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An investigation on the applicability of the hybrid sensor for detecting high frequency partial discharge

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Abstract: In this paper, a hybrid sensor has been proposed and fabricated for the first time to detect HFPD taken place inside the power apparatus. And also its design conception is well described based on the results of the experimental investigation.

Remarkable technical advantages have been proved such as noise discrimination giving rise to high signal-to-noise ratio SNR and safe protection of the measuring system.

Keywords: Hybrid Sensor, Partial Discharge, modelling and simulation

Résumé : Dans cet article, nous proposons un détecteur hybride destiné à détecter des HFPD produit à l'intérieur des appareils électriques. La conception de ce détecteur a été vérifiée sur la base des résultats d'investigations expérimentales. Les avantages techniques de ce détecteur ont été prouvés : une proportion élevée de SNR (signal-to-noise) par la discrimination du bruit et une protection sûre du système de mesure.

Mots-clés : Détecteur hybride, Décharge partielle, Maquette et simulation

1. Introduction

In general, CT(Current Transformer) and Shunt have been conventionally employed as a sensor for detecting the partial discharges in order to diagnose the present insulation state of the electric power apparatus. The former is very convenient for the practical application since it is not only non-contact method but its frequency bandwidth and resonance frequency could be chosen for the specific application. However, it has been proved to have poor linearity and low sensitivity. For the latter, even though it is an ideal sensor, the noise from the power source as well as the earth could flow into the measuring system and also surge current from the testing system would give rise to a severe breakdown.[2], [10]

In order to overcome the shortcoming of the above sensors, a hybrid sensor has been newly proposed and designed under the concept as follows: different impedances could provide three passages of the signals in different frequency band. In this way, the discrimination of the noise could be achieved very effectively with high ratio of signal to noise(SNR) with little influence from the external noises and the breakdown.

For this purpose, the evaluation of the reliability related to the on-site applicability of the newly proposed sensor has been performed by comparing with the results measured by the commercialized CT at the perfectly shielded room. Its application to detect the corona discharges and PD generated from the motors has been realized showing satisfied performance.

2. Design conception of the Hybrid Sensor

2.1 Hybrid Sensor model

Regardless of the technical advantages of the conventional sensors such as CT and Shunt, their sensitivity and safety are disclosed to be insufficient. And thus, a hybrid sensor is proposed and designed taking into account the advantages of the above sensors. Technical advantages for the possible three type of sensors are summarized as follows:

- **CT sensor:** High SNR can be obtained at the resonance frequency which can be chosen for the specific purpose. [1], [2], [14]
- **Shunt sensor:** High sensitivity without oscillation
- **Hybrid sensor:** Little influence by the noise coming from power source with high SNR and safe protection against breakdown.

The schematic representation of the newly developed hybrid sensor is shown in Fig.1 in which three passages with different impedance are provided for the signal to be passed as follows: