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SECURITY STUDY OF PROPOSED DISTRIBUTED GENERATORS IN POLONNARUWA

A dissertation submitted to the
Department of Electrical Engineering, University of Moratuwa
In partial fulfillment of the requirements for the
Degree of Master Science

By

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DECLARATIO

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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Abstract

The power flows in distribution network are altered with a considerable addition of Distributed Generation (DG). It is necessary to develop a methodology to study the security levels and standards and practices to ensure the DG integration does not reduce the quality of supply offered to consumers.

DG is an emerging concept to relieve the network capacity at the back bone level. But network experiences security, stability and power quality issues with the addition of such distributed generators. The Sri Lankan power system has adopted a liberalized concept over the addition of renewable generators and there by exposed to the addition of distributed generators. This study analyses Pollonnaruwa Medium Voltage network associated power system security and stability circumstances in adding 5 distributed generators proposed at 2012.

A steady-state analysis of post-disturbance system conditions due to single failures of generators has carried out to check the violation of voltage constraints using SynerGEE standard distribution software. The study reveals there is no voltage or overloading issues by addition of DG to the network. But when certain generators trip from the network under certain conditions, under-voltage conditions have to be experienced in some areas. Fast voltage regulating devices has to be introduced to the network with better coordination to overcome the situation.

A dynamic security study has been carried out to study the ability to withstand the transients from state *n* to state *n-1* bifurcation. Rotor angle stability of generators for synchronism after a disturbance by single generator tripping is studied to check the synchronism sustainability of remaining generators. A computer based model in MATLAB/Simulink platform has developed to study dynamic behavior of the proposed network.

The load angles of all the generators are in acceptable stability values with stability margins of 89° and 77° at steady state. The maximum deviation of load angles is approximately 12.5° at single generator tripping transients, and stabilizes within two seconds period. Therefore it is ascertained that the system of generators are operating in the network with a good stability margin between state *n* and state *n-1* transitions.

Therefore the authors present a novel concept of the power system stability analysis in state transitions between system security states.

Dedication

To my ever loving passed father and mother who lightened my life with wisdom and talents.

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