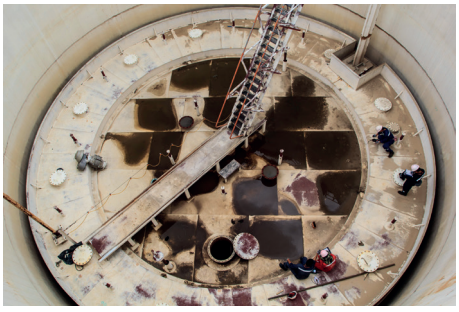
STAY AFLOAT USING RADAR TECHNOLOGY

The use of tank gauging technology to remotely monitor floating roofs increases safety at terminals

More than half of the world's larger tanks used for storing common petroleum products have floating roofs, and this proportion is likely to rise due to tightening demands for reduced vapour emissions.

Floating roofs offer environmental and economic benefits over fixed roofs without the need for vapour balancing and recovery. However, issues such as sinking, tilting, leaking and sticking decks can affect the performance of floating roofs - potentially leading to costly structural damage and major environmental and safety risks. Therefore, it is vitally important that any problems can be detected as soon as possible, so that action can be taken to correct issues at an early stage before they can lead to a serious incident.

To successfully meet this challenge, operators need to closely monitor their external floating roofs. Traditionally this would be performed by personnel climbing tanks to carry out visual inspections, but this is a practice that tank farm operators are keen to minimise for the safety of those involved. Therefore, in line with the use of automatic tank gauging for monitoring liquid levels, operators are increasingly favouring a continuous and automated roof monitoring solution that offers greater efficiency and reliability, and keeps personnel out of harm's way as much as possible.



Manual inspections and personnel entering the roof are risky and costly operations

POTENTIAL PROBLEMS WITH EXTERNAL FLOATING ROOFS

When rain water or snow accumulates on top of a floating deck it can lead to serious problems. Any excess build-up of this nature is usually removed via overflow drainpipes, but there is a risk that these will become blocked. If the water or snow can't be drained away, it could eventually become heavy enough to cause the roof to float too low, or the weight on top of the roof could become unbalanced, causing the roof to tilt. Strong winds pressing down on the roof can also cause it to tilt, especially in combination with water on the roof, while leaking pontoons or a punctured deck could affect the roof's ability to retain its buoyancy and remain afloat.

Rim seals, also known as peripheral seals, are used between the floating roof and the tank shell to prevent the evaporation of hydrocarbons. These can sometimes be fitted incorrectly or be damaged, and if the seal is not tight enough there is a risk of vapour leaks. A seal that has been fitted too tightly risks causing the roof to stick or move unevenly.

Dual and even triple seals are becoming increasingly popular as a means of minimising vapour emissions, but this increased rim seal friction also increases the danger of the roof sticking. Tank wall abnormalities can also prevent the roof from floating freely, and further problems can arise if the roof access rolling ladders are not moving freely.

Should a floating roof malfunction, it would pose a major environmental and safety risk. A sticking or collapsing roof risks causing significant mechanical damage to the tank, which would not only be extremely costly but would also result in the long-term loss of storage capacity. A sinking, tilting or leaking roof could cause hydrocarbon vapour to be released and the product in the tank to become contaminated. Unexpected vapour release is not only an environmental issue, it would also mean a huge safety risk if it ignites, causing a tank fire and an explosion hazard, potentially putting lives at risk.

Photo courtesy of www.ASTanks.com

A malfunctioning roof drain is a common problem which could lead to severe consequences

EARLY DETECTION OF PROBLEMS

Given these various issues that can affect floating roofs, it is vital that operators are given an early warning should any abnormal situations occur. It is possible to rely on visual inspections, with personnel climbing to the top of the tank and assessing the roof condition, as well as entering the floating deck to inspect the integrity of the pontoons. However, this approach has several drawbacks.

It risks the safety of the personnel involved, it is a time-consuming and inefficient process, and most importantly it is not failsafe, as it is not always easy for workers to identify a problem. It is not uncommon for manual inspections not to take place, with other tasks

being prioritised ahead of them. However, even if these checks are performed daily as part of an inspection round, there is still the risk that a significant amount of time could pass between an inspection taking place and an issue being noticed. An incident is most likely to happen when you are not looking.

Consequently, many operators are keen to minimise visual inspections, and instead favour an automated solution, using a system of intelligent level instruments to monitor the status of their external floating roof tanks. This provides the advantage of continuous surveillance and real-time verification that the floating deck is operating as it should. If there is any deviation from normal operation, such as increased or decreased buoyancy, the roof starting to tilt or the liquid level changing but the roof not moving, automatic systems will issue an instant, actionable alert.

Automated solutions offer a much-improved means of maintaining the integrity of the roof, helping operators adhere to the recognised industry standard API 650, which establishes minimum requirements for storage tank design and inspection.

Automating what was previously a manual task can also help operators meet local health and safety regulations. For example, there are places where it is mandatory to monitor the roofs of tanks larger than 60m (180ft) in diameter. Automated solutions can also support companies' own personnel and process safety policies, as well as their environmental policies.

