

ESE AND OTHER NON-CONVENTIONAL LP SYSTEMS

by

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THE TECHNICAL ASPECTS:

Great efforts have been devoted to improve the efficiency of lightning protection and many possibilities have been suggested over the years.

Radioactive rods have been used for many years but have shown no advantage relative to ordinary lightning rods, and the use of radioactive material for this purpose has now been abandoned in most countries.

Laser-triggered lightning involves an electrically powered, sophisticated and sensitive setup that might prevent its practical use as lightning protection except at very special situations. In addition the method has until now shown difficulties with certainty to ensure subsequent flashes.

Early Streamer Emission System (ESE), attempts to utilize an emission of early discharges (streamers) on special lightning rods, to provoke and trigger an early lightning flash and thus protect the surrounding over a greater area than in the case of ordinary lightning rods. Even though the name Early Streamer Emission indicates, that it is the early onset of streamers on ESE rods relative to the ones on ordinary lightning rods, that is a measure for the advantage, it appears that the advantage actually is determined by the time difference between the instances of the first appearance of any type of discharges on the two types of lightning rods, an interpretation that will favour the rod with the smallest curvature radius on the tip.

Even though the hypothesis seems logical, actual experience in the field has shown that the triggering of a flash is extremely complex and much more complicated than anticipated in the hypothesis.

An indication of this complexity is apparent in the experience with rocket-triggered lightning. In spite of great effort to trigger the lightning stroke at a suitable instance, a flash often fails to follow regardless of the extreme influence caused in the electric field by the trailing wire from the rocket, and the resulting generation of very long streamers and leaders.

Another experience with formation of long streamers is found under EHV (Extra High Voltages) and UHV (Ultra High Voltages) switching impulse tests where extremely long streamers are experienced often with termination in the blue sky and sometimes terminating on the ground far away from the test object often without causing subsequent flashover.

Therefore, the concept of early streamers is not sufficient and inadequate as a parameter for the determination of any advantage of ESE rods versus ordinary lightning rods.

Moreover, several investigations (for inst. by Z.A.Hartono and by Charles B.More et al) have shown numbers of missinterceptions, and lightning stokes terminating in the close vicinity of ESE rods, and that competition race between ordinary Franklin rods and ESE rods arranged in parallel setups and exposed to natural lightning did not favour the ESE rods as it should be expected according to the claimed properties.

Creditability of the claimed properties for non-conventional LP devices:

In the opera "The Elixir of Love" (L'Elisir d'amore) by Gaetano Donizetti, the quack Dulcamara sells medicine at a high prize against all sorts of sufferings including love problems. To make the story short, the medicine appears to work in a peculiar way, mainly because people believe in it.

To avoid that sort of business in real life, laws have been issued against dishonest or fraudulent advertisements requiring that the manufacturers or vendors must be able to prove the advertised properties.

Thus the arguments "I am convinced it works" or "I believe it work" just isn't enough.

In most countries laws concerning Product Responsibility and laws concerning Product Reliability have been issued, but the laws are not always followed.

An advertisement for a known beauty cream promises the user to get 10 years younger skin. If this was true, a warning should be given not to be used by children less than 10!

Because this advertisement is not dangerous, nobody seems to object even though the advertisement violates the laws.

On the other hand, if safety problems are involved there exist tough requirements for the acceptance of products.

As an example, this is the case for the acceptance of new drugs where strict requirements have to be fulfilled and numerous tests conducted before such drugs can be marketed.

As another example, the knowledge of the actual tensile strength for straps and slings are necessary in order to evaluate the load such straps and slings can be used for with a sufficient high safety margin. I think that everyone will agree that it is indispensable to perform actual tensile strength tests, and that it will not be sufficient indirectly to evaluate the tensile strength by means of measurements of other parameters, for inst. the elasticity coefficient.

