Progress in automation is changing the way oil and gas producers operate. The ability to efficiently meter remote activity at low cost opens up new opportunities for real-time optimization of control systems, raising the overall efficiency and productivity of processes.

In the gas industry, many older wells are declining – the consistency of the gas (presence of liquids) makes it increasingly difficult to extract. Newer wells are increasingly being drilled into fields that pose similar challenges. This calls for a tighter control of the extraction process, which in turn places demands on remote monitoring.
Accurate measurement, improved productivity, and increased natural gas production are the fundamental reasons for continued growth in the use of remote natural gas measurement and automation systems.

These areas of endeavor represent key business drivers. The successful exploitation of these set stronger companies apart from weaker ones. The decline rate of wells is increasing and automation is an important option to extend the lives of these wells. The gas produced in many new wells is mixed with associated liquids, requiring artificial lift methods from the start of production.

Given that it might take an hour or more to drive to any given location, it is desirable that the system minimize the number of required site trips.

From the producer’s perspective, there are numerous operational and economic bottom-line advantages associated with deploying advanced measurement and automation technologies, including lower operating costs, increased labor productivity, increased production, improved custody transfer accuracy, reduced equipment and well downtime.

The topics treated in this article provide an inside look at remote measurement and automation systems using ABB’s TotalFlow metering technology.

Characteristics of remote systems
Besides their coexistence with prairie dogs, coyotes and the like, what other characteristic(s) are important for instruments and systems used in markets and environments such as the one shown in [1].

Autonomous power supply
It is unusual for an electricity supply to be available in remote locations, hence rechargeable batteries fed by solar panels are the preferred technology. In locations where adequate solar radiation is not available (far north/south latitudes) thermoelectric generators are preferred.

Harsh environment
Field equipment should not be too particular about its environmental conditions. The equipment is often exposed to the elements, and hence prone to significant variations in temperature, moisture, wind, dust and electromagnetic radiation. Despite this, remote technology must continue to deliver stable performance around the clock.

Accurate Measurement
It is not enough for the equipment to simply maintain stable operation in a harsh environment. The custody transferring market demands exceedingly high performance in such environments. Accuracy is of prime importance.

Sensors must remain stable despite temperature and pressure variations. For differential producing meters (which integrate a rate equation to derive the quantity volume), it is important that the real-time clock that drives integration time-slices, remains stable. Computational accuracy is vital. The equations used, which include sophisticated numerical methods involving complex polynomials with fractional exponents, conform to standards of organizations such as AGA, API and ISO. Determinism to within 50ppm is the accepted norm for floating point math accuracy.

Minimize site visits
Given that it might take an hour or more to drive to any given location, it is desirable that the system minimize the number of required site trips.

The derivation and collection of custody transfer totals ideally occurs without visiting the metering site. Therefore being capable of remote data telemetry is of significant benefit [2]. If telemetry is not available, the optimum system requires only one trip per billing cycle.

Hazardous Area Operation
Electrical safety certification is usually required for equipment in proximity of a natural gas source. Freestanding equipment, not enclosed within another structure, is usually considered DIV 2 (Zone 2) [3] if five feet (1.5 metres) or more away from the meter run. If within five feet or if enclosed inside a non-vented structure, then...
DIV 1 (Zone 1) 2) is usually indicated.

Secure Against Intrusion
Given the goal of unattended operation, it is also important that the equipment remains secure against intrusion. This includes both physical and digital entry.

Integrated functionality
The ability to integrate measurement and automation functions within the same device reduces the number of devices required in remote applications. Initial system cost and cost of ownership are reduced. It also improves the user experience as training on one device applies to all the applications.

Data Types of Remote Systems
On many of today’s oil and gas production, transmission and distribution systems, data exists in four principal categories.

- EFM (Electronic Flow Measurement) gas accounting database
- General-purpose trend files
- Near real-time polled data
- Exception-based alarming data

Custody transfer EFM databases support transaction records, which can be edited and audited. American Petroleum Institute (API) standard 21.1 specifies the details of EFM data requirements for custody transfer.

