SURFACE LEAKAGE CURRENT SIGNAL RESPONSE ON THE FIELD-AGED HIGH VOLTAGE POLYMERIC INSULATOR

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This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

by

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I hereby, declared this report entitled SURFACE LEAKAGE CURRENT SIGNAL RESPONSE ON THE FIELD-AGED HIGH VOLTAGE POLYMERIC INSULATOR is the results of my own research except as cited in references.

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Author : Mohd Syahiran Bin Norazli

Date: 15/6/2020

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

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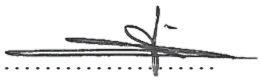
Signature : 

Supervisor Name : Ts. Asri Bin Din

Date : 19/ 2/ 2021

DEDICATION

To my parents

To my supervisor, Ts. Asri Bin Din

To my supportive lecturers

And then, to all friends who knows me.

ABSTRACT

This project presents determination of field-aged polymer insulators on the high voltage surface leakage current. Insulators are devices that are used to support, separate or contain high voltage conductors in electricity supply networks. Aging processes are typically complicated and occur under various type of stresses at same time. Insulation measured at the contact angle under consideration leads to the surface being approximately horizontal to the top surface. Insulators of a polymer form have slowly replaced ceramic insulators. Polymer insulator is exposed to the natural environment after field-aged high voltage polymer insulator such as sunlight, solar radiation and acidic agents so the propagation of degradation on the insulator surface continues to begin. Researchers around the world have looked into different types of evaluation and analysis methods. This evaluation and analysis involve physical evaluate, analyze and compare the conditions of polymer insulator degradation using a simple measured information and spectrogram. Therefore, the research goal is to conduct a comparative study of the condition of polymeric insulator degradation between 6-year and 18-year field-aged insulator. The comparison involves the physical evaluation performance of polymer insulator which is surface roughness and to statically gather the root mean squared LC data of 6-year and 18-year insulator. The project test and analysis consist of software hardware part the measurement of surface roughness using surface roughness analyser and the LC signal parameter test using the inclined plane test (IPT). Labview and Matlab software are used for the software part for the process and study of LC capture. Since hardware testing is not possible, the project focuses on data analysis carried out by Matlab software to analyse spectrograph signal data. As the overall result, the LC signal parameter which is surface leakage current able to significantly differentiate the surface condition of 6-year and 18-year insulators compared with the surface roughness data.

ABSTRAK

Projek ini menunjukkan penentuan penebat polimer yang berumur di lapangan mengenai arus kebocoran permukaan voltan tinggi. Penebat adalah peranti yang digunakan untuk menyokong, memisahkan atau mengandungi konduktor voltan tinggi dalam rangkaian bekalan elektrik. Proses penuaan biasanya rumit dan berlaku dalam pelbagai jenis tekanan pada masa yang sama. Penebat yang diukur pada sudut kontak yang dipertimbangkan membawa ke permukaan yang hampir mendatar ke permukaan atas. Penebat berbentuk polimer perlahan-lahan menggantikan penebat seramik. Penebat polimer terdedah kepada persekitaran semula jadi setelah penebat polimer voltan tinggi di lapangan seperti cahaya matahari, sinaran matahari dan agen berasid sehingga penyebaran degradasi pada permukaan penebat terus bermula. Penyelidik di seluruh dunia telah melihat pelbagai jenis kaedah penilaian dan analisis. Penilaian dan analisis ini melibatkan penilaian fizikal, analisis dan perbandingan keadaan degradasi penebat polimer menggunakan maklumat dan spektrogram yang diukur sederhana. Oleh itu, tujuan kajian adalah untuk membuat kajian perbandingan keadaan degradasi penebat polimer antara penebat berumur 6 tahun dan 18 tahun. Perbandingan ini melibatkan prestasi penilaian fizikal penebat polimer iaitu kekasaran permukaan dan untuk mengumpulkan secara statistik data LC kuadrat rata-rata bagi penebat 6 tahun dan 18 tahun. Ujian dan analisis projek terdiri daripada bahagian perkakasan perisian pengukuran kekasaran permukaan menggunakan penganalisis kekasaran permukaan dan ujian parameter isyarat LC menggunakan ujian satah condong (IPT). Perisian Labview dan Matlab digunakan untuk bahagian perisian untuk proses dan kajian tangkapan LC. Oleh kerana ujian perkakasan tidak mungkin dilakukan, projek ini memfokuskan pada analisis data yang dilakukan oleh perisian Matlab untuk menganalisis data isyarat spektrograf. Sebagai hasil keseluruhan, parameter isyarat LC yang merupakan arus kebocoran permukaan dapat membezakan keadaan permukaan penebat 6 tahun dan 18 tahun secara signifikan berbanding dengan data kekasaran permukaan.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Ts. Asri Bin Din for their guidance and motivation throughout the process of this project. They have been such a great help to me.

I like to say thank to all my lecturers who had taught me so much valuable lessons during my journey here in UTeM. They are passionate in carrying out their duties as a lecturer which is to enlighten students with knowledge and they were very patient in doing so. I am very glad to meet them here.

