OVERFILL PROTECTION: A REVIEW OF API 2350 4TH & 5TH EDITION

In a two-part article series, Philip Myers and Brock Trotter of PEMY Consulting examine the new 4th and 5th editions of API 230 and how it affects overfill standards

The overfilling of a petroleum storage tank is potentially among the most devastating events that can occur at a terminal or refining facility.

The loss of product is only a minor consequence of spilling petroleum liquids from a tank compared to potential outcomes such as lawsuits, fines, damage to reputation, fires, injury to personnel, a vapour cloud explosion (VCE) and possible facility closure. Figure 1 shows the destruction of the 2005 Buncefield terminal VCE caused by overfilling a petrol tank.

Filling a storage tank seems uncomplicated but repeating the process thousands of time, flawlessly, for hundreds of tanks over decades requires robust procedures, training, equipment, a good management of change (MOC) process as well as the right corporate culture. API/ANSI 2350 4th and upcoming 5th edition guides users on these prerequisites for best practices that can ward off overfills. The new 4th and 5th editions of API 2350 radically change that way the tank receipts are supposed to be handled from a best practices point of view and from lessons of the past.

EVOLUTION OF OVERFILL STANDARDS

API/ANSI Standard 2350 provides petroleum facilities with the minimum standards for overfill protection of storage tanks. The 4th edition of the standard was published in May of 2012, and the 5th edition is currently in the committee development and is expected to be issued this year or the next.

Figure 1: Result of the Buncefield vapour cloud explosion (VCE)

The differences between the 4th and 5th editions of API 2350 are slight and are expected to clarify some problems of interpretation as well as to make the document more user-friendly. Frankly, in terms of procedural or technical issues, not much will be changed between the 4th and 5th editions.

Originally, the scope of API 2350 applied only to flammable liquids storage, that is, NFPA Class I liquids which have a flash point below 100˚F. This was because significant losses were occurring too often, caused by fires.

Later, environmental protection was applied to overfill prevention practices in the 3rd edition of API 2350 published in January 2005. API 2350-3 applies to all aboveground tanks which store 1,320 gallons or more of Class I or Class II petroleum liquids. The Class II liquids have a flash point between 100 F-140 F which includes jet fuels, kerosene and most diesel fuels.

API/ANSI 2350 does not apply to underground tanks, solid storage tanks, small tanks (less than 1,320 gallons), or the storage of Class III liquids (eg. lubricating oils), or pressure vessels. Note, however, that the principles can be applied to other tanks not covered by the standard and this is encouraged where appropriate.

The original concepts of API 2350 were informal best practices and therefore labeled 'recommended practices', however a seminal change to the standard occurred with the 4th edition. The 4th edition of the document is a 'standard', and no longer a 'recommended practice'. The most important changes from previous editions, by far, were the introduction and formalisation of the 'management system' concepts that must be applied to tank filling operations. API 2350-4 calls this 'overfill prevention process' (OPP).

OPP APPROACHES

OPP, like any safety management system, requires companies to use a risk assessment programme to prioritise and understand the risks of overfill. The application of a maintenance programme must include training and written procedures, specific rules for communication between parties involved with the tank filling operations, measures that address normal and abnormal conditions, and initiation and maintenance of tank parameters (i.e. management of change) as well as other components. Because there are so many types of companies and managements systems, integration of OPP into the corporate DNA is an important task to overcome.

