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NON-STANDARD LIGHTNING PROTECTION DEVICES – A CRITICIZM

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***Abstract*:** Non-standard lightning protection air terminals are briefly described in this paper. They have been classified into two groups: early streamer emitters and lightning preventors. They have been criticized as not more effective than the conventional lightning protection systems, much more expensive and more dangerous.

***Keywords*:** lightning protection, early streamer emitters, lightning preventors.

1. Introduction

During the last decade many technical innovations came to Estonia, Latvia, Lithuania, Poland and other countries from the former Soviet block. Many of the novelties aid the technological progress. Unfortunately, some of them do not. Among them there are so-called "active" or "unconventional" lightning protection devices. The economic transition period in our countries can be profitable for some manufacturers and vendors trying to find new markets for stuff made with no scientific/technical grounds and inconsistent with respective international standards. Non-standard installations can be met in many places (Figures 1 – 4).

Fig. 1. ESE device at Riga airport, Latvia

Fig. 2. ESE device in Vilnius, Lithuania

Fig. 3. ESE device in the centre of Warszawa, Poland (photo from the web site of Megatech, one of the ESE sellers)

The vendors succeed in selling such devices, taking advantage of incomplete accommodation of regulations in our countries to the free market rules. The best way in distinguishing the cheat from the technically correct solution is to make use of recognized international standards.

The existing lightning protection standards, that should be referred to, are: IEC/EN 62305 [1] or their previous versions IEC/EN 61024 and 61312 [2, 3]. Some national references may also be considered, e.g. NFPA 780 [4]. Any hardware that is inconsistent with requirements of these standards should be rejected.

Fig. 4. ESE air terminal in Bialowieza, Poland

Non-standard lightning protection devices can be classified into two main groups:

1. The lightning attracting air terminals (early streamer emitters – ESE) that are claimed to be able to capture the lightning to them (and hence away from the protected zone) in order to protect the building that they were installed on.
2. The lightning prevention air terminals (charge dissipaters) are claimed to be able to prevent lightning from occurring and hence protect the building.

These products deserve a skeptical reception. Their uselessness has been described in many publications, e.g. in [5-7].

The aim of this paper is to increase the consciousness of the potential purchasers about risk of buying of such devices/systems, which are improper, expensive, and can cause serious threat to people and electronic equipment.

2. Early Streamer Emitters

There are different types of so-called Early Streamer Emission (ESE) devices.

1. Radioactive (not in use in most countries since the 1980's),
2. Electronically activated,
3. Piezoelectric,
4. Specially-profiled.

Examples of such devices are presented in Fig. 5. Many of them have peculiar, magic shapes and distinguishable commercial names, e.g.: Pulsar, Prevectron, Paratonerre (France), EF (Switzerland), St. Elmo (Italy), DAT Controler (Spain), Corona, Satelit, TerraStreamer (USA), Dynasphere, Interceptor (Australia), SE Accelerator (Poland).

Fig. 5. Examples of the ESE air terminals

The claimed function of an ESE device is the triggering of an upward streamer at time ΔT earlier than the triggering time of a conventional Franklin rod. This earlier initiated streamer is said to occur in a smaller electric field than is required for the initiation of a streamer by a conventional lightning protection system.

Time ΔT is referred to as the time advantage of the device. The length ΔL of the triggered discharge is determined as:

$$\Delta L = \upsilon \, \Delta T, \tag{1}$$

where υ is the velocity of the upward discharge (typically it is assumed: $\upsilon = 10^6$ m/s = const. [8]). The declared ESE advantage is that an ESE rod of length L gives the same protection as a simple lightning rod of length $L + \Delta L$ [6]. Hence, the zone protected by the ESE device is assumed much bigger than the zone protected by the conventional Franklin rod.

