

Master Thesis

Analysis of High-Bandwidth Field Measurements of Switching Operations with High-Voltage Vacuum Circuit Breakers

Background and Motivation

High-voltage installations currently predominantly use SF₆ circuit breakers. These are characterized by their high interrupting capability of large short-circuit currents and are considered a mature technology in the high- and extra-high-voltage range. However, since SF₆ (sulfur hexafluoride) has a very high global warming potential (GWP), the EU F-Gas Regulation provides for a medium- to long-term phase-out of this insulating and arc-quenching medium.

Vacuum circuit breakers represent a possible alternative. They have been an established technology in medium-voltage applications for many years, but in the high-voltage range they are still in the introductory phase.

In order to gain operational experience, the first 123-kV vacuum circuit breaker installed in Austria was tested in a substation under both normal switching operations and fault switching conditions. Using high-bandwidth measurements, effects were recorded that will be analysed in more detail in this work.

Research Questions

- What specific characteristics and differences must be considered among high-voltage circuit breaker technologies (SF₆, vacuum, alternative gases)?
- How can the arc-extinguishing behaviour (with regard to re-ignition) be reproduced in a circuit breaker model within simulation programs?
- What are the influencing factors of the measured switching overvoltages on their frequency and amplitude?

Methodology

- Literature and document review on available SF₆-free high-voltage circuit breakers
- Analysis of high-bandwidth measurements from field tests
- Modelling of a vacuum circuit breaker in simulation tools (e.g., EMTP, Simulink, DigSILENT PowerFactory)

Organisational Details

Start immediately possible

Financial support possible

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