WIND-SOLAR-DIESEL HYBRID MODEL FOR TELECOMMUNICATION BASE STATIONS

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by

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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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1/28/2011

I endorse the declaration by the candidate.

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Abstract

Telecommunication is one of the most suffered industries due to the immaturity of grid power distribution network in Sri Lanka. Lack of electrical grid access to rural and remote areas cause the companies to expend high operational cost for operation of telecommunication base stations full time on diesel generators, which causes considerable economical disadvantage and adverse effects to the environment due to heavy emission of green house gasses.

Hybrid energy systems using renewable energy sources like wind, solar, biomass and micro-hydro are recognized and recently widely accepted as a viable alternative to grid supply to provide electricity to remote areas, where grid extension is not feasible or economical, as the new hybrid systems are becoming more economical than the standalone renewable energy generating methods. Hybrid system has been recognized more suitable than systems that only have one energy source for supply of electricity to off-grid applications due to higher degree of availability, flexibility and increased efficiency, but the design, control and optimization of the hybrid systems is very complex.

In the present study, a procedural approach to design of a wind-solar-diesel hybrid energy system for remote telecommunication base station was attempted, by using weather dependent solar and wind energy sources and weather independent diesel generators.

HOMER simulation tool, which is a useful software for complex hybrid energy system component selection and sizing, was used for designing of this hybrid energy system after establishing the validity of the software. The validation was done by comparing six months data of an actual solar- diesel hybrid energy system with simulated results of a system with same configuration.

Several implementations done during the past decade are proved to be viable alternatives for full time generator operation and it was attempted to establish a procedural approach to design a wind- solar- diesel hybrid energy system with demand side management in the telecommunication base station environment.

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List of Acronyms

CEB	Ceylon Electricity Board
NREL	National Renewable Energy Laboratory
HOMER	Hybrid Optimization Model for Electric Renewables
USAID	United States Agency for International Development
GSM	Groupe Spécial Mobile
GPRS	General Packet Radio Service
NASA	National Aeronautics and Space Administration
NACA	National Advisory Committee for Aeronautics
IPCC	Intergovernmental Panel on Climate Change
SOC	State of Charge
MPPT	Maximum Power Point Tracking
DC	Direct Current
PV	Photo Voltaic
USD	United States Dollar
LKR	Sri Lankan Rupees
IRR	Internal Rate of Return
ROI	Return On Investment
NPV	Net Present Value
NPC	Net Present Cost
CAPEX	Capital Expenditure
OPEX	Operational Expenditure