

# HYDROCARBON PROCESSING®

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## CYBER SECURITY AND PROCESS CONTROL

Case histories showcase technologies to improve plant operations and reliability while defending against internal and external cyber breaches

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## VIEWPOINTS

Cyber threats are real; experts provide helpful advice



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### HP | Special Report

#### CYBER SECURITY AND PROCESS CONTROL

Implementing advanced process control and optimization is one of the most cost-effective ways to improve plant profitability, safety and reliability. The use of artificial intelligence such as neural networks, expert systems and “smart” field will increase. Information technology (IT) now connects conventional computers, operating systems, network computers and software platforms. The interconnections of plant information and operating systems have introduced more risks, including breaches of cyber security. In the modern business environment, data- and information-sharing must continue. However, plant operators must take steps to minimize system vulnerability and ensure quick recovery if a cyber attack breaks through all IT and operating defense systems.

Both operating data and maintenance alerts are shown on screens within the Rompetrol refinery’s central control room. Photo courtesy Emerson Process Management.

## The future of refining is wireless

Refineries are under constant pressure to operate continuously and to increase production without increasing facility size. In North America and Europe, some older refineries are either closing due to economic and oversupply considerations or continuing to operate with minimal further enhancements. This means that the remaining facilities must keep operating costs low to stay competitive or import finished products to meet local market needs. Such actions are undertaken in the face of austerity and economic uncertainty.

In other places around the globe (especially in Asia-Pacific and the Middle East), greenfield refineries are being built, albeit under tight construction and commissioning schedules. Many of these refineries are located in the developing world, where it is difficult to find experienced operating personnel. These sometimes severe economic and staffing realities facing refiners do not eliminate the demand for refineries to improve performance while maintaining (and if possible, improving) safety, energy efficiency, reliability and availability.

Wireless transmitters can offer a solution to these overlapping problems by providing a combination of process operation and equipment monitoring benefits primarily in four areas:

- Flexibility to add new measurements that are necessary for process monitoring
- Monitor second-tier pumps and other rotating equipment
- Make new measurements available, such as acoustic and vibration transmitters
- Replace field gauges with transmitted measurements.

**Wireless usage.** For cost reasons, most refineries were built with the minimum instrumentation and controls necessary to safely operate the units. Since each additional measurement adds cost, process designers generally specify the minimum amount of instrumentation to safely start up and run the plant, leaving any further instrumentation to the end user. One area often neglected has been in equipment condition monitoring. This is due partly to economic reasons and also because wireless vibration transmitters and acoustic transmitters did not exist more than a few years ago and therefore were not a part of the designers' toolbox.

In the past, many readings were taken and read by a field operator using handheld capture devices or local indication pressure gauges and thermometers. This arrangement was a laborious and inefficient use of staffing. It limited how often readings could be made and may require personnel to gather data by climbing ladders on hot operating equipment, increasing exposure to possible injuries.

It is difficult to establish a condition-based maintenance program without information on the equipment's condition, and unexpected equipment failures can lead to inefficient operation, off-spec product or unwanted shutdowns. Additional instrumentation can improve knowledge of an asset's condition, but adding instruments has traditionally been costly. There is the instrument's purchase price, along with the necessary wiring of additional I/O points for connection, the expense of changing documentation and the need to follow management of change (MOC) procedures. What can be done to alter this dynamic?

**Wireless, the enabler.** One cost-effective way to add instrumentation is to use wireless devices. Wireless instrument technology is now easily available and proven in use all around the world. WirelessHART technology is proven and is an international standard (IEC 62591). Implementation requires minimum engineering: It is easy to install and commission and it is easy to expand. Adding instruments to a WirelessHART network actually increases communication reliability and expands network coverage without repeaters.

**Where wireless is not appropriate.** While wireless transmitters have many advantages, they are not the best choice for all applications. This is mostly due to their data rates: while some wireless devices can be set up to transmit as often as once per second, they are better suited to applications in which update times range from several times per minute and longer. Assets that need quick response, such as flow and pressure control, are best handled with wired instrumentation, and some users may want to avoid using wireless for control of any sort. Fortunately, those types of applications, by their very nature, can justify wired instrumentation.

