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**Section 5.4.3**~ **National Lightning Safety Institute** ~

## Scientists Oppose Early Streamer Air Terminals

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I wish to make readers aware of the extent of the opposition of the scientific community to Early Streamer Emission (ESE) lightning rods. In an unprecedented move, 17 scientists who are members of the Scientific Committee of ICLP (International Conference on Lightning Protection) issued a joint statement opposing ESE lightning rod technology. The scientists represent 15 countries including the USA, Japan, Great Britain and 12 countries from Continental Europe, and 14 of them are well-known university professors.

The statement was sent to NFPA (National Fire Protection Association of the USA) in connection with the NFPA review regarding whether a standard for ESE devices should be considered. It is worth noting that a draft standard for such devices was rejected by the NFPA in 1995.

ESE proponents, led by the Heary Brothers, then sued the NFPA alleging improper motive behind the rejection of their draft standard. The litigation was settled out of court by the NFPA agreeing to form a new panel to re-consider whether ESE devices have a scientific basis. The ICLP statement was submitted to the NFPA Panel, which is headed by Dr. John L. Bryan, in connection with the subject review. A list of the 17 scientists follows:

1. Professor Ch. Bouquegneau (Belgium)
2. Mr. L. Dellera (Italy)
3. Professor O. Farish (United Kingdom)
4. Professor Z. Flisowski (Poland) - Vice-President of ICLP
5. Professor W. Hadrian (Austria)
6. Professor T. Horvath (Hungary)
7. Dr. J. Huse (Norway)
8. Professor T. Kawamura (Japan)
9. Professor C. Mazzetti (Italy) - President of ICLP
10. Professor C. Menemenlis (Greece)
11. Mr. E. Montandon (Switzerland)
12. Professor Aa. E. Pedersen (Denmark) - Honorary Member
13. Professor S. Lundquist (Sweden) - Honorary Member
14. Professor V. Scuka (Sweden) > 15. Professor M.A. Uman (USA)
16. Professor P.C.T. van der Laan (Netherlands) > 17. Professor J. Wiesinger (Germany)

A transcript of the ICLP fax to NFPA, which was dated February 26, 1999, follows:

### **THE ICLP STATEMENT TO THE NFPA DRAFT STANDARD 781.**

Referring to the NFPA request for information and comments to their Panel set up to prepare a reexamination report of the NFPA draft standard 781 on ESE devices, which has been reopened for a new evaluation, ICLP (International Conference on Lightning and Lightning Protection) wishes to give the following information.

### **THE ASSUMPTIONS BEHIND THE NFPA ESE DRAFT STANDARD 781**

Lightning protection is a primary safety issue. Protection systems and means are provided in order to ensure personal safety and to reduce the risk of fire, equipment and systems damages, malfunctions and production interruptions etc. to a tolerable level. To fulfill these requirements and avoid legal actions, including claims of economical losses etc., standard of lightning protection systems should be based on scientifically proven and indisputable technical arguments.

The claimed function of an ESE device is the triggering of an early upwards streamer/leader at a time,  $\Delta T$ , earlier than the triggering time of a simple lightning rod. The time difference,  $\Delta T$ , is defined as the time advantage. It is proposed that this time advantage be multiplied by a constant velocity of the upwards progressing discharge. The velocity multiplied by  $\Delta T$  determines the length,  $\Delta L$ , of the triggered discharge.

The philosophy of the promoters of ESE rods is, that an ESE rod of the length  $L$  gives the same protection as a simple lightning rod of length,  $L$ , plus the above-mentioned  $\Delta L$ , i.e.,  $L + \Delta L$ .

On this assumption the protection, as specified in the draft standard, is designed in principle using the Rolling Sphere Method.

### **ICLP's COMMENTS AND STATEMENTS**

The subject of Early Streamer Emission devices has been analyzed closely by the Scientific Committee of ICLP and its members. Moreover, the subject has been dealt with in connection with discussions of papers presented during the recent year's conferences.

With this background, and on the basis of the latest results within the fields of lightning physics and the individual lightning processes, and the results of field tests, ICLP wish to submit the following information on major aspects of the subject to the NFPA and their Panel concerning the draft standard 781 under examination.

1. Unfortunately the above mentioned function claimed for the operation of the ESE rod has never been proven to be correct under natural lightning conditions. Independent researchers have been unable to demonstrate the expected advantages determined by means of the specified laboratory tests. On the contrary, the ESE rod and the simple Franklin rod do not show any major difference in the protection distance and the difference in the number of flashes to the Franklin and the ESE rods in competition tests.

2. The draft standard does not clearly distinguish between the different types of discharges: streamer, cold and hot leader, and whether the discharges are stable (self-contained) or if they will cease (be extinguished). This is unfortunate, because each of the different types of discharges has its own set of properties: current, field-strength, velocity etc. Moreover, for the specified determination of the "upwards leader initiation time" in the laboratory in connection with break down tests of the different types of rods, the minimum dimensions specified are so small, that it is doubtful whether the initiated streamer develops into a (cold) leader. Finally, the draft standard does not consider what relationship the streamer or (cold) leader-initiated breakdown has to the initiation of a stable hot leader as they develop under natural lightning conditions.

3. The specified laboratory test does not consider the immense difference in scale for the laboratory set-up and the actual dimensions in the field. Due to these differences, the different field conditions in a high voltage laboratory versus the ones under natural lightning conditions, and due to the highly nonlinear nature of the different discharge phenomena, it is impossible in the laboratory to determine the development of a stable progressing hot leader, as it develops under natural conditions.

In any case the specified minimum dimension is so small that it might even be impossible for the streamer to develop into a stable (cold) leader. Finally, even if it were possible in the

laboratory to determine the onset of a stable progressing (cold) leader, the draft standard specifies an unrealistic high velocity of the progressing discharge, which has no resemblance to the velocity of a hot leader as developed under natural conditions.

4. The specified field qualification test seems not to be adequate for the determination of the order of merits of the different types of rods when considering the findings given in comment 1. Apparently, the reason is that the current specified in the draft standard for the pre-discharge under natural conditions, does not ensure, that the discharge will progress continuously nor, if it seems to do so, that a junction with the down coming leader automatically will follow.

5. The specified concept for the determination of the protection distance by means of the Rolling Sphere Method rests on a misconception of the methods. Therefore, the results determined by the draft standard are incorrect. The position of an imaginary conducting plane, at a given height of the construction, before the application of the Rolling Sphere Method, as indicated in the draft standard [cf. for inst. Figure C-3.2(b) Example of design], will completely change the original field around the object. The result will therefore be invalid for the original construction. Thus, the evaluation of the protection, for inst. for a Franklin rod, will be different depending on whether it is determined according to the draft standard or the IEC standard (and the corresponding American standard). This difference may imply legal consequences when responsibility of a lightning protection failure will be judged.

6. When considering the above-mentioned information, and considering that the lightning protection is a matter of achieving safety, it is evident that the concept of the ESE rods is inadequate to provide the safety such as defined in the draft standard. For this reason alone the draft standard does not satisfy the minimum requirements for a safety standard. Therefore, the NFPA draft standard 781 should not be accepted.

As a consequence, ICLP strongly recommends the suspension of the draft standard completely as it has already been done once before.

Finally, ICLP wants to express its willingness to provide NFPA and the Panel with more detailed information if requested.

On behalf of ICLP

Signed by:

Prof. Dr. Ing. C. Mazzetti, President of ICLP  
Prof. Dr. Zdobyslaw Flisowski, Vice President of ICLP  
Abdul M. Mousa; Burnaby, BC Canada

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