A guide to hydrocarbon measurement

Precise measurements and control at critical points

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Contents

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Overview

Why measure hydrocarbons?

Hydrocarbons are naturally-occurring compounds which are comprised of hydrogen and carbon atoms. They are the basis of natural gas and crude oil. When burned, hydrocarbons combust to produce water, heat and carbon dioxide—all great sources of fuel.

Hydrocarbon measurement takes place at many critical points of the oil and gas supply chain. From production to distribution, it is crucial to maintain precision and reliability of the product. One way to maintain its integrity is through how it is handled. Flow measurement and process control are critical aspects of producing, handling, and transporting hydrocarbons around the world.

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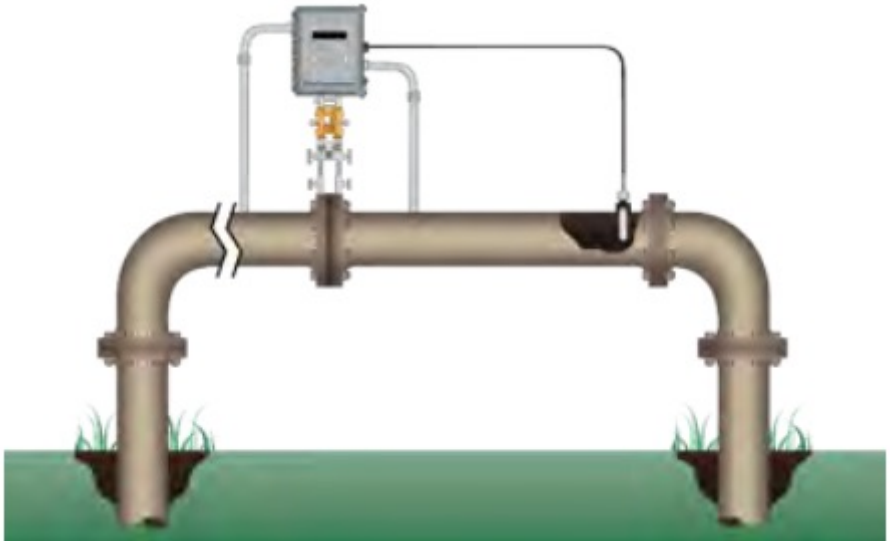

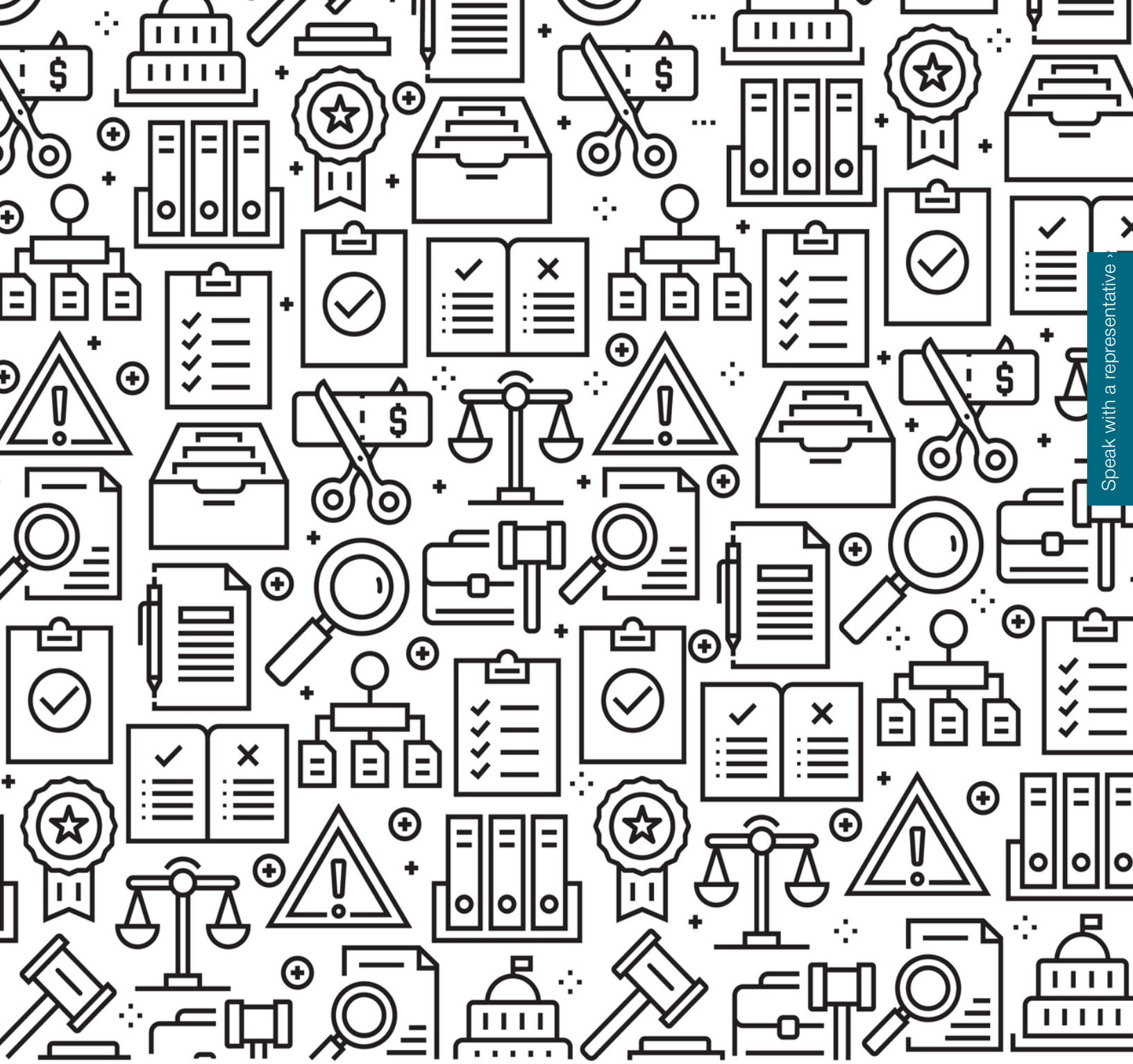

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Regulations

Regulations: United States

With fiscal oil and gas industry transactions relying heavily on measurements of crude oil, natural gas, and other hydrocarbons, it's extremely important to understand measurement standards. It's crucial not only for those physically in the field to learn and retain this knowledge, but for those who are not. The standards defined by various organizations provide a mutually acceptable basis between a buyer and a seller (and, sometimes, a government oversight agency) for custody transfer measurement. Each organization is made up of technical committees that oversee development and maintenance of their standards.

The primary entities that manage these standards include:

AGA
American Gas Association

API
American Petroleum Institute

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Regulations: Two key standards

Two key standards associated with the measurement of petroleum products are indicated below: Manual of Petroleum Measurement Standards Chapter 21.1-Electronics Gas Systems and Chapter 21.2-Liquid Electronic Systems address the ability to audit and verify the information produced by a flow computer. These standards define the data which a flow computer should retain, the items which should be audited if modified, the reports which the system will be capable of producing, and the methodologies to follow.

International metrology standards:

- OIML R117-1 for liquids
- EN12405 for gas
- ISO 9001:2008

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Regulations: Top 7 critical areas of measurement and control

Top 7 critical areas:

- Well production
- Separator (2 & 3 Phase)
- Gathering: Custody transfer
- Gas Plant: Inlet and outlet
- Transmission Pipeline Stations: Flow and pressure control
- Storage: Injection, withdrawal, and odorization
- City Gate

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Monitoring technology

Measurement technology

Flow computers are designed to monitor and measure hydrocarbons to optimize operations while minimizing worker risks. When the right flow computer is applied to a situation, it can help reduce cost, decrease lost material, automate processes, and monitor critical points along the process. They provide greater control, instill confidence in the measurement process, and ensure reliability. Flow computers are used across the measurement spectrum—from field to control room and upstream to downstream.

