EXPERIENCE WITH OFFLINE PD-DIAGNOSIS ON MV CABLES – KNOWLEDGE RULES FOR ASSET DECISIONS

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ABSTRACT

The detection, location and evaluation of partial discharges (PD) inside the insulation and the accessories of XLPE and PILC cables offer the possibility of an early diagnosis of cable network failures, however, with the need of a clear differentiation between the insulation systems and the accessories.
In order to be able to carry out an evaluation of the risk factor of PD defects as exactly as possible, the applied voltage for a PD diagnosis should be within the range of the operating frequency, because the typical PD parameters, such as inception and extinction voltage, PD level and PD pattern then correspond to the relevant values under operating conditions.
On the other hand, the electrical stress during the diagnosis measurement should be limited to the extent that no irreversible damage and hence deterioration of the condition of the test objects takes place.
The main difficulty is to evaluate the risc of PD occourences on the reliability of the cable system. If an sufficient amount of PD diagnostic data for the cable components is available statistical methods can be used for determing threshould levels and relevant condition indexes for the asset management.

KEYWORDS

Condition assessment, MV power cables, PD measurement on site

INTRODUCTION

Due to privatisation and regulation of the electricity market the relaibility of distribution networks became more and more importance. Customers minutes lost has to be monitored and the asset management departments are requesting clear indication about the condition of MV cables and their accessories. Since the beginning of the eighties, a large number of XLPE first generation cables have shown the known “water treeing“ and have meanwhile been exchanged or renovated for the most part. It is possible to determine the condition of these cables with the known dielectric diagnosis methods [1-3], which will certainly be necessary for the next 10 years as well.
The much older paper-oil-cables on the contrary are rather inconspicuous regarding their operating performance, even though their predicted lifetime of 40 years has long since been surpassed. As these cables, as every technical insulation, are subject to complex operating stress, ageing and partly forced local damage accumulation have to be reckoned with.

IMPORTANT PARAMETERS FOR PD DIAGNOSIS

The physics and causes for PD defects in XLPE and PILC cable systems is mainly well known and described in detail in several publications. [4 - 8]
From the view of the network owner it is in the first line important to know, if the cable system is operating with permanent PD occurrences under normal service conditions or not.
The second important issue is the behaviour of the insulating system in case of over voltages due to earth faults or switching. In networks with resonance grounding a voltage of 1.7 Uo is applied over some hours to the cables. If a cable system has during normal operation at Uo continuous PD the question about the risk of these PD is raised.

Basically, three parameters are important for the judgement of the PD behaviour of a cable system.

PD Inception Voltage Ui, PD Extinction Voltage Ue and PD Level . Normally, the maximum impulse charge at Uo is used as a assessment criterion. There are already relatively good experiences in order to evaluate the risk factor for the reliability of operation depending on the location of the PD (cable, joint, terminations), the type of insulation of the cable and the design of the accessories. The occurrence of PD impulses also characterizes the risk coming from a PD source.

IMPROVED TECHNOLOGY FOR PD ONSITE TESTING WITH DAC

About 80 Systems with damped AC technology for medium voltage cables are in use worldwide with excellent experience [6-9]. Due to the resonance principle the PD test is performed by exiting the cable with a voltage shape close to service voltage. The short duration of the exiting voltage is non-destructive which is also very important.
The experience of 6 years field application leads to some improvements in the new generation of the OWTS M-versions (figure 1).