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Detection of partial discharges in HV terminations using a capacitive sensor
HVIDSTEN S., LUNDGAARD L., SINTEF Energy Research, Norway

Abstract: This paper reports results from measurements of partial discharges (PD) in high voltage XLPE cable terminations. A metallic ring-shaped sensor for high frequency for PD detection of incipient cable breakdown is developed and tested. The sensor is placed outside the stress-grading cone of the termination close to the end of the insulation screen of the cable and the semi-conductive field-grading of the termination. High frequency PD measurements as well as conventional PD measurements have been performed to examine the effect of the position of the sensor relative to the PD source and the sensitivity for a typical defective installation causing PD's. The best sensitivity (5pC) is achieved with the sensor placed directly at the field-grading unit. The sensitivity decreased to approximately 20pC when the sensor is placed outside the housing with a larger distance to the PD source. Due to the intermittent nature of PD for the investigated defect, measurements should be performed periodically and over a longer period to allow for an efficient and safe detection.

Keywords: Condition Monitoring, HV XLPE Cable Terminations, Partial Discharges.

1. Introduction

Breakdowns of high voltage cable accessories can due to possible explosions cause a high risk for personnel. Moreover, in Norway the grid owners now have to pay a penalty for interruptions in power supply lasting more than 5 minutes. This penalty is proportional to the energy not delivered. The cost also depends of the type of load, being more than ten times higher for industrial loads than for households. Condition assessment of power apparatus by diagnostic testing is therefore becoming increasingly important in Norway.

Several failures have occurred during service over the last years. A simple sensor for partial discharge (PD) monitoring that could be retrofitted to existing equipment was therefore wished for.

Résumé: Cet article présente les résultats de mesure de décharges partielles (PD) aux extrémités de câbles XLPE haute tension. Un capteur métallique haute tension, de forme annulaire, pour détecter l'apparition d'une déficience dans un câble a été développé et testé. Le capteur est placé hors du cône de distribution du champ de l'extrémité du câble. Il est situé proche du bout de l'enveloppe isolante du câble et du répartiteur de champ semi-conducteur de l'extrémité. Des mesures de PD haute fréquence ainsi que des mesures PD conventionnelles ont été faites pour examiner l'effet de la position du capteur par rapport à la source de PD et pour étudier la sensibilité sur une installation défectueuse classique causant des PD. La meilleure sensibilité est obtenue avec le capteur placé directement au niveau de l'unité du répartiteur de champ. La sensibilité décroît approximativement de 20pC lorsque le capteur est situé hors des isolateurs en porcelaine à une plus grande distance de la source des PD. Due à l'intermittence des PD pour les déficiences étudiées, les mesures doivent être effectuées périodiquement et sur une longue durée afin de permettre une détection efficace et sûre.

Mots clés: procédures de contrôle, câbles XLPE haute tension, extrémités, PD

This paper presents results from laboratory PD measurements on 145 kV XLPE cable terminations using a ring sensor previously proposed by [1]. VHF and UHF measurement techniques, that has proven useful for PD measurement on other apparatus was therefore investigated. Frequency domain wide band measurements in the frequency range of 1 to 500 MHz have been performed using a spectrum analyser. Wide band time domain measurements have been performed using an oscilloscope with a high sampling rate. Phase resolved high frequency PD measurements were carried out using the spectrum analyser in zero-span mode as a narrow band filter. In addition, conventional PD measurements were performed, serving as a