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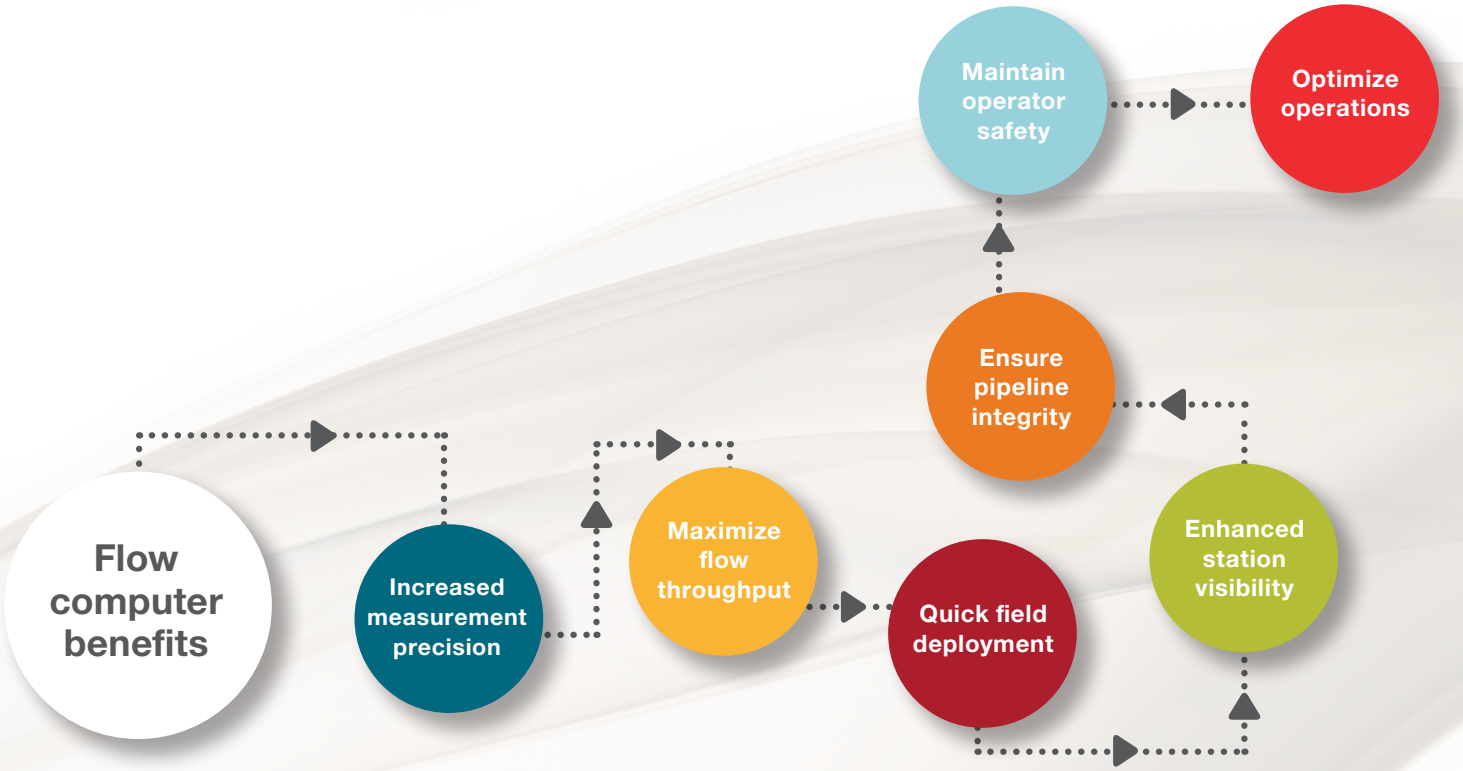


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APPLICATION NOTE

Thermo Scientific™ Prima PRO Process Mass Spectrometer

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Oil and gas segments

There are three core areas of measurement in the flow control and measurement process—**Upstream**, **Midstream**, **and Downstream**.

