SENSITIVITY VERIFICATION PROCEDURE OF VHF PD DETECTION SYSTEMS

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ABSTRACT

Partial Discharges (PD) in a power cable system can occur due to different insulation defects. If allowed to continue, PD will erode the insulation, eventually bridge the conductors resulting in a complete breakdown and failure of the cable system. It is known that PD pulses consists of energy frequencies up to hundreds of MHz. Therefore using a VHF/UHF sensor detecting partial discharges is possible. However, the high-frequency behaviour of the sensor, the measurement cables, etc. have a strong influence on the response of VHF/UHF PD detection systems. Therefore, calibration is difficult and several related issues are presented analytically and discussed.

KEYWORDS

Partial Discharges, VHF/UHF detection, Calibration, Sensitivity Check.

INTRODUCTION

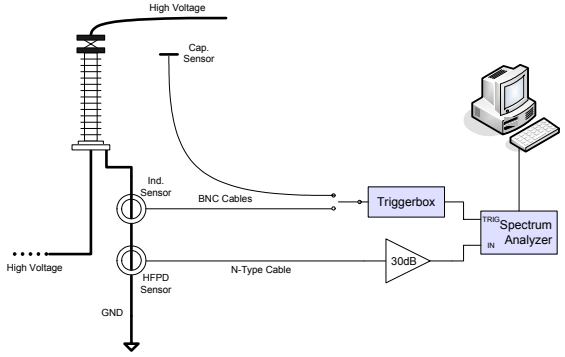
Partial Discharges (PD) in a power cable system can occur due to different insulation defects: such as at a gas-filled cavity, a protrusion in a semi conductive layer, or conversion of a water tree by a lightning or switching etc. [1]. If allowed to continue, partial discharges will erode the insulation, usually forming a tree-shaped pattern of deterioration (electrical tree) which will grow through the dielectric and eventually bridge the conductors resulting in a complete breakdown and failure of the cable or accessory.

The purpose for testing new installed power cables is mainly checking the assembly or workmanship performed in the cable accessories. As a result of poor workmanship, defects can be introduced. Moreover, since the power cable itself has been tested in the factory it may be assumed that the cable itself is defect-free. Therefore, for new installed power cables, the accessories are the main interest of the investigation. Due to local field enhancement till breakdown, discharge pulses are produced at the defect site, which consists of energy frequencies up to hundreds of MHz.

In this respect, partial discharge (PD) detection during the on-site after-laying test is getting more and more important to ensure high quality of the power cable installation. The presence of partial discharge activity can be used to assess the condition of the cable accessory during e.g. the rise of the test voltage and the test can be put on hold in order to take the proper actions. To enable PD detection, non-conventional detection techniques based on very- or ultra-high frequencies are more and more applied. Although these techniques are very sensitive and detection of small insulation defects is possible, the calibration of these systems in a similar way as a conventional detection system is not possible yet. This paper will give an overview of the influencing parameters and discuss a procedure that can be used to check the sensitivity of the detection system on-site.

VHF/UHF PARTIAL DISCHARGE DETECTION

The PD pulses as occurring in the cable insulation can contain frequencies of up to several hundreds of MHz. However, especially the higher frequencies tend to attenuate rapidly with the distance. As a result, picking up the higher frequency components is only likely when the sensor is close to the discharging site. In the case described here, the focus is on cable accessory testing



and the sensor will therefore be always close to possible discharging defects.

Figure 1: Sketch of the high frequency partial discharge detection system for testing of cable accessories.

As known from high-frequency PD measurements on GIS, a spectrum analyzer (SA) is a suitable and convenient instrument of capturing and analyzing the PD pulses [2]. Figure 1 shows the measuring setup at a cable termination. The system can be divided into a signal part and triggering part. The signal part consists of an internal or external high frequency PD sensor, a signal amplifier