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ENERGY STORAGE SYSTEMS FOR OPTIMUM ENERGY UTILIZATION OF VILLAGE HYDRO SCHEMES IN SRI LANKA

By

J.M. Athula

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This thesis was submitted to the Department of Mechanical Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Engineering in Energy Technology

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and behalf, it contains no material previously published or written by another person nor material which to substantial extent, has been accepted for the award of any other academic qualification of a university or other institute of higher learning except where acknowledgment is made in the text.



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ABSTRACT

Compared to the other countries in the region, Sri Lanka has a deep penetration of approximately 75% of grid electricity. However, providing electricity every rural household is a difficult goal, without employing off-grid technologies. Accordingly, the present 2% of household are receiving off-grid electricity will become 6% by year 2010, according to the prevalent government policy. This requires new technological interventions in the micro hydro sector, as the quality of hydro resources available for exploitation is coming down rapidly.

This study aims at developing a concept of optimum energy storage to explore such meagre hydro resources. The proposed concept takes the advantage of highly developed technologies such as power electronics to offer an energy to energy matching supply. Demand solution as opposed to the orthodox micro hydro technology which is designed to match the evening peak lighting load of a rural village.

The most critical aspect of an energy storage system is the sizing of energy storage. Aspects such as storage capacity, charging time, level of discharge and life cycle of storage play critical roles in designing a system. The proposed system uses the daily energy requirement of a rural village as the basis of a system sizing and measured data from six village hydro schemes to determine the generation capacity. Through the field measurements carried out, availability of excess energy in orthodox village hydro system has been determined. A new rural energy solution based on improved energy utilization factor is proposed for both existing and new village hydro schemes. In the case of existing village hydro schemes, the recovered energy can be used to extend the energy services to several more rural households and in the case of new schemes, the solution can be used to bring down the cost of project by substantially reducing the power generation component sizes including auxiliary civil structures.

A financial analysis was carried out and the solution was found to be feasible. A pilot scale project was implemented in Dodampitiya, a rural village in the general area Opanayaka and was commissioned on 15th March 2007. The system is operating satisfactorily provides good opportunities to further develop the technology and requires to be closely mentioned well into the future.



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