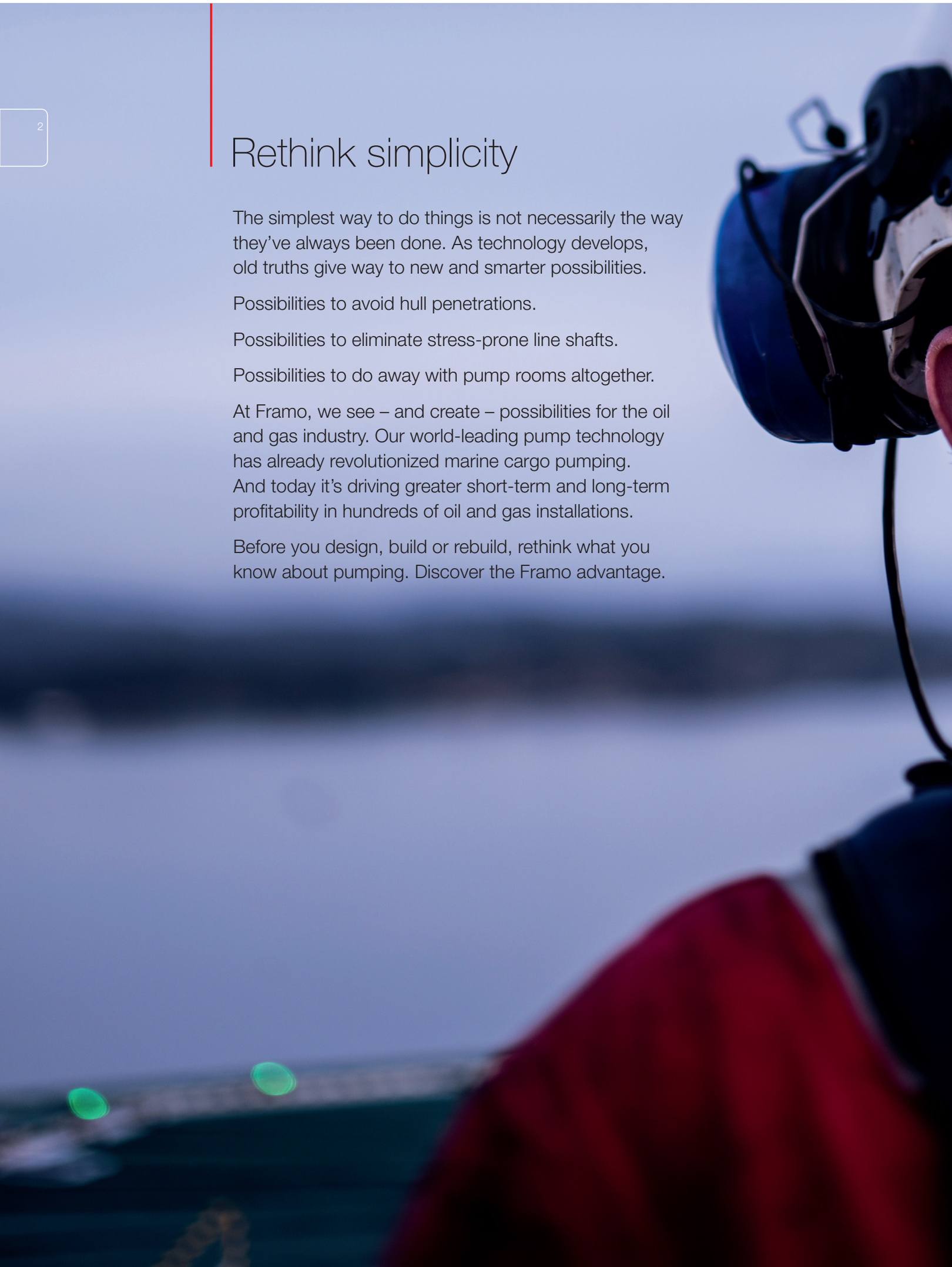
Possibilities to avoid hull penetrations.

Possibilities to eliminate stress-prone line shafts.

Possibilities to do away with pump rooms altogether.

At Framo, we see – and create – possibilities for the oil and gas industry. Our world-leading pump technology has already revolutionized marine cargo pumping. And today it's driving greater short-term and long-term profitability in hundreds of oil and gas installations.

Before you design, build or rebuild, rethink what you know about pumping. Discover the Framo advantage.

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Framo at the forefront

Framo pump technology has proven its worth in marine cargo pumping, where it is the indisputable industry standard. But it holds even more potential for the oil and gas industry – where leading installations are already profiting from its simplicity, safety and cost effectiveness.

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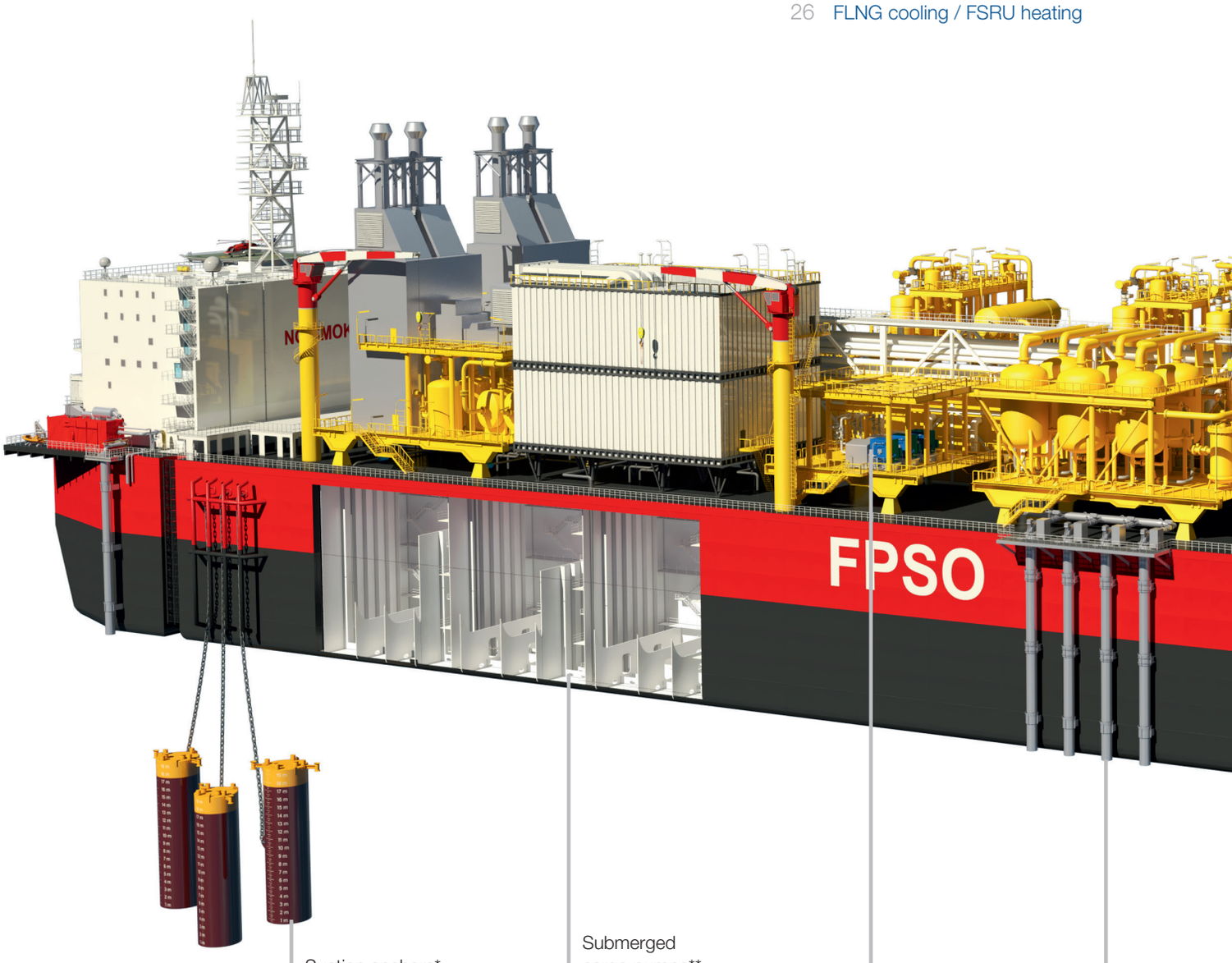

Suction anchors*

*) These products are described in a separate Supply and Recovery Pumping Solutions brochure.

Submerged cargo pumps**

**) These products are described in a seperate Cargo Pumping brochure.

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THE FRAMO ADVANTAGE

Why it pays to think outside the pump room

Pumps are the heart of all oil and gas processes. But traditional pumps in a central pump room mean wasted space, added risk and increased operating costs.

Framo submersible pumps are different. Installed in caissons, which are either outside or integrated into the hull, they offer safe assurance of better business.

The pump that changes everything

Framo began with an idea, that a pump should be where the action is – not isolated in a pump room. Using a hydraulic drive or the unique electric Framo cable-free concept, individual pumps can be submerged right in the place where they do their job.

Money on the side

When the pumps are submerged, the entire pumping installation can be moved outside or integrated into the hull. Instead of a massive internal pump room and extensive piping, simple side-mounted caissons do the job with no hull penetrations.

This reduces risk, for example, by removing the possibility of uncontrolled flooding. But it also means lower total CAPEX and far lower OPEX.

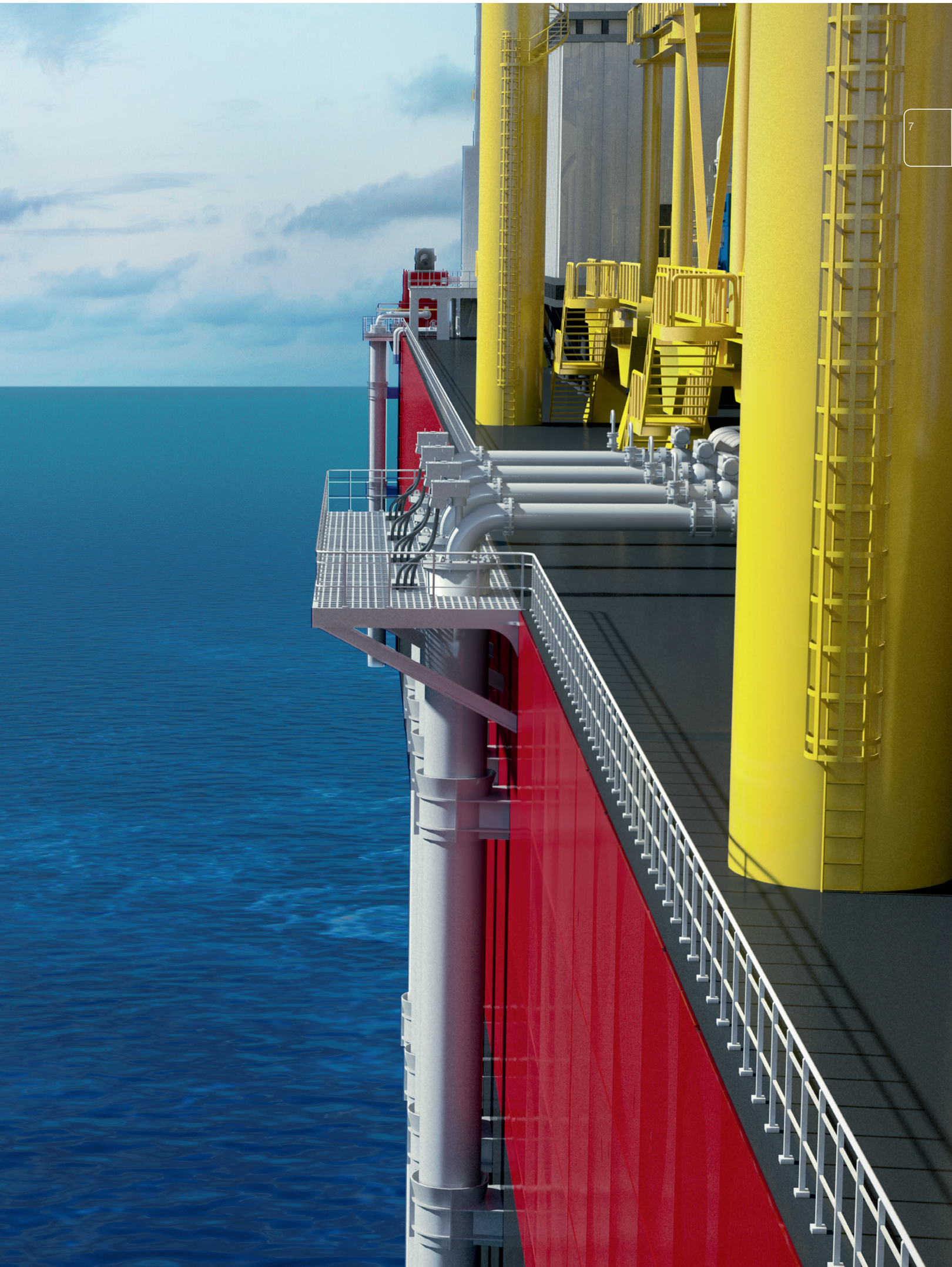
The shortest route to reliability

Not all caisson solutions are created equal. If caisson pumps are installed with the drive motor topside, the long rotating line shaft makes tension and vibrations inevitable.

In Framo solutions, both the pump and its drive motor are submerged. This eliminates the long rotating line shaft, and with it, the strain that can lead to excessive maintenance and breakdowns.

Total peace of mind

The reliability of Framo pumps is only equalled by the reliability of Framo itself. Framo experts are available worldwide and 24/7, and service is dispatched within hours of a call. Without exception, our focus is keeping pumps – and oil and gas businesses – running smoothly.



Numbers matter, but be sure to consider all of them

When the complete system cost is taken into account, a Framo caisson pumping system provides outstanding economy – from initial CAPEX to total lifecycle cost.

