DISTRIBUTION TRANSFORMER MODEL FOR TRANSIENT STUDIES

L.S.Hasthanayake

09/8657

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

February 2014

DISRIBUTION TRANSFORMER MODEL FOR TRANSIENT STUDIES

Lahiru Saminda Hasthanayake

09/8657

Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science in Electrical Engineering

Supervised by: Prof. J.R.Lucas, Eng. W.D.A.S.Wijayapala

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

February 2014

DECLARATION

"I declare that this is my own work and this dissertation 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.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books)".

.....

Signature of the candidate Date:
(L.S.Hasthanayake)

The above candidate has carried out research for the Masters Dissertation under my supervision.

.....

Signature of the supervisor Date:
(Prof. J.R.Lucas)

.....

Signature of the supervisor Date:
(Eng. W.D.A.S.Wijayapala)

ABSTRACT

Distribution transformers are expensive components in the distribution network of the country. Records from Ceylon Electricity Board show that considerable numbers of failures of these distribution transformers are due to lightning surges. This is a huge cost for the utility suppliers like Ceylon Electricity Board (CEB) and Lanka Electricity Company (LECO).

The study area of distribution transformers under transient conditions needs to be broadened and availability of a transformer model to represent a distribution transformer used in Sri Lankan network is very much essential. If there exists a model with acceptable level of accuracy to represent the distribution transformer under transient conditions, many criteria relating to the distribution lines can be studied without actually implementing them.

In this research, a methodology is presented to obtain a model to represent a distribution transformer under transient condition. Parameters are calculated and a model is presented based on the details of the 160 kVA, 33/0.415 kV, distribution transformer. The same methodology can be extended to obtain the respective models of distribution transformers with other power ratings.

The proposed model is simulated using the PSCAD software and output results are obtained when the standard lightning waveform and chopped surge waveforms are input to the model. The simulated output along the transformer winding is observed and compared with the result of an already carried out experiment presented in a research paper. Both the simulated and experimental outputs took fairly the same shape and the model is validated.

Key words: Transformer Model, Surge Distribution, Winding, Simulations

ACKNOWLEDGEMENT

First, I pay my sincere gratitude to my supervisors Professor J.R.Lucas and Eng. W.D.A.S. Wijayapala who encouraged and guided me to conduct this investigation and on preparation of final dissertation.

I would like to take this opportunity to extend my sincere thanks to Mr.R.Rukshika, Factory Manager (LTL), Mr. D. Ratnayake, Electrical Engineer (LTL), Mr. P. Haputhanthri, Electrical Engineer (LTL), Eng. J. Karunanayake, Mr. M.Seneviratna, Chief Engineer (CEB), and Mr. N.Chamikara, Electrical Engineer (CEB), Mr. A.J.Edirisinghe, Electrical Engineer (CEB) who gave their co-operation to conduct my investigation work successfully.

It is a great pleasure to remember the kind co-operation extended by the colleagues in the post graduate programme, friends who helped me to continue the studies from start to end.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
CEB	Ceylon Electricity Board
DDP	Diamond Dotted Paper
HV	High Voltage
LECO	Lanka Electricity Company
LTL	Lanka Transformers Limited
LV	Low Voltage