Your automation partner in Marine

Reliable and safe offering for a challenging environment

Endress+Hauser
People for Process Automation

Keep your business afloat

We help shipbuilding and offshore activities perform, comply and thrive.

Meeting evolving demands Although energy flows around the world can be volatile and unpredictable, your operation cannot be.

From shipbuilding to offshore, from upgrades to new projects, we have the instrument application expertise to help you succeed.

At a time when the sector faces skill shortages and tightening regulations, our organization is here across the full life cycle of your project, always with your deadlines in mind.

While complexity of facilities and processes is ever increasing and downtime must be reduced, your competitiveness is enhanced with reliable, accurate and traceable asset information.

Need to do more with less? Take advantage from a dependable partner who is by your side for the long haul and ready across the globe, offering:

Safety This topic allows no compromise. We manufacture accurate, robust and reliable instrumentation to ensure safety and elevate your overall reliability and productivity.

Efficiency Just as your goal is to extract maximum resources, ours is to maximize your efficiency and return on investment (ROI).

Availability The Marine sector faces three challenges: the availability of resources, services and technology. Endress+Hauser can assist you with each.

Driven by our purpose of safeguarding life, property and the environment, we never compromise on quality or the integrity design of our products, solutions and services.

Complexity threatens safety

Ships and offshore units have never been so sophisticated. A major consequence is that the risks for people, environment and assets are now much higher than in the past.

Endress+Hauser can support with tested and certified instruments:

- With our state-of-the-art point level switch, you avoid any overspill.
- Our complete solution produces the performance of a SIL3 graded overfill prevention system.

Not wasting a single drop of fuel is key to efficiency

Today fuel cost can represent up to 60% a modern ship's operational cost. Bunker operation and the use of fuel in different areas - ME, GE, boilers, etc, - now require the highest attention.

Therefore the times when mechanical flowmeters were used to give a rough indication of the fuel consumption is over.

With Endress+Hauser solutions, you precisely monitor the amount and quality of fuel during bunkering, fuel usage and find fields for optimization.

Best-fit products, solutions and services for higher availability

For more than 60 years Endress+Hauser has proven to be competent, reliable and trustworthy. We are where you need us, already present in more than 120 countries around the globe.

With our offering ranging from single sensors to complete automated solutions, we are your one-stop partner in instrumentation and automation. We are happy to support you with technical expertise.

Modern shipbuilding requires a smart partner

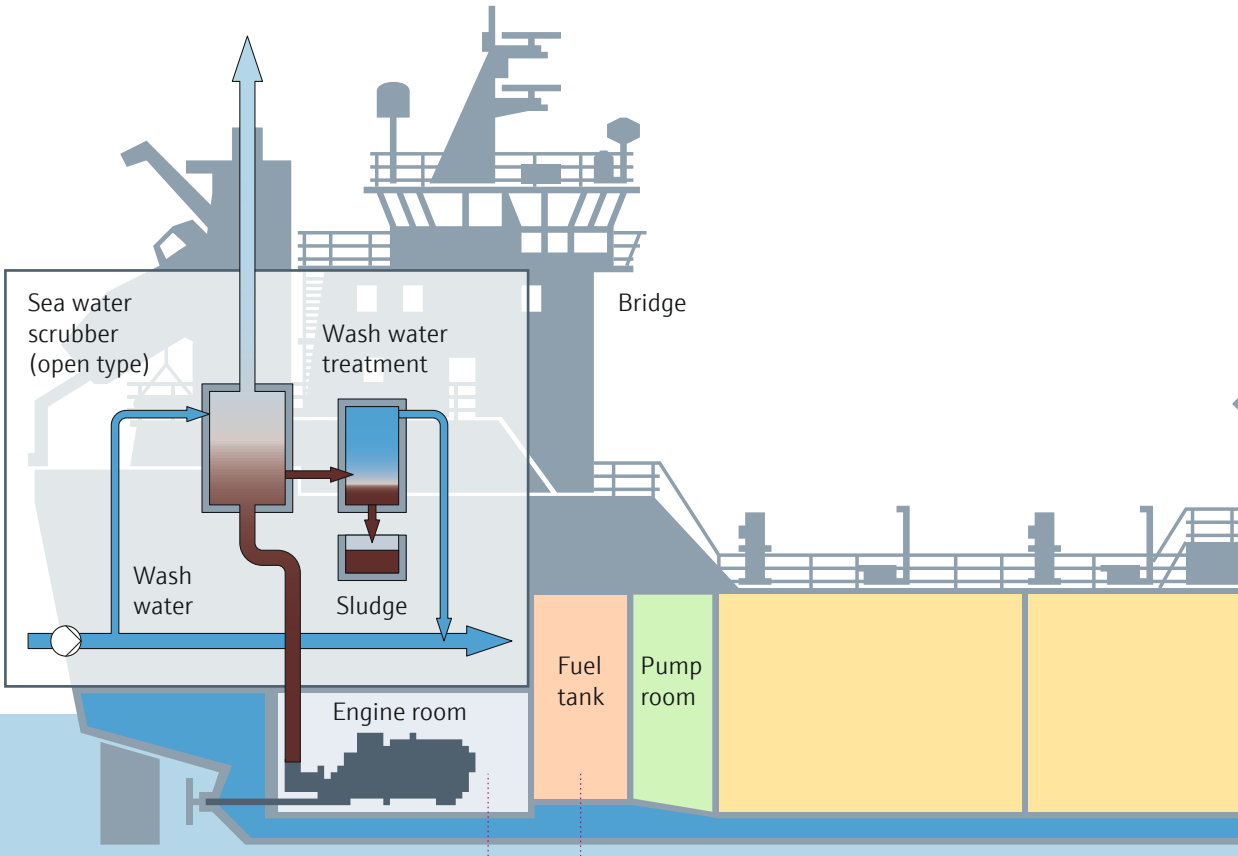
Shipbuilding is not just building a floatable hull and putting an engine inside. It makes considerable use of prefabricated sections: entire multi-deck segments of the hull or superstructure are built at different locations in the shipyard, then transported to the building dock or slipway and lifted into place. The most modern shipyards pre-install equipment, pipes, electrical cables and any other components within prefabricated sections, thus minimizing effort needed to assemble or install components deep within the hull once it is welded together. Shipbuilding is a logistical puzzle with thousands of pieces.

All these pieces have to be linked in a sophisticated way to form a modern ship. This is why you need partners who understand the requirements of a modern shipyard, especially when it comes to develop, deliver and commission the important parts of instrumentation and related solutions in time.

We are by your side.


NO SMOKING

Automated solutions for modern vessels



Improve sustainable efficiency via meaningful KPIs
Operating the vessel smartly is a must for companies looking for new ways of sustainable efficiency improvement. Endress+Hauser provides the digital platform for transferring physical events into valuable information.

Read more on page 8

Get transparency with bunker fuel metering solutions
With vast quantities of bunker fuel involved, the slightest inaccurate measurement during bunker operation will cause a shortage in the "cash register". Endress+Hauser's metering solutions ensure accurate supply and prevent incorrect billing and unwanted disputes.

Read more on pages 10 - 11

Ensure complete control of fuel consumption and achieve environmental compliance
Endress+Hauser's metering solutions and fuel management system provide a safe, accurate and transparent way to acquire, process and share fuel consumption data. The system produces the required MRV reports.

