By: ANGELA E. SUMMERS, Ph.D.,
President
SIS-TECH Solutions LP

By: WILLIAM HEARN,
Fellow
SIS-TECH Solutions LP

Automate tank overfill protection: Latest safety standards

Overfills can be traced to loss of level control leading to high level and ultimately to loss of containment. The Buncefield incident in the United Kingdom occurred when a terminal tank was overfilled releasing hydrocarbons that ignited and caused widespread damage. API 2350-2012 requires the owner and operator perform a risk assessment addressing potential tank overfills. When the assessment determines risk reduction is required, one alternative described in the standard is installation of an Automated Overfill Prevention System (AOPS). API 2350 has guidelines for AOPS in new and existing facilities, which simplifies the job of selecting, designing and implementing the appropriate safety instrumented system. Apply AOPS when the risks are sufficiently high and manual tank operation is just not good enough.

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Level seems so simple to detect that anyone should be able to recognize it and respond in a timely manner. Estimating the likelihood of overfills is complicated by the combination of manual and automated control that is often provided. The degree of automation provided is typically related to the operator workload. Automated control and safety systems are generally added when work complexity has increased to the point where the expected human error rate is no longer acceptable.

API requires a safe fill limit must be specified. The consequence of exceeding it should be explained in the operating procedures.

Procedures and training must ensure the automated trip does not become part of normal level control (e.g., high level trip stops the pump every fill rather than the operator stopping the pump), so trip initiation should be monitored and reported as a performance metric.

An AOPS is a safety instrumented system (SIS) that detects high level and prevents filling beyond the safe fill limit. The SIS can be a simple hardwired system using an independent level sensor (e.g., switch or transmitter) to detect high level and an independent final element (e.g., motor control circuit or block valve) to terminate or divert feed. The SIS is automatically initiated at a setpoint that allows sufficient time for the action to be completed safely. The design should place the setpoint far enough from the normal control range to allow time for effective operator response to pre-trip alarms. Risk analysis determines the safety integrity level (SIL) required to ensure the overfill risk is adequately addressed. While there are exceptions, the majority of SISs are designed and managed to achieve SIL 1 or SIL 2.

The trip point is selected to automatically terminate feed so the level rise is stopped prior to reaching the postulated failure level. When an alarm is also implemented, the alarm setpoint should be conservatively set below any trip setpoint, allowing the operator sufficient time to stop level accumulation prior to the trip being initiated. Otherwise the alarm loses merit as a protection layer and simply serves as pre-trip notification.

Functionality is demonstrated by forcing the sensor to "see the process variable" and to generate the correct signal at the specified setpoint. Testing must prove the equipment can operate as required to prevent overfill. Although diagnostics can detect many types of failures, a proof test is still necessary to demonstrate operation at the required setpoint. This is the only means to fully prove the equipment works as required.

API 2350 provides extensive requirements and guidance intended to address overfill risk. As the terminal and storage tank industry move forward with implementing API 2350, it is important to recognize the first step to any problem is understanding its risk and then the second step is putting in place systems to address it. Fundamentally, you need to analyze the specific tank application, understand how operator error and equipment failure contribute to overfill risk, assess set points and operator interfaces to ensure there is adequate response time, and install independent automated back-up systems to serve as the final answer to overfill prevention.

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