

**TECHNO - ECONOMIC COMPARISON BETWEEN
GENERATION CAPACITY RESERVES AND UTILITY SCALE
BATTERY STORAGE TO FACILITATE VARIABLE
RENEWABLE ENERGY INTEGRATION IN SRI LANKA**

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Degree of Master of Science in Electrical Engineering

Department of Electrical Engineering

University of Moratuwa

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Dissertation submitted in partial fulfilment of the requirements for the
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DECLARATION OF THE CANDIDATE & SUPERVISOR

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Prof. K.T.M.U. Hemapala

Abstract

At present, the Sri Lankan power system has a total installed capacity of approximately 4,087 MW by end of year 2017 with a total dispatchable capacity of 3,525 MW. The maximum demand recorded in 2017 was 2,523 MW.

Sri Lanka is a country with abundance of renewable energy sources which could be utilized to generate clean energy at zero fuel cost. Currently the Sri Lankan power system has renewable capacity (except major hydro) of 609 MW, and by the Long Term Generation Expansion Plan (LTGEP) 2018-2037 of Ceylon Electricity Board (CEB), a considerable increase in integration of renewable energy into the system is projected.

But integrating variable renewable energy (VRE) sources such as wind and solar energy to an islanded power system like Sri Lanka presents numerous technical and economic constraints. These constraints arise due to the inherent qualities of VRE such as intermittency of the resource, lack of inertial response for frequency regulation, high capital cost and the cost of maintaining adequate generation capacity reserves to compensate for variability and uncertainty of VRE. Therefore successfully overcoming the technical and economic barriers is essential in integrating more renewable energy into the power system.

Utility scale battery storage systems are considered as a possible solution to the variability and uncertainty of VRE, by facilitating energy storage from solar PV plants during the day and inject stored energy to the system at night. The battery storage system also can be used for ancillary services such as voltage support, frequency control and load smoothing, as well as ramp rate control in order to maintain grid stability. This study specifically explores the use of battery storage

KEYWORDS: Variable Renewable Energy, Operating Reserves, Utility Scale Battery Storage

Acknowledgement

It is with great pleasure that I express gratitude to those who helped and encouraged me in completing my research project.

Firstly, I would like to express my sincere gratitude to my supervisor Prof. K.T.M.U Hemapala for his valuable insights and perspective with much patience throughout the entire period and his continuous support with immense knowledge motivating me to do this research. Thank you very much for giving me the opportunity to work with you.

In addition, I would like to thank all the Lecturers in the Department of Electrical Engineering and the Post Graduate Studies Division, Faculty of Engineering, who engaged in this MSc course in various ways to educate us and broaden our vision.

My sincere thanks go to my managers and colleagues at Ceylon Electricity Board, who helped me in many ways during this period.

Finally, I am thankful to my family members including my wife, who always encouraged and help me to complete this research.

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List of Abbreviations

Abbreviation	Description
LTGEP	Long Term Generation Expansion Plan
VRE	Variable Renewable Energy
CEB	Ceylon Electricity Board
MW	Mega Watt
GWh	Giga Watt hour
NPV	Net Present Value
SAM	System Advisory Model
NREL	National Renewable Energy Laboratory