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LOCATING PD IN TRANSFORMERS THROUGH DETAILED MODEL AND NEURAL NETWORKS

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In a power transformer as one of the major component in electric power networks, partial discharge (PD) is a major source of insulation failure. Therefore the accurate and high speed techniques for locating of PD sources are required regarding to repair and maintenance. In this paper an attempt has been made to introduce the novel methods based on two different artificial neural networks (ANN) for identifying PD location in the power transformers. In present report Fuzzy ARTmap and Bayesian neural networks are employed for PD locating while using detailed model (DM) for a power transformer for simulation purposes. In present paper PD phenomenon is implemented in different points of transformer winding using three-capacitor model. Then impulse test is applied to transformer terminals in order to use produced current in neutral point for training and test of employed ANNs. In practice obtained current signals include noise components. Thus the performance of Fuzzy ARTmap and Bayesian networks for correct identification of PD location in a noisy condition for detected currents is also investigated. In this paper RBF learning procedure is used for Bayesian network, while Markov chain Monte Carlo (MCMC) method is employed for training of Fuzzy ARTmap network for locating PD in a power transformer winding and results are compared.

K e y w o r d s: Bayesian network, detailed model (DM), fuzzy ARTmap (FAM) neural network, partial discharge (PD), transformer

1 INTRODUCTION

Partial discharges (PD) are well known as a source of insulation degradation and the major sources for insulation failure in power transformers, which play important role in electric power system [1, 2]. The capital cost of a power transformer is relatively high and economic penalty due to transformer failure and consequent outage is remarkable. Thus deterioration of insulated material caused by PD activity can be detected in early stage, then incipient insulation failure can be identified and preventive maintenance measures can be done [3]. PD detection technique is classified into acoustic and electrical methods. Electrical method is based on detecting of created impulses in the cavity of transformer insulation. Assessment of PD in electrical method is possible by using current transducers, which are connected to measuring terminals. In this method different procedures such as tip-up, dielectric loss analysing, inductive probes, pulse detecting and analysing, or other methods can be employed [4].

The advantage of acoustic relative to electrical technique for PD detection is its simplicity. However acoustic method has low sensitivity. On the other hand complicated structure of power transformer causes difficulty due to propagation velocity of acoustic waves associated with PD [5]. Therefore in recent years most reports are available concentrated on electrical methods [3–7]. Most of these reports deal with discharge between transformer winding and ground, and discharge between coil to coil has received little and incomplete attentions.

In this paper, partial discharge in the insulation between coil to coil is considered With EMTP simulation tools and DM of transformer. Then the current of neutral point of winding was measured when PD model was located at different positions in the winding and is used to finding location of PD using Fuzzy ARTmap neural network and Bayesian network. Simulated results must contain measurement noise for approximate to the truth. For mentioned reason in the last section simulated currents is changed to new one with considering measurement noise. Then the corrected currents are used for determination of the location of PD in transformer with aforesaid neural networks.

2 PARTIAL DISCHARGE MODEL

PD is localized ionization within insulator caused by high strength electric field. PD occurs in the part of insulation and is limited to some extends. Therefore PD does not cause full insulation breakdown immediately [4]. In this paper three-capacitor model shown in Fig. 1 is employed for PD modeling, which its accuracy is verified by EMTP software [5]. In this model we have

- C_g is the capacitance of the region in which discharge occurs,
- C_b is the capacitance of region located in series with C_g,
- C_a is the capacitance of the other region in dielectric.

If discharge happens in C_g a current (I_d) flows from external terminals through C_a and C_b.

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