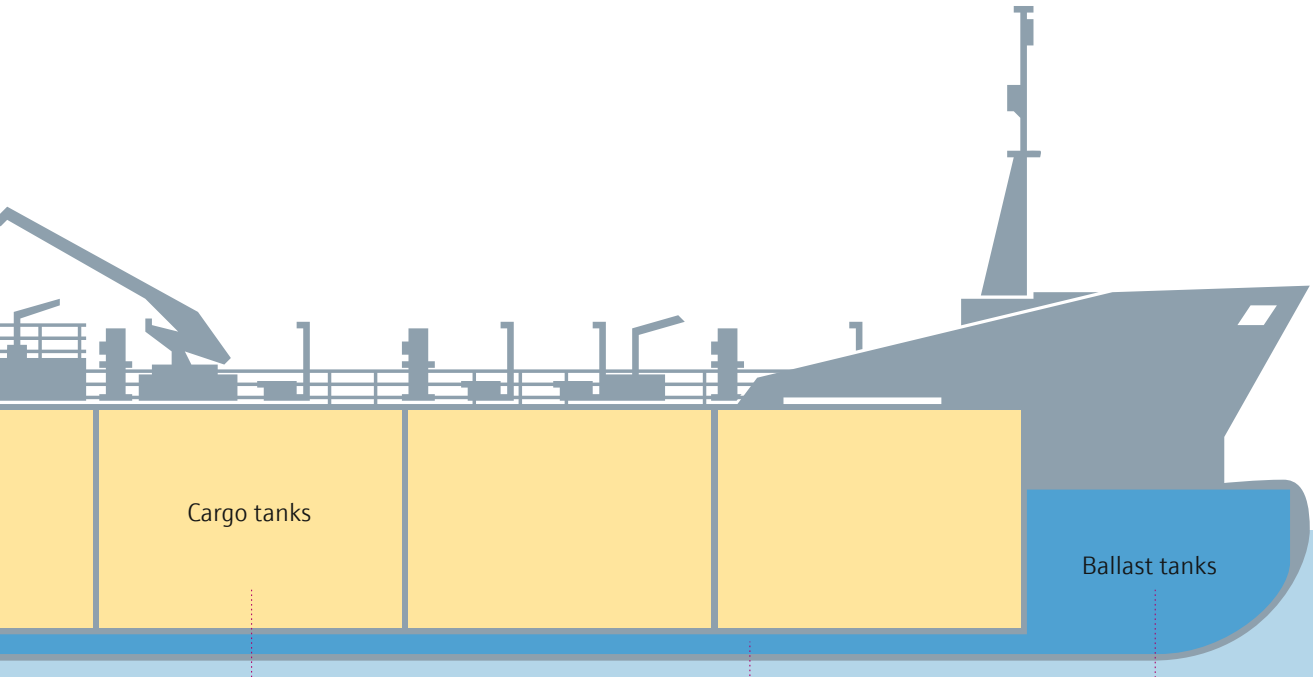
Read more on pages 12 - 14

Make sure exhaust gas treatment is efficient
In order to comply with regulations for the prevention of air pollution, the use of different fuels and the cleaning of the exhaust gases are the most common solutions. Endress+Hauser's solutions control critical parameters, which optimizes the cleaning process in scrubbers, SCR, etc.

Read more on page 15

Maintain expertise
Rely on a knowledgeable partner to support you from conceptual design to commissioning services

Read more on page 27



Avoid any harm caused by cargo
Most substances contained by cargo tanks are dangerous for the environment and require a fail-safe overfill prevention system independent from other instrumentation. Endress+Hauser provides a SIL3 designed overfill prevention system, which integrates the highest safety standard possible.

Read more on page 26

Optimize ballast water treatment
Ballast water discharge transfers invasive species to new marine environments, making it mandatory to install ballast water treatment systems (BWTS) in concerned ships. Endress+Hauser's solutions control critical parameters to optimize efficiency in BWTS.

Read more on page 18

Increase stability with tank monitoring
Keeping the ship stable in all circumstances is of utmost importance. To address this challenge, Endress+Hauser has developed Ship Vision. This approved tank monitoring software provides all the information you need to operate your unit in a safe manner. You can also operate valves, pumps and actuators.

Read more on page 16

Reliably measure ballast water
From a chemistry standpoint, ballast water can be one of the most aggressive waters. Furthermore the chemical composition may vary depending on the location where it was taken, which is why it is difficult to measure ballast tanks. Endress+Hauser has developed a dedicated sensor, absolutely ballast water resistant.

Read more on page 17

Improve sustainable efficiency via meaningful KPIs

Endress+Hauser provides the digital platform for transferring physical events into valuable information.

The challenge Shipping is a business based on cost cutting and efficiency. Therefore it is a true challenge to continuously improve the KPIs in order to achieve sustainability. Moreover, maritime technology has reached a point of maturity where any new evolution only influences the efficiency marginally.

A new model is taking shape: Smart Shipping. Basically, this model relies on the way a ship is operated rather than how it is built or equipped. To facilitate the transition to Smart Shipping, maritime technology should embrace the concept of Internet of Things (IoT).

Our solution Mass Flowmeters — as well as other onboard metering devices and control systems — are not mere instruments of observation; they are part of an integrated "ecosystem" where readings are converted into data elements; data combined with other physical events create valuable information that enable companies to take safe decisions and operate their vessels in a smart way.

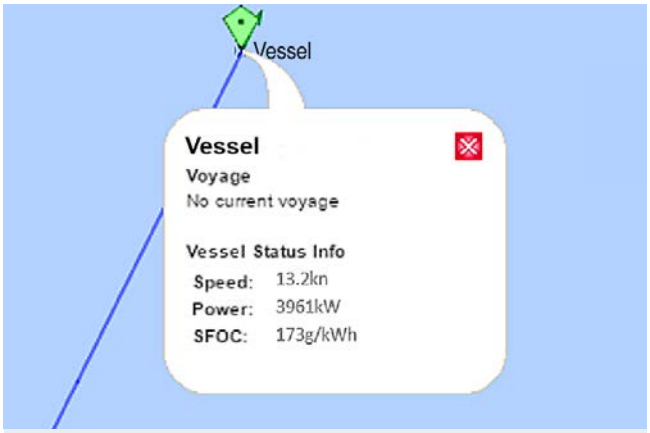
Using the SeeMBox-V© Open Digital Platform from SetelHellas, Endress+Hauser offers a holistic approach on fuel and energy management. This integrated solution enables ship owners and operators to:

- Enjoy insightful decision making, based on accurate, timely and auditable data.
- Ameliorate efficiency.
- Minimize operating expenses.
- Demonstrate predictability, increased productivity and eliminate downtime.
- Ensure conformity with environmental regulations and directives.
- Achieve compliance with any current, or future, emission or consumption monitoring directive (EU, IMO, etc.).
- Monitor and react on any critical or underperformance issue or any other related KPI, before it affects the operational results of a vessel.
- Experience significant reputational benefits towards a highly competitive market.

SeeMBox-V©: This rack mounted vessel data acquisition unit from SetelHellas is integrated into Endress+Hauser's Fuel Management System.

How it works The Promass mass flowmeters deliver readings onto the integrated SeeMBox-V© Open Digital Platform through a secure and independent network. These readings are converted to data and then combined with information from other vital equipment of the vessel: vessel speed, weather conditions, draft, shaft torque power and ME RPM, generator output, up to more advanced information on engine operation and conditions affecting the performance.

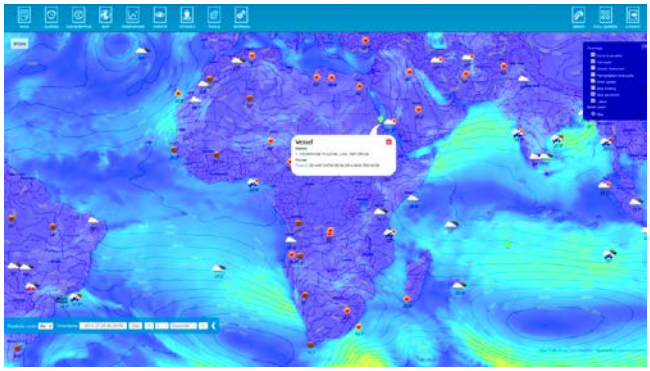
All the information is transferred from the Vessel to the Office through a secure channel, without any human intervention, thus ensuring complete transparency.



Benefits at a glance

This holistic view enables Companies to follow all types of performance and safety KPIs and also set their own by combining operational readings, information and observations with financial elements, enabling them to:

- Continuous improvement
- Internal and external benchmarking
- Set incentives



Navigation and Weather monitoring - screen shot of SeeMBox-V© Navigation Module.

Specific Fuel Oil Consumption (SFOC)

Specific fuel oil consumption is the measure of the mass of fuel consumed per unit time to produce per kW. The SFOC is used to determine the efficiency of a marine engine. In order to achieve a sufficient accuracy, the fuel consumption and the power developed need to be measured over a suitable time period, in fair weather. The formula is:

SFOC (g/kWh) = Mass of fuel consumed per hour / Power developed in kW

The flow readings at the main engine should be noted over the specified time interval (e.g. 1 hour). With the difference in readings the volume of fuel consumed is obtained. It can also be measured by noting down the HFO service tank readings, provided the oil only supplies the main engine.

