

REE's Research and Development projects related to predictive maintenance based on monitoring of critical parameters in high voltage underground cables.

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ABSTRACT

In order to increase the useful life of underground circuits, it is very important to identify (and monitor, if possible) the critical elements and parameters of the installations, so their condition can be controlled.

Two different projects have been developed, within the REE Research and Development policy, in order to achieve the target of online monitoring two different critical parameters related to underground lines: partial discharges and sheath currents.

The added value of these projects consists in making possible to assess the current condition of the installation by means of continuous online monitoring. As a result, maintenance design plans are more adequately adapted to reality.

KEYWORDS

Continuous monitoring, condition based maintenance, partial discharges, sheath currents, underground lines.

INTRODUCTION

Underground lines have increasing importance for utilities in order to guarantee the energy supply, especially in urban areas. Due to their specific characteristics, performing visual inspections is not always feasible or convenient. In addition, the effects of aging of the underground lines are often not visible externally, until the fault is irreversible.

Any system capable of monitoring continuously the critical parameters of the cable lines may provide useful information to check the state of the assets. REE has developed two different prototype systems to face the problem of continuous monitoring partial discharges (PD) and sheath currents (SC) in existing underground lines [1].

The analysis of the data obtained by these systems can help to prevent future failures and to introduce a condition based maintenance practice, in order to improve the reliability of existing grid components.

PARTIAL DISCHARGES MONITORING SYSTEM

The project of online monitoring of partial discharges (PD) was the result of an association between REE and DIAEL (High Voltage Electrical Insulation Diagnosis). This system has been installed in an underground cable system of the electricity transmission network in the metropolitan area of Madrid.

This pilot R&D initiative will allow us to know the insulation condition of underground cable systems under different network conditions and external factors that could affect their integrity.

The monitoring system employs PD measuring units placed in the cable system accessories (terminations and joints). Each PD measuring unit has HFCT (High Frequency Current Transformer) sensors installed around the ground connection cables of the accessories and communicates with the other units and with a control and analysis unit by fiber optic links. Every data acquisition is synchronized and sent to the control and analysis unit for analysis.

The system includes a software tool to discriminate between PD pulses and noise signals, to estimate the PD measurement sensitivity, to identify and locate existing PD sources and to correlate each PD source with its associated defect.

Pilot PD Monitoring System

Four PD Measurement Systems (MS) have been installed along 1662 meters of 220kV cable system. A Control Analysis System (CAS) has been installed in the substation to manage the MS units. The first MS unit has been installed in correspondence of the terminations of the high voltage (HV) cables in the substation. The next two synchronized MS units were installed in two HV joint bays. The last MS unit was installed in correspondence of the other terminations on a high voltage tower.

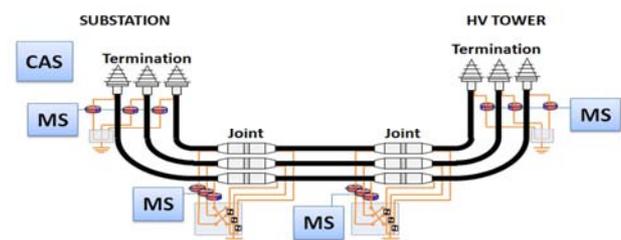


Fig. 1: PD Monitoring System

The rack cabinet containing the CAS unit has been installed in a building near the substation. The measurement systems were housed in boxes with an appropriate protection level for each location. For each MS unit three HFCT sensors, developed for outdoor environment, have been installed around grounding connection of the cable sheath.

Communication and Synchronization

Synchronized acquisitions are managed by the CAS to acquire the PD events by all the distributed sensors with