

Modelling and Simulation of Power Transformers under a DC Offset Produced by Load Current

HMAI Herath¹ and JP Karunadasa^{2#}

¹General Sir John Kotelawala Defence University, Sri Lanka

²University of Moratuwa, Sri Lanka

#ayeshaih@gmail.com

Power electronic intensive loads and sources operating in the distribution system inject small amounts of DC current back to the distribution system that add to a significant value at the distribution transformer, in comparisons to its magnetizing current. This DC current offsets the symmetrical magnetization of the transformer resulting in heavy asymmetry between half cycles of the magnetization current and substantially high current peaks due to magnetic saturation. The problem of DC current is not confined to the secondary side of the transformer, and it repeats with even greater severity as a circulating DC current in the delta connected primary winding producing significant consequences. To investigate the effects of DC current in a distribution transformer, the model of the transformer should be accurate and linked with the true magnetization characteristic of the transformer. This paper presents a self-tuning model for a transformer for this type of investigations with the magnetization characteristic extracted from no-load measurement. Test measurements carried out on a real transformer for different levels of injected DC currents and the simulation results of the same conditions using the model show extremely close agreement validating the model. Simulations are done in MATLAB and the simulation models are detailed and presented. Results reveal substantial distortions at input current for even a moderate value of DC current. Simulated and test waveforms are presented considering the case of a single phase transformer.

Keywords: Modelling, DC offset, Distribution Transformer, Magnetization characteristic