UPSTREAM

MIDSTREAM

DOWNSTREAM

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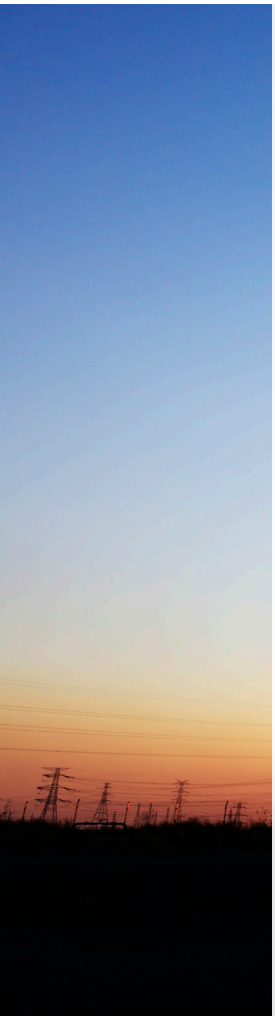
Upstream segment



Exploration and production

The upstream oil and gas sector encompasses both the exploration and production of hydrocarbon products. Upstream includes the extraction of oil, gas, and water from underground formations in a cost-effective manner. Typical applications include plunger lift, gas lift, separator control, well testing, and automation. There are two primary methods of drilling set ups associated with upstream collection process—onshore and offshore drilling. The biggest difference in onshore versus offshore drilling is the way in which the rigs are supported.

Onshore

- In onshore drilling, wells/rigs are drilled into the earth's subsurface for the extraction of oil or natural gas from reservoirs.

Offshore drilling

- Offshore drilling extracts petroleum from rocks beneath the seabed through a well bore.

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Upstream segment (con't)

If well pressure drops and water flows from the formation to the well bore and accumulates, it creates a gradual increase in backpressure. Gas production slows or stops altogether as liquids increase in the well tubing. If left unattended, production and well life decreases—the opposite of what needs to occur.

Minimizing production costs and increasing production via enhanced oil recovery (EOR) are critical parameters in the upstream oil and gas sector. Maximizing well production is the key to maximizing profits. To do so, flow and measurement tools must be in place. Intelligent, customizable, and easy-to-implement solutions are needed to maximize operations monitoring. The plunger lift systems installed in the well works in tandem with the flow computer. The flow computer monitors the pressure as the plunger drops and indicates when the well can be reopened, optimizing the gas flow and collection process. Flow computer systems can increase well production by as much as 20 percent.

