Measurement Instrumentation for Upstream Oil & Gas

From wellhead to custody transfer, reliable measurement reduces uncertainty, protects people and assets, safeguards revenue, and improves performance across the upstream value chain.

EMERSON™

The world's energy consumption patterns and supply chains are constantly changing, driven by availability, cost, and geopolitical disruptions. This affects the upstream segment particularly as it often requires rebalancing production across the globe. In these conditions, maintaining safe, reliable, and profitable operations depends on accurate, consistent insight into what is happening across production assets.

Reliable measurement instrumentation plays a critical role to meet these challenges by reducing uncertainty, improving visibility, and maintaining control across upstream operations. Across production, five common challenges consistently impact performance, safety, and revenue.



EMERSON

Wellheads

Gas Lift

Separators

Heater Treaters

Oil & Water Tanks

LACT

Natural Gas Sales to Pipelines

Facilty-Wide Safety



Protecting People and Assets in High-Risk Environments

All links in the energy production chain are hazardous, especially the upstream segment. Well sites deal with flammable products, high pressures, and toxic gases such as hydrogen sulfide (H_2S), so safety must remain the top priority. Operators must have the tools to detect abnormal conditions early to prevent incidents, protect personnel, and avoid unplanned downtime.

Improving Efficiency Through Accurate Allocation Measurement

Many well sites have inadequate instrumentation, leading to uncertain production data. When oil, gas, and water measurements are unreliable, it impacts revenue, production optimization, and reservoir understanding. With continuous and accurate allocation measurement, decision-making and revenue reporting are more accurate.

Advancing Sustainability Without Sacrificing Performance

While upstream sites are reducing overall methane emissions, they still account for about 75% of all methane lost within the industry. This has environmental effects, but also represents lost product, so reducing fugitive emissions, minimizing flaring, and improving energy efficiency are critical responsibilities. Operators need reliable measurement to identify losses, verify improvements, and demonstrate compliance.

Reducing Reservoir Uncertainty Through Better Well Testing

Production strategy for individual wells depends on frequent well testing to verify reservoir models. Where testing is inaccurate or haphazard, production can suffer unnecessarily. Continuous, reliable measurement enables better long-term field planning.

Minimizing Human Error Through Standardization & Guided Maintenance

Producers are constantly dealing with the effects of remote locations, workforce turnover, and manual processes. These work together to increase operational risk and increase costs. Deploying instrumentation to provide standardized, automated measurements with diagnostic data reduces reliance on manual intervention and helps optimize assets.

Measurement Instrumentation Across the Upstream Value Chain

The oil & gas production chain begins in the upstream segment, covering exploration and initial production. This eBook will concentrate on sites already in production, focusing on these three main areas: well operation and management, including various enhanced recovery techniques; initial separation into crude oil, natural gas, and water streams via a conventional separator or heater treater; and custody transfer as oil and gas move to their respective next stages.



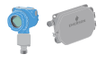
Well Pad and Individual Wellheads

Well Pad and Individual Wellheads

The well pad is the primary interface between the subsurface reservoir and surface production, with core wellhead equipment (casing head, tubing head, Christmas tree) providing mechanical control, pressure containment, and first-point flow management in onshore, offshore, and subsea environments. Measurement made here directly influence safety, production allocation, and downstream revenue, yet are complicated by changing flow regimes, extreme pressure and temperature, abrasive solids, and corrosive H_2S, CO_2, and chlorides. As the first opportunity to detect anomalies such as well loading, choke erosion, or pressure excursions, wellhead instruments must deliver reliable, accurate data under harsh conditions.



PT1 Rosemount 4051S Pressure Transmitter



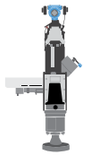
PT2 Rosemount 3051S Wireless Pressure Transmitter with Emerson Wireless 1410S Gateway



TT Rosemount X-well Technology with Rosemount 3144S Temperature Transmitter



SM Rosemount SAM42 Acoustic Particle Monitor



FT Roxar 2600 Multiphase Flow Meter



GD Rosemount 928 Wireless Gas Monitor



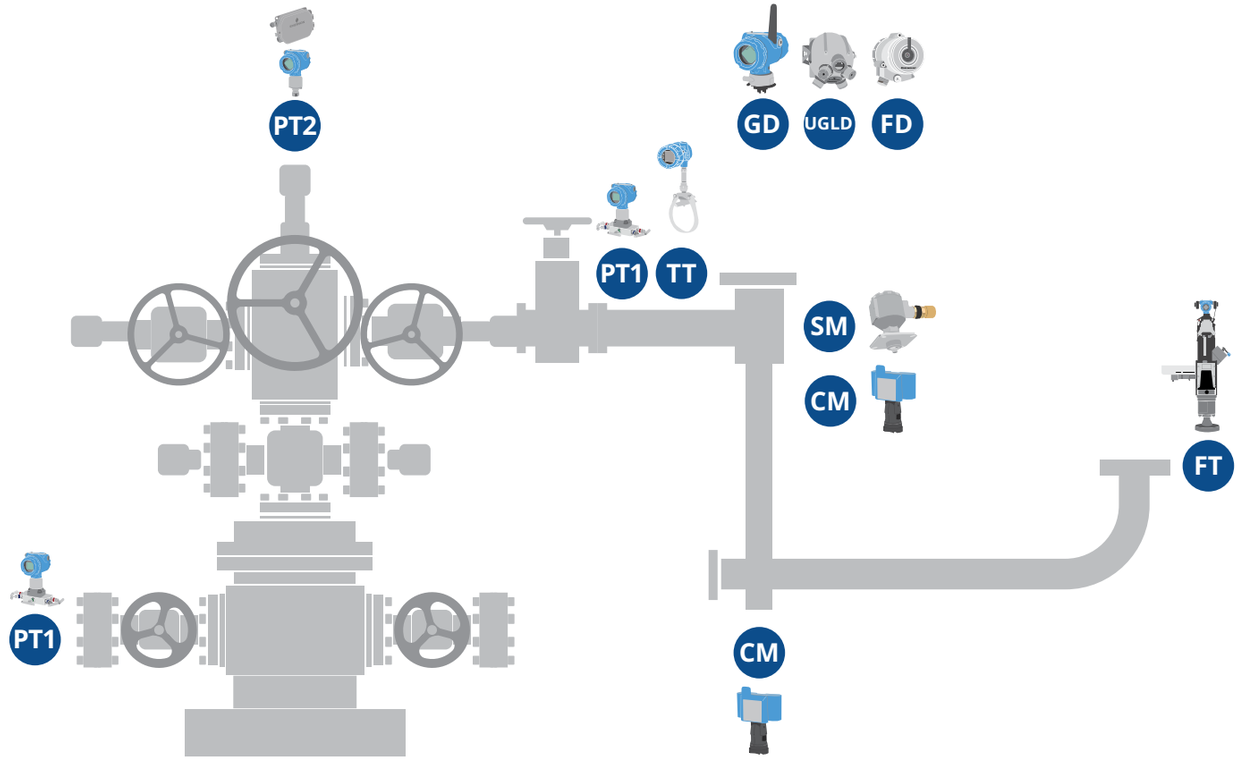
UGLD Rosemount Incus Ultrasonic Gas Leak Detector



FD Rosemount 975 Flame Detector



CM Rosemount Wireless ET210 Corrosion and Erosion Transmitter



Managing Rapid Wellhead Pressure Changes Across Remote Assets

Wellhead pressure can change rapidly during choke adjustments, startups, and shut in events, making control and issue detection difficult across remote multi well pads. Wired infrastructure is costly and time intensive to deploy at every wellhead, limiting visibility as operations grow. Emerson's Rosemount™ 4051S Pressure Transmitter (Figure 1) addresses this issue by delivering fast, accurate pressure measurement of tubing, casing, and flowlines, even during transient conditions. With 0.025% span accuracy and 20 year installed stability, the Rosemount 4051S provides reliable data to run, control, and monitor wells—while detecting pressure imbalances caused by leaks.

