Lyncole Presents
Improving Safety in the Petroleum Industry
Through Lightning Protection on Petroleum Tanks

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Safety Standards

In the petroleum industry, we extract, transfer, and store many extremely volatile and poisonous liquids and gasses. During each phase of the process, we are required to maintain some of the strictest safety protocols known to man. We wear protective personal equipment like respirators, flame retardant/chemical proof clothing, and eye protection. We carry personal gas monitors that alert us when the level of flammable/poisonous gasses and the oxygen level in the air is unsafe. We have procedures where we review each task we undertake prior to the initiation of that task. These reviews identify the risks associated with every task. We then formulate a maintenance plan to follow in the performance of this task. This plan addresses all the hazards and reduces the risks to their lowest level. We have daily safety briefings where our supervisors go over the maintenance plan and reinforce the importance of safety. Although, even with all this preparation, we can never eliminate the risks completely. We all understand that every time we dawn our protective clothing and go to work, we are placing our lives in the hands of our co-workers. We approach each day with the philosophic hope that we all return home to our families at the end of our shift.

Fire Hazards in the Petroleum Industry

A major hazard in the petroleum industry is fire and explosions. To mitigate this risk, we reduce the number of man-made ignition sources by using intrinsically safe radios and electronic equipment, spark proof tools, etc. However, there is no way to eliminate the possibility of ignition created by lightning, electrical surges and static electricity.

Personnel Safety is First & Foremost

Lyncole recognizes that the safety of personnel is first and foremost. We also understand that even if no one is injured, fires or explosions cost the industry millions of dollars every year. Lyncole strives to help save lives and money by protecting the personnel and equipment through proper training and the installation of specialized and technologically advanced lightning, grounding, static control, and bonding equipment.

3 Main Causes of Fires & Explosions

In the following paper, I will provide a brief description of the three main causes of fires and explosions, (Static Electricity, Lightning, and Electrical Potential Differences) in petroleum industry.

Static Electricity

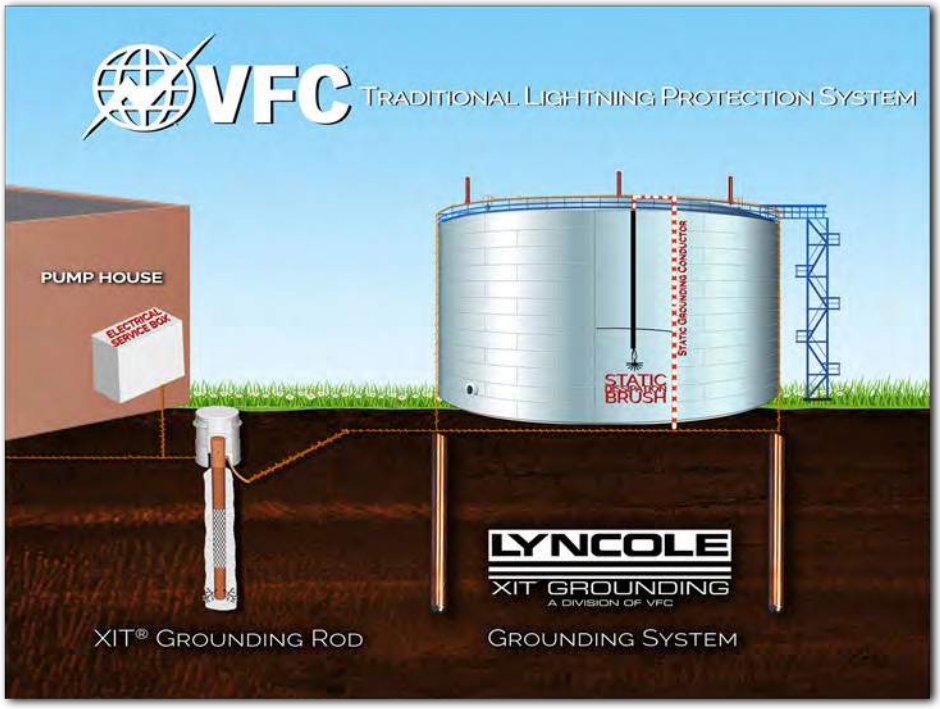
Static Electricity, the most prominent, can be caused by many conditions. Windblown dust particles, fluid transfer and storage, and friction to mention a few. Our conversation will be focused on the transfer and storage of fluid at a natural gas fracturing well-head. The natural gas is expelled from the well contaminated with liquid containing fracturing fluids, sand, acids and other impurities. This mixture is called natural gas liquid. The contaminated natural gas goes through a purification process which strips it of all the natural gas liquid. The liquid is then transported through a series of pipes to on-site holding tanks where it is stored until it can be transferred to trucks and transported to the recycling/disposal locations. As the volatile natural gas liquid is transferred through the pipes, it becomes electrically charged by friction. Many of today's natural gas liquid holding tanks are made of fiberglass and do not allow the electrical charge to dissipate. As the holding tank fills, the charge grows and the difference of potential between the liquid and other conductive materials is created. If that potential difference reaches a certain point, an electrical arc occurs and the results are catastrophic.

