DEVELOPMENT OF A COST OPTIMIZED LV DISTRIBUTION SYSTEM EMPLOYING THE POLYGON-BASED PLANNING

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Degree of Master of Science in Electrical Engineering

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DECLARATION OF THE CANDIDATE & SUPERVISOR

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.

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Signature of the supervisor: Date

Dr. J.V.U.P. Jayatunga

Signature of the supervisor: Date

Dr. P.S.N. De Silva

ABSTRACT

Network planning is a critical task in an electrical utility. A network should be capable of suppling the demand continuously with minimum disturbances. The responsibility of the network planner is to ensure a reliable supply, confirming the network parameters like loading levels, voltage drop, loss levels, etc. within the defined limits. Loss is one critical parameter since it is directly related to the income of the utility. So utilities strive to reduce the loss while maintaining other network performance indices at satisfactory levels. Using various methods and developed tools, High Voltage (HV) and Medium Voltage (MV) networks are planned to fulfill the above requirements.

However, being at the bottom of the network structure, utilities pay less attention to Low Voltage (LV) network planning. The largest share of loss is associated with LV networks due to the flowing higher currents and higher number LV feeders. So a systematic planning approach is essential for LV networks. Further, unlike the MV networks, LV networks have a number of alternative criteria for planning to deliver the same outcome. As an example various transformer sizes and conductor sizes are available for using in planning the LV networks. Identification of the proper planning criteria is essential to select the best alternative for satisfactory performance at minimum cost.

This project proposes a novel methodology to design a cost optimized LV distribution system employing the polygon-based planning, based on the load density of the area, while maintaining all network operational parameters within required limits. In this project, polygons-based planning method in which transformer feeding areas are represented by regular polygons has been adapted for identifying the optimum planning criteria. Further the identified criteria have been validated through an analysis performed on an existing network.

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ABC	- Arial Bundle Conductor
CEB	- Ceylon Electricity Board
ENS	- Energy Not Served
GIS	- Geographical Information System
HV	- High Voltage
LECO	- Lanka Electricity Company (Private) Limited
LF	- Load Factor
LV	- Low Voltage
MV	- Medium Voltage
NPV	- Net Present Value
PS	- Primary Substation
SCM	- Standard Cost Manual
UTL	- Utilization Time of Losses