Where wellheads are distributed across a large well pad, Emerson's Rosemount 3051S Wireless Pressure Transmitter can be used with the Emerson Wireless 1410S Gateway to capture the same fast changing pressure data without the need for cabling (Figure 2). This allows operators to maintain visibility and control across multiple installations while reducing installation time and infrastructure costs.

Monitoring Critical Temperature Changes in Harsh, Remote Wellhead Environments

Produced fluid temperature at the wellhead is a key indicator of well health and flow assurance, but reliable monitoring is difficult in remote, harsh environments with limited maintenance access. Temperature shifts can indicate well loading issues, hydrate risk, or changes in reservoir inflow, while large temperature swings can stress equipment and increase failure risk. Emerson's Rosemount X-well™ Technology measures process temperature without a thermowell or process penetration, reducing mechanical risk and enabling flexible placement (Figure 3). When used with the Rosemount 3144S Temperature Transmitter, which features Bluetooth® connectivity and industry-leading 0.05°C accuracy, obtain stable, accurate temperature measurements over long service intervals, with simplified configuration and diagnostics.



FIGURE 1

Emerson's Rosemount 4051S Pressure Transmitter includes the latest developments for accurate performance and ease of use.



FIGURE 2

Where long distances must be covered, WirelessHART® avoids the need for costly cabling.



FIGURE 3

Emerson's Rosemount X-well Technology makes it possible to read temperature through a pipe or vessel wall non-intrusively.

Reliable Multiphase Flow Measurement in Topside and Subsea Conditions

As reservoir conditions change, gas fraction, water cut, and liquid flow rates shift, making real time multiphase measurement critical for allocation and production optimization. Emerson's Roxar™ 2600 Multiphase Flow Meter (Figure 4) measures oil, water, and gas inline before separation, supporting reliable allocation without test separators. Its compact design and use of impedance, venturi, and gamma density technologies deliver consistent data even in the most challenging and varied flowing conditions, for both single well and multi-well applications. In subsea wellheads, where separators are unavailable and intervention costs are high, long-term reliable and repeatable measurements are essential. Emerson's Roxar Subsea Wetgas Meters provide accurate gas, water, and condensate flow rate measurements with unparallelled formation water detection sensitivity, supporting flow assurance in inaccessible subsea environments.



FIGURE 4

For both onshore and offshore use, topside, Emerson's Roxar 2600 Multiphase Flow Meter (left) provides flow rates for oil, water and gas, without the need to separate the flow. On the seafloor, Emerson's Roxar Subsea Wetgas Meters (right) provide highly accurate water, gas, and condensate flow rates.

Monitoring Sand Production to Protect Wellhead Integrity

Undetected sand production drives rapid erosion of chokes, piping, valves, and instrumentation, and damage is often only discovered after failure, especially since sand rates spike during startups, and pressure changes and point-in-time sampling is not sufficient. Continuous monitoring is needed for effective choke management and erosion control. Emerson's Rosemount SAM42 Acoustic Particle Monitor (Figure 5) measures entrained sand in real time without process penetration, enabling installation without shutdown, and allowing operators to adjust velocity to limit metal loss while maintaining production.



FIGURE 5

Emerson's Rosemount SAM42 Acoustic Particle Monitor can determine when conditions are causing metal loss threatening equipment life. It mounts without a process penetration, so no shutdown is necessary.

Ensuring Corrosion and Erosion Insight for Wellhead Asset Protection

H_2S, CO_2, and produced water create corrosive conditions that degrade pipe walls and instrument surfaces, with sand-driven erosion often occurring simultaneously. Without continuous monitoring, metal loss can go undetected until integrity is compromised, making it important to track corrosion and erosion separately to identify the dominant damage mechanism. Emerson's Rosemount Wireless ET410 Corrosion and Erosion Transmitter (Figure 6) provides real-time metal thickness data using a non-intrusive, battery powered ultrasonic design, enabling continuous monitoring of corrosion and erosion impacts on assets.



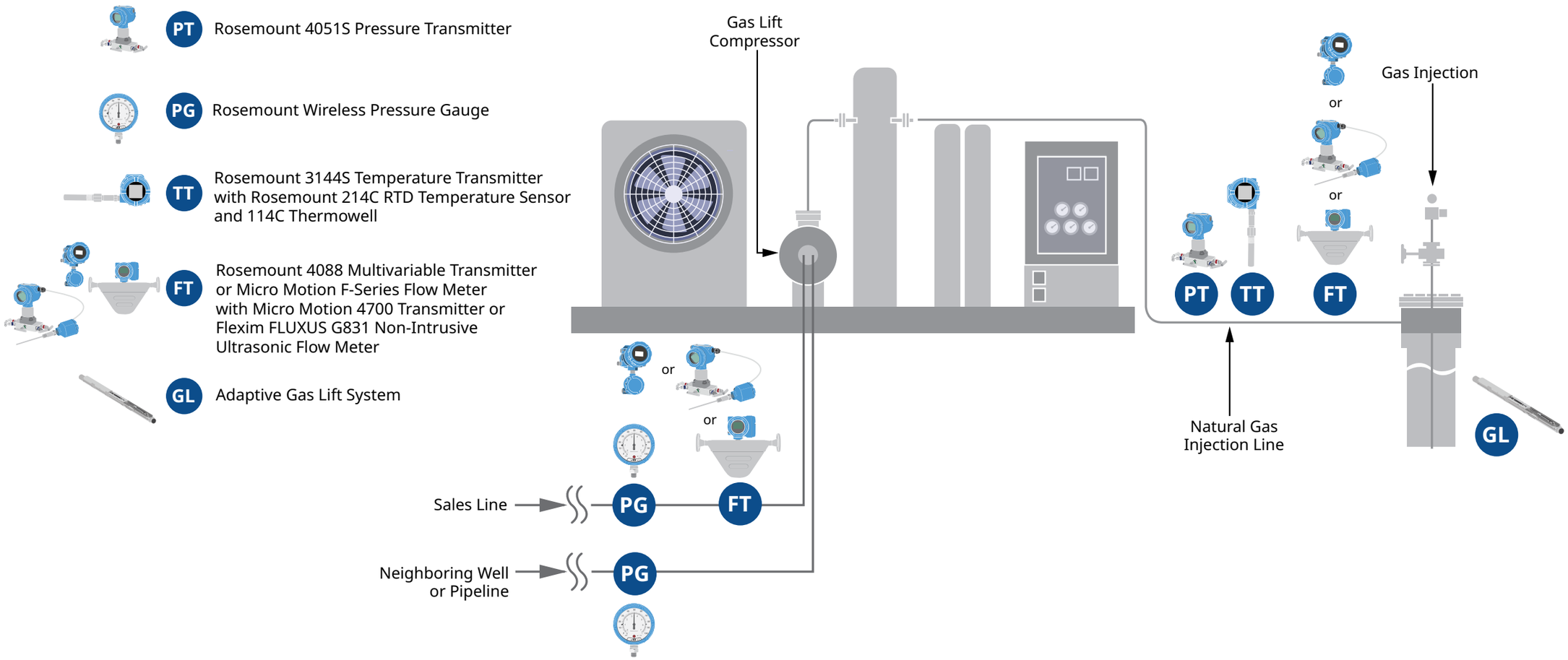
FIGURE 6

Emerson's Rosemount Wireless ET410 Corrosion and Erosion Transmitter measures metal thickness in real time, helping maintenance teams make more informed decisions regarding asset condition. It is quick and easy to install and delivers data via a WirelessHART network.

