JICABLE '99

B6.6

On-site partial discharge diagnosis and monitoring on HV power cables

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Résumé

L'utilisation croissante des matériaux à isolation polymère dans les câbles électriques de 400kV et plus, requiert des systèmes de mesures adéquats, afin de dévoiler des défauts naissants et éviter des claquages prématurés. Cet article décrit les méthodes et techniques utilisées pour l'enregistrement, l'analyse et la surveillance de l'activité de décharges partielles sur de tels câbles en opération normale.
Les matériaux à isolation polymère tels que XLPE, EPR et PE de première génération étant largement utilisés dans les câbles de distribution, un nombre considérable de vieux câbles en service nécessite ainsi une technique de diagnostique fiable, pour supporter la décision de remplacer un circuit de câbles, ou encore de prolonger sa durée de vie utile. Les méthodes pour la mesure de décharges partielles in-situ, ainsi que les techniques de couplage sont discutées en détail.

Abstract

The increased application of polymeric insulation materials with power cables in the voltage range of 400kV and above requires enhanced measures to unveil incipient failure and to avoid early breakdown. The contribution describes methods and techniques to register, analyze, and monitor partial discharge activities with such cables in a field environment.
As polymeric insulation material such as XLPE, EPR, and PE from the early days is widely applied with the distribution class cables, a large population of aged cables demands reliable diagnostic techniques to support the decision regarding the replacement or the continuation of the service of such cables. Field applicable partial discharge measurement methods and coupling techniques are discussed in detail.

Introduction

Partial discharge activity is the most prominent indicator of insulation defects and ongoing degradation of high voltage insulation systems.
With transmission class cables on-site partial discharge measurements on preferably embedded sensors validate the proper installation of the prefabricated and factory tested accessories.
Sets of modular instruments offer the assessment of the partial discharge signals of all accessories of a cable system with the first application of rated voltage. The full information concerning all accessories is available within minutes and a bad joint, for instance, is clearly identified. Thus, the costly installation of two joints is avoided in case, as the faulty component is identified prior to breakdown. Subsequently, these instruments can be used to remotely monitor the cable system during the first load cycles.
With distribution class cables the main concern besides the verification of a new installation is to identify weak cables and accessories of aged cable systems. Therefore, mainly provisional and external sensors are used to capture signals of partial discharge activity. Compact and portable instruments offer convenient acquisition of the partial discharge pattern. Further, coupling capacitor based partial discharge fault location either at line frequency or with the cable energized by a low frequency high voltage source at 0.1Hz, for instance, is applicable.

Partial Discharge Sensors

In general, several physical principles are suitable to capture partial discharge impulses occurring within a cable or accessory [1-4].
In order to offer effective coupling as well as reliability, the design of partial discharge sensors must follow basic guidelines. A sensor must provide:

- No influence on the insulation properties of the accessory to be monitored, i.e. no installation of additional HV components weakening the reliability of the overall system.
- High coupling efficiency to the partial discharge signals.
- Noise rejection or immunity as integral property of the sensor.
- Low cost of the sensor and effortless installation or integration.