2nd URSI AT-RASC, Gran Canaria, 28 May – 1 June 2018

Electromagnetic Noise Generated by an Arc Tracking between DC Conductors during its Early Time

V. Degardin[(1)], P. Laly[(1)], L. Kone[(1)], F. Valensi[(2)], M. Lienard[(1)] and P. Degauque*[(1)]
(1) University of Lille, IEMN/TELICE, 59655 Villeneuve d'Ascq cedex, France
(2) University of Toulouse, INP Laplace, 31062 Toulouse, France

With the development of electrical cars and more electrical aircrafts, detection of an arc occurring between DC conductors and evaluation of the impact of this arc on sensitive electronic systems becomes an important issue. Among all types of arc, the arc tracking is of primary importance since it corresponds to an arc initiated between conductors and, owing to a degradation of the insulation, propagates between the 2 wires over a relatively long time, up to a few seconds.

To characterize current and voltage produced by such an arc on a two-wire line (TWL), a measurement set-up has been developed. At one end, the wires are connected to a generator providing continuous current with adjustable value (up to 100 A) and a maximum voltage of 110 V. To initiate an arc, the insulating sheath of the two wires is partially removed and the two metal cores are brought closer together. A droplet of salted water and a small copper wire placed between the two cables facilitate arc initiation. A detailed description of the test bench is given in [1]. Just after the initiation of the arc, the current is not yet regulated and the generator delivers its maximum DC current equal to 110 A. Then, after about 100 ms, DC current is equal to its regulated value and the arc propagates along the TWL. In previous works as described in [1], only this last and "stationary" phase of the arc was studied. In this case, the TWL was open at the other end, and the high frequency (HF) content of the parallel arc, typically between 1 and 30 MHz, was studied. A Thevenin generator equivalent to the arc in this frequency band was proposed.

However, it is also important to characterize the arc in its early phase and at both ends of the TWL. This is useful to develop fast response protection devices based on the HF noise generated by the arc but also to predict possible high disturbing voltages which may appear during the initiation of the arc.

To achieve this goal, the open end of the TWL situated in the vicinity of the arc, was connected, through a capacitive coupler, to a voltage sampling card. Its input impedance is of 50 Ω, the sampling frequency being 200 MHz. A high-pass filter with a 3-dB cut-off frequency of 100 kHz, combined with diode clipping circuits, protects the analog-to-digital 12-bit acquisition card. Since this end remains open for the DC current, one can expect that the arc still remains a parallel arc, no series arc occurring between two parts of the same wire.

During the early phase of the arc, no part of the TWL being melted or vaporized, the time-varying generator equivalent to the parallel arc delivers a current propagating on both sides of the TWL. First, large fluctuations of the HF voltage measured near the arc occur. This corresponds to a highly unstable phase of the arc with a series of brief discharges. Then, the DC current reaches the maximum value that the DC generator is able to deliver, equal to 110 A in our case. The statistical distribution of the peak voltage and the variation, versus time, of the spectral components of the disturbing voltage generated by the arc in the 1-30 MHz range are studied. They are then compared to those obtained in the stationary phase.

1. V. Degardin, L. Kone, F. Valensi, P. Laly, M. Lienard, and P. Degauque, "Characterization of the High-Frequency Conducted Electromagnetic Noise Generated by an Arc Tracking Between DC wires," *IEEE Trans. on Electromagn. Compat.,* **58**, 4, Aug. 2016, pp. 1228-1235, doi: 10.1109/TEMC.2016.2549744.