The mass of the consumed fuel is directly measured by the mass flowmeter. There is no need for volume to mass conversion any more. This leads to higher accuracy compared to traditional volume flow measurement. The horsepower can be measured using a dynamometer—if fitted on the shaft of the engine—that displays the BHP on a digital indicator. Otherwise, the horsepower can be calculated using the engine speed and the average pump fuel index, with the aid of engine characteristic curve of various sea trials which is supplied by the manufacturer. However, the calorific value of the fuel used for sea trial may differ and hence compensation factor has to be determined to achieve a sufficient accuracy in calculation.

Mass Flow Meter - Direct savings through accurate and transparent bunker metering

Endress+Hauser's metering solutions ensure accurate supply and prevent incorrect billing and unwanted disputes.

The challenge Day after day, a vast quantity of bunker fuel is pumped into the fuel tanks of passenger and container vessels, tankers and bulk carriers. The slightest inaccurate measurement during bunker operation causes shortages in the "cash register" and time consuming disputes.

Everybody is aware that the traditional quantity measurement involves a relatively high uncertainty due to:
- Error-prone volume to mass calculation, and
- The fact that it does not consider air content caused by tank stripping and the "cappuccino effect".

Very often, this leads to incorrect billing and unwanted disputes between supplier and buyer.

Our solution Ship owners have increased installation of special bunker fuel metering systems, which ensure transparent and accurate bunkering. These systems contain mass flow meters, that have been tried and tested for decades in custody transfer applications.
Endress+Hauser has developed a sophisticated and reliable bunker metering system capable of measuring accurately aerated fuel oil. This system offers several benefits:

Profitability combined with improved efficiency
- Direct savings of fuel costs due to accurate metering
- Up to 3h shorter bunker operation due to no opening and closing sounding
- No costly and lengthy disputes

System integrity
- Guaranteed traceability of measurement
- Sealing through certified verification officers
- Audit trail function

Industry accepted
- MID (Measurement Instrument Directive) MI-005 Certified
- MPA (Maritime Port Authority of Singapore) approved
- In compliance with TR48 Bunker Standard

Easy to operate with
- Always accessible online
- All functions are available at your fingertips
- Data storage of up to 50 bunker operations

Benefits at a glance

- Confidence and profitability
- Increased transparency
- Higher and sustainable efficiency
- Unlimited security
- Time saving

Have control on fuel consumption

Endress+Hauser's metering solutions provide clear view of fuel usage in different areas of the ship.

The challenge Fuel consumption represents up to 60% of the vessel's running cost, the use of fuel in different areas — ME, GE, boilers, etc. — requires an accurate consumption measurement.

Our solution The times when mechanical flowmeters were used, to give a rough indication of the fuel consumption, is over — the industry now appreciates mass flowmeters. Based on the Promass mass flowmeter, Endress+Hauser's fuel consumption system provides:

- Accurate and reliable fuel consumption measurement
- Seamless system integration
- Gateway for existing instrumentation
- Data transfer for remote vessel monitoring
- Heartbeat Technology for automatic flowmeter self verification

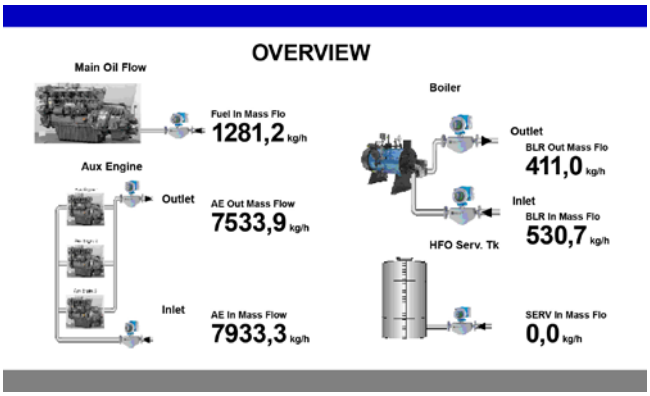
New challenges due to fuel switching When ships enter emission controlled areas (e.g. Europe, America) they have to reduce the emissions of their engines. Changing fuel from Heavy Fuel Oil (HFO) to Marine Diesel Oil (MDO) with low sulphur is a common solution to achieve this reduction.

The flowmeters that measure consumption, experience stress during the use of two different fuels. These flowmeters need to be precise on high viscose liquids (HFO) and on low viscose liquids (MDO). The liquid temperature also drastically changes: 130°C (266°F) in one case, 30°C (86°F) in the other one.

Our solution The specially designed Promass mass flowmeter's accuracy is barely influenced by temperature and viscosity changes. Therefore this mass flowmeter ensures an absolute precise consumption measurement. It does not need a zero point verification when the liquid temperature and viscosity have changed.

In addition to the meter, Endress+Hauser has created a local and versatile HMI which can provide separate counts of e.g. HFO, MDO, trip, day, etc. The data is stored by the RSG45 data collector thus avoiding any further manipulation. The software allows to customize the data format and to transfer data via a satellite link or a USB stick.

Onboard visualization for fuel consumption monitoring with RSG45 recorder and Promass 100 mass flowmeter



Screenshot example - fuel consumption monitor

Easily manage fuel consumption data

Endress+Hauser's fuel management solution provides a safe, accurate and transparent way to acquire, process and share fuel consumption data.

The challenge Monitoring the fuel consumption and bunkering in an accurate and seamless way is essential to Smart Shipping. However, in the vast majority of the Commercial Vessels, the information is still not stored electronically and the reporting of fuel consumption from the vessel to the office is still manual. Moreover, the data is aggregated on average figures that hardly help analyzing the consumption based on physical events or identifying possible malfunctions of the machinery.

Performance Office Dashboard displayed by SeeMBox-V© Fuel Consumption Module

Our solution Endress+Hauser provides a solid and at the same time flexible solution to address those challenges. The Promass mass flowmeters are interfaced to the SeeMBox-V© Open Digital Platform where all readings are converted into data and stored on a secure database onboard. With this information, the crew can monitor and get their own reports of actual consumption at specific time intervals and send them to the SeeMBox-V© Office Hub, where it is displayed for the office personnel. Moreover, this information can be shared with other 3rd party applications — both onboard and onshore — through a unique Digital Data Fusion feature.

How it works The Promass mass flowmeters are connected through their Modbus interface to SeeMBox-V© onboard platform. The readings are sampled and stored every one minute on a secure database. The solution comes with a dedicated workstation which enables the crew to monitor and extract reports on fuel consumption. Connecting the solution to the vessel's communication gateway enables to transmit the information back to the office at any specific rate — the transmission is seamless, secure and unattended. The digital platform also acquires, stores and transmits a wide range of diagnostics from the Promass mass flowmeter, providing valuable data for efficient and effective support.

Fuel transfer meter - HFO transfer pump to HFO settling tank

Ensure accurate and transparent environmental compliance

Endress+Hauser's solution produces the required MRV reports and accommodates the new forthcoming regulation expected from IMO.

The challenge In order to reduce greenhouse gas emissions from international shipping at the European Union level, a system is being introduced for the monitoring, reporting and verification (MRV Regulation) of CO_2 emissions due to ships' fuel consumption. Since the introduction of the Ship Energy Efficiency Management Plan (SEEMP) back in 2012, regulatory bodies enforced more regulations, with the EU MRV being the most recent. All these regulations refer to fuel consumption, creating an urgent need for accurate, transparent and automated reporting.

Our solution Manual reporting on paper logs and pre-set forms cannot cope with the rising need for transparency and accuracy. Recognizing this challenge, Endress+Hauser has integrated a complete and robust solution that combines the proven Promass mass flowmeter technology with the SeeMBox-V© technology. The solution fully complies with the MRV regulation.

