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Reduce the risks of tank gauging by using work practice control

Manual tank gauging is a common oilfield activity that's resulted in multiple worker deaths in recent years. By using work practice control, operators can reduce the risks it poses significantly.

Every year, in survey after survey, oil and gas producers cite environmental health and safety as their number one priority. Many, however, continue to perform routine oilfield tasks that can be significantly improved by employing available technology.

Tank gauging is a prime example of this. Today, the vast majority of operators gauge their tanks manually. Among all of the archaic, business as usual-type activities that still take place in the oilfield, manual tank gauging is one of the most concerning because of the significant health and safety risks it poses to workers.

In 2016, the Occupational Health and Safety Administration (OSHA) and National Institute for Occupation Safety and Health (NIOSH) announced that from 2010 – 2014 nine fatalities occurred during manual gauging and sampling of production tanks. Since the announcement, a number of reports and warnings have been issued informing operators of the dangers associated with completing this task; however, little has been done to educate companies on effective methods of prevention. One of the most reliable ways is by installing a radar level measurement device.

Dangers of Manual Tank Gauging

Manual tank gauging is a labor-intensive process that requires a worker to travel to a production tank (usually multiple tanks per day), climb a ladder to the top of it, open the thief hatch, and drop one end of a tape measure down to check liquid level.

When a thief hatch is opened, hydrocarbon gases and vapors that were previously in the equilibrium with production liquids (i.e., crude oil) are released into the atmosphere. In many cases, this can result in the creation of an acutely toxic and oxygen-deficient environment, which poses an immediate and life-threatening risk to the individual(s) gauging the tank.

The specific type and volume of vapor released when the hatch is opened is dependent on a number of factors, including product composition, temperature, wind speed, presence of a vapor recovery unit (or VRU), etc. Vapors commonly encountered include low molecular weight hydrocarbons, such as methane, ethane, propane, and butane. Depending on ambient conditions, heavier hydrocarbons, some of which are carcinogenic (i.e., benzene), may be present as well. On sites with "sour" wells, poisonous hydrogen sulfide gas (H2S) can also be a concern.

Without proper PPE, exposure to the gases and vapors released when the tank hatch is opened can affect the eyes, lungs, and central nervous system. If present in high enough concentrations, it can cause abnormal rhythms and cardiac arrest. Even very brief exposure (30 seconds or less) to a low-oxygen atmosphere can lead to the sudden onset of hypoxia and fatal cardiac arrhythmias, which can result in incapacitation within seconds, followed shortly by death if the individual is not removed from the environment .

The leading cause of death in the fatalities identified by OSHA and NIOSH was cardiac arrest brought on by exposure to hydrocarbon vapors and oxygen-deficient atmospheres.

Proper PPE Only Goes So Far

Oil and gas environments often allow workers to work independently and remotely. Climbing tanks requires awareness, knowledge and experience using fall protection equipment in some cases. In some cases, respirators require a proper fit and a cleanly shaven face for the seal to be effective, provided that the correct cartridges and (if needed) breathable quality supplied air is used. Perhaps the biggest challenge in this activity is complacency: "it will never happen to me. I have been doing this for years." There are engineered control methods to minimize and eliminate several of these known and recognized risks.

When it comes to ensuring worker safety in manual tank gauging, proper PPE can only go so far. While air-purifying respirators with organic vapor cartridges are effective in preventing worker inhalation of heavier hydrocarbon vapors, they are largely ineffective against light hydrocarbon gases, which can pass through the activated charcoal sorbent in respirator cartridges.

In addition, the respirators do not provide protection against low-oxygen atmospheres or concentrations of hydrocarbons exceeding the maximum use concentration. In at least one of the fatalities identified by OSHA and NIOSH, the worker was found unconscious wearing an air-purifying respirator. Supplied air respirators or self-contained breathing apparatus can protect workers from toxic exposures and oxygen-deficient atmospheres — however, their use in most instances is impractical.

Gas monitors are another piece of PPE that workers are often required to wear when manually gauging tanks -- but like respirators, they are not a full-proof prevention method.

