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A CURRENT-COMPARATOR-BASED SYSTEM FOR CALIBRATING HIGH VOLTAGE CONVENTIONAL AND NON-CONVENTIONAL CURRENT TRANSFORMERS UNDER ACTUAL OPERATING CONDITIONS OF HIGH VOLTAGE AND DISTORTED CURRENT WAVEFORMS UP TO 100 kV AND 2000 A

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Abstract

The development of a current-comparator-based calibration system to evaluate the current ratio errors of high voltage conventional/non-conventional current transformers, under actual operating conditions of high voltage and distorted current waveforms, up to 100 kV and 2000 A will be presented. The importance and critical need of such calibration system will be described.

Summary

The measurement of high voltage conventional and non-conventional current transformer ratio errors, including that of high voltage Rogowski coils, is usually carried out under conditions where the primary and secondary windings are at, or near ground potentials. In actual use, however, the current transformer may be operated with one, or the other, or both of these windings at a voltage which is substantially different from the test conditions at ground potential. Capacitive currents, which were not present or were negligible before during calibrations, will then flow when the current transformer is connected to high voltage and a significant variation in the current transformer error may result.

Therefore, there is a need to have a system for the calibration of high voltage conventional and non-conventional current transformers, including Rogowski coils, under actual operating conditions of high voltage and distorted current waveforms that better reflect the conditions under which they are used. The transformer ratio errors are dependent on the operating voltage. Since this variation is a function of voltage, it is convenient to designate this as the voltage coefficient of a current transformer.

At the National Research Council of Canada, it is customary to specify that the error of a current transformer applies to the ratio of currents at certain

designated or "marked" terminals of the primary and secondary windings. The specification of the voltage of these marked terminals with respect to ground then completely defines the conditions under which the transformer was calibrated.

Capacitive effects have been studied, but only in relation to other impedances within the transformer itself [1, 2]. The effect of externally applied voltage has not been considered.

For accurate current measurement, however, the voltage coefficient must be taken into account. This is especially important in precision high voltage current transformer calibrations, especially when they are of Class 0.15 and used in high voltage revenue metering systems.

The new calibration system which today can operate up to 100 kV and 2000 A is based on having a reference two-stage current transformer with magnitude and phase errors of less than 10×10^{-6} and $10 \mu\text{rad}$, respectively, which has a negligible voltage coefficient. A current-comparator technique [3], including a digital sampling system [4], is then used to compare the output signal of the reference current transformer and that of the transformer under test. The current-comparator-based system, including its error sources and uncertainties, and some results obtained during testing of high voltage current transformer will be described and presented.

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