Gas Lift

Gas Lift

Accurate per-well injection gas measurement is fundamental to optimizing lift efficiency and allocation. Without it, operators can't determine true gas-to-production ratios or identify underperforming wells. Injection gas streams are subject to pressure, temperature, and composition variability that affect measurement accuracy, so proper compensation and meter selection is essential to maintain reliable totalization across changing operating conditions.



Accurate Flow Measurement for Gas Lift Production Monitoring

Liquid carryover in injection gas can disrupt well performance, restrict flow, and accelerate valve wear, with water slugs often cleared by plunger lift systems controlled by the flow meter. All gas wells require real time flow measurement for monitoring and control, with Emerson's Rosemount 4088 MultiVariable™ Transmitter (Figure 7) supporting plunger lift and production with extended range performance to capture pressure spikes while maintaining accuracy. For applications requiring mass flow measurement, Emerson's Micro Motion™ F Series Coriolis Meters with the 4700 Transmitter provides accurate flow and density data across a wide pressure range and can integrate with plunger lift systems, with optional Bluetooth connectivity improving safety and simplifying configuration.



FIGURE 7

Emerson's Rosemount 4088 MultiVariable Transmitter flow meter (left) can handle the high pressure and flow variability common to well output. Using a Micro Motion F-Series Coriolis Meter with the 4700 transmitter (right) for individual well monitoring provides mass flow as well as volume data.

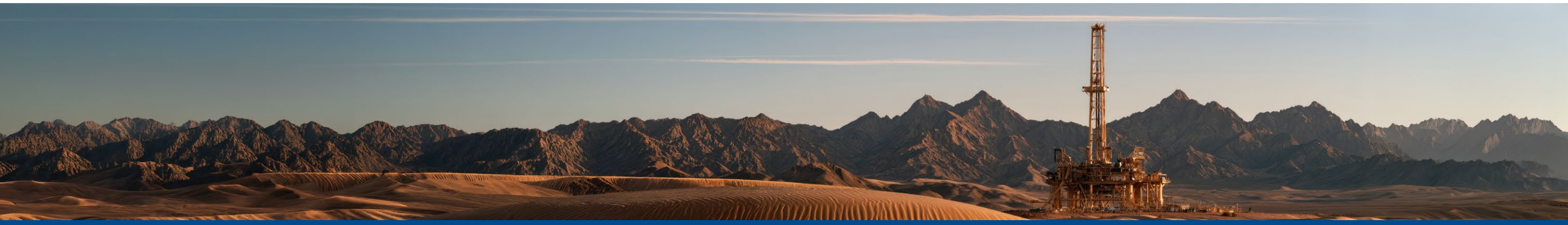
Reliable Non-Intrusive Flow Measurement for Sour Gas and High-Pressure Service

Especially for high-pressure and large pipe diameters, Emerson's Flexim™ FLUXUS G731 and G831 clamp-on ultrasonic flow meters (Figure 8) provide reliable measurement without pressure limitations or process penetration. Mounted outside the pipe, they are unaffected by corrosive or toxic sour gas compositions such as H_2S, while the integrated Dynamic Gas Meter feature automatically compensates for changing gas properties and compressibility to deliver reliable standard volume and mass flow data under varying operating conditions.



FIGURE 8

Flexim FLUXUS G731 and Flexim FLUXUS G831 flow meters leverage the advantages of Emerson's non-intrusive clamp-on ultrasonic technology.



Monitoring Injection Pressure to Maintain Gas Lift Efficiency

Precise injection pressure control is critical to lift efficiency, as over injection wastes lift gas and under injection reduces production, with monitoring at each injection point needed to detect uneven distribution or blockages. Emerson's Rosemount Wireless Pressure Gauge (Figure 9) provides reliable local pressure indication with a robust design that resists pressure spikes, up to 10 years of maintenance free operation, and WirelessHART technology for remote data access without cabling.



FIGURE 9

Emerson's Rosemount Wireless Pressure Gauge looks like a conventional mechanical unit, but it has no fragile bourdon tube or gears. It also sends data via WirelessHART.

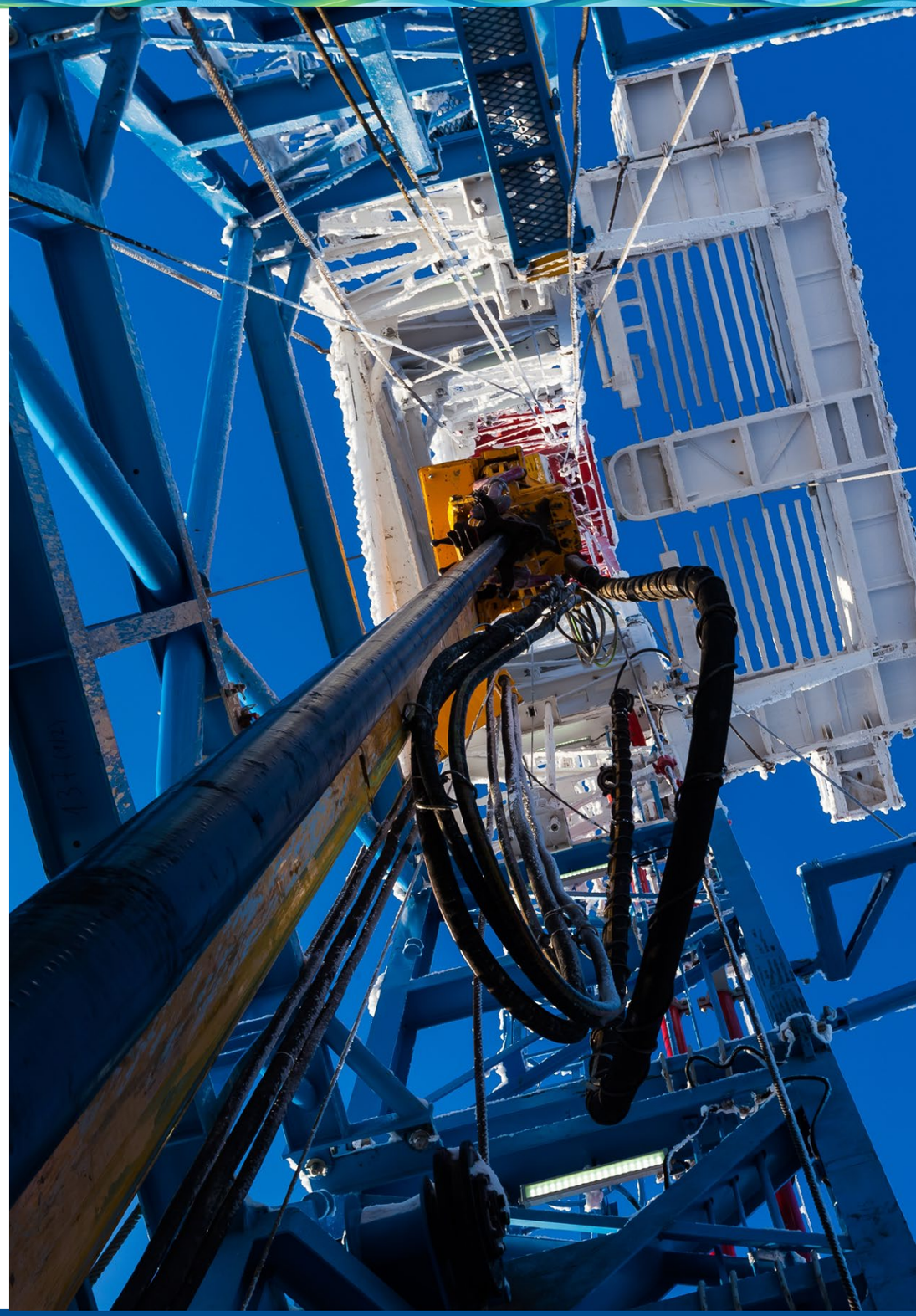
Enabling Real-Time Control of Gas Injection Rates Without Costly Well Interventions

