

**USING DIAGNOSIS GAS ANALYSIS AS A TOOL FOR POWER  
TRANSFORMER MAINTENANCE**

**SANURI BIN ISHAK**

**UNIVERSITI TEKNOLOGI MALAYSIA**

USING DIAGNOSIS GAS ANALYSIS AS A TOOL FOR POWER  
TRANSFORMER MAINTENANCE

SANURI BIN ISHAK

A thesis submitted in fulfilment of the  
requirements for the award of the degree of  
Master of Engineering (Electrical)

Faculty of Electrical Engineering  
Universiti Teknologi Malaysia

AUGUST 2014

## ACKNOWLEDGEMENT

First praise is to Allah, the Almighty, on whom ultimately we depend for sustenance and guidance. I am greatly indebted on His mercy on giving me strength to complete my research study.

Second, my sincere appreciation goes to my supervisor Associate Professor Dr. Mohd Muhridza Bin Yaacob, whose guidance, careful reading, encouragement, constructive comments and his willingness to share his valuable knowledge.

A big thank to Deputy Dean (Academics), Faculty of Electrical Engineering, Professor Dr. Mohd Wazir Bin Mustafa for his continual support, assistance and invaluable advice at the initial stages of this research study until the submission day of my thesis.

I am also indebted to my colleagues in Transmission Division, Tenaga Nasional Berhad, especially to En. Mohd Suffian bin Mohd Yusof from the Condition Monitoring Unit, for the information given related to my research study and his share of knowledge and expertise when this project was developed.

Finally, I would like to thank to my beloved family for their understanding the importance of this work suffered my hectic working hours. To my wife Rohani Ismail and my children Muhamed Danish, Nur Dini, Muhamed Irfan, Muhammad Irsyad and Muhammad Nazran.

## ABSTRACT

The importance of Diagnosis Gas Analysis (DGA) has been recognized by electrical industry nowadays as one of the tools for power transformer maintenance to monitor the performance of transformers and provide early information about the health of a transformer. The lifespan of a transformer depends on the condition of the transformer oil. Transformer problem causes an increase in temperature of transformer components, thereby increasing the temperature of the insulating. When the oil is exposed to heat, it will result in the formation of a number of gases dissolved in transformer oil. The purpose of this research is to investigate the relationship between dissolved gases in transformer oil and its relationship to the damages suffered by the transformer. This research used oil samples taken from a number of power transformers installed in Tenaga Nasional Berhad, an electrical utility company in Malaysia. Oil samples were sent to a laboratory for analysis. This research is aimed at finding the causes and consequently identify damages to the components by using five methods of interpretation using the DGA namely Rogers Ratio Method, Doernenburg Ratio Method, IEC Method Ratio, CIGRE Ratio Method and Duval Triangle Method Ratio Method. Three actual cases are discussed in this thesis based on the investigation and repair works on 132kV and 275kV transformers. It is found that DGA can be used to locate defects in the components of the transformer.

## ABSTRAK

Kepentingan *Diagnosis Gas Analysis (DGA)* telah dikenal pasti oleh industri elektrik pada masa ini sebagai salah satu alat penyelenggaraan alatubah kuasa. Ini adalah untuk meninjau prestasi alatubah tersebut dan memberi informasi awal mengenai kesihatan sesebuah alatubah. Jangka hayat sesebuah alatubah berhubungkait dengan keadaan minyak alatubah. Alatubah yang bermasalah akan menyebabkan peningkatan suhu kepada komponen alatubah, seterusnya peningkatan suhu juga akan berlaku pada minyak penebatnya. Apabila minyak penebat terdedah kepada haba, ianya akan mengakibatkan pembentukan gas yang larut di dalam minyak alatubah. Tujuan penyelidikan ini dijalankan adalah untuk mengkaji hubungan antara gas-gas yang terlarut di dalam minyak alatubah dan pertaliannya dengan kerosakan yang dialami oleh alatubah tersebut. Penyelidikan ini menggunakan sampel minyak yang diambil daripada beberapa alatubah kuasa yang dipasang di Tenaga Nasional Berhad, sebuah syarikat utiliti elektrik di Malaysia. Sample minyak ini kemudian dihantar ke makmal untuk dianalisa. Penyelidikan ini adalah bertujuan untuk mencari punca dan seterusnya mengenalpasti kerosakan pada komponen dengan menggunakan lima kaedah interpretasi menggunakan DGA iaitu kaedah nisbah Rogers, kaedah nisbah Doernenburg, kaedah nisbah IEC, kaedah nisbah CIGRE dan kaedah Segi Tiga Duval. Tiga kes sebenar telah dibincangkan di dalam tesis ini berdasarkan kajian dan kerja-kerja pembaikan pada alatubah 132 kV dan 275 kV. Ke-kes ini telah dibincangkan secara terperinci dan adalah dididapati DGA boleh digunakan untuk mencari kerosakan komponen didalam alatubah.