

## Evaluation of lightning-related faults that lead to distribution network outages: An experimental case study

Marcelo Antônio Ravaglio<sup>a</sup>; Kristie Kaminski Küster<sup>a</sup>; Signie Laureano França Santos<sup>a</sup>; Luiz Felipe Ribeiro Barrozo Toledo<sup>a</sup>; Alexandre Piantini<sup>b</sup>; André Eugênio Lazzaretti<sup>c</sup>; Luciana Gonçalves de Mello<sup>c</sup>; Cleverson Luiz da Silva Pinto<sup>d</sup>

<sup>a</sup>Institute of Technology for Development (LACTEC), Avenida Comendador Franco 1341, Postal Code 80215-090 Curitiba, PR, Brazil

<sup>b</sup>Institute of Energy and Environment, University of São Paulo, Avenida Professor Luciano Gualberto, 1289, Postal Code 05508-010 São Paulo, SP, Brazil

<sup>c</sup>Federal University of Technology – Paraná (UTFPR), Avenida Sete de Setembro 3165, Postal Code 80050-315 Curitiba, PR, Brazil

<sup>d</sup>Energy Company of Paraná (COPEL), Rua José Izidoro Biazetto 158, Postal Code 81200-240 Curitiba, PR, Brazil

### ABSTRACT

Lightning activity is often one of the major causes of voltage transient disturbances and interruptions in distribution networks. Although important researches have been performed on the correlation of lightning-related events and faults in distribution networks, there is still an open question about in which situations will a lightning-related fault self-extinguish or evolve to a sustained short-circuit that will lead to a power outage. This study aims to show, based on an analysis using data from a real monitored distribution system and high-voltage laboratory tests, that the conditions for sustained arc-formation from a lightning-induced fault depend on the utility infrastructure construction patterns and the characteristics of the distribution equipment available. The distribution feeder was modeled based on laboratory test results and the digital simulations are validated by comparing calculated and actual measured overvoltages. This paper presents an analysis of lightning-related faults in power distribution feeders, integrating experimental data and digital simulations. The proposed method is promising in predicting the effects of lightning on distribution networks, especially in identifying the feeder sections most prone to failures.

**Keywords :** Power distribution networks;Power outages;Power quality analysis;Lightning-related faults;Transient monitoring