



Kenny Heidel, Magnetrol International, UK, explains how companies that lean on industrial recommendations and technology solutions can improve tank overfill prevention protocols.

Tank overfill incidents, in recent years, have resulted in loss of life and billions of dollars in damages to petroleum facilities worldwide. One of the worst incidents, the overflow of a gasoline storage tank at the Buncefield oil depot, UK, has been traced to the failure of level control to maintain containment of the flammable liquid. The resulting explosions caused the largest fire in Europe since World War II and brought an aggressive focus on overfill prevention at a global scale.

In the wake of this incident, both the Major Incident Investigation Board (MIIB) and the American Petroleum Institute (API) updated their recommendations, based on the findings of Buncefield investigations (it was found that a combination of electro-mechanical servo gauges and a failure of the high level switch combined to allow the overfill event).

The updated recommendations in the MIIB's Buncefield Report and the API Recommended Practice (RP) 2350 are similar in organisation and are wide ranging in topics, from coverage of systematic assessments of SIL requirements to creating a culture where high performance and leadership are valued and nurtured.

Widely accepted guidelines such as these provide an essential framework for overfill prevention of petroleum storage tanks and, indeed, companies commonly integrate these guidelines into their own corporate safety protocols to leverage industry knowledge and best practice. As part of continued safety improvements, and to provide verification of systems defined as critical to the safety of its storage tank inventory, one major oil company contracted with Letico Inc. to review current operating practices. A key driver of the

API RP 2350 key points

Applicability

Aboveground storage tanks (ASTs) with capacities greater than 1320 gal. (5000 l) that store Class I, II or III flammable or combustible liquids, and that receive liquids from mainline pipelines or marine vessels.

Management system

API RP 2350 recommends a management system focused on overfill prevention. This system should include documented procedures for normal and abnormal conditions including safety, emergency response, trained and competent personnel, properly maintained and tested OPS, management of change process and incident reporting and investigation.

Independence

A key feature of API RP 2350 is that the sensors and alarms used for HH tank level or any part of the AOPS may not be used for routine tank filling operations. In addition, the HH level sensor on Category 3 tanks must be independent from all other level sensors.

Required alarms

High-high alarm (Category 2 and 3) and optional diagnostic alarm (Category 3).

Equipment

Overfill prevention system (OPS) typically includes an alarm signal system and allied support systems – shutdown or diversion valves, communications, sensors, and logic solvers. An OPS should be on an uninterruptible power supply. Use of wireless communication is prohibited by API 2350.

Redundancy

A common strategy for critical level detection is redundancy of the sensors. Ideally, redundant sensors will be of disparate technologies to avoid multiple failures due to application concerns.

Proof testing

All OPS equipment required to terminate receipt must be tested annually. The HH sensor and alarm must be tested semi-annually. Method of proof testing must stimulate an overfill situation as closely as possible, but may not require filling the tank above the maximum working level. Possible methods are manual testing, push-button testing, self-diagnostics or devising a wet probe testing.

Floating roof sensors

A sensor used on a floating roof tank must detect the roof, as well as the liquid, should it cover the roof.

project was to assess and improve the company's operational standards, spurred by what occurred at Buncefield.

Letico, an engineering services firm based in Montreal, Canada, provides process control and systems integration solutions in various industrial sectors, including oil and gas.

The oil company held more than a dozen storage terminals across Canada, with facilities and tanks varying by time of construction or installation. Their designs dated back to when equipment was not as advanced, and overfill prevention did not receive a heightened focus. Given the hazards of petrochemicals storage, the customer wanted to have an accurate overview of its overfill protection status and a plan to improve effectiveness and enterprise-wide consistency of its own internal standards and engineering practices.

At the project's outset, and as part of ongoing safety improvements, Letico and its customer agreed on systems integration goals:

- Identify level-related alarm gaps.
- Establish recommendations to rectify these gaps.
- Quantify tank level alarm setting at various fuel storage terminals across Canada.
- Confirm compliance with corporate engineering practices, defining the minimum engineering and system configurations required for storage tank level alarm systems.
- Ensure compliance with the requirements for gauging and independent level alarms for atmospheric tanks (fixed roofs both with and without IFRs).
- Consider the recommendations of the Buncefield Incident Final Report of the Major Incident Investigation Board, as well as API 2350 Overfill Protection for Storage Tanks in Petroleum Facilities 4th Edition.
- Modify in-service tanks to comply with API 2350 4th Edition.
- Calibrate ATG systems with reference to the independent level devices.

Systems integration management

The Letico team managed the project in phases: reporting, implementation, documentation, and installation/testing. In the reporting phase, critical initial steps were to audit existing terminals and tank installations to evaluate overfill prevention processes and technology.

The company needed to identify if these individual operating systems were meeting or deviating from internal engineering standards, and if they would meet industry standards for safety. At the time, the API was preparing the API RP 2350 4th Edition, but the information was not yet available when the project was initiated. The plan was to apply the customer's internal engineering practices, which were quite comprehensive and specific, while anticipating the publication of the 4th Edition and its impact on current standards.

