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2010.01.06

THE INDUSTRIES FAILURE TO VERIFY THE CLAIMED ESE EFFICIENCIES

The ESE industry has recurrently been requested to present some form of solid verifications of the claimed efficiencies of ESE lightning receptors that according to the manufacturers' claims only require a very small numbers of ESE receptors in comparison to the required number of ordinary lightning rods specified in the worldwide recognized lightning protection standards, unfortunately requested without results.

Even though the ESE receptors have been on the marked for about 30 years none of the ESE industries (or anyone else for that matter) has presented such solid verifications of the improved efficiencies claimed compared to ordinary lightning rods.

The only defense presented by the industry for the claimed functions is:

1. The laboratory test specified in the national French ESE standard and the corresponding standards in some other countries. (See comments in Appendix 1 to the problems concerning the ESE laboratory tests)
2. The waste number of ESE installations, claimed to work with only little customer complaints, and similar industry reports without independent researchers' verification. (See comments in Appendix 2 to the above used argument)
3. The results from model simulations for which the models have been incapable of providing results in agreement with nature and the results therefore have to be refuted. (See for inst. the work by Prof. V. Cooray and his group)

Why has the industry and the proponent not been able to do better in spite of urgent and repeated requests and considering the great number of years on the market?

The reason is that it is simply physically impossible to provide the proof or verification of the ESE technology called for, as the ESE receptors do not function in practice according to the predictions and claims of the ESE industry. This discrepancy between claimed and actual function is caused by the use of a none-realistic laboratory test designed on hypotheses that have shown to be inadequate and wrong, both facts that is devastating for the ESE technology.

This lack of agreement between the claims and the results in practice has been shown repeatedly over the years by independent scientists and experts, and additionally, the hypotheses have similarly been proven wrong and therefore must be refuted as not applicable.

The incapability of the ESE technology to provide the claimed and promised efficiencies has been proven over and again by independent scientists and experts by means of:

- Results from monitored test-stations under natural lightning conditions.
- Results of theoretical investigations.
- Results from investigations of actual constructions protected according to the ESE specifications and the malfunctions experienced.

These findings have proved that a ESE receptor do function similarly to a simple lightning rods and do not provide any higher degree of protection. **Therefore, it is dangerous to use ESE types of lightning receptors when trusting the no-existing, but claimed, improved efficiencies.**

This raises the following questions:

- Why do the ESE industries ignore or disregard these findings that are so simple to check?
- Why do they instead continue with their unfounded and literal false advertisements?
- Why does the industry still persuade innocent people to prefer such inefficient systems before ordinary lightning protection systems that over more than two hundred years have shown its merits?
- Why do some of the ESE proponents still try hard to get the ESE technology into different standards, even though none of the leading standards or standard organizations have given in for their unduly pressure?

Additional information about ESE and other non-conventional systems can for inst. be found on:

- ICLP's homepage: www.iclp-centre.org, and on
- LightningProtection@yahoogroups.com

Additional information published for inst. by:

- Prof. C. Moore, Prof. W. Rison and associates – New Mexico Institute of Mining and Technology, Socorro, New Mexico, US.
- Prof. V. Cooray and his group - Uppsala University, Sweden.
- Prof. V. A. Rakov and Prof. M. A. Uman and their groups - Department of Electrical and Computer Engineering, University of Florida, US.
- Mr. Z. A. Hartono et al., Lightning Research Pte. Ltd. Kuala Lumpur, MALAYSIA.
- Lightning Protection Consultant Dr. A. Mousa, Vancouver, B.C., Canada.

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APPENDIX 1

CONSIDERATIONS CONCERNING INVESTIGATION OF EFFICIENCIES OF LIGHTNING PROTECTION DEVICES

HIGH VOLTAGE LABORATORY TESTS

From the well known test technique in highvoltage laboratories, the determination and presentation of the results of withstand or flashover properties of air gaps under influence of repeated impulse voltages from low to high prospective amplitude values are given in two different ways namely:

a) As the probability frequency distributions (or accumulated probability distributions) curves, or
b) As volt-time curves depicting the time to breakdown from the time of voltage application for tests from low to high voltage values.

