Electrical Power and Energy Systems 33 (2011) 1784–1785

Contents lists available at SciVerse ScienceDirect

Electrical Power and Energy Systems

journal homepage: www.elsevier.com/locate/ijepes

Book Review

Condition monitoring and assessment of power transformers using computational intelligence. W.H. Tang, Q.H. Wu. Springer, London (2011).

Power transformers are among the most expensive and critical units in a power system [1]. Transformer failures are sometimes catastrophic and almost always include irreversible internal damage. Therefore, all key power transformers equipped in a power system should be monitored closely and continuously in order to ensure their maximum uptime. In recent years, rapid changes and developments have been witnessed in the field of transformer condition monitoring and assessment (CMA). Nowadays, with the use of advanced computational intelligence techniques, system operators are able to interpret correctly various fault phenomena and successfully detect incipient faults. In the deregulated electricity market environment, increasing interest has been seen in CMA of power transformers, because CMA can reduce operating costs, enhance the reliability of operation, and improve power supply and service to customers. That is why power transformer CMA has been a subject of research work for many years and it continues being a subject of strong interest [2–33].

With this book Professors Tang and Wu contribute to the diffusion of power transformers CMA in a fresh way. More specifically, *Condition Monitoring and Assessment of Power Transformers using Computational Intelligence* applies a broad range of computational intelligence techniques to deal with practical problems of transformer CMA. More specifically, this book covers three important up-to-date aspects of computational intelligence, including the evolutionary approach, the logical approach, and the cybernetic approach, which are employed for model parameter identification, fault feature extraction and classification, and dealing with uncertainties for undertaking condition assessment of power transformers, respectively.

This book is self-contained with adequate background introductions underlying analytical solutions of each topic and links to the publicly available toolboxes for the implementation of the introduced methodologies.

Another very interesting aspect of this book is that it deals with practical transformer operation problems by analyzing real-world measurements with a broad range of advanced computational intelligence techniques. The book presents many examples of using real-world measurements and realistic operating scenarios of power transformers, which fully illustrate the use of computational intelligence techniques to deal with a variety of transformer modelling and fault diagnosis problems.

This reference book presents practical and useful information about transformer CMA. Professors Tang and Wu are authors of important articles in international refereed journals in the area of power transformer CMA. Their research experience ensures the theoretical and practical treatment given to their book.

The material of the book is organized in eleven chapters. Chapter 1 presents the background of transformer condition monitoring and assessment. Then, it analyzes the four main aspects of condition-based diagnosis techniques, i.e., thermal modelling (TM), dissolved gas analysis (DGA), winding frequency response analysis (FRA), and partial discharge analysis (PDA). It also discusses the drawbacks of conventional transformer diagnosis techniques. Chapter 2 presents the fundamentals of three evolutionary algorithms, i.e., genetic algorithm (GA), genetic programming (GP), and particle swarm optimization (PSO). Chapter 3 focuses on three mathematical theories dealing with uncertainties, i.e., the evidential reasoning (ER) theory, the fuzzy logic (FL) theory, and Bayesian networks (BNs). Chapter 4 develops two thermal models built upon the thermoelectric analogy (TEA) theory, i.e., a comprehensive TEA thermal model (CTEATM), and a simplified TEA thermal model (STEATM). These models are established to calculate real time temperatures of main parts of an oil-immersed power transformer. Chapter 5 employs a simple GA to identify thermal parameters of CTEATM and STEATM using on-site measurements. Chapter 6 gives a brief literature review of DGA and briefly discusses several widely used DGA classifiers. Chapter 7 is concerned with intelligent fault classification for DGA using three combined classifiers, i.e., GP with artificial neural network, GP with support vector machine, and GP with K-nearest neighbor. Chapter 8 deals with the uncertainties arising from DGA diagnosis from three different angles, i.e., evidence congregation, crispy decision boundary, and probabilistic inference. Chapter 9 presents the technical background of FRA, discusses the advantages and disadvantages of various winding models, and summarizes the conventional FRA interpretation methods. Chapter 10 proposes a model-based approach to identifying distributed parameters of a lumped-element model of a power transformer winding using an improved PSO method. Chapter 11 transfers an FRA assessment process into a multiple-attribute decision-making problem using a revised ER algorithm. It also presents two examples of transformer winding condition assessment problems using two ER evaluation analysis models, where it demonstrates the potential of the ER approach to combining evidence and dealing with uncertainties.

This is a useful book for postgraduate students, academic researchers, and professional engineers working in the area of advanced condition monitoring and assessment of power transformers.

In conclusion, the implementation of the methodologies presented in this book could open the possibility of obtaining the maximum practicable operating efficiency and optimum life of power transformers, minimizing risks of premature failures and generating optimal system maintenance strategies.

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