Voltage Driven Finite Element Analysis of a Plunger Core Reactor with Parallel Winding Paths

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Abstract:

Many high voltage distribution networks utilize a plunger core reactor for the compensation of short circuit currents in case of earth faults. Since the topology of the network will change under normal operational conditions, the total network capacitance is alterable and a continuously variable inductance is necessary. This can be realized by different air-gaps of the plunger core reactor.

The paper presents 3D finite element analyses of a plunger core reactor with four parallel connected winding paths. Due to the parallel windings and the magnetic coupling, voltage driven analyses have to be used to determine the current distribution. Based on a formulation with the magnetic vector potential and the electric scalar potential, the finite element model utilizes a direct circuit coupling to take into account for the applied voltage and the parallel windings paths. Consequently, the four coil currents are obtained with the full influence of the asymmetric winding arrangement according to the position of the plunger core. Moreover, the Lorentz forces acting on the windings and the Maxwell forces acting on the plunger core under steady-state operational conditions are calculated in dependence of the plunger core air-gap.