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## Reserch of sweep frequency impedance criterion to determine transformer winding deformation

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The reliable running of the transformers are extremely important for the electric system. However, during operating the transformers will inevitably suffers the various impacts, such as short-circuit current and mechanical vibrate. It will lead to permanent deformation, for example warping, shifting and bulge of the windings, within a power transformer. If cannot be detected on time, the deformations may accumulate over a long period and finally lead to transformer accidents.

In order to supervise the condition of transformer windings, people developed a large amount of methods to diagnose the winding deformations. Among these methods, short circuit impedance (SCI) and frequency response analysis (FRA) had been used widely due to their good performance. However, some defects shown up according to many experiences of test: SCI is insensitive to some little deformation, and FRA has no quantitative criterion and is easily influenced by onsite condition. Therefore, sweep frequency impedance (SFI), as a new technique, is combined with the characteristics of FRA and SCI. Moreover, it has a higher signal-to-noise ratio, a better repeatability and reproducibility. That make it to be a good replacement of SCI and FRA.

Presently, SFI relies on 50Hz short circuit impedance, correlation coefficient, and grey correlation to determine the situation of transformer winding deformation. But the existing method has defects such as poor anti-disturbance ability, low sensitivity results in hard to analyze quantitatively, and incapability in identifying defects at early stage. This paper proposes a new SFI criterion to determine transformer winding deformation. It identifies the graphic shape circled by normal state and fault state to detect transformer winding deformation. This paper verifies the accuracy of the new method by testing different faults on the transformer and analyzing sweep frequency curve in different situation.

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