Multiphase Metering Advances In Onshore Fields

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To maintain profitability, today's onshore operations require more accurate, reliable and cost-effective means of measuring oil and gas flow since traditional separation methods have become relatively cumbersome, particularly when addressing multiple phases in unconventional shale plays.

However, recent advances in multiphase metering technology are providing operators a means of obtaining real-time measurement in unconventional oil and gas extraction while also reducing capex for increased operational efficiency.

Key measurement drivers

There are several key drivers for onshore operators today when it comes to measuring their oil and gas flows.

First, there is asset optimization, with a focus on both reservoir and well optimization. To produce as much as possible at the lowest cost, there is a need for operators to know more about what they are producing and at what volumes so they can make adjustments to optimize production.

Second, there is process integrity and safety and the need to track flow assurance and integrity of pipelines. To this end, detecting small changes in water production can play a crucial role in mitigating risk from hydrate and scale formation.

Third, there are transactions and allocations. Many assets have joint ownership structures where it is necessary to accurately establish the volumes from each asset and different pipelines to correctly allocate financial gain and royalty payments.

Finally, there are regulations and government requirements regarding areas such as fiscal metering, reporting and taxation. Such regulations and accuracy requirements can vary widely between countries, states and even owners.

All four of these aspects require measurement of the well's production, either through multiphase or single-phase flows.

This image depicts a sampling connection of the Roxar modular meter at the inlet tree. (Source: Emerson Automation Solutions)

Multiple flowstream phases

Historically, such measurement needs have been handled by separation followed by measurement, with the traditional well pad architecture consisting of a combination of separator and traditional flow measurement technology.

But traditional flow measurement technologies do not handle multiple phases in the flowstream very effectively. For example, some flow measurement technologies such as liquid turbine meters can be damaged by sand or bubbles caused by gas coming out of the liquid phase.

Differential pressure measurement can account for these phases but has difficulties in measuring the amount of each of the individual phases when commingled. With single-phase technologies there is also a danger that the models, algorithms and assumptions used to calculate flow are prone to breaking down when well and field characteristics change.

In addition, well test separators come with significant equipment infrastructure, instrumentation and associated costs, with well pads often needing a test separator for each well. Such test separators are vulnerable to instrumentation failure and can significantly increase measurement-per-well costs.

Therefore, there is a need for more cost-effective well pad construction and operations and for new modular and flexible multiphase meters that can reduce equipment and deliver continuous insight into a well's production, which is particularly important with the rise in unconventional plays.

In this way, operators can reduce costs per well pad by as much as 50%, double the efficiencies of field technicians and meet the changing needs of the well over the reservoir life.

The rise of onshore multiphase metering

Multiphase metering technology is becoming an important option for onshore production applications. Although multiphase meters have been used for more than two decades, they have only recently been adopted for unconventional oil and gas extraction.

Such meters provide the individual phase flow rates for oil, gas and water mixtures. By using a multiphase meter, there is no need for a test separator, manifold or line, with each well tested without having to redirect to the test line.

The result is continuous real-time measurement rather than periodic testing of crucial information on well performance and the conditions that affect production flows for asset optimization, process integrity and safety, allocation, and regulatory requirements.

A flexible and modular approach

But for all of their benefits, multiphase meters have been considered unwieldy and expensive for onshore consideration, with many operators put off by the scale and potential expense of such deployments.

In addition, there is also the possibility that such meters won't last for the lifetime of the field—a particularly important issue in unconventional fields where operators are ideally looking for well pads to "run themselves."

Finally, to better manage cost and capex, such operators also must prioritize which wells warrant multiphase meters.

As a means of reducing such costs and to ensure more flexible and accurate metering, Emerson has developed a new modular family of multiphase flowmeters that can either be one component of an integrated well test system or provide cost-effective standalone wellhead measurement. The fact that such meters are so cost-effective also allows the possibility of allocating one meter per wellhead.

The Roxar modular meters are based on a proven measurement technology platform that has been used in more than 1,500 meter installations worldwide.

This includes advanced signal processing, field electronics and electrode geometry as well as high-resolution sensors capable of capturing very small changes in the electrical properties of the multiphase fluid passing through it.

The dual-velocity system, cross-correlation capabilities and optional gamma system also provide measurements capable of handling multiple flow regimes.

Operators need only purchase the features they require and can select from a set of meters designed for

- Trending water cut, gas breakthrough and flow rates from a single well installation;
- Generating high-accuracy flow rates for oil, gas and water over a broader range of applications in a single well installation;
- Improving meter accuracy and robustness through the addition of a gamma source; and
- Providing flowback measurements, well-testing and allocation metering in zboth single-well and multiwell applications.

In addition, such meters can be easily retrofitted on the well pad and, according to estimates, can reduce capital investments at the well pad by more than 50%, vital for operators looking for capital efficiencies in their shale assets. Continuous well and field insight from multiphase meters together with artificial lift optimization programs also can yield up to 20% more in production.

Well characteristics in unconventional fields

One of the greatest challenges in unconventional fields, however, is generating accurate flow rate and fluid information from wells that have artificial lift, high gas fractions, high water cuts, unpredictable flow regimes and low operating pressures.

It's with these specific characteristics in mind that Emerson recently has launched a small-size modular flowmeter specifically designed to address the flow profiles of North American shale and unconventional fields.

The Roxar meter, which has an internal diameter of just 35 mm (1.38 in.), specifically aims to address unconventional fields' unique well characteristics through improved algorithms and models, graphical views and trending software.

The meter can be used for applications such as flowback measurements, well testing and allocation metering and can detect changes in flow rates and fractions immediately, providing accurate royalty payments and enabling precise actions to be taken.

Significant gains are being made in reducing the capex of well pad processing equipment, with the growth in flexible multiphase measurement technology reducing the cost of multiphase allocation and production measurement. E&P