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GROUP 4 LIGHTNING ATTACHMENT CHAIRMAN'S REPORT

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ORAL SESSION

4.1. The collection surface concept as a reliable method of proceeding strike location.
Hartono Z., Robiah I., *Malaysia*.

4.2. A study of non-conventional air terminals and stricken points in a high thunderstorm region.
Hartono Z., Robiah I., *Malaysia.*

4.3. A modern perspective on direct strike lightning protection.
D'Alessandro F., Gumley J.R., *Australia.*

4.4. Lightning to earthed structures: Comparison of models with lightning strike data
Petrov N., *Russia* – **D'Alessandro F.,** *Australia.*

4.7. A comparison between lightning dissipators and Franklin rods on the impulse response of a scale model of a 110 kV transmission line.
Gallagher T., Huang C., Holly M., Kelliher C. *Ireland.*

4.8. Rolling sphere. – Theory and application.
Horváth T., *Hungary.*

4.13. Attachment process models for the meshwork external protection.
Szczerbinski M., *Poland.*

4.22. Interception of a lightning stroke.
Menemenelis C., *Greece.*

4.23. The development of the tree dimensional „collection volume method" as an improved electro-geometric model for the protection of structures.
D'Alessandro F., Gumley J.R., *Australia.*

4.25. Lightning magnitude and protection properties of air terminals.
Mazur V., Ruhnke L., *USA*.

POSTER SESSION

4.5. Laboratory study of Franklin rod height impact on striking distance
Grzybowski S., Gao G., *USA*

4.9. Influence of earth discontinuity on the capture zones of a vertical lightning conductor.
Boubakeur A., Chouchou A., Boumaza S., *Algeria.*

4.10. Determination of attractive-area and collection-volume of earthed structures.
Petrov N., Petrova G., *Russia* – **Waters R.,** *UK.*

4.11. The influence of the local space charges on the lightning attachment process.
Drabkin M., Carpenter Jr R., *USA.*

4.12. Experimental study of the emission current from ion plasma generator.
Drabkin M., Grzybowski S., *USA.*

4.17. Computer modeling of earth conductivity and relief effects on lightning orientation.
Noskov M D., Pleshkov O I., Lopatin V V., *Russia.*

4.21. Model experiments of lightning discharge characteristics to power lines.
Goto Y., Sato T., Ono I., Sato T., *Japan*

4.24. Modeling lightning connection process to a ground structure.
Fofana I., Beroual A., *France.*

OUT OF SCOPE OF THE GROUP

4.15. Effect of the lateral distance expression and of the presence of shielding wires on the evaluation of the number of lightning induced voltages.
Borghetti A., Nucci C A., Paolone M., Bernardi M., *Italy.*

ORAL SESSION

THE ROLLING SPHERE

The rolling sphere method was introduced in the Hungarian standard of lightning protection in 1962 as the historical review reports in Paper 4.8. Its theoretical basis was the same which is known as rolling sphere theory today. Although this theory has been surpassed in Hungary the rolling sphere is the best method for construction of air terminals. In contrast to the radius proved by more than 30 years experience in Hungary the international practice is dubious and therefore the applied radius of sphere has been assumed with great caution. In contrast to the practical application the rolling sphere cannot give a basis for theoretical studies on the efficiency of interception devices.

Many other papers refer to the rolling sphere method from different points of view. Paper 4.1. takes this method as a scientific basis and tries to go forward by its modification inheriting all problems of the rolling sphere theory too. Paper 4.13. takes the rolling sphere with the radii by IEC a basis for comparison. Because of the small radius the results are uncertain. Paper 4.3. refers to the rolling sphere theory and says the radius of 45 m by IEC too small. Paper 4.25. takes the rolling sphere method as correct but finds problems with its radius.

COLLECTION VOLUME/SURFACE CONCEPT

It seems to be a new method but the author of this summary presented its more sophisticated version in his first report on the „7. Internationale Blitzschutzkonferenz" in Arnhem, 1963 and later several times (Munich 1971, Graz 1988, Firenze 1996) and in a book: „Computation of lightning protection" 1991. It is nice that this way has recently been found again but to read the old ICLP proceedings would be useful as well. Other authors also made some steps on this way (Hofbauer in Graz, 1988) and Vo Viet Dan found almost the final solution (Graz, 1988).

Paper 4.1. refers on several methods used for construction of protected space and compares them with observed striking points. The high number of recorded strokes is very important. The comparison demonstrates the failures of the construction methods. The application of the mentioned sophisticated computation method would lead to conclusions which harmonize with the results of this paper..

Paper 4.4. is very similar to the computation method described previously in several ICLP proceedings as referred before. In principle it seems to be correct but it is difficult to follow or reproduce because of the many „empirical formulas" which cause different corrections. The checking of the calculated results is also correct but pore, because it is related only on one case. It would be useful to make a comparison with observations on other towers, on transmission lines in the case of protective earth wires.

Paper 4.23. deals with the application of the above described method. For this purpose a typical structure is taken as an example which can be protected by 9 rods in contrast to the rolling sphere method according to IEC61024-1: protection level III. For this construction a 45 m rolling sphere was applied. Concerning the conclusions there are some open questions: What does it mean the assumed 93% protection level? Is it sufficient or would be increased?

NON-CONVENTIONAL AIR TERMINALS

Paper 4.2. presents a study which demonstrates that buildings have been struck by lightning in spite of the different types of ESE air terminals. Another part of the observations shows by observed lightning strokes the mostly exposed points of the buildings which need local air terminals.

Beside other topics the Paper 4.3. deals with the effect of the shape of air terminals and states that the space charge greatly reduces the electric field around a sharp electrode. If the steamer initiation attempt is too early it can delay the establishment of a stable, propagating upward leader.

Paper 4.7. describes a model experiment with the 1:100 scale model of a 110 kV line. The lightning channel was represented by a metal rod in 100 m height according to the scale. Although the validity of this experiment may be doubtful it produced the expected results. A special statement is that the spline ball dissipators did not eliminate the lightning strokes and their interception efficiency was less than the simple Franklin rod.

Paper 4.22. concludes to the statement that the interception efficiency of a device is determined by the length of the upward leader emerging from its tip. The corona or early streamer discharge do not produce the same effect than the upward leader. To develop an upward leader a minimum energy must be supplied into the discharge channel, which is induced by the downward leader. The corona or early streamer devices produce only space charge but do not increase the supplied energy, therefore they cannot intensify the interception.

POSTER SESSION

SCALE MODEL EXPERIMENTS

Paper 4.5. concludes to the statement that a Franklin rod attracts the negative strokes then the positive. This is in agreement with similar old scale model experiments.

Paper 4.9. aims to study the inhomogenity of the earth but according to the description of the applied model there is a geometrical difference between the two parts of the earth electrode.

Paper 4.21. investigates the behavior of transmission lines with wires covered by insulating material. The lightning was modeled with discharges along the surface of an insulating plate.

SIMULATION BY FIELD CALCULATION

Paper 4.10. simulates a tower with a half ellipsoid in vertical homogeneous field. On this basis an attractive cone is defined which is applied to calculate the expected frequency of lightning stoke.

Paper 4.17. studies the influence of the earth on the lightning path by field calculation. The conductivity and the shape of the earth are considered. Wit a random simulation the branching of the lightning channel is also simulated.

The physical processes are simulated by Paper 4.24. in the downward leader, the connecting leader and the transition into the main discharge after their contact.

EFFECTS OF SPACE CHARGE

Paper 4.11. deals with elimination of the lightning flash instead of its interception.

Paper 4.12. describes current measurements on spline ball electrodes without direct referring to the lightning.