Beyond measurement, operators need the ability to actively optimize gas lift performance as reservoir conditions evolve. The Adaptive Gas Lift System (AGLS) (Figure 10) provides real-time control of gas injection rates through a retrievable electric gas lift valve, enabling continuous optimization without costly well interventions. Operators can respond quickly to production instabilities, optimize gas usage when injection gas is constrained, increase production from underperforming wells, enhancing well profitability throughout the lifetime of the well.



FIGURE 10

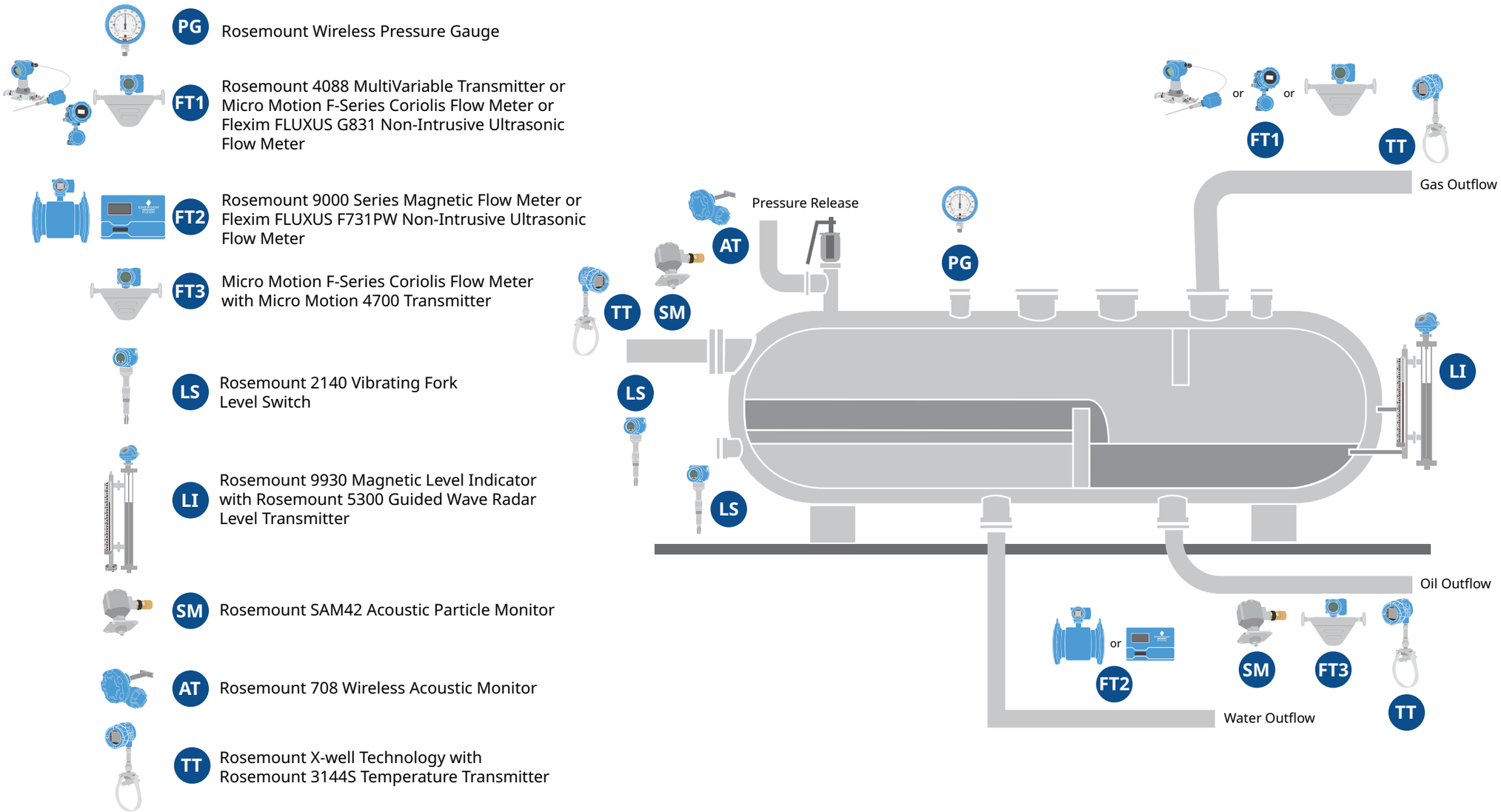
The unique, low power, electrically actuated gas lift valve enables continuous and remote control of the choke opening to optimize gas injection rate, drawdown and production.



Separators

Separators

Oil separators are the mainstay of upstream petroleum operations. Their task is relatively simple yet crucial for site operations. The oil separator vessel receives a three-phase mix of oil, water, and gas from the wells and separates them so they can be processed and recovered. When process control is upset, product can be lost and downstream equipment can be fouled, often requiring throughput to be significantly reduced to improve control.



Ensuring Accurate Oil Leg Flow Measurement for Allocation Integrity

Gas entrainment and water carryover distort oil flow measurement, causing over reading and density errors when fluid properties change over time, requiring meters that handle shifting conditions without bias. Emerson's Micro Motion F Series Compact Coriolis Flow and Density Meters (Figure 11), combined with a Micro Motion 4700 Transmitter with Advanced Phase Measurement (APM), distinguish oil from water and detect entrained gas or water, delivering highly accurate mass flow across a wide pressure range, with optional Bluetooth Technology improving safety through wireless configuration.

Reliable Produced Water Flow Measurement for Environmental Compliance

Oil carryover into the water leg leads to production loss, downstream treatment challenges, and potential compliance risks. The water stream also often carries paraffin, scale, sand, and other contaminants that foul sensors and degrade performance over time. This makes reliable water flow measurement and durable instrumentation critical for both process and disposal needs. Emerson's Rosemount 9732 Magnetic Flow Transmitter and Rosemount 9205 Magnetic Flow Sensor (Figure 12) provide reliable measurement, advanced diagnostics, and ease of use, engineered to handle demanding oil and gas water applications.

Where a process penetration is not practical, Emerson's Flexim FLUXUS F731PW Permanent Flow Meter for Process Water (Figure 13) is a non-intrusive, clamp-on dual channel ultrasonic flow meter, rated for water applications in hazardous areas. With volumetric flow accuracy better than ±1% of reading, it provides required data without piping modifications for water injection and produced water handling.



FIGURE 11

Emerson's Micro Motion F-Series Compact Coriolis Flow and Density Meters can differentiate between the three product streams coming out of the separator.



FIGURE 12

Emerson's Rosemount 9000 Series Magnetic Flow Meter, comprised of the Rosemount 9732 Magnetic Flow Transmitter and 9205 Magnetic Flow Sensor, provide measurements required for enhanced water management.

