IMPROVEMENT OF VOLTAGE STABILITY OF A SOLAR PV DOMINATED POWER SYSTEM USING SVC'S- SRI LANKA CASE STUDY

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DECLARATION OF THE CANDIDATE AND SUPERVISORS

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

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ABSTRACT

According to the Ceylon Electricity Board (CEB), Sri Lanka Long Term Generation Expansion Plan 2020-2039, in the forthcoming years the contribution to meet national energy demand by major hydro sources will become stagnant. However, the development of other renewable energy resources will enhance the renewable energy share to be maintained above 35-40% during next 20-year period.

The increase in solar penetration to the grid can lead to voltage instability problems due to solar ramp rates. Currently solar inverters do not operate in the voltage controlling mode, and they are not capable of producing or absorbing reactive power. Thus, Flexible AC Transmission System (FACTS) devices, such as Static Var Compensators (SVC) are useful to support the reactive power need to sustain voltage stability in the system even under the loss of large generators supplying reactive power in the system.

The behaviour of SVC with the maximum penetration of renewable energy, focusing on solar and wind power generation was studied to size and locate the SVC in the transmission system. The Sri Lankan transmission system of year 2030 base case model simulated in Power System Simulator for Engineers (PSS/E) was used for the study.

The study showed the best location for placement of SVC was Biyagama Grid Substation considering SVC placement at Biyagama, Kotugoda and Pannipitiya Grid Substations (GSS). Furthermore, this study highlights that it is beneficial to consider a further increase of the currently proposed SVC capacity in order to improve the voltage collapse point under increased penetration of renewable sources in the Sri Lankan Power system in year 2030.

DEDICATION

I dedicate this thesis to my ever loving husband for his unconditional love, care and support given at all times to help me achieve this milestone.

To my beloved parents and brother for their continuous motivation and guidance.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CEB	Ceylon Electricity Board
CLODAL	Complex load model
DP	Day Peak
ESAC1A	IEEE Type AC1A Excitation system
ESST1A	IEEE Type ST1A Excitation System
FC	Fixed Capacitor
GAST	Gas turbine governor
GENROU	Round Rotor machine model
GENSAL	Salient pole machine model
GSS	Grid Substations
HYGOV	Hydro turbine governor
Max RE	Maximum Renewable Energy
Min RE	Minimum Renewable Energy
Mvar	Mega volt-amps (reactive)
NP	Night Peak
ORE	Other Renewable Energy
PS	Pumped Storage
PSS/E	Power System Simulator for Engineers
PV	Power-Voltage
QV	Reactive Power-Voltage
SCRX	Bus fed static exciter
SEXS	Simplified Excitation System
SVC	Static Var Compensator
TCR	Thyristor Controlled Reactor
TGOV	Steam turbine governor
TSC	Thyristor Switched Capacitor
UFLS	Under Frequency Load Shedding

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