

## New approach for online detection of partial discharges in cable systems via voltage detection ports (VDS)

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### ABSTRACT

For Online partial discharge (PD) testing the cable system is disconnected from the network for a short time to install the PD sensors on the cable. The power shutdowns for today's heavily loaded medium-voltage cables are undesirable. The paper describes a new technology for PD testing using easy connection via the voltage detection ports, which are installed on every self-contained compact switchgear or ring main unit. The new technology allows for a more efficient use of offline PD test systems by quickly pre-selecting cables with PD during operation.

### KEYWORDS

Online partial discharge testing, PD capturing, HFCT coupler, voltage detection ports (VDS), condition based maintenance, wind farm

### INTRODUCTION

Medium voltage cables systems play an important role in power distribution systems. Condition based maintenance approaches require to check cable circuits at regular intervals for their insulation quality and reliability.

For the network operator it is essential to determine that the cables are reliable and safe to operate. For this important information, a cable test or a diagnostic measurement is indispensable.

Partial Discharge Detection (PD) is a widely used cable diagnostic technology for early detection of weak points in the cables systems reflecting the current state of knowledge. This advanced diagnostic technology is used around the globe for acceptance tests as well as for maintenance during all the life cycle of a cable system.

Various PD technologies are available, which are basically divided into offline PD test and online applications.

Partial discharge activities in the cable or cable accessories may lead to deterioration of the insulating material, which may result in faults that may occur and consequentially initiate the power supply to fail. Partial discharge measurement is applied for early detection of insulation faults so that the weak insulation spots can be replaced before the cable system may fail.

Mostly, the partial discharge diagnosis is carried out with mobile cable test and diagnostic systems. Furthermore, the number of permanently installed PD diagnostics for online monitoring of cables is constantly growing. PD online monitoring systems are expensive. They are typically installed on one cable system or in one station, which is common in MV networks. For tests on large cable populations and in various stations, mobile PD online techniques, also called PD spot testing, is applied and cable by cable is periodically checked (Fig.1). Advanced techniques are used to distinguish the PD signals from the

many interfering signals thereby reducing the number of false positives.

### PD capturing by HFCT

For online PD measurement in medium and high voltage cables the PD signals are captured with suitable PD couplers, which are mostly based on HFCT techniques. PD detection based on HFCT sensor techniques is well proven for cables with radial cable design. The signals of PD faults between conductor against shield are detected well.

For online PD detection, HFCT sensors are mounted individually on each cable neutral wire to detect PD by each phase separately. Also for mobile online PD spot testing the HFCT sensors are used for capturing the PD signal.



Fig.1: Set up for PD online spot testing

Many medium-voltage cables are connected to enclosed compact switchgears. In most cases, the cable terminations are not accessible. For installation of PD sensors the cable cell of the switch gear needs to be opened.

### Power shut down required

The installation of the HFCT sensors (Fig.2) is in most cases not feasible during operation and therefore requires a shutdown of the cable system. In practice, this poses a particular and difficult challenge. The cable is disconnected from the grid for a short time for installing the required PD sensors on the cable. The power shutdowns for today's heavily loaded medium-voltage cables are undesirable and require a long planning phase as well as a time window,