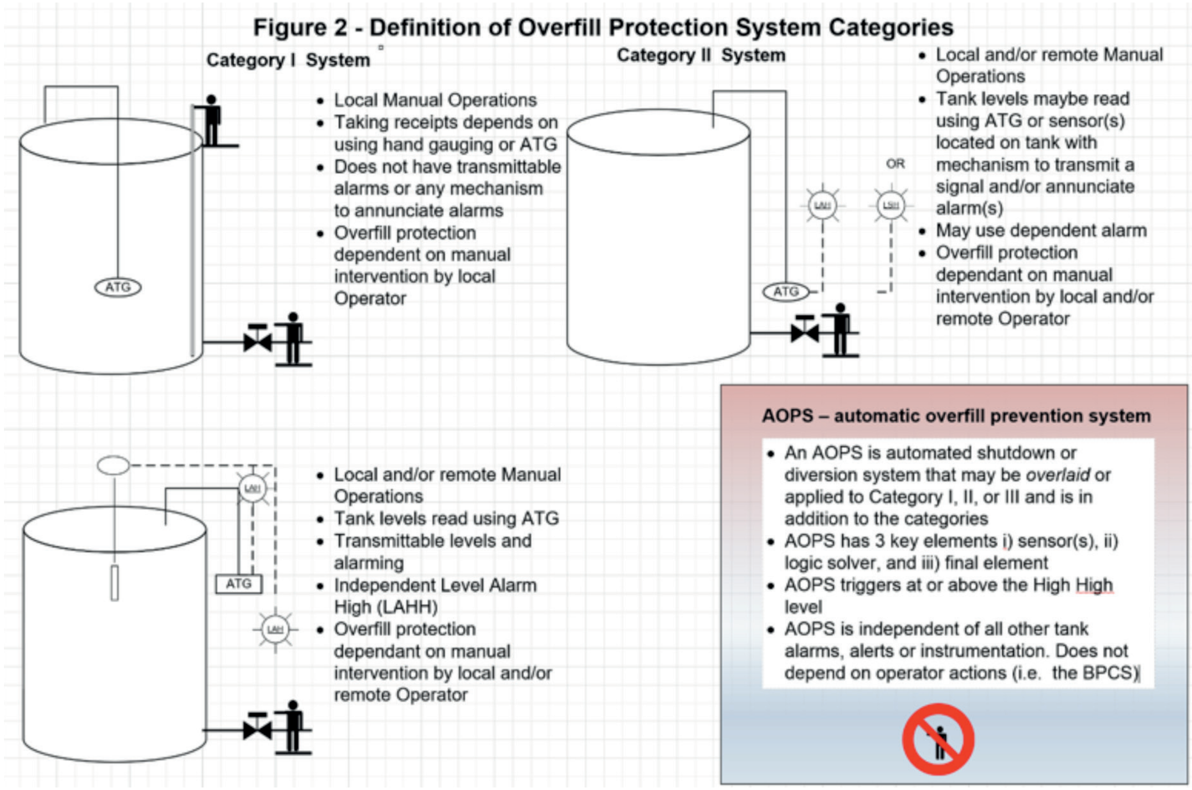

Figure 2: Overfill equipment categories

CATEGORIES

OPP is the systematic approach to shutting down a pump, diverting the incoming flow, closing a receipt valve or alternative means of terminating the flow of liquid into a tank. There are three basic equipment configurations or categories of OPP addressed by API/ANSI 2350 (shown in Figure 2) which should be considered in developing an OPP. Categories serve as a starting point for understanding system risk and for categorising the numerous tanks that a company has into manageable groups:

A Category I system does not have transmittable level or alarms and is entirely dependent on the operator and manual gauging to prevent an overfill. While this type of operation has been around a long time and can be highly reliable, it is limited to a low frequency and low rates of transfer that an operator is able to cope with.

The Category II configuration uses level and alarm data, which can be transmitted to a control room. Thus, the operator can deal with many more receipts at a high frequency when tank level and alarm data are transmitted to a control room. The Category II configuration dominated the large petroleum facilities up to and including the 1990s. The weakness of the Category II system was that it had no redundancy in terms of reliability. If the level alarm failed, then most likely there would be an overfill.

Category III systems are the same as Category II, but they are much more reliable because of the redundancy in the alarm system. Category II requires an independent second alarm usually called the 'high-high' to operate should the first alarm be failed or because an operator was not able to react to terminate the receipt at the first or 'high' alarm. The failure of the high-high cannot be caused by any failure of the automatic level gauge or by the high alarm.

These categories are summarised in Figure 2.

AOPS

The 4th edition of API 2350 introduced the idea of Automatic Overfill Prevention Systems (AOPS). Most overfill prevention systems use the operator to control the receipt and terminate it before an overfill occurs. In the jargon of IEC 61511 for safety instrumented systems, this control is referred to as the Basic Process Control System (BPCS) and forms the most basic control over the process, whether it is an operator or some combination of operator and instrumentation. A safety system can be applied to a hazardous process such as filling a tank, but it should be independent of the BPCS and no initiating event in the BPCS should affect the safety system.

This system, called AOPS, is independent of the BPCS and requires no human intervention in its ability to terminate a receipt. The design and operating framework for AOPS arise from industry trends in controlling highly hazardous processes and the use of recent safety standards such as ISA S80 and IEC 61511. AOPS, being an independent system, may be used in addition to the three categories of OPP. AOPS is characterized by the automatic termination of product flow into a tank upon activation of a Level Switch High (LSH). AOPS provides redundancy to the filling process, reducing the risk of an overfill event.

AOPS can provide additional redundancy, but it can present many practical issues with implementation. For example, an incorrectly designed AOPS applied to a pipeline could cause a pipeline rupture due to hydraulic shock. The use of safety instrumented systems and function in typical oil distribution terminals is often beyond the typical capabilities of the people and companies associated with designing and implementing these systems. A glaring example of AOPS implementation failure was, in fact, the Buncefield incident.

Also, AOPS costs are high. The expense is not because of equipment or installation costs, but because a whole new process that applies to the entire lifecycle of the equipment including documentation and other management system elements such as testing and auditing functions.

Fortunately, AOPS is only one way to reduce risks. It may be the best solution in many cases, but certainly not all or even most. There are many considerations when deciding to implement an AOPS and alternatives must be considered.

FOR MORE INFORMATION

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