**Solutions for existing refineries.** An essential asset monitoring program for a refinery typically covers four distinct fields. These are:

- Pumps for increasing vibration relative to the equipment baseline that could be caused by bearing wear, alignment issues and impeller or blade damage (**FIG. 1**)
- Forced draft and induced draft fans and other blowers for bearing wear, alignment issues, louver damage, blade damage and resonance frequency
- Compressors for bearing wear, lubrication issues, blade imbalance and alignment problems
- Cooling towers for bearing and gear failures, misaligned drive shafts and excessive vibration.

Pre-engineered heat exchanger solutions are available that use existing wired and new wireless instrument applications for cost-effective automated 24/7 monitoring, enabling operations improvements and reduced energy costs. Such packages allow maintenance personnel to schedule cleaning and maintenance times that still allow for optimal heat transfer. As a result, facilities can reduce energy and capacity loss due to fouling by up to 10%. For a 250,000-bpd refinery, that could mean a savings of as much as \$3.5 million or more annually across all process units.

One type of wireless device that has provided significant benefits in refineries (and probably was the first class of wireless device used in many plants) is the wireless vibration transmitter. These transmitters are extensively used for monitoring cavitation and bearing problems on pumps, as well as bearings on motors.

A leaking steam trap wastes steam (and money). Smart wireless acoustic transmitters can be used with software packages to provide critical, online information regarding the monitored steam trap population's condition, offering notification and location data should a steam trap fail.

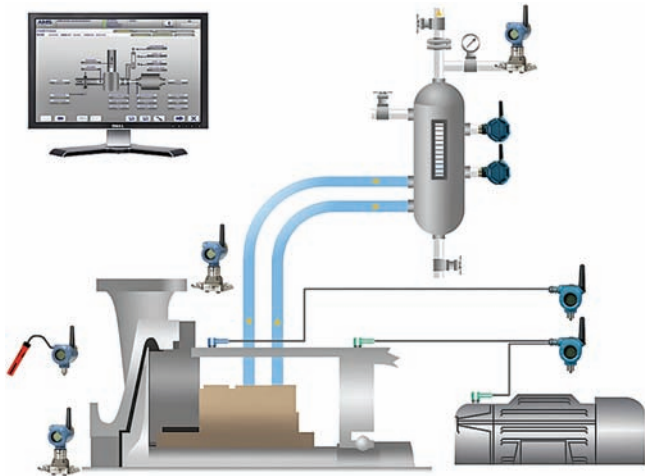


FIG. 1. An essential asset management program for an existing refinery typically includes monitoring of pumps for cavitation and bad bearings.

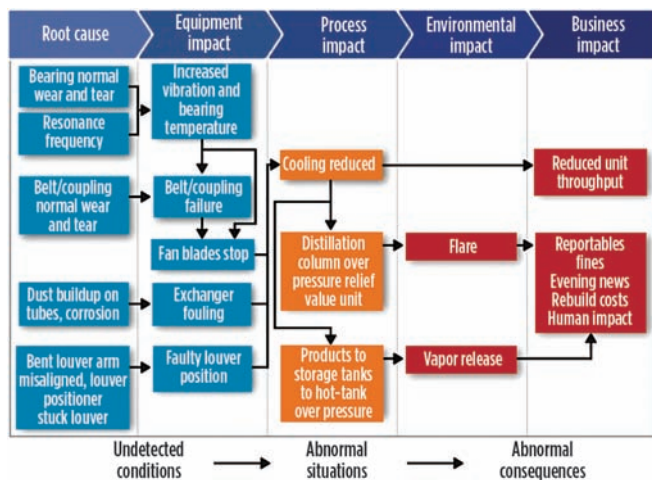


FIG. 2. Vibration transmitters are useful in an essential asset monitoring program for air cooled heat exchangers (“fin fans”), monitoring for reduced cooling, resonance frequency, alignment issues and louver damage; and liquid-to-liquid heat exchangers for fouling.

A leaking pressure relief valve is troublesome. It wastes valuable material and, under some conditions, causes a release of flammable and/or toxic material. Such releases can lead to regulatory actions for fugitive emissions. A smart wireless acoustic transmitter detects the turbulence generated by a leaky valve and provides notification when release is occurring and when the release has ended.

Wireless transmitters are also useful as part of an essential asset monitoring program for air cooled heat exchangers. They can monitor for reduced cooling, resonance frequency, alignment issues and louver malfunction (FIG. 2).

Many process heat exchangers were installed with “test wells”—thermowells with no thermometer or thermocouple-sensing element—inserted to make it possible to capture the process temperature that can make it possible to detect the fouling of the exchangers. It is easy to insert a thermocouple element into the empty thermowell and connect it to a wireless temperature transmitter, thus allowing for the possible heat exchanger fouling to be monitored online, as shown in FIG. 3. Software is available that performs the calculations and then trends the results. Wireless transmitters are also available to monitor process pressure and track hydraulic limits.