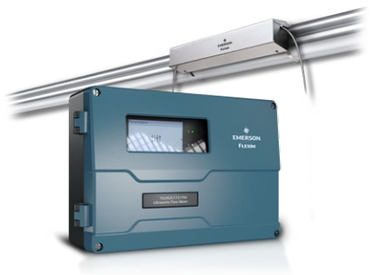


FIGURE 13

Emerson's Flexim FLUXUS F731PW Non-Intrusive Ultrasonic Flow Meter for Process Water can be mounted to any pipe without process penetration.

Managing Gas Outlet Flow Measurement Under Variable Separator Conditions

Gas at the separator outlet is rarely truly single-phase because condensate and liquid droplet carryover are common due to wet gas, causing single-phase gas meters to overstate actual dry gas volumes, introducing errors into sales allocation and emissions reporting. Gas composition, pressure, and temperature vary at the outlet, and upset conditions can also introduce oil into the gas line, making accurate measurement difficult with conventional technologies. Emerson's Rosemount 4088 MultiVariable Transmitter (Figure 14) compensates for these changing conditions to provide reliable readings for production monitoring.



FIGURE 14

Emerson's Rosemount 4088 MultiVariable Transmitter flow meter is well suited for the challenge of measuring gas flow at a separator.

Optimizing Three-Phase Separator Performance with Reliable Level Measurement

Reliable level measurement is essential for safe, efficient, and stable three-phase separator operation. The Rosemount 5300 Guided Wave Radar delivers continuous level and interface measurement to optimize separation performance, and the Rosemount 9930 Magnetic Level Indicator provides local visual verification for quick field validation (Figure 15). Together, these technologies form a comprehensive measurement and safety solution that helps maximize separation efficiency, prevent process upsets, improve safety, reduce maintenance costs, and extend asset life.

FIGURE 15

Emerson's Rosemount 5300 Guided Wave Radar and Rosemount 9930 Magnetic Level Indicator provide level and interface monitoring.



Monitoring Sand Accumulation to Maintain Separator Performance

Sand accumulation in the separator reduces effective volume and can plug outlets or damage internals, often going undetected without continuous level monitoring, especially in unconventional wells where frac sand and fines are highest during early flowback. Real time sand level detection enables proactive cleanup to protect vessel integrity and maintain separation efficiency. Emerson's Rosemount 2140 Level Detector Vibrating Fork (Figure 16) provides a reliable alert when sand reaches the sensor, indicating that cleanout is required.

FIGURE 16

Emerson's Rosemount 2140 Level Detector-Vibrating Fork can differentiate between water and sand, identifying when too much sand has accumulated.



Heater Treaters

Heater Treater

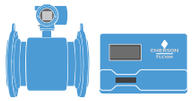
Heater treaters help facilitate crude oil/water separation by speeding up emulsions separation by applying heat. Most are low pressure, 3-phase separators equipped with firetubes, and they separate gas from the incoming emulsion, and then separate the emulsion into a water phase and an oil phase.



TT Rosemount 3144S Temperature Transmitter with Rosemount 214C RTD Temperature Sensor



FT1 Micro Motion F-Series Coriolis Flow Meter with Micro Motion 4700 Transmitter



FT2 Rosemount 9000 Series Magnetic Flow Meter or Flexim FLUXUS F731PW Non-Intrusive Ultrasonic Flow Meter



LI Rosemount 9930 Magnetic Level Indicator with Rosemount 5300 Guided Wave Radar Level Transmitter



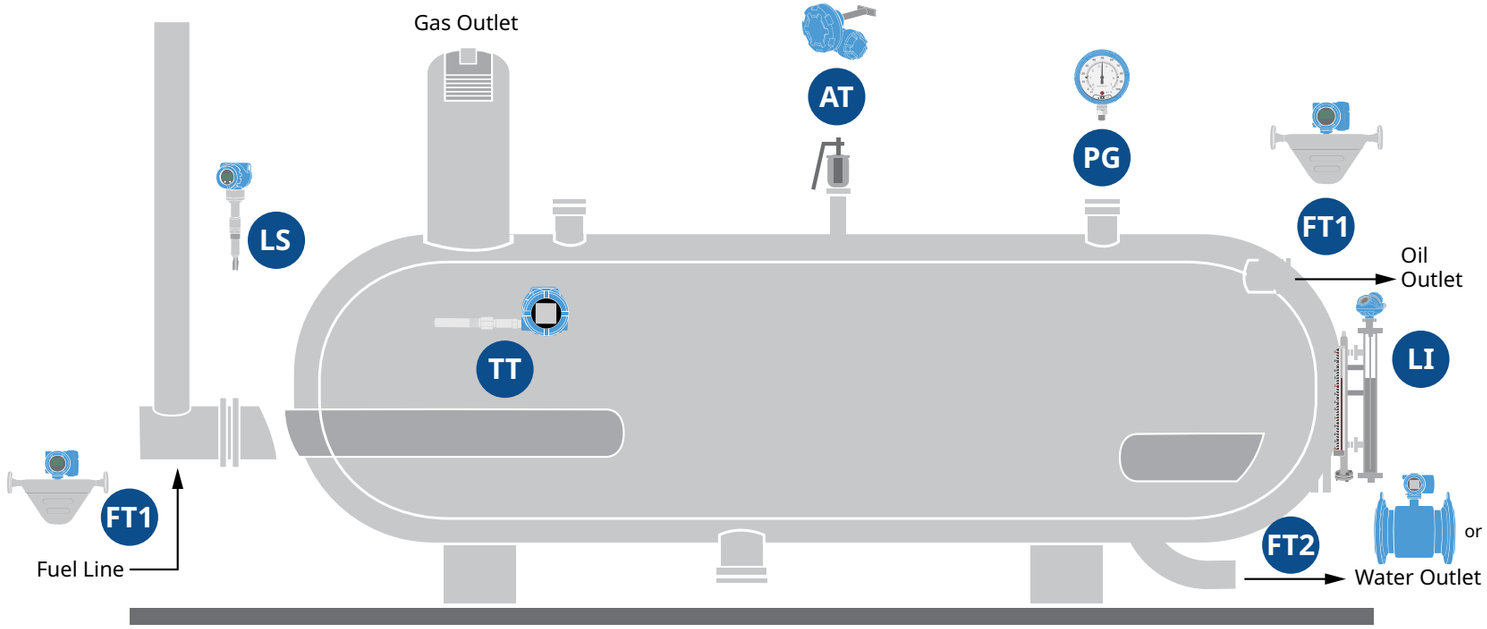
LS Rosemount 2140 Vibrating Fork Level Switch



PG Rosemount Wireless Pressure Gauge



AT Rosemount 708 Wireless Acoustic Monitor



Accurate Temperature Measurement for Heater Treater Process Control

As with almost every heating process, temperature measurements are required at several strategic points. Emerson's combination of a Rosemount 3144S Temperature Transmitter with a Rosemount 214C RTD Temperature Sensor and a Rosemount 114C Thermowell (Figure 17) provides accurate and robust measurements, even in harsh environments. The transmitter's ReadyConnect™ Technology, which enables plug-and-play sensor configuration, and Bluetooth Technology provides easy, error-free configuration and diagnostic coverage. The transmitter's built-in RTD Measurement Protection also helps to avoid loss of measurement and downtime by converting your sensor configuration from a 4-wire to a 3-wire if a wire is broken or damaged.

