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ScienceDirect

Procedia Technology 21 (2015) 667 – 675

Procedia Technology

SMART GRID Technologies, August 6-8, 2015

Modeling and Simulation of Solar PV and DFIG Based Wind Hybrid System

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Abstract

The increasing energy demand and depletion of fossil fuels has risen in awareness of searching for alternative energy source thus the inexhaustible solar and wind energy is becoming an interesting topic which has grabbed the attention of researchers to make it sustainable power. The objective of this paper is to provide sustainable power for rural areas and remote places.This paper gives the architecture of hybrid system. The proposed system consists of solar PV and Doubly Fed Induction Generator (DFIG) based wind turbine. In Solar PV MPPT technique is used to maximize the power and boost converter is used to rise the DC voltage of solar PV and fed to the three phase PWM inverter. The DFIG has two controllers Rotor side control and Grid side control. Rotor side converter and Grid side Converter have the capability of generating or observing reactive power and to maintain constant rotor speed, and controls the DC-link voltage, controller for boost converter, inverter AC-DC-AC is implemented using vector control method. Simulation study of the proposed system is carried out with MATLAB Simulink and simulation results are provided.

Peer-review under responsibility of Amrita School of Engineering, Amrita Vishwa Vidyapeetham University

Keywords: Hybrid system; DFIG; PV cell; MPPT; Converters;

1. Introduction

Hybrid is a combination of two or more energy sources which generates efficient energy power because we are combining more than one energy source. Now a days Hybrid Energy System(HES) have more scope especially in rural and remote areas because these areas do not benefit from the grid supply and because of increased demand, global warming, depletion of non-renewable energy sources are compel to go for renewable energy sources. Many

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Peer-review under responsibility of Amrita School of Engineering, Amrita Vishwa Vidyapeetham University
doi:10.1016/j.protcy.2015.10.080

hybrid systems are there among them Solar and wind energies gives better results because these two energy sources are complimentary in nature. The drawback of solar and wind are intermittent in nature this make unreliable but combining the solar and wind energy reliability of the system can be enhanced.

Often solar and wind energies are complimentary in nature when there is no sun there is plenty of wind vice/versa. In present scenario, renewable energy increasing .As government giving subsidiary for solar panels. We are using MPPT for solar to track maximum power point it is very much essential for solar array .From the review paper [1] Many MPPT's are discussed. Autonomous wind will be available in rural areas and we can make use of it. DFIG based WT is used which is normally preferred for larger scale power generation [2].The converters that are used in this topology uses only 20-30% of the total capacity of the output power [3]. Other major advantages are we can independently control the both active and reactive power .Converter control employs d-q vector.

2. Proposed system

Fig. 1 shows the block diagram of the proposed system.The output of solar panel is connected to boost converter to step up the dc voltage and fed to the three phase inverter and output of the inverter connected to the grid and output of the DFIG is directly connected to the grid.

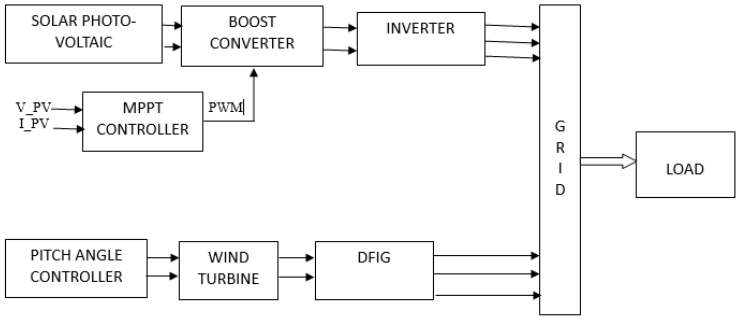

Fig. 1. Proposed system block diagram

3. Solar PV system description:

In PV system sun light energy is converted into electricity based on the concept of photovoltaic effect .The photo current depends on irradiation and temperature. If irradiation is higher current released by the cell will be more.

The equivalent circuit of a Photo Voltaic cell is shown in the Fig. 2. An ideal solar cell is represented by a Current source and a diode parallel with it. However no solar cell is ideal there by series resistance Rs which has very small value and Rsh is the equivalent shunt resistance whose value is very high. The PV cell current equation (1) as follows.

$$I = I_{pv,\,cell} - (Io\,[e\,(v + IRs / V_T) - 1] + V + IRS / Rp) \quad (1)$$

Where Ipv, cell is the current generated by the incident light, depend on the solar radiation and cell temperature. Io is the reverse saturation or leakage current of the diode, VT is the thermal voltage