Testing and Diagnosis of Long-Length Distribution Cables using Damped AC Voltage

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ABSTRACT

Since the end of previous century damped AC (DAC) testing is in use for on-site testing and diagnosis of MV cables. In this contribution the newest mobile solutions for DAC field-testing up to 60 kV and cable lengths up to 40 km will be presented. As an innovation to the existing single side medium voltage (MV) DAC systems, an additional range extension solution will be presented for energizing long lengths with compact high-power sources, together with a dual side PD detection on longer cable lengths. Finally, the selection of procedures will be discussed, based on the field experiences collected in the past 10 years, to support different types of on-site tests e.g., for after-laying-, maintenance- and diagnostic purposes.

KEYWORDS

Distribution power cables, long lengths testing, partial discharge diagnosis, after-laying and maintenance testing.

INTRODUCTION

After-laying tests of new installed and diagnostic testing of service aged distribution power cables are important aspects to obtain knowledge about the actual condition of the complete cable system and to prevent breakdowns during service. The application of damped AC (DAC) voltages including standardized conventional PD detection and analysis is worldwide accepted for on-site testing and diagnosis of MV power cables [1]. This technology is based on the off-line energizing of a cable circuit with the possibility of testing with elevated voltages. The damped AC technology makes it possible using one single unit to energize long lengths of power cable with a high capacitance with a low input power demand [2-4]. In addition to the PD inception equivalence of sinusoidal damped AC voltages (in the frequency range of 20-300Hz) compared to the 50/60 Hz network stresses the characteristics of the applied technology meets the specification of an on-site testing system:

- Lightweight single unit system,
- Compactness in relation to the output voltage,
- Low effort for system setup,
- Low input power demand, even for long cable lengths,
- Low level EM noises and possibility of sensitive PD detection and dissipation factor measurements.

Onsite testing with damped AC voltages makes is possible to include the IEC60270 standardized PD detection method. There are different parameters that can influence the quality of the partial discharge measurement [5-10]. Especially in the case of long length power cable systems, the PD detection sensitivity is a known matter that can be challenging. Also the PD origin localization in long cable lengths can become more complicated compared to shorter cable lengths. Due to limited sensitivity, which is affected by the noise level at the on-site situations, the detectable PD magnitude is an important factor for each PD test. To localize the origin of PD, a common used method is the time domain reflectometry (TDR). Using this technique, a detectable reflection of the PD pulse from the far end of the cable has to be detected by the measurement device.

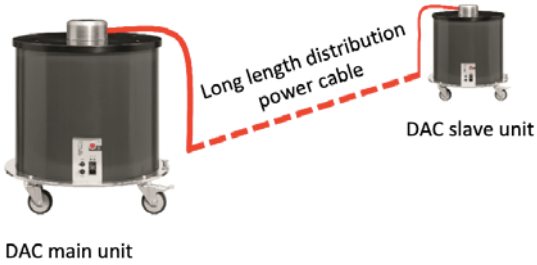

Fig. 1: Example of a 60 kV DAC test system with double side PD testing and diagnosis extender for long distribution power cable circuits

The PD measurement sensitivity and localization chance can be extended by using an additional PD measuring system at the second (far) end of the cable, see Fig. 1 and Fig. 2.

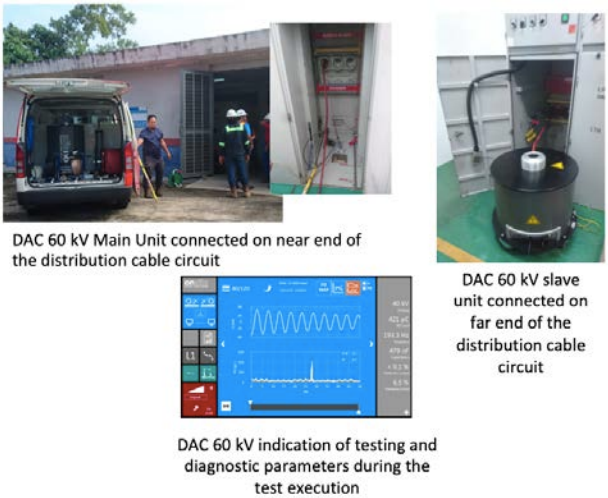

Fig. 2: Example of a 60 kV DAC test system with double side PD testing for diagnosis for long distribution cable circuits.

This unit measures PD activity with the conventional standardized PD detection, synchronized with the damped AC test voltage and synchronized with the PD measurement at the near end of the cable. This two-sided measurement provides higher detection sensitivity, especially in the case of long cable lengths. This technique provides more precise PD measurements and