Scott Keller, SignalFire Wireless Telemetry, USA, explains how operators can optimise tank farm operations using a wireless tank level monitoring system.

THE WIRELESS WAY

In the past, tank level monitoring was a manual task performed by 'sticking' a tank or reading a level indicator. Operators drove to remote sites, travelling from tank to tank, checking instrumentation and manually recording various operational parameters for input back at the control centre. Even if monitored by a skilled worker, the state of tanks could change drastically before the next inspection, and problems would go undetected, to the detriment of productivity and operator safety. The level of manual operator intervention made system operations expensive, error-prone and inflexible to change.

While some tank farms now use wired systems that connect sensors to a data collection system, unique attributes related to tank farms pose challenges regarding installation, cabling and inflexibility to scale. Wireless remote tank level monitoring can virtually eliminate all costly installation issues by providing a simple and easy to install connection between the control system and the tanks. They also provide added flexibility by

Figure 1. SignalFire Sentinel wireless nodes with Modbus interface to tank level float sticks. The node's internal batteries power both the sensor and radio, transmitting critical asset data that is used by the operator to monitor tank levels.

Figure 2. SignalFire Sentinel HART Wireless nodes with Class 1 Division 1 solar power provide wireless access to HART data from guided wave radar level sensors on these tanks.

interfacing with the user's sensors of choice, and can operate as part of an automatic shutdown system.

This article outlines the attributes of a wireless remote monitoring system, which improves operational efficiency in monitoring tank farms while reducing costs.

Eliminating costly conduit runs

Tanks can be spread distances apart from each other on tank farms. To maintain communications, a wired system may be required to run thousands of yards of cable. As installed costs fluctuate from US$10 - US$20/ft, a wired system can be expensive. Add to that the cost of burying cables to address terrain or environment challenges. In some cases, wires just cannot be run on property not owned by the production company, such as roads, streams or other structures.

As wireless systems are, as the name suggests, wireless, there are no conduit requirements, which immediately eliminates the need to both purchase and bury wires and cables. Powered by battery, solar, local power, or a power-scavenging device, wireless systems can monitor and control effectively without the need for wires or power lines. Even when operating in hostile and dangerous environments, wireless systems can run unattended for years, without being affected by environmental conditions such as snow, rain, dust storms and ice. However, components of wireless remote monitoring and control systems must be capable of operating safely in the presence of caustic and explosive environments, so specialised wireless systems rated for hazardous areas are often preferable to off the shelf solutions.

Wireless tank monitoring systems also reduce the risk of lightning damage. Most tank level sensors are located on the top of 20 - 24 ft metal tanks, making them ideal targets for lightning. While nothing survives a direct hit, a wireless system can better withstand the rapid changes in electric fields when lightning strikes. Moreover, since there are no wires, a worst case scenario is the loss of a single asset, not the entire wired system.

Reduced maintenance and labour

When repairing or reconfiguring a wired system, replacing and maintaining cables can be difficult, especially if trenching was involved. Operators may be required to stay several days to a week retrofitting a tank configuration. Downtime results in lost revenue. Mostly configured and tested in the shop, wireless tank level systems can require 50 - 75% less onsite labour.

Limited operator intervention

With a wireless system, operators can remotely monitor conditions, troubleshoot problems, change

Figure 3. A well pad with associated tank battery. The tank battery holds the crude oil/water awaiting transport to a refinery. SignalFire wireless equipment is used to monitor and control various well pad automation points, including tank level.

parameters and even shut down operations from the convenient location of their computer at the central plant. Instead of making trips to inspect different tanks, or even troubleshoot those indicating problems, remote operators can contact onsite engineers about problems for the most cost effective resolution.

Greater asset tracking

When based on a scalable open architecture, such as those used in mesh technology, wireless tank monitoring systems can interface with a variety of sensors that can be added or subtracted as the need to measure parameters, such as pressure, temperature, level, flow and leak detection, to automate tank farm functions further.

Many tank level technologies limit interfaces to one or two types of sensors. However, the materials (oil, water, etc.) being monitored, and the environment, must dictate the best sensing technology. The right sensor for a tank level task might be a radar, float, pressure sensor, ultrasonic sensor, piezoresistive sensor or guided wave radar. Wireless modules that have an open architecture with industry standard interfaces permit the user to choose the sensor type that is the best for each application, and bring all that data from different sensor types to a single point with a single data interface.

Automatic remote shutdown capabilities

Tank level measurement can also be wirelessly integrated with well shutdown controllers. A tank farm, for example, may have a variety of tanks that collect oil and/or water from different wells located several hundred yards to miles away. If tanks fill up, wells must be shut down (turned off or a valve closed) to prevent overflow. A remote shutdown capability of the wireless tank system can monitor and control with failsafe logic, which is necessary for wireless operation of critical systems. In addition, a remote monitoring system may also provide alarms that help prevent spills and avoid equipment failure and/or damage.

Wireless remote monitoring at work

When a chemical plant wanted to add level and temperature monitoring to a set of tanks on the edge of its property, the initial proposition was to run a highway addressable remote transducer (HART) cable from the control room to the tank site, and then branch out to each tank and wire in the level and temperature sensors. The wire length would be several thousand feet between the two points, and then more to wire sensors to each tank. The cost and time associated with this wiring effort, however, was found to be enormous. In addition to the cost of expensive wire, trenching and running conduit was another large added cost. The proposed budget for this upgrade was close to US$100 000 for just the connection costs.

Taking a more cost effective route, the chemical plant decided to use a wireless link. Multidrop HART wireless nodes were installed on the top of each tank and connected, locally, to the sensors associated with each tank. Nodes serve as the wireless, long distance communication link in the remote monitoring and control of assets such as tank levels. The nodes extract then transmit data from sensors via a wireless mesh network to a gateway, where data is available via a Modbus remote terminal unit (RTU) or transmission control protocol (TCP) interface. The total cost of the equipment and installation was a small fraction of the cost of running the cable alone, and the startup time was a few hours as opposed to weeks. Additionally, because it was so simple to add additional wireless measurement points, other monitoring points can be easily added to the network in the future.

Conclusion

When an operator is considering designing a tank farm to include wireless remote monitoring control capabilities, the ultimate purpose is gathering data for decision making. Important implementation design considerations relate to how and where data will be analysed and what actions will be taken regarding asset management. A system should be selected that meets the user's requirements for long distance wireless communication among widely dispersed assets, and can process data in remote locations other than the local RTU. T&T