A pumping system is designed to function for up to 20 years. CAPEX is an important factor in selection, and Framo caisson pumping systems offer clear savings. But OPEX is equally important, because it accumulates year after year.

Here we present a real-life example of a pumping system's total cost using a recent FPSO conversion. To find out exactly how much you can save, contact us to discuss your particular project and its needs.

Step 1

Concept selection

Capacities for seawater lift pumps vary depending on production rates and temperatures. Normally, the pumps are configured in N+1 units to ensure redundancy. In recent projects, the 100% design capacities have been as high as 15,000 m^3/h.

This creates big challenges when considering a pump room installation: large sea chests on each side of the vessel, 52" suction manifolds, 52" closing valves and suction strainers with isolation valves before the pumps, followed by filters and a discharge manifold to route water to coolers up to 300 m away.

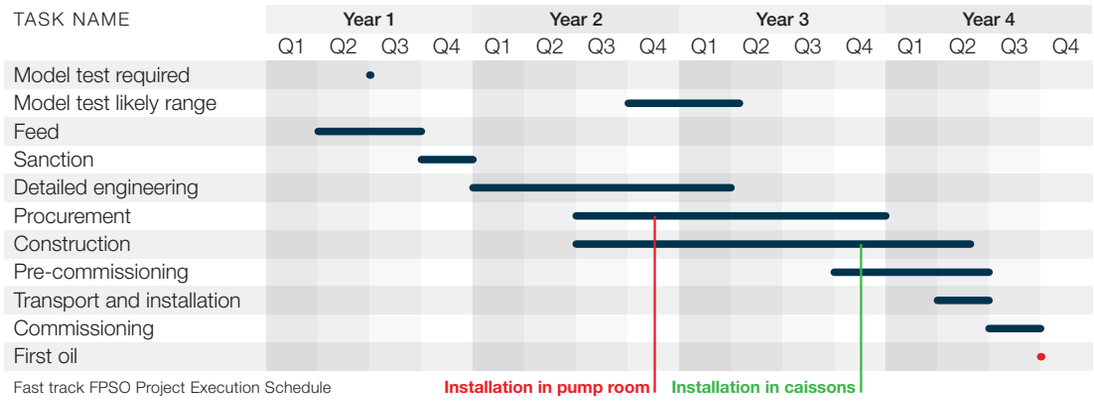
Step 2

CAPEX

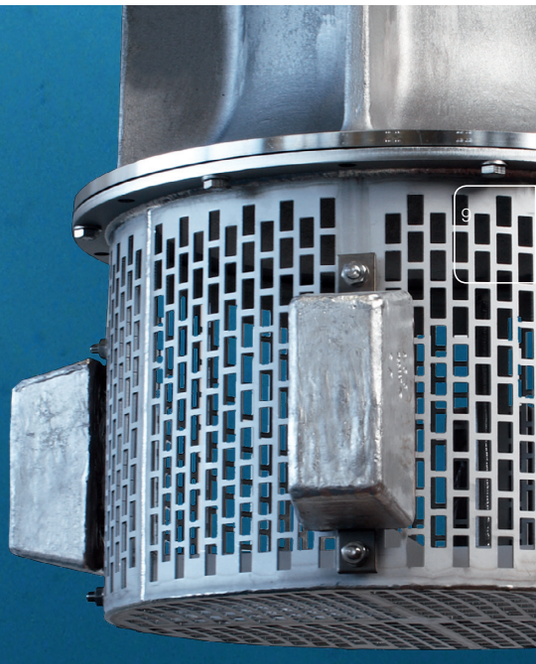
In a recent project, the client made a comparison between a pump room system and a Framo caisson pumping system. Although the price of the submerged pumps was 85% more than that of the dry-mounted pumps, the total cost of the caisson solution was 50% lower.

	Pump room system	Framo caisson pumping system
Unit cost	39%	72.2%
Machinery space	56.1%	--
Caissons	--	23.6%
Sea chest	23.7%	--
Material handling	8%	--
Piping	11.9%	2.1%
Power cables	7.5%	1.2%
Instrument cables	4.9%	0.9%
TOTAL	**151.1%**	**100%**

Investment can be postponed
Pumps can be installed up to a year later in the building or conversion process with a Framo caisson pumping system. This leaves more time for process adjustment and creates savings through deferred procurement.



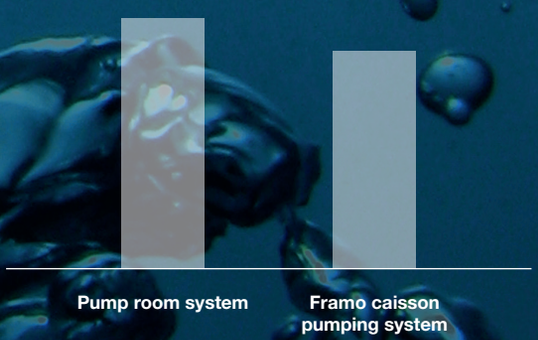
Fast track FPSO Project Execution Schedule



Step 3

OPEX

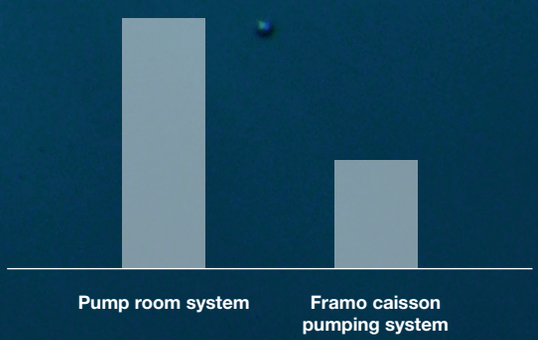
A longer distance between pump and consumer means higher friction losses. In addition, it places a larger number of critical valves and manually maintained strainers below sea level. When higher HVAC costs and other factors are also considered, the expected maintenance and operational costs are substantially higher.



Step 4

Total lifecycle cost over 20 years

Total lifecycle cost depends on many factors. Nonetheless, a Framo caisson pumping system ensures major savings in any seawater lift or fire water pumping application.



The difference is more than the caisson

Framo is not the only supplier of caisson pumping systems. But only Framo caisson pumping systems have submerged pumps with short stiff shafts.

Other caisson pumping systems have top-side motors and long rotating line shafts with bearings every few metres. High starting torque, vibrations and alignment are just a few of the challenges for these systems.

Framo systems, by contrast, have low starting torque, low vibrations and no alignment issues, as well as oil-lubricated pump bearings that are lubricated even during standby. Not only do the pumps limit wear and tear, they also have a higher recommended capacity that can reduce the total number of pumps needed.

CABLE-FREE ELECTRIC SUBMERSIBLE PUMPS

Framo submersible pumps at the core

Framo submersible pump technology has improved business at sea for over fifty years. The revolution that began with our unique hydraulic pumps continues with our cable-free electric submersible pumps, which lie at the heart of most oil and gas applications.

No submerged penetrations

An intact hull means a higher degree of safety. The unique Framo cable-free concept eliminates the concerns associated with electric submersible pumps, such as submerged cable penetrations and the hassles of cable handling.

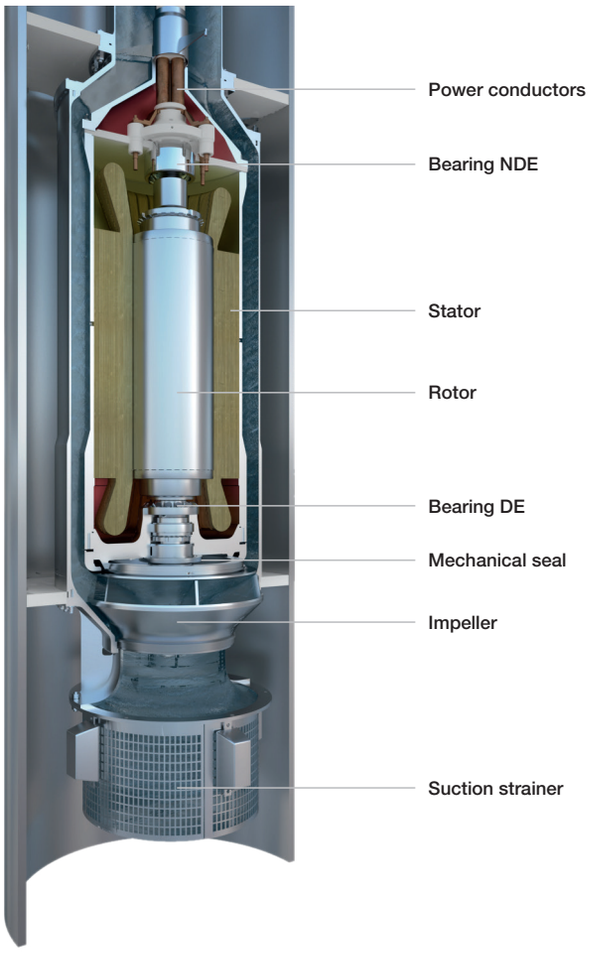
In the Framo cable-free concept, the electric submersible pump is suspended from a riser pipe containing a built-in transmission system for the electrical power. The pump itself is an end-suction centrifugal pump, driven by an integrated oil-filled induction motor designed for direct on-line start (DOL) or variable-speed drive (VSD) operation.

Protected and integrated power

The unique Framo riser system offers mechanical protection while eliminating electrical cables and their disadvantages. Flanged at both ends, the riser pipe sections contain a built-in cooling system and three power conductors spaced by insulation pieces.

When the riser pipe sections are stacked, spring-loaded sliding connectors on the conductors create a safe and reliable electrical connection. The oil pipe sections are fitted with connectors, and the flanges are bolted together to complete the assembly.

FPSO Fluminence, Brazil. Courtesy of Shell.



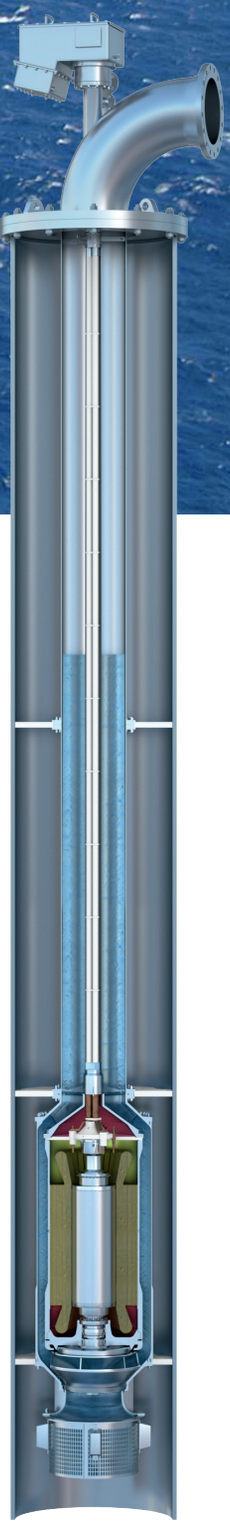
Continuous condition monitoring

The finished pumping system is insulated, cooled and lubricated by a small external oil circulation unit, which creates an internal overpressure that prevents any ingress. The double sealing system further ensures that no oil is leaked to the seawater side via the conductor system. The external circulation unit also continuously monitors the condition of the submerged pump/motor, providing information about temperature, pressure, cleanliness and seal integrity to the control system.

In brief

The Framo cable-free concept is certified for hazardous areas and means:

- End suction to ensure maximum NPSH (net positive suction head) availability
- No submerged penetrations or cable handling
- Built-in power transmission
- Stiff shaft operating below first critical speed, ensuring low vibration levels
- Ingress protection through overpressure
- Compact, low-weight design
- Simple and easy installation
- Condition monitoring



Valemon, Norway.
Photo: Courtesy of Statoil

SEAWATER LIFT

Smarter and safer with Framo seawater lift pumps

Seawater lift is critical to offshore applications, from cooling to ballasting to firefighting. But it also claims a great deal of space – and involves considerable risk. With Framo cable-free electric submersible pumps installed in caissons, it can be handled outside the hull, which frees up valuable space and eliminates hazardous hull penetrations.