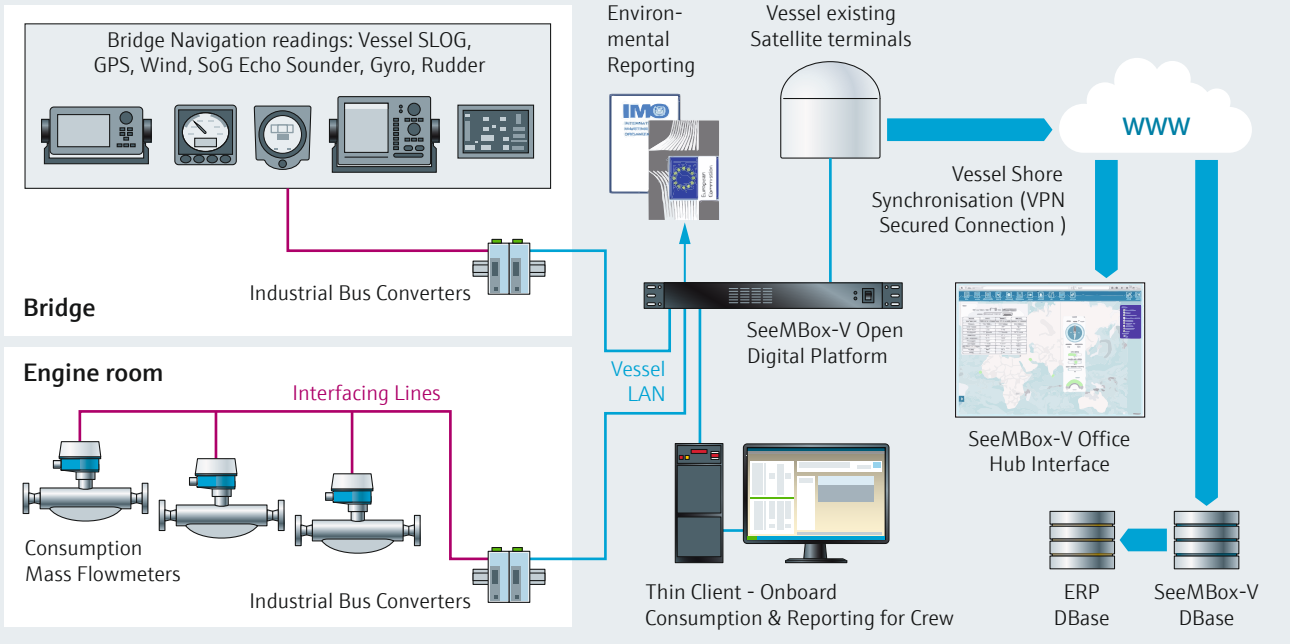
How it works The Promass mass flowmeters are connected through an industrial bus converter to the SeeMBox-V© Open Digital platform. Utilizing IoT Technology, the solution empowers shipping companies to take full advantage of the Digital Transformation:

- The consumption readings are combined with other automated readings (e.g. speed, position and distance) and the crew's manual entries on the monitored events (sailing, berthing, loading etc.);
- The system automatically produces the required MRV reports at the end of each period.
- The data is automatically transferred to the shore Head Office, thus allowing constant monitoring as well as analytical records on vessel's consumption and efficiency KPIs as required by the regulations.
- Automatic validation at entry minimises human error mistakes and provides seamless and accurate reporting.

The solution is designed to accommodate any new forthcoming regulation that is bound to the fuel consumption such as the one expected from IMO.

The SeeMBox-V© is certified by an independent verifier for EU MRV compliance.

The system architecture



Make sure exhaust gas treatment is efficient

Endress+Hauser's solutions control critical parameters, which optimizes the cleaning process in scrubbers, SCR, etc.

The challenge Within the International Maritime Organization (IMO), the Marine Environment Protection Committee (MEPC) has introduced regulations for the prevention of air pollution. The Annex VI of MARPOL Convention imposes a framework of mandatory limits on emissions of sulphur oxides (SOX) and nitrogen oxides (NOX) both globally and within designated sea areas, known as Emission Control Areas (ECAs). Regional legislative differences and a number of technical options are available to meet these requirements. Other than the use of different fuels within these areas, the cleaning of the exhaust gases is the most common solution.

Our solution Endress+Hauser's solutions efficiently monitor the exhaust gas cleaning process. They monitor the critical parameters of flow, level, pressure, temperature and analysis. Certified for the use in the marine industry, our instrumentation ensures your cleaning process complies with regulations.

Increase stability with tank monitoring

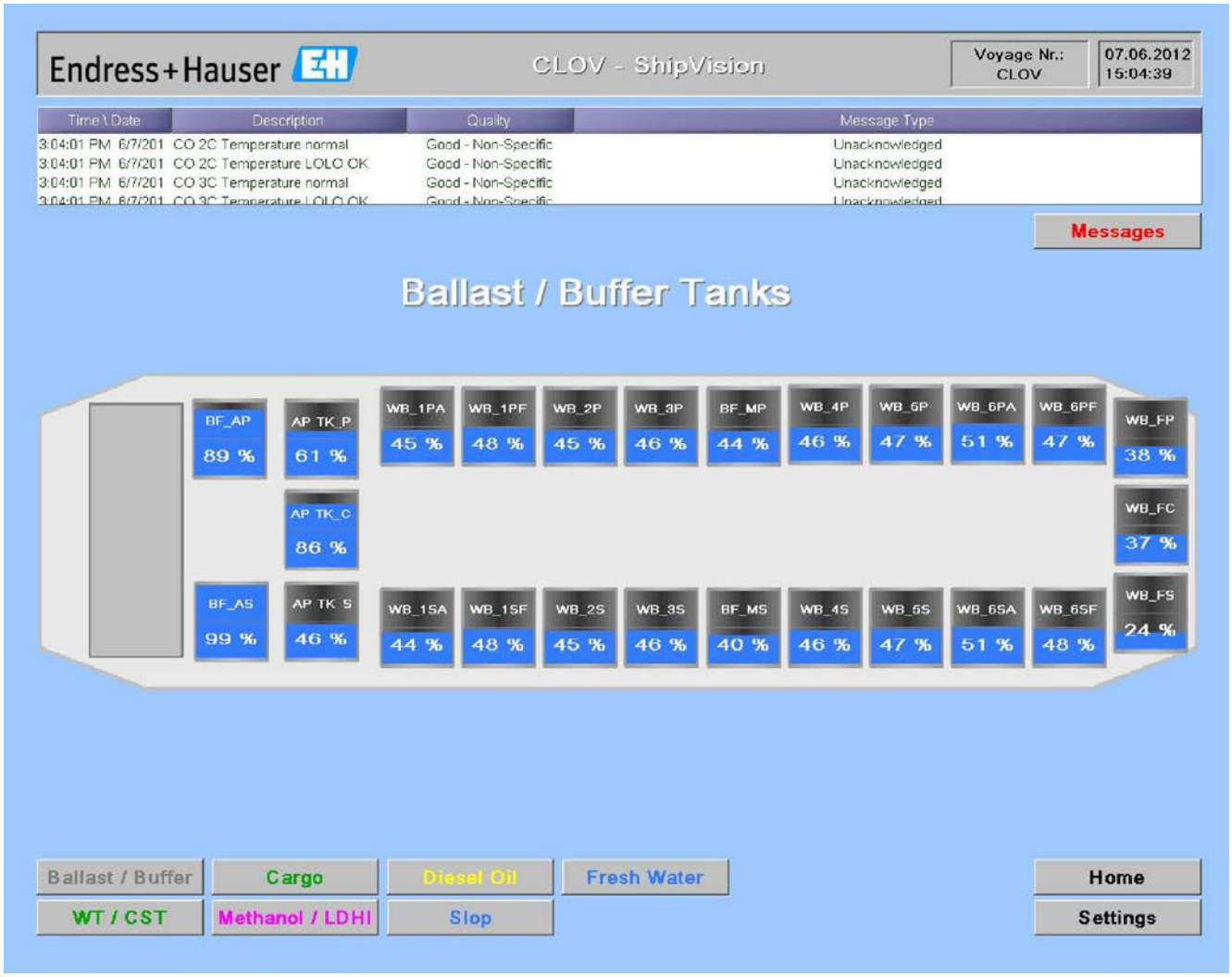
Ship Vision provides all the information you need to operate your unit in a safe manner.

