Hybrid Controller For Renewable Energy Power Plant In Stand Alone Sites

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Abstract- *This work presents a control of stand-alone hybrid system including photovoltaic (PV), wind turbine, fuel cell (PEMFC), storage systems and a dump load (in our case, an electrolyzer). All these sources are connected by a continuous bus to three phase load through a DCeAC converter. A strategy for the power management is designed for the proposed hybrid system to supervise power amount among various energy resources, the storage system and the dump load. In the design, the PV and wind systems are considered as main power resources, whereas PEMFC is used as an additional support, and the dump load is used for the effect of consumption of the surplus power available from sources (i.e. PV and wind), when the battery has been charged completely. The hybrid system includes a modified control algorithm, which has been developed to maintain the DC bus voltage at its reference through the regulation of the DCeDC bidirectional converter between the battery and DC bus. A dynamic model of various components of stand-alone hybrid system is presented along with a maximum power point tracking (MPPT) algorithms of the PV and wind system..*

Keywords- Hybrid Photovoltaic Wind Storage MPPT Control.

I. INTRODUCTION

The usage of conventional fuels for instance oil, coal and natural gas in the production of the most frequent energy resource e electricity has become much expensive tool due to the extinction of the natural resources, lack of efficiency and environmentally hazardousness. For these reasons, the renewable and alternative energy resources, so-called wind, solar, biomass and harvester systems have been good resources for some decades, and offered numerous advantages with almost free and environmental-friendly features . However, the major disadvantage in renewable energy resources is their unstable nature due to the external climatic conditions .The load depending on the annual or daily fluctuations is not necessarily correlated with these resources. To meet the hourly load demands, they should be integrated with other different resources for instance diesel, fuel-cell, and storage device. Indeed, such an idea gives the motivation to design and construct the Hybrid Energy Systems (HESs).

A HES includes at least two or more different energy types together with the storage system and have been deployed for especially rural electrification in many countries. Strictly speaking, this system is generally used for the generation of electricity in the isolated regions without interruption. Much important thing to build up a HES for the rural electrification is to know the actual energy demand and the sources available at the rural electrification (for instance, the PV system not available at night or in cloudy periods). This will permit to design the HES, which meets the load demands of the located facilities at best. The main role of a HES is to ensure the required energy by the charge and, if possible, to produce the maximum amount of energy from the renewable energy sources, while maintaining the quality of the energy supplied. There exist two main types of HES: Stand-alone HES and grid connected HES. Stand-alone solar and wind power sources are among the most motivated technological problems for the electrification of remote or far-grid consumers. Accordingly, different control algorithms are proposed to extract maximum power under the changing weather conditions..

II. LITERATURE SURVEY

1. OPPORTUNITIES FOR RESEARCH AND DEVELOPMENT OF HYBRID POWER PLANT

For decades, wind, solar, and other renewable energy technologies have had minimal deployment with respect to fossil-fuel, hydropower, or nuclear-based generation assets in electric power systems. However, driven by consideration of environmental impacts, policy decisions, and significant cost reductions in wind, solar photovoltaic (PV), and energy storage (particularly battery) technologies; new installations of electricity generation have been dominated by renewables in the United States, Europe, and globally (Bloomberg New Energy Finance 2017; BP Energy Economics 2018; International Energy Agency [IEA] 2018).

2 DESIGN of a HYBRID POWER GENERATION SYSTEM USING SOLAR-WIND ENERGY

Renewable energy is an alternative solution for power generation in the day today life. Power generation from

conventional energy is having a drastic effect to the environment and the ecological life of humans. The energy from renewable sources are abundantly available over the universe. Energy from renewable sources are clean, eco friendly, efficient and reliable. Solar and wind are gaining much importance in the present world. The project aims to develop a grid connected hybrid power generation system using solar and wind energy in the Matlab/Simulink software.

The model is designed based on the availability of solar irradiance, sunshine hours, temperature, wind speed, wind direction and topography. Based on the datas, a model can be developed combining the energy from solar and wind resources.

3 A REVIEW PAPER ON HYBRID POWER SYSTEM WITH DIFFERENT CONTROLLERS AND TRACKING METHODS

For fulfilling the global energy demand hybrid energy system is the better option. Hybrid energy system is the integration of wind, solar, hydro etc different renewable energy sources to that of existing transmission distribution system. This paper is a review on stability of hybrid power system. In this paper analysis of stability problem and different controllers which affects the output power of hybrid power system are discussed. The main problems of hybrid system is involved with stability and power quality. For these problems improvement many types of facts devices and other methods are used. Nowadays hybrid power system are increasingly used.

1.4 OBJECTIVES

The main objectives of this system are as follows:

- The hybrid system with solar and wind energy is applicable for power generation in both rural and urban areas.
- The hybrid system maintains a continuous supply of power.
- Hybrid systems utilizing energy from nature can overcome the drawbacks caused due to unfavorable climatic conditions in the environment..

