JURISIC Bruno

Institut PASCAL, co-tutelle UBP/Université de Zagreb (Croatie)

Method for calculations of high frequency transmitted overvoltages through a power transformer

Traditional transformer models available in EMTP-like software packages are not capable of representing transformer behaviour at high frequencies which occur during fast transient. Moreover, the existing high frequency transformer models are often too complex or require confidential information on transformer geometry.

In this Doctoral Thesis two models of a transformer compatible with EMTP-like software packages capable of representing the electromagnetic interaction between a transformer and an electric system, as well as voltage and current at the external nodes of the transformer, are established. These models are suitable for usage in insulation coordination studies, especially for power utilities' engineers. The developed Black Box model is based on sweep frequency response analyser measurements of the transformer's admittance matrix, while the developed Grey Box model is based on a finite elements method calculation, derived from limited knowledge of the internal lay-out of the transformer. Both models are prepared for use in an EMTP-like software packages using the rational approximation, passivity enforcement and state space equations. The models were validated using lightning impulse tests' measurements and transformer's frequency response field measurements.

Furthermore, the developed models were tested on a real application, taking into account the randomness of lightning. Therefore, a procedure for the calculation of transmitted lightning overvoltages through a power transformer in EMTP-like software package, which takes into account the uncertainties of the lightning current parameters, is established.

As one of the developed transformer models is based on a limited knowledge of the internal lay-out of the transformer, it is important to have tools helping the engineer to debate the most influential parameters. A sensitivity analysis using the Morris' Method is conducted to detect the most influential parameters on the electromagnetic behaviour of power transformers, as well as to detect zero-influential ones.