The challenge Keeping the ship stable under all circumstances is of utmost importance. To operate your unit in a safe manner, you need to be able to gather all the data provided by the installed instrumentation and operate valves, pumps and actuators from various manufacturers. In addition, to succeed in automating a ship or an offshore platform, it is important to build a partnership with one who has required experience and can solve tasks thoroughly and reliably.

Our solution Ship Vision offers a unique, type-tested software solution for managing and monitoring ballast, fuel and cargo tanks for marine and inland navigation vessels as well as offshore facilities. Ship Vision includes all the components to automate a ship or offshore platform:

- Type-tested high precision field instrumentation
- Type-tested controls
- Type-tested valves and actuators
- Type-tested software modules

Operators can easily change the displayed language, which is an important feature for crews with several nationalities.



Reliably measure ballast water

Endress+Hauser has developed a dedicated sensor, absolutely seawater resistant.

The challenge Ballast water is one of the most critical substances to measure on ships and offshore facilities. Due to the corrosiveness of the ballast water, standard metallic sensors have a limited lifetime in ballast tasks. This lifetime depends on used material—SS316, Monel or Tantal.

Our solution Submersible sensors are a revolutionary design for ballast water and provide a lasting solution. The use of rubber coated and ceramic materials for sensor membranes reduced claims against ballast water sensors to 0%.

The sensor has an easy installation process, which does not contain special holders. Commissioning is also quite simple via the 4-20 mA state-of-the-art electronics with the HART protocol.

As the cable length can be max. 300 m (984 ft), this ballast water sensor can be used on any kind of seagoing units.

Installed sensor in ballast water tank

Optimize ballast water treatment

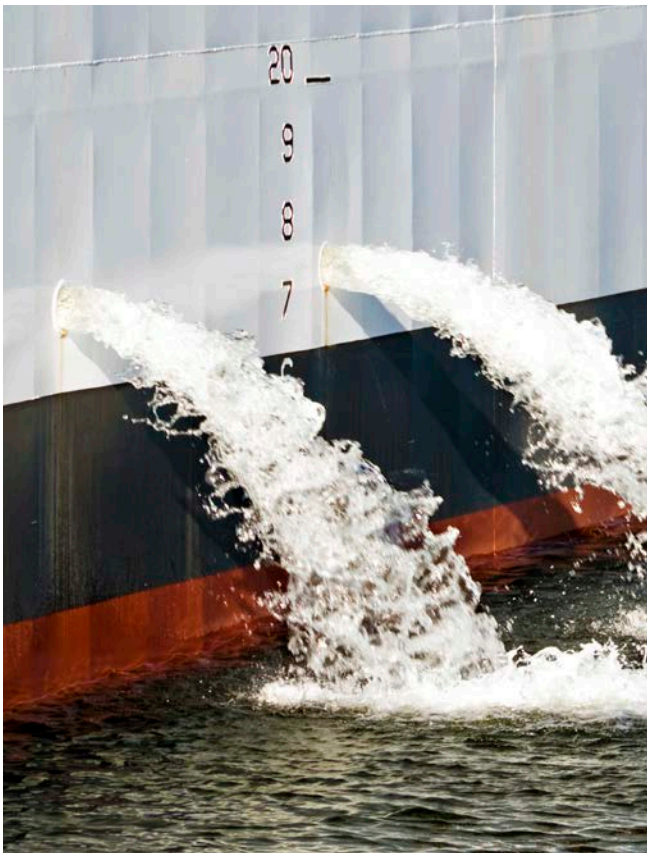
Endress+Hauser's solutions control critical parameters to optimize efficiency in BWTS.

The challenge Loading and discharge of ballast water are essential steps of a ship's operation - they ensure stability and maneuverability under different conditions of load. For large vessels, each of these steps may involve thousands of tons of water... with a considerable impact: the ballast water contains hundreds of different species which are transferred to regions where they are not native. Most of these species do not survive the voyage, but those which do will establish themselves in a new environment. As non-native species, they can have a severe impact on local ecology, economy and public health.

Recognizing these effects has made ballast management increase the importance of marine environment. The International Maritime Organization (IMO) developed a Convention focused on the prevention of these harmful effects. It adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Ballast Water Management Convention) in 2004.

The installation of Ballast Water Treatment Systems (BWTS) is necessary to meet environmental and legislative requirements on a local and global level. A variety of BWTS technologies (see graph on page 15) are available depending on factors like e.g the route and length of the voyage, water quality and the size of the vessel. Several critical parameters are measured, controlled and documented by the BWTS.

Magnetic flowmeter in ballast water line



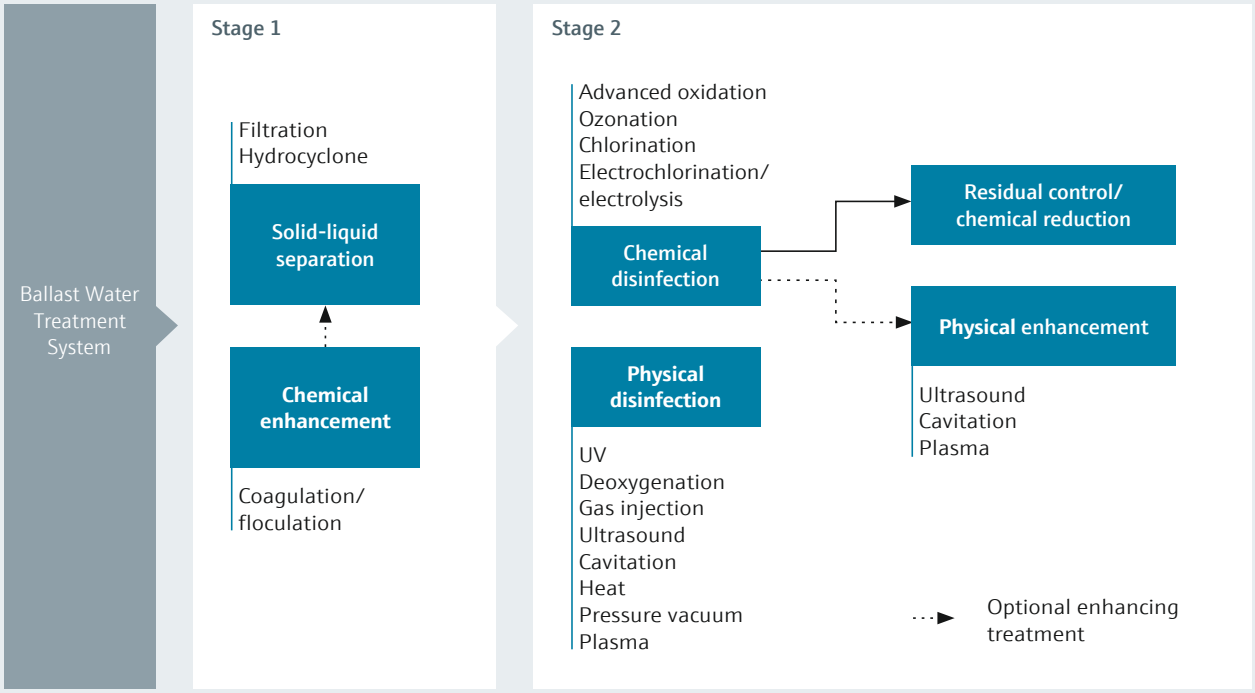
To ensure discharge ballast water complies with regulations, the BWTS undergoes tests and approvals by IMO for use on-board.

Our solution Endress+Hauser offers numerous solutions in order to optimize efficiency in the BWTS. These include measurement and control to most required parameters such as flow, level, pressure, temperature and analysis.

