NLSI

~ National Lightning Safety Institute ~

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A letter from an NLSI contributor

Charge Transfer System is Wishful Thinking, Not Science

New Mexico Institute of Mining and Technology, Socorro, NM 87801
Langmuir Laboratory for Atmospheric Research
Phone: (505) 835-5423 Fax: (505) 835-5913

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Jodi Haasz
Standards Board
Standards Activities
IEEE- Power Engineering Society
P. O. Box 1331
Piscataway, NJ 1331-1331

Subject: Project Number P1576 (Proposed Standard for Lightning Protection System Using the "Charge Transfer System" for Industrial and Commercial Installations.)

Dear Administrator Haasz:

The purpose of this communication is to recommend that the IEEE be extraordinarily careful in its consideration of the proposed standard. Before a standard for the use of "Charge Transfer Systems" is issued, the Standards Board members should obtain and assess information on the electrical responses by these devices under active thunderstorms that has been measured by competent, independent investigators.

The present consensus held by members of the lightning and thunderstorm electricity community in both the American Geophysical Union and in the American Meteorological Society about these devices is that they are replays of Benjamin Franklin's original, failed ideas about lightning rods. In the course of some parlor experiments, he and his associates discovered that they could discharge electrified objects silently, without sparks, by approaching them while holding a sharp-tipped needle directed at the object. This discovery of the "point discharge" or "corona current" phenomenon led Franklin to suggest that, perhaps, thunderclouds could similarly be discharged, thus preventing lightning, by taking away its electricity. However, after Franklin erected a sharp-tipped iron rod for this purpose, instead of discharging a thundercloud passing above, his rod was struck by lightning. Thereafter, Franklin recognized that a primary function for an elevated rod was to be a lightning receptor and to carry the lightning to Earth, around structures that were to be protected.

Despite this new and unexpected function that his rods appeared to serve, Franklin (1767) remained enamored of the "power of a point" and recommended that the tips of lightning rods be sharp, a configuration that is still widely used today although the virtue of having sharp tips on lightning rods has never been established. Our assessment of the experience gained since Franklin's time is that sharp rods and "dissipation arrays" exposed in isolation on high towers are often struck by lightning but there is no credible evidence that they prevent lightning, which usually initiates high up in thunderclouds

My associates, Drs. William Rison and Paul Krehbiel in the Electrical Engineering Department at New Mexico Tech, have constructed and deployed a "lightning mapping array" that records the

occurrence, with a GPS time tag, of the strongest VHF radiation caused by lightning every 100 microseconds at each of the ten measuring stations in the array. By using time-of-arrival techniques, they are the able to locate, three dimensionally, the location of each source. (For more information on this array, go to *www.lightning.nmt.edu*).

Drs. Rison and Krehbiel find that the negative cloud-to-ground lightning here in New Mexico, in western Kansas and over central Oklahoma typically starts at altitudes between 5 km (about 16,400 feet) and 6 km (about 20,000 feet) above sea level at heights where it is unaffected by objects at the surface of the Earth. It is now well established that surface conditions have little to do with the initiation of cloud-to-ground lightning discharges, high in thunderclouds.

During the 1969 summer, we were hosts to Willard Starr, Roy Carpenter's predecessor and father-in-law, during the early field tests of his "charge-dissipation" system. (Starr believed that the corona discharges from elevated barbed wires could eliminate lightning, hurricanes and tornadoes.) We showed Starr how to measure the currents flowing to his array of barbed-wires, furnished him with a recorder and with a physical interpretation (which he ignored) of the sudden, large displacement-current surges caused by the lightning that continued despite his large array of elevated barbed wires.

In the years since there has been many incidents in which lightning has struck these "dissipation arrays". There are photographs of strikes to a tall tower at Eglin Air Force Base, to a 500 foot meteorological tower at Kennedy Space Center and to a "lightning eliminator" at Langmuir Laboratory here in New Mexico. Beginning in 1988, the Federal Aviation Administration carried out a test of "multipoint discharge lightning protection systems" in Florida. On its termination in 1990, the FAA Associate Administrator for Airway Facilities, Arnold Aquilano, wrote to Congressman M. A. Sabo:

> "The study shows that the LDS (Lightning Dissipation System) did not out-perform the standard FAA lightning protection system during periods of storm activity. We have also proven, to our satisfaction, that we can prevent damage to FAA facilities with a properly designed overall protection scheme using standard Franklin air terminals at a much lower cost. For these reasons, we will continue to protect FAA facilities with the standard lightning protection system. The lightning dissipation systems at the Tampa airport and the lightning deterrent systems at the Orlando airport were removed and replaced with the standard Franklin air terminal systems."

The FAA final report itself on FAATC T16 Power Systems Program, ACN-210 was more specific:

> "It can be concluded from the video tapes and the magnetic tapes that there were lightning strikes to both the Sarasota and Tampa Air Traffic Control Towers (Conventional lightning protection was installed on the Sarasota tower which suffered no damage from the strike. A lightning dissipation array was installed on the tower at Tampa; "several systems suffered outages at Tampa as a result of this incident".) It can also be concluded that loss of equipments from lightning strikes to a facility can be attributed to improper protection practices."

Our assessment of the "Dissipation Array System" system and the concept on which it was based are simply replays of Benjamin Franklin's failed intent for lightning rods which was to prevent the occurrence of lightning by neutralizing the charge in thunderclouds overhead with the emissions from pointed electrodes on the Earth. However, the charges emitted by a sharp-tipped "charge transfer" device can influence the last stages of a lightning strike in its vicinity. These charges can shield the device and thus reduce the chances that it will take the strike while some other object nearby is hit but this effect is unpredictable and depends on the wind and on the local geometry.

The undeniable facts are that "dissipation" devices do not prevent the occurrence of cloud-to-ground lightning strikes and that they are not designed nor intended to be the preferential receptors of the lightning strikes in their vicinity. Accordingly, such devices serve no useful protective purpose in the prevention nor in the reception and conveyance of lightning to Earth.

In my opinion, the "Charge Transfer System" method does not have technical merit for lightning protection and there is little probability that it will acquire any technical merit in the future.

It would be a disservice to the public for the IEEE to issue a standard supporting the use of these devices as being suitable for protection against lightning.

Sincerely,

/s/ CBM
Charles B. Moore
Professor Emeritus
Atmospheric Physics
New Mexico Institute of Mining and Technology

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National Lightning Safety Institute

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