The above-described function has never been proven to be correct under natural storm conditions. Independent researchers have also been unable to demonstrate the expected advantages by laboratory tests. In particular, the typical measured velocity of the upward streamer in natural conditions is of order less ($\upsilon \approx 10^5$ m/s = var.). The ESE devices and the simple Franklin rod do not show any considerable difference in the protection distance and in the number of attracted flashes in competition tests [5 – 6].

There exists a quasi-technical/scientific background for designing the ESE protection zone. In some countries the ESE manufacturers were able to develop their product standards. The most known is the French standard NF C 17-102 [8]. ESE vendors in many countries make reference to this standard. This standard is inconsistent with the IEC standards [1 – 3]. It should be noted that France is a member of the IEC and had subscribed to the IEC standards.

In Australia and New Zealand the Collection Volume Method (CVM – Fig. 6) was accepted as an informative appendix of the standard AS/NZS 1768 [9]. A modification of CVM is called the Field Intensification

Method (FIM). These methods are used to design the ESE-protected zones to justify the reduction in number of air terminals compared to what is required by the internationally accepted electrogeometric model (the Rolling Sphere Method [1 – 4]).

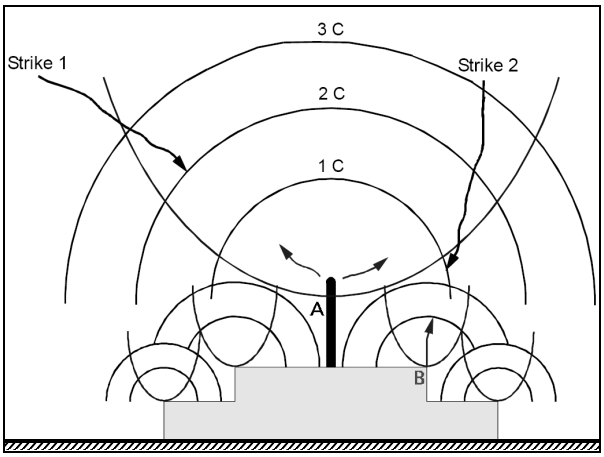

Fig. 6. Illustration of the Collection Volume Method (adopted from [10])

Similar to the French standard, the proposed standard NFPA 781 was developed by the ESE manufacturers and submitted to the US NFPA (National Fire Protection Association). In 1995 the NFPA Standards Council rejected consideration of the ESE for a new standard. After the second study, in 2000, the council upheld the 1995 rejection.
The ICLP (International Conference on Lightning Protection) Scientific Committee had issued a joint statement by its members to reject the ESE air terminal on scientific basis [6].

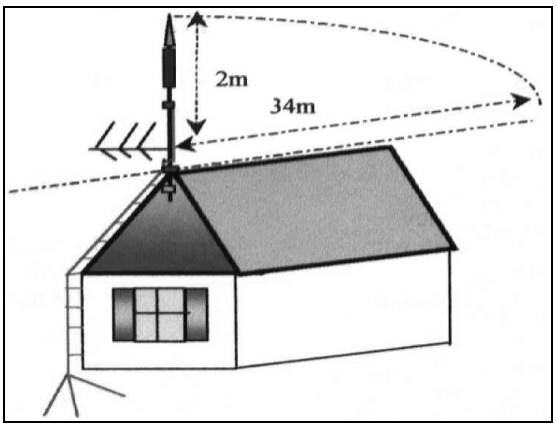

Fig. 7. Example of ESE design advice – a single down conductor and a "hen's leg" grounding system (adopted from a catalogue of one of ESE manufacturers)

Note that grounding of ESE devices, recommended to make by a single down conductor (sometimes two down conductors), increases threat to people and to apparatus in comparison to classical lightning protection system equipped with perimeter grounding electrode (Fig. 7).
Often met recommendation of a single down conductor application is in contradiction to the basic principles of lightning protection:

- principle of the perimeter grounding – to reduce the step voltage,
- principle of dividing the lightning current into parts – to reduce the threat of spark-over,
- principle of reduction of the LEMP field into a cage formed by the outer lightning protection system.