No penetrations or flooding risk

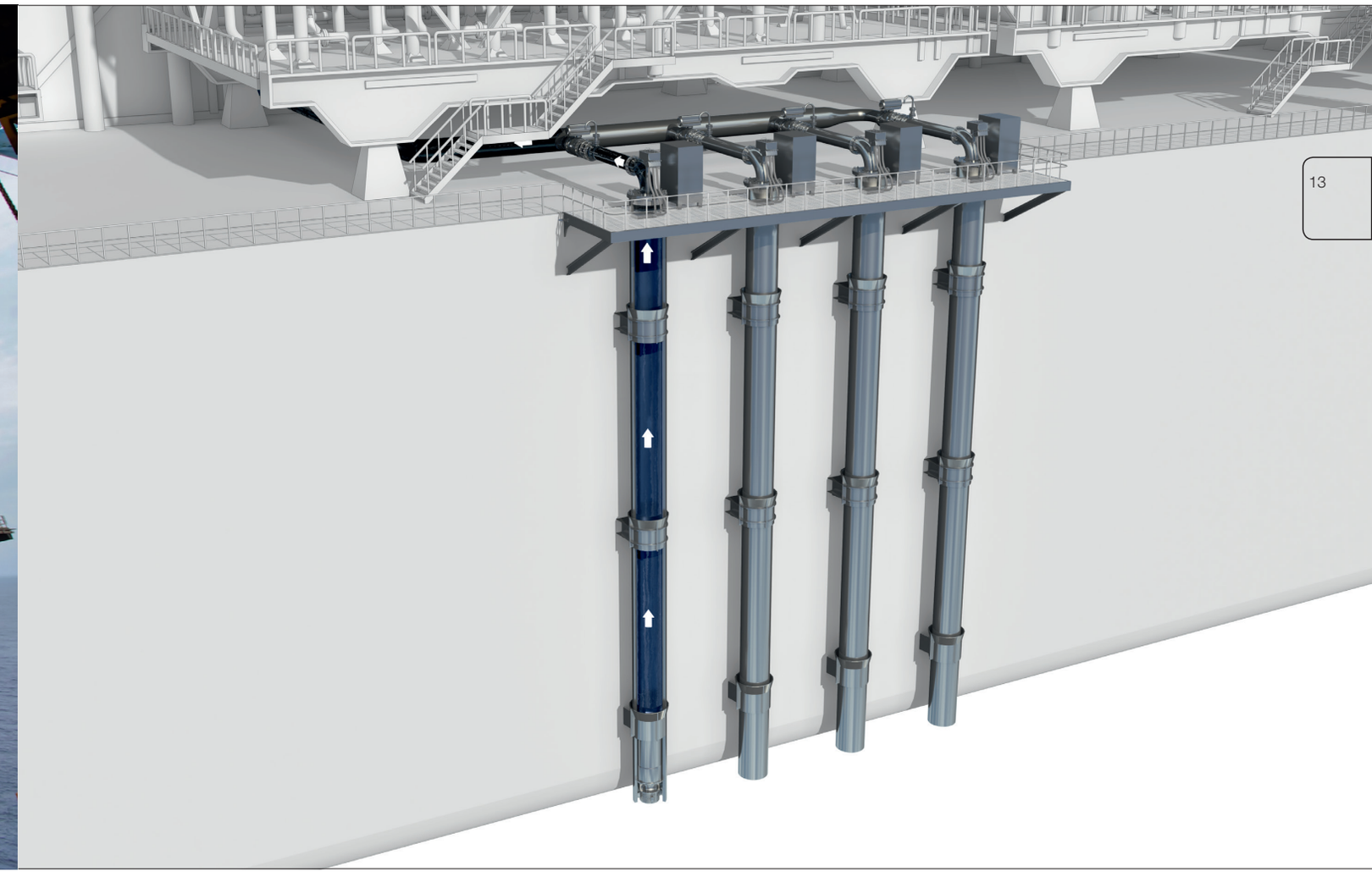
Framo seawater lift pumping systems take full advantage of the Framo cable-free concept (pages 10–11). Instead of being installed in a pump room, the submersible electric pumps are suspended from riser pipes in caissons mounted outside or integrated into the hull.

Seawater is discharged through the riser pipes, which have an integral system for providing electrical power to the end-suction centrifugal pumps. Because there are no hull penetrations, there is never any risk of uncontrolled flooding.

Integral power transmission

Each riser pipe and pump hangs from a top plate, flanged to the top of its caisson. Unlike other caisson solutions, where the motor is top-mounted, the drive motor is integrated with the pump itself. This means there is no long rotating shaft – only a short, stiff shaft that minimizes vibration.

Internal overpressure prevents water ingress to the motor and power system. The pressure is created by a small external oil circulation unit, which also cools, insulates and lubricates the pumping system. A 90° discharge elbow is fitted with the connections for the oil system, as well as the main power junction box.



A simple way to save

Installed and serviced at deck level, hull-mounted caissons are safer than a pump room below the water line. But they also mean greater economy.

Unlike a pump room, caissons have no suction valves, strainers, HVAC or utilities to maintain. Likewise, their distance to seawater consumers is much shorter, which reduces friction losses, power consumption and pipework.

Both CAPEX and OPEX are lower for a caisson system. Moreover, the pumps can be installed later in the building or conversion process, which postpones your CAPEX investment.

AKPO FPSO, Nigeria.
Photo: Courtesy of Total.

Hywind, Sheringham Shoal, Scotland. Courtesy of Statoil.

SEAWATER LIFT

Framo seawater lift pumps for smaller seawater needs

For smaller seawater needs, Framo can deliver cable-free electric submersible pumps with motors smaller than 400 kW and an integrated oil circulation system. Installed in caissons, these create seawater lift systems with the same benefits as our larger solutions.

Integrated oil circulation

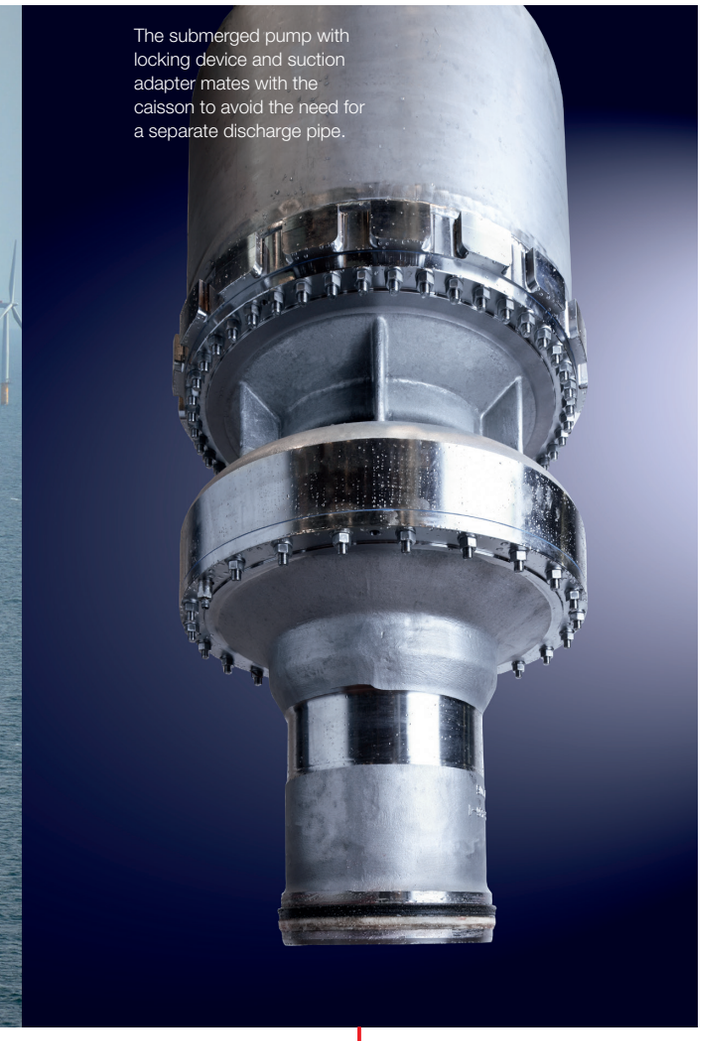
Smaller Framo seawater lift pumping systems, which are often used for auxiliary services, are much like their larger counterparts. The systems are located off the hull rather than in a pump room, and they make use of the Framo cable-free concept (pages 10–11).

The main difference between these and larger systems is the construction of their riser pipes. The power conductors, instead of being within the pipe sections, are mounted on the outside. Instead of an external oil circulation unit, there is a shaft-mounted turbine impeller inside the riser pipe, which circulates the oil internally.

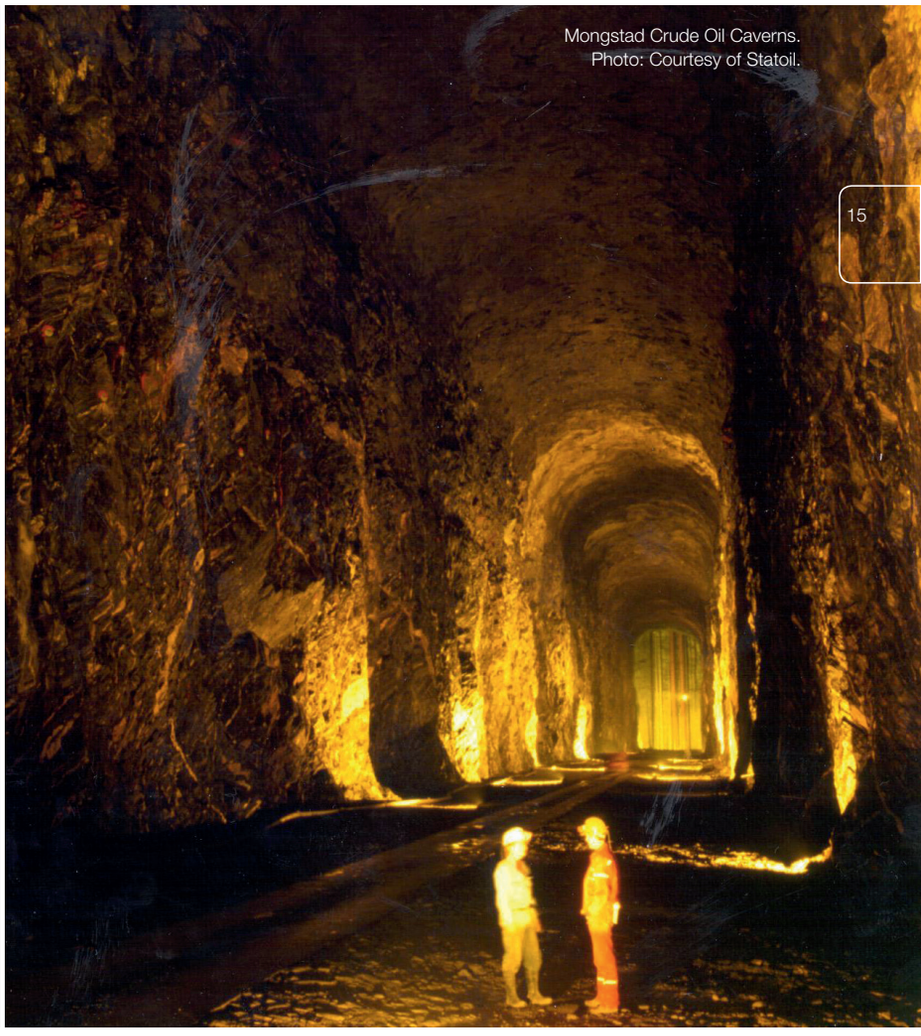
Protection and cooling

Overpressure within the system provides protection for the motor, power transmission and rotating parts. The circulated oil is cooled in a chamber whose direction of flow is towards the pumped liquid, and usually no extra cooler is needed.

For special applications with higher temperatures, the oil can be circulated topside, where additional cooling can be added. In such cases, a separate header tank for oil is mounted on the caisson's top plate.



The submerged pump with locking device and suction adapter mates with the caisson to avoid the need for a separate discharge pipe.



Mongstad Crude Oil Caverns. Photo: Courtesy of Statoil.

CAVERN PUMPING

Deep advantages with Framo cavern pumps

Land-based cavern storage is another key application for Framo cable-free electric submersible pumps. Larger Framo cavern pumping systems handle the actual transfer of oil, while smaller systems are used for seepage water service at underground storage facilities.

Safe installation

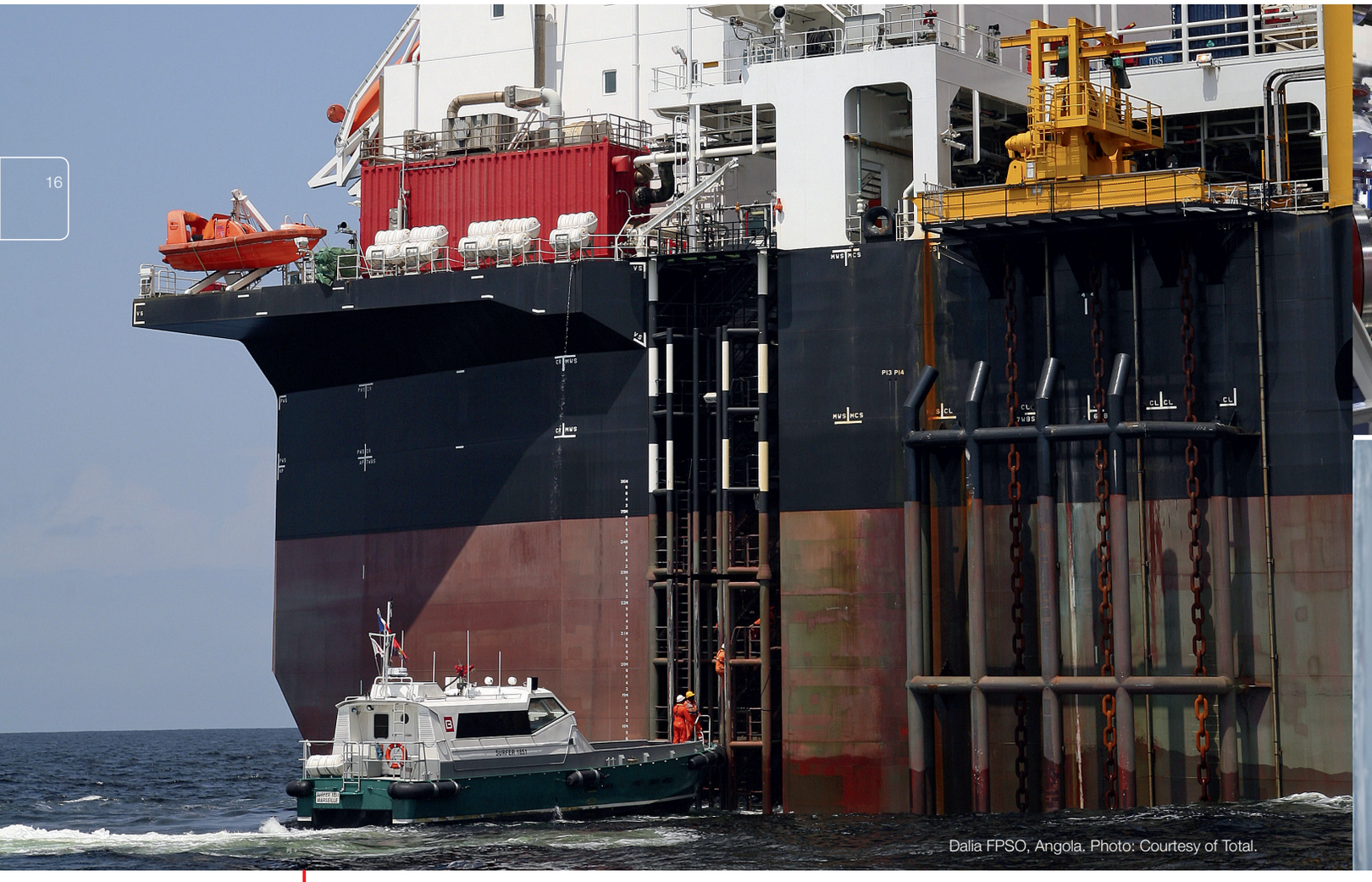
The Framo cable-free concept (pages 10–11) is as suitable for underground oil storage as it is for pumping at sea. With overpressure protecting both the power transmission system and the submerged electric motor, Framo cable-free electric submersible pumps can be safely installed within the hazardous zone.