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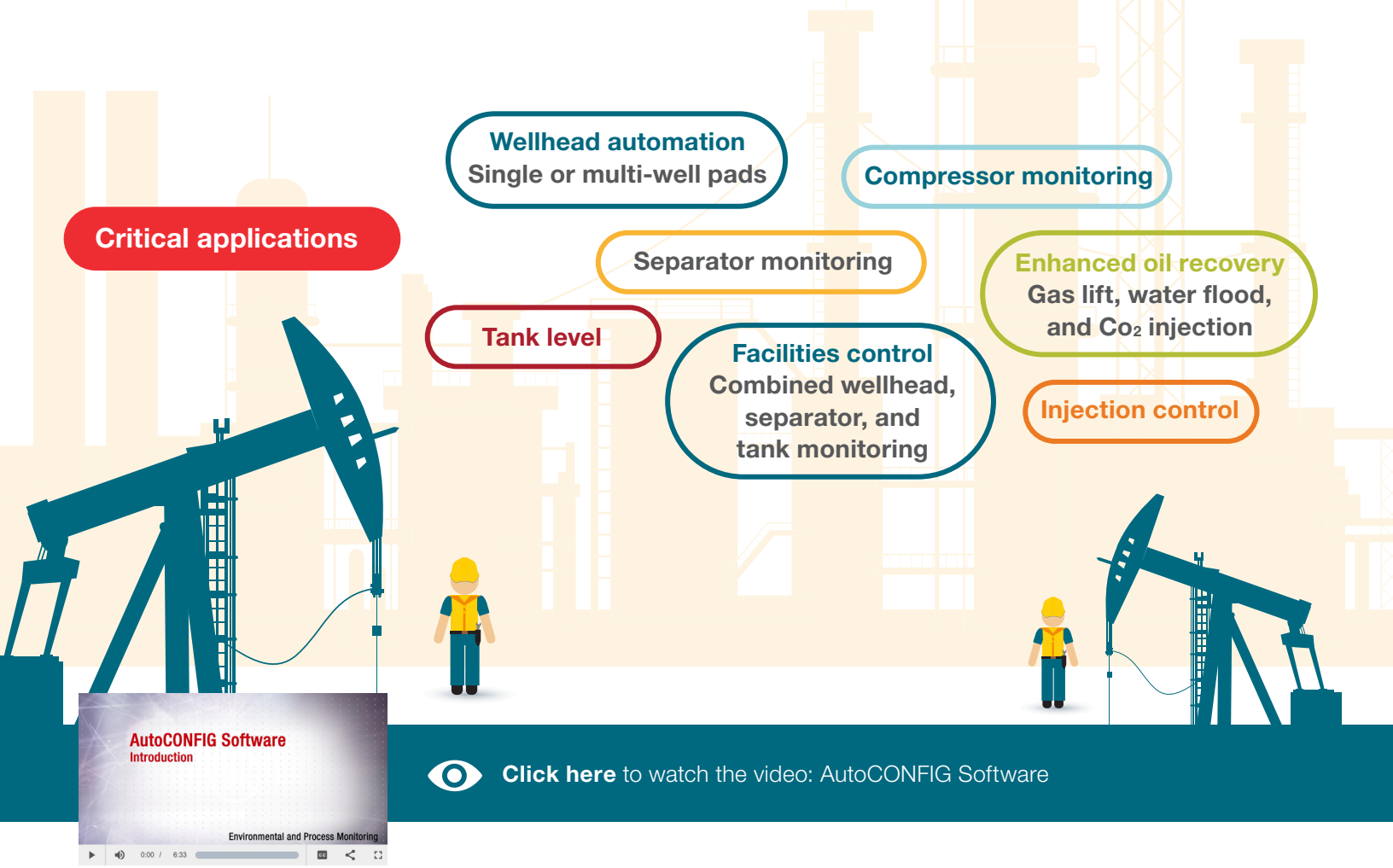

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Midstream segment

Gathering and processing

The midstream oil and gas sector refers to the gathering, processing, and storage of natural gas, crude, or refined petroleum products. Pipelines and other means are used to gather crude oil and natural gas from production sites to processing plants and then to downstream customers. Typical applications include custody transfer, storage, gas control, system balance, and automation.

Successfully managing lost and unaccounted (LAUF) levels is a key driver in midstream applications. Instruments that offer effective means of balancing the gathering system will provide accurate, repeatable measurements and will have advanced analytics capabilities.

In the midstream segment of the market there are two core areas that need to be carefully addressed—the transmission of liquid natural gas (LNG) and the pipelines used in the process, and the storage of the LNG. These two areas must be monitored extremely closely on a continuous basis to ensure there are no variations to temperature, flow pressure, etc. outside the normal parameters.