III. EXISTING SYSTEM

Stand-alone hybrid power plants based on renewable energy sources are becoming a more and more interesting alternative. However, their management is a complex task because there are many variables, requirements and restrictions as well as a wide variety of possible scenarios. Though a proper sizing of the power plant is necessary to obtain a competitive cost of the energy, smart management is key to guarantee the power supply at a minimum cost. In this work, a novel hybrid power plant control strategy is designed, implemented and simulated under a wide variety of scenarios

Existing Block Diagram

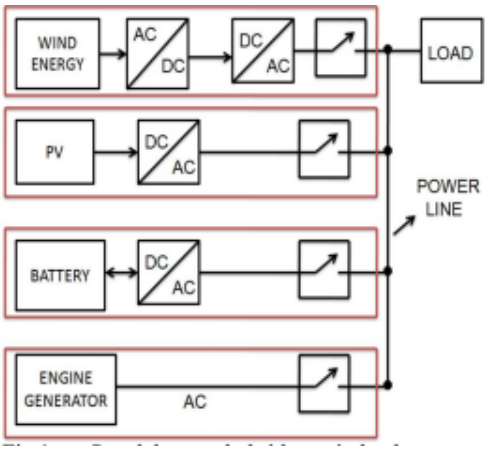

Fig 1.1 Existing Block Diagram

IV. PROPOSED SYSTEM

A hybrid energy system combining solar photovoltaic and wind turbine as a small-scale alternative source of electrical energy where conventional generation is not practical. The figure.3.2.shows proposed system of Stand-alone hybrid power plants . A simple and cost-effective control technique has been proposed for maximum power point tracking from the photovoltaic array and wind turbine under varying climatic conditions without measuring the irradiance of the photovoltaic or the wind speed. The proposed system is attractive because of its simplicity, ease of control, and low cost. A complete description of the proposed hybrid system, along with detailed simulation results that ascertain its feasibility, are given to demonstrate the availability of the proposed system in this article.

Proposed Block Diagram

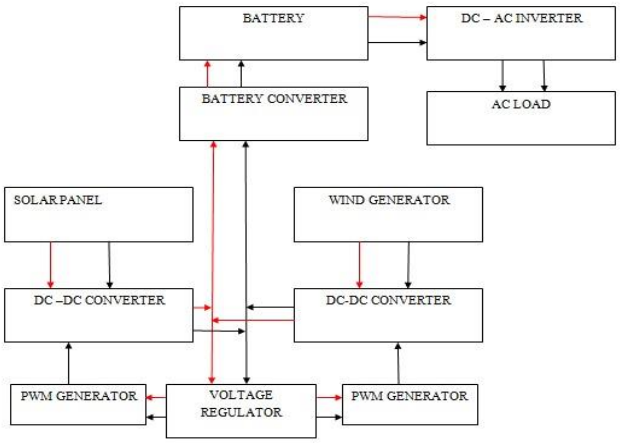

FIG 1.2 Proposed Block Diagram

EXPERIMENTAL RESULT

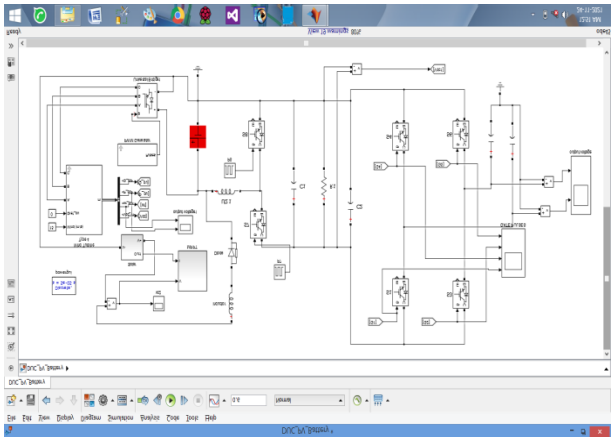

FIG 1.3 Simulation of PV system

The PV and Wind energy systems are modeled in Matlab/Simulink software using the Simulink blocks. To start with a Simulink model first the Matlab/Simulink software is started. Open a new Simulink file and the file is saved. Using the block sets from library, these blocks are added to the file, then blocks are connected, initiate the blocks by adding values and thereby model is created. Further updates in the model is done, initiated the model. Then the model is simulated. The simulation output is viewed.