Savings with a single pipe

Framo cavern pumping systems are designed with the end-suction centrifugal pump at the end of a riser pipe with integral power transmission – as in seawater lift pumping systems – or suspended from the power transmission pipe. In either case, the caisson is used as the discharge pipe.

Discharging through the caisson instead of a separate pipe reduces weight, cost and the complexity of installing and maintaining the system. The lower part of the caisson is part of the pump delivery, as is a special suction adapter to segregate the suction and discharge sides of the system.

The same concept is used for high-capacity cooling water pumps in refinery installations.



Dalia FPSO, Angola. Photo: Courtesy of Total.

FIRE WATER PUMPING

Smart defence with Framo fire water pumping systems

Fire water pumps are the first line of defence in preventing a catastrophe. Usually supplied as complete containerized units that require no pump room, Framo fire water pumping systems are available in hydraulic and electric versions to match the amount of water to be discharged.

Many years of proof

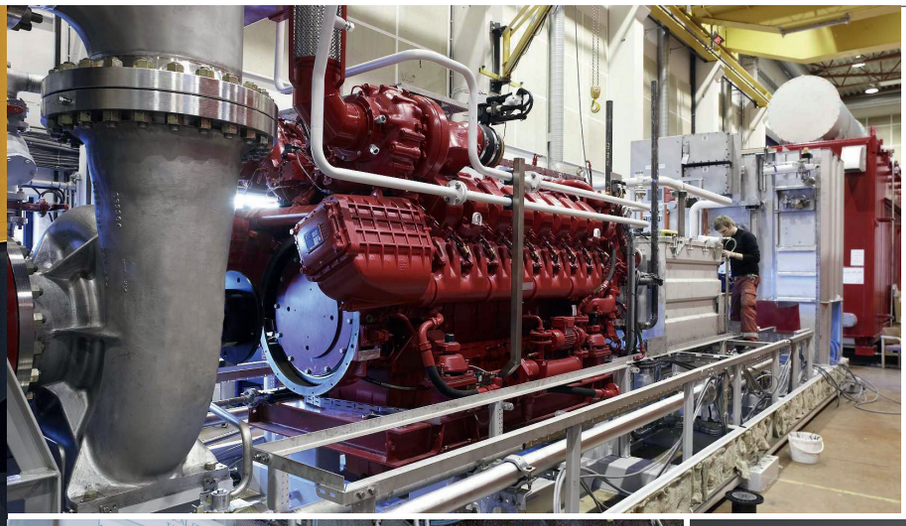
Preventing the spread of fire is critical for any oil or gas installation. Framo fire water pumping systems are the most responsive and reliable firefighting solutions available, trusted for four decades. We delivered our first diesel-hydraulic fire water pumps to the Norwegian Ekofisk offshore field in 1977.

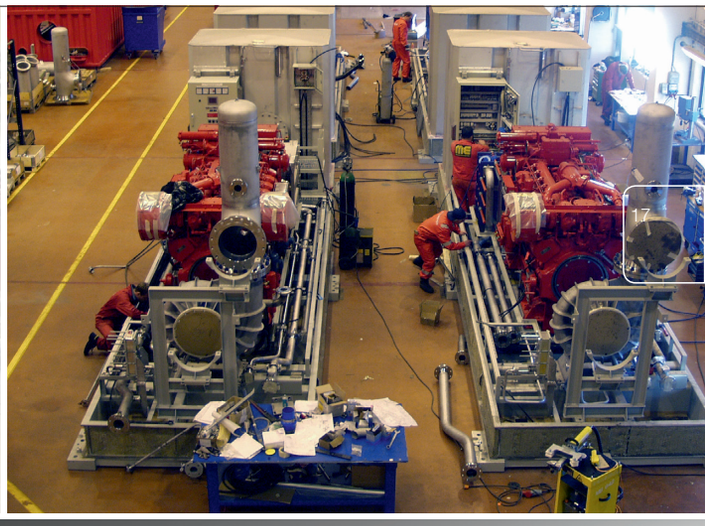
Over the years, continuous development and improvement have made Framo systems the solution of choice for fighting fires offshore. Today both diesel-hydraulic and diesel-electric pumping systems are used, depending primarily on the volume of water to be discharged.

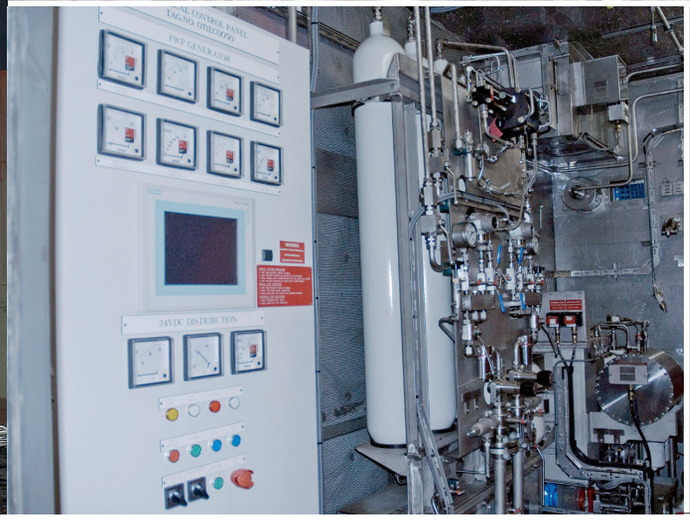
Complete containerized solutions

Most Framo fire water pumping systems are delivered as complete systems in containerized units, ready for installation. This compact and attractive solution has many advantages. For example, each system undergoes full-scale testing before it leaves our plant.

Above all, containerized systems significantly reduce the space needed for firefighting equipment. With the container on deck and the submersible pumps installed off-hull, less time is needed for onsite assembly and commissioning. Likewise, the easily accessed equipment is far simpler to maintain or repair.

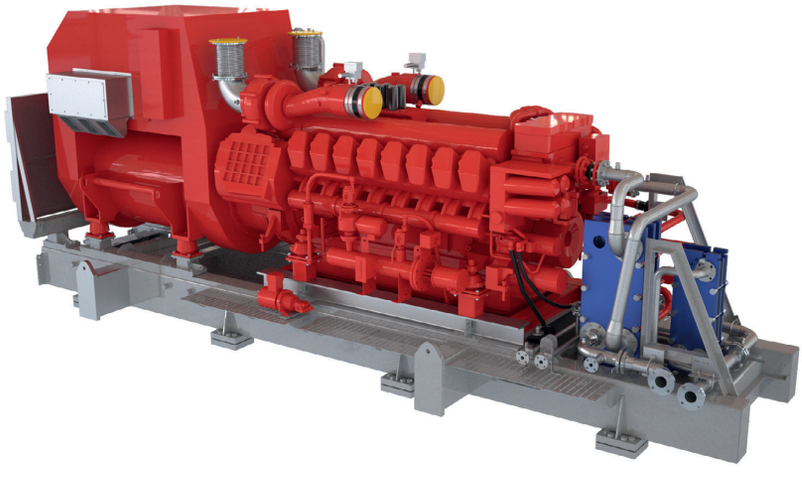






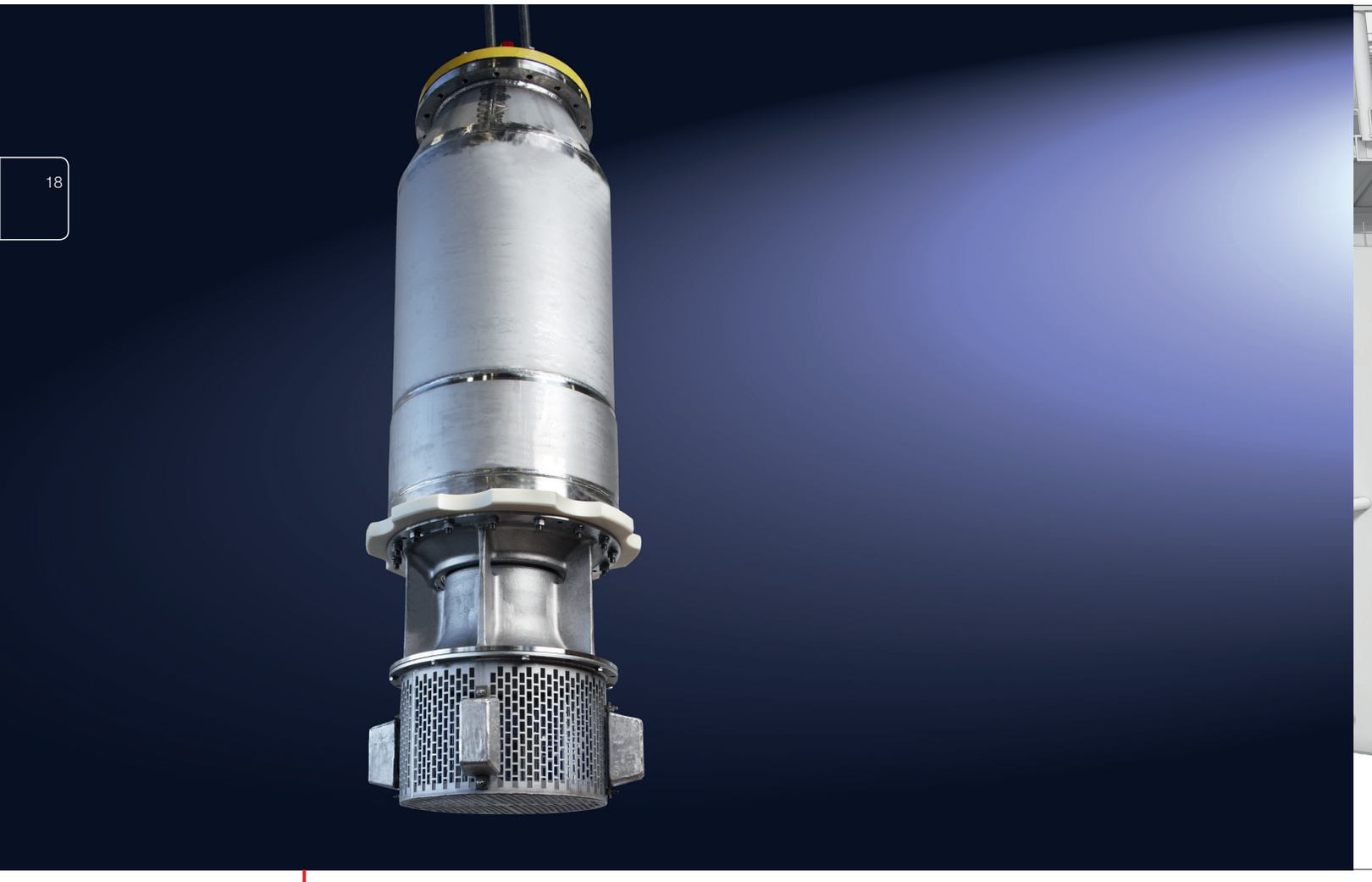
Skid-mounted options

If preferred, Framo fire water pumps can also be supplied as individually skid-mounted units. These can be installed in sheltered areas on fixed platforms or below deck on floating installations. The pump system configurations, including diesel supply and all auxiliary systems, can be tailored to suit the application.



Features

- Low-weight containerized systems
- Submerged pumps with end-suction design
- Continuous condition monitoring of submerged pumps
- High installation flexibility



FIRE WATER PUMPING

Framo hydraulic fire water pumps for rapid response

Framo hydraulic fire water pumping systems, with single-stage pumps that rotate slowly during standby, offer a minimal start load and the best possible preparedness.

Faster to bring online

Framo hydraulic fire water pumping systems use a submerged, hydraulically driven pump. This pump lifts the water to deck level, where it feeds into a pump that is directly driven by the diesel engine. Consequently, the diesel engine's start load is kept to a minimum.

Typically, there is a 30/70 load split between the submerged pump and the direct-driven pump. This means the main engine start load is just 30% of its full load. As a result, the whole firefighting system can be brought online much faster and with less start load on the engine.

