



Development and optimization of a PV/diesel hybrid supply system for remote controlled commercial large scale FM transmitters



M. Moghavvemi^{a,b,c}, M.S. Ismail^{a,b,*}, Bala Murali^{a,b}, S.S. Yang^d, A. Attaran^{a,b}, Sedigheh Moghavvemi^e

^a Department of Electrical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia

^b Center of Research in Applied Electronics (CRAE), University of Malaya, 50603 Kuala Lumpur, Malaysia

^c Faculty of Electrical and Computer Engineering, University of Tehran, Tehran, Iran

^d Department of Electrical Engineering, University Malaysia Sabah, Sabah, Malaysia

^e Faculty of Business & Accounting, Department of Information System, University of Malaya, 50603 Kuala Lumpur, Malaysia

ARTICLE INFO

Article history:

Received 8 May 2013

Accepted 1 July 2013

Keywords:

Photovoltaic (PV) panels
PLC
SCADA
Fault sensing
Remote transmitter sites
Renewable hybrid system

ABSTRACT

This paper is devoted to a renewable hybrid PV–diesel generator developed to supply power to a designated remote controlled FM transmitters located in remote locations. The developed system can guarantee the energy demand of the station (100% reliability) with less cost of energy production. In addition, this paper presents a remote control supervisory system designed to improve the entire transmitter-facilities processes which includes applications for sensing, managing, controlling and measuring transmitter site parameters and performance from a networked computer or a dial up computer. The need for detailed monitoring of the performance of transmitter site equipment including monitoring of electrical systems as well as monitoring of communication systems is becoming critical as these sites are becoming larger and more sophisticated. The systems was set up and tested through rigorous simulations of the transmitter site failures and evaluated for three consecutive months. The proposed systems have been installed and continuously operated on live FM transmitter facilities at six locations in Malaysia. The proposed hybrid power system can be also integrated into the current electric power network of Malaysia as a backup or as a main source of power for the entire transmitter facility. The supervision and control signals of the proposed power hybrid system can be easily included and integrated with the other existed FM transmitter supervisory and control signals. The concrete study in this paper is directed to one of the FM stations located in a remote area in Kuantan, Malaysia.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Hybrid renewable energy systems are nowadays used to supply different types of grid connected or isolated applications [1–8]. A hybrid system is constructed from more than one energy source. It usually combines renewable and conventional energy sources [9–16]. The increased reliability is one of the important benefits of these hybrid systems. Furthermore, these systems are usually less costly than single source systems [17–19]. The hybrid system which depends on photovoltaic (PV) is the most popular among these systems. Using PV hybrid systems to supply telecommunication stations is very popular due to the fact that numerous stations are located in rural areas and mountain regions [20–24]. Large number of these stations is already supplied by small diesel generators. The operational costs of these diesel generators are usually

high due to high fuel, maintenance and transportation costs. Using PV standalone systems that depend on PV panels and battery bank to supply such stations is also costly due to large number of panels and battery units required for this system to cover station load demand at different climatic conditions.

Using hybrid systems that depend on renewable energy sources also decreases the dependency on fossil fuels that are going to be depleted in not a distance future. Combining this with the fact that high levels of global warming gases are also emitted from these fossil fuels encourages governmental and non-governmental institutions around the world to invest in these renewable hybrid systems for different applications. In line with this purpose, this paper aims to develop and optimize a PV/diesel hybrid supply system to supply power to a designated remote controlled FM transmitters located in remote locations. The idea is to optimize sizes of the hybrid system components to minimize the cost of energy production while covering the energy demand with 100% reliability. Moreover, this paper presents a developed and tested remote control supervisory system designed to improve the entire transmitter-facilities processes in commercial large FM transmitters. As this renewable

* Corresponding author at: Department of Electrical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia. Tel.: +60 11 2209244.

E-mail addresses: mahmoud_kafa@yahoo.com, mahmoudkafa@gmail.com, mahmoud@um.edu.my (M.S. Ismail).