Improving cable system reliability by monitored withstand diagnostics - Featuring high efficiency at reduced test time

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Today the medium voltage cable systems are degrading over time and subsequently more failures are recorded. Effective asset management strategies are required to manage the aging underground cable infrastructure.

Utilities are forced to improve the cable system reliability by adequate maintenance programs. Commonly voltage withstand tests are applied to test the electric strength of the cable system and thereby determine the voltage withstand performance. This approach is well accepted for new cable installations whereas aged cable systems fail often by unnecessary high voltage stress. There smart cable diagnostic methods take place offering information on cable degrading at reduced test voltage levels. Effective maintenance programs help thereby to renew in time the weak cable accessories or cable sections avoiding the costly replacement of the whole cable.

Sinusoidal VLF test voltage is used to avoid unnecessary damages of aged XLPE cables. Thereby well established diagnostic methods are applied providing a deep analyze for estimation of the remaining cable live cycle. Partial discharge measurement (PD) provides information on weak spots especially on electrical treeing phenomena and allows localizing points of degradation.

Often weak cable joints or terminations are detected. PD testing also detects weak spots in PILC cables. Field tests by Endesa Baleares over the past years have proven that PD testing is limited to its PD- and electric treeing phenomena. PD testing was found to be limited in detecting the global cable aging condition of old cable installations as often not providing information on fault causes generated by moisture ingress on cable accessories even those are statistically present in the failure cause list.

A dissipation factor measurement (tan delta) was found most useful to inform about the global aging condition of the cable. Tan delta ramp up measurements provide a deep analyze of the complete cable circuit.

The paper provides first hand information on measuring results of distribution cable systems gained by Endesa Baleares featuring a new tan delta trend monitoring, which provides useful information on cable circuit integrity as well as offers key information to differentiate the pre-fault phenomena. The tan delta trend monitoring provides unique information to judge for high failure risk on wet joints and carbon tracking in joints, terminations and cables.

The paper also provides case studies on complex PD and Tan Delta diagnosis of old PILC Hybrid cable circuits.

Best practice examples of monitored withstand diagnostics based on PD and tan delta is illustrated. Monitored withstand diagnostics differs from lately introduced monitored withstand testing as it aims to avoid unnecessary electric overstress on old cable installations.

This paper further focuses on how to improve the test and diagnostics productivity factor.

Latest developments enable to run tan delta and PD measurement simultaneously that provides additional diagnostic information during voltage ramp up and allows trending of PD and tan delta.

This features the potential to reduce the time spent on site for cable test and diagnostics drastically and allows an essential time saving of 50%.

High efficiency in cables diagnostics and optimizing the time spent on are essential factors for effective asset management strategies.