Hybrid Wind Solar System for Efficient Power Generation

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Abstract- The most popular renewable energy technology is Hybrid Power System consisting of wind and solar energy sources because the system is reliable and complimentary in nature. Wind / PV Hybrid system is commonly used in Distributed generation (DG). This paper proposes a new solution for improved voltage stability with quality power output. In this system voltage out from wind energy conversion system(WECS) and Photo voltaic panels are given to separate DC DC converters, independently controlled and connected to a common DC bus and from there it is inverted. In the proposed controller the voltage stability is obtained by applying adaptive Honey Bee Optimization (HBO) algorithm along with a PI controller. The implementation of the proposed method is done by using Simulink platform. The performance of the suggested co ordinate control system is analyzed by comparing the computer simulation results with and with out using controllers and it shows that the proposed system is more efficient. .

Keywords- Hybrid Power System, Distributed Generation (DG), Honey Bee algorithm, PI, Wind and solar energy

I. INTRODUCTION

Electricity plays an important role in human life. Conventional and non conventional energy sources are used for electrical power generation. Due to the continuous use of conventional sources they are going to vanish from the earth and the main draw backs are the contribution to air pollution and global warming , the search for the other sources of energy ends with nonconventional sources of energy. Some of the nature friendly renewable energy sources like solar and wind energy are widely used for electrical power generation because they are complimentary in nature. In sunny days wind is calm and in cloudy days wind is strong, therefore the hybrid operation of wind- solar energy conversion system is popular [1]. Uninterrupted power generation can be done irrespective of the weather condition aims to hybrid operation. Some modifications in solar panel, ie Nano antenna array has been introduced and an improved version of hybrid system having large scale production with minimum cost /unit is achieved [2]. By the introduction of suitable DC- DC converter in between the sources and battery, over come the high voltage transformation problems [3]. Modified multilevel inