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VOLTAGE PROFILE IMPROVEMENT IN MV DISTRIBUTION LINE: COST OPTIMAL ALLOCATION OF REACTIVE POWER COMPENSATORS

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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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(Dr. Asanka S.Rodrigo)

ABSTRACT

The distribution power lines have some power quality problems such as voltage drop voltage sag, voltage fluctuation, voltage flicker, transient voltages etc. Those are some common problems in the distribution systems all over the world. Those problems are occurred due to reasons such as loading pattern, length of the line, consumer behavior in the feeder etc.

Considering Sri Lanka, in recent history there was no much power requirement and the demand of the electricity supply is less. At present distribution system is expanded to the whole country and provides the electricity to each house hold. Additionally due to growing of economy in the country the industries, factories are also established and the demand growth is occurred very fast. Therefore the Power quality problems were raised in the distribution system rapidly in past few years.

To minimize the voltage violation of the regulation, the several temporary solutions were adopted to the system in time to time by implementing the short term planning proposals. But they were not much suitable solutions to mitigate the voltage violation of the system permanently.

This research was done to enhance the system voltage by applying the reactive power compensators along the distribution feeders. Analysis of the whole network of Sri Lanka by simulating is a very difficult task and therefore the most critical feeder of the down south network of the electricity is selected as a case study of the research. The same procedure is followed by another feeder also as derivation of the results.

For this drastic problem, this study is carried out to find the solution by placing of reactive compensators in the distribution feeder to improve the voltage level within the required limit of ± 6% of 33 kV as the CEB planning guide lines.

The Synergee software is used to prepare a model and to analyze the feeder. Loading data of the transformers and conductor data in the feeder is required to prepare the model. This model is a mathematical model and by using load flow technique the model is analyzed. In this analysis, a range of voltage drops were recorded by adding capacitor banks to the line and there by the required sizes and locations of the capacitor banks were recorded as in the relevant voltage drop. Study about the capacitor bank types and installation methods were carried out to get the most effective solution. The results obtain from the study is to install one switching capacitor bank of 3600 kVar ,and two fixed capacitor banks of 150 kVar and one 300 kVar fixed capacitor bank in the feeder which improve the voltage level within the required level of the regulation of CEB.

As a Conclusion of this study, the voltage level improvement can be carried out with reactive power compensator placement to the medium voltage distribution line economically. The total capacitor bank sizes installed in the distribution feeder should be less than the required reactive power in that feeder. The Fixed capacitor banks should be installed at the most affected load ends with validation of off peak loads also. After selecting the fixed capacitor banks sizes the rest of the reactive power requirement should be installed with capacitor banks having switching facility and the harmonic damping reactors should be installed at the load center. The power utilities can implement the capacitor bank installation techniques to improve the voltage level up to regulated level in the distribution network. It is an economically viable solution where thoes capacitor banks can be used with any other feeder enhancement in the future and they will provide the additional benefits of improving power factor, reducing feeder losses etc.

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LIST OF ABBREVIATIONS

Abbreviation	**Description**
CEB	Ceylon Electricity Board
IEEE	Institute of Electrical and Electronic Engineers
MV	Medium Voltage
LV	Low Voltage
GSS	Grid Sub Station
LBS	Load Break Switch
AR	Auto Reclouser
R	Line Resistance
I	Line Current
V_s	Sending End Voltage
V_r	Receiving End Voltage
V_0	Nominal Voltage (33kV)
V_1	Node Voltage
PF	Power Factor
λ	No.of Capacitor Banks
C	Cost of Capacitor Bank