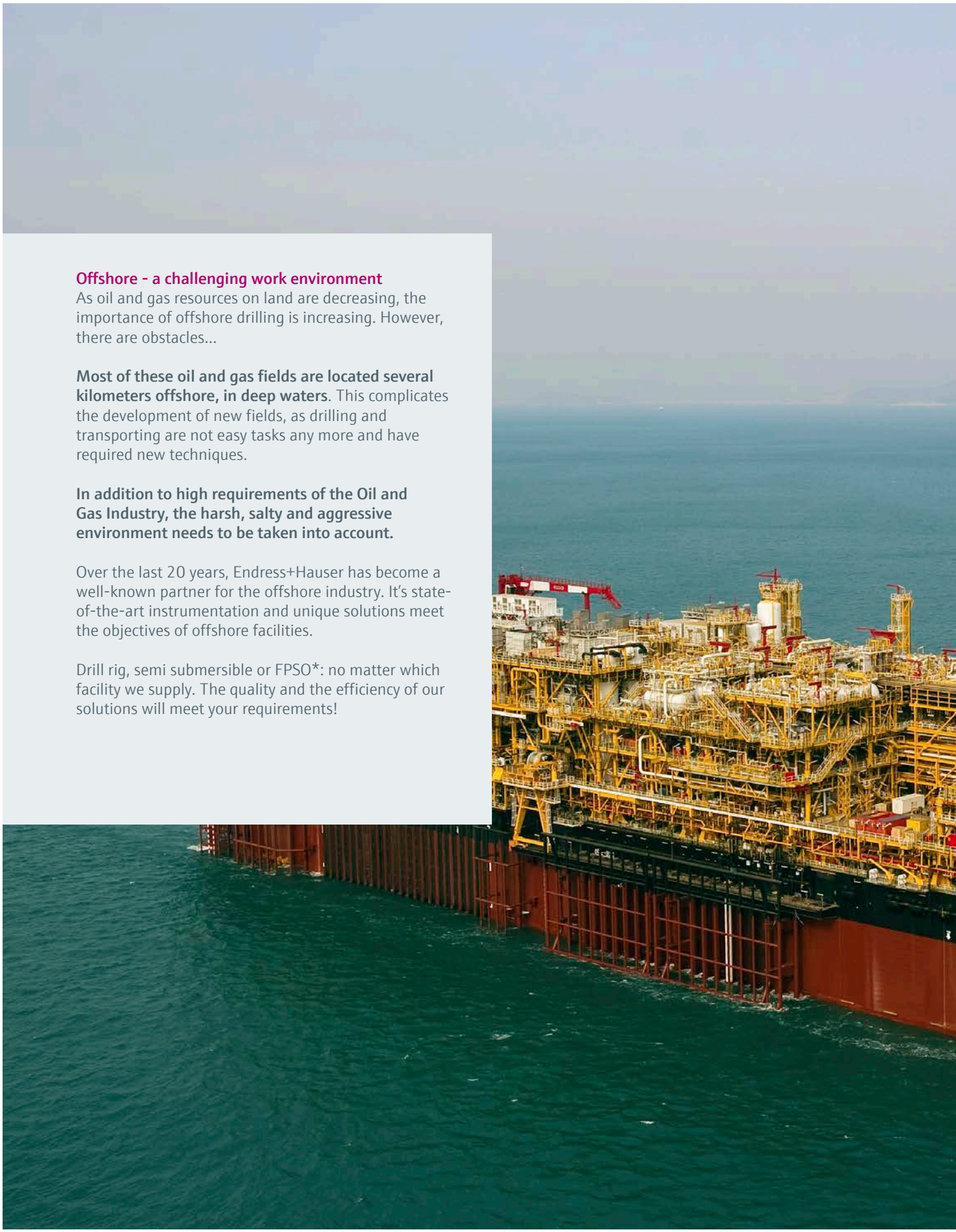
Instrumentation involved in BWTS
Flow measurement is key: it is used on inlet and outlet water and where treatment technologies (e.g UV) may be influenced by flow and require a control loop. For detailed monitoring, the system may include temperature and pressure measurement, pH, conductivity or oxygen measurements.

The standard configuration of the BWTS can be adapted to fit the available space.

BWTS Technologies



BWTS use different technologies such as Mechanical, Physical and Chemical Treatment or a combination of several technologies.
Source: Adapted from Lloyd's Register Group Ltd, 2014



Offshore - a challenging work environment

As oil and gas resources on land are decreasing, the importance of offshore drilling is increasing. However, there are obstacles...

Most of these oil and gas fields are located several kilometers offshore, in deep waters. This complicates the development of new fields, as drilling and transporting are not easy tasks any more and have required new techniques.

In addition to high requirements of the Oil and Gas Industry, the harsh, salty and aggressive environment needs to be taken into account.

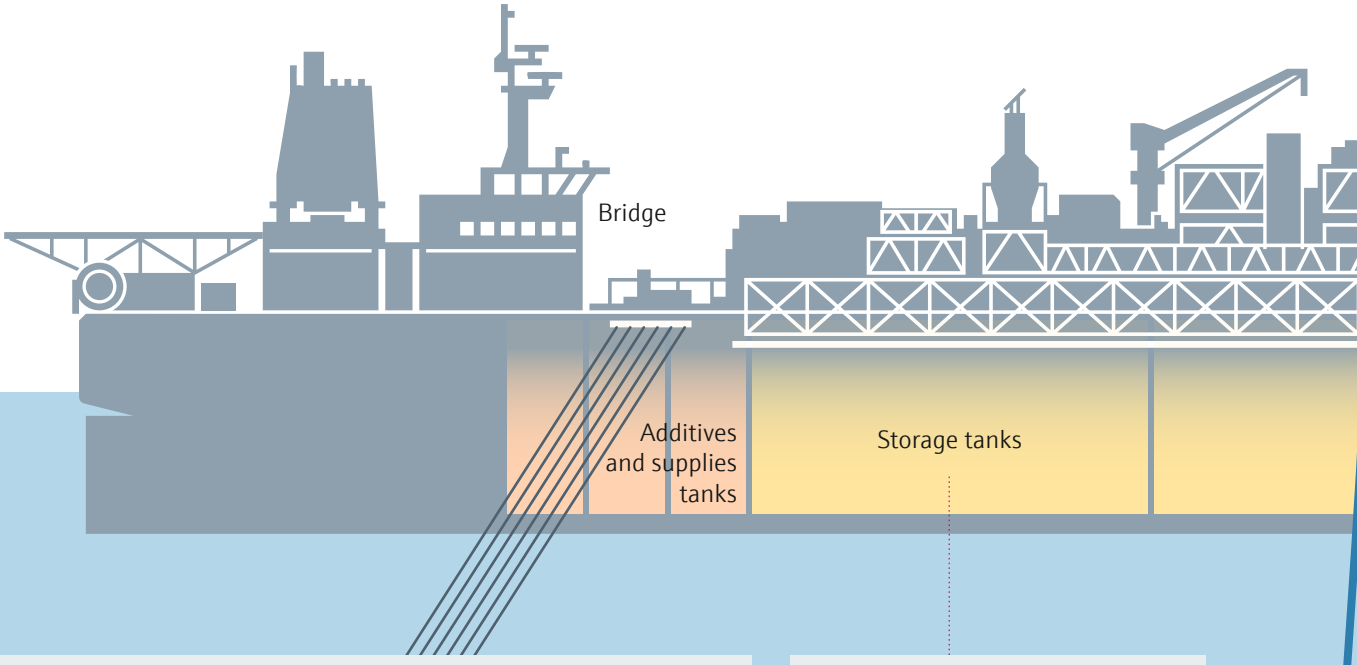
Over the last 20 years, Endress+Hauser has become a well-known partner for the offshore industry. It's state-of-the-art instrumentation and unique solutions meet the objectives of offshore facilities.

Drill rig, semi submersible or FPSO*: no matter which facility we supply. The quality and the efficiency of our solutions will meet your requirements!

* FPSO: Floating Production, Storage and Offloading


FPSO
PAZFLOR

Our solutions for the offshore industry



Your processes run smoothly 24/7
When coming out off the ground, crude oil contains a large amount of substances - mostly gas, water, sand and oil. Several processes are necessary to separate these substances before clean oil and gas can be stored and then transported to the shore and subject to the refining process. This is a challenging task, as the crude oil generally comes up under high pressure and at high temperatures.

All these processes must run 24/7 under supervision of operators and crew members on board. Spare parts are not easily retrievable because FPSOs and drilling units are far offshore. Therefore, the installed equipment must be reliable and long lasting - this includes instrumentation.

Ensuring reliability and accuracy are our focus when we design new solutions or develop new instruments for the offshore industry.

