1. Introduction

A Strike Termination Device is a lightning protection system component that is intended to intercept lightning flashes and connect them to a proper path to ground. Strike termination devices may consist of traditional air terminals (Franklin Rods), advanced lightning protection systems, metal masts, permanent metal parts of a structure, and overhead ground wires installed as a catenary lightning protection system.

For the protection of structures containing flammable vapors, flammable gases, or liquids that can give off flammable vapors, masts and overhead ground wires may be utilized to create a catenary lightning protection system. In addition, for any mission critical facility or complex petrochemical or explosive storage facility where installation of traditional air terminal systems is not applicable both from installation and safety performance perspectives, catenary LP systems are commonly utilized. Safety performance is evaluated with the requirement of minimum distance between a strike termination device and the structure to prevent side flashes (arching). According to the NFPA-780 (2011) Std., the zone of protection of a lightning mast and overhead ground wire shall be based on a striking distance of 30m (100’) and defined by 30m (100’) radius arcs, concave upward (a rolling sphere).

To prevent side flashes, the minimum distance between a mast or overhead ground wire and the structure to be protected shall not be less than the bonding distance or side flash distance.

   a. **The sideflash distance from a mast shall be calculated from the following formula:**

   \[
   D = \frac{h}{6}
   \]

   where:

   D = sideflash distance from a mast
   h = height of the structure or object requiring protection

   b. **The sideflash distance from a catenary shall be calculated as:**

   \[
   D = \frac{L}{6n}
   \]

   where:

   D = sideflash distance from a mast or overhead ground wire
   L = length of a lightning protection conductor between its grounding point and the point being calculated
   n = 1.5 where there is a single overhead wire or more than one wire interconnected above the structure to be protected, such that only two down conductors are located greater than 20’ and less than 100’ apart.
   2.25 where there are more than two down conductors spaced more than 25’ apart within a 100’ wide area that are interconnected above the structure being protected.
2. Lightning Shielding Analysis

Alltec has the capability to design two and three dimension models showing effective protection systems for a facility, in order to perform lightning shielding analyses based on recognized standards. Engineers utilize a unique lightning shielding analysis software to perform the analysis.

Lightning shielding analyses can be performed either with Protection Angle or Rolling Sphere methods. The specific angle is determined based on the height of an independent Lightning Mast and the protection cone is evaluated to analyze the lightning shielding effectiveness.

The rolling sphere method is the most used method to determine the lightning protection zone for an explosive facility. The red dots in the following graphics indicate the direct lightning strike point corresponding to rolling a sphere with a radius 100’. This type of computer modeling aids in determining the required number and placement of independent Lightning Masts to prevent direct lightning strikes to any structures considered within the facility.

3. Facility Description

In the case of this model, the facility under consideration is comprised of three tanks housing explosive liquid, with dimensions of 61.5’ (H) × 34’ (D) and 30’ (H) × 12’ (D). The walkway structure is extruded 4’ above the top of the tanks, and lightning protection is required to protect the facility from direct lightning strikes. Independent masts are required to be installed for an effective LP system. Lightning strike energy shall be diverted away from the tank in order to reduce the potential for sideflash from direct lightning strikes.

Case I: Analysis with Independent Lightning Masts
A three dimensional model of the facility is created along with four (4) 86’ independent Lightning Masts. The lightning shielding analysis is performed with both protection angle and rolling sphere methods to evaluate the effectiveness of the installed protection system against direct lightning strikes.

As shown in the figures below, independent masts do not provide effective lightning protection system for the entire facility.
Fig 1-a: Protection Angle Analysis
**Fig 1-b: Rolling Sphere Analysis with sphere radius of 100’**

*Fig 1-c: The Electro Geometric model analysis shows that the elevated structure within the facility is struck with 8 kA lightning strikes*
Case II: Analysis with Catenary Lightning Protection System
A Catenary Lightning Protection System is designed with 86’ masts above grade with stainless steel over-head ground wire. A three dimensional model of the facility is created along with installed tower and stainless steel over-head ground wire. The lightning shielding analysis is performed with rolling sphere method (100’ radius) to evaluate the effectiveness of installed protection system against direct lightning strikes.

As shown in the following figures, designed and installed independent masts with over-head ground wire will provide effective lightning protection system for entire facility.
Fig 2-a: Two (2) and Three (2) Dimensional model of the facility along with proposed Catenary LP system
Fig 2-b: Rolling Sphere Analysis with sphere radius of 100’
Fig 2-c: The Electro Geometric model analysis shows that the elevated structure within the facility is protected even from 5 kA lightning strikes. Although rolling sphere radius of 100’ corresponds to return stroke current of 7.8kA, the proposed catenary LP system is sufficient to protect the facility from 5 kA lightning strikes.
Fig-3: An artist’s rendition of the lightning protection system built at NASA’s Kennedy Space Center Launch Pad 39B. The launch pad was modified to support launches of Ares and Orion spacecraft.

Image credit: NASA
Fig 4: Four towering lightning protection masts seem to stand guard as NASA’s Mars Science Laboratory (MSL) spacecraft, sealed inside its payload fairing, awaits liftoff aboard the United Launch Alliance Atlas V rocket. (NASA/Bill White)

4. Installation Design of Catenary LP System

Alltec’s Engineers and Designers use a custom lightning protection analysis of your facility to prepare installation design drawings of a complete Catenary Lightning Protection System indicating proper placement of lightning masts/towers, over-head ground wires, down conductors, grounding system layouts, and additional accessories. Comprehensive installation drawings of the Catenary LP system are prepared as shown in the figures that follow.

Call or email now to discuss your lightning protection needs.