DESIGN AND OPTIMIZATION OF HYBRID ENERGY SOURCE - A CASE STUDY AT GURULUWANA

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Power generation from small hydro increased rapidly in past few years and present install capacity is around 97.5 MW. This leads to congestion of electrical network in some part of the country, thus prevents any new small hydro connections. Furthermore, most of the existing projects found it difficult to payback their bank loans due to poor turn over especially during dry months. The above factors demand an option where small hydro power plant can work right through the year in an isolated mode supplying power to a specific load. It was found that best solution available is hybrid system based on a hydro-diesel scheme.

This paper presents a case study of a hybrid model with the integration of hydro and thermal power generations at Guruluwana in Ratnapura District. In Guruluwana area, continuous stream flow and sudden elevation drop of the Kalu Ganga valleys make a very good location for micro-scale hydropower generation.

Stream flow of Kalu Ganga at Guruluwana was obtained from monthly rainfall data and with the knowledge of topography and soil characteristics of the catchment area. Design and optimization of the hybrid energy sources was carried out using the Hybrid Optimization Model for Electric Renewables (HOMER) simulation package, which is developed for economical hybrid power system design. Simulation results were 1.00 m^3/s flow rate, 169 kW hydro power, 53 kW thermal power and unit cost of Rs. 4.40. It also showed that annually hydro plant produces 1.35 GWh, diesel generator 0.15 GWh and 51600 liters of diesel. This optimum design produces 150 kW of power constantly throughout the year. Then IPSA simulation package, which is developed for power system design and operation applications, was used for load flow calculations such as voltage variation in feeders, transmission losses in network and power flow of lines.

Financial analysis was carried out to verify the economical viability of the project. From the cost benefit analysis, it was found that Benefit Cost Ratio (BCR) is 1.5. The total project cost calculated to be 19 Million rupees with payback period of 4 years. After the payback period only expenses are maintenance and diesel cost, therefore average net profit will be 6 Million rupees. The results show that the proposed project is economically viable.

The proposed hybrid system gives more reliable power supply to micro grids. The MHP developments in rural areas can be enhanced using the hybrid technique. This technique will electrify the rural communities effectively.

The authors would like to thank Mr. Sunith Fernando Director of Resource Management Associates (Pvt) Ltd and the Department members for their support.