

**COST EFFECTIVE RELIABILITY IMPROVEMENTS IN  
33kV/11kV ELECTRICITY DISTRIBUTION NETWORKS –  
A CASE STUDY IN WESTERN PROVINCE SOUTH 1,  
CEYLON ELECTRICITY BOARD, SRI LANKA.**

**Degree of Master of Science in Electrical Engineering**

**Department of Electrical Engineering**

**University of Moratuwa**

**Sri Lanka**

**APRIL 2021**

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

Department of Electrical Engineering

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Sri Lanka

APRIL 2021

## DECLARATION

I declare that this thesis is my work and to the best of my knowledge and belief there is no any material incorporated therein previously submitted for a Degree or Diploma in any other University or institute of higher learning, without giving the proper acknowledgement to that effect. It also does not contain any material previously published or written by another person except where due acknowledgement is made in the text.

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Signature of the supervisor:

Date:

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Prof. W.D.A.S Wijayapala

Late Prof. H Y Ranjit Perera

## **ABSTRACT**

Electricity Distribution system in Sri Lanka consists of 33kV, 11kV and Low Voltage (400V/230V) networks. Providing reliable supply to the end user is a challenging task to any utility. Therefore, utility is trying to develop their network to provide a highly reliable supply to user by investing in system developments.

In this research, a method is introduced for selecting a cost-effective solution to improve the reliability of the 33kV and 11kV distribution systems among different proposals. Improvement of conductor, its insulation and protection of short duration faults are focused to develop in this research. Part of the method developed in this research, includes the software tool (DisFeeRIA) to analyze the reliability indices and cost for the relevant proposal. Data Base of the DisFeeRIA software tool includes failure rate improvement, mean time to repair, costing of each option considered etc. The analysis is done using user input of the particular feeder, data base of the software which are the part of outcome of the research.

Medium Voltage Underground cable (MVUGC), Medium Voltage Aerial Bundle Conductor (MVABC), Medium Voltage Covered Conductor (MVCC), Room Temperature Vulcanizing (RTV) Si-R coating on existing bare line ceramic insulators are considered as options for improving conductor and its insulation. One of the latest & innovative technologies used in distribution network, Pulse closing technology is used to reduce momentary interruptions and enhance the life time of the equipment which used in distribution network.

Developed software and method were tested by case study done for Distribution network in Western Province South – 01 of Ceylon Electricity Board (CEB). Three (03) feeders were selected in different areas from Urban, Coastal & Rural.

The method that is introduced in this research is very important to utilities for planning of Electricity Distribution network.

## **ACKNOWLEDGEMENT**

I would like to express my sincere gratitude to my project supervisors, Late Prof. H Y Ranjit Perera and Prof. W.D.A.S Wijayapala in the Department of Electrical Engineering at University of Moratuwa, for their continuous support in my M.Sc. studies and research. Their patience, motivation, enthusiasm and guidance have been the source of inspiration behind my success.

I would also like to thank academic staff members of the Department of Electrical Engineering for their encouragements and insightful comments during progress review sessions.

I would like to express my sincere gratitude to Ceylon Electricity Board for the support extended to me. In particular, I thank the Heads of Divisions and my peers in Ceylon Electricity Board, who provided me with their expertise knowledge.

I would like to convey my sincere gratitude to my father W R V G Nandadasa, mother-in-law W G Sumanalatha, spouse H K S Anjula, children W R V G D Insuka & W R V G S Thewmina and family members who helped me in numerous ways to achieve my targets all the time.

Last but not least, I would like to remember my mother late J P Hariot, My brother late W R V G Nandun Sampath.

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## **LIST OF ABBREVIATIONS**

|       |  |
|-------|--|
| CEB   | - Ceylon Electricity Board               |
| LECO  | - Lanka Electricity Company              |
| MV    | - Medium Voltage                         |
| LV    | - Low Voltage                            |
| MVBOH | - Medium Voltage Bare Overhead           |
| MVUGC | - Medium Voltage Underground Cable       |
| MVABC | - Medium Voltage Aerial Bundle Conductor |
| MVCC  | - Medium Voltage Covered Conductor       |
| RTV   | - Room Temperature Vulcanizing           |
| Si-R  | - Silicon Rubber                         |
| UV    | - Ultraviolet                            |
| HDPE  | - High Density Poly Ethylene             |
| MDPE  | - Medium Density Poly Ethylene           |
| RMU   | - Ring Main Unit                         |
| GSS   | - Grid Sub Station                       |
| PSS   | - Primary Sub Station                    |
| F     | - Feeder                                 |
| LBS   | - Load Break Switch                      |
| DDLO  | - Drop Down Lift Off                     |
| FSD   | - Fuse Switch Disconnecter               |
| HRC   | - High Rupturing Capacity                |
| MCCB  | - Miniature Current Circuit Breaker      |
| CT    | - Current Transformer                    |
| PT    | - Potential Transformer                  |

|       |  |
|-------|--|
| ACSR  | - Alluminium Conductor Steel Reinforced          |
| AAAC  | - All Aluminium Alloy Conductor                  |
| SAIDI | - System Average Interruption Duration Index     |
| SAIFI | - System Average Interruption Frequency Index    |
| MAIFI | - Momentary Average Interruption Frequency Index |
| yr    | - Year   |
| hr    | - Hour   |
| int   | - interruptions                                  |
| Cust. | - Customer                                       |
| FOB   | - Free on Board                                  |
| MTTR  | - Mean Time to Repair                            |
| GUI   | - Graphical User Interface                       |
| GDP   | - Gross Domestic Product                         |
| SPP   | - Simple Payback Period                          |
| IRR   | - Internal Rate of Return                        |
| BCR   | - Benefit to Cost Ratio                          |
| MLKR  | - Million Sri Lankan Rupee                       |

## **OBJECTIVE**

*“Specific objective of this research is to develop a methodology for economic evaluation of reliability improvement options for 33kV/11kV Distribution Networks.”*