

# **BREAKDOWN CURRENT MEASUREMENT FOR DETECTING THE INITIATION OF TWO-STAGE EXTERNAL FLASHOVERS OF A VACUUM INTERRUPTER**

Tobias Jesberger<sup>1</sup>, Karen Flügel<sup>1</sup>, Dietmar Gentsch<sup>2</sup> and Michael Kurrat<sup>1</sup>

<sup>1</sup>elenia – Institute for High Voltage Technology and Power Systems, TU Braunschweig,  
Schleinitzstraße 23, 38106 Braunschweig, Germany

<sup>2</sup> Electrification – Distribution Solutions (ELDS), ABB AG, Oberhausener Str. 33, 40472 Ratingen

## **ABSTRACT**

In the medium voltage level, vacuum interrupters have become prevalent for current switching [1]. However, due to the decreasing breakdown strength behaviour in vacuum, SF<sub>6</sub> has been used as an insulating gas in the high voltage level, [2] which has recently been banned by the EU [3]. Consequently, a lot of effort is being put into the development of vacuum interrupters to enable their application in higher voltage levels.

In prior research, the resilience of vacuum interrupters to external electric stress under lightning impulse voltage was examined. This involved utilizing a two-stage Marx impulse circuit to induce the required conditions. [4] Simultaneously, flashover events were captured via high-speed camera recordings, providing insight into the trajectory of the flashover. These observations revealed a two-stage flashover process. [5] The flashover path occurred from the high-voltage potential to the metal vapor condensation shield, followed by a secondary path leading to the chamber's earth potential.

To deepen understanding of the flashover mechanism, current measurements were implemented. Coaxial shunts were strategically positioned on both earth and high-voltage potentials for this purpose. The measurements were conducted using the Genesis 7t measurement system by HBM, with a sampling rate of 100 MS/s. This system interfaced with the relevant HV6600 Isolated Digitizer GN110 satellites via optical fiber cables, enabling measurements to be taken at high-voltage potential levels. Analysis of the current measurements revealed disparate activation times depending on the polarity of the current.

## **References**

- [1] Baum, Benjamin; Design and implementation of a test environment to study late-breakdowns in high voltage vacuum circuit breakers, Dissertation, Technische Universität Darmstadt, 2017
- [2] Ito, Hiroki; Switching Equipment; Springer International Publishing; 2019
- [3] REGULATION (EU) 2024/573 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014, Official Journal of the European Union 2024/573, 2024.
- [4] Flügel, K., Gentsch, D., Kurrat, M.: Investigations of Lightning Impuls Voltage on Vacuum Circuit Breakers and Comparison of Effects between Industry and Research, 8th ITG International Vacuum Electronics Workshop, Bad Honnef, 2.- 3. September 2022
- [5] Flügel, Karen; Meyer, Timo; Gentsch, Dietmar, Kurrat, Michael, „Partial breakdown detection in vacuum interrupter under lightning impulse voltage“, The 23rd International Symposium on High Voltage Engineering, Glasgow, United Kingdom, 2023