

Designing a Low Cost Voltage Controller for Micro-Hydro Power Plant

**By
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Power Plant**

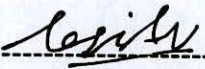
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**Theses submitted to the University of Sri Jayewardenepura for
the award of the Degree of Master of Science in Industrial
Mathematics**

DECLARATION

The work described in this thesis was carried out by me under the supervision of Mr. K.R.C. Wijesinghe, Dr. N.Nanayakara, and Dr.S.K.Boralugoda, and a report on this has not been submitted to any University or any other institution for another degree /diploma.



P.H.L.J.Ranasinghe

06 / 07 / 2006

Date

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

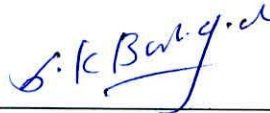
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ABSTRACT

The most economical way to supply electric power to the rural areas of the country is micro hydro power. However the basic problem with these systems is their high voltage fluctuations due to the rapid variation of loading conditions. The present voltage regulators used in Sri Lanka has a poor voltage variation which is not suitable for modern electronic equipments.

The basic problem with the existing systems in Sri Lanka are that they are based on analog electronic circuits which have their limitations in implementing some complex transfer functions which required to attain the required voltage variation. The digital systems used in developed countries are too expensive, and economically not viable to be used in Sri Lanka.

Here we present a micro-controller based digital voltage controller which is capable of producing the output with the required voltage regulation and can be produced at a low cost appropriate for Sri Lankan micro-hydro power projects. This design is based on the low cost micro-controllers which are easily available today. The design was tested using MatlabTM simulation software and it gives the variation of only 3.43 %, which is well bellow the IEE recommended variation of ± 6 %.

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P.H.L.J.Ranasinghe

ABBREVIATIONS

P_{in}	Generated active power of the induction generator
P_{losses}	Mechanical and other losses of the induction generator
Z_L	Load impedance
V_{ref}	Reference voltage
V_{err}	Difference of reference voltage and output voltage
A/D	Analog to digital converter
D/A	Digital to analog converter
P_{dummy}	Power demand of dummy load
SEIG	Self excited induction generator
MH	Micro hydro
ELC	Electronic load controller
AC	Alternative current
MOSFET	Metal oxide semi conductor field effect transistor

GROSSARY OF TERMS

Maximum demand

It is the greatest demand of load on the power plant during a given period.

Load Factor

The ratio of average load to maximum demand during given period.

Percent Voltage Regulation

One measure of power supply performance in terms of how well the power supply is able to maintain a constant voltage between no-load and full load conditions.

Gird System

The connection of several generating plants in parallel.

Power Plant

Bulk Electric power is produced by special plant

Peak Load

The various peak demand of load over and above the base load of the power plant

CHAPTER 1

INTRODUCTION

1.1 Power scenario in Sri Lanka

Sri Lanka has a total installed capacity of 2500 MW with an average load factor of about 55%. This amount mainly consists of 1,297 MW of hydropower and 1200 MW of thermal power and 3 MW of renewable power.

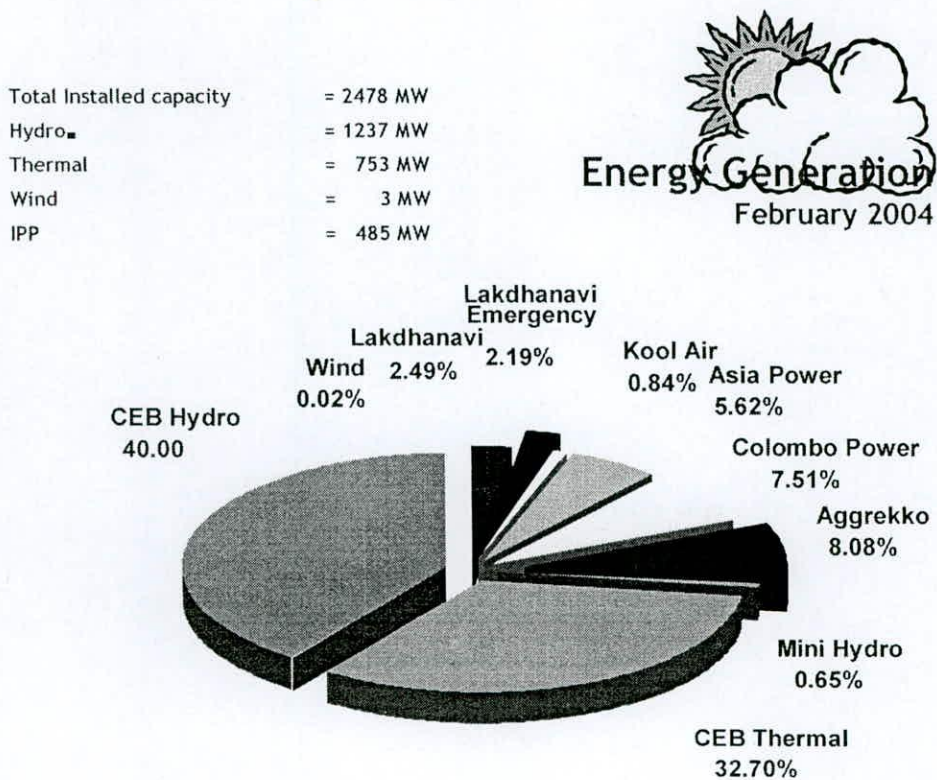


Fig. 1.1

The total electricity demand within the country is met by the hydro & thermal power generating plants. Ceylon Electricity Board owns more than 95% of the total