RADAR TECHNOLOGY

increases safety by remotely monitoring floating roof movements

Lena Hansson of Emerson Automation Solutions explains how continuous, real-time monitoring provided by non-contacting or guided wave radar devices can provide an early indication of floating roof problems, thereby helping to prevent serious incidents.

External floating roofs on storage tanks are a common cause of safety incidents in the petroleum storage industry. On larger tanks, floating roofs are often preferred to fixed roofs because they eliminate vapour space, which greatly reduces evaporative product loss. However, the performance of floating roofs can be affected by issues such as sinking, tilting, leaking and sticking, the consequences of which can include significant structural damage and major environmental and safety risks. This vulnerability was exposed in the USA in August 2017, when the weight of torrential rainfall from Hurricane Harvey caused dozens of floating roofs to sink as the storm swept across the Houston area. These floating roof failures led to fuel spilling from tanks, pollutants being released into the air, product becoming contaminated, and a loss of storage capacity.

Causes of problems

Hurricane Harvey was an extreme incident, but less dramatic accumulation of rainwater or snow on a floating roof can still cause serious problems. Overflow drainpipes, which usually remove excess build-up, can become blocked. The weight of the water or snow can then eventually cause a roof to float too low or - if the build-up is unbalanced - tilt. Strong winds can also cause tilting, while leaking pontoons or a punctured deck can affect roof buoyancy and lead to sinking. Rim seals, which are used between the floating roof and the tank shell to prevent hydrocarbons evaporating, can also cause problems. If they are fitted incorrectly or damaged, hydrocarbon vapour can leak from the tank, creating an environmental hazard and potentially putting lives at risk. If seals have been fitted too tightly, the roof could stick or move unevenly.

The roof can also be prevented from floating correctly if there are tank wall abnormalities, or if roof access rolling ladders are not moving freely.

Traditional roof monitoring

Given how devastating the consequences of failures can be, it is vitally important to closely monitor whether floating roofs are operating correctly, so that problems can be detected as early as possible and remedial action taken before a serious incident occurs. Traditionally, roof position and tilt were monitored by workers climbing tanks to perform visual inspections. However, this is a time-consuming process that risks worker safety, and is also inefficient, because identifying problems visually is not always easy. Many tank storage operators are therefore keen to minimise visual inspections. Continuous, automated roof monitoring solutions, which provide greater safety, efficiency and reliability, are instead becoming more widely applied.

Automated roof monitoring solutions

Various technologies can be used to provide level measurement in storage tanks, which is important for inventory control and custody transfer accuracy. Among the most widely applied are non-contacting radar and guided wave radar (GWR) devices. These automated technologies can also measure level for safety purposes, such as overfill prevention, and can provide continuous surveillance and real-time verification that a floating roof is operating correctly. An instant, actionable alert is issued when there is any deviation from normal roof operation, such as increased or decreased buoyancy, tilting, or when the liquid level changes but the roof does not move. Maintaining the integrity of the roof in this way helps companies comply with the industry standard API 650, which establishes requirements for storage tank design and inspection. Automating a previously manual task can also help companies meet local health and safety regulations and support their internal personnel, process safety and environmental policies.

Installation points

Automated monitoring solutions involve installing level measurement devices at multiple points, either on top of the tank or on the floating roof itself. In top-of-the-tank applications, up to six non-contacting radar level devices can be installed at equal distances from each other, although three is a more typical number. This solution tracks roof buoyancy by comparing each of these level readings against a reference level reading. Roof tilt is tracked by comparing the distance between each radar gauge and the floating roof, checking for differences in the measured levels. Measurements from the radar level devices are transmitted via either wired or wireless communication to the control room, enabling a console operator to monitor the roof status. These solutions are highly accurate and reliable, and are suitable for any tank size. The functionality as overfill prevention devices, and the redundancy of the level measurement, are important benefits.

When positioning directly on a floating roof, wireless and battery-powered GWR devices can be installed in existing nozzles, with rigid probes penetrating through the roof into the liquid below. Wireless devices greatly simplify installation, although flexible wiring is available that can cope with the movement of the roof. A wireless repeater mounted at the top of the tank ensures that when the roof is at a low point the radar level devices can still transmit uninterrupted data to the control room despite the devices being below the upper edge of the tank shell. Typically, three radar level devices are deployed, with potential roof tilt tracked by comparing the distance from the floating roof down to the product surface. Alarms can be generated for issues with roof tilting, buoyancy, sticking or sinking. A major advantage of this solution is its ease of installation, configuration and communication. Installation can be completed in just two hours and with the tank still in operation. GWR configuration can be performed remotely via wireless, and roof tilt data is available in the control room.

Summary

The consequences of floating roof failures can be devastating, yet most incidents are preventable. Level measurement technology that continuously verifies the status of a floating roof significantly reduces the risks involved. Applying automated roof monitoring solutions based on either non-contacting or guided wave radar technology helps to meet environmental and safety requirements, and enables organisations to detect failures early. This allows them to take remedial action before the situation worsens and leads to a serious incident, thereby safeguarding their assets and personnel, and reducing plant downtime.

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