Monitoring Pressure Relief Events to Minimize Gas Loss and Emissions

Since heater treaters are pressure vessels, PRVs are required. When they open during upsets, operators lose product, generate emissions, and face regulatory reporting obligations. Emerson's Rosemount 708 Wireless Acoustic Transmitter (Figure 18) monitors PRVs continuously by detecting relief events and leakage, communicating alerts via WirelessHART. When paired with the Plantweb Insight™ Pressure Relief Valve Application, event data is automatically logged and analyzed to quantify gas loss, simplify compliance reporting, and drive faster corrective action, transforming PRV activity from a hidden risk into actionable insight.

Reliable Fuel Gas Measurement for Heater Treater Efficiency

Heater treater fuel is often raw natural gas. This must be monitored for environmental purposes and overall efficiency data. Measuring gas flow with a mass flow meter provides an accurate picture of energy consumption, rather than just gas volume, since density relates to energy content. Emerson's Micro Motion F-Series Compact Coriolis Flow and Density Meters combined with a Micro Motion 4700 Transmitter (Figure 19) provide a highly accurate mass flow reading across a wide pressure range, with easy integration to a host system.

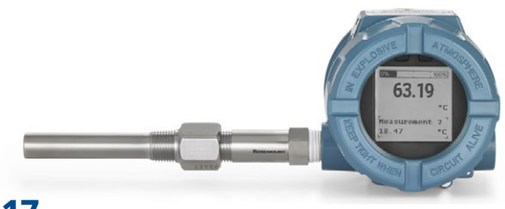


FIGURE 17

The Rosemount 3144S Temperature Transmitter provides complete diagnostic coverage from process to control room.



FIGURE 18

Emerson's Rosemount 708 Wireless Acoustic Transmitter can be mounted using clamps on the discharge pipe of a PRV to capture releases and leakage data.



FIGURE 19

Emerson's Micro Motion F-Series Compact Coriolis Flow and Density Meters can measure energy flow to the heater even when heat value for the gas is variable.

Oil and Water Tanks

Oil and Water Tanks

Production tanks store separated crude oil and produced water before transfer or disposal, with measurement forming the basis for production accounting, royalty calculations, and regulatory reporting. Measurement integrity at this stage carries direct financial, legal, and compliance risk because undetected overfills, leaks, or errors can lead to spills, regulatory exposure, and environmental liability, making reliable level monitoring and high level alarms essential.



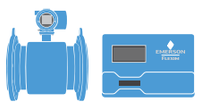
LT Rosemount 5300 Guided Wave Radar Level Transmitter and Rosemount 3408 Non-Contacting Radar



LS Rosemount 2120 Vibrating Fork Level Switch



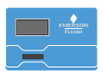
FT1 Micro Motion F-Series Coriolis Flow Meter with Micro Motion 4700 Transmitter



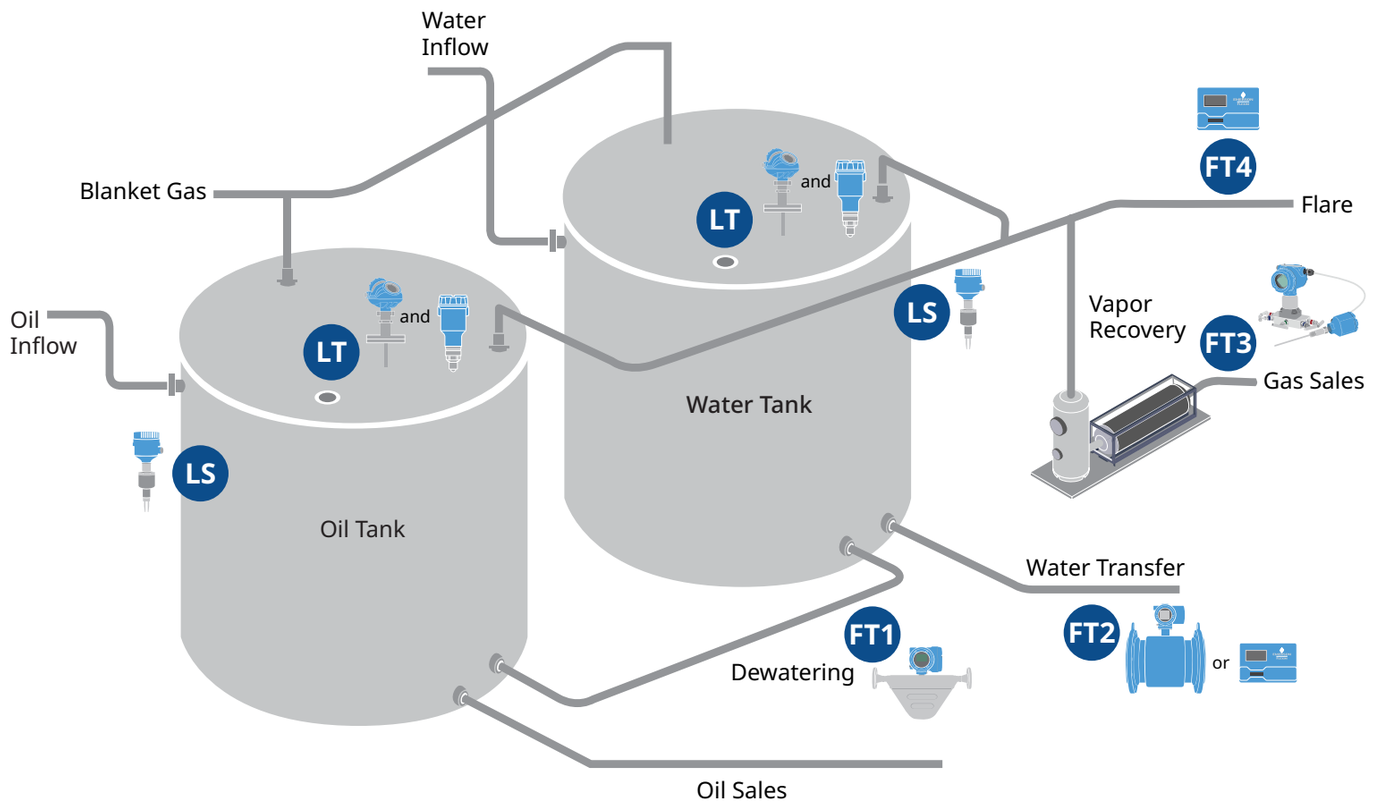
FT2 Rosemount 9000 Series Magnetic Flow Meter or Flexim FLUXUS F731PW Non-Intrusive Ultrasonic Flow Meter



FT3 Rosemount 4088 MultiVariable Transmitter



FT4 Flexim FLUXUS G731 Non-Intrusive Ultrasonic Flow Meter



Reliable Level Measurement for Hydrocarbon Recovery and Produced Water Storage Tanks

Reliable level and interface measurement is essential for maximizing hydrocarbon recovery, maintaining production accountability, and preventing overfills in crude oil and produced water storage tanks. The Rosemount 3408 Non-Contacting Radar Level Transmitter (Figure 20) delivers accurate gross level measurement with Smart Echo Supervision™ technology for dependable performance in challenging conditions, including produced water applications where vapors, foam, chemical injection, and turbulent process conditions can interfere with measurement. Because it is non-contacting, the Rosemount 3408 avoids the fouling and mechanical wear risks associated with probe-based technologies, making it well suited for produced water service and installations where inserting an electrode is difficult.

For interface measurement, the Rosemount 5300 Guided Wave Radar provides highly accurate, SIL 2-certified level and interface measurement to support product quality and minimize losses. For independent overfill protection and Emergency Shutdown (ESD) functions, the Rosemount 2120 Vibrating Fork Level Switch provides reliable point level detection as an additional layer of protection. Together, these technologies help optimize product recovery, improve safety, reduce environmental risk, and support production accounting and regulatory compliance.



