DESIGNING EARTHING SYSTEM FOR DISTRIBUTION TRANSFORMERS IN HIGH RESISTIVE SOILS AT RESTRICTED AREAS

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Degree of Master of Science

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Master's thesis under my supervision.

Signature of the supervisor:……..

Dr. W.D.Asanka S. Rodrigo

Date……

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ABSTRACT

Earthing of Distribution Transformer is very important in the sense of safety and protection of human beings, livestock and equipment. The construction personals have faced critical issues on earthing when they engage in Installations of Electrical equipment due to high values of earth resistance. The research was carried out to find solutions for two objectives. One of objectives is to design an earthing system for high resistive soil. The other objective is to find solution for earthing in restricted area.

It was found that high resistive soil exists in sandy soils in coastal areas as well as hard rocky areas in central part of the Island. There are some rocks located in coastal area too. The soil resistivity plays vital role in earthing of electrical installations. Thus the research was done by using soil enhancement materials such as Charcoal, Lime and Sand of the same location. The mixture of above materials improves the electrolytic property of soil to bring down soil resistivity.

The research was done in the field and at laboratory by varying the ratios of Charcoal, Lime and Sand. The test results showed that resistivity becomes minimum value, when the ratio becomes 1:1:3.of Charcoal: Lime and Sand respectively. The usage of optimum land area for earthing of distribution transformers were achieved by using the base of poles of transformer structure as alternative earth pits. A new design for earth mesh for pole base earth pits was introduced as a result of the research. An economic analysis was carried out to find the benefits of using soil enhancement materials instead of cement block earths. As a result of eliminating cement block earth, there is a financial gain of 18.39%.

The case studies were carried in Chilaw area for two different soil types by mixing soil enhancement materials. In this study moisture content of the soil was measured to identify the effect of presence of moisture in soil. The results of the research indicated that the earth resistance drastically reduces due to the presence of moisture content and the organic substances of the soil in addition to the soil enhancement material.

Finally, the Ansys-Maxwell software was used for simulate the earthing system in homogeneous medium. The results of simulation were shown that major portion of the energy absorbed by the narrow region, very close to the earth rod. Therefore, the diameter of the earth pit can be reduced to minimize the area of land required for earthing of distribution transformers. It shows the voltage distribution and energy dissipation in the critical cylinder very clearly.

In this research a new conceptual design was carried out to reduce earth resistance in newly designed earthing system and in existing transformers by increasing the moisture content around the earth rods of earth pits. An external water container is introduced to

provide water drops to earth pit to keep it at wet condition in dry season to improve the efficiency and effectiveness of the earthing system.

Contents

LIST OF ABBREVIATIONS

R- Resistance

ρ- Resistivity

J- Current density

L- Length

A- Cross sectional area

I- Currant

V- Voltage

l- Length

kA- kilo Ampere

kV- kilo Volts

s – seconds

μs- micro seconds

HV –High voltage

MV- Medium voltage

LV – Low voltage

RE- Rural Electrification

CEB- Ceylon Electricity Board

LTL- Lanka Transformers (pvt) Ltd

NWP- North Western Province

EE- Electrical Engineer

ES- Electrical Superintendent

DGM- Deputy General Manager

FEM- Finite Element Method

ABC- Aggregate based course

DDLO – Drop Down Lift Off switch.

LIST OF APPENDICES