OPTIMUM REACTIVE POWER COMPENSATION METHODOLOGY TO MINIMIZE SYSTEM OVERVOLTAGE CONDITIONS

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Department of Electrical Engineering

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Electrical Installations

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Declaration

I declare that this is my own work and this thesis 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:

(C. K. S Perera)

09th February 2017

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

Signature of the supervisor:

(Dr. Asanka Rodrigo)

09th February 2017

Abstract

Sri Lankan Power system has experienced power frequency over voltages at steady state conditions predominantly at New Anuradhapura, New Chilaw and Chunnakam Grid Sub Stations. New Anuradhapura being connected to the lengthiest 220kV transmission lines from Kothmale (163km) and New Chilaw being connected to the Lakvijaya Power Station, which accounts to the highest capacity of national generation contribution and Chunnakam having long distance radial connection are the root causes for the issue.

Currently the network overvoltages are mainly monitored at 220kV level due to sensitivity of the protection schemes implemented on the 220kV network equipment. Eg v/f, overvoltage protection, but all network equipments are vulnerable to overvoltage conditions despite their operation voltage level.

In 27th September 2015, the most destructive event in terms of overvoltage occurred in the Sri Lankan power system initiating with tripping of Lakvijaya Gen 03 and ultimately causing a blackout. Post failure studies concluded with stressing out lack of reactive power compensation for overvoltage scenarios in present network topology.

In power system, the reactive power compensation is important for system voltage profile. This is also helpful to power factor improvement and loss reduction.

This study illustrates effectiveness of dynamic stability with integration of variable shunt reactors and static var compensators to the existing network topology, further studies are carried out to assess the effectiveness of disconnecting selected circuits to minimize overvoltage problem.

Dedication

Thank you GOD

I dedicate this thesis to my beloved parents, the two pillars in my life who have guided and motivated me to reach for my best.

To my sister who has been the strength and joy for my whole life.

To my beloved wife, your love made everything possible.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CEB	Ceylon Electricity Board
GSS	Grid Sub Station
LVPS	Lakvijaya Power Station
PSS/E	Power System Simulator for Engineers
SVC	Static Var Compensator
VSR	Variable Shunt Reactor
SCC	System Control Centre
PS	Power Station
BSC	Breaker Switch Capacitor
BB	Bus Bar