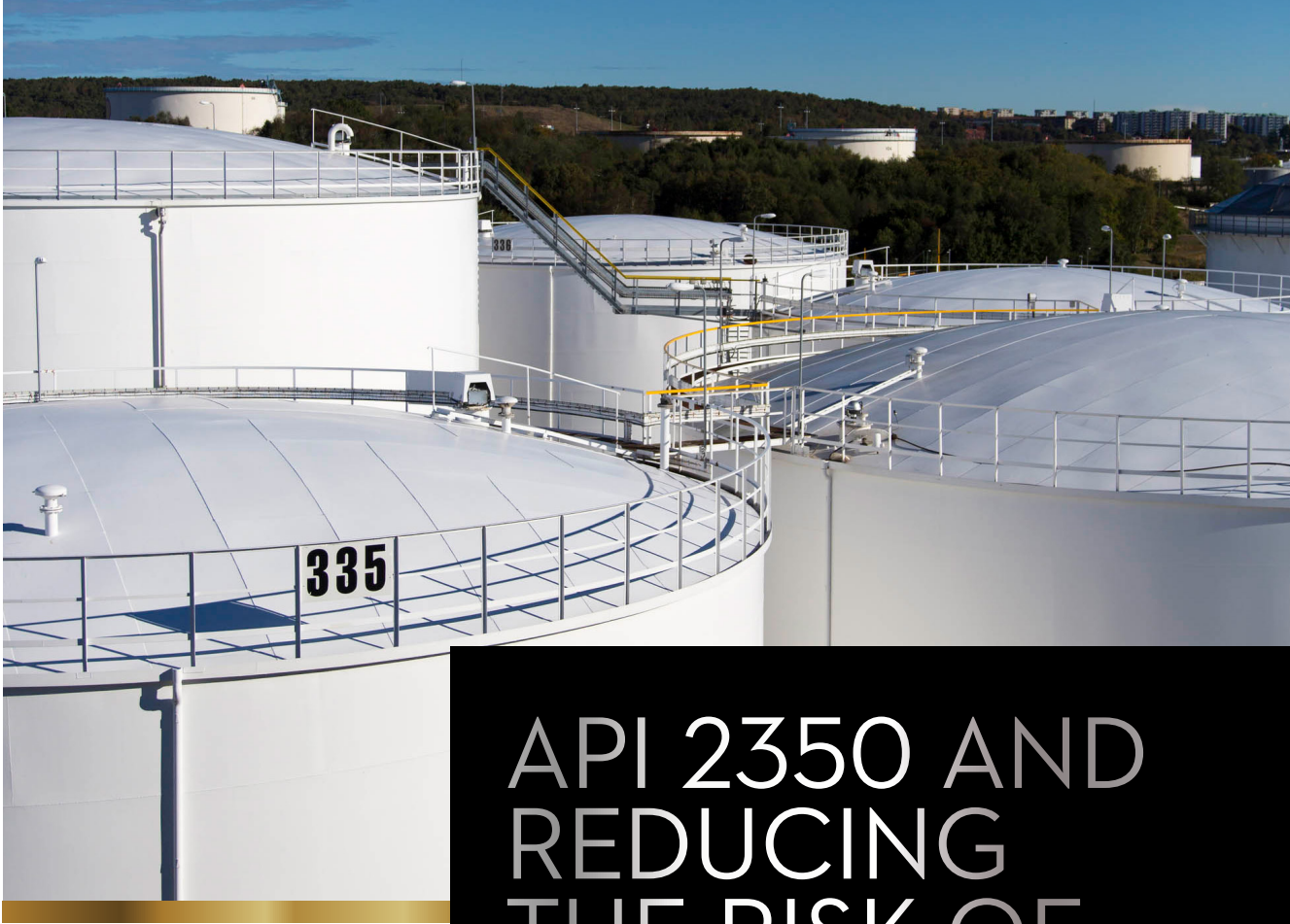


API 2350 provides minimum requirements to comply with modern best practices in the specific application of non-pressurised above-ground large petroleum storage tanks



API 2350 AND REDUCING THE RISK OF OVERFILLS

The American Petroleum Institute's API 2350 standard is one of the key global standards that relate to overfill prevention and it provides minimum requirements to comply with modern best practices in the specific application of non-pressurised above-ground large petroleum storage tanks.

