Preface

Power transformers are among the most expensive and critical units in a power system. The normal life expectance of a power transformer is around 40 years, and in many power systems the percentage of transformers operated more than 30 years is increasing due to the investment boom after the 1970s. As a result, the failure rate of transformers is expected to rise sharply in the coming years. 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. Generally, there are four main aspects of transformer condition monitoring and assessment, including thermal dynamics, dissolved gas, partial discharge and winding deformation, which should be monitored closely in order to determine power transformer conditions.

In recent years, rapid changes and developments have been witnessed in the field of transformer condition monitoring and assessment. Many research institutions and utility companies have their own condition monitoring and assessment guidelines for large power transformers. Most of such efforts are dedicated to developing accurate transformer models and reliable transformer fault diagnosis systems. These approaches are usually based upon empirical models, which are sometimes inaccurate and incomplete concerning abnormal operation scenarios. The major drawbacks are rooted in the inaccuracy of empirical thermal models, the lack of knowledge and evidence in dissolved gas analysis and intricate issues in winding deformation diagnosis. Nowadays, owing to the advance in computational hardware facilities and software data analysis techniques, the in-depth understanding of various phenomena affecting transformer operations has become feasible. With the use of advanced computational intelligence techniques, system operators are able to interpret correctly various fault phenomena and successfully detect incipient faults.

This book is dedicated to advanced model-based approaches to accurate transformer modelling and intelligent data mining techniques for reliable transformer fault diagnosis. It introduces three important up-to-date aspects of computational intelligence techniques to handle practical problems of transformer condition monitoring and assessment. These techniques include the evolutionary algorithms, the logical approaches and the cybernetic methods, which are employed for model parameter identification, fault feature extraction and classification and dealing with uncertainties for undertaking condition assessment of power transformers, respectively.

We wrote this book in belief that applying computational intelligence techniques to transformer condition monitoring and assessment would open the possibility of obtaining the maximum practicable operating efficiency and optimum life of power transformers, minimising risks of premature failures and generating optimal system maintenance strategies. 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. It deals with practical transformer operation problems by analysing real-world measurements with a broad range of computational intelligence techniques. This book has presented 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. We hope that this book will be useful for those postgraduates, academics researchers and engineers working in the area of advanced condition monitoring and assessment of power transformers.

We would like to thank Dr. Almas Shintemirov for his contribution to chaps. 7 and 11, made during the period of his Ph.D. study undertaken at The University of Liverpool. We also wish to thank Dr. Kevin Spurgeon and Dr. Shan He for their contributions, made during the period of their Ph.D. studies undertaken at The University of Liverpool, to part of the achievements presented in this book. Special thanks are given to Mr. Zac Richardson and Mr. John Fitch of National Grid for supporting this work and providing useful discussions.

Special thanks also go to Anthony Doyle (the Senior Editor), Claire Protherough and Sorina Moosdorf for their professional and efficient editorial work on this book. Our thanks are also extended to all colleagues in the Intelligence Engineering and Automation Research Group, The University of Liverpool, for all assistance provided, and who have not been specially mentioned above.

The University of Liverpool, June 2010

Dr. W.H. Tang
Prof. Dr. Q.H. Wu

Springer

http://www.springer.com/978-0-85729-051-9

Condition Monitoring and Assessment of Power
Transformers Using Computational Intelligence
Tang, W.H.; Wu, Q.H.
2011, XVIII, 202 p., Hardcover
ISBN: 978-0-85729-051-9