Lastly, I like to express my appreciation to my parents and my family for constantly motivating and helping me throughout of this project. I also like to thank them for not giving up on me and were always giving me positive energy whenever I am in amidst of hardship.

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l	the sampling length of the test,
y(x)	the height function of the sample
n	no. of sample
H	highest measured harmonic component
$I_{h,RMS(t)}$	RMS harmonic current

LIST OF ABBREVIATIONS

LC	**Leakage Current**
HV	**High Voltage**
EPDM	**Ethylene Propylene Diene Monomer**
RMS	**Root Mean Square**
THD	**Total Harmonic Distortion**
IPT	**Inclined Plane Test**
IRMS	**Root Mean Square Current**
RA	**Surface Roughness**

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Chapter 1 will discuss about the context of the project regarding the current signal response of high voltage surface leakage including the equipment used for recovery purposes, description, objectives and conclusion. This chapter also sets out the outline for this project and the paper material.

1.2 Background

Insulation is the important part in high-voltage engineering or its applications to avoid current flowing to undesirable paths. Electrical field and dielectric strength are main properties of insulating material and are the key factors determining the isolation failure. Many power utilities around the world, like Malaysia, are largely embracing this. There are many advantages of polymer composite material over conventional ceramic material. A strong insulation system gives the electrical equipment better design, efficiency and life span. Given its widespread use, there are still many problems like life expectancy, its aging performance and long-term reliability are unknown. To resolve these, a lot of research activities have been carried out to improve their performance. These consist of production of new materials, knowledge of the chemical, electrical and mechanical aspects, manufacturing processes and service performance reliability methods. Significant quantities of requirements have recently been distributed to composite insulators used for transmission as well as for distribution.

The polymer insulator have advantages which are light weight, easy to install, increased contamination efficiency and increased vandal resistance. This organic insulator is still suffering from degradation. Heat, ultraviolet, condensation and acidic compounds is the part of environmental stress that have been naturally located on its

surface will further propagate the degradation. It is unavoidable factor that based on the state of local environment faced by outdoor insulators in the service sector.

These multiple stresses vigorously speed up degradation causing surface monitoring, degradation, hydrophobicity loss of surface area, partial arc discharge and increase in leakage current. There are different type of analysis technique to the surface leakage current signal response on the high voltage insulator condition such as Time-Domain Analysis, Frequency-Domain Analysis and Time-Frequency-Domain Analysis.

1.3 Problem Statement

The performance of polymer insulator is very important thing for wet and dry condition. The polymer insulator are exposed to many type of stress like electrical, environmental, mechanical and thermal. The problems of polymer insulator are related to their age, surface roughness and degradation of insulator. The problem statement for this project is lack of information and studies about the performance of polymer insulator. To solve the problem of this insulator, need to know the comparison of performance between the two difference type of field age insulator such as 6 years and 18 years and from the data need to analysis the parameter of leakage current such as Irms to analyse the performances of insulator. This two difference polymer insulator is at the same environment which is at village. If Irms can compare in two condition such as age and environment, so it will know the difference performance between the insulator.

1.4 Objectives

1. To investigate the physical evaluation performance of polymer insulator which is surface roughness.

2. To statistically gather the root mean squared LC data of 6 year and 18 year insulator.

3. To compare the degradation performance between 6 year and 18 year insulator using the surface roughness and LC signal parameter.

1.5 Scope of project

Surface leakage current signal response on the high voltage will be analyse by using Matlab software and Lab View software. The material that uses on this project is polymer field aged insulator between 6 year and 18 year. This project will be analyse by the data that has been collected before. The data will be collect in mechanical and electrical data from the software that has been uses. The signal shows by spectrogram that will be uses to extract the electrical signal parameter such as Irms.

1.6 Conclusion

The background, problem statement, objectives, scope of project and organisation of the report had been explained above. This chapter has alsostated how to solve the problem and how the project is carried out.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Chapter 2 will discuss about in detail the previous research related to this project. It will consist of review on the surface leakage current signal response on the polymeric insulator, the degradation and the surface roughness of insulator.

2.2 Electrical Insulator

In an electrical device, an electrical insulator is used to avoid excessive leakage of current from its supporting points to the ground. The insulator is the main role in electrical system. The insulator is high resistivity track that basically no current can pass through. The overhead conductors in transmission and distribution networks are normally protected by towers or pole support. All the towers and poles are firmly rooted.

2.2.1 Polymer Insulator

A polymer insulator has two elements such as EPDM (Ethylene Propylene Diene Monomer) and a rod-shaped core reinforced by glass fiber epoxy resin. The rod-shaped core has weather sheds. The core of insulator has been protected by weather sheds against surrounding environment. The polymer insulator is also referred as a composite insulator. It's also consists of two parts, which are core and sheds. The rod-shaped core is fixed on both sides by galvanized cast steel from end fittings made from Hop dip.