

AN EFFECTIVE METHOD OF SEGREGATION OF LOSSES IN DISTRIBUTION SYSTEMS

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Department of Electrical Engineering

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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.

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

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Dr. Tilak Siyambalapitiya

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Abstract

Power system losses have turned out to be a major challenge for electricity utilities worldwide. Bulk of the losses occurs in electricity distribution. In 2012, the overall energy loss and the distribution system loss in the Sri Lanka power system were about 14% and 10% of the gross generation respectively. Before formulating strategies for loss reduction, it is essential to determine the losses at each level. Once losses are segregated, utility can clearly identify their priorities and launch effective programmes to arrest losses.

The objective of this research study is to segregate losses in a selected area of the distribution system of Ceylon Electricity Board, and evaluate an advanced metering solution in view of reduction of losses. Western Province North of which the distribution network spreads in the entire Gampaha district, Sri Lanka, was selected for the study. Accordingly, the losses were segregated into medium voltage network loss, losses in distribution transformers and low voltage network loss. The total energy loss in the distribution system was 7.1% of the energy input to the system in 2012. The loss in the low voltage network was 5.1 % of the total energy input. However, it was 15.7% of the energy input to the low voltage network itself.

A study was also carried out to determine losses in the low voltage networks of two distribution substations. The technical losses were estimated and thereby the non-technical losses were derived. The total losses were 13.9% and 8.8% of the respective energy input to the low voltage networks of the two substations. The technical losses were 5.1% and 4.8% while non-technical losses were 8.9% and 3.9% respectively. The viability of an advanced metering solution was assessed based on the same low voltage networks. Deployment of advanced metering systems solely with the purpose of arresting non-technical losses is not viable. However, viability of full scale deployment of advanced metering shall be studied at broader level considering any future requirements for time of use metering, avenues for demand side management, opportunity to reduce system peak through demand response principles, possible levels of reduction of losses and other benefits to utility and country as a whole.

Key words – Technical Loss, Non-technical loss, Load factor, Load loss factor, Advanced metering

TABLE OF CONTENT

Declaration of the candidate and supervisors.....	i
Acknowledgement.....	ii
Abstract.....	iii
Table of Content.....	iv
List of Figures.....	vii
List of Tables.....	ix
List of Abbreviations.....	xi
List of Appendices.....	xii
1. INTRODUCTION.....	1
1.1 Background.....	1
1.2 Distribution Losses.....	4
1.3 Electricity Consumer categories in distribution system.....	5
1.4 Existing metering system of low voltage consumers.....	6
1.5 Scope of study.....	8
1.5.1 Objectives.....	8
1.5.2 Methodology.....	8
2. ELECTRICITY DISTRIBUTION SYSTEM IN SRI LANKA.....	10
2.1 Electricity distribution systems.....	10
2.2 Electricity distribution in Sri Lanka.....	11
2.3 Technical losses in distribution system.....	15
2.4 Non-technical losses (NTL).....	17
2.4.1 Overview and Sri Lankan scenario.....	17

2.4.2 Electricity theft.....	18
2.4.3 Other forms of Non-Technical Losses	21
2.5 Economic impact of losses	21
2.6 Reduction of distribution losses.....	22
2.7 Case study of Western Province North (WPN)	24
2.7.1 Overview of distribution system in WPN	24
2.7.2 Electricity distribution system in WPN, CEB.....	25
2.7.3 Distribution losses in WPN.....	26
3. MODELLING AND ESTIMATION OF DISTRIBUTION LOSSES.....	28
3.1 Introduction.....	28
3.2 Medium voltage network	28
3.3 Power distribution transformers.....	29
3.3.1 Losses in transformers.....	29
3.3.2 Load loss factor and estimation of energy loss	30
3.3.3 Calculating energy loss of a large number of transformers	31
3.4 Low voltage distribution network.....	32
3.4.1 Overview of low voltage network.....	32
3.4.2 Uniformly distributed loads	34
4. ESTIMATION OF DISTRIBUTION LOSSES IN WPN	39
4.1 Introduction.....	39
4.2 Medium voltage network	40
4.3 Transformers of low voltage bulk consumers.....	41
4.4 Distribution transformers (Supplying low voltage consumers and street lamps)	43
4.5 Overall energy flow in the distribution network in WPN.....	45
5. SAMPLE STUDY – LOW VOLTAGE NETWORK LOSSES.....	49