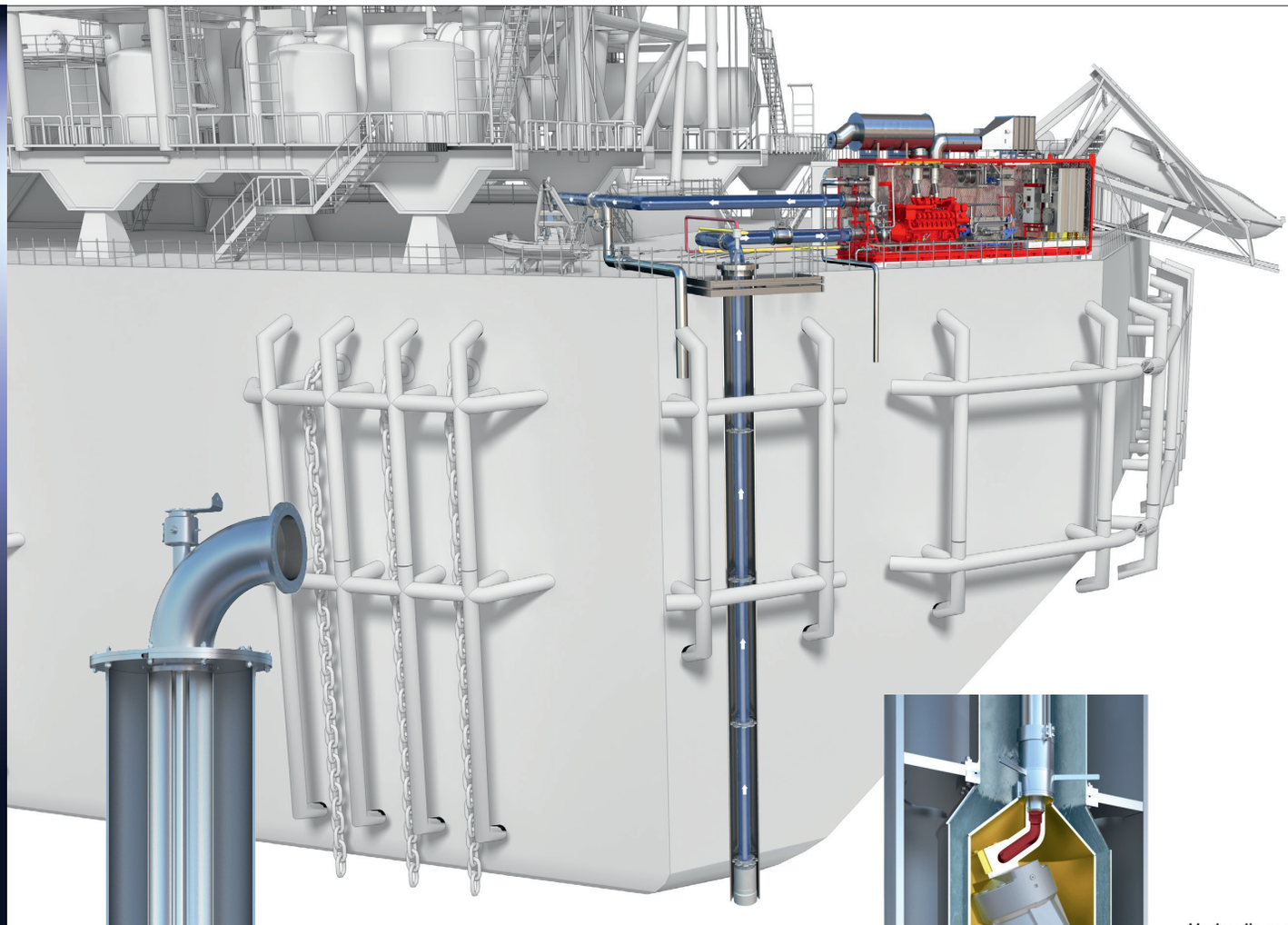
Always in motion

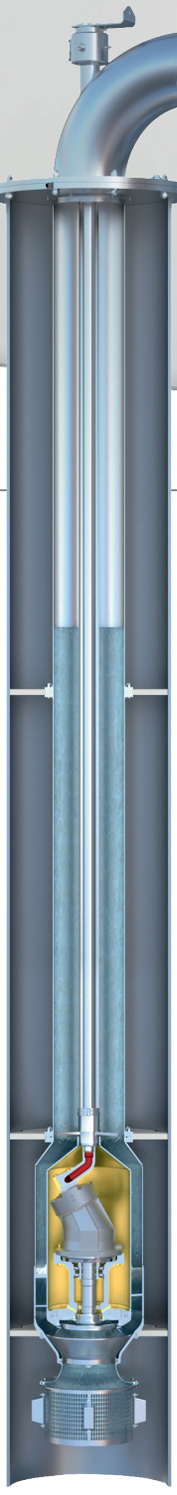
The submerged lift pump is a single-stage, end-suction centrifugal pump driven by a hydraulic motor. Suspended in the water from a riser pipe, it has a short, stiff shaft that minimizes strain and vibration. Water is delivered through the riser pipe to the main pump above.

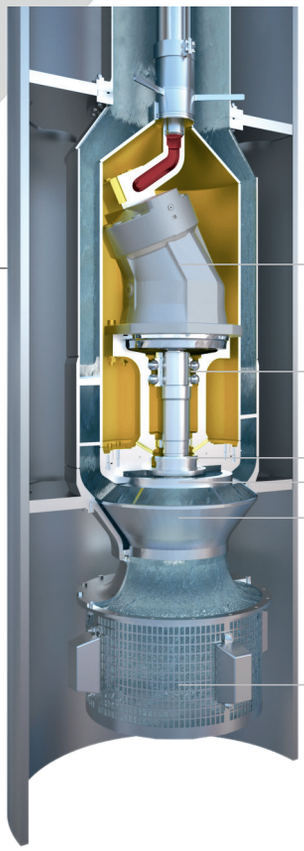
The lift pump runs continuously at low speed (40–50 rpm) in standby mode, driven by a flow of low-pressure hydraulic fluid circulated by a small electrically driven pump. The fluid is circulated to and from the lift pipe through concentrically mounted pipes within the riser pipe.

Smart, protected construction

The riser pipe is constructed of flanged sections, while the hydraulic oil pipes inside it are fitted with connectors. This construction protects the hydraulic fluid transmission and enables the lift pump to be installed without an external caisson.







The diesel engine package comes complete with fuel tank, starting system and ancillaries, which are installed on a single skid and completely enclosed in a fire-protected, containerized module.

Features

- End suction to ensure maximum NPSH (net positive suction head) availability
- Low start load
- Submerged lift pump with single-stage, end-suction design
- Continuous rotation of the submerged lift pump in standby mode
- Continuous condition monitoring of the submerged lift pump
- Compact, low-weight system

Available options

- Electric or pneumatic start system in accordance with NFPA 20, with optional hydraulic black start
- Diesel fuel oil system for 12, 18 or 24 hours
- Several options for combustion air and exhaust gas systems, including cooled exhaust under 200cc
- HVAC that can be delivered for pressurization in Zone 2 areas
- Anti-surge device with air release and vacuum breaker valve with optional minimum flow and/or test facilities
- Local PLC-based control panels in communication with fire and gas system
- Electrical distribution panel with optional cabinet for hazardous areas
- Fire and gas detection within container
- Fire extinguishing systems
- AFFF system including tanks, pumps and control systems, powered by the fire pump engine

Gjøa FPU fire water pump/deluge test.
Photo: Courtesy of Jens Bang, Statoil.

FIRE WATER PUMPING

Framo electric fire water pumps for high capacity demands

Framo electric fire water pumping systems are the preferred solution when higher pumping capacities are needed, or when the generator package is located too far from the fire water pump.

Reliable and flexible

Optimized for maximum reliability and safety, Framo electric fire water pumping systems have proven very robust in operation. They can be used when the capacity per unit exceeds the limitations of a hydraulic solution, or when the diesel generator must be placed a long distance away from the fire water pump. A diesel-electric alternative offers greater flexibility in equipment layout and the placement of the diesel generator set.

Soft pump starts

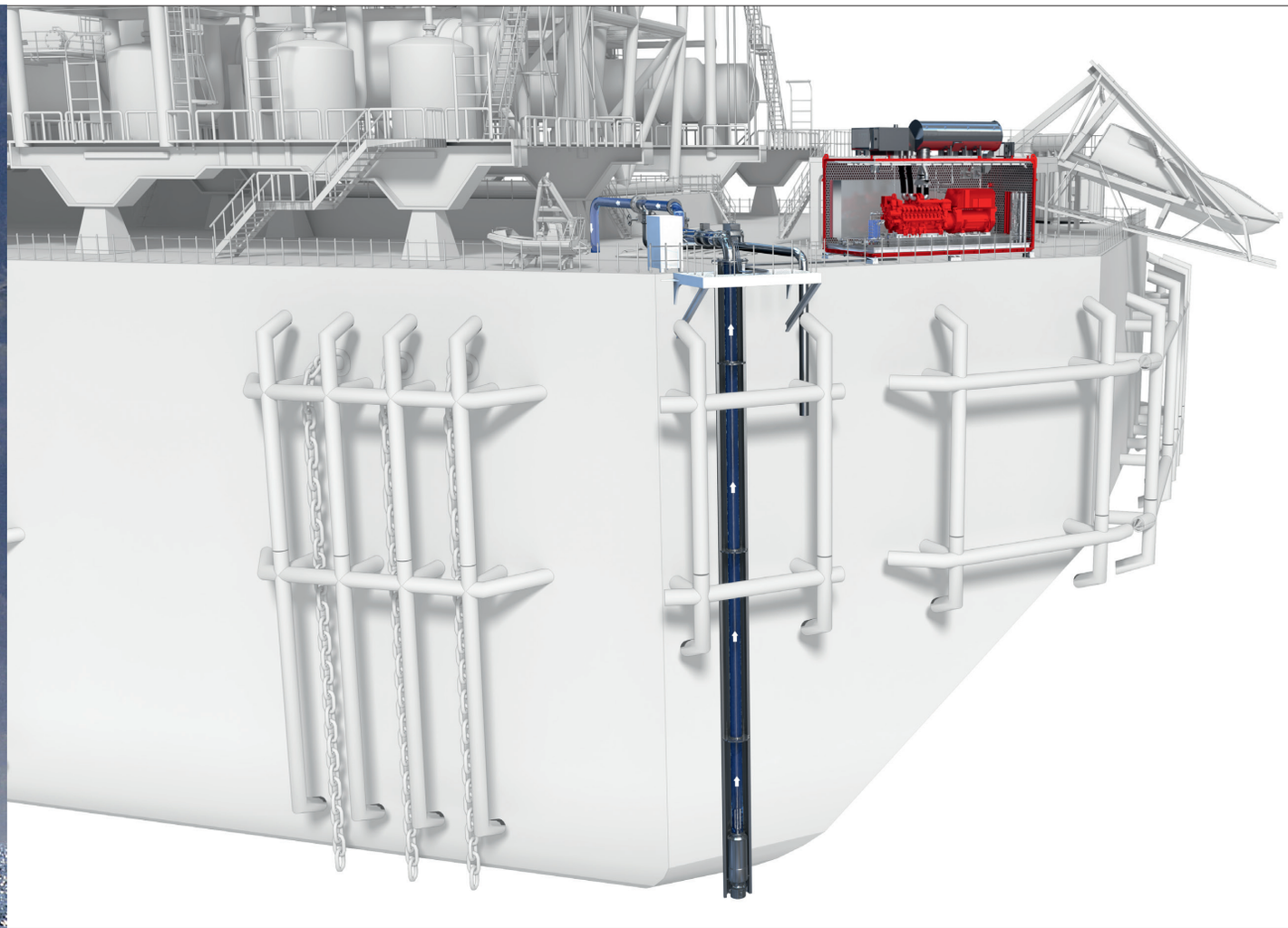
In Framo electric fire water pumping systems, the diesel generator supplies power to a cable-free electric submersible pump (pages 10–11). Depending on the pressure required, the submersible pump can be designed with one or two stages.

The pump is block-coupled to the generator with delayed generator magnetization, which gives it a soft start load.

Compact, containerized power

The generator package is a complete containerized unit. It includes a fuel tank, starting system and ancillaries, installed on a single skid in accordance with NFPA20 and industry standards for fire water systems.

Having all components in a single, fire-rated enclosure offers technical advantages that lead to savings. Optimized in size and weight, the module is simple to install on deck and designed for ease of maintenance. Internal lifting beams and removable panels allow the diesel engine and generator to be removed if required.



Features

- Block-coupled start-up
- Submerged pump with end-suction design and one or two stages
- Continuous condition monitoring of the submerged pump
- Compact, low-weight system
- High equipment layout flexibility

Available options

- Electric or hydraulic pneumatic start system in accordance with NFPA 20
- Diesel fuel oil system for 12, 18 or 24 hours
- Several options for combustion air and exhaust gas systems, including water-cooled exhaust
- Electric or hydraulic pneumatic
- Optional minimum flow and/or test facilities
- Local PLC-based control panels in communication with fire and gas system
- Electrical distribution panel with optional cabinet for hazardous areas
- Fire and gas detection within container
- Fire extinguishing systems
- AFFF system including tanks, pumps and control systems, powered by the fire pump engine

Gullfaks B, Norway. Photo: Courtesy of Statoil.

WATER INJECTION

Framo water injection pumps boost production

Extracting more oil from the reservoirs is a challenge for all operators. A Framo water injection pumping system is a reliable, compact and cost-effective tool for maintaining reservoir pressure and achieving more profitable production.

