

The Reliability and the Efficiency of the Early Streamer Emission Concept

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Abstract—This paper is a compilation of answers to the critics and comments frequently heard or written on the Early Streamer Technology. The ESE concept and the theory are criticized by partisan of the conventional method.

Keywords—*Early Streamer Emission, Leader*

I. INTRODUCTION

Since the publication of the first standard on ESE technology, the lightning protection market has been modified.

The supporter of the old and conventional technology of have been upset and used to critics with recurrent topics the ESEs.

In order to answer those critics, this paper proposes some explanations and gives some ideas on the Early Streamer effect.

II. THE EARLY STREAMER EFFECT

This section aims to show that ESE air-terminals work properly as well in laboratory and in nature.

A. Laboratory sequence of Tests

An international committee has work on a new version of ESE standard; the result is the publication in 2011 of the last NFC 17-102 [1].

The new procedure of tests of the NFC 17-102 includes five sections of tests in order to confront the ESE tested to natural conditions.

The conventional technology claims that they needn't any test to confront there product. The field experiences and the past are considered sufficient to validate their technology and their product.

Recent in situ studied realized by Moore & all [2], have shown that a simple rod will catch the lightning in a different way with respect to the radius curve and the shape of the tip

The attractive effect and the repetitiveness of a simple air-terminal depend directly of its shape and form. Moore have shown that blunt rod will be more efficient to capture the lightning strike.

So it can easily be understood that 2 different shape rods will no react the same way when confronted to the lightning. Perhaps one will have a greater radius of protection than the other.

A laboratory test may be useful to insure that any simple rod presents the radius of protection defined in the EN 62305-3 standard [3].

B. Test in Situ all over the world

Some ESE manufacturers have designed a lot of tests in situ. Those tests enable to validate the in situ well working of the ESE air-terminal.

Actually a project of standard [4] to validate in situ all lightning protection system is in progress. This project standard enables to validate a concept by analyzing its performances.

This project aims to analyze the efficiency of a technology by comparing the number of interceptions regarding the keraunic activity of the site and the possible bypasses in the protection volume.

C. Experience feedback and survey

A recent empirical survey [5] realized in 2011 explains that during the last 25 years, the number of ESE installed all over the world is equivalent to 4,5 millions of accumulated years of experience. According to standards theory, an acceptable number of bypasses is possible. The available data gives a very low number of incidents with.

Moreover, the last OP marketing survey [6] realized between 2012 and 2014, concludes that the users of the ESE air-terminals are globally satisfied (93%) by their lightning protection, and 82% are convinced by the liability of the technology.

D. No more bypass than others technologies

ESE air-terminals are criticized by opponents because they are supposed to have bypass. Unfortunately, there is also bypass with conventional technology.

According to figure 1, we can easily see that an impact occurs at a distance of 2 meters from a Franklin rod.



Fig. 1. church protected by a simple rod and impacted

When a mesh cage is used, and when the principle of the rolling sphere is applied, there is some possible bypasses that can impact the structure.

We are going to take the example of a volume protected by a mesh wires non-isolated according to the mesh method of the EN62305-3.

The figure 2 is extracted from the standard and shows the structure and the volume protected.

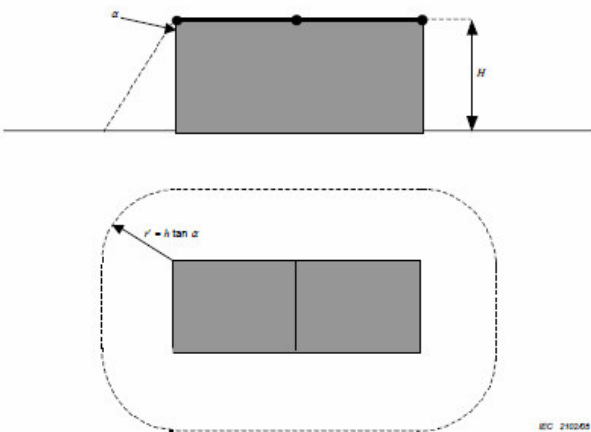


Fig. 2. Volume protected by non-isolated wires combined in a mesh

This method is in complete opposition with the rolling sphere method.

Indeed, when you make the sphere roll on the structure, you easily see that impacts are possible on the structure “protected” like in figure 3.

