

Effect of shield placement for transient voltage mitigation due to switching surges in a 33/11 kV transformer windings

ABSTRACT

This study presents an investigation on the effect of shield placement for mitigation of transient voltage in a 33/11 kV, 30 MVA transformer due to Standard Switching Impulse (SSI) and Oscillating Switching Impulse (OSI) surges. Generally, the winding and insulation in transformers could experience severe voltage stress due to the external impulses i.e. switching events. Hence, it is important to examine the voltage stress and identify the mitigation action i.e. shield placements in order to reduce the adverse effect to the transformer windings. First, the resistances, inductances, and capacitances (RLC) were calculated for disc type transformer in order to develop the winding RLC equivalent circuit. The SSI and OSI transient voltage waveforms were applied to the High Voltage (HV) winding whereby the transient voltages were simulated for each disc. The resulting voltage stresses were mitigated through different configurations of electrostatic shield placements. The resonant oscillations generated due to switching surges were analysed through initial voltage distribution. The analyses on the transient voltages of the transformer winding and standard error of the slope (SEb) reveal that the location of shield placement has a significant effect on the resonant switching voltages. The increment of the shield number in the windings does not guarantee optimize mitigation of the resonant switching transient voltages. It is found that the voltage stress along the windings is linear once a floating shield is placed between the HV and Low Voltage (LV) windings of the disc-type transformer under the SSI and OSI waveforms. These findings could assist the manufacturers with appropriate technical basis for mitigation of the transformer winding against the external transient switching overvoltage surges.