Proven reliability

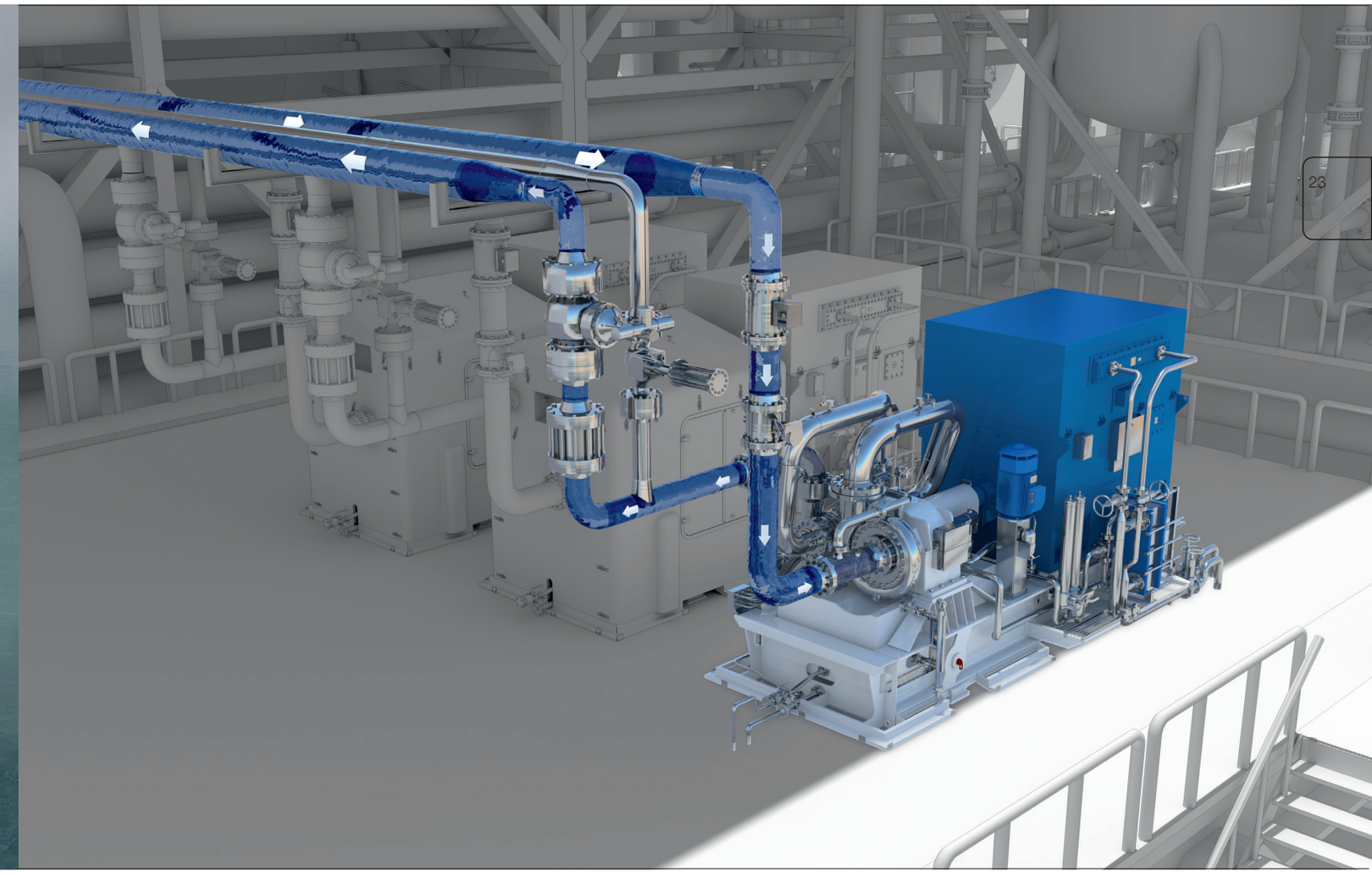
Framo water injection pumping systems are the reliable way to increase reservoir pressure. The high-power stages are arranged back-to-back for balanced thrust forces, and the high-speed shaft operates well below first critical speed.

This creates a dynamically robust design, as shown by 25 years of pressure-boosting experience. Framo water injection pumping systems have shown more than 98% average availability in over 4,000,000 operating hours logged.

Flexibility in design and operation

With pumps available in series or parallel configuration, Framo water injection pumping systems offer high flexibility. The standard design is for electric motor drives, but systems can be delivered for turbine drives as well.

Impellers can be switched without hydraulic tools or rebalancing the rotating assembly. This means that different pump duties can be achieved at short notice. As a result, the same pump can perform both normal injection and reservoir fracturing operations.



Less space, CAPEX and maintenance

Despite their versatility, Framo water injection pumping systems have less than half the footprint of a barrel casing pump. Because a booster pump is integrated into their main injection pump, they eliminate the need for a separate pump with associated piping, valves and manifolds.

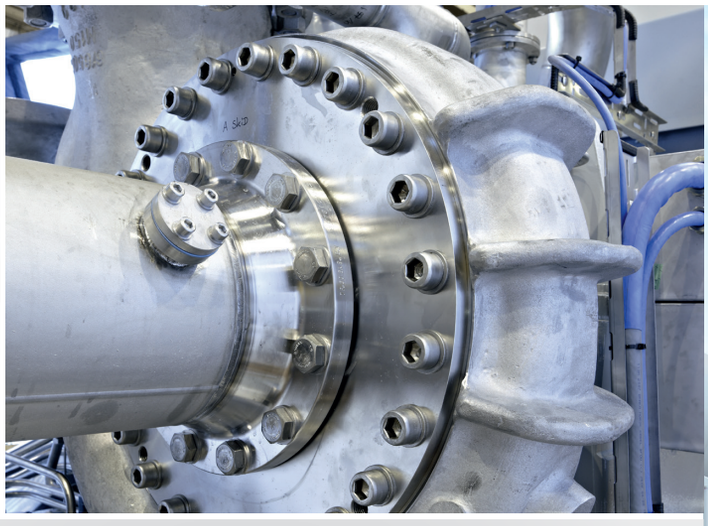
The removal of equipment and deck structure means lower system CAPEX. Plus it creates easy access to the pump skid, with service items such as lube filters in easy reach – and no cartridge pull-out space needed. Combined with the easy impeller and seal changes, this means lower maintenance-related OPEX as well.

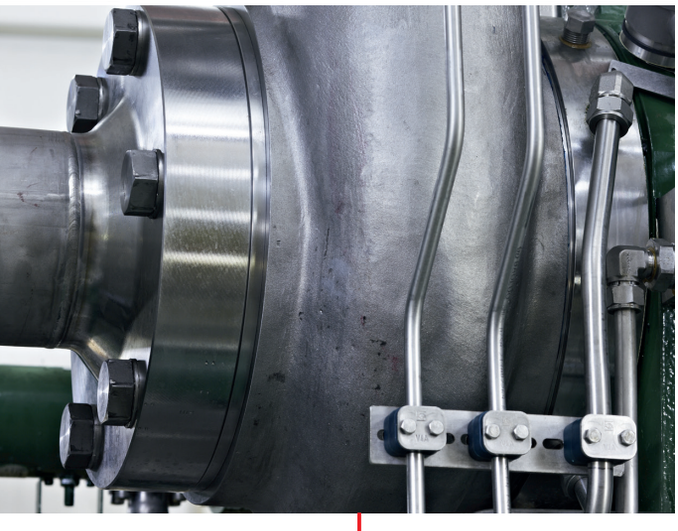
Broad scope of use

Framo water injection pumping systems can also be an excellent compact alternative for other high-pressure pumping applications, such as crude oil export.

Features

- Integral booster pump for simplified installation and reduced overall cost
- Operation below first critical speed
- Performance flexibility to suit changing reservoir conditions
- Impellers available for reservoir fracturing
- Serial or parallel configuration
- Compact, low-weight design with high power-to-weight ratio





WATER INJECTION

Higher uptime with Framo water injection pumps

Framo water injection pumping systems are designed for minimal wear and tear, even when working with produced water. Combined with the ease of maintaining them, this ensures more time in operation.

Handling produced water

Reinjecting produced water is a common practice, both for boosting well pressure and for reducing polluting discharge into the sea. However, produced water has challenging characteristics that can lead to sand erosion and scaling within the pump.

To deal effectively with produced water, Framo water injection pumps employ tungsten carbide wear surfaces in combination with double mechanical seals with liquid barrier fluid. This design has proven very successful in reducing wear and tear.

Low-effort maintenance

The compact, low-weight design of Framo water injection systems provides easy access to rotating components. As a result, it takes less than one offshore shift to replace impellers, wear rings and mechanical seals. Exchanging an impeller and mechanical seal can be done in less than four hours from pump shutdown to startup.

This means less downtime than with any other large water injection pump, with the added advantage of minimal service space and lay-down area requirements.

Emergency power generators at Johan Sverdrup.
Photo: Courtesy of Statoil.

POWER GENERATION

Framo diesel generator systems keep production underway

A reliable and robust emergency power system is vital for any offshore unit. Framo skid-mounted or containerized diesel generator systems provide valuable security, ensuring that emergency and essential power is available at all times.

Power to count on

Able to operate independently or in parallel with other generators, Framo diesel generator systems offer reliable access to essential or emergency electrical power. Designed for fail-safe start-up, even during a cold-start sequence, they can operate continuously at rated power for a specified period of time.

The systems comprise a generator that is directly driven by a diesel engine, which can be started pneumatically, hydraulically or by means of an electric battery. The generator set is either seawater cooled with separate freshwater cooling circuits for engine and alternator, or air cooled by means of integral or external radiators.

Containerized simplicity

In most cases, Framo diesel generator systems are arranged as containerized units that include all necessary auxiliary systems. The fire-rated enclosure has a general layout that ensures easy maintenance, as well as lifting beams and removable panels to allow dismantling of the generator or diesel engine.

The enclosure is equipped with an inlet for the diesel engine's combustion air, as well as a dry-lagged or water-cooled exhaust system. It can be connected to the platform or vessel HVAC system via the ventilation inlet flange, or delivered with its own independent HVAC system including fans and heater.

Prelude, Australia. Photo: Courtesy of Shell.

FLNG COOLING / FSRU HEATING

Less space and weight for FLNG cooling or FSRU heating

On FLNGs and FSRUs, temperature control is a critical but space-consuming application. Framo FLNG cooling systems and FSRU heating systems combine open and closed loops, which allows both parts to be optimized and streamlined.

Cooling or heating via the hull

FLNG cooling and FSRU heating have traditionally been managed by large conventional pumps, installed as topside modules. Today, however, there is a more compact and economical solution.

Built with leading heat transfer technology, Framo FLNG cooling systems and FSRU heating systems combine a closed thermal loop with an open loop, which leads to system-wide savings in space, weight and cost. Integrated with the hull, they replace topside pump modules with compact seawater lift pumps using the Framo cable-free concept (pages 10–11).

Savings in two steps

Savings can be found in both the open and closed loops of these integrated Framo systems.

In the open seawater loop, the pumps, filters and heat exchangers are configured to provide the right cooling or heating performance with the minimum amount of equipment. The effect this has on power consumption is negligible, yet it reduces weight by 25% and creates a 15–20% savings in CAPEX.

In the closed freshwater loop, compact cable-free electric submersible pumps replace the topside pump modules. These take up no space on deck and create equally dramatic weight savings.

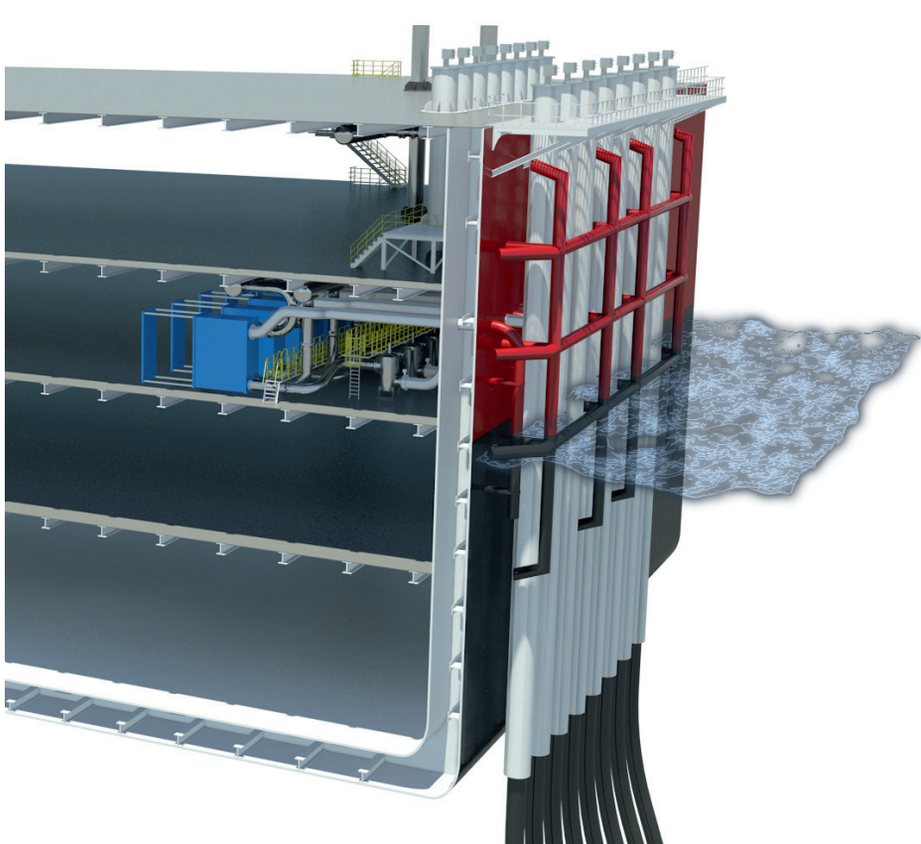
FSRU Independence, Lithuania. Photo: Courtesy of Höegh LNG.

Freeing up space and time

The total result is a massive reduction in both foot-print and weight, which means less CAPEX, lower OPEX and space topside that can be used for other processes. In addition, the seamless system interface ensures easy access that reduces the time needed for maintenance work.

Features

- Hull-integrated system with no topside installation
- Compact submersible pumps for both seawater lift and closed-loop cooling
- Optimum operating conditions
- Greatly reduced installation weight
- Significantly lower CAPEX



Fire water pumps, seawater lift pumps and essential generator on Ivar Aasen. Photo: Courtesy of Statoil.

FIXED OFFSHORE PRODUCTION

Total reliability in fixed installations

On an offshore platform, installed in a harsh environment far from land, pump reliability is top priority. Framo pumping systems provide the peace of mind offshore platform operators are looking for, along with considerable benefits in terms of space and weight.

Rising to the task offshore

Framo has been a supplier of pumping systems for fixed platforms for many years. Since the first Framo hydraulic fire water pumps were installed on platforms in the late 1970s, we've provided successful solutions to customers all over the world.

At the heart of all fixed offshore platforms are a variety of pump types, some located topside, others out of sight in submersible duties. Many operate continuously, such as seawater lift pumps on cooling duty or water injection pumps for maintaining reservoir pressure. Others, such as fire water pumps, run only when needed. In all applications, our compact and lightweight pumping systems have demonstrated excellent performance and flexibility.

