The new global standard

TANK GAUGING

The fourth edition of the American Petroleum Institute (API) standard 2350 provides the international oil industry with a comprehensive tool to reduce risk of overfill disasters in the storage of oil products. *Hans Westerlind** looks at what it offers and what operators need to be aware of

The advantage of API 2350 is that it is a modern safety standard for a specific use-case (overfill prevention) in a specific application (non-pressurised aboveground large petroleum storage tanks). It was created by the industry for the industry. A wide spectrum of industry representatives participated in its creation: tank owners and operators, transporters, manufacturers and safety experts, to mention just a few. It is a compilation of the minimum requirements needed to comply with modern best practices in this specific application.

While its main purpose is to prevent overfills, another common result of applying this standard is increased operational efficiency and higher tank utilisation. And it does not compete with other more generic safety standards, but instead acts as a complement. Using Safety Instrumented Systems (SIS) designed in accordance with IEC 61511 is, for example, one way of fulfilling some of the requirements in API 2350.

API 2350 does not stipulate exactly how to implement overfill prevention, but it does give a robust framework of the processes and equipment configurations that have to be in place. The updated standard is a welcome modernisation that can be a great help for terminals in their overall work with safety improvements.

First set your terms

All tank farms are different and the risks vary based on such factors as location, the products being handled, tank integrity and operational procedures. API 2350 categorises tanks based on attendance level and degree of complexity.

These categories are a method of grouping all the possible tank overfill gauging configurations into three broad categories. Although the standard says nothing about which category is 'better' it is generally understood that the higher the category the more reliable the gauging and alarm system.

Category 1 systems are essentially manual systems such as the use of tapes and rods to measure product levels. Although an Automatic Tank Gauge (ATG) may be at the tank and used for level measurement, it has no capability to transmit level signals so all information about level is localised to the tank. This category should only be used when the risks are low (no Class 1 liquids), the receipt operation is infrequent, the rate of level rise is slow and where the operation is so simple that an operator has virtually no chance of making a mistake. Category 1 systems may, as per the standard, only be used for a fully attended operation.

Category 2 systems have the ability to transmit level and alarm information to a centralised control room. However, an ATG failure can cause total loss of information about the tank levels as well as the alarms. Category 2 systems have no redundancy and should only be used if the failure rate of the ATG and level system is extremely low (i.e. the best possible technology available). Category 2 is permitted only for attended and semi-attended facilities. Many tank facilities fitted with Category 2 systems are also fitted with unreliable ATGs, making these particularly vulnerable to an overfill event.

Category 3 systems are like Category 2 systems but are characterised by having an independent alarm. The independent alarm ensures that an ATG failure will not cause a failure of the alarm function. Category 3 systems are considered the best available configuration and technology for tank filling operations and alarm systems. They may be used at a facility that is attended, semi-attended or unattended. A Category 3 tank allows for better tank utilisation as a higher working level can be used.

Basically, any modern tank farm will be classified as a Category 3 facility, and at a minimum will be equipped with one ATG per tank and a separate, independent overfill protection system.

The API 2350 standard includes all the requirements for implementing Category 3 tank operations. A summary of the required steps can be found under "latest API 2350 guidance" at www.api-2350.com, where there are also helpful checklists and example equipment configurations.

Overfill protection

API 2350 recognises that technology is advancing and that better devices are available today than ever before. The standard thus allows for further automation by using an Automated Overfill Prevention Systems (AOPS) that automatically stops any filling above a certain

level. It should be noted that an AOPS is a Safety Instrumented System (SIS) according to the IEC 61511 standard.