Wireless asset monitoring instrumentation can be augmented over time by adding at will wireless pressure, temperature, vibration, level and pH to bring additional functionality to network of various monitoring applications.

A thorough maintenance program also includes corrosion monitoring. Today’s wireless corrosion monitoring transmitters allow for affordable and continuous online monitoring at previously inaccessible locations.

Online corrosion rates can be used by operators to detect a spike in corrosion and correlate with other process data for root cause analysis to reduce operating costs, extend asset life and maximize the time between shutdowns. The assets through which these materials flow are often aging, susceptible to corrosion and not easily adapted to hard-wired online systems. An effective way to prevent corrosion failures in this environment is to incorporate wireless corrosion transmitters with a reliable data transmission and processing system.

Another major advantage of wireless devices is that they minimize the need for operators to go to the field and take measurements on pressure and temperature gauges; any time you

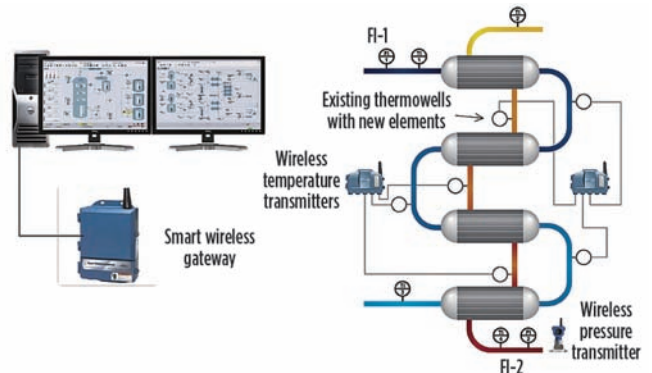


FIG. 3. It is easy to insert a thermocouple element into the empty thermowell on a heat exchanger and connect it to a wireless temperature transmitter, allowing for online monitoring of fouling.

can reduce the amount of time that personnel need to go into the hazardous plant areas increases overall personnel safety.

**Solutions for greenfield refineries.** More greenfield refineries are being built in Asia-Pacific and the Middle East, where growing populations drive ever-increasing demand for refined petroleum products. The trend shows that growth will continue for years to come. To meet the demand, the national oil companies are adding refineries.

While the sizes of these projects vary, the overall trend is to build larger capacity facilities. At the same time, many projects involve multiple engineering, procurement and construction (EPC) companies from different parts of the world, which makes project scheduling more critical. Even without multiple EPCs, changes to engineering design are inevitable throughout the project duration.

In a 2009 study using real data from a near-6,000-point greenfield aromatics project, wireless was applied to 44% of all points. Wireless showed savings of 36% in automation and installation as compared with a completely wired HART solution; and while FOUNDATION fieldbus was slightly less expensive than WirelessHART due to the use of high-density temperature measurement, wireless combines its relative low cost with the advantages of ease of use for difficult monitoring locations, flexibility and future growth.

The study concluded that wireless gives maximum cost advantage where installations are difficult, remote monitoring is

required and auxiliary systems are involved. Wireless eliminates the need for spare I/O capacity. Wireless devices simplify matters when it comes to making changes late in a project. Plus, it is very easy to add incremental wireless points compared to wired bus points. Training and engineering are simplified with the inherently easy wireless technology. And the additional measurements from wireless deliver larger, long-term operational benefits.

To realize such advantages, end users and EPCs are working together for the inclusion of wireless networks during the front end engineering design of these capital projects, not only for process measurement devices but also for equipment monitoring devices such as wireless vibration transmitters and wireless acoustic transmitters.

**In short.** Wireless technology adoption has been steadily growing over the years, both in existing refineries as well as in new refinery projects. Wireless mitigates unscheduled slowdowns and shutdowns by augmenting manually checked asset monitoring with an online monitoring program that measures, analyzes, alerts and allows for timely information to be used prior to asset failure. This technology can solve many problems in refinery operations. It provides a cost effective way to monitor the health of equipment in parts of the facility that would otherwise be inconvenient or impractical to monitor. Wireless technology also makes possible a more rational maintenance policy. Smart wireless devices can significantly increase availability and therefore effective increase in production capacity. **HP**