

E.S.E. and non conventional LP systems

Extracts from the paper of Prof. Aage E. PEDERSEN introduced during the 27th I.C.L .P. conference in Avignon- France- and interesting comments and response from a Malaysian lightning protection engineer.

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The following are Quotes extracted from the paper and our Comments with regards to your quotes.

THE TECHNICAL ASPECTS:

Quote:

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.

Comment:

Radioactive rods have been abandoned not because it shows no advantage relative to ordinary rods but because of environmental concern as it contains Radioactive substance which are currently banned in most countries after the nuclear disaster in Russia. In actual fact, radioactive rods are part of ESE rods too. The only difference is that Radioactive substance were used to launch the upstreamers while majority of today's ESE rods rely on the electric field to trigger the launch of upstreamers.

Quote:

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.

Comment:

I think there has been some confusion between the upstreamer and other discharges. Sharp tip does not mean that it can launch up streamer earlier. Sometimes the Corona Effect of a sharp tip forms space charge to prevent the launch of up streamer. A good ESE rod will launch upstreamers only at suitable time to prevent space charge problem.

Quote:

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.

Comment:

If TRIGGERING of a flash is extremely complex and much more complicated than anticipated, then is it correct to state the following?

Quote:

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.

Comment:

If the ESE rods do not have early streamer emission then the number of ESE rods required to protect a building will have to be the same as ordinary lightning rods i.e. one ESE rod every 10 to 15 meters apart. However there are many buildings that are equipped with only 1 ESE rod or even 1 ESE rod for several buildings.

In Hong Kong a total of more than 1000 ESE rods of our proprietary product; E.F. have been installed since 1975. Out of which 450 systems were monitored through our maintenance scheme as attached in Appendix A «E.F. in Hong Kong». Some of these systems were equipped with lightning counters and the total number of lightning discharges onto the system till date is 1266. The very rare cases where lightning did bypass the ESE rod and caused very minimal and minor damages are also listed in Appendix A. Based on this data, if ESE rod does not have any advantage versus ordinary lightning rods, then wouldn't most of the building suffer damages to the façade especially at the corners since the ESE rods are mostly placed at the centre of the buildings?

Quote:

«Moreover, several investigations (for inst. by Z.A.Hartono and by Charles B.More et al) have shown numbers of missinterceptions, and lightning strokes 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.»

Comment:

Does this mean that there are NO missinterceptions by the ordinary rods? Could we have more information as to the parallel setups? Were these setups done in actual Field Application where both ESE and ordinary Franklin rods were in placed? How many systems were installed? What was the coverage area?

The Lightning Flash Density in Kuala Lumpur is more than 25 per kilometer square per year (1). We have been supplying E.F. since 1995 in Malaysia and till date we have supplied more than 250 systems with 75 systems located in Kuala Lumpur. If there are missinterceptions and ESE rods do not have the claimed properties, then wouldn't all these buildings have damages to the façade especially when located in an extremely high lightning flash density area? For your further information, 45 of these buildings located in Kuala Lumpur are higher than 60 meters while more than 95% of the systems installed in Hong Kong are higher than 60 meters. Our data clearly proves the effectiveness of ESE rods for buildings of any height and open areas. This would also mean that our proprietary product is above IEC 1024 and NF C 17-102 since the standards are meant for buildings less than 60 meters only.

Creditability

New concepts are always turned down by authorities who are always cautious. It normally takes a long time; sometimes many decades to centuries before a new theory or concept is being approved depending on the evolution of the item especially any theory that cannot be simulated or tested in laboratory. For example, when car was first invented, people said that a car can never run faster than a horse but today we cannot live without a car. When Kolaj Kopenik first presented the theory that the earth moves around the sun no one believed him and he was even persecuted. After he died many years, then only people accepted his theory. As another example, when wireless communication was first invented, a British general said that wire is the only way for telecommunication. Today, a mobile telephone has become a basic necessity. Even until today, some people still disagree with Darwin's evolution.

Quote:

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.

Comment:

I agree that standards are important especially where safety is the issue. However in lightning protection can any standard i.e. IEC 1024, NF C 17-102, BS 6651, etc. provide 100% guarantee? If lightning cannot be simulated in the laboratory and triggering lightning is very complex, then can any standard prevent or withstand Mother Nature?

In today's world, a day can hardly go by without the use of electronics. However electronics are very susceptible to damaged by effects of a lightning strike. BS 6651:1992 Appendix C. «General advise on protection of electronic equipment within or on structures against lightning» provided a guidance on this topic. However when this standard was revised in 1999, it still remained in Appendix C. When will be the next issue and will it be part of the standard or remain as Appendix C? This clearly shows that for a standard to recognize new components, apparatuses or systems, it takes a very long time and until it has been fully adopted, end-users continue suffer damages and losses.

Quote:

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.

Comment:

Because of the unpredictable nature and incomplete understanding of the mechanism of lightning, the condition of today's lightning research has not changed much from Benjamin Franklin's time where there were no verified physical theory and models. All suggested modeling of today are still full of assumptions which means it is not much different from Benjamin Franklin - No Model.

