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Tank Overfill Protection "Better Practices"

By Bob Blundell

The Buncefield and CAPECO terminal explosions – what do these two tragic industry events have in common? Besides costing tens of millions of dollars and injuring dozens of people, both of these storage tank incidents began when:

- Storage tanks were being filled with flammable hydrocarbons,
- The terminal crews involved in each of these incidents were operating without a functioning level instrument on the tank(s), and
- The ensuing investigations determined that operations personnel had failed to recognize the associated risk and potential consequences of the scenario.

Though these events occurred several years ago, tank overfills are still one of the most common causes of Losses of Containment in the industry. As companies have begun to recognize the risk of operating storage tanks and spheres, better practices have emerged to address this issue. Here are just a few of the better practices that may be beneficial to consider to protect your facility from a tank overfill and the ensuing consequences of its occurrence. The foundation for a strong system for preventing overfills should include a mix of:

- Reliable "Facilities" to ensure that operations personnel always know the tank status
- Robust procedures and work practices that are consistent with industry guidelines to recognize and respond to the risk of these operations, and
- Alarm functionality specific to tank and sphere operations that may alert operators of abnormal conditions

<u>Facilities</u>

- Tanks must have reliable level instrumentation. ATGs, (automatic tank gauges) should be checked against a manual gauge periodically to validate their accuracy and adjusted when the variance exceeds a pre-defined tolerance, usually within an 1/8 inch (3 mm). As a best practice this comparison should be done monthly.
  - There should be a preventative maintenance (PM) schedule appropriate for the type of level instrument to ensure a very high reliability percentage. Mechanical gauges (e.g., Varecs) may require more robust PM systems than newer Radar gauges due to their propensity to sometimes "stick" in the gauging well.
  - A site should have a tank gauge "bad actor" program that documents incidents when gauges give bad data so that problem instruments can be identified and improvement plans developed to address them.

Work Highlights

Process Development

- *Concluded selected process and mechanical development consultation on a pilot plant for new process technology to capture CO_2 from air. This team effort involved six separate companies and was based on our client's proprietary data. Their hope is that this work will be the initial basis for innovative facilities that will have broad applications with worldwide implications, and ultimately result in a cleaner, healthier, environment due to reduction and recovery of greenhouse gas from the atmosphere.*
- *Provided on-going technical process development, design, and heat transfer support to a major domestic client for "first-of-kind" biomass process development for ethanol production from cellulose, including Devol and CO_2 removal, specialty reactor cooler design, POX/ATR technology evaluation.*

Training

- *Conducted hydroprocessing training course at the owner's facility.*
- *Presented a course covering the design and maintenance of pressure vessels at a US refinery location. Current pressure vessel issues that attendees brought to class were discussed and on-the-spot recommendations provided.*

- Independent High-Level alarms should be considered for higher risk tanks such as those in hazardous product service or those that may be near roadways or navigable water where an overfill may have an immediate public impact. These instruments would provide data on product level in the tank in the event of a loss of the primary gauge.
- Most of the industry has begun migrating away from mechanical gauges and relying on Radar-based gauges. Mechanical gauges can stick while filling or drafting a tank giving erroneous data to the operator. This specific failure mode was a factor in both of the catastrophic incidents mentioned earlier.

Work Practices

- In the event that a tank level instrument becomes out of service and there is a strong business need to continue product going into or out of the tank, then a "risk based" out-of-service gauge procedure should exist to standardize the expectations for monitoring the liquid level. There should always be an alternate means of monitoring (e.g., periodic manual gauging) the liquid level of a tank. An out of service gauge procedure should take into consideration elements such as:
  - Fill rate
  - Where the liquid level is in the shell (i.e., top 50% or bottom 50%), and
  - The product characteristics in the tank
    - With higher fill rates and product in the top half of the tank, alternate monitoring frequency should be more frequent
  - Consideration can also be given toward reducing the tank fill height when filling if its gauge is not functional
- Procedures should be clear that operating with a level instrument out of service is viewed as a high-risk activity. Many sites handle loss of a level device on a high-risk tank similar to how Safety Instrumented System (SIS) bypasses are managed with clearly defined mitigation plans developed while this critical layer of protection is out of service.

Process Control Computer Capability

- For more complex facilities, having certain alarm functionality specific to tank farm operations is critical. In the industry, in addition to base requirements for Alarm Management standards such as seen in ISA 18.2, alarm functionality specific to tanks may include:
  - Alarming when a tank liquid level stops moving (filling or drafting) which may be an indication of a "stuck" mechanical gauge
  - Alarming when there is a significant rate change which might be an indication of a problem in the field
- High and High/High level alarm set points on tanks should take into consideration peak fill rates as well as the operator response needed to respond to the alarm. These set points should only be modified after going through a robust change management process.

These are just some of the recommended practices that can be considered to reduce the potential for tank overfills. Carmagen Engineering has experienced specialists who have the expertise to assist facilities in evaluating their risk of operations and identify further opportunities to reduce the potential for an incident.

About the Author

***Bob Blundell** has over 40 years' experience in refinery and marine terminal operations. His strong analytical and leadership skills provide him with a depth of experience in leading or participating in a team environment. He is a subject matter expert in refinery "offsites" operations (marine, tank farm, blending, and shipping operations). Bob has a significant background in work management systems (routine maintenance work) in a refinery/manufacturing environment with specific emphasis on Risk Based Work Selection (RBWS).*

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