Therefore, relevant standards are important for components, apparatuses or systems where safety is the issue, or where safety is involved, and moreover, that the standards contain tests' specifications relevant to the circumstances under which the items are going to be used.

Consequently standards, norms and code of practice should comply with at least one of the following requirements:

- Founded on recognized and verified physical theory and models.
- Founded on recognized and verified empirical models and experiences.
- Founded on recognized tradition and practice and experiments from the field collected over sufficient number of years.

Question 1: Do the non-conventional lightning protection systems, as safety providing systems, obey the abovementioned requirements for safety?

Answer 1: No, none direct measurement of the protection offered has been successfully conducted or sufficient empirical data collected from field tests to convince the international technical and scientific community within this field, nor are the systems founded on any recognized or verified physical theory.

Question 2: Does the French ESE standard NF C 17-102 (1995) rest on any of the stated preconditions for safety standards?

Answer 2: No, the French ESE standard does not require or specify any direct method to evaluate the efficiency of the protection offered by the non-conventional lightning protection system, leaving the evaluation of the performance alone on the basis of an indirect method, a method that is partly inadequate partly incorrect. The same seems to apply for the other national ESE standards.

The French ESE standard and its major deficiencies:

- The hypothesis for the function of the ESE rod is insufficient and inadequate, and the hypothesis seems to be limited alone to discharges over smaller distances.
- The French standard does neither require nor specify verification tests under natural lightning conditions.
- Only laboratory tests for the verification of the function is specified and required. However, laboratory tests are insufficient and inadequate because it is impossible in any laboratory to simulate natural lightning conditions not least due to the limited space and the vast nonlinear characteristics of the lightning processes.
- Only negative lightning is considered.
- The standard misinterprets the use of the rolling sphere concept.
- The standard seems to cover a wide range of lightning rods with auxiliary stimulation of pre-discharges on the tip of the rods. However, the standard does not distinguish between the different types, for which reason the standard is lacking necessary specifications versus the different form and principles for the individual device.
- Tests of the electronic components and auxiliary systems for the ESE rods, including the power supply for the ones which need it, to withstand lightning influences and aging are missing. Similarly are tests for evaluating the effect of the external environment missing, for example the effect of contamination for floating electrode systems.
- Requirements and specifications for the recurrent inspections and possibilities for testing of the individual ESE rods, including any necessary auxiliary systems, to verify their original and unchanged properties, are neither required nor specified in the French ESE standard or in its copies in other countries.

To conclude:

Even though the hypothesis behind the ESE concept at a first glance might seem rational and likely, it has shown to be partly wrong and in any case insufficient. Moreover, the working group

has selected a laboratory test in the standard for the determination of the advantage over ordinary lightning rods, a non-representative test in a non-representative environment, and thus a test that cannot take into account the nonlinearity of the discharge phenomena between laboratory conditions with stroke lengths quoted in meters while lightning discharges are quoted in kilometres.

As done by the working group behind the standard, it is fully legitimate to extrapolate the theories and models for discharges over moderate distances to lightning conditions in spite of the vast nonlinearities of the discharge phenomena. However it is indispensable subsequently to demonstrate and verify that the extrapolation with sufficient accuracy does work in practice. Unfortunately this has not been done, and it seems to reveal that the working group has suffered the lack of support by scientists with sufficient knowledge concerning physics of lightning.

In addition to the missing requirement in the standard for verification tests under natural lightning condition, the manufacturers have never succeeded in verifying the claimed efficiencies for any of the different ESE types (in a way that satisfies the international technical and scientific community within this field) in spite of the repeated promises over more than 15 years.

Similarly, it has neither been possible for independent scientists nor organizations to confirm the claimed advantages. On the other hand several investigations have indicated that the ESE devices offer no advantages relative to ordinary lightning rods.

To avoid similar problems and unfortunate errors and mistakes in the future, any standard ought to be exposed to international criticisms, especially when the standard concerns safety matters and devices used for safety purposes.