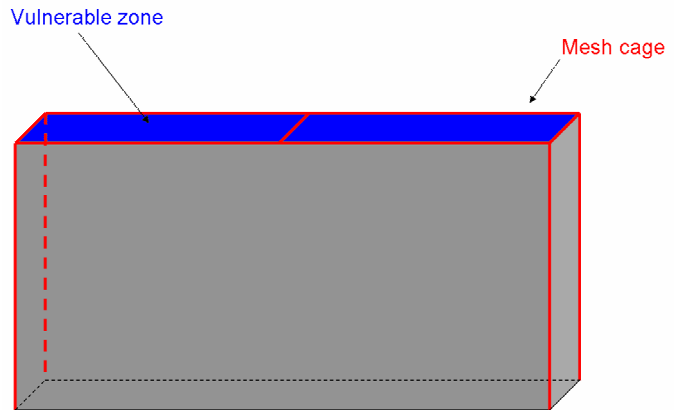


Fig. 3. Vulnerable zone of a protection by mesh wires

We have pointed above two cases of bypass with the conventional method. Opponents to ESE are used to show some cases with lightning strikes in some ESE lightning protection volume.

They usually forget to analyze the reason of the bypass. It is often an installation reason or a mistake in the design of the protection. The ESE should not be the unique reason of the bypass of the protection.

The installation rules of the new 17-102 standard is as requiring as the one of the EN 62305-3 standard.

Moreover in some particular points of the installation, the ESE standard is even more severe:

- Earthing system resistance value
- Number of fixations per meter

So if the rules are respected, the installation is safer than an equivalent installation with conventional lightning protection system.

Unfortunately, sometimes, the incriminated ESE can be a bad ESE or a copy. In this case, bypass in the protection may occur.

The new test procedure of the NFC 17-102 (2011) described in Section A, aims to avoid this kind of possibility. Indeed, the reinforcement of the tests implies more serious and more efficient products on the market.

E. Propagation of the leader

One of the common critics is the about the Leader emitted by the ESE air-terminal which is the principle of the ESE

technology. The opponents of ESE technology have said that there is no ESE effect.

Nowadays, they agreed that the effect is possible in laboratory. However, they claim that it can't work in nature because of a difference of scale between the nature and the laboratory.

Recent results and pictures have shown that ESEs are able to generate upward streamers.

For example, 7 ESEs installed on the 7 piles of the viaduct of Millau have generated simultaneously 7 leaders.

Two of them have evaluated and have reach the downward streamer and lightning return strokes occur about 10kA. Lightning strokes haven been registered according to Météorage analysis [7]

According to the picture published, we can estimate that upward leaders are greater than 100 meters.

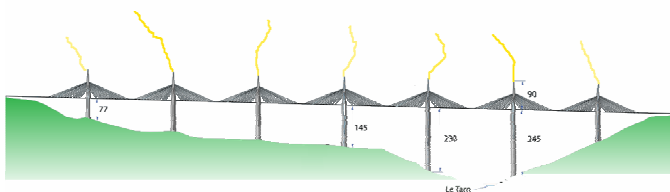


Fig. 4. Leaders emitted by the ESEs

We can conclude that the ESE principle is active and as if the leader has been created earlier than a simple rod, it has stay in life and finally has caught the lightning.

It is often said that the upward streamer that have been generated too earlier are lost because they won't be attracted by the downward streamer. Effectively, it is possible, but it seems that the streamer is still alive, and a new upward streamer may be able to reactive it and use it as a path for the future channel.

Concerning the speed of the upward leader, we are not actually able to define surely it. With the latest generation of high speed cameras, some observation and measurements have

been realized and datas available are now more and more precise.

Warner [8] has measured upward leader with a speed camera at speed about 6.10^5 m/s. However, this speed is a 2 directions measurement. We can think that the real speed is faster because the third dimension has not been considered.

For sure, the speed of the upward leader is not as slowly as claimed by some people.

III. CONCLUSIONS

To conclude, this paper gives some arguments to explain the early streamer effect and argues on the liability and efficiency of the technology and of the ESE principle.

Last pictures and video confirm the well functioning of the ESE in natural conditions. Moreover, the progress in scientific technology tends to confirm the performances and the efficiency of the ESE technology

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