Recognized tradition? In the 1990s, French scientists made «life-size» experiments on lightning during several years in Saint Privat d'Allier. Subsequently in 1995, the NFC 17-102 standard was issued.

Practise and experiments from the field? Improvement of ionising initiation used in ESE devices is also inspired by what has always been observed in the nature such as lightning strikes favoured by hot ionised air coming out of chimneys, emission coming out of radioactive rocks, discharges between objects with a floating potential, etc.

Quote:

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.

Comment:

Therefore I agree that at this moment we should only consider Field Application instead of laboratory test because lightning is unpredictable and a natural event. However my interpretation of Field Application is to collect data containing the following parameters namely:

- a) The total number S lightning strike intercepted by ESE systems.
- b) The number N of ESE system observed/monitored
- c) Monitoring period in Year
- d) Number F lightning bypass the ESE system
- e) Number K bypass due to malfunction of ESE system such as poor up keep and incomplete system or misapplication
- f) The area covered by the above monitored ESE systems.
- g) Exact location of installation for third party to verify the data easier.

With the above parameter, we can calculate the failure rate R of ESE system in respect to number of ESE system by:

$$R = \frac{F - K}{N}$$

And the failure rate P of ESE system in respect to number of lightning strike by:

$$P = \frac{F - K}{S}$$

In order to minimize the random effect, the field statistic should fulfill the following criteria:

- 1) The number of ESE systems to be observed must not be in tens but in hundreds to thousandsthe more the better.
- 2) The area covered must in the hundreds to thousands KM2 ...the more the better.
- 3) The monitoring period must be more than 10 yearsthe longer the better.

We know that there are not many sites in the world that can fulfill the above conditions, except Hong Kong. Nearly 70% of Hong Kong buildings are using ESE systems which have been installed since the 1970s (2). Appendix A shows that we have been monitoring the systems and have records of more than 20 years. It clearly proves the effectiveness of E.F. i.e a type of ESE rod. A similar study of another brand of ESE system also indicates the effectiveness of ESE system. The failure rate R is less than 1% per year and the main reason of failure was weak lightning discharge. If you or any other international independent research body is interested to have a further study or research through the Hong Kong platform, please contact us and we are willing to render our assistance.

To conclude:

Quote:

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.

Comment:

If ESE rods are ineffective but there are so many buildings around the world that utilizes it, then would it mean that these buildings are not protected from lightning? Malaysia has the second highest lightning incidences in the world and there are more than 1,000 installations of ESE rods by many different manufacturers in the entire country. If your findings are true, then at least 50% of these buildings would have damages to the façade. We cannot provide a very detailed data as our Hong Kong counterpart can, but what we can share is the following:

- 1. Empire Tower in Kuala Lumpur installed E.F. on 27th Dec. 2001 has recorded 2 lightning discharges as of 11th March 2002.
- 2. Berjaya Times Square in Kuala Lumpur installed E.F. on 11th Sept. 2002 has recorded lightning discharges as of 24th Nov. 2004 as follows:

	Total Lightning Discharge
High Zone Tower A	15
High Zone Tower B	18
Low Zone Tower B	4
Low Zone Tower A	0

- 3. Federal Hill Housing installed E.F. on 2nd Dec. 2004 has recorded 3 lightning discharges as of 2nd Dec. 2005

THE MORAL ASPECTS:

Quote:

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.

Comment:

What other proof is better than seeing and experiencing it yourself? ESE rods have been used for 30 years. If it is not proven in Field Application, this system would have been abandoned just like the others. Engineers continue to use ESE rods and ESE market continue to expand instead of shrinking not because person, organizations, companies, etc. are being intimidated but merely because they are confident in ESE rods. The number of systems installed without having much problems arising after thunderstorm has

proved the effectiveness of ESE rods. Lightning is totally unpredictable but with its wide used in tropical country it is only a matter of collecting the data from Field Application as a prove.

THE LEGAL ASPECT:

What sort of responsibility do standard bodies carry? In MS IEC 61024-1-2:2001 it states in the National Foreward «Compliance with a Malaysia Standard does not of itself confer immunity from legal obligations.» In IEC 61024-1-2 clause 1.1 states «This part of IEC 61024 serves as a guide and is applicable to the design and installation of LPS for common structures up to 60 m high». Hence if an engineer were to do any design for lightning protection does the standard enlighten their responsibility? What more when the building is more than 60m high?

I hope to hear from you soon on the issues I raised because I strongly feel that it is unjust to ban ESE system unless you can provide reference data. We also hope that you will consider withdrawing your paper until a thorough study on ESE performance in Field Application is carried out.

References:

- (1) MS 1460:1999 pg. 3
- (2) A Preliminary Survey of Lightning Protection Practices in Hong Kong Buildings. By Y DU, PhD CENG MIEE and K M LAU, B Eng (Hons) Msc. Published in The Hong Kong Institution of Engineers Transactions. Volume 10. Number 3.