In order to evaluate such data as fluid level control versus well production, compressor condition, well casing pressure, dehydrator temperatures and delivery line pressure, it is beneficial for the system to support remote trending (data logger trend files derived in real time by the remote device).

Generally, near real time polled data is comprised of only a few variables (registers) polled on a frequent basis (ranging from every few seconds to a few times a day). The polling frequency depends on the use of the data, the communications system bandwidth, and the ability of the remote power system to maintain battery autonomy.

At times, the system should provide exception-based alarm detection capability – especially when polling and data collection cycles overrun an acceptable time limit in obtaining status of critical equipment. In order to filter out spurious, unwanted alarms the field equipment must be capable of using alarm filtering and detection logic. Detected alarms must be queued for automatic status transmission to a host system. This technique is often referred to as “alarm cry out” or “exception reporting”.

Examples of remote systems
A few examples of remote systems representing different applications in different segments (production, gathering, transmission and distribution) of the oil and gas industry are given below.

Energy Metering and Blending System
Landfills produce an inexpensive consumable gas that is sometimes used as an energy source. However, the heating value of the gas is low and varies significantly as a function of temperature (seasonal and day/night cycles). In order to produce a stable fuel of consistent heating value, higher quality natural gas is blended with it. The goal of such a system is to maintain acceptable heating value, yet consume as much of the landfill gas and as little of the higher quality gas as possible.

Remote measurement and automation, are helping the oil and gas industry operate more efficiently, more safely, more accurately and productively

Such a system is made up of two subsystems; the first being an energy metering system comprised of a primary element, a flow computer and a natural gas analyzer. The flow computer acts as the system master extracting composition and heating value from the analyzer. The flow computer then combines this data with the volumes derived from the primary meter in order to integrate both energy and volume.

The same basic elements of a natural gas energy metering system provide the building blocks of the blending system. In this case, two streams are measured. Additionally, the flow
computer performs feedback control, dictating the proper blend need to obtain the desired energy from the fuel gas 3.

Plunger lift (for liquids removal)
The production of natural gas often produces liquids (oil and water). When the down-hole pressure cannot lift the liquids through the production tubing, artificial lift methods are adopted. These methods can be subdivided into three main categories, within which several variations exist. The three main types of artificial lift are intermitting, pumping and injection. Basic intermitting involves closing the production line by shutting a valve. The down-hole gas pressure rises until it pushes liquids through the production tubing. With the liquids removed, gas can flow again, but as it flows, the liquids build up again and choke gas production repeating the cycle.

Plunger lift is a form of intermitting where a device (the plunger) is inserted into the well’s tubing. The plunger provides a more efficient mechanical seal, thus helping to maximize utilization of down-hole pressure to life the liquids. It rises when gas in the well begins to flow and falls when the well stops flowing. When the plunger rises to the top of the tubing, the flow computer detects it and the plunger’s transit time derived. This information is used to adapt the intermitting control algorithm and so tune the valve-shutting decision in real-time 4.

Liquid measurement custody transfer using tank level
In the production field, produced liquid is usually stored in tanks as the title picture of this article depicts. Liquid product is either transferred from such tanks into a pipeline or loaded into tanker trucks. By interfacing tank level sensors to a flow computer or RTU the foundation for automated measurement is in place.

When loading a tanker truck, such a system can produce an electronic run ticket. The RTU constantly monitors tank level and detects when loading begins, based on a rapid drop in the level. The RTU remembers the starting level. Based on the level readings, fluid temperature, fluid density and an electronically stored strapping table, the RTU integrates the volume transferred, throughout the loading process.

When the tanker load is completed (detected by a stable liquid level) an electronic ticket is finalized and made available for electronic transfer.

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Indispensable technology
Remote measurement and automation, including field technology, wireless communications networking and host system software, are helping the oil and gas industry operate more efficiently, more safely, more accurately and productively. These systems continue to mature and increase in functionality, providing enhanced capability for managing important assets.

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Footnotes
1) An area in which explosive substances can occur but do not do so under normal operating conditions.
2) Explosive substance likely to occur under normal operating conditions.