API 2350 was created by and for the petroleum industry, with contributions from a wide range of industry representatives, including tank owners and operators, transporters, manufacturers and safety experts. It is aimed at owners and operators of fuel distribution terminals, refineries, chemical plants, and any other facilities that receive petroleum or chemical products into storage.

API 2350 was written from an international perspective, and is valid and applicable worldwide. The intention was not that it should compete against other safety standards, such as the International Electrotechnical

Johan Sandberg discusses the significant changes in the fifth edition of the API 2350 safety standard relating to non-pressurised above-ground large petroleum storage tanks, and explains how these help to simplify the implementation of overfill prevention solutions, leading to enhanced plant and worker safety

Commission's IEC 61511 standard, but instead to complement them.

SCOPE OF API 2350

The API 2350 standard applies to storage tanks that are above ground; have a capacity greater than 5,000 litres (1,320 gallons); store class I, II or III petroleum liquids; and receive liquids from mainline pipelines or marine vessels. It is worth noting that it does not apply to tanks

that are underground; have a capacity below 5,000 litres; are integral to a process; and where loading or delivery is from wheeled vehicles. It also does not apply to LPG and LNG tanks, tanks at service stations, and tanks compliant to the Petroleum Equipment Institute's PEI 600 recommended practices.

Although API 2350 is focused on these specific industry applications, many of its recommendations and

guidelines are regarded as generally accepted good engineering practice, and its principles are applicable to any tank operation where there is a risk of an overflow. This has led to the standard being widely adopted in applications outside its specific scope, such as storage tanks in the chemical industry, for example.

API 2350 FIFTH EDITION

The original edition of API 2350 was published in March 1987. Subsequent editions have significantly expanded the scope of the standard, and integrated the lessons learned from incidents such as the Buncefield oil depot conflagration of 2005 to ensure that the standard conveys the most up-to-date best practices for tank filling operations across the petroleum industry.

The fifth and most recent edition of API 2350, entitled 'Overfill Prevention for Storage Tanks in Petroleum Facilities', includes a number of changes from the previous edition. These changes aim to resolve some issues, clarify certain aspects that were open to interpretation, and make the standard more user-friendly, thereby encouraging more successful implementation. The key

API 2350 requires category 3 tanks to be equipped with at least one independent overfill prevention system, and one automatic tank gauge, such as the Rosemount 5900S Radar Level Gauge from Emerson



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► areas of focus include management systems, risk assessment systems, defining operational parameters, and procedure requirements supporting overfill prevention, including for automated overfill prevention systems (AOPS).

MANAGEMENT SYSTEMS

API 2350 formalises the safety management system concepts that must be applied to tank filling operations, and calls this the overfill prevention process (OPP). The OPP includes the people and equipment associated with tank filling operations that are required to maintain an optimally tuned system for high performance without overfills. The inclusion of the OPP in API 2350 is significant because it means the standard is no longer just referring to the design, operation and maintenance of management systems, but also to how an organisation should run its processes and procedures associated with tank filling operations.

To reduce significantly the risk of an overfill incident, API 2350 now requires tank owners and operators to develop and implement a satisfactory safety management system that clearly outlines elements including operating procedures, tank data, alarm setpoints and calibration data. However, the latest edition of the standard does not provide prescriptive guidance on how this should be achieved. Instead, the onus is on the organisation to determine what would work best at their facility.

The fifth edition points to the use of modern, digital wireless networks as an acceptable means of deploying overfill prevention

In order to be effective, safety management systems must be integrated into the organisation’s corporate culture and be fit for purpose. Even the simplest system requires a lot of time, energy and resources and therefore must be actively supported by management and executives if it is to be effective.