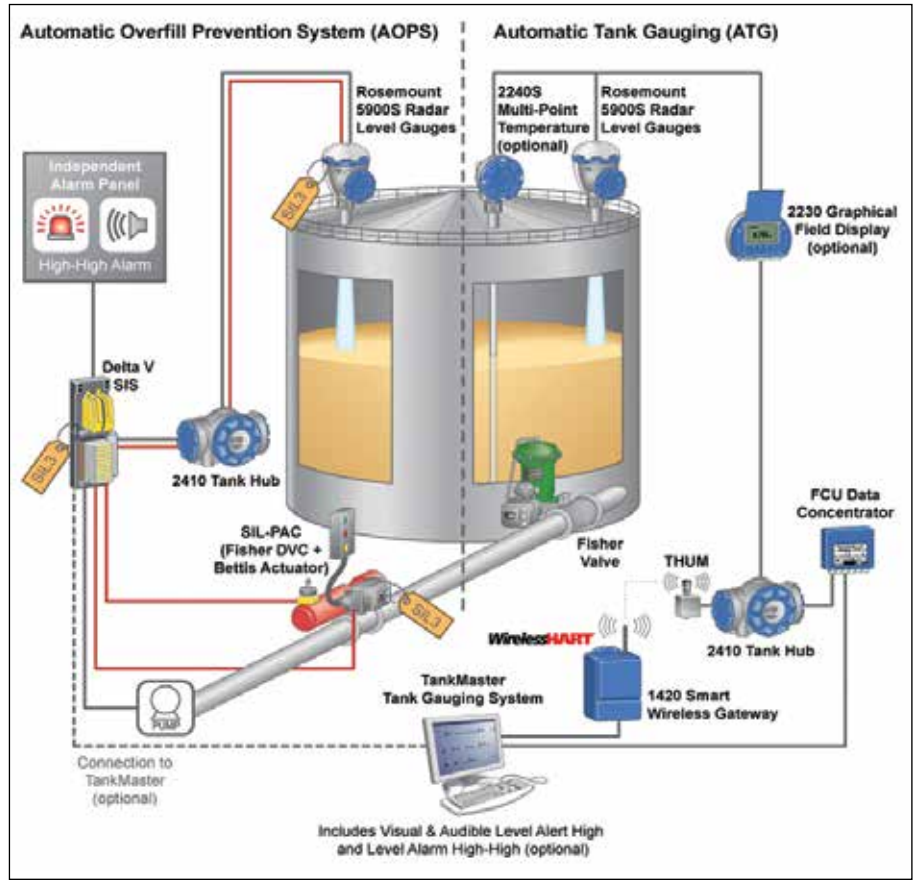
Such an AOPS must be independent of and additional to the Basic Process Control System or BPCS (which in this case is the normal operations control system). The AOPS can be combined with any of the tank Categories 1 to 3. However, in most cases, it would make sense to combine it with either a Category 2 or 3 overfill prevention system. Sometimes AOPS is called 'Category 4'.

Although AOPS is not yet widely employed in tank filling operations, it will eventually become an important tool in preventing overfills. In order to fulfil the API 2350 such automatic overfill prevention systems in new facilities must be compliant with IEC 61511.

In the world of safety instrumented systems, IEC 61511 is one of the specific industry standards that have been developed to apply to electrical and/or electronic and/or programmable electronic devices to control dangerous processes. These standards cover possible hazards caused by failure of the safety functions in safety-related systems. They represent the best possible methodologies to ensure that safety systems operate as intended. These safety instrumented systems are applied to railway signalling systems, remote monitoring and operation of process plants, emergency shutdown systems, burner management systems and many more. By their very design, when combined with normal operating systems and basic process control systems, they can achieve a level or risk reduction that cannot be achieved without them.

So why the hesitancy to use them in the tank storage sector? One key reason is that if not properly designed, an AOPS that closes off product flow too quickly can cause damage to a pipeline. In order to avoid this, the valve closure time must be sufficient so that there is no possibility of a line rupture. A significant amount of data collection and engineering is required to prevent the risk of a pipeline rupture.

Care must also be taken during the receipt of product from tank ships. The jetty hoses that connect the ship to the terminal can disengage or rupture due to hydraulic transients, and a spill in the water is generally more serious than a spill in the terminal. Special care must therefore be exercised when applying AOPS to any marine or pipeline operation.



Dual continuous gauges

One interesting approach to overfill protection offering a potential for considerable safety and operational improvement is dual continuous level measurement, which uses more than one continuous measurement device instead of discrete switches. By using two separate radar level gauges it is possible to compare the results and immediately spot if one gauge is not working. Adding on a temperature-compensated leak alarm allows for early detection of small and gradual spills, which may occur due to corrosion.

This approach has a number of advantages. There is an obvious redundancy, adding to reliability and availability, while it means it is possible to have equipment being tested continuously at all levels.

As safety concerns have become more important within the industry, more and more tanks are equipped with dual and even more level devices. In some applications such as LNG (although this is not covered by API 2350) the use of two or more gauges has been a common practice for a long time.

To make device installation easier and less costly, an innovative solution is to use two radar gauges in one housing. This 2-in-1 feature provides redundancy by using two independent gauges, while obviating the need for separate housings. This method is particularly attractive where installation of two separate gauges is difficult, for example on LPG tanks or floating roof tanks. Indeed, depending on installation and operational conditions there are several ways to configure redundant overfill prevention as required for Category 3 tanks as described by API 2350.

Many tank overfill incidents in the past were the result from faulty instrumentation. Today, the high-tech, self-diagnostic equipment available has outstanding reliability. It is worth considering a migration process where the highest risk facilities are systematically upgraded to the best overfill prevention equipment. The API 2350 standard is a good starting point, providing the required tools.

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