

Preface

Impulse testing of transformers is being carried out in the High Tension Laboratory of Jadavpur University in Kolkata, India, for more than four decades. The first author of this book is a faculty member associated with this laboratory for the last 28 years and is the In-Charge of this laboratory for the last decade. The insight gained through such testing and also the specific queries of the designers of transformers, which are being tested, gave the impetus to carry out detailed research on impulse fault analysis of transformers. The authors would like to thank the brilliant research scholars, who had taken part in this research program funded by national funding agencies. This research led to the development of accurate tools for impulse fault diagnosis in transformers. However, impulse tests are design acceptance tests that are performed on transformers before they are put in service. In the early parts of the last decade, the first author was having regular discussions with academics as well as engineers from power utilities not only in India but also in Europe, USA, and Australia, wherein the main focus of the discussions mainly veered on development of accurate methodologies for estimating the condition of transformers in service. This is of great importance in view of the large number of transformers that have been installed over the globe in the 1960s and 1970s and are still in service. From the maintenance point of view, these transformers pose a threat to continuity of service, but from the economic point of view these units cannot be replaced overnight. Hence, condition-based maintenance and estimation of remaining life are of paramount importance to power utilities in this deregulated era.

At this juncture, the first author thought of initiating a research program on condition monitoring techniques of transformers. Needless to say, the conventional techniques of transformer condition monitoring have been in place for several decades. But during the last two decades, major works are being carried out at different laboratories around the world for development of reliable and accurate condition monitoring techniques, which are noninvasive in nature. In this context, promising electrical methods were being proposed. So the research at the High Tension Laboratory of Jadavpur University was also focussed in this direction. The greatest difficulty that was faced in this context was the inhibiting cost of diagnostic equipments that were available in the market. The first author did not have enough funds to procure such equipments to carry out the intended research. So there were two alternatives: either to develop the equipments starting from scratch

or to abandon the research. At this hour of despair came two outstanding researchers, who not only developed required equipments but also developed accurate analysis tools using state-of-the-art data acquisition and signal processing tools. The efforts of these three have resulted in filing several patents in India as well as in the US, out of which one has already been granted. The news about the work carried out by this research group spread widely within India and quite a few leading power utilities came for cooperative work. One such work has led to successful implementation of the techniques developed by this research group in one of the largest power companies in India. After the completion of the doctoral work of these two bright researchers and successful practical implementation of their techniques in real life, the first author requested them to write this book, wherein they can share their expertise and insight gained through research works over several years.

The authors feel that during the course of these research works and in the preparation of this manuscript they have successfully transcended from academicians involved in laboratory research to ones who know how to implement their research works in real life taking into account all the nuances of practicality. These experiences have enriched their vision of engineering research enormously.

A substantial proportion of the material is original, and has been the outcome of the researches carried out by the authors. However, help has also been taken from the published literature. In writing this book, the authors have assumed that readers are well acquainted with the very basic concepts of transformer design, operation, and testing. The main characteristics of this book are:

- (i) it assumes that the reader's goal is to understand the critical balance of cost and quality along with the pros and cons of different condition monitoring techniques;
- (ii) it presents a selection of techniques with appropriate technical background to understand their domain of applicability and to consider variations to suit technical and organizational constraints;
- (iii) it intends to extend the vision of condition monitoring testing and analysis which is integral to modern maintenance practice; and
- (iv) it treats condition monitoring testing and analysis tools together in a coherent framework, as complementary approaches so that adequate quality is achieved at acceptable cost.

By going through this book, students and researchers will gain a proper understanding of the principles and issues in condition monitoring of transformers. Practicing engineers, including quality assurance professionals, will find a variety of techniques with enough discussion on technical issues to support adaptation to the specific requirements of their organization and application domain. Technical managers will find a coherent approach to weaving condition monitoring techniques into the overall maintenance strategy.

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Finally, the responsibilities for any mistakes and for the ideas expressed in this book are those of the authors' only.

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