LIMITATION OF Δt UPTO 60μs IN THE STANDARDS FOR LIGHTNING PROTECTION WITH ESE AIR TERMINALS

Early Streamer Emission Air Terminals (ESEAT) start the upward leader before other objects connected to the ground. This characteristic is proven in a high voltage laboratory by measuring such advance time, which determines its protection radius. The formula for calculating the protection radius is therefore based on a physical process and it cannot be applied to any value or condition.

The downward leader approaches to the ground steppedly. According to the electrogeometrical model, at each step it can get to any point of a sphere with radius r around the point reached in the last step. While descending it increases the electric field and then corona discharges and the upward leader appear at the grounded objects. When both parts meet then the path for the arc and therefore for the lightning current is created. Low magnitude lightning (2-3kA peak current) are the most difficult ones to be intercepted because they should approach very close to the structure for creating the conditions needed for the formation of such path. Even being small, their associated current is thousands of amperes and therefore they can cause significant damages.

The laboratory tests simulate the electric field at the structure level. If the distance between the plate and the rod is very large then a higher voltage should be applied to the plate for obtaining the upward leader since the standard fixes certain conditions for the slope of the applied voltage wave. But in nature the air terminal must create the upward leader even for low magnitude lightning (in case of Protection Level I) as explained above. If the downward leader is very far away, especially in case of small lightning, then **the electric field around the air terminal will not be high enough for creating the upward leader**.

Besides, for long distances **the electric field around the air terminal would be lower than the one employed in the laboratory**. A test performed according to the standard applies a local electric field slightly lower than 5MV/m. 60μs advance time implies a length of 60m, and at that distance a small lightning (2,4kA) causes a local electric field of 5MV/m. However, for an air terminal with 100μs advance time, the distance would be 100m and then the local electric field around the air terminal would be only 2,8MV/m, which means inception conditions not only insufficient for generating the first corona discharges (E_{onset}=3MV/m) and thus the upward leader, but also much lower than the ones existing in the laboratory.

Due to all the above explained, the last edition of the standards for lightning protection using ESE air terminals have **limited the advance time used to determine the radius of protection to a maximum of 60μs or, more accurately, the model cannot be applied to higher advance times**. This means that in the laboratory an air terminal could obtain higher advance times, but in nature this would mean too large distances that would not create the appropriated electrical conditions and therefore those high advance times cannot be turned into larger protection radii.

If we take the typical example of vehicle velocities, a car can indeed reach a higher speed than the one that is allowed at the roads, but if the road is no created such capability has no use. The air terminal does not only depend on itself: the downward leader or in general the charge of the cloud is the one that should create the appropriated conditions and only then the air terminal can work.

All manufacturers members of ILPA and their agents commit to follow the Standards requirements and support this rule.

ILPA Technical Committee