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Midstream segment (con't)

Transmission/pipelines

- Custody transfer is where one party changes ownership of the natural gas in its possession with the next part in the value chain. During custody transfer, there are several types of tools that can be used to ensure pressure and temperature stay within range: ultrasonic meter (measure volumetric flow of the LNG); turbine meter (simple to operate and maintain, reliable, cost effective); orifice meter (used to measure gas, liquid, and fluids).
- Pipeline integrity means ensuring the pipeline and all related components are running properly. This includes guaranteeing every pipe, instrument, and valve are up to code and working efficiently and safely.

Storage

- Because of its large volumes and high pressure, natural gas is generally stored underground until it is ready to be transported to market. Depleted gas reservoirs, salt caverns, and aquifers are common storage facilities.
- LNG is stored in a specialized type of tank, which maintains a very low temperature of -162 °C. The storage containers are made of double tanks—the inner tanks holds the LNG, while the other tank stores insulation materials. The temperature will remain constant provided that the pressure does as well, which is accomplished by boiling off gas.

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Midstream segment (con't)

Time invested in review of a company's LAUF gas loss will improve the measurement accuracy and continue to reduce the measurement uncertainty. The first step towards the identification, reduction, and management of LAUF gas loss relates directly to understanding both the problem and the data. To be an industry leader and enhance service to your customers, a focus on improving the understanding of LAUF is critical to elevate your business to a new level.

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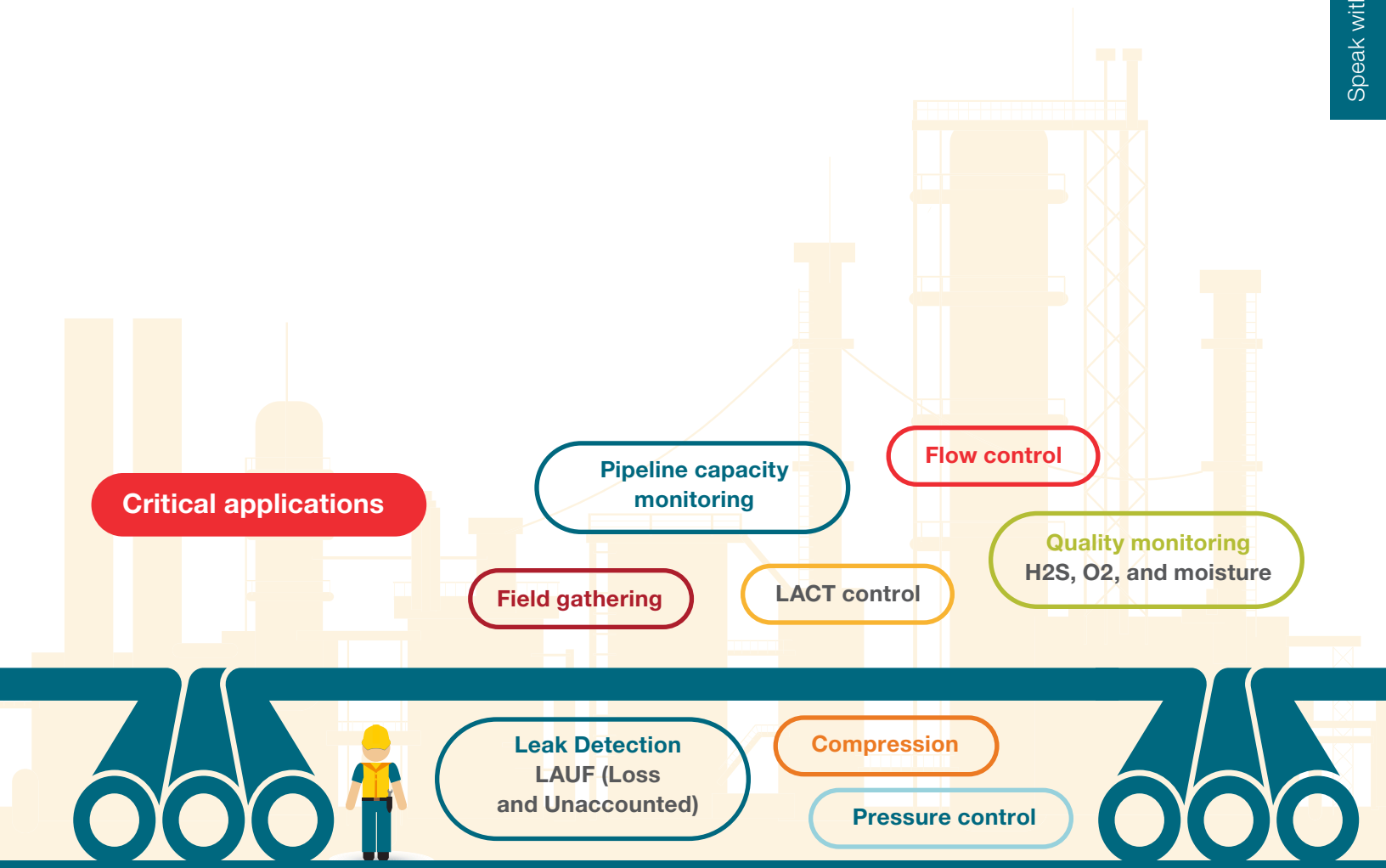

