SRI LANKAN POWER SYSTEM FREQUENCY STABILITY WITH FAST GROWING RENEWABLE POWER ADDITION

Y.M.T.A. Sandamal

159378G

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Department of Electrical Engineering

University of Moratuwa

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Y.M.T.A. Sandamal

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science in EI

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Dr. Asanka S. Rodrigo

Abstract

World is moving forward to a renewable energy base era while retiring conventional thermal energy generation. With this world trend in renewable energy, Sri Lankan power sector has also planned to integrate more renewable energy into the Sri Lankan power system within recent years.

This research analyzes the effect of renewable energy integration in small island mode power systems like Sri Lanka with actual measured data. Impact of the intermittent nature of the renewable power and the replacement of conventional power plants with non-inertia supportive renewable plants are mainly focused in this research work.

This research demonstrates renewable power variations in Sri Lanka and subsequent power system stability with these variations. Simulation results indicate that power system is not stable with high share of renewable power integration. Combined operation of selected conventional power plants and renewable power plants has been proposed to stabilize the power system. Technological improvements of the renewable plants to mitigate adverse effects were also addressed during simulations.

Keywords: Renewable energy sources, Wind power, Solar power, Power system stability, Frequency control, Intermittency, PSS/E simulation

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List of Abbreviations

Abbreviation	Description
LTGEP	Long Term Generation Expansion Plan
CEB	Ceylon Electricity Board
PSS/E	Power System Simulation for Engineers
LNG	Liquefied Natural Gas
HVDC	High Voltage Direct Current
HMOP	Hydro Maximum Off Peak
WSMDP	Wind and Solar Maximum Day Peak
VSC	Voltage Source Converter
LCC	Line Commutated Converter
ORE	Other Renewable Energy
ST	Steam Turbine
GT	Gas Turbine
PS	Pump Storage
AI	Artificial Intelligent
DFIG	Doubly Fed Induction Generator
SCADA	Supervisory Control And Data Acquisition
GSS	Grid Sub Station
LVPS	Lak Vijaya Power Station
UFLS	Under Frequency Load Shedding