C.8.1.9.

Detection of partial discharges in HV terminations using a capacitive sensor

Sverre Hvidsten and Lars Lundgaard
SINTEF Energy Research, Sem Saelandsvei 11,7465 Trondheim, Norway

Breakdown in high voltage accessories can cause a high risk of life for personnel present in the vicinity due to a possible explosion of the component. In Norway the network owners now have to pay a "fine" for service interruptions. This fine is proportional to the energy not supplied during an interruption. These costs can become very high, especially in case of breakdown of high voltage transmission grid components. Condition assessment of power apparatus by diagnostic testing is therefore becoming increasingly important in Norway.

It is very likely that a precursor for breakdown is the initiation of partial discharges. These can be generated from defects introduced during installation or manufacturing of the accessories.

The main objective of this paper is to present results from laboratory and on-site partial discharge measurements on 145 kV XLPE cable terminations. A simple and sensitive sensor is developed and used during the measurements. High frequency wide band measurements have been performed using a spectrum analyzer in the frequency range from 50MHz to 1 GHz and an oscilloscope with a high sampling rate. High frequency narrow band measurements (phase resolved) were carried out using the spectrum analyzer in zero-span mode. In addition, conventional measurements of partial discharges were also performed during the laboratory measurements.

The results show that the sensitivity of the sensor is only slightly changed by changing its position, making it possible to safely place the sensor closer to ground potential. Measurements on an artificial defect (void) caused by a bad installation, show that the magnitude of the partial discharges are relatively low during the initiation stage. The maximum sensitivity for typical discharges is obtained in the frequency range of about 200 – 400 MHz. After some months of ageing, this range is decreased to about 100 – 200 MHz. In addition, the discharges appear as rear bursts, indicating that continuous measurements are necessary in order to detect these signals.

On-site measurements show that the external noise can be low in some relatively narrow frequency intervals up to 250 MHz, where the signal from the typical defect measured in the laboratory is high. This makes it possible to perform sensitive on-line measurements by selecting suitable frequency ranges.

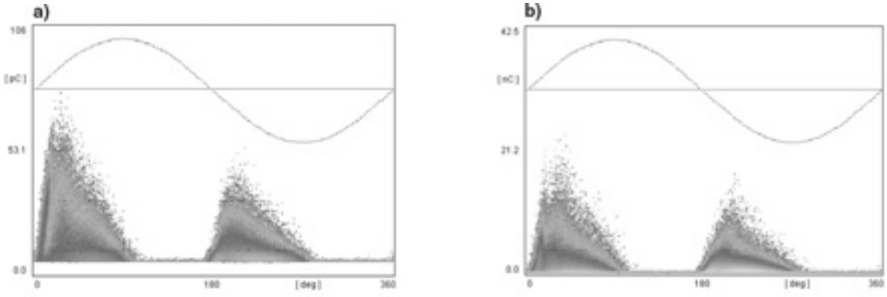

Fig. 1. Comparative laboratory (phase - resolved) partial discharge measurements on a 145 kV XLPE cable termination, with an artificial defect (void) caused by a bad installation.
a) Conventional measurements at service stress. b) High frequency narrow band measurements at service stress using the capacitive sensor and the spectrum analyzer in zero-span mode.