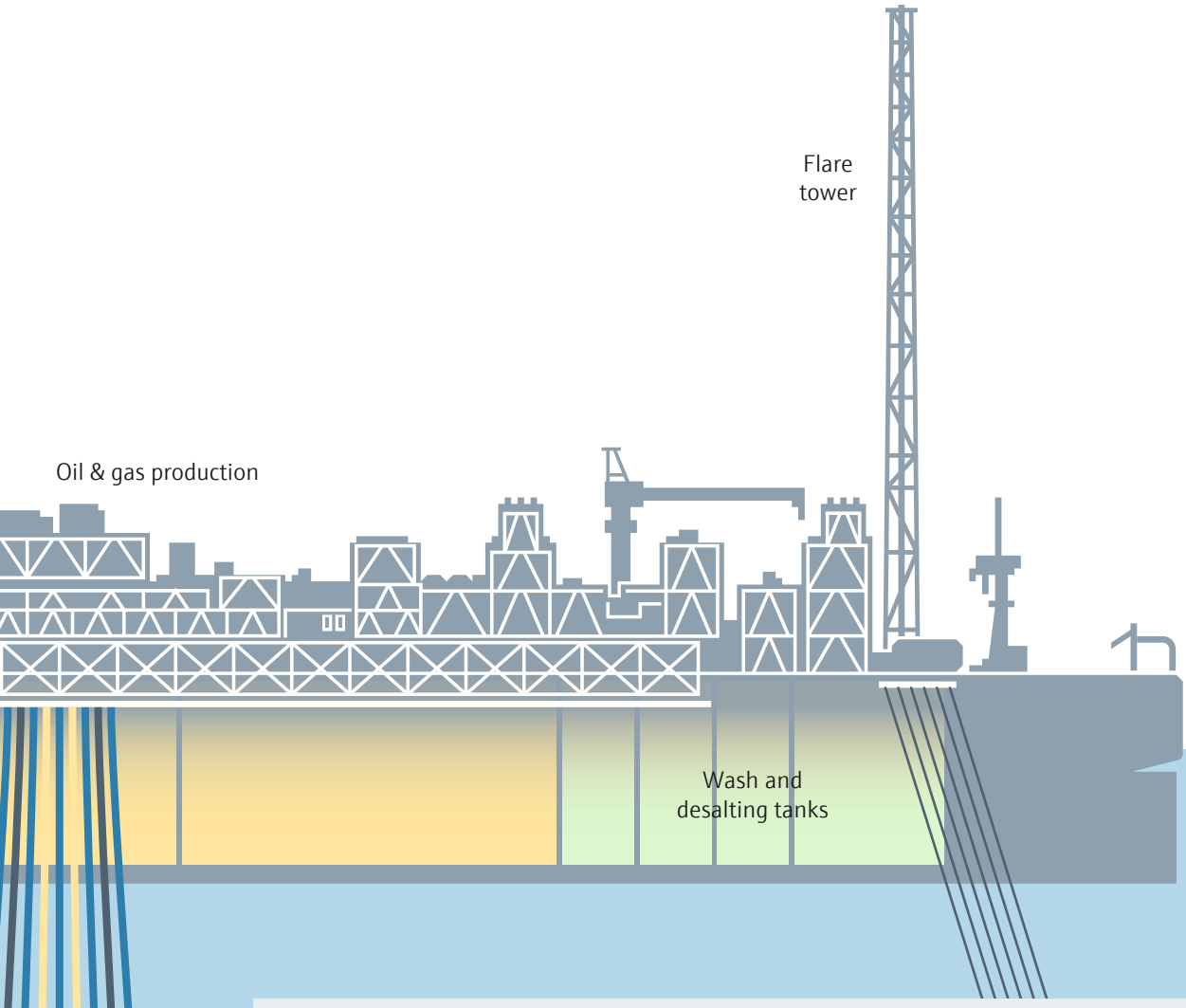
One example is our solution for **bottom water detection in crude oil tank**.

Read more on page 25

You avoid any harm caused by cargo
Most of the substances contained by storage tanks are dangerous for the environment and require a fail-safe overfill prevention system, independent from the other instrumentation.

Endress+Hauser provides a SIL3 designed overfill prevention system that integrates the highest safety standard possible.

Read more on page 26



You get a clear view of the separation process

Separation is the key process on every FPSO. This process determines whether the operation will be profitable or not. Therefore, it is of utmost importance to know what happens inside the separator.

The separator is a laying cylinder several meters in diameter (4 to 7 m) and is 20 to 30 m long. One drop of oil may need half an hour to travel from the inlet to the outlet. In the past, an instrument used to be placed at the end of the separator to measure achieved oil quality - this was comparable to driving a car and steering while only looking through the rear-view window.

Endress+Hauser has collaborated with customers to develop a new design for the separators. The device gives the operator the ability to have a clear view of what happens during the separation process, from the moment crude oil enters the vessel until it leaves it in the form of sand, water, gas and oil. This enables the operator to knowingly act on the flow rate.

Read more on page 24

Maintain expertise

Rely on a knowledgeable partner to support you from conceptual design to commissioning services

Read more on page 27

A clear view of the separation process

Endress+Hauser's Density Profiling System provides the density from top to bottom.

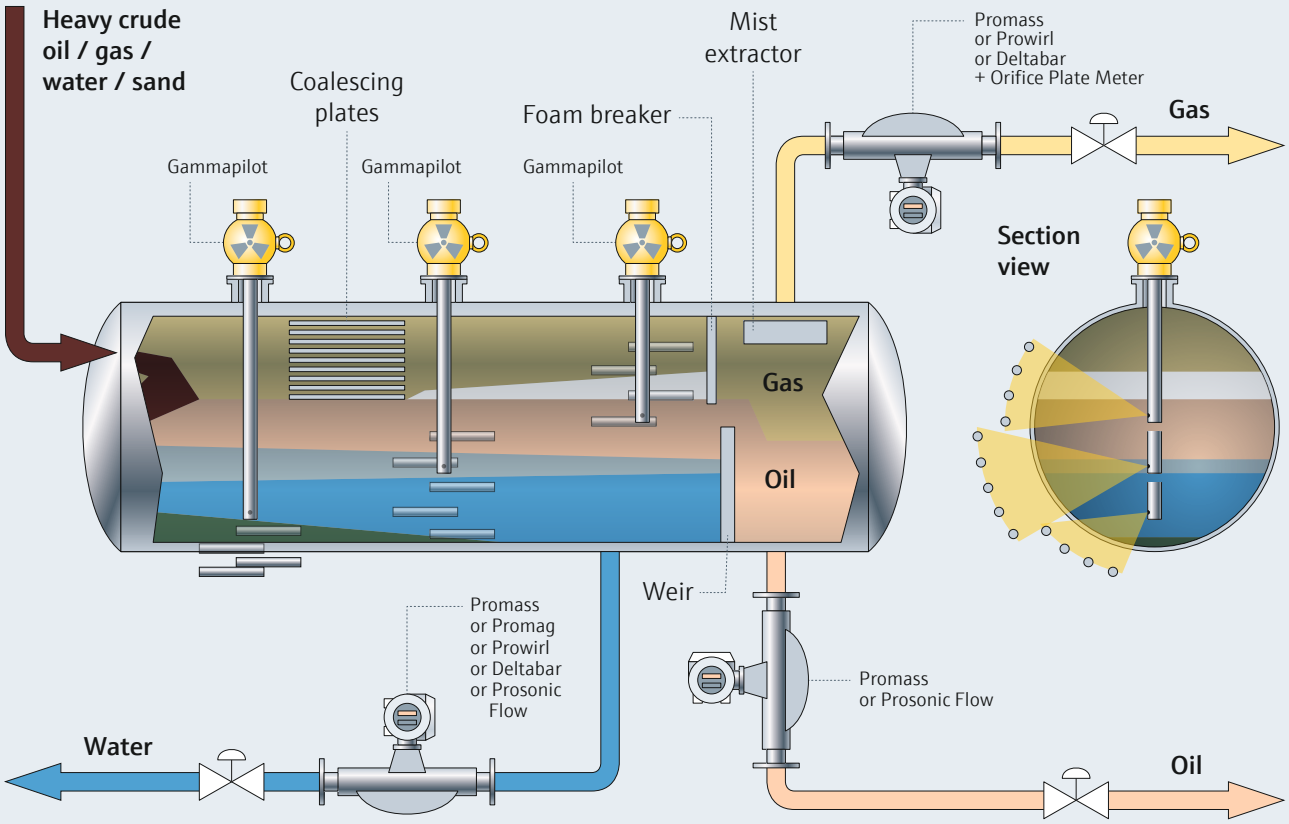
The cleaning process of crude oil is done in separators, FWKO, BOTs and Desalters. Knowing the density from top to bottom optimizes the time and cost of the operation. Moreover, the position and thickness of the emulsion layer determines the amount of chemical emulsion breakers that must be added.