FIGURE 20

Emerson's Rosemount™ Radar Level Transmitters are available in both guided wave and non-contact versions and provide reliable level measurement, while the Rosemount 2120 Level Switch adds an independent layer of overfill protection.



Lease Automatic Custody Transfer

Lease Automatic Custody Transfer

A lease automatic custody transfer (LACT) unit is the critical control point where produced oil is measured, verified, and transferred from the lease to a pipeline or purchaser, establishing ownership and revenue accountability. It integrates flow measurement, sampling, and quality verification into an automated system, ensuring consistent and traceable custody transfer. When measurement accuracy or system performance is compromised, it can directly impact revenue, reporting, and regulatory compliance, making reliable operation essential at this stage of production.



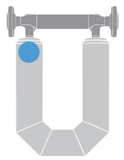
PG Rosemount Wireless Pressure Gauge



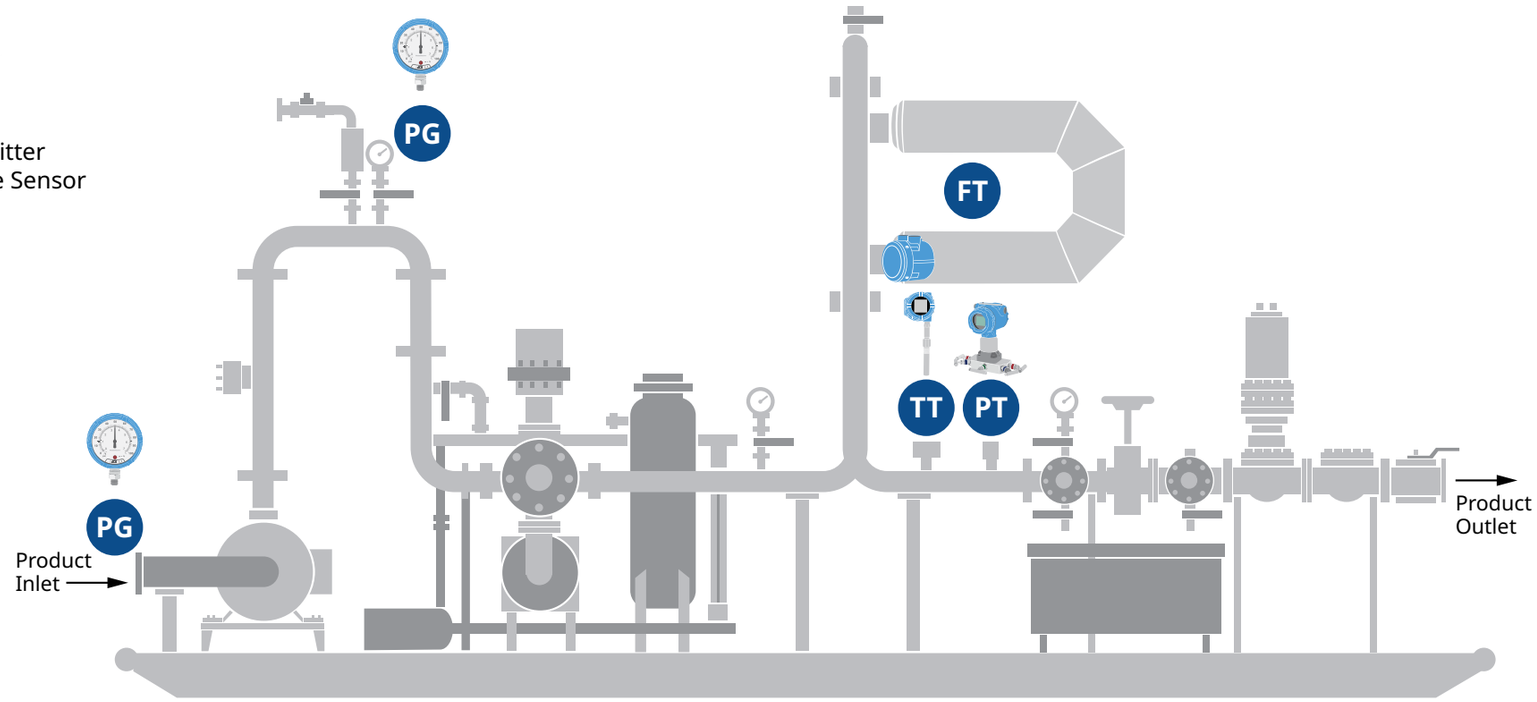
PT Rosemount 4051S Pressure Transmitter



TT Rosemount 3144S Temperature Transmitter with Rosemount 214C RTD Temperature Sensor and 114C Thermowell



FT Micro Motion ELITE Coriolis Flow Meter with Micro Motion 5700 Transmitter



Ensuring Accurate Flow and Density Measurement for Custody Transfer

Measurement accuracy at the LACT is directly tied to revenue, with every barrel determining payment, making it the most critical fiscal point in upstream operations. Accuracy must be maintained across changing crude properties because any drift leads to financial errors. Emerson's Micro Motion ELITE Peak Performance Coriolis Flow and Density Meter (Figure 21), paired with a Micro Motion 5700 Field Mount Transmitter with net oil capability, delivers precise mass flow and density measurement to verify oil quality and detect water in the line.

Reliable Integrated LACT Systems for Fiscal Measurement Integrity

A LACT unit relies on multiple integrated measurement and control components, and using equipment from different vendors can introduce integration gaps, calibration issues, and unclear accountability at a critical fiscal point. A turnkey system from a single provider ensures flow measurement, compensation, proving, and controls are fully integrated and factory tested, reducing commissioning time and risk. Emerson's Liquid Metering Solutions (Figure 22) deliver customizable LACT skids that support accurate measurement, verify oil quality, and handle complex transactions—helping reduce fiscal risk, maintain compliance, and optimize performance.



FIGURE 21

Emerson's Micro Motion ELITE Peak Performance Coriolis Flow and Density Meter series is the first choice in countless custody transfer applications due to its accuracy and reliability.



FIGURE 22

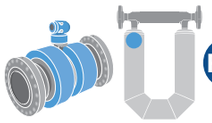
Emerson's Liquid Metering Solutions builds custom custody transfer installations for all manner of application requirements.



Natural Gas Sales to Pipelines

Natural Gas Sales to Pipelines

Natural gas fiscal metering governs custody agreements between operators and midstream partners, defining measurement standards, recalibration frequency, and providing financial settlement terms. Systematic errors, meter drift, and poor volume correction quietly accumulate into significant volume discrepancies, driving lost and unaccounted for gas (LAUF) between contracting parties. Upstream piping configuration, control valve turbulence, flow disturbances, and contamination can distort velocity profile measurements, introducing systematic bias that directly impacts custody transfer accuracy and LAUF calculations.