We pride ourselves on meeting – and often exceeding – the most rigorous operating requirements of our offshore customers. Efficient designs, engineering precision, manufacturing quality and factory testing are brought together to give customers reliable pumping solutions, notable for their ease of operation, low maintenance and long life.

Fire water and seawater lift pumps on Oseberg A GBS. Photo: Courtesy of Statoil.

Water injection and fire water pumps on Volve platform. Photo: Courtesy of Maersk Contractors

Fire water and seawater lift pumps on Sakhalin platforms. Photo: Courtesy of Shell.

Fire water pumps on Gullfaks A GBS. Photo: Courtesy of Statoil.

Fire water and seawater lift pumps at Sleipner field. Photo: Courtesy of Statoil.

Fire water pumps, emergency generators, water injection pumps and seawater lift pumps on Goliat. Photo: Courtesy of ENI.

FLOATING OFFSHORE PRODUCTION

Meeting tough challenges in floating production

Framo pumping systems have served the FPSO market for nearly 30 years. With submerged pumps installed in caissons, they eliminate both pump rooms and the risk of flooding, which means easier maintenance and considerable cost savings.

Pumping systems that go further

As one of the industry's leading pumping system suppliers, Framo has decades of experience delivering to a wide range of floating installations. FPSOs began using Framo hydraulic and electric submersible pumps in the early 1990s, and the idea of replacing pump rooms with caissons has gained traction ever since.

Producing hydrocarbons offshore is a tremendous challenge, especially as the work moves into deeper waters, harsher environments and more remote locations. In the case of floating facilities, it poses extreme demands that only the most robust and reliable pumping equipment can meet. Whether used on FPSOs or FSOs, or on semi-submersible drilling or production units, pumps must be engineered to the highest standards.

This is why Framo pumping systems are designed, manufactured and tested for unfailing performance. No matter what the pumping challenge, they can be counted on to start as demanded – and to operate continuously in the toughest conditions.

Water injection, seawater lift and ballast/deballast pumps on Heidrun TLP. Photo: Courtesy of Statoil.

Seawater lift water pumps on Espirito Santo FPSO. Photo: Courtesy of Shell.

Fire water and seawater lift pumps on Gjøa FPU. Photo: Courtesy of GDF Suez.

Fire water and seawater lift pumps on Pazflor FPSO. Photo: Courtesy of Total.

Fire water pumps on P52 FPU. Photo: Courtesy of Petrobras.

Crude cavern offloading and seepage water pumps in crude oil caverns U1 and U2, Korea. Photo: Courtesy of KNOC.

Crude cavern offloading and seepage water pumps in crude oil caverns U1 and U2, Korea. Photo: Courtesy of KNOC

LAND-BASED STORAGE

Safe and secure handling of underground storage

Underground storage of crude oil, natural gas and oil products is an increasingly attractive means of securing an energy supply. Having delivered submersible pumps to cavern applications since the 1970s, Framo can provide a hydraulic or electric pumping concept for any storage need.

Performance that runs deep

Four decades ago, we supplied the first Framo hydraulic cavern pumping system to Norway's Mongstad refinery. Since then we've delivered over 200 hydraulic and cable-free electric submersible cavern pumps worldwide. Among them are the twelve largest electric submersible pumps in the world, each with a capacity of 5000 m^3/h, which have been operating at Mongstad crude oil terminal since 1987.

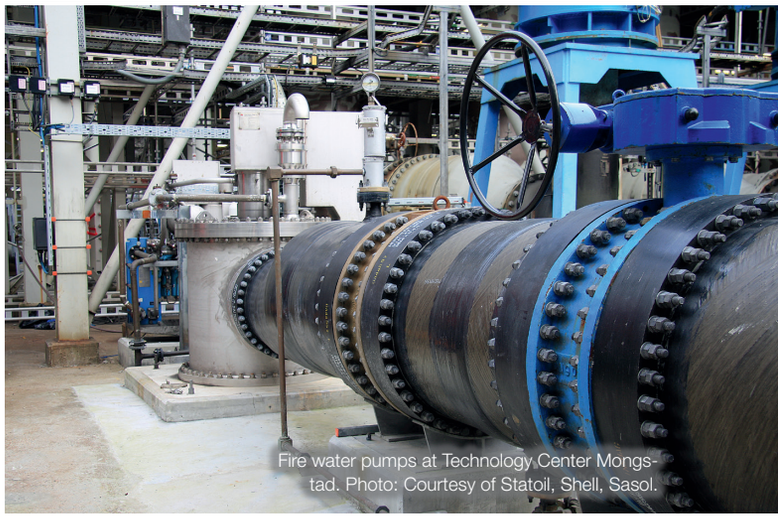
The sheer dimensions of underground storage caverns make large pump capacities a must.

But pump reliability is equally important, as is the ability to operate in the cavern's potentially explosive atmosphere. Framo submersible pumps meet all of these requirements and offer major advantages for cavern facilities.

In fact, Framo is one of the few pump suppliers in the world with strong capabilities in cavern pumping. With our experience in the application and our high level of pumping expertise, we can provide the most suitable concept and equipment for any cavern storage service.

Mongstad refinery.
Photo: Courtesy of Statoil.

Fire water pumps at Melkøya gas terminal.
Photo: Courtesy of Statoil.



Fire water pumps at Technology Center Mongstad. Photo: Courtesy of Statoil, Shell, Sasol.

LAND-BASED OIL AND GAS PRODUCTION

Supporting onshore installations

Framo pumping systems are most prevalent in marine and offshore applications, but our technology can be found on land as well. At coastal facilities for oil and gas production, our seawater lift pumps, fire water pumps and power generation solutions also come into play.

Proven strengths in new areas

Traditionally, onshore facilities have used line shaft pumps to supply water for cooling or firefighting. Usually installed on the quay or in the water intake pit, they typically comprise a top-mounted vertical motor that drives a 10–15 m pump shaft with impeller.

Nonetheless, a growing number of companies have seen that the Framo advantage can apply on land. Submersible pumps with short stiff shafts provide cost-saving reliability, in onshore applications as well as offshore.

Our first onshore deliveries were in the early 1980s, when we supplied fire water pumping systems for the Stavanger area of Norway and the west coast of Sweden. Recent customers include prominent gas terminals, as well as the Technology Centre Mongstad, a joint venture between the Norwegian state, Statoil, Shell and Sasol. The latter site is the world's largest testing facility for CO_2 capture.

Framo AS headquarters at
Florvaag, Bergen, Norway

OUR COMPANY

A partner to rely on

Framo has proud roots that stretch back to 1938. Customers have put their trust in our unique pumping technology since we introduced it in the early 1960s. But even more important is the trust they place in us.

Driven by a simple idea

Framo has a belief that pumps should never be isolated from the task they perform. It's a belief that revolutionized marine cargo handling, where a submerged pump in each tank is now the standard for faster, safer, more cost-effective business. And it offers similar gains to the oil and gas industry.

It's also a belief backed up by experience. Framo has existed for nearly 80 years, and for the last 50 years our sole business has been pumps and pumping systems.

Full control over production

We don't just design Framo solutions. We see our designs through at our own facilities in Norway. No Framo product is delivered from anywhere else.

Our manufacturing in Flatøy is built on decades of experience, plus the most advanced machinery and techniques in the industry. Each of our skilled employees there takes pride in delivering the best – and is integral to the finished result.

From Norway to the world

Framo is a recognized leader in pumping systems for oil and gas needs. Customers around the globe turn to us, both for pumps and for expertise in meeting their challenges.

Today Framo is also part of Alfa Laval, a world leader in heat transfer, centrifugal separation and fluid handling. As a result, our pumping technology contributes to still more comprehensive solutions.


FRAMO
an Alfa Laval brand


Bergen
Rotterdam
Houston
Busan
Tokyo
Shanghai
Dubai
Lagos
Singapore
Luanda
Rio de janeiro

R&D, TESTING AND STANDARDS

Achieving the highest goals

For Framo, nothing is more important than delivering fully on customer needs and expectations. This is why we have full-scale testing facilities in Norway, and why we maintain the greatest commitment to quality and peace of mind.

Customer-driven R&D

At Framo, nothing is left to chance. Our strategic R&D dives deep into the science of materials, mechanical properties and more, identifying the factors that lead to pumping challenges – and pumping success.

Our R&D programme is driven by customer commitment and shaped by customer challenges. Everything we do to improve our pumps and pumping systems is a way of ensuring our customers' success.

Full-scale testing in-house

Before any Framo product is delivered, it undergoes comprehensive testing and quality control. At our own facilities in Norway, in direct connection with our manufacturing, we perform full-scale string testing of Framo pumping systems at rated capacity, pressure and speed. Likewise, we perform extensive qualification testing on critical components.

This reduces the commissioning time needed, and it ensures that our products will perform as promised. In the oil and gas industry, where project schedules are a critical driver, it makes a valuable difference.

Quality assurance (QA)

Framo's focus on quality extends to all our activities, throughout the product lifetime. Operational experience is fed back into our organization, which supports the continuous improvement of our products and procedures.

Our QA system meets the requirements of the internationally recognized ISO-NS 9001:2000 standard, as well as those of ISO 3834-2:2005. Framo is certified by Det Norske Veritas (DNV) according to these standards and is regularly audited by both DNV and customers.

Framo is also a certified manufacturer of explosion-proof equipment in compliance with directive 94/9/EC/ATEX and IECEx.

Health, safety and environment (HSE)

Health and safety are of vital importance to Framo, as is the protection of the environment. Our HSE policy is aligned with both Norwegian and international standards, and we are accredited by DNV in accordance with Environmental Management System Standard ISO 14001:2004.

sellihca
empowered by Achilles

Achilles JQS
empowered by Achilles
Qualified

IEC IECEx

DNV
NORWEGIAN ACCREDITATION
MSYS 002
ISO 9001/ISO 3834-2/ISO 14001
CERTIFIED COMPANY

SERVICE

Support when every minute counts

Pumping systems are the very heart of critical operations, which means there's no time for them to fail. That's why Framo backs the world's best pumping systems with a service organization like no other. When you turn to Framo Service, the response is swift, certain and thorough.

Commitment to service

Following technical support during installation and commissioning, Framo provides professional service throughout a project's lifetime. In addition to our service resources in Norway, we have service and repair facilities in Busan, Dubai, Houston, Rio de Janeiro, Rotterdam, Shanghai, Singapore and Tokyo.

Our Framo Service team also has a guiding principle: downtime is unacceptable. Framo engineers are available 24/7, whether for advice or immediate dispatch to any location worldwide. If a problem arises, their priority is fixing it – and anything else can wait.

Focus on uptime

Even more important than fixing problems is making sure they don't arise. Framo offers services that safeguard availability, so that you can have full peace of mind when it comes to your Framo pumping systems.

Annual inspections, pre-docking inspections and hydraulic oil monitoring programmes can all be provided, along with project-specific maintenance programmes to suit your needs. Through condition-based maintenance and exchange of wear and tear parts, we can help you reduce your operating costs and ensure optimal pumping capacity.

Framo spare parts

Genuine Framo spare parts are part of keeping our pumping systems going strong. Our Framo service and repair centres deliver them rapidly worldwide, and we can even provide reconditioned Framo spares. To fully optimize their supply and use, we maintain statistics for all of our parts.

Expert training

Framo experts help you to get the best from your Framo pumping systems. They do this through service bulletins, which provide technical updates and operator tips for better utilization, but also through comprehensive training. The Framo Service team offers standard seminars and tailor-made courses at all our facilities worldwide, as well as training on your site or vessel.

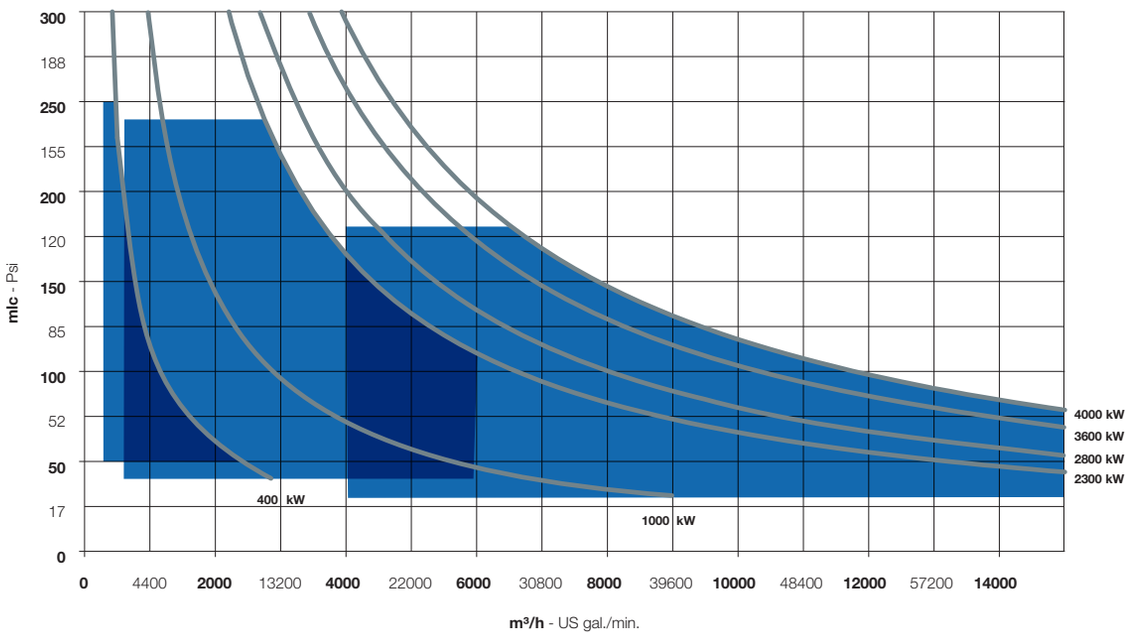
Framo service and repair centres

- Bergen
- Busan
- Dubai
- Houston
- Lagos
- Luanda
- Rio de Janeiro
- Rotterdam
- Shanghai
- Singapore
- Tokyo