RISK ASSESSMENT

The science of assessing risk comes down to one basic formula: risk = consequence x probability. Risk assessment is a cornerstone of modern overfill prevention because it creates awareness of hazards and risks, identifies who or what may be at risk and the potential cost of an incident, determines if existing risk reduction measures are adequate, and prioritises risk reduction activities.

A risk assessment is not a guarantee of zero accidents. However, tank overfills are predictable and risk assessment is a necessary tool to determine which protection layers should be implemented and how they should be designed and managed over time. When an overfill prevention system is used to reduce risk, the risk assessment determines the required safety integrity level.

API 2350 requires the use of a risk

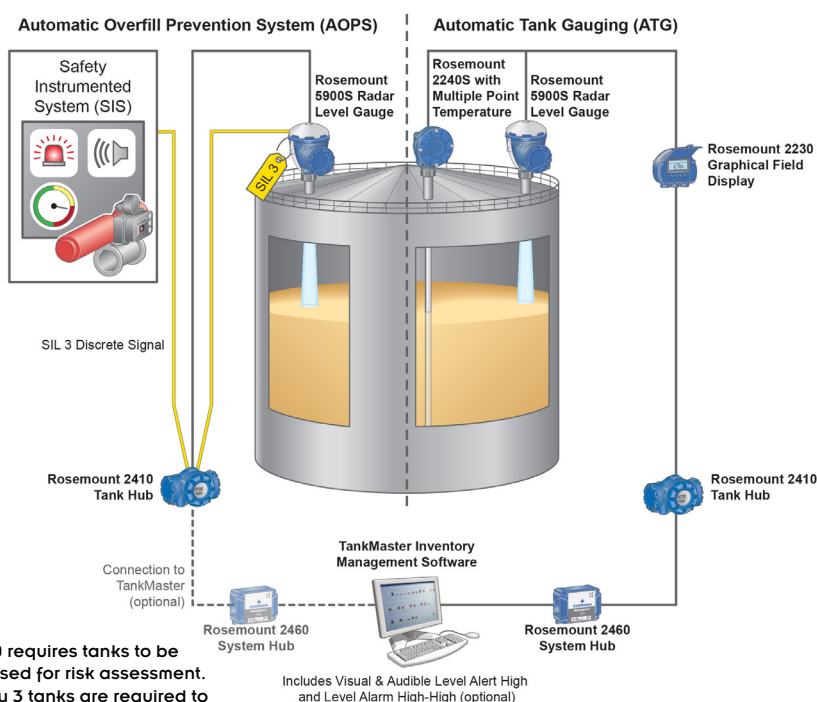
assessment system, with each tank having a risk assessment performed to determine whether risk reduction is required. The standard does not prescribe exactly how an organisation should go about performing a risk assessment at its facility. However, the fifth edition includes three new very informative annexes, which provide guidance to owners and operators.

These are: Annexe E – An informative overview of risk assessment techniques; Annexe F – Considerations at the transporter/owner interface (transfers); and Annexe G – Informative description of categorisation of tanks for a risk assessment. Organisations may choose to use this method of categorisation for risk assessment, which elevates the annexe to become a ‘normative’ requirement as part of the fifth edition. It should be noted that the fifth edition has introduced a category 0 classification, which is for tanks with manual hand gauging only.

OPERATING PARAMETERS

Organisations that adopt API 2350 must establish or validate tank operating parameters. These include knowledge about tank categories, levels of concern (LOC), alarms, alerts, AOPS, and attendance type. In the fifth edition of the standard, Annexe D provides a detailed approach to determining these parameters, thereby helping organisations to achieve compliance.