Thus, the ESE vendors' recommendation concerning the number of down conductors is misleading.
Some examples of ESE lightning "protection" look even stupidly, as shown in Fig. 8, where a single down conductor is intentionally driven into a house, thus forming a dangerous path for a lightning current.

Fig. 8. Stupid advertisement (www.megatech.com.pl): a down conductor coming into a "protected" house

There are many publications, e.g. Hartono and Robiah [7], presenting damages to buildings on which the ESE devices were installed.

3. Lightning Preventors

Lightning elimination (prevention) devices are declared to employ corona discharge from multiple points to reduce electric charges collected within storm clouds. There are two basic types of lightning elimination systems in the market:

1. One is claimed by its vendors to be able to eliminate lightning strikes.
2. The other is declared to be able to drastically reduce the magnitude of the lightning strike current.

The first product has its commercial name as the Dissipation Array System (DAS). Its shape is similar to a barbed umbrella (Fig. 9). The lightning elimination claim was short lived since American scientists were able to photograph several lightning bolts striking on the DAS itself [5]. Nevertheless, the product presently named the Charge Transfer System (CTS) is still a commercial success, especially in Asia [7].

In 2001, the manufacturer had applied for a proposed standard for the CTS from the IEEE. Due to the absence of any scientific background, the proposed standard had stalled. However, the vendors continue to sell the system with the claim that an IEEE standard is being developed.

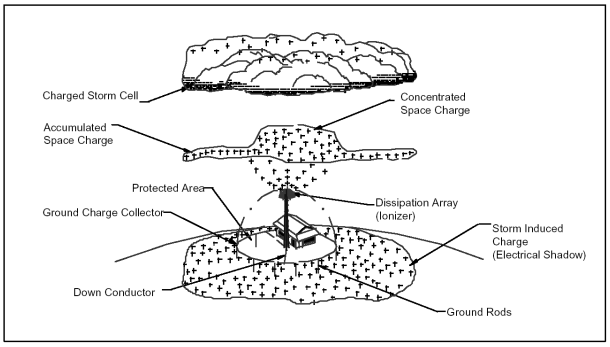

Fig. 9. DAS concept (adopted from [11])

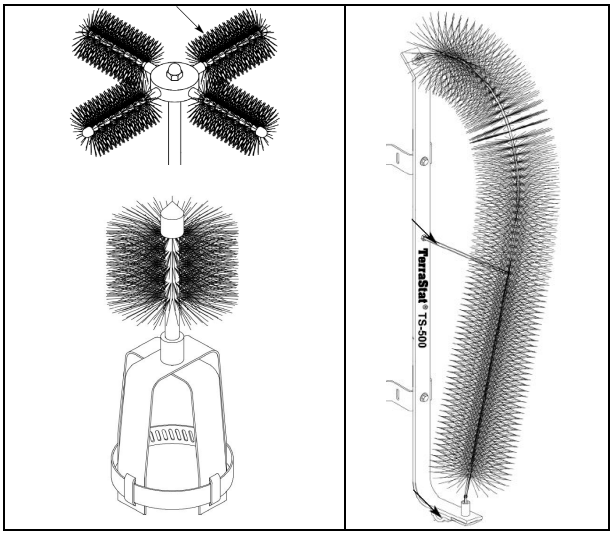

Fig. 10. Other lightning preventors (adopted from [12])

Other lightning prevention air terminals have been brought into the market in recent years. They are much smaller in size and in various shapes, similar to brushes, e.g. TerraStat Dissipators (Fig. 10), Spline Balls. However, they still made analogous claims as that of the DAS. At least the strike current reduction is claimed.

4. Conclusion

Neither data nor theory supports claims that "lightning elimination" and "early streamer emission" techniques are superior to conventional lightning protection systems [5]. Making use of these devices is not recommended.
One of the vendors' arguments in advertisements is that NASA investigated the offered devices. But "investigated" does not mean: "recommended". A result: NASA applies a conventional air termination system for the space shuttle launch tower.

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