THE CRITICAL FIRST LINE OF DEFENCE AGAINST OVERFILLS

If tank gauging systems work reliably and efficiently, the root cause of problems can be prevented and fewer incidents will occur

Overfills are not random occurrences – they are predictable and therefore preventable. Yet insurance data shows that one in every 3,300 filling operations results in an overspill. As technology advances, more options are becoming available to operators of tank farms and bulk liquid storage facilities when it comes to installing the right equipment for safe, efficient, reliable tank gauging.

More facilities are accepting the need for multiple layers of overfill protection, such as an automatic overfill prevention system, and while these back-up measures are undoubtedly vital, it should be remembered that the tank gauging system provides the critical first layer of overfill prevention.

The case for investing in a better tank gauging system, and therefore boosting overfill protection, is a compelling one – safeguarding workers, plant assets and the environment, complying with regulations, increasing efficiency and reducing the cost of risk.

Consequently, more operators are now coming to realise the importance of swapping their old mechanical equipment and manual measuring and recording techniques for a reliable tank gauging system, because when overfills do occur, the consequences can be – and have been – catastrophic.

Emerson's SIL 3 certified Rosemount 5900S Radar Level Gauge takes safety to a higher level

WHEN DISASTER STRIKES

To illustrate why an accurate and reliable tank gauging system is so important, one needs only to look at the US Chemical Safety Board's (CSB) recently-released report into the massive explosion at the Caribbean Petroleum (CAPECO) facility near San Juan, Puerto Rico, in 2009.

The CSB reported that: CAPECO was routinely transferring more than 10 million gallons of unleaded petroleum from a docked tanker vessel. The only storage tank large enough to hold the full shipment was already in use, so CAPECO planned to distribute the product among four smaller storage tanks. CAPECO used a simple mechanical device, consisting of a float and automatic measuring tape, to determine the liquid level inside the tanks. An electronic transmitter card sent the liquid level measurements to the control room, but the transmitter card on one of the tanks (409) was out of service, so operators were required to manually record the tank level readings once every hour.[1]

The report continues: At 10pm, an operator read the level of tank 409 from the side gauge and reported it to his supervisor, who estimated that the tank would be full at 1am. But shortly before midnight the tank started to overflow. A vapour cloud and a pool of liquid formed in the tank's containment dike and the cloud ignited when it reached electrical equipment as it headed towards the facility's wastewater treatment area. A flash fire raced back towards the storage tanks. Seven seconds later there was a massive explosion. The shockwave damaged 300 nearby homes and businesses, and the ensuing blaze destroyed 17 of the facility's 48 storage tanks. The incident left CAPECO facing claims for hundreds of millions of dollars in damages, and in August 2010, the company declared bankruptcy.[1]

The CSB report determined that: CAPECO had an unreliable system for monitoring and controlling the level of gasoline inside the storage tanks, and this had set the stage for the incident. The float and tape measuring devices used by CAPECO were prone to mechanical failure, were poorly maintained, and were frequently not working on multiple tanks at the same time. Cable breakages often disabled the electronic transmitters that sent tank level measurements to the control room. CAPECO routinely took two weeks to repair problems with the level monitoring system, with operators instead checking tank levels hourly and manually calculating the time it would take for tanks to fill.[1]

The CSB report also found: The float and tape measuring system was the only control system CAPECO used to avoid overfilling a tank. When that system failed, the facility did not have additional layers of protection in place

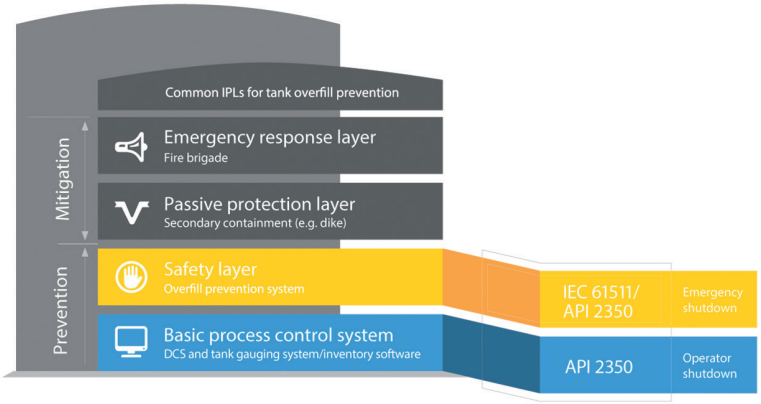
to prevent an accident.[1]

The CSB report notes that: good engineering practice would have called for at least one additional layer of protection, to detect and alert operators to the danger of an overfill, even if the primary system for measuring the tank level fails, and to shut off or divert the flow into another tank when the level is critically high. Had this been in place and properly maintained, the accident most likely would not have occurred.[1]

LAYERS OF PROTECTION

But of course, a properly-working, accurate and reliable tank gauging system would have helped to prevent the incident at its root cause.