As mentioned previously, in certain instances, when the thief hatch is opened, the displacement of oxygen in the workers breathing zone is so rapid that it can result in almost immediate incapacitation. In such cases, the gas monitor alarm may sound but the worker will only have seconds to remove him or herself from the vicinity before going unconscious. In at least one of the fatalities identified by OSHA and NIOSH, the worker was wearing a 4-gas monitor, which reported an oxygen-deficient atmosphere and the presence of hydrocarbons exceeding 100% of the lower explosive limit at the approximate time of death .

Embracing Digitalization

As is the case with any safety issue, the most effective way to reduce the risks associated with manual tank gauging and prevent future fatalities is to minimize the need for the worker to enter the hazardous environment. Automatic tank gauging with a radar level measurement device does exactly that.

Radar level transmitters have become commonplace in the process and refining sector where operators have been more willing to leverage the advantages offered by Industrial Internet of Things (IIoT). In the oilfield however, where legacy systems and procedures are still employed, they've yet to be widely adopted.

When used on a well site, a radar level measurement device is installed on top of the tank and wired down to human machine interfaces (HMI) at ground level. This allows a worker to accurately and reliably gauge the tank without having to work at heights or enter a potentially dangerous environment. In instances where measurement instrumentation is used with wireless transmitters, data can be communicated to remote terminal units (RTUs) and then to offsite control centers, allowing an operator to check liquid level on multiple tanks simultaneously – all from the safety of a computer chair.

Aside from dramatically improving worker safety, automatic tank gauging using radar level measurement technology has a number of advantages. Some of these include:

Cost / Labor Savings - By funneling measurement data from multiple locations into a single monitoring center, companies can leverage the power of IIoT and employ a fully digital approach to tank gauging. This results in significant cost savings from reduced labor requirements and worker transportation expenses.

Improved Accuracy – Manual tank gauging is a non-standardized process in which accuracy can be impacted by a number of factors, such as the worker reading the tape wrong, bobbing or kinking of the tape, presence of sediment at the bottom of the tank, uncalibrated tape, etc. Often times, a single worker is required to gauge multiple tanks as part of their work order in a short period of time, which increases the likelihood of an error. All of these problems are eliminated when taking a digital approach and installing a radar level measurement device, which is accurate to the tenth of an inch.

Reduced Emissions - According to the EPA, storage vessels account for a large percentage of overall VOC emissions in onshore oil and gas production. Tanks that emit, or are expected to emit, more than six tons of VOC emissions per year are considered affected facilities and will need to reduce VOC emissions by 95% per EPA federal regulations (CFR) 40, Part 60, Subpart OOOO (Quad-O). By eliminating the need to open the thief hatch, a radar level transmitter can drastically reduce the volume of VOCs released into the air.

Enhanced Visibility – Real-time collection of data from devices across the oilfield allows operators to create a "digital twin" of their well pad or tank battery. In simple terms, a "digital twin" is a software model that uses sensor data to mirror the status, working condition or position of an object or piece of equipment. This affords operators increased visibility and provides them with deeper insight into what types of changes will lead to better outcomes.

Changing the Culture

While the dangers associated with manual tank gauging have become more widely recognized in recent years, there is still an increasing need to educate environmental health and safety managers on reliable and cost-effective methods of prevention.

Currently, OSHA and NIOSH recommend that operators implement alternative tank gauging and sampling procedures, which enable workers to monitor tank fluid levels without having to open the thief hatch. Installing a radar level measurement device satisfies that recommendation.

Today, the vast majority of producers who perform tank gauging manually are doing so to save costs. This notion completely misaligns with the "safety first" mantra that virtually every company claims to operate by. It's also misinformed, as the implementation of a radar level transmitter can generate significant cost savings, particularly when leveraged as part of an overall digital strategy.

The nine fatalities that occurred from 2010, 2014 were completely preventable – and while regulations may very well prohibit manual tank gauging in the coming years, operators should take it upon themselves to ensure the safety of their employees by embracing automation and ending this dangerous practice.

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