The challenge Traditional technologies are unable to give a clear overall view of the level and emulsion layer. In addition, they must be installed inside the separator and are often susceptible to contamination. The measurement device must be removed for cleaning regularly, wasting valuable time.

Our solution The graphics describe Endress+Hauser's Density Profiling System. The separator is divided into three density detection areas:
(1) The presence of sand is measured at the bottom of the separator to ensure the entire volume for separation is available.
(2) The position and thickness of the emulsion layer is measured to optimize the separation process and avoid any underdosing or overdosing of chemical emulsion breakers.
(3) Clean crude is monitored at the top for quality verification.

Integrated PLC collects and scales all measurement data. Visualization of up to five different interface levels is possible (sand, water, emulsion, oil, and foam).

Extra heavy and heavy crude oil separation



Effective bottom water detection

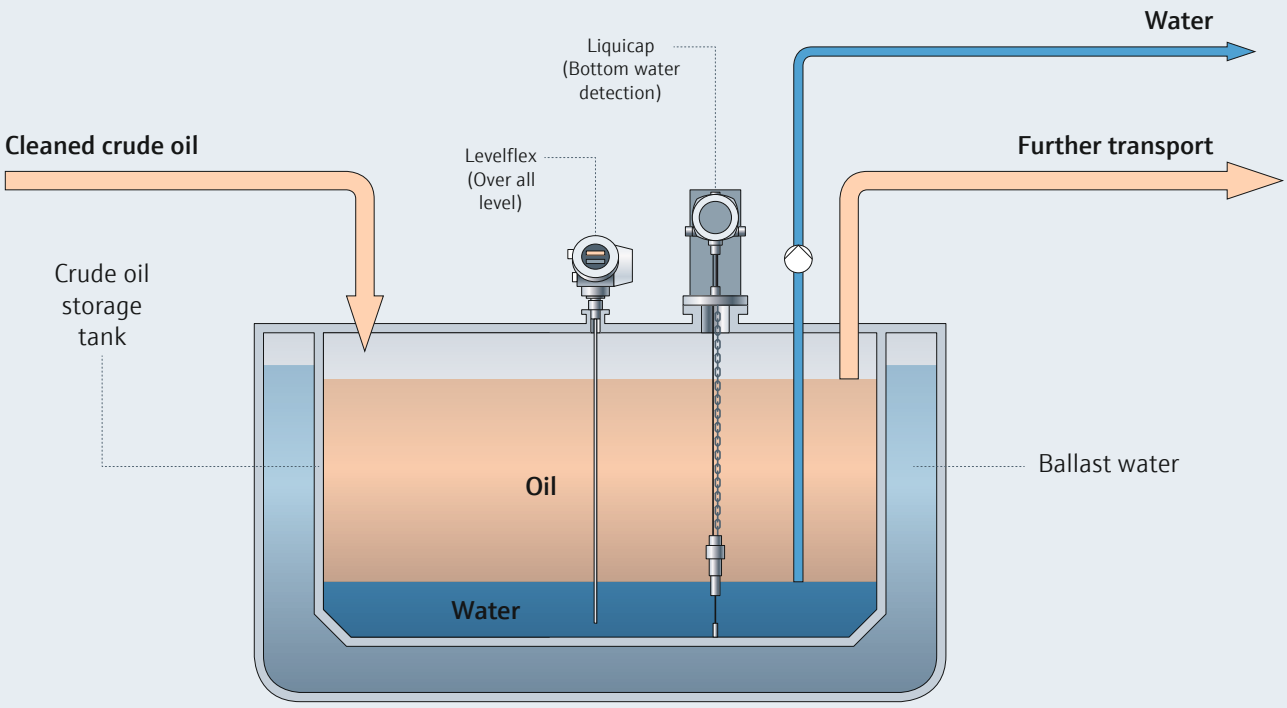
A specially designed capacitance level probe overcomes limitations of traditional technologies.

When the crude oil comes out of the cleaning process, it is poured in a storage tank. It still contains some water, which will separate gravimetrically in the tank.

The challenge The standard guided wave radar technology cannot detect the water level because of the overall height of these tanks (up to 40 m / 110 feet) and the thick layer of oil above the water.

Our solution A specially designed capacitance level probe handles this application accurately. It detects the water level under oil, allowing automatic start/stop of the water lifting pump. This ensures only clean crude oil is transferred for further processing.
The capacitance sensor can easily be installed into the storage tank.

Bottom water measurement in crude oil storage tanks



Capacitance level measurement
Liquicap M FMI52 with submersed capacitive rope sensor

- No calibration necessary for media with a conductivity of 100 µS/cm and higher
- Wetted parts are made of FDA listed, corrosion resistant materials
- Two stage over-voltage protection against discharge from the container (gas discharger + protective diodes)
- Self monitoring of sensor to detect damage to insulation and rod breakage or tearing
- Interface measurement

Avoid any harm caused by cargo

Endress+Hauser provides a SIL3 designed overfill prevention system that integrates the highest safety standard possible.

The challenge Most of the gases and liquids transported by cargo tanks are dangerous for the environment and crew safety. Efficient monitoring of these particular goods depend upon reliable instrumentation. In addition, the prevention of overfill requires a fail-safe overfill prevention system, independent from the other instrumentation.

Our solution Endress+Hauser provides a state-of-the-art 95% and 98% overfill monitoring system. It achieves the marine class requirement and is approved for connection to an alarm system. All used components and instruments are marine class approved and designed to be used on an open deck. The instrumentation is self regulated and provides high availability and measurement safety.

98% limit switch installation

SIL 3 prefabricated cabinet

Maintain expertise

Rely on a knowledgeable partner to support you from conceptual design to commissioning services

As a FPSO or vessel operator, plant builder, package supplier, main equipment supplier, or an EPC, you are looking for a reliable partner to help increase productivity and performance. Whether you are operating domestically or internationally, you can rely on Endress+Hauser's experts. We are at your side with a broad scope of supply:

- Project management
- Basic and detailed engineering
- Selection and delivery of measurement and automation solutions
- Installation and commissioning
- Onboard Survey, MID certification, System re-verification
- Documentation
- Support throughout the life cycle
- Training

Engineering

- Project specification: generation of the User Requirement Specification (URS) and the Functional Design Specification (FDS) of instrumentation and automation solutions
- Generation of the Engineering Documentation package containing: instruments list, components list, automation components list, CAD drawings, electrical drawings, installation charts, cable schedules, and calculation notes for design compliance
- Quality management that covers testing such as Factory Acceptance Test (FAT), and Site Acceptance Test (SAT)
- Constant availability of data on measurement devices and automation solutions during the life cycle

Support to maintain solutions

- Quick and easy online access to all information related to installed equipment
- Maintenance report for each device
- Full traceability of the completed maintenance operations for each device
- Service Level Agreement

Maintenance optimization

- Analysis of your installed base
- Generation of a comprehensive report listing all suggested areas of improvement needed to achieve a balanced maintenance plan

Training

- At your site or online
- At your local Endress+Hauser training facility
- At specialized training centers

Endress+Hauser men and women work closely together with worldwide and local organizations, foundations and institutes, such as First Point Assessment Limited (FPAL) for cost reduction and performance improvement. Our instruments are designed and manufactured according to global standardized certifications such as API, ISO, SIL and IP. Global approvals and certificates include:

Approvals for hazardous areas (Ex certificates)
▪ ATEX ▪ FM ▪ CSA ▪ TIIS ▪ IECEx ▪ NEPSI

Further approvals
▪ CE ▪ FCC ▪ R&TTE

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Endress+Hauser

People for Process Automation