TECHNICAL DATA

Framo cable-free electric submersible pumps

Performance domain



Submerged lift pump

	Small		Medium			Large			
PUMP TYPE	**SE200**	**SE225**	**SE280**	**SE315**	**SE355**	**SE400**	**SE450**	**SE500**	**SE560**
Required caisson diameter	18”	26”	30”	34”	40”	46”	52”	58”	62”
Flow range [m³/h] (BEP)	200-500	300-1000	600-2400	700-3200	1400-6200	2800-8500	3000-10000	4000-12000	4000-15000
Pipestack diameter min/max	6”	10”/14”	10”/18”	14”/20”	18”/28”	24”/32”	24”/44”	24”/44”	24”/44”
Max power (50/60Hz) [kW]	175/220	400/400	800/1000	1000/1200	2100/2500	2200/2800	2900/3600	3300/4000	3800/4000
Max power (50/60Hz) [kW] 11kV	NA	NA	NA	NA	1400/1750	1800/2150	2200/2700	2600/3150	3800/4500
Voltage min/max [kV]	0.40/0.69	0.40/0.69	0.40/4.16	0.40/6.6	0.40/11	3.3/11	3.3/11	3.3/11	3.3/11
Weight pump/ motor unit max [kg]	900	1500	2700	5000	6600	8500	10200	12000	13500
Weight per 6m pipestack min/max dia [kg]	200	394/500	394/591	500/720	591/915	770/1150	770/1300	770/1300	770/1300
Weight top-bend and top-plate min dia/max dia [kg]	*	380/415	430/500	535/651	670/1050	1200/1250	1380/1500	1600/1700	1750/1850

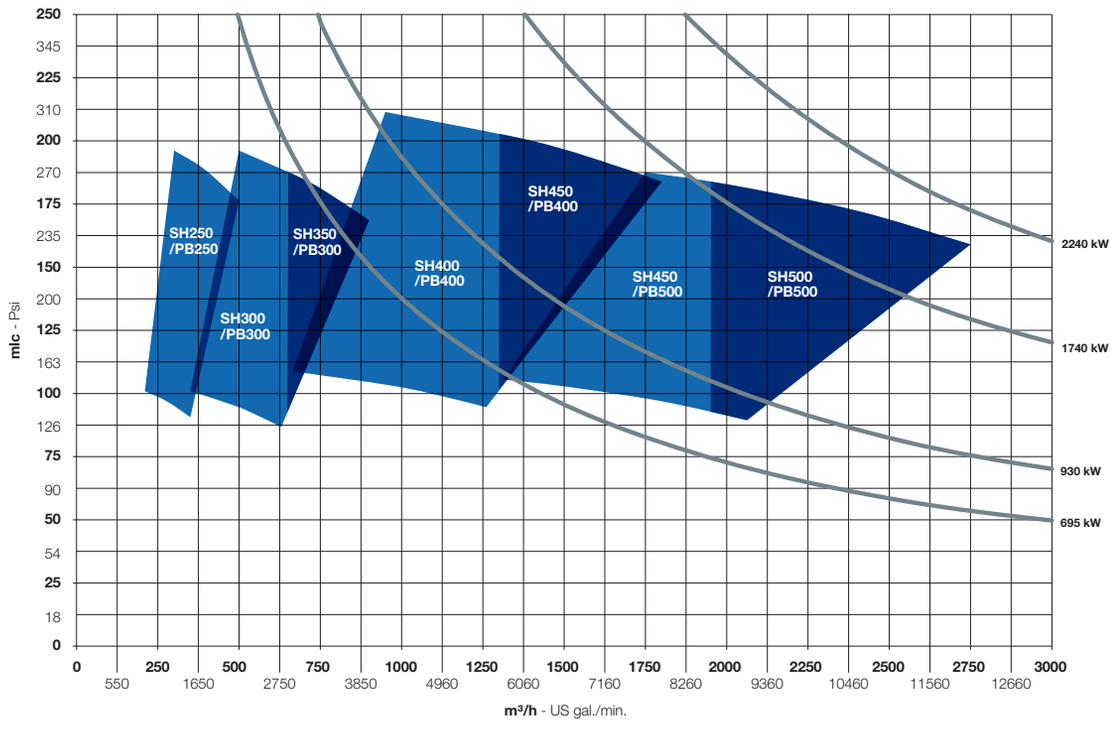
* Application dependent

Note: The range chart and the data table show the normal operating range. However, for special cases, the pumps can be modified to cover duties outside this range.

TECHNICAL DATA

Framo hydraulic fire water pumps

Performance domain



Diesel-hydraulic FWP

Diesel engine rating	695 kW	930 kW	1740 kW	2240 kW
Skid dimensions (L x W x H) [m]	5.0 x 1.8 x 3.5	5.4 x 1.8 x 3.5	6.8 x 2.3 x 3.5	7.3 x 2.3 x 3.5
Skid weight (Dry ex. fuel tank) [kg]	9900	10500	15500	16700
Module dimensions (L x W x H) [m]	8.5 x 2.8 x 3.5	9.1 x 2.8 x 3.5	10.6 x 3.1 x 4.0	11.8 x 3.1 x 4.0
Module weight (Dry) [kg]	26000	31400	41500	47600

Submerged lift pump

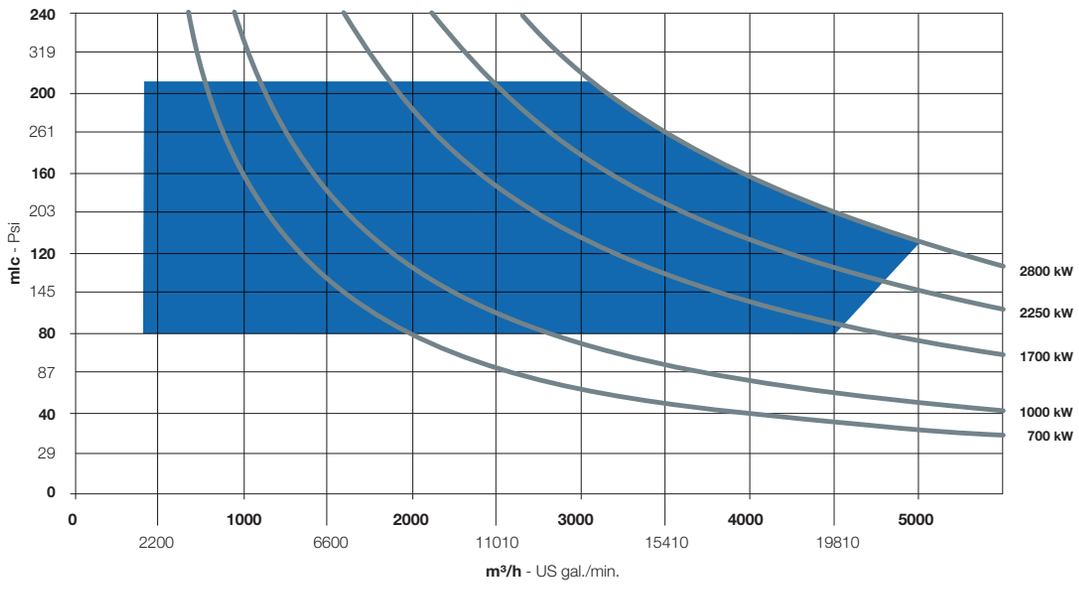
Pump type	SH250	SH300	SH350	SH400	SH450	SH500
Required caisson diameter*	26”	28”	28”	30”	36”	36”
Pipestack diameter [mm]	250	300	350	400	400	500
Weight pump/motor unit [kg]	540	700	700	850	2000	2000
Weight per 6m pipestack [kg]	333	396	599	569	609	674
Weight top-bend and top plate [kg]	296	323	351	492	530	585

* Include space for 1” anti-fouling injection hose

TECHNICAL DATA

Framo electric fire water pumps

Performance domain



Diesel-electric FWP

Diesel engine rating	695 kW	930 kW	1680 kW	2240 kW	2800 kW
Skid dimensions (LxWxH) [m]	5.0 x 2.2 x 3.2	5.4 x 2.2 x 3.2	5.6 x 2.2 x 3.2	6.2 x 2.2 x 3,2	7.4 x 2.2 x 3.2
Skid weight (Dry ex. fuel tank) [kg]	10300	11900	1740	19000	27200
Module dimensions (LxWxH) [m]	7.0 x 4.2 x 4.0	7.3 x 4.2 x 4.0	7.6 x 4.5 x 4.0	8.1 x 4.5 x 4.0	9.8 x 4.8 x 4.2
Module weight (Dry) [kg]	33100	35400	47100	51300	67000

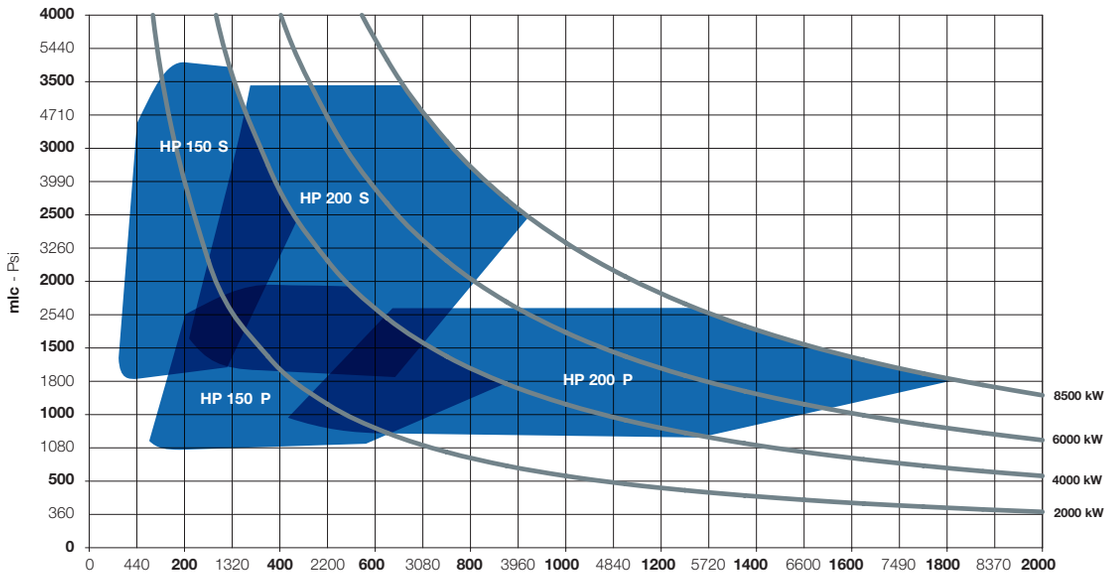
Submerged lift pump

Pump type	SE225	SE280	SE315	SE355	SE400	SE450
Required caisson diameter*	26”	30”	34”	40”	50”	54”
Pipestack diameter min/max	10”/14”	10”/18”	14”/18”	18”/24”	20”/32”	24”/32”
Max. power (50 Hz/60 Hz) [kW]	400/400	800/1000	1000/1200	2100/2500	2200/2800	2900/3600
Voltage (min/max) [kV]	0.40/0.69	0.40/4.16	0.40/6.6	0.40/11.0	3.3/11.0	3.3/11.0
Weight pump/motor unit [kg]	1500	2100	5400	6400	7400	10200
Weight per 6m pipestack [kg] (min dia./max dia.)	394/500	394/591	500/591	591/792	740/1150	792/1150
Weight top-bend and top plate [kg] (min dia/max dia)	350/360	490/511	365/601	701/845	755/960	995/1070

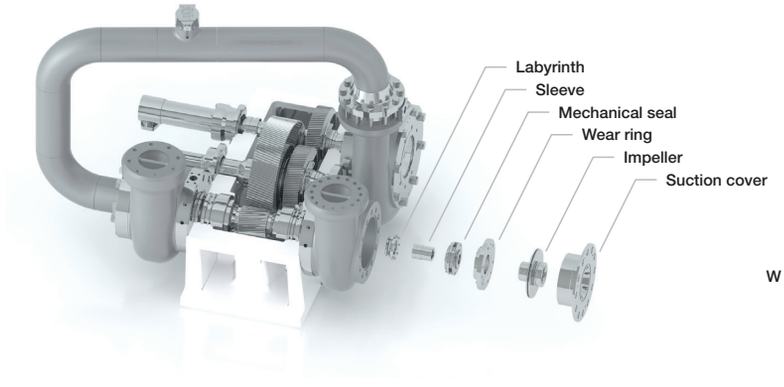
* Include space for anti-fouling hose

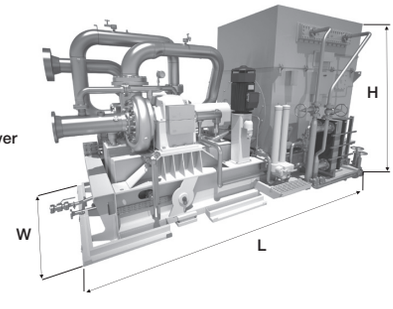
Framo water injection pumps

Performance domain



S= HP stages in series
P= HP stages in parallel





Pump type / Rating	Length [m]	Width [m]	Height [m]	Weight [kg]
HP150/1000	4.6	2.6	2.5	14200
HP150/2000	4.75	2.6	3.3	17200
HP150/3000	4.9	2.6	3.3	18500
HP150/4000	5.1	2.6	3.3	19200
HP200/5000	5.6	2.9	3.7	24900
HP200/6000	5.8	2.9	3.7	29000
HP200/7000	6.0	2.9	3.7	30000
HP200/8500	6.2	2.9	3.7	33000

Note: The range chart and the data table show the normal operating range. However, for special cases, the pumps can be modified to cover duties outside this range.

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