FT1 Rosemount Gas Ultrasonic Flow Meter or Micro Motion ELITE Coriolis Flow Meter



FT2 Flexim FLUXUS G831 Non-Intrusive Ultrasonic Flow Meter



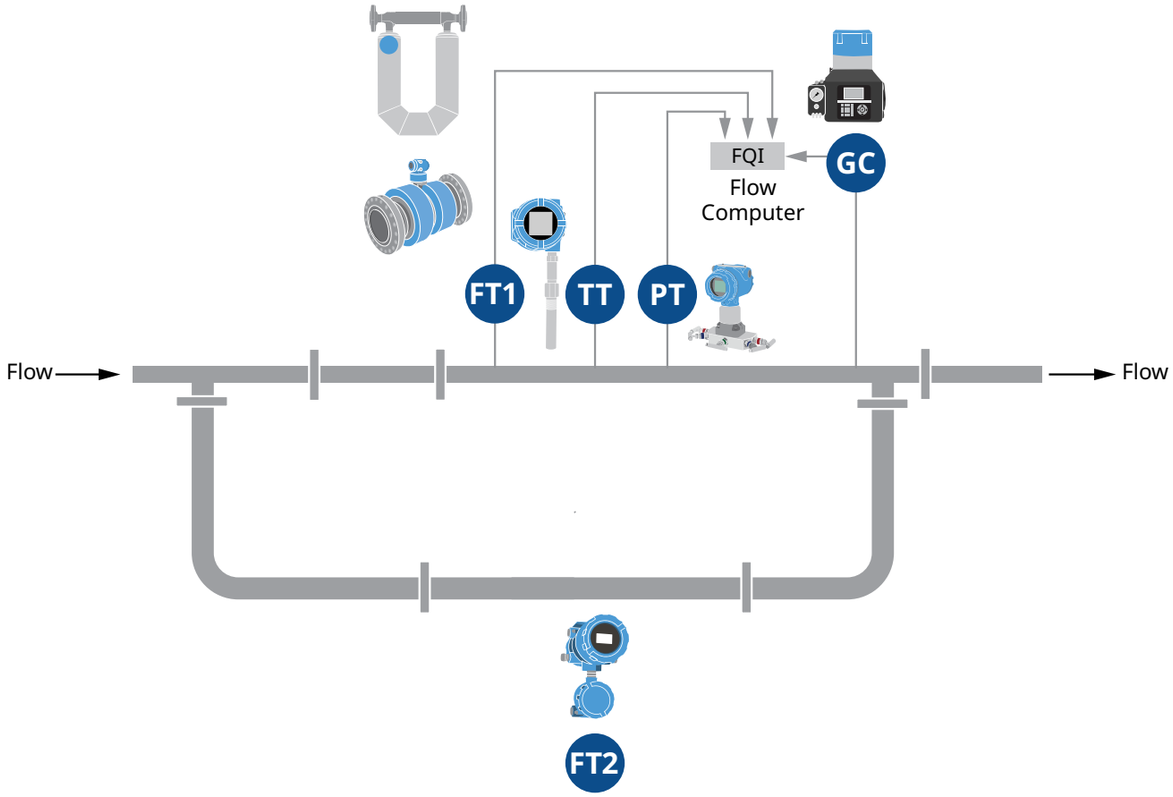
TT Rosemount 3144S Temperature Transmitter with Rosemount 214C RTD Temperature Sensor and 114C Thermowell



PT Rosemount 4051S Pressure Transmitter



GC Rosemount 470XA Gas Chromatograph



Accurate Pipeline Gas Measurement for Custody Transfer Compliance

Varying process conditions in gathering systems challenge meter accuracy, while fouling or contamination can lead to undetected measurement errors if diagnostics are not actively used. Emerson's Rosemount 3410 Series Gas Ultrasonic Flow Meters (Figure 23), combined with Rosemount 3410 Series Electronics, uses high sampling speed and multiple paths to handle disturbed flow and detect blockages, with MeterLink™ Software providing predictive diagnostics and corrective actions to help avoid disruptions.



FIGURE 23

Emerson's Rosemount 3410 Series Gas Ultrasonic Flow Meters measure at multiple points through the flow cross section to compensate for velocity disturbances.

Maintaining Gas Custody Transfer Accuracy Across Integrated Systems

Natural gas transactions are settled on an energy or volume basis, so inaccurate composition measurement directly misstates custody transfer billing. In commingled gathering systems, rapidly changing composition requires a chromatograph that can track these shifts, otherwise systematic errors and disputes with midstream partners can occur. Multi-vendor setups introduce integration gaps, calibration mismatches, and split accountability, complicating commissioning, certification, and ongoing LAUF resolution. Emerson's Gas Metering Solutions (Figure 24) deliver integrated, accurate, and reliable flow measurement to support compliance, reduce risk, and improve operational performance.



FIGURE 24

Emerson provides full natural gas custody transfer solutions using Coriolis or ultrasonic technologies as required for the installation.



Facility-Wide Safety

Facility-Wide Safety

Flammable and toxic gases are present at every unit operation, so continuous monitoring is a regulatory requirement. A single undetected release can escalate to catastrophic loss of containment with consequences far exceeding any detection system cost. Frequent false alarms erode operator trust and create dangerous complacency, so reliable detection with minimal nuisance trips is equally as critical as sensitivity. Many well-run and well-maintained production sites, outfitted with appropriate safety equipment and staffed by conscientious people at all levels, compile a long record of safety.

Detecting Flammable and Toxic Gas Hazards in Remote Production Facilities

Emerson offers a range of flammable and toxic gas detection solutions to meet the needs of any upstream oil and gas application. Point gas detectors like Rosemount 925FGD and Rosemount 625IR (Figure 25) are typically installed at specific high-risk locations. For facilities where wired infrastructure is impractical, the Rosemount 928 Wireless Gas Monitor offers a WirelessHART solution for detecting flammable and toxic gases with long battery life and high network reliability. If larger area coverage is needed, the Rosemount 935 and Rosemount 936 Open Path Gas Detectors are an excellent solution for long range line-of-sight flammable and toxic gas detection.

Detecting Pressurized Gas Leaks

Another way to detect gas leaks is to use Emerson's Incus Ultrasonic Gas Leak Detector (Figure 26). It is an acoustic detector, listening for high frequency sound created by a compressed gas leak of any kind and alerting plant personnel so that they can respond effectively. The Incus is a great choice to use in combination with gas detectors because it is unaffected by wind, rain, or other environmental conditions and does not need to be in contact with the gas cloud to detect a leak.

Ensuring Rapid Flame Detection for Incident Response

Steam, dust, and solar radiation can trigger false alarms while obscuring real flame signatures, and mismatched spectral response can delay or miss detection. Rapid detection of unexpected fires is critical in oil & gas facilities to prevent equipment damage and protect personnel. Emerson's Rosemount 975 Flame Detector with QuadSense™ Technology (Figure 27) uses four IR sensors to detect hydrocarbon fires within seconds while remaining highly immune to common false alarm sources, such as sunlight, arc welding, and lighting.



FIGURE 25
Emerson offers a full portfolio of gas detection solutions for upstream oil & gas.



FIGURE 26
Emerson's Rosemount Incus Ultrasonic Gas Leak Detector responds to the sound of leaking gas.



FIGURE 27
Emerson's Rosemount 975 Flame Detector provides confident flame detection with high false alarm immunity even in the most demanding applications.

Enabling Autonomous, Resilient Upstream Operations

Keeping well pads operating efficiently has always been a challenge for upstream companies. They're inhospitable with most equipment out of doors, they're in remote locations, and when problems occur, the effects are very costly. The desire to reduce or eliminate manual intervention is very strong as it is a major expense, hence the need for automation to keep things running smoothly and efficiently, while ensuring long-term reliability.

These sites also challenge automation for the same reasons. Any instrumentation deployed must stand up to harsh conditions and be able to operate for years, or even decades at a time, with little or no human interaction. Any pressure transmitters, temperature sensors, or flow meters must be highly durable with minimal maintenance required.

Emerson understands these requirements. Our engineers are constantly working on developing products with that level of durability, but that are also intuitive and easy to work with. Emerson understands this, and we're working with customers around the world to solve these and other problems in countless industries, including upstream oil & gas.



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