

# WORKING WIRELESSLY



**Vance Ray, R3 Automation, USA,** explains how wireless sensing helps producers and facilities cut emissions and comply with tough regulations.

**T**hief hatches are installed on the top of low pressure and atmospheric tanks in both the oil and gas, and chemical industries, as well as others, to allow access to the tank. They can be used to take samples of a tank's contents and determine the tank's level. They also protect the tank from over pressure and excessive vacuum.

The thief hatch acts as a pressure safety device on the tank. When closed and latched, two separate spring-loaded seals protect against excessive pressure or vacuum. If excessive pressure builds up in the tank, the hinged hatch cover will break its seal and lift, allowing the pressure to escape to the atmosphere. When the pressure or vacuum is reduced to the setpoint, the seal is reseated by sealing the tank.

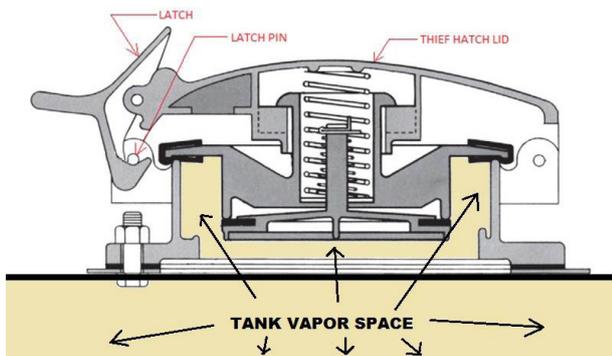
When a thief hatch closes, either due to gravity or a worker closing it, the hatch may not seal unless it is

firmly latched. This allows vapours in the tank to leak into the atmosphere, which can violate regulations.

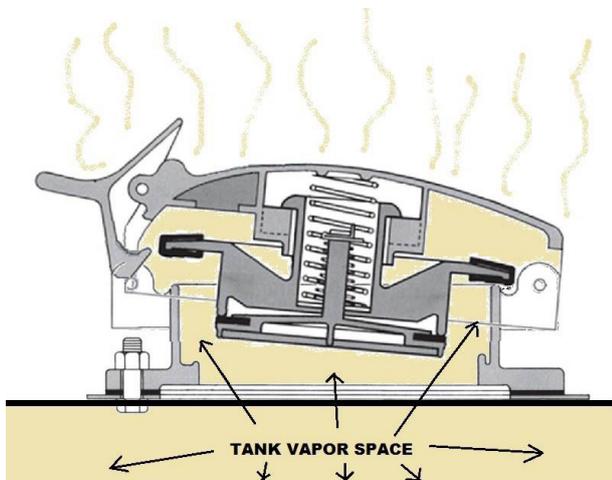
To avoid stiff penalties and protect the environment, Great Western Oil and Gas Co. (Great Western) installed wireless thief hatch monitoring systems on its oil tanks in the Denver-Julesburg (DJ) Basin in Colorado, US. The DJ Basin is a 70 000 square mile area in Northeast Colorado, Southeast Wyoming and Southwest Nebraska. More than 52 000 wells have been drilled in the basin and Great Western has more than 600 operating wells there, producing nearly 13 800 bpd of oil.

### **Tough regulations**

The State of Colorado has some of the oil industry's toughest environmental regulations. The Colorado Department of Public Health and Environment requires



**Figure 1.** A thief hatch has a lid that can be opened manually. The latch (upper left) keeps the lid closed and the tank sealed when closed.



**Figure 2.** An unlatched thief hatch allows volatile gases to escape.



**Figure 3.** A Great Western thief hatch fitted with a WirelessHART monitoring system. When the latch is open, the transmitter sends a signal to the facility's controller so it can be logged or an alert can be sent out.

monitoring of thief hatches on oil and water tanks to prevent the release of methane and volatile organic compounds to the atmosphere. The XII.E.4.d regulation reads: "For all atmospheric condensate storage tanks, the owner or operator shall check for and document on a weekly basis that the thief hatch is closed and latched."

To enforce the regulation, Colorado inspectors regularly check for emissions from leaks and open thief hatches with thermal scopes and infrared cameras. The state inspectors document any open thief hatches, and compare their records to the producers' by time and location. If the producer can confirm the thief hatch was open, perhaps for maintenance or sampling, when the inspector found it open, then there is no problem and no penalty. If the producer cannot confirm why the hatch was open from its records, penalties and fines are assessed. Penalties are severe, with fines reaching up to US\$15 000/d per open thief hatch, with many facilities having many thief hatches per site.

Oil producers across the US fear that the US Environmental Protection Agency (EPA) will soon adopt a similar regulation, and are searching for ways to monitor their thief hatches in a cost-effective manner.

### Inside thief hatches

A thief hatch is a rugged device that is designed for harsh environments and handling by 'less than gentle' users. Made from cast aluminium, thief hatches are used on fibreglass and steel tanks in the oil and gas, chemical, and other industries. Most tanks used in these heavy industry applications come with a thief hatch (Figures 1 and 2).

The thief hatch has a latch that locks the lid closed. If an operator opens the hatch to check tank level or take a sample, he or she lifts the latch, raises the lid, performs the necessary function, and closes and latches the hatch. If the lid is not properly latched, the tank will not be sealed and will, therefore, vent to atmosphere. Colorado wants to eliminate the unnecessary release of methane and volatile organic compounds (VOCs) into the atmosphere from production facilities.

### Monitoring thief hatches

R3 Automation has been working with Emerson Process Automation and several oil and gas companies to develop a thief hatch monitoring system. Rosemount 702 discrete WirelessHART® transmitters can be installed on existing thief hatches and tank batteries to ensure the hatches are closed and latched (Figure 3).

The concept is fairly simple: a switch at the latch detects when the latch is closed (Figure 4). The switch is non-powered, has no magnets, is easy to install on new or existing thief hatches, and no hot work is required. The switch is wired to an intrinsically safe wireless transmitter. The

battery-powered transmitter is also easy to install. It requires no power wiring and no signal wiring, so it can be mounted in any convenient location on top of the tank. To conserve battery life, the scan rate is once per minute, which is more than sufficient for this monitoring application.

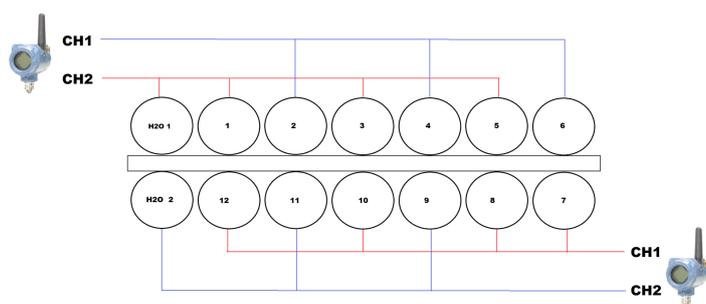
The estimated cost for installing a WirelessHART thief hatch monitoring system on one tank battery (eight tanks) was calculated to be approximately US\$8300, including switches, wire, terminations, transmitters and labour.

The cost per tank can be substantially reduced if latches on a tank battery are wired in series to a single WirelessHART transmitter. This type of installation will indicate if one of the hatches in the bank is open, but not which one. In practice, once alerted, an operator would be sent to site to determine which hatch needs to be fully closed and latched. This method of monitoring complies with regulations, is practical, and allows quick response to any open hatch conditions.

If a tank farm does not already have a WirelessHART infrastructure, the cost of a gateway must be added. To date, R3 Automation has installed



**Figure 4.** A simple switch (yellow) detects if the latch is open or closed.



**Figure 5.** Great Western's tank farm has WirelessHART thief hatch monitors on two water and 12 oil tanks.

its thief hatch monitoring systems on more than 100 tanks at five different oil producers in the DJ Basin.

## Tank monitoring in Colorado

At Great Western's tank farm in Colorado, R3 Automation's thief tank monitors were installed on two water and 12 oil tanks. The tank monitoring system is arranged in banks, as shown in Figure 5. At the top of the image, oil tanks 2, 4 and 6 are wired in series to channel 1 of the transmitter. Water tank 1 and oil tanks 1, 3 and 5 are wired in series to channel 2 of the transmitter. Meanwhile, at the bottom of the image, oil tanks 7, 8, 10 and 12 are wired in series to channel 1 of the transmitter. Water tank 2 and oil tanks 9 and 11 are wired in series to channel 2 of the transmitter.

The wireless transmitters send data to a gateway mounted on a DIN rail in the facility's main control room.

In addition to the thief hatch monitors, the tank farm has 30 more Rosemount level switches, temperature transmitters and pressure transmitters mounted on the tanks to create a comprehensive tank monitoring system. The data from all transmitters goes to the WirelessHART gateway, which is hardwired to a TotalFlow remote terminal unit. The system is programmed to monitor the thief hatch signals and report any open hatches to the operators.

Because the tanks are wired in four banks, operators can narrow down an open hatch condition to four tanks at most, making it quick and easy for field technicians to locate the offending hatch and latch it closed.

## Results

The monitoring system alerts operators to open hatch conditions within 1 min., allowing quick resolution of any problems. Field technicians do not need to periodically monitor and document the status of thief hatches manually. Instead, they only need to respond to an open hatch alert. This reduces manpower requirements for monitoring thief hatches, and demonstrates that Great Western is employing an efficient technology to protect the environment and comply with regulations.

In addition to the tanks in Colorado, R3 Automation has installed its thief hatch monitors at two other Great Western tank farms. At the time of writing, none of the thief hatches have been detected open by the State of Colorado because the facility can react quickly to open hatch conditions.

## Summary

Although Colorado is the only state to issue tough regulations for monitoring thief hatches, such regulations are probably coming from the EPA, or from individual states. The R3 Automation thief hatch monitoring technology is a cost-effective solution to avoid fines, reduce product loss to the atmosphere, and cut emissions. 