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Fluid handling industry growth
2013 review and 2014 outlook

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All new magazine covering fluid handling technologies, operation and maintenance across the chemical, petroleum, food and beverage, pharmaceutical and water/wastewater sectors

Transfer line failure: use of passive shutdown systems

When incompatible parts are used together and hoses come loose from their fittings, the result can be devastating on workers and the surrounding environment. Add a confined space to the mix and it can become fatal.

An end blowing off causes the remaining portion of the hose to 'whip' about until flow stops and allows the medium being conveyed through the hose to escape. If the medium is a gas, its expansion can cause this to be extreme. Where the medium is a liquid it can be hot or corrosive, leading to further risks. The mediums being carried in them are often hot and flammable. Failures can result in injuries such as oil injection, burning, fire. There's also the environmental damage from the escaping medium. Whipping hoses can cause serious injury or death.

Since the landmark incident in Sanford, North Carolina, to the more recent tragedy in Riverview, Michigan, reliance upon excess flow valve technology to stop the potentially catastrophic consequences of hose and line failure has been eroding. Through legislation requiring 'passive device' technology to formal warnings against this reliance issued by all of the major regulatory agencies in the US, to special permits that provide regulatory relief for users of passive device technologies, a growing trend has commenced toward eliminating this over-reliance upon excess flow valves in the event of transfer line failure.

Sanford incident

For more than a decade, safety concerns have been proliferating throughout industry, none more so than in the LPG industry. Incidents have spawned greater concern over 'weak links' in the safety chain of LPG transfer systems, causing countless millions of dollars and claiming many lives.

On 8 September 1996, in Sanford, North Carolina, during delivery of propane to a bulk storage facility by an MC 331 bulk transport, more than 35,000 gallons of propane were released. The discharge hose separated from its hose coupling at the delivery end of the hose. Most of the transport's 9,800 gallons of propane and more than 30,000 gallons from the storage tanks were released. If this quantity of released propane ignited, local authorities estimated that about 125 emergency response personnel could have been injured or killed.

This incident along with others pointed to a fundamental flaw in the fluid transfer system—over-reliance on the excess flow valve. This recognition spawned a landmark rulemaking issued by the US DOT-RSPA in which they declared formally that excess flow valves are not reliable to address hose failures, and new technology must be identified and developed to provide a greater degree of safety and reliability.

The new technology included the term 'passive technology' which was defined as: 'Shutdown equipment that has the capability to shut off the flow of product without human intervention within 20 seconds of an unintentional release caused by complete separation of a delivery hose.' This definition changed the safety landscape, and the rulemaking marked the first of several important steps that have since been taken to require alternative means to address the consequences of transfer line failure by relying upon systems other than excess flow valves.

Rulemaking HM-225 and 49 CFR 173.315

Regulation HM-225A, in effect since July 1, 1999, imposed new requirements on operators of cargo tanks used to transport liquefied compressed gases and new procedures for unloading liquefied compressed gases from cargo tanks. The regulation seeks to prevent unintentional releases during unloading of liquefied compressed gases, assure prompt identification of unintentional releases and reduce the consequences of unintentional releases. Specific provisions include:

- Inspection, maintenance and testing requirements for cargo tank discharge systems.
- Unloading requirements for liquefied compressed gases, including revised

A chlorine repacking plant receives 4 railcars contained nearly 250,000 lbs of chlorine to be repacked into cylinders and other distribution. After 59 days, a hose wrongfully identified as a chlorine hose catastrophically failed spilling 48,000 pounds of Chlorine over 3 ½ hours. The root cause in addition to the hose failure, is that backup systems (ESD'S) as well as excess flow valves (EFV's) failed to work

attendance requirements.

- Requirements for emergency discharge control equipment, such as passive systems that will shut down unloading without human intervention and remote control devices that enable an attendant to stop the unloading process at a distance from the vehicle.

The requirements for emergency discharge control equipment on cargo tanks used to transport liquefied compressed gases are keyed to the degree of risk associated with the transportation of specific liquefied compressed gases. Regulation 49 CFR 173.315 specifies two types of emergency discharge control equipment. One type, passive shutdown equipment, must shut off the flow of product without human intervention within 20 seconds of an unintentional release caused by complete separation of a delivery hose.

This landmark legislation marked the first time that any regulatory body not only identified the risks associated with excess flow valve reliance, but further regulated against their use in lieu of other technology. Since this regulation went into effect in 1999, several systems have been developed, and no recorded incidents have occurred.

Pressure monitoring systems

Various systems have been devised which are intended to close shutoff valves along the length of a flexible hose based upon a drop in monitored pressure when the hose breaks. Pressure monitoring systems for automatically closing the ends of a flexible hose have various reliability concerns. Near the completion of the unloading operation when the liquid level gets low in the tank, the sucking action at the pump inlet creates a vortex or whirlpool effect in the liquid, causing vapor to enter the pump in a random fashion. The entry of shots of vapor causes pump cavitation-like pressure spikes and drops which will shut-in a device that is triggered by the outlet pressure dropping below a given level. The device could be overridden manually when the tank is near empty to prevent the premature trip of the shutoff device. A separate problem, however, involves determining when the tank is near empty since the unloading time is a function of pressure and pump condition, and typically lasts for over 30 minutes. Even if one could determine when to engage and override, this creates a situation where the operator could override the device at will and defeat the purpose of a system that automatically closes off the ends of the hose.

Passive shutdown systems

Given the numerous, detailed and accurate warnings from manufacturers, advocacy groups, government agencies and from accidents themselves, it is not reasonable for anyone to be surprised when the next hose bursts and an EFV fails to stop the catastrophic consequences. These warnings are advice to beware to professionals charged with the safety of facilities, communities and individuals, and are intended to be actionable.

The passive device addresses directly the deficiencies of the excess flow device. These deficiencies are not an indictment of the EFV device, as the device behaves exactly as designed when used and installed properly. Rather, where the fault lies is in the properties and attributes that industry affixes to these devices to do a job for which they were not designed. The EFV is designed to trigger at a preset flow rate exceeding normal operation and contemplating the 'shearing off' of valves or other catastrophic hardware event. In the event of a transfer line failure, in truth the EFV does not fail; it simply works as designed, as the flow through a transfer line is likely within the parameters of normal operation and a rate at which the EFV is set to accept.

The passive device is designed to shut off the flow of product in both directions in the transfer hose in the event of a failure between the couplings. When the next transfer lines fails and the call goes to the responsible party, rather than wondering if they have dodged a bullet with an EFV, the first question will be, 'What did the hose do?'

For more information:

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