API 2350 outlines several LOC, which are liquid level positions set by an organisation for alerts, alarms and other AOPS functions. Defining these positions correctly for each tank at a facility is a critical aspect of overfill prevention, as it enables potential problems to be identified before an overfill happens. The highest of these LOC is the critical high, which is the liquid level at which an overflow or damage can occur. This



API 2350 requires tanks to be categorised for risk assessment. Category 3 tanks are required to have an automatic tank gauge and an independent overfill prevention system=

The importance of proof-testing cannot be over-emphasised

A large portion of API 2350 is devoted to proof-testing the important sensors and systems in an overfill prevention safety loop. The digital technology available in modern level measurement devices enables operators to perform proof-testing remotely from the control room



is followed by the high-high alarm, for when the level is approaching critical high. This is the only alarm required by API 2350, and the AOPS level will be set at or above this point. Next is the maximum working level, which is the highest level to which a tank can normally be filled. An alert may be used at this level if the operator chooses.

API 2350 fifth edition requires default minimum response times – ie, the time required to detect a LOC, trigger an alarm and terminate receipt. These response times vary depending on the category of tank concerned. The standard also requires a liquid level safety margin of no less than 75mm (3ins) between two LOC, for example the critical high and the high-high. A further requirement of the fifth edition is that according to the OPP, all LOC must be periodically reviewed and updated. Any changes to LOC should undergo a management of change process, which is part of the overfill management system.

WIRELESS TECHNOLOGY

Wireless technology has been deployed widely for measurement applications in process plants, but its use within safety functions has not been permitted. API 2350 recognises that, while overfill prevention should be a priority for tank owners and operators, high installation costs due

to lack of wiring infrastructure at many facilities can be an economic barrier.

The fifth edition points to the use of modern, digital wireless networks as an acceptable means of deploying overfill prevention utilising the International Electrotechnical Commission (IEC) and Industry Standard Architecture (ISA) network standards now widely available from major device manufacturers.

PROOF-TESTING

API 2350 does not address which equipment or technology should be used in overfill prevention. However, a large portion of the standard is devoted to procedures that ensure the correct ongoing operation of the equipment, such as proof-testing (or verifying) the important sensors and systems in the overfill prevention safety loop.

The importance of proof-testing cannot be over-emphasised. When systems such as tank alerts, alarms or AOPS fail, the failures are for the most part unrevealed. This type of failure is referred to as a dangerous undetected failure. Great advances have been made in terms of self-diagnostic functionality available within level sensors and automatic tank gauging systems. This enables monitoring of many of the failure modes and the output of a diagnostic alarm in such cases, although no system has a 100 percent probability of diagnosing system faults. The only way to positively find all potential dangerous undetected faults is to proof-test the entire loop from the sensor to the final output (sensor, logic solver and final element or valve). It is recommended that the proof-testing requirements specified for AOPS are also applied to all alarms.

API 2350 fifth edition now requires all components involved in terminating a receipt to be proof-tested at least annually, unless otherwise supported by a technical justification (i.e., a probability

of failure on demand calculation). Varying types of sensors are discussed in Annexe C, with differing testing procedures associated to each type. Annexe H provides owners and operators with informative considerations when deciding on a proof-testing regime.

BENEFITS

Adopting and implementing processes and procedures according to the API 2350 standard is a significant challenge, but is essential to mitigate the potential risk of an overfill due to failed equipment or human error. Although the main purpose of API 2350 is to help organisations increase safety by preventing overfills, applying the standard can also lead to other significant benefits in day-to-day operations, including improved operational efficiency and increased tank utilisation.

Operational benefits may result from simplified and clarified alarm responses, improved operator training and qualification, better procedures for both normal and abnormal conditions, and enhanced inspection, maintenance and testing practices.

GUIDE TO THE REVISED STANDARD

The complete API 2350 fifth edition is available to purchase from the API website. To support end users, Emerson has produced a simple overview of the standard.

The Complete Guide to API 2350, Fifth Ed is free to download and details the purpose and scope of the standard, the latest revisions, and the wider benefits of compliance.

www.Emerson.com/API2350Guide ■

Johan Sandberg is senior business development manager for tank gauging at Emerson

Subsequent editions of API 2350 have significantly expanded the scope of the standard