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Title: Control of a Hybrid Transformer to Improve the Power Quality in a Distribution Network

Abstract:

Most Hybrid Distribution Transformers (HDT) configurations comprise a series converter and a parallel converter, where the parallel converter is typically integrated into the main transformer via an auxiliary winding, and the series converter is connected to the secondary side of the transformer. In these configurations, the main transformer is unprotected from the grid voltage and load current disturbances. Even while using the parallel converter to compensate for the nonlinear load currents, and provide sinusoidal currents on the medium voltage side, nonlinear currents circulate through the secondary winding of the transformer. Moreover, the nonlinear currents injected by the parallel converter flow through the auxiliary winding of the main transformer. On the other side, under grid voltage disturbances, the series converter compensates for the voltage disturbances providing a sinusoidal voltage to the load. Nonetheless, polluted and unbalanced voltages are still applied to the transformer terminal. These operating conditions can reduce the lifetime of the main transformer, potentially damaging it. To address the issues presented in most HDTs, this work proposes an HDT configuration in which the series converter is connected to the primary side winding, and the parallel converter is connected directly to the secondary side winding. This configuration improves the power quality of the transformer by reducing the THD of the current and the voltage to its terminals while at the same time providing a regulated voltage to the loads. Moreover, retrofitting of the main transformer is potentially allowed.

Keywords:

Hybrid transformer, power quality, distribution grid