

Dynamic Behaviour of Transformer Winding under Short-Circuits

Muhammad Salman Aslam Minhas

Abstract

The work presented in this thesis contributes to the understanding of the dynamic behaviour of large power transformer windings under short circuit forces. A simple yet accurate method of prediction of electromagnetic forces is developed and used as input to the dynamic mechanical model. In developing this model the mechanical properties of oil-impregnated pressboard have been investigated and measured in a specially designed rig which simulates the typical power transformer environment. Assumptions have been made regarding these properties to enable them to be meaningfully incorporated in a dynamic model of a transformer. Predictions made using the model have been compared with actual measurements on a transformer and a correlation within 20%-30% was achieved. The work demonstrated the importance of mechanical prestress to ensure that no serious nonlinearities will be encountered in the mechanical behaviour when short-circuit forces are present in a power transformer. It was also found that for small radial deflections, the axial and radial behaviours are independent. This work provides a theoretical basis for further work in which precise determinations of the mechanical properties of oil-impregnated pressboard can be used to model the dynamic behaviour of a large transformer to a high degree of accuracy.