The current best practice is to use different protection layers to try to prevent or provide mitigation against overfills. The basic process control system, comprising a DCS, tank gauging system and inventory software, is the first and most important layer of defence. The second level of protection is an automatic overfill prevention system, and the third level is a layer of secondary overfill containment, for example dikes. In a worst case scenario, the top level is the emergency response layer, namely alerting the fire brigade and other emergency services.



How different protection layers are used to prevent or provide mitigation against overspills

MODERN, RELIABLE TANK GAUGING

Accurate and continuous control of tank content enables quicker transfers, better tank utilisation and longer intervals between proof tests. It also helps to minimise risk by reducing the need for workers going out to the tanks to make inspections and take readings.

Modern systems such as Emerson's Rosemount tank gauging system provide precise tank gauging through the use of a radar level gauge, a tank hub to collect the level measurements, and an inventory management system that enables operators to observe and check the level measurements easily and efficiently.

A new development in safe tank gauging is 2-in-1 technology, which enables a single radar device to contain two separate and independent electrical units within its transmitter head. These can act as one primary and one back-up level gauge, or one level gauge plus a high level alarm. This system offers enhanced reliability as the gauges are always in operation, have no moving parts and do not make contact with the liquid in the tanks. It also means that just a single tank opening is required.

WIRELESS

Many tank storage facilities that would benefit from modern, non-contacting gauging have obsolete or non-existing signal wiring from the tank storage area. Retrofit of the gauging system in such plants is normally expensive and time consuming as the distance between storage tanks and the control room can be more than one kilometre, requiring extensive trenching and cabling. By connecting a tank gauging system to a wireless network, these issues can be bypassed, expanding the type and number of applications.

Emerson's tank gauging system for example can connect to an existing or newly installed *Wireless*HART network using smart wireless communication with the radar level gauges. The automatic overfill prevention system is always wired, but using wireless and wired communication in combination provides two independent data paths to the host/DCS. The use of wireless for tank gauging data means that the existing field cabling (which may have limited availability) can be used for other purposes, for example when operators need to get both tank gauging data and a high level alarm signal back to the control room but only have one set of wiring available to the tank. The high level SIL relay signal from the tank hub is connected to the existing wiring and the complete tank gauging data is sent via the wireless network.

EXPERT ADVICE

Tank gauging systems are in continuous operation, which is why they are the primary tool in preventing overfills. Select and apply them correctly and this will significantly reduce the need for the subsequent layers of protection to be required to act. Finding the right solution to specific tank gauging requirements is important. Emerson's overfill prevention experts support enquiries globally, regularly handling questions relating to regulatory compliance, sustainability policies, union demands and insurance requirements. Tank farm assessments can be performed, to make sure they fulfil standards IEC61511 and/or API 2350. A typical assessment comprises evaluations of tanks and operations, management system, risk assessment, and a compliance report with gap closure recommendations.

CONCLUSION

Tank overfills have been a main cause of serious accidents in the process and bulk liquids industries, and when a major incident occurs – as with the CAPECO case – the consequences can be devastating.

However, there are always vital lessons to be learned from such catastrophes, and safety demands are becoming ever more stringent. Modern equipment and prevention methods, including a greater focus on getting things right at the primary tank gauging stage, are playing a pivotal role in helping to prevent similar incidents from occurring in the future.

REFERENCES

1. US Chemical Safety Board, Final Investigation Report – Caribbean Petroleum, 21/10/2015 (http://www.csb.gov/caribbean-petroleum-refining-tank-explosion-and-fire).

FOR MORE INFORMATION:

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A 2-in-1 radar tank gauge has two separate electronic units. They work in parallel and have independent power supply and communication lines