THE MORAL ASPECTS:

In spite of the lack of verification of the claimed properties, and in spite of the repeated criticisms from the scientific community, the ESE manufacturers have continued for more than 15 years to sell and promote ESE systems with promises of the non-proven efficiencies compared to ordinary lightning rods.

Instead of providing the repeatedly promised proofs for their claims, they have intimidated persons, organizations, companies and standard-organizations with threats of legal actions when they have pointed out, that the claimed advantages are un-proven and when they have warned against the use according to the claims until proven. Some manufacturers and vendors have even got so far as actually suing some of them.

Even the French Engineering Society (SEE) has been threatened with legal action by the French manufacturer.

THE LEGAL ASPECT:

- In the light of the current laws, what sort of responsibility does the manufacturers of ESE devices carry for their products?
- Is it possible for the manufacturers and the vendors to liberate themselves for any responsibility by referring to the French ESE standard or its copies in other countries, and leave the responsibility to the national standard organizations?
- Do the working groups behind the standards (and its single members) carry any legal responsibility?

- Who is in the last end responsible for the standard in France (and in other nations for the copies of the French ESE standard)?

- What sort of responsibility does scientists and scientific organizations like ICLP carry to enlighten similar problems like the ones in the ESE standards with protection systems that might be dangerous to use?

WHAT TO DO ABOUT THE SITUATION?

- How can the relevant authorities in France (and other nations) be approached to inform them about the problem with the ESE devices, and what can we do to help them solve the problems with the ESE standards?

- Do we need some sort of Codex for standardization, production, verification and commerce of safety devices like lightning protection devices, or should we merely leave it up to the market?

Title
:
CAUTIONARY MESSAGE ! of the ICLP Scientific Committee

Date
:
26-07-2004

Text
:
The Scientific Committee of ICLP wishes to inform all the ICLP Participants and Guests as well as the Visitors of ICLP Expositions that the displayed products, including any claimed properties, are solely the responsibility of the individual exhibitors, and thus ICLP has neither endorsed these products nor does it take any responsibilities for their functioning.

The message, as above, is given for the following reasons:

ICLP is a scientific/technical organ trying to promote science within lightning and the use of the results hereof for improving protection for people, animals and properties against the effects of lightning. According to its bylaws ICLP has a special responsibility to promote good practice and to warn against the use of devices that might jeopardize the required degree of protection and to prevent any promotion and advertising of devices and systems that are, or may be, dangerous. In line with this obligation, ICLP has several times been asked to give its statements concerning different forms of non-conventional lightning protection devices, like air terminations based on early streamer emission (ESE) technology or other no-proven air terminating systems or protection methods. In this context ICLP has warned against production, marketing and use of such systems before their claimed effects have been verified and the results generally agreed upon by the international scientific community. In addition these repeated warnings have also included

warnings against issuing standards for the use and specifications of such systems and methods (e.g., in USA, Australia, France and Spain), before the above requirements have been met.

In the call for papers ICLP, and its organizing committee, invite specialists and experts to present papers within the specified scopes with the proviso that papers will be rejected provided that they do not comply with the scientific state of art and the scope of the different sessions or disregard the general requirements in the call for papers, that: ***"Only papers of sufficiently high technical/scientific level will be accepted, excluding commercial papers promoting or advertising specific products or systems"***.

Similarly, and with the following condition, ICLP has provided possibilities for manufacturers and vendors against a modest fee, ***to exhibit their services and products illustrating the present state of lightning protection technology, . . "***. However, in order to categorize commercial products as part ***of the present stage of lightning protection technology***, the products have to be proven relevant and effective with regard to the claims of the manufacturers and vendors.

Therefore, in order to preserve ICLP's integrity and scientific standing, ICLP does not permit any commercial advertisements, promotions or exhibitions of the abovementioned non-proven devices during its conferences, a condition that will be enforced in order to avoid any repetitions of noncompliance with this requirement during exhibitions in connection with former conferences.