LOW- AND VERY LOW FREQUENCY SHORT-CIRCUIT CURRENT INTERRUPTION IN VACUUM

Dietmar Gentsch[1], Andreas Lawall[2], Sergey Gortschakow[3]
[1] ABB Ltd. Electrification - Distribution Solution (ELDS), Oberhausener Straße 33, 40472 Ratingen / Germany
[2] Siemens AG, 13629 Berlin / Germany
[3] Leibniz Institute for Plasma Science and Technology, 17489 Greifswald, Germany
dietmar.gentsch@de.abb.com

ABSTRACT

Vacuum interrupters are a safe and reliable part of electrical power systems. Those devices are designed for a broad operation frequency range from 50/60 Hz [1] in conventional networks down to 16.7/25 Hz in rail electrical power systems [2]. Expanding green energy applications such as wind turbines, pumped storage, DC to AC converters in solar parks and shipboard applications bring new requirements to interrupter systems as they can generate temporary fault conditions with very low frequencies [3]. Depending on phasing, the long arcing times and high transferred charge may occur, making current interruption at the current zero (CZ) difficult [4]. In the present work the interruption performance limit to frequencies between 0.5 – 2 Hz based on the test performed at 16.7 and 50 Hz was calculated [5]. The contact erosion rates were also grouped into three different clusters as a function of the current, and the erosion during multiple short-circuit operations from 10-40 kA rms at 50 Hz and at several hundred of amperes at 0.5 – 5 Hz. Test sequences from the generator circuit breaker standard are also examined, such as delayed CZ and very high direct current (DC) offset tests. These tests are effectively equivalent to lower frequency tests. In addition, low frequency tests at 2.4 Hz and 1250 A have been performed to observe the impact of multiple switching operations on the contacts, metal vapor deposit on the ceramics, and heat build-up. The vacuum interrupters equipped with three different contact systems and sizes were used.
Finally, in order to study the properties of arc at low frequencies more in detail, experiments in a model vacuum chamber at 2.4 and 3.5 Hz and rms current in the range 1000 – 1750 A have been performed. Arc dynamics have been analysed by means of high-speed camera technique.

References

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