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Applications to cable diagnosis of new methodology for partial discharge inference

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Abstract: The application to power cable and cable accessories of a new methodology for quality control and diagnosis based on partial discharge (PD) measurements is presented in this paper. The PD system records a large number of PD pulses, that can provide statistics of shape, height and phase derived quantities. Classification and separation of different PD sources, including noise, is then achieved resorting to artificial intelligence methods. The identification of PD source typology refers to each class of PD thus obtained, allowing very good identification effectiveness to be reached. This procedure is validated through PD measurements made in laboratory on cables and accessories with artificial defects, routine tests on joints and cables fed by a resonant mobile test set at variable frequency. It is shown that efficient rejection of power-electronic noise is obtained in the measurements using the resonant generator, and that identification of the nature of defect(s) producing PD is successfully identified in cables and joints, thus improving reliability of quality control and diagnostic procedures.

Keywords: partial discharge signal separation and classification, noise rejection, HV cables and accessory.

Résumé: L'application aux câbles de puissance et aux accessoires pour câbles d'une nouvelle méthode pour le contrôle de qualité et le diagnostic basé sur les mesures de décharges partielles (DP) est présentée dans cet article. Le système de mesure enregistre un grand nombre d'impulsions de DP, ce qui fournit des statistiques sur la forme, la hauteur et les quantités dérivées de la phase. La classification et séparations des différentes sources de DP, bruit de fond inclus, est effectuée par des méthodes d'intelligence artificielle. L'identification des typologies des sources de DP attribuée à chaque classe de DP est ainsi obtenue, ce qui permet d'obtenir une très bonne efficacité de l'identification. Cette procédure est validée par des mesures de DP effectuées en laboratoire sur câbles et accessoires avec défauts artificiels, des tests de routine sur jonctions et câbles énergisés par un générateur mobile résonant à fréquence variable. L'efficacité de la réjection du bruit lié à l'électronique de puissance est démontrée, ainsi que la validité de l'identification de la nature du/des défaut(s) produisant les DP dans les câbles et les jonctions, ce qui permet d'améliorer la fiabilité des contrôles de qualité et des procédures diagnostiques.

Mots clés: séparations et classification de signales de décharges partielles, réjection du bruit, HT câbles et accessoires.

1. Introduction

Identification of defects which generate partial discharges (PD) is one of the main purposes of diagnostic of electrical insulation systems. Identification is usually performed through phase-resolved PD pattern and statistical quantities obtained from PD peak and phase associated quantities [1-5]. Generally, identification of defects generating PD is left to experience of operators performing PD measurements, since the achievement of objective rules to identify defects from PD measurement output is a complex task. First of all, data coming from PD measurements can be affected largely by external noise, sometimes comparable or even larger than PD pulse signals. Noise may be able to affect processing of PD-data, which can lead to wrong or misleading identification. The same may occur if more defects generating PD are active at the same time, thus PD signals relevant to each discharge activity overlap. In order to perform an effective defect identification mixed signals coming from different PD sources and affected by noise should be separated in different classes, each one relevant to a single kind of PD generating defect (or PD source) and noise. After that, noise classes can be identified by appropriate techniques [6], keeping, for further processing, only the classes relevant to real PD. Finally, defect identification can be performed on each class. Identification is easier and more robust, in this way,