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Downstream segment

Refining and distribution

- In the downstream segment of the oil and gas sector, petroleum crude oil is refined, raw natural gas is processed and purified, and petroleum products and natural gas are distributed and sold to end users and consumers. In this segment, we see custody transfer, tank level, flow control, and plant balance applications all in play. The closer an oil or gas provider is to the ultimate consumer, the further downstream they are in the industry. In addition to consumers, the downstream segment also includes refineries and the final provider of the oil and gas to the end user.
- Accurate, reliable measurements are critical to realizing maximum profitability of the petroleum or gas product. Instruments that provide precise and repeatable measurements out of the box, as well as units that ensure worker safety, are key factors when considering a solution in the downstream sector.

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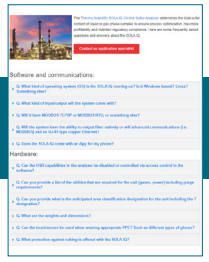

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Downstream segment (con’t)

Distribution

- City gate is a measuring station or point along a natural gas pipeline. It is here the gas utility company receives the natural gas from the main pipeline or transmission system.

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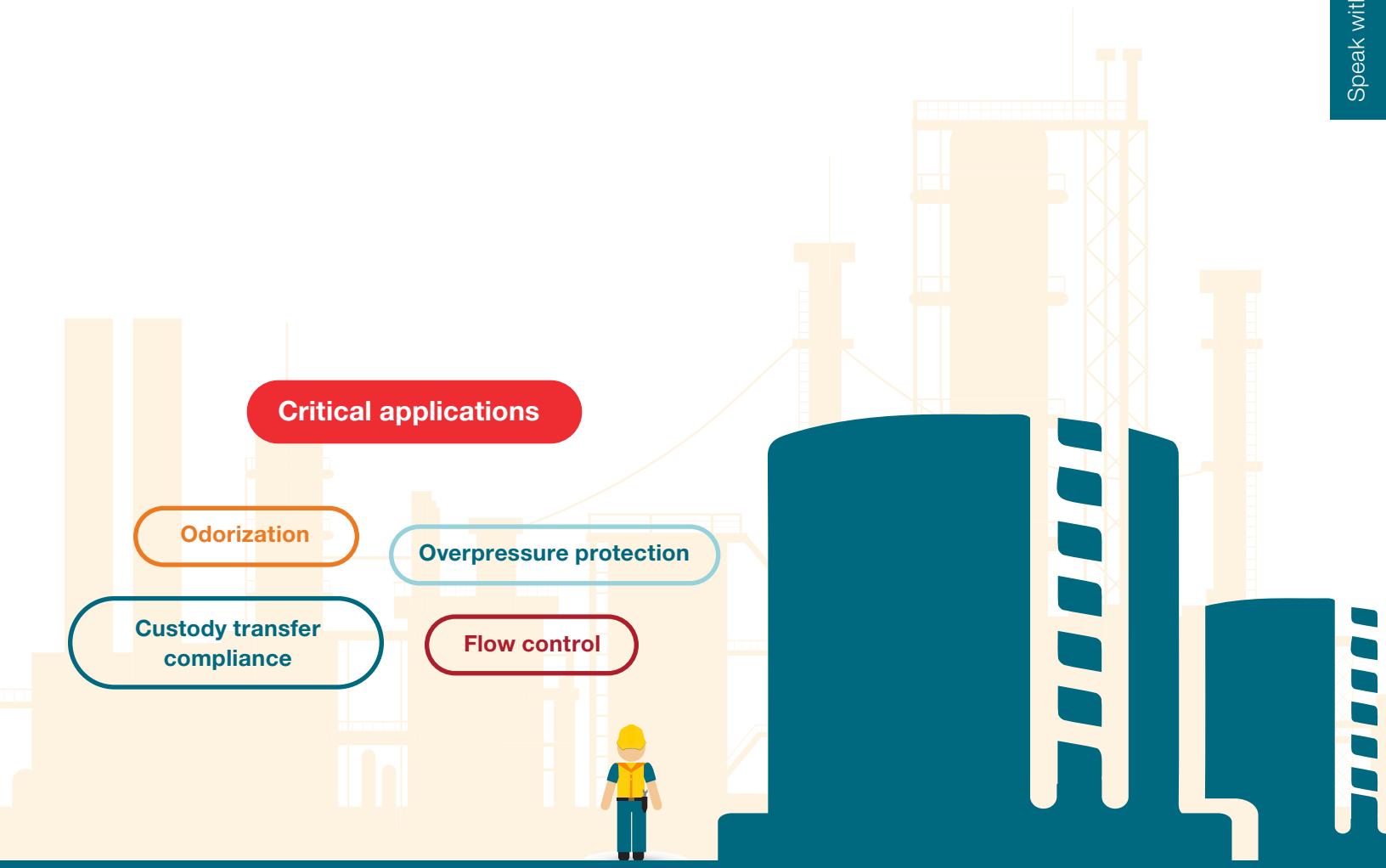

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Equipment

AutoCONFIG

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Thermo Scientific AutoCONFIG software is the robust interface for the **AutoSERIES of Flow Computers** and the **SOLA iQ Online Sulfur Analyzer.** Designed to empower the user, the interface is simple to configure, and eliminates the need for in-depth programming. It is capable of recording multiple wells simultaneously, in addition to the casing and tubing from each well. The software can consolidate oil, gas, and water measurements for maximum control and efficiency.

AutoCONFIG software is available on the following Thermo Scientific instruments:

- AutoFLEX Flow Computer
- AutoXP Gas and Liquid Flow Computer
- AutoXP-SMV Smart Multivariable Transmitter
- SOLA iQ On-line Sulfur Analyzer

Thermo Scientific™ AutoCONFIG built-in software

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Now Introducing: AutoFLEX

The **Thermo Scientific AutoFLEX Flow Computer** offers a flexible platform allowing operators from the wellhead to the end consumer to increase their ability to monitor instrument performance and flow throughput. The increased processing power of the **AutoFLEX** helps avoid costly unplanned downtime, which can enable users to make better maintenance decisions based on collected data. The **AutoFLEX** tool can enable users to save tens of millions of dollars per year on lost productivity and repairs.

- Eliminate the need for multiple devices
- Analyze multiple data points critical to the transportation of hydrocarbons
- Oversee transfers with confidence using any of the two robust ethernet communications supporting up to five simultaneous connections each
- Safeguard against uncertainty and maintain worker safety
- Avoid downtime by quickly identifying disruptions through data driven actions to meet demands
- Enable field technicians to effectively and efficiently manage product delivery

Click here to download AutoFLEX Flow Computer Product specifications

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