AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
ELECTRICAL POWER AND MACHINES DEPT

DIAGNOSTIC FOR DETERMINING LIFETIME OF POWER TRANSFORMER AND ITS PREVENTIVE MAINTENANCE

A Thesis
Submitted in Partial Fulfillment for
the Requirement of Degree of Master
of Science in Electrical Engineering

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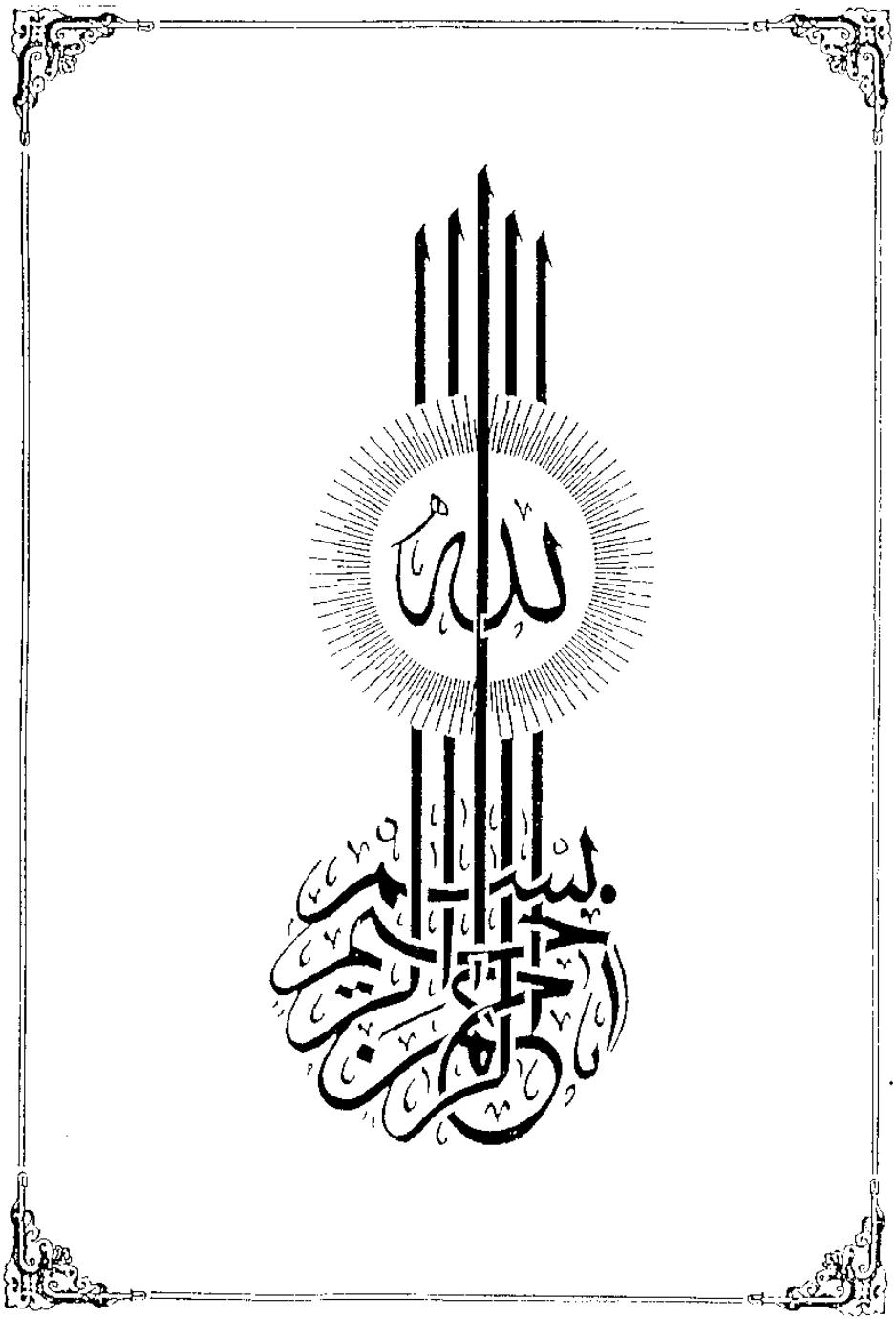

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master in Electrical engineering .

The work included in this thesis was carried out by the author . No part of this thesis has been submitted for a degree or a qualification .

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ACKNOWLEDGEMENT

The author is greatly honored to express her sincere and deep gratitude to professor Dr. A. Nosseir , chairman of the Electrical power & Machines Department , Faculty of Engineering , Ain shams university , for giving her the privilege of working under his supervision . She is deeply thankful for his continuous encouragement and valuable guidance .

Special thanks are due to prof. Dr. A. Soliman who supervised the work at its early stages for his continuous help & guidance .

The author wishes to express her deep gratitude to Dr. M. M. Awad , chairman of the North upper Egypt Zone , EEA for his continuous support , unfailing discussions and valuable instructions . His continuous advice was always simulating and especially essential to complete his work .