Strategic supply

One of the suppliers being assessed for the project's level instrumentation needs, Magnetrol International, was able to step in and help Letico and its client understand the new API RP 2350 guidelines, which were imminent at the time. Magnetrol was represented on the API 2350 publication committee and shared valuable insight on the forthcoming recommended practices with Letico's team. It was able to prepare, to evaluate, and potentially implement compliance measures based on the API standard, even while the company was moving ahead independently of its publication.

Based on customer approval of Letico's reporting, the systems integrators began the implementation phase by standardising on equipment. Magnetrol was able to demonstrate a powerful automated tank gauging system solution using the A15 single-point top mount buoyancy displacer switch and single-point Echotel® model 961 contact ultrasonic switch, with the A15 used to detect tank floating roofs and the 961 used for direct product detection in stilling wells, as well as free tank space. The units were utilised as an independent high-high alarm sensor.

The tank configuration was a critical consideration when selecting technologies. The company had to specify units for storage tanks with floating roofs and fixed roofs – ease of installation and testing capability were of paramount concern.

The SIL 2 suitable Magnetrol model A15 point level sensor actuates at a discrete level and can detect the roof, as well as the liquid level, should the floating roof become submerged – a new requirement of the API RP 2350 4th Edition. The non-sparking, hollow-shell brass displacer provides dual detection of both floating roof and liquid levels. The units are equipped with a proofer manual checker to enable proof testing.

The Echotel model 961 contact ultrasonic level switch serves as a point level sensor that triggers the high-high alarms and is suitable for SIL 2 applications. The unit has both automatic and push-button, self-test ability to enable proof testing. The diagnostics monitor the electronics, transducer and piezoelectric crystal.

At this point of the project, Letico documented comprehensive tank operational data, confirming accurate dimensions, flow rates, response times and other metrics for level calculations.

Using its extensive knowledge of the AP RP 2350 4th Edition, Magnetrol had created useful tools to allow its customers to easily review the 4th Edition and take steps to implement the new tank overfill prevention standards. This 'tool kit' became instrumental to the Letico team's efforts, because it helped the company focus on what it needed to do to deliver a successful installation to the customer. It had to adopt a way of standardising on nomenclature because each company uses different terminology in its internal engineering practices. The API 2350 4th Edition classified tanks, levels, alarms, technologies and procedural systems, which gave Letico a yardstick to use for its level calculation and documentation. The worksheet and other materials in the 'tool kit' helped provide guidance for terminology standardisation and overall overfill prevention process (OPP) methodologies.

Conclusion

One of the most valuable impacts the 4th Edition has made is the emphasis it places on safety instrumented systems (SIS) and safety integrity level (SIL) certified/suitable equipment.

The project's results were instrumental in embedding standardisation and documentation into a robust operating process system and a culture of safety. Across the organisation, workers are now thinking the same way and

Action Levels and Responses

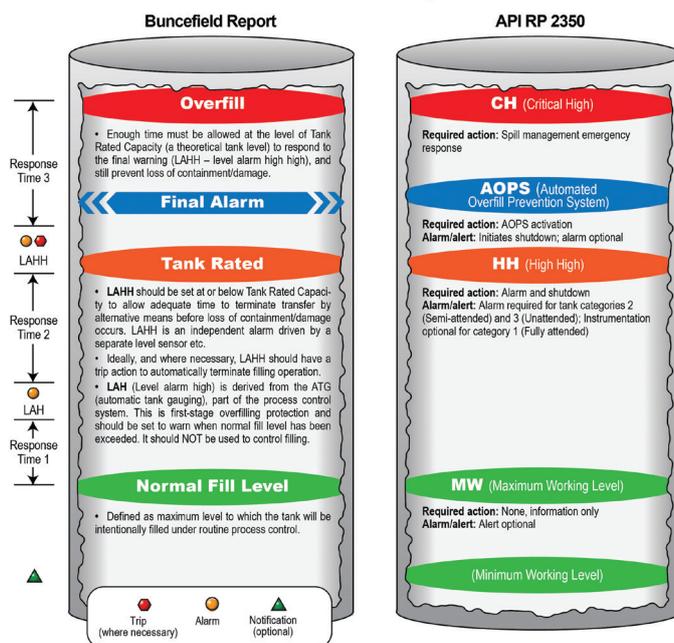


Figure 1. Since their publication, the MIIB Buncefield Report and the API RP 2350 have been major drivers of process improvement surrounding tank overfill prevention and share similar overfill prevention system (OPS) recommendations. Source: Magnetrol International.



Figure 2. Letico standardised on the Magnetrol® A15 displacer switch and Echotel® 961 ultrasonic switch across the tank inventory for detection of tank floating roofs and direct product detection in free space and stilling wells, respectively. Source: Magnetrol International.

looking at things the same way. Actions are standardised, response times are measured, and calculations are uniform. When there is a change in the data, it is documented and specific modifications are implemented as a result. **I&T**