Common Practices

There are many recommended practices that can reduce the rate of the buildup of the static charge in the natural gas liquids. Slow fill rates, filling from the bottom of the tank, not allowing the liquid to splash, reducing the turbulence in the liquid and similar practices only slow the buildup and delay the inevitable.

Lyncole's Recommendation

Lyncole recommends that a grounded brush type element be installed in the tank. This element extends from a weight at the bottom of the tank to the top of the tank and is covered with thousands of tiny metallic pointed bristles. These bristles act as miniature receptors that absorb the electrical charge and transfer it to the elements center core. This core is then bonded to a grounding electrode system providing a low resistance path to earth. By creating this low resistance path to earth, the element dissipates the charge as it occurs, before it has a chance to buildup. Eliminate the charge buildup, eliminate the risk. These "Brushes" come in differing lengths and with multiple sized weights, can be configured to fit any size/shape tank, and are corrosion resistant.



Traditional Lightning Protection System

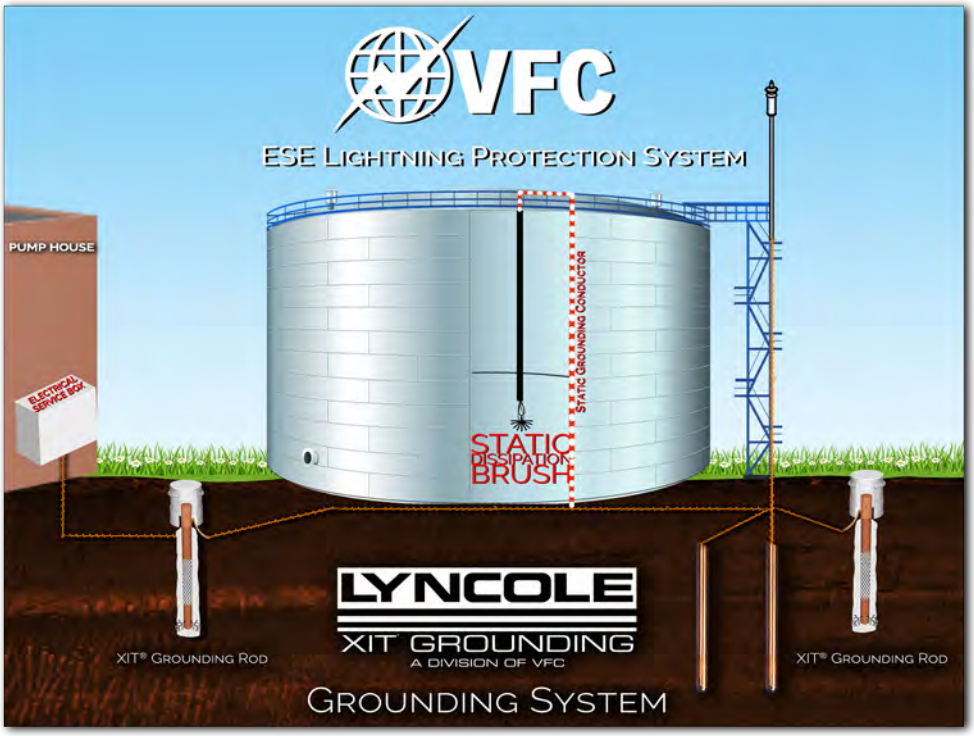
Lightning

Lightning, is major source of ignition that we cannot stop. There is no way one can eliminate the risk of a lightning strike. However, we can design lightning protection systems which, when lightning does strike, we can reduce the risk of damage. Yes, I said reduce the risk, not eliminate the risk. When you are dealing with thousands of amps of current and the resulting millions of volts, nothing is 100%.

