ECONOMIC SELECTION OF DISTRIBUTION TRANSFORMERS FOR RURAL ELECTRIFICATION PROJECTS IN NORTH CENTRAL PROVINCE

G.P.H.P. Damayanthi Yalegama

(08/8315)

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

March 2013

ECONOMIC SELECTION OF DISTRIBUTION TRANSFORMERS FOR RURAL ELECTRIFICATION PROJECTS IN NORTH CENTRAL PROVINCE

Gardiye Punchihewage Pubuduni Damayanthi Yalegama

(08/8315)

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

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

March 2013

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 thesis/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: Date: 25th March 2013

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

Signature of the supervisor: Date: 25th March 2013

Abstract

The total cost of a transformer includes the initial purchase costs, maintenance cost and the cost due to losses of the transformer throughout the lifetime. Cost of losses depends on tariff, load curve and load growth over the life of the transformer. The cost due to losses will be a cost for the country as a whole since this will affect to the total generation capacity to meet the country's demand. Therefore the proper selection of transformers is vital for any electrical installation.

The Ceylon Electricity Board gives special concessions to electrify rural areas to uplift the living standard of the people in rural areas by providing the electricity, which is a basic need. The rural electrification project 4-extension is proposed to conduct in North Central Province targeting an electrification level towards 100% in North Central Province. With this project 550 new distribution transformers will add to the electricity distribution system in North Central Province. In this study, an economic analysis is done for proper selecting of distribution transformers for this rural electrification project.

The load factor of the rural areas of the Province is calculated by collecting the load curves of the selected transformers already installed in rural areas. According to the findings the load factor of the rural areas of North Central Province is 0.4.

The load growth rate of the rural areas was analyzed by collecting the historical data of 367 Nos. identified transformers which are installed in rural areas. Exported energy from each transformer since year 2002 was collected in order to determine the load growth rate.

This research project concludes that the average load growth rate of the rural areas of the North Central Province is 5% per annum with a standard deviation of 2%. If the initial peak load of the transformer is less than 30 kVA, the most economical transformer is 63 kVA. Similarly for the initial peak load of 30-40 kVA, 40-100 kVA and 100-160 kVA the most economical transformer installations are 100kVA, 160kVA and 250kVA respectively.

Acknowledgement

Thanks are due first to my supervisor, Professor J. Rohan Lucas his great insights, perspectives and guidance throughout the research. My sincere thanks go to the officers in Post Graduate Office, Faculty of Engineering, University of Moratuwa, Sri Lanka for helping in various ways to clarify the things related to my academic works in time with excellent cooperation and guidance. Sincere gratitude is also extended to all the staff who serves in the Department of Electrical Engineering Office.

I convey special acknowledgement to Eng. B.W.N. Rupasinghe, Former General Manager, Central Engineering Consultancy Bureau for his valuable advice and guidance throughout the course.

I would like to extend sincere gratitude to Eng. S.R.K. Gamage, Chief Engineer (P&D-R1), Ceylon Electricity Board for his valuable guidance and support.

Further, my sincere gratitude to the officers of Ceylon Electricity Board, Planning and Development branch-Region 1, Billing Center, and North Central Province Planning branch for their valuable support.

This dissertation would not have been possible unless the understanding, encouragement and patience provided by my family. Therefore I owe my deepest gratitude to my family members, specially my mother and my beloved husband, for encouraging me all the time and helping me by caring our little daughter and son.

Finally I should thank my friends and colleagues who have not been mentioned here personally in making this educational process a success. May be I could not have made it without your support.

Table of Contents

List of Figures

List of Table

List of Abbreviation

ADB	- Asian Development Bank
CAARP	- Conflict Affected Area Rehabilitation Project
CEB	- Ceylon Electricity Board
DCB	- Decentralized Budget
LRMC	- Long Run Marginal Cost
NCP	- North Central Province
SIDA	- Swedish International Development Co-operation Agency
SIN No.	- Substation Identification Number

List of Appendices