The information gained by the two methods is complementary but even in combination do not contain the full information of the insulation properties.

The first method a) is suitable for determining the voltage levels, where no flashover will occur or voltage levels that always result in a flashover or alternatively the 50% value in connection with the form of the frequency probability distribution (or slope of the accumulated distribution function) for the estimation of the same quantities. It should be remembered that the determination of any point of the probability distribution curve, taking the statistical distribution of the physical phenomena into account, requires a high number of repeated tests.
However, as time is a hidden parameter the method is not well suited for insulation coordination purposes and the results in principles only apply when not influenced by other objects.

The other method b) is more suited for determining whether one type of air-gap will protect another gap as for inst. demonstrated in the well known experiment showing the difference between sphere-gaps and rod-gaps, where flashover (when the two gap distances are properly adjusted) always occur in the rod-gap at low voltage values, but at high values of the prospective voltage the flash-over always occur in the sphere-gab and thus at high prospective voltages will protect the rod-gap, and vice versa for low voltage values. This phenomenon is, as all of us know, caused by the shorter time required for breakdowns in sphere gaps when a sufficient voltage have been reached.

The situation, however, is even more complicated and complex as the time to breakdown, at a given value of the applied voltage, similarly exhibit a distribution of the time to flashover at each voltage level. This means that at some voltage levels the break down sometime will happen in the rod-gap, sometime in the sphere-gap, and sometime it may not lead to breakdown at all.

As the system voltages increased, beyond 200 kV, it was unexpectedly observed that the withstand voltages for slowly rising impulses, as experienced during switching operations, did not increase proportional to the increase in system voltages. This gave rise to a tremendous number of research programs to investigate the phenomena.

One of the interesting results of the experiments was the formation of extremely long streamers (in comparison to the distances between the electrodes under tests). The streamers developed from the high voltage electrodes, sometime to the ground far away from the testobject, sometime followed by a flash, sometime without, and some streamers developed randomly into the air without terminating on the ground.
Unfortunately, the behavior of the streamers, and thus the breakdown, is impossible to predict and due to the randomness impossible to calculate in detail, thus leaving the determination to experiments and experience.

DETERMINATION OF EFFICIENCIES OF LIGHTNIUNG PROTECTION DEVICES

Turning now to lightning protection, the determination of the efficiencies of different protection devices is much more complicated, as the influencing factor, the lightning flash, varies tremendously compared to the situation in a high voltage laboratory with fixed impulse voltage shapes in more or less fixed set-ups. For this reason and due to the above mentioned randomness in streamer formation imply that for the time being it is impossible to model and calculate the final result, and for the same reason laboratory tests (indoor or outdoor) for the determination of the efficiencies of lightning protection devices are similarly impossible. Furthermore, it is not alone necessary to have a streamers/leader formation from the approaching lightning leader, but also from the protection device, and even more, they have to meet and provide the final flash.

At present there seems only to be two methods available for the determination of the efficiency of different lightning protection devices of which none of the methods are particularly satisfactory, accurate or fast.

The two methods are characterized by the following possibilities and shortcomings:

A) The first method concerns the collection and critical analyses of field data of protection failure for different protection devices in dependence of positioning and proximity to other objects to be protected including other protection devices.
Such investigations take an extremely long period of time in order to get sufficient data, and require an extreme accuracy in the collection of data and the analyses hereof.
Faster methods to provide results can be achieved by instrumented and monitored test stations exposed to natural lightning where different devices are exposed to the same influences.
In order to get sufficient number of lightning flashes, such test stations are normally setup at locations with high lightning density, but the results achieved may not necessarily be representative for other locations.
Moreover, such test results show only which type of device that is better than another type, but not how much*.
This is clearly demonstrated by the results from the well known test station in New Mexico, planned and conducted by Prof. C. Moore and Prof. W. Rison.
The long term test period showed that blunt rods were more efficient than sharp pointed rods, but such results, unfortunately, do not indicate the degree of the improved efficiency of blunt rods.
As a great surprise, the long term test of simple lightning rods in competition with ESE rods showed that all of the lightning flashes terminated on the simple lightning rods and none on the ESE rods.
This demonstrated clearly, that the ESE rods did not function as well as the simple rods, but the difference in efficiency might be marginal.
However, the advertised advantages of ESE devices have been effectively punctured and proven as non-existing. The results have additionally proven that the ESE laboratory qualifi-

* In addition it is nearly impossible within a reasonable time to investigate the behaviour of the devices under positive flashes due to its lower flash density.

cation test (developed and specified by the ESE proponents) and on which the claimed increase in efficiency rest, is inadequate and results in wrong predictions of efficiencies of lightning protection devices.

