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Optimised cable end termination systems for laboratory tests on MV, HV and EHV cables

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For the control of the extreme inhomogeneous electric field on the ends of plastic-insulated cables, use of water of a defined conductivity has been common practice in test laboratories for many years. Available test systems for this purpose mainly consist of two cable end termination tubes and the water conditioning unit. Because of that resistive control in the termination tubes and the electric loss involved, the water heats up. Therefore the water conductivity and temperature has to be controlled by the conditioning unit. Moreover, the electric loss influences the characteristics of the HV testing circuit, in some cases even decisively. That means the water properties as conductivity, temperature, pressure and flow rate become also important for the design and operation of the high-voltage (HV) test system.

The present paper describes the optimisation of the operation range of water end termination systems. Modern 3D-calculations of the electrical field strength and latest knowledge of the water chemistry and processing allow an exact description of the operation mode of a termination system. The operating diagram of an example is shown. Based on this operating diagram, the limits both the dielectric and thermal limit are discussed. The requirements on the water quality and parameters are derived from the operating diagram. Finally it results in a fully automatically run conditioning unit for the water processing. Control hardware and software of the conditioning unit are designed for data transfer to the HV test system. The systems both the cable end termination system and the HV test system can be operated as a whole from a single operator device. It makes the testing procedure easier.

Partial discharge (PD) and dissipation factor (tan δ) measurements complete the HV tests on cables. Especially the tan δ measurement is influenced a lot by the electric loss of water in the end terminations. The design of electrodes of the end termination tubes considers it. An additional electronic amplifier compensates the influence of that loss and makes sensitive tan δ measurements possible, even for the application of non-conventional dissipation factor measuring methods.