The author is sincerely grateful to Dr. H. M. Said , the resident engineer for Ayoun Moussa power plant project , for his kind assistance continuous help and precious advice .

Finally , deep appreciation is expressed to all colleagues in the Egyptian Electricity Authority (EEA) in particular the staff of both the extra high voltage research center and the central chemical laboratory , for their cooperation and help in carrying out the tests and measurements .

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Diagnostic Methods For Determining Life Time Of Power Transformer And Its Preventive maintenance

By
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For
The M. SC. Degree

ABSTRACT :

Some methods are used to diagnose the transformer status such as partial discharge , short circuit reactance , low voltage impulse , dielectric strength . Oil analysis and chromotographic gas analysis are also used .

Some investigators defined the approximate gas concentration levels as safe , caution or fault levels .

The present investigation contains a complete survey of the power transformers existing in the Egyptian unified power grid . Samples from those transformers were selected . Gas in oil analysis were carried out over a period of two years . The dielectric strength and dissipation factor were also measured . A test model for accelerated ageing of oils was constructed to define the characteristics of oil after ageing . The acceptable ratio of mixing different oils can be determined by such model .

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Some of the conclusions are :

- The forced outages in Egypt are relatively high and monitoring is important .
- The monitoring can be done by electric measurements and gas in oil analysis periodically .
- It is recommended that a caution level of some dissolved gases should be defined according to the local condition of operation .
- Gas in oil analysis can be used to define the type and place of the fault in a transformer .
- Accelerated ageing tests are essential to study the effect of ageing on the insulation and cooling efficiency of oil .

The thesis includes five chapters . Chapter one is an introduction to the present work . Chapter two is a review of the previous work related to the subject . Chapter three includes the testing technique and the details of the test circuit . Chapter four contains the test results and their analysis . chapter five presents the summary , conclusions and some suggestions for future work .

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CHAPTER ONE

INTRODUCTION

During the recent years , diagnostics and maintenance of equipment for power generation and transmission has become more and more important . The reason is that in the electric power industry , economy and quality of power supply have become vital issues . The world - wide decrease in economic growth makes replacements of equipment more difficult and necessitates a higher availability of existing equipment . This in turn requires an improved knowledge on the current condition of such equipment which can be provided only through reliable diagnostic techniques .

The power transformer is one of the most important member in any electrical network . The reliability of the network depends mainly on the availability of equipment , in particular the power transformer . Beside the disturbance caused by transformer failure , an economical overview has to be considered with respect to the shortage of power supplied to the consumers .

The operational behavior of a transformer is determined by the technical know-how of the designer , and achieved by expertise in manufacture . But to ensure that such behavior is maintained in operation , proper servicing and maintenance is required .

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The costs for such servicing must be based on a safe operation throughout the life of the transformer , on the requirements laid down for a reliable supply of power , and on economy . Furthermore , it must also be possible for a correct determination of the operational reliability and the maintenance requirements to be made by less qualified personnel . Ideally , what is required is a series of tests which can be carried out in the field , fulfilling simple criteria , and / or lead to reproducible results .

Materials used in the manufacture of transformers gradually undergo changes in their structure which reduce their ability to withstand stress : this is true in particular for the insulation system , whose properties deteriorate under the influence of temperature , humidity , ingress of oxygen , vibrations and mechanical stress , and finally break down completely . A lifetime of approximately 30 years is generally presumed for power transformers . For this reason it is important to ensure that no unexpected ageing processes develop during the life of the transformer , through overstressing or insufficient maintenance . On the other hand , natural ageing which is unavoidable in service must not be allowed to lead to undesired system failure .

The most important of those components which produce ageing in the transformer are the paper used for conductor insulation , the transformer board insulation , insulating oil , on - load and off - load tap-changers and bushings .

Nevertheless it should be pointed out that the reliability of accessories is most important for the availability of transformers . Protection and control devices must be

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carefully chosen therefore to prevent unwanted interruptions during service and regular switch off operations for the sole purpose of supervision or replacement of such auxiliary equipment .

An important prerequisite for the operational safety of a transformer is the purity and the dielectric strength of its oil . Impurities are mainly foreign bodies , parts of the solid insulation , frame , and gaskets used in construction which have dissolved in the oil . Products of the ageing of the oil itself are also found to be present . Furthermore the oil retains information on damaging processes occurring within the transformer (local hot-spots , electrical discharges) , in which gases , caused by the breakdown of the solid insulation , or by degradation of the oil are released and dissolved in the oil .

Monitoring of power transformers can be achieved by different methods . The dissolved gas in oil analysis (DGA) is the simplest , reproducible , cheaper and effective method . Investigators all over the world used this method long time ago to diagnose the status of transformer .

Users and manufacturers were using the DGA in detecting the faults (type , severity and location) inside any faulty transformer . In the present study it is suggested to use this method as a tool to define the status of transformer during service conditions .

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