LIGHTNING PROTECTION OF INHERENTLY SELF-PROTECTING STRUCTURES

Are inherently self-protecting structures really self-protecting?

The three major components of a lightning protection system (LPS) are the strike termination devices (lightning rods), the main and down conductor system, and the grounding (earthing) system.

Strike termination devices are intended to intercept lightning strikes, and include lightning rods, metal masts, ground wires, and permanent metal parts of structures that are a minimum of 3/16" thick to withstand direct lightning attachment. They establish zones of protection, that is the space adjacent to a lightning protection system that is substantially immune to direct lightning flashes. Any strike in the area is supposed to attach to a strike termination device, not the structure, thereby mitigating physical damage.

Main and down conductors convey the lightning energy to ground. They connect all strike termination devices to one another, and form two or more paths from each strike termination device to ground. They may consist of dedicated conductors (wires) or qualifying conductive components of a structure.

The grounding system dissipates lightning energy into earth (ground). Each down conductor must terminate to a dedicated grounding electrode, including a ground rod, concrete encased electrode (Ufer ground), grounding plate, or the structure or facility grounding system.

Obviously, most process control plants incorporate these features into their very design. The top of the structure is adequate to serve as the strike termination devices, the framework is adequate to serve as the conductor system, and the plant ground is adequate to provide lightning protection system grounding.

In recognition of that, both National Fire Protection Association NFPA 780 and Underwriters Laboratories UL 96A contain an allowance to consider certain structures to be "self-protecting". What does this mean and how should it be correctly applied to various structures? In this case, the section does not necessarily convey what the title infers. It is important to understand what this designation actually means so as not to expect what it cannot deliver.

Self-protecting in this context describes a structure that, by its construction, materials and layout does not require a dedicated lightning protection system (LPS) because the components and layout of the structure are comprised in such a way that they intrinsically provide all the required components of the LPS.

It is important to remember that lightning protection standards are designed to protect the protected structure from fire – to keep it from burning down. That is why it is covered under a

National FIRE Protection Association standard. This was fine back in the days of wood barns and houses. Lightning would attach to the LPS strike termination device, be conveyed around the structure on the conductor system and be dissipated to earth in the grounding system. However, fire is not the main concern in a process control plant. Lightning is highly unlikely to ignite a steel structure. The real problem is damage to the control (SCADA) system caused by secondary effect and electromagnetic pulse (EMP) resulting in plant shutdowns and lost production. Even if the LPS works exactly as designed, this type of damage is still likely to occur. Again, fire is not the primary lightning problem. Reliability is. As these plants continue to sustain damage to equipment and control systems, they are, in the real world, obviously not self-protecting. So, the "self-protecting" designation does not really apply to a process control plant as the LPS does not prevent or control the most likely types of damage.

In order to provide adequate and effective lightning protection system performance, structural lightning protection is a good place to start. However, conventional lightning rods provide little to no benefit. We strongly suggest installing ultra-sharp point air terminals in place of conventional lightning rods. The purpose of this technology is two-fold. The primary function is to discourage lightning attachment to the protected structures. Ultra-sharp point air terminals delay the formation of lightning-completing streamers by dissipating the ground charge to atmosphere before it builds into a streamer. If the charge build-up exceeds the dissipation ability of the air terminal, it reverts to its role as a lightning rod, intercepting the strike and conveying it to ground. The secondary function is to act as a static discharge wick and discharge static build-up to the atmosphere. By doing so, the technology limits unwanted and damaging current flow on plant SCADA conductors, reducing equipment damage, outages, and down time. Please see the white paper entitled, "The Evolution of Lightning Protection Technology: From Rods to Reliability."

Therefore, we recommend a complete and complementary system of structural lightning protection, appropriate state-of-the-art surge suppression on both ends of all conductors entering or exiting each structure, and, to the maximum extent possible, single-point grounding of all services and equipment.