WIND GENERATOR WITH BRIDGE RECTIFIER

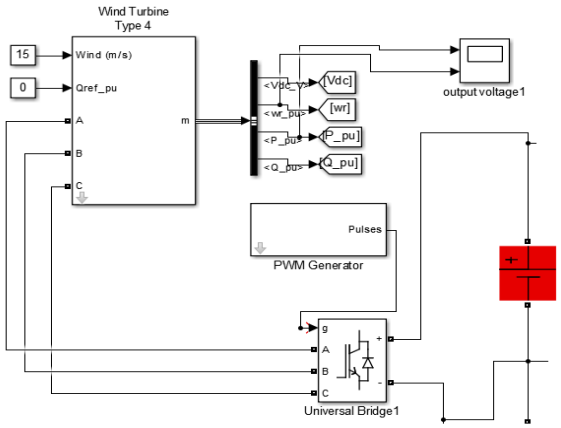

FIG 1.4 Wind Generators with Rectifier

Wind energy is one the most promising renewable source of energy to meet the growing demands of the world. It is environmental friendly and clean form of energy. The motion of air is termed as wind. The kinetic energy derived from the wind using wind turbines are converted to mechanical energy. This mechanical energy is further converted into electrical energy using generators. Different types of generators are available for wind energy generation and the most commonly used are permanent magnet synchronous generator(PMSG) and induction generators(IG). The field of excitation is provided by permanent magnets rather than excitation coils in permanent magnet synchronous generators

SOLAR PANEL WITH MPPT

The Maximum Power Point Tracking system is an electronic device for tracking the maximum available energy resource thus, improving the output performance and efficiency of the solar PV panels. Due to variations in weather condition the output has a nonlinear behavior and changes frequently. This device helps to track the available power in the atmosphere and operate at maximum power point thus increasing the efficiency. In a PV panel the voltage at which maximum power is attained is called maximum power point

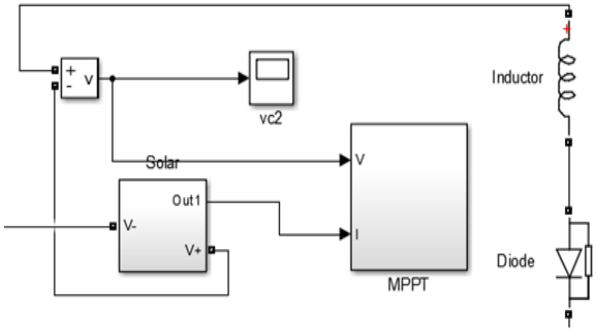

FIG 1.5 Solar Panel with MPPT

DC – SINGLE PHASE AC INVERTER

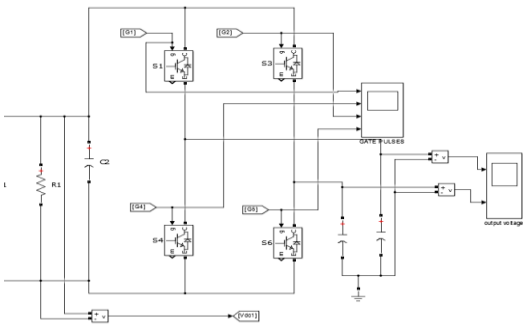

FIG 1.7 DC to Single Phase AC Inverter

Inverters are power electronic devices used to transform a DC output to an AC output at a specified frequency. Inverters are classified based on the source voltage and source current. The main two classifications of inverters are voltage source inverter (VSI) and the current source inverter(CSI). For a voltage source inverter DC voltage supplied at the input of the inverter will have low impedances and for a current source inverter the supplied at the input of inverter current will be in variable with high impedances. The inverters are further classified based on the phases such as single-phase inverter and three phase inverters

WIND GENERATOR

Observations are done on varying the temperature value. The temperature values are varied from 25°C to 100°C keeping the irradiance value at 1000W/m2 . On varying the temperature value keeping the irradiance same it is observed that the value of voltage decreases, and the current value remains somewhat same.

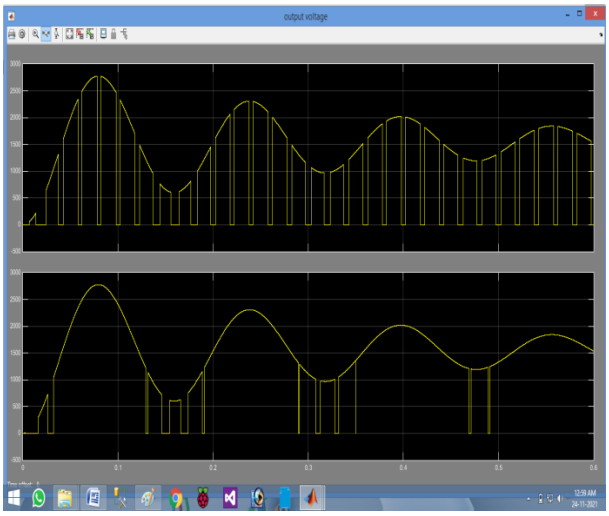

FIG 1.8 Wind Generator Output

V. CONCLUSION

In this paper, an application of new stand-alone HES has been designed and performed. It has been understood that the proposed system design and connections among the several energy resources such as wind, solar, fuel cell and battery storage units work very well in order to achieve a good output power on the load. The validity of the proposed model has been tested for different scenarios of output environmental conditions for the sake of good performance. Although the THD of the phase voltage becomes lower, the hybrid system works well to harvest energy from the changing environmental conditions. Besides, the proposed control structure is capable to supply the electrical loads without any interruption to enable the generation of the maximum power for PV and wind power resources to regulate the DC bus voltage

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