Permanent PD monitoring experiences on Shanghai 500kV power cable lines

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For the safety operation of a 500kV 15.6 km-length power cable line, a permanent PD monitoring system was installed in September 2013. The cable line included 2 circuits and 6 phases in total, with 147 cable joints and 12 GIS terminations. 159 HFCTs and PDDs were installed on the grounding cable of each joint and termination.

Based on installation experience and 1 year operating experience of the PD monitoring system, this paper illustrates some key factors for cable line PD monitoring. These factors include HFCT installation, calibration, alarm setting, and PD pattern recognition.

Different positions to install HFCT sensors are compared in this paper, and HFCT sensor on the grounding cable is recognized as the best sensitivity for PD monitoring. For joint only with coaxial grounding cable available, it was recommended to install HFCT inside the cross bonding box and modify the box to make the signal cable out from the box.

Currently no calibration standard is available for PD measurement based on HFCT method. This paper recommends injecting PD calibration signal directly into each HFCT, measured by the distributed system, to find out a relative calibration factor, e.g. 4.9 was mostly used in Shanghai project.

Alarm setting was another key issue in Shanghai 500kV cable line PD monitoring, and this paper recommends using 72 hours data for alarm criteria. The alarm might be triggered by extreme weather if time period is too short, or by the surface discharge of overhead line insulators which were connected to the cable sealing end. PD pattern recognition was the most important tool for the judgment of PD defect in cable line. The PD alarm of the monitoring system was only a calling for PD experts. Detailed analysis of the alarm signal was required by PD experts.

With the experiences of PD on-line measurement for cables, defects in cable insulation can be measured in very wide range of signal frequency, up to 20 MHz, depending on the HFCT specification; defects in cable outer semiconductor might only be measured in a limited signal frequency range up to 3 MHz. Therefore, adjustment of the measurement frequency was very important for PD measurement on cable lines. This paper presents a method to use both PD pattern and frequency response pattern for judgment of PD defects in cable.