To design an effective lightning protection system, one must understand the basics of lightning. Lightning is nothing more than a static electrical charge within the clouds. As the water and dust particles are moved within the clouds by wind turbulence, the friction creates an electrical charge. This charge creates an opposite charge in the earth and structure directly below the cloud. As the opposing charges continue to build, step leaders are generated. These step leaders leave the clouds, stepping towards the opposite potential. It is theorized that the length of each step is approximately 150 feet and this distance is the basis for today's 150 foot rolling ball theory for "conventional" lightning protection. At the same time the step leaders are formed, streamers are generated extended into the sky from the earth and facilities. The main lightning strike occurs when the step leader and streamer connect. This condition ionizes the air and forms a conductive path for the main lightning strike. This phenomenon is why it is said that the tallest structure is probably going to be struck by lightning. Currently in the U.S. it is common place for a lightning protection system to include Franklin rods, specialized conductors, and driven grounding electrodes. The Franklin rod will be placed on or near the structure with its tip at least 10 inches above the structure. The rod is then bonded to the specialized conductors which, in turn are bonded to the grounding electrodes. The intent is that with the tip of the Franklin rods being 10 inches taller than the structure, its streamer will start closer to the step leader and therefore meet the step leader before the streamer of the structure. This type of lightning protection system allows the lightning to strike (arc) to the Franklin rod within inches of the structure. In an extraction well tank battery, there is a high possibility of a plume of flammable gasses surrounding the well-head and tanks. If we allow the lightning to strike within this plume of gasses the results would probably be explosive.

A Solution

A solution to this problem is to install a lightning protection system that can be installed outside the boundaries of the flammable gasses and still protect the structures. Due to the suspected area covered by the volatile plume of gasses, this would be a challenging task with Franklin rod systems. An alternate solution is to use a type of specially designed lightning protection system that can be installed outside =that area and still protect the structure. The Early Streamer Emission (ESE)system is just that. It is designed using a head including electrical components that create the streamer sooner than the Franklin rod. If the streamer is created sooner, it is like an athlete that jumps the gun in a race. The streamer reaches the finish line (step leader) before the streamers from the structures. The basic principle is that the electronic circuitry within the ESE head is charge by the difference in potential in the atmosphere, the charge builds up quicker than the charges in the structures and the streamer is "fired" before the structures' streamer. The time difference allows the ESE head to cover more area than the Franklin rod. This added area (zone) of protection allows the ESE lightning protection system to be placed outside the area suspected to contain the flammable gasses.



ESE Lightning Protection System

Surge Protection

Surge Protection components will be installed on all electrical panels as well as any communication lines entering or leaving the site. These surge protection systems will also be bonded to the grounding electrode system to limit the amount of let-through voltage to the protected equipment.

One of the basic principles of electricity is that current will not flow unless there is a difference in potential. An example of this is when an electrical lineman performs an inspection of high voltage lines. They are flown to the by line by helicopter and then step directly onto the live wires. The helicopter is jumpered to the line and when the lineman reaches out to touch the wires he is at the same electrical potential as the line and not electrocuted.

A Common Grounding Electrode System

A Common Grounding Electrode System consisting of a bare stranded conductor and grounding electrodes should be installed in direct contact with soil encircling the site. All the metallic components within the area, the lightning protection systems, the tank static brush conductor and the surge protection should be bonded to this grounding electrode system. This will serve two functions. It will ensure everything is kept at an equal potential and it will provide a low resistance to earth and keep the ground potential rise to a minimum during electrical faults and lightning strikes.

In Conclusion

In conclusion, proper attention should be paid to all aspects of electrical protection. All categories complement one another. If one category of protection is missing, catastrophic failures could occur. Some appear as common sense while others, like static buildup in fiberglass (non-conductive) tanks, are less obvious. With the deployment of a "Total Site Protection System" as discussed above, countless expenses and possibly lives can be saved.