B) The second method concern modeling of the single physical processes encompassed in the flash.
Unfortunately not all of the physical processes are known, and not known with sufficient accuracy, and even if known, the calculations would be so complicated and only feasibly when the models have been sufficiently simplified [confer for inst. the problems concerning the randomly development of streamers and the breakdown probability during switching impulse tests, and the comments in the introduction to a) and b), both as listed above].
This means that the outcome of such models and calculations will be correspondently limited in accuracy.
Therefore, the results of such models should be evaluated accordantly and only be used for analytical purposes and limited to investigations within a narrow range of changes in parameter values.
Even though great improvements in modeling have been reached in recent years, it might take several decades before calculations can substitute results from actual lightning events, and additional decades before general agreement can be reached on the models and the programs to be used for the evaluation of the actual and effective efficiency of different lightning protection devices and as a function of their positioning.

CONCLUSION

As a conclusion it seems that the only possibilities for the time being are limited to:

1) Evaluation of the relative efficiency of the single devices by investigating their ability to protect some specific objects by comparing the efficiencies of different protection devices in instrumented and monitored test stations under natural lightning exposure.
2) A critical analysis of the lightning protection bypassed by lightning flashes in actual protected structures.
3) The use of the available knowledge in lightning physics, and the results of models as analytical tools, trying to explain the observations collected under 1) and 2).

Therefore it will be extremely important to continue the investigation and improve the measurement of the different lightning parameters in further detail and to continue the attempts to develop better models suitable for calculation, for which the unavoidable simplification do not obscure the results as compared to what happen in nature. This will be tuff tasks, but necessary tasks.

The considerations above are important to take into account in detail when planning tests to evaluate lightning protection devices, especially when such research are sponsored by industries interested in gaining support for own designs.

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2011.01.06

APPENDIX 2

WHY ARE ONLY VERY FEW MISS-INTERCEPTIONS REPORTED FROM ESE-PROTECTED BUILDINGS?

Old Farmhouses:

Farms are usually situated isolated in rural areas each of them directly exposed and prone to lightning. In older days, in our country, most of the roofs on farms were at that time generally made of inflammable material, normally as thatched roofs, for which reason most of the farms were protected against lightning.

As a consequence of the inflammable roofs any miss-interception was liable, with great probability, to start a fire.

Therefore it was necessity to optimize the lightning protection to save farms animals and people, if not designed or installed well enough, the results as fire could be seen miles away.

Due to the serious consequences for animals, properties and human lives farmers did not go to bed during a lightning storm. In order to stay awake they drank strong coffee, named thunder-coffee, a name still used today for strong coffee.

Collection of data and the following analysis showed the very big difference between non-protected and protected farms and in addition great difference between the different qualities of lightning protection. As a consequence the costs for fire-insurances were subsequent graduated accordantly.

Modern Buildings and Houses:

Today most of the bigger buildings are made by reinforced concrete or as steel structures filled with prefabricated elements and thus very difficult to set on fire. Thus miss-interceptions to such buildings are much more difficult to recognize as normally the only consequence will be that small lumps of concrete will be blown off at the terminating point of the flash, where a flashover to the conductive material in the building will take place. Such incidents will normally pass unnoticed except when the pieces of concrete falls down on old ladies or on children, and the incidents afterwards will be reported in the news. It is even more difficult to detect miss-interception when the roof is metal cladded.

These difficulties in recognizing miss-interception in such buildings may be the reason for the very small numbers of customer complaints collected in connection with ESE protected buildings.

However, when making a thorough investigation many of the miss-interceptions can readily be localized and identified as repeatedly reported after such investigations.