Tanks beware

Lightning is Mother Nature's own explosive and unpredictable mega-Taser which can be deadly and destructive. Tank storage terminals around the world: pay attention

Whether downstream or upstream, oil and gas, chemical manufacturing or exploration, all companies storing volatile and combustible liquids should not only be considering risk mitigation plants for lightning protection, but implementing them. This includes both grounding engineering and surge protection.

A direct lightning strike is not the only issue to contemplate. While a tank that is hit by a strike is more than likely to explode, a strike which hits near a tank and is carried through the ground and/or pipes and wiring buried in the surrounding area can do as much damage.

Without proper grounding engineering or surge protection, the tank can still explode and critical electronics and operations impacted. This damage can be incurred immediately or in the future, if one factors in meantime-between-failure scenarios. Lightning is tricky and devious. The secret is not having it strike within an area that needs protection.

While it can be tracked, and storm cells provide advanced warning, it cannot be predicted where lightning will strike. The odds of an individual getting struck by lightning in a year are about one in 775,000, according to statistics from the National Weather Service. This chance increases to one in 10,000 in a person's lifetime.

Citing statistics like these, however, does not account for structures, nor can it. A structure has a much greater chance of being hit due to its composition and height, in addition to several other factors. But odds do not matter because once a facility is hit, it is too late. The cost of damage can easily soar into the millions of dollars and that is without taking into consideration regulatory fines, legal ramifications and the loss of life.

Lightning is on the rise

Last September the New York Times published an article, 'Study sees a higher risk of storms on the horizon'. This article was based on a study by climate scientists from the universities of Stanford and Purdue, published in April 2013, entitled 'Robust increases in severe thunderstorm environments in response to greenhouse forcing'.

In addition to these studies and reports, Lightning Eliminators and Consultants, a provider of integrated lightning protection and prevention products, solutions and services, has also noticed what appears to be a worldwide increase in lightning activity over the past two years.

More strikes were noted across the UK and Europe, while Australia became inundated with stronger, more deadly storms. Storms began occurring earlier and more frequently in locations along the US Gulf Coast; during April and May 2013 alone, three storage facilities were hit in nine days.

In addition, more tank batteries began exploding in the US states of North Dakota, Oregon, Maine and New Hampshire – locations not historically known for a lot of lightning. Heading into 2014 and there are already signs of storms across the US starting as early as February.

These increased lightning strikes will have a tremendous effect on many industries, causing physical damage, downtime and degradation to sensitive electronics and equipment. It is therefore apparent that any company

DAS lightning protection with spline ball ionizers protecting a tank farm

and facility storing flammable liquids should stand up, take notice and ultimately prepare.

Downstream: aboveground storage tanks

Lightning is an explosive, rapid event that releases large amounts of energy in just a few milliseconds with an unpredictable path.

In a strike that terminates on or near a floating roof tank (FRT), for example, the current will flow in all directions and will vary in proportion to the lowest path of impedance. One unexpected arc across the roof-shell interface could ignite the fumes that are almost always present and, as a consequence, put that tank and an entire facility in immediate danger.

Fairly recent strikes suffered by storage tanks in the US states of Texas, Kansas, North Carolina and Kentucky show what has become the norm: one strike sparks a fire resulting in millions of dollars in lost profit, product, replacement costs, government oversight and downtime. In one incident, at an unprotected facility in Map Ta Phut, Thailand, the cost of the incident was in the billions, resulting in the facility being permanently shut down.

A review of petroleum storage tank fires between 1951 and 2003 found an average of 15-20 fires per year are reported with about one-third attributed to lightning. Another study directed by oil industry companies found that 'lightning is the most common source of ignition' in 52 of 55 rim seal fires studied.

And the reality is there are more tanks today than in 2003. It has recently been discovered that between 2003 and 2013, there were 87 tank fires and/or explosions definitely known to be caused by lightning across the world. Additionally, several others cited weather and/or were unknown initiators, but certainly could have been caused by lightning. This is an increase of at least three tanks per year, since the earlier study.

Financial damage

It is not just the direct strike against a facility that needs to be taken into consideration when determining protection. Beyond the hard costs like the loss of product, the downtime following a strike and the replacement costs of the facility, what about the soft costs? They notoriously pile up and are rarely considered.

While the total cost of damages is not easy to determine from incident to incident, one point cannot be ignored: if the companies in question had an integrated lightning protection solution in place, the worries of lost profits or lawsuits would be minimal. The relatively small cost to protect against lightning – typically less than $30,000 (€21,700) per tank – could have saved those companies which have not considered lightning protection systems many millions of dollars and, in some cases, saved lives.

For storage tanks, a remedy using a dissipation array system (DAS) and retractable grounding assembly (RGA), in conjunction with appropriate surge protection, has been the answer. Many Fortune 500 companies across the world implement this solution and swear by it. The concept is counter to the conventional lightning rod and favours prevention rather than collection by using charge transfer technology (CTS). It is preferable if the substance being handled and stored can explode.

Upstream: tank batteries and arc discharge

Electrical discharge and the subsequent explosive detonation of the ullage inside chemical storage tanks is another hot topic. In recent years there has been a growing trend to use fibreglass and lined storage tanks in the oil and gas industry, especially with the increase of fracking. The majority of these tanks are used at remote well sites and salt water disposal sites located throughout the US.

According to the American Petroleum Institute

RGA installation on floating roof tank

(API), fibreglass tanks should not be used for oil production but, due to the corrosive nature of this production process, fibreglass tanks are typically the preferred storage method at these locations. Fibreglass tanks, due to their non-conductive construction, create a number of challenges that directly relate to the effects of a lightning discharge.

If a fibreglass tank is adversely affected by a lightning-related event, the results can be monumental with some of these lightning triggered events costing millions of dollars for product loss, cleanup, capital loss and litigation. Even if the tanks are not struck directly by a lightning termination, a nearby lightning strike can still create an internal spark that can and, in some cases, will lead to an explosive event and a catastrophic failure.

High electrostatic fields produced during thunder and lightning storms create vulnerability through both primary and secondary sources, causing arcing both internally and externally which can lead to:

- Explosive detonation
- Electronic and electrical degradation of instrumentation and control systems
- Complete shutdown or failure of operational systems
- Dangerous step and touch potentials.

Again, the solution is dependent on not one, but a combination of technologies which include lightning strike protection, grounding engineering and surge protection. The solution in this case can be as low as $1,000 per tank and introduces the in-tank potential equaliser (IPE) as the primary grounding solution with DAS and surge protection. Once again it focuses on prevention rather than collection. Ignoring a solution for these tanks can be astronomical and dangerous especially with the apparent increase of lightning across the hemispheres globally.

With the invention of DAS, the RGA and the IPE, Lightning Eliminators and Consultants has mastered the science of preventing lightning damage to facilities, taking both a comprehensive and customised approach and considering all needs when it comes to protecting against lightning's unpredictable and far-reaching carnage.

For more information:
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IPE grounding solution from Lightning Eliminators and Consultants