SHOULD THE INDUSTRY RETHINK STORAGE TANK FIRE PROTECTION?

Following recent high-profile fires, including the Intercontinental Terminals Company Deer Park fire, there is a renewed need for a new fire protection approach to mitigate the devastating impact these incidents can have.

After the ITC Deer Park incident, the industry urgently needs to discover what went wrong and how is it possible that the fire escalated to a large blaze that lasted almost four days, resulting in the destruction of 11 tanks and two reignitions that occurred in the days after.

The ITC Deer Park fire resulted in the destruction of 11 tanks

HIGH HAZARD ENVIRONMENTS

Tank farms are, by their very nature, high-hazard environments. No matter how stringent and encompassing a facility's fire-safety protocols, lightning may strike at any time and equipment may malfunction. In today's geopolitical climate, there is the present and ever-increasing threat that militants or others may target oil refineries or chemical plants.

Any of these unforeseeable events may ignite a catastrophe that can easily spin out of control, given the huge quantities of flammable materials on site. The risk is far from theoretical. Since 2000, the international media has reported on more than 70 major fires at storage tank farms that have killed 243 people, injured 1,669 and inflicted monetary losses in excess of $10 billion and there are countless other incidents, which while not reported still caused damage.

One significant example is Buncefield. On 11 December 2005, faulty gauges led to an overfill situation and later to an explosion at the Buncefield Oil Depot just outside London in the UK.

The resulting blast and fire engulfed some 22 storage tanks and wrecked homes and businesses in a 2km radius. While no deaths resulted, about 40 people were injured. Tanks were reduced to heaps of charred metal. Damage claims amounted to more than $1.4 billion. Extinguishing the Buncefield catastrophe required a huge mobilisation of manpower and resources. Some 180 firefighters battled the blaze using 180,000 liters of foam concentrate dispensed from a dozen high-volume pumps. They also doused the site with 53 million liters of water. Despite the massive effort, the fire persisted for nearly five days.

We may have thought that this could not happen today, especially not in the heart of the oil industry. However, on March 17, 2019, a leaking tank, containing volatile naphtha, ignited at the Intercontinental Terminals (ITC) storage terminal in Deer Park, Texas and quickly spread to two nearby tanks. Within several hours, seven tanks were on fire. Firefighters battled the flames for three days, but they could not prevent further escalation.

Luckily no serious injuries or death were reported. Yet, 11 storage tanks were destroyed during the incident. Federal, state and local officials have begun investigating whether Mitsui & Co's ITC facility met safety and environmental regulations. The blaze released toxic benzene, which forced five school systems to shut for two days and prompted two cities to warn residents to stay indoors amid fears of toxic gases.

Afterward, three tanks reignited and a dike wall breached and released a large amount of chemicals and firefighting foam into the nearby waterways. As a recovery effort, 130 watercrafts were sent to the channel, and 120,000 feet (37 km) of containment boom was placed along affected shorelines. Additionally, 4,100 feet (1250m) of a taller 'ocean boom' was set, mostly near the more heavily affected Tucker Bayou and about 64,000 barrels of an oily water mixture was collected from the waterways.

A NEW APPROACH IS NEEDED

Swiss Fire Protection Research & Development AG (SFPRD) has conducted an exhaustive analysis of storage tank fires over the last 20 years.

The data showed that a high number of extinguishment efforts failed even though the firefighting systems reached – or even exceeded – the foam intensity and application time prescribed by industry standards. It can be assumed that in most cases, the prescribed or even greater intensity is available for the fire brigades. The storage tanks at Deer Park, for example, were relatively small, yet, with all the efforts of the firefighters, the escalation could not be impeded. The exact reasons for that will be revealed in the final report.

One of the possible reasons for the difficulty in defeating storage tank blazes, like Buncefield and Deer Park, is that mobile extinguishment systems cannot approach the blaze safely and dispense foam with the necessary intensity to the right place, therefore cannot stop the escalation.

When asked about the ITC fire and the current industry standards by reporters, Guy Colonna, NFPA's senior director of engineering

said that the current recommendation for petrochemical tanks, called NFPA 30, 'does not require fixed fire suppressants'.

Traditional fixed systems are not mandatory in many countries, and even where it is for specific tanks, the authorities accept the semi-fixed systems as built-in ones. Although they can help to transfer the foam to the right place, they lack the most significant advantage of the built-in systems: the quick start of extinguishment.

If and when updated standards or regulations are adopted, the required changes will entail significant budgetary demands. Therefore, it can be expected that there will be a certain lag time before industry players adopt the new firefighting technologies.

For the time being, the current parameters will remain in place. This may be problematic. Mobile units, presently the preferred method of battling fires in the hydrocarbon industry, need anywhere from 30 minutes to several hours to arrive to the scene and set up their equipment before actual extinguishment can begin. During this time, burning liquids get hot enough to dissipate the foam with greater ferocity once it arrives. Instead of the foam extinguishing the fire, the fire consumes the foam. There is also the possibility that the fire escalates until the foam attack can begin. The result is more property lost, more lives at risk.

