

**A DYNAMIC LOAD SHEDDING SCHEME FOR
MAINTAINING SYSTEM FREQUENCY STABILITY
WITH THE INCREASING RENEWABLE ENERGY
PENETRATION**

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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa
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of the University of Moratuwa in partial fulfillment of the requirements for the
Degree of Master of Science in Electrical Installation



August 2021

Supervisor: Dr. L N W Arachchige

DECLARATION OF THE CANDIDATE AND SUPERVISORS

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Signature of the supervisor:

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Date: 25-08-2021

Dr. L. N. Widanagama Arachchige

ABSTRACT

Renewable energy power plants, especially grid connected solar and wind generation units are displacing the conventional generator stations with rotating machines with inertia. In Sri Lanka, renewable energy generation has begun to increase significantly. The total solar and wind energy penetration is 13% for 2020 and according to the least cost long term generation expansion plan 2018 – 2037 of Ceylon Electricity Board, this amount will be 47% by 2030. With the increased penetration of wind and solar energy generations units having no rotational inertia, there would be a variation in operational and dynamic characteristics in the power system. The power generation of solar power plants varies drastically with the cloud cover. The power output of solar and wind energy varies with their intermittent nature and as a result of it, the system frequency deviations becomes faster and risking the stability of power system as well. This study is focused on evaluating the frequency stability of Sri Lankan power system at major contingencies during the day-peak periods having maximum wind and solar generation.

In Sri Lanka, static under frequency load shedding scheme is used to restore the stability of power system after major disturbances. This load shedding scheme is initiated based on the rate of change of frequency and under frequency settings, which shed pre-determined load amounts at frequency set points in six stages. This thesis analyzes the frequency response of Sri Lankan power system with the maximum wind and solar generation for year 2030 to evaluate the performance of the present load shedding scheme in maintaining system stability. A dynamic load shedding scheme can provide quick and optimal solution by using real-time data of operating conditions. Therefore, this research is proposing a new load shedding scheme based on dynamic load shedding method to improve the frequency stability of Sri Lankan power system while absorbing maximum solar and wind power into the system.

Keywords: Static under frequency load shedding scheme, Renewable energy penetration, Solar power, Wind power, Dynamic load shedding scheme, Power system stability, Frequency stability

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LIST OF ABBREVIATIONS

Abbreviation	Description
CEB	Ceylon Electricity Board
LECO	Lanka Electricity Company
LSS	Load Shedding Scheme
NCRE	Non-Conventional Renewable Energy
ORE	Other Renewable Energy
PPP	Private Power Producers
PUCSL	Public Utilities Commission of Sri Lanka
PV	Photo Voltaic
ROCOF	Rate of Change of Frequency
SCC	National System Control Center
UFLS	Under Frequency Load Shedding

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