

수배전반 내부 전력기기의 부분방전 진단기술

Partial Discharge Diagnosis Technique for Power Facilities in Switchboards

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Abstract This paper presented the detection of partial discharge (PD) using a transient earth voltage (TEV) sensor for on-line condition monitoring of power facilities in switchboards. An artificial defect was fabricated adjacent to the high voltage winding of a cast-resin transformer and a TEV sensor was attached on a metal plate. The TEV signal was acquired using a data acquisition unit and was analyzed in terms of frequency spectrum, phase-resolved partial discharge pattern, and discharge magnitude distribution.

Keywords : Switchboard, Power facilities, Partial discharge, Transient earth voltage, Condition monitoring

1. Introduction

A switchboard, which is equipped with cast-resin transformer, busbar, circuit breaker, insulator, and other power facilities, is widely used in the railway substations. However, due to the defects generated during the manufacture, installation, and transportation procedures, partial discharge (PD) occurs, causing progressive deterioration and final failure of the facilities. Therefore, it is necessary to detect the PD signal in advance to ensure the reliable operation of switchboard [1,2]. The conventional electrical method introduced in IEC 60270 is not suitable for on-line detection of PD as the coupling capacitor need to be installed. When PD occurs, it generates the electromagnetic wave, which propagates away from the discharge and couples onto earthed metal surfaces of the switchboard, inducing the transient earth voltage (TEV) signal. Such signal can be detected by a TEV sensor mounted on the metal surface using a magnetic clamp [3]. Since the sensor can be easily installed and it is a contactless measurement, the TEV

method is introduced in this paper for on-line condition monitoring of power facilities in switchboards.

2. Experiment and Results

2.1 Experimental setup

The experimental setup that simulates PD occurring in switchboards is shown in Fig. 1. A 220V regulator was used to apply voltage to the primary winding of the cast-resin transformer, which had an artificial defect in its high voltage side. The voltage was increased gradually to generate PD signal. A TEV sensor was mounted on a metal plate to detect the PD-induced electromagnetic wave. The signal was acquired using a data acquisition unit (DAQ). The frequency spectrum,

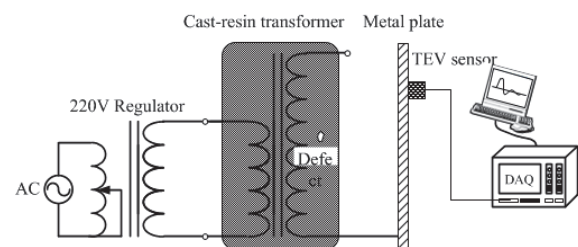


Fig. 1 Experimental setup

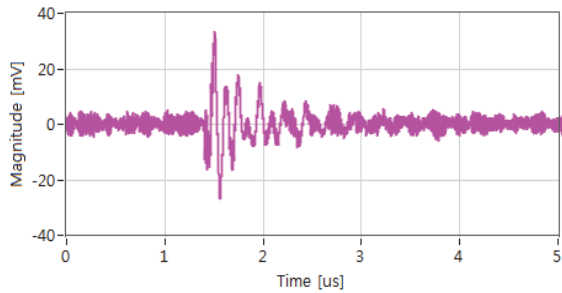
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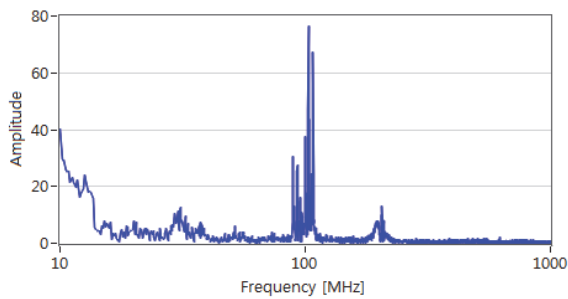
phase resolved partial discharge (PRPD) pattern, and discharge magnitude distribution were analyzed based on LabVIEW program.

2.2 Results and analysis

Fig. 2 shows the detected TEV pulse and its frequency spectrum. It can be seen that the TEV signal induced by PD in the cast-resin transformer had a frequency range of 80MHz-120MHz.



(a) Single pulse



(b) Frequency spectrum

Fig. 2 TEV signal

The PRPD pattern and discharge magnitude distribution are shown in Fig. 3 and Fig. 4, respectively. The TEV signal distributed in phase of 40° - 46° and 216° - 263° , and in magnitude of 8mV-34mV.

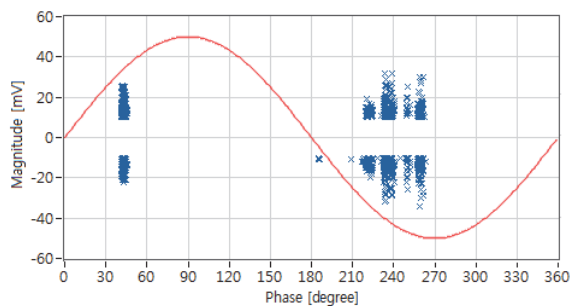


Fig. 3 PRPD pattern

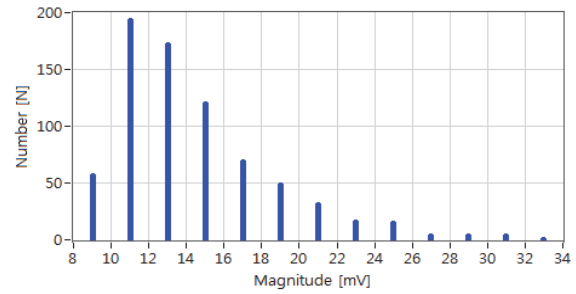


Fig. 4 Discharge magnitude distribution

3. Conclusions

In this paper, an artificial defect was fabricated to simulate the PD source in switchboards and the PD signal was detected by a TEV sensor. From the results, the PD induced TEV signal had a frequency range of 80MHz-120MHz. And the PRPD pattern and discharge magnitude distribution can be used for defect identification and condition evaluation of power facilities in switchboards.

Acknowledgement

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