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Lightning performance evaluation of quasi-hemispherical air terminations versus a Franklin rod

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2012-02-01
http://hdl.handle.net/10539/11233

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Abstract

This research aims to investigate the effect of adding a quasi-hemispherical object at the top of a Franklin rod. This will significantly reduce corona and hence the space charge under the high electric fields experienced during the descent of the downward moving leader. By obtaining the appropriate size and shape of the object at the top of the air termination the aim is to send a single streamer at precisely the correct moment for it to undergo streamer to leader transition and intercept the downward moving leader. Research as well as preliminary simulation and experimentation point to a critical radius of approximately 300 – 350 mm. A test setup with a 5 m air gap was designed and manufactured with the aim of producing upward leaders from the competing air terminations, thus simulating natural lightning conditions more closely. It is an inverted rod plane gap and includes all the necessary d.c. biasing circuitry and measuring equipment. Eleven air terminations were tested against the Franklin rod in a point to point breakdown configuration and the results captured with a high speed gated camera. 1.2/50 µs lightning impulse waveform was used during testing and the air gap was 4.5 m long. Results showed that all of the strikes during competition testing were to the Franklin rod. There was no evidence of upward leader formation and electric field enhancement dominated breakdown. The air gap needs to be extended and waveforms with longer rise times, more energy and hence better chance of upward leader formation need to be used. The Franklin rod proved to be the best air termination during testing.