COULD FIXED SYSTEMS BE THE SOLUTION?

SFPRD believe that an adequate fixed system can excel in two critical factors: intensity and speed.

The first critical factor is the ability to apply foam at a suitable rate. If a foam blanket is thick enough, it spreads faster and it can smother the flames before they have time to consume the foam itself. If it is too thin, it cannot cool the surface effectively and cannot create high enough hydrostatic pressure, so combustible vapours bubble up through the foam, exacerbating the blaze and rendering the entire exercise useless.

> A system is needed that can provide the immediate launch of extinguishment with a precise, loss-free foam introduction & with huge foam intensity

The biggest mobile monitors can dispense foam solution at a rate of up to 60,000 liters (16,000 gallons) per minute, which sounds enormous, but usual capacity is much smaller than that, around 15,000-20,000 liters (4,000-5,300 gallons). In practice, only around half of this capacity actually reaches the burning liquid surface due to targeting and updraft losses. This may be sufficient for putting out fires in smaller tanks after long exhausting work. In large tanks, even with multiple foam monitors, the foam blanket cannot achieve the adequate covering before it decomposes in the flames.

However, a traditional, pump-station-based fixed system's foam intensity is limited by the capacity of its pumps. The rate of 4-8 l/m^2/min (0.1-0.2 gpm/ft^2/min), as prescribed by standards, cannot create a foam blanket fast enough to put out fires in large tanks before severe damage occurs. The flames eat most of the foam away. So, something more intense is needed, but that would spiral up the costs, which are already quite high in case of a traditional fixed system, due to the costs of the sophisticated machinery.

The second critical factor is to create a system that can launch extinguishment immediately before the fire has a chance to intensify to unmanageable levels. Studies show that a full-surface blaze may heat a tank's walls to 500°C (932°F) – the point at which steel structures begin to become critical regarding their structural integrity – within five minutes. Once this happens, the tank usually must be demolished after the flames have subsided. Mobile-extinguishment systems, as well as the related semi-fixed systems, cannot save the tank because they require too much setup time. By the time extinguishment can commence, firefighters often have no choice but to allow the fire to burn itself out while trying to prevent it from spreading to other tanks.

Plant managers may opt for built-in, or fixed firefighting systems. The traditional systems

25m-diameter storage tank extinguished under 40 seconds by Pi Foam System


The ITC Deer Park fire took four days to extinguish

employ a network of pumps and generators that dispense foam directly onto a burning-liquid surface automatically. Extinguishment can begin within several minutes.

Therefore, a system is needed that can provide both: the immediate launch of extinguishment with a precise, loss-free foam introduction and with huge foam intensity, which is not limited by the performance of the machinery.

SFPRD'S SOLUTION: PRESSURISED INSTANT FOAM (PI FOAM)

SFPRD's associates have devoted years to finding a way to overcome these problems. The result is the Pressurised instant (Pi) foam system, an automatic foam-based system with a speed and intensity that can extinguish a fire on any tank, no matter how big, in three minutes or less.

The Pi foam system can accomplish this feat because its pressure is not created by pumps; rather, the foam is stored in a vessel under pressure, created long before any fire event. Therefore, the Pi foam system's capacity is scalable to any tank size. The vessel is linked to a network of pipes that connect to foam dispensers strategically mounted along the rims of the tanks. When fire strikes, sensors send a signal that opens the vessel's valves, unleashing the foam with up to 20 times higher intensity (40-80 l/m^2/min or 1-2 gpm/ft^2/min) than traditional, fixed systems can muster. Against that quantity of foam, the fire does not stand a chance, thus the possibility of a quick, less than three-minute extinguishment time. The tank emerges unscathed. With the fire burning for such a short period of time, the temperature of the tank wall never reaches a critical value, so no deformation will occur. The tank can be put back in operation in a much shorter period of time. The product inside the tank is also saved.

ALL-INCLUSIVE (PI) FOAM SOLUTION

Contrary to conventional mobile and fixed systems, Pi foam operates immediately, in significantly higher intensity. The amount of foam necessary for successful extinguishment is much lower if the intensity is considerably higher than regular rates. So, due to the lack of mechanical elements, the Pi foam system easily produce high intensity with the same basic construction. This results in a smaller foam tank – and most importantly – significant cost reduction in construction and operation costs.

Pi foam system can be adapted to the various size, location and extension of risk areas and it comprises high performance conventional or biodegradable instant foam, which is adjusted to the burning material.

The hope is that there will be more built-in systems around the world. While it requires a significant amount of investment, if it is designed and maintained properly, it can bring its value back hundredfold at the first incident. And there are solutions out there, like Pi Foam, where cost savings do not mean efficiency reduction.

FOR MORE INFORMATION

www.pifoam.ch, www.sfprd.com