5.1 Introduction.....	49
5.2 Selection of substations and low voltage network for sample study	50
5.3 Methodology	51
5.4 Calculation of distribution system losses.....	53
5.4.1 Calculation of distribution losses (Technical + Non-technical).....	53
5.4.2 Calculation of technical losses	54
5.4.3 Derivation of Non-technical losses	58
5.5 Meter testing results	60
6. ADVANCED METERING TECHNOLOGY FOR LV CONSUMERS	61
6.1 Advanced metering technology – overview	61
6.2 Comparison with existing metering and billing system of CEB	63
6.3 Cost benefit analysis of AMI.....	63
7. CONCLUSIONS, REMARKS AND DISCUSSION.....	69
Reference list	72
Appendix A: Calculation of energy losses of distribution transformers and low voltage heavy consumer transformers.....	75



List of Figures

	Page	
Figure 1.1	Structure of Electricity Industry in Sri Lanka	2
Figure 2.1	Energy flow in distribution system	12
Figure 2.2	Geographical boundaries & operational areas of distribution licensees	13
Figure 2.3	Single and three phase electro-mechanical meters used by CEB	19
Figure 2.4	Parts of a single phase meter where tampering often occurs	20
Figure 2.5	Area of distribution network of WPN	24
Figure 3.1	Single phase equivalent circuit	33
Figure 3.2	Phasor diagram of single phase equivalent circuit	34
Figure 3.3	Uniformly distributed loads	35
Figure 3.4	Load lumped at midpoint	35
Figure 3.5	One-half load lumped at end point	36
Figure 3.6	Power loss model of uniformly distributed load	38
Figure 3.7	Exact lumped load model	38
Figure 4.1	Major components in distribution system in WPN with energy flows	39
Figure 5.1	Metering installations at H 048 substation	52
Figure 5.2	Metering installations at G 011 substation	52
Figure 5.3	Layout of feeders in Gampaha G 011 substation	55

Figure 5.4	Percentage peak power losses of the Gampaha G 011 substation	55
Figure 5.5	Layout of feeders in Veyangoda H 048 substation	56
Figure 5.6	Percentage peak power losses the Veyangoda H 048 substation	56
Figure 6.1	Architecture of an AMI solution	62
Figure 6.2	Existing metering and billing system of CEB	63



List of Tables

	Page	
Table 1.1	System Losses in Sri Lanka	3
Table 1.2	Performance of distribution licensees	5
Table 2.1	Tariff wise consumer mix among DL areas	13
Table 2.2	Tariff wise energy sales (GWh) mix among DLs	14
Table 2.3	Energy loss in distribution system	14
Table 2.4	Statistical data on WPN distribution system	24
Table 2.5	Distribution network data in WPN	25
Table 2.6	Consumer details and energy sales in WPN	25
Table 2.7	Results of meter testing in WPN	27
Table 3.1	Calculation of losses in transformers	32
Table 4.1	Details of medium voltage network in WPN	40
Table 4.2	Average peak loading of bulk consumer transformers	41
Table 4.3	No load and full load losses of distribution transformers	41
Table 4.4	Calculation of LF, LLF and CF of transformers	42
Table 4.5	Calculation of monthly energy loss of transformers	42
Table 4.6	Energy loss of the LV bulk consumer transformers	43
Table 4.7	Average loading of distribution transformers	44
Table 4.8	Calculation of average loading of transformers	44

Table 4.9	Total power loss of the distribution transformers	45
Table 4.10	Summary of annual energy flow in the distribution system, WPN	46
Table 5.1	Details of electricity sales and LV line lengths	49
Table 5.2	Substations selected for the sample study	50
Table 5.3	Calculation of total energy loss of the LV feeders	53
Table 5.4	Peak loading of the feeders	54
Table 5.5	Calculation of load factors of the feeders	57
Table 5.6	Energy loss (Technical) of the feeders	58
Table 5.7	Non-technical losses of the feeders	59
Table 5.8	Results of meter testing	60



List of Abbreviations

Abbreviation	Description
AMI	Advanced Metering Infrastructure
CEB	Ceylon Electricity Board
CFL	Compact Fluorescent Lamps
DER	Distributed Energy Resources
DL	Distribution Licensee
GDP	Gross Domestic Production
LECO	Lanka Electricity Company Pvt. Ltd
LF	Load Factor
LLF	Load Loss Factor
LV	Low Voltage
MD	Maximum Demand
MDMS	Meter Data Management System
MV	Medium Voltage
NTL	Non-Technical loss
PLC	Power Line Communication
PUCSL	Public Utilities Commission Sri Lanka
RF	Radio Frequency
TL	Transmission Licensee
TOU	Time Of Use
UF	Utilization Factor
UTL	Utilization Time of Losses
WPN	Western Province North

List of Appendices

Appendix	Description
Appendix - A	Calculation of energy losses of distribution substations and low voltage heavy consumer transformers.....75



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