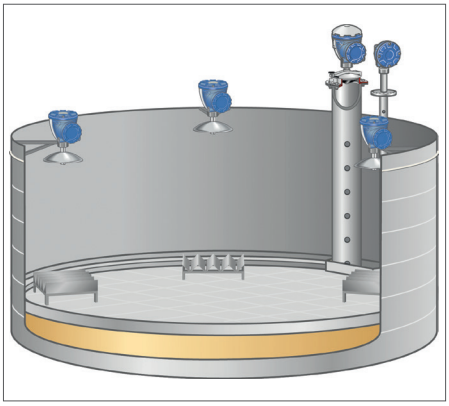
HOW AN AUTOMATED SOLUTION WORKS

An automated monitoring solution involves level instruments being installed at multiple points. There are two options for where these instruments can be placed – either on top of the tank, or on the floating roof itself.

In the first option, where the devices are placed on top of the tank, typically three non-contacting radars such as Emerson's Rosemount 5400 series or Rosemount 5900 series are installed, mounted at 120 degrees from each other. A reflector plate on the roof enables accurate measurements to be performed without being affected by any protruding objects on the roof surface. The presence of roof tilt can be tracked by comparing the level value from all three radars. This solution tracks how well the roof is floating by comparing the roof readings against an automatic tank gauge, which measures the liquid level through a still pipe.

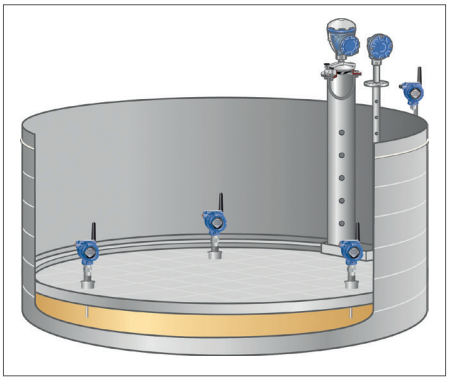
The measurements from the three non-contacting radars are transmitted via wired or wireless communication to the control room, where a console operator can monitor the status of the roof using Emerson's Rosemount TankMaster software package. This solution enables automatic alarms to be generated should issues arise concerning roof tilt, buoyancy and roof sticking, as well as an overfill prevention alarm.

This non-contact solution is highly accurate and reliable. It is suitable for any size of tank, and can be retro-fitted to existing tank gauging systems. Its functionality as overfill protection is a further benefit, along with the redundancy of the level measurement.



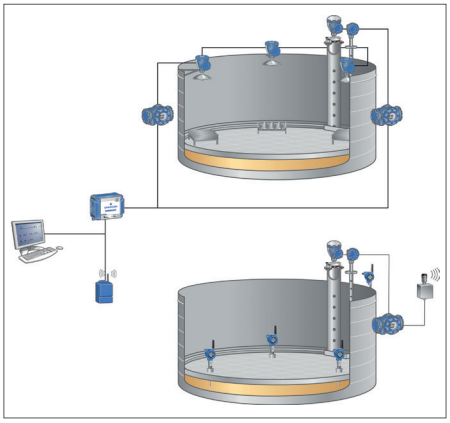
Three non-contacting radars measuring the position of the floating roof

In the second option, where the measurement devices are positioned on the floating roof, wireless and battery-powered guided wave radars (GWR), such as Emerson's Rosemount 3308, are installed in existing nozzles, with rigid probes penetrating through the roof and into the liquid below. The wireless devices enable installation without the need for flexible wiring that can cope with the movement of the roof. A wireless repeater mounted at the top of the tanks ensures that when the roof is at a low point the radars can still transmit uninterrupted data back to the control room despite the devices being below the upper edge of the tank shell. When three radars are deployed, they are typically installed at 120 degrees from each other. Potential roof tilt is tracked by comparing the immersion levels of the probes into the liquid product. Using this solution, alarms can be generated for issues with not only tilting, but also buoyancy and roof sticking or sinking.



Three wireless guided wave radars measuring the distance between the floating deck and the liquid surface

One major advantage of the rooftop configuration is its ease of installation, configuration and communication. Installation can be done in just two hours and with the tank still in operation. The configuration of the GWR can be performed remotely via wireless on an easy-to-use configuration screen, and the roof tilt data will be available in the TankMaster software in the control room. The three GWR readings are monitored in TankMaster along with the primary radar level gauge, which measures liquid level for inventory purposes. The TankMaster solution also allows for connection to all major distributed control systems (DCS).



Flexible, scalable and fully automated solution to monitor floating roof tanks from the control room

As an additional advantage, other sensors can be integrated into an automated solution to further minimise business-critical risks from a floating roof malfunction. The use of wireless communication makes such expansion easy and cost-effective. An example of where this can be used is in monitoring the roof water drain by using a wireless level switch. The frequency monitoring functionality of the latest wireless vibrating fork switches, such as Emerson's Rosemount 2160, can be used to quickly identify the type of liquid present in the water drain on the tank roof – such as whether it is water or oil. If the switch detects water, it could mean that the drain is blocked or closed, while in the case of hydrocarbons it could mean that either the drainpipe or the roof is leaking. Being able to make this distinction provides major benefits in terms of health and safety, and in preventing product loss and contamination.

CONCLUSION

An automated monitoring solution provides operators with 24/7 surveillance and real-time verification that a floating roof is operating normally. It also issues automatic alarms in case of any incident or deviation from normal operation, such as increased or decreased buoyancy, the roof starting to tilt, or the liquid level changing but the roof not moving.

Getting an early warning of this kind enables tank farm operators to take appropriate corrective action before the situation worsens and leads to a serious incident. An automated solution helps to meet environmental and health and safety requirements, and provides a significant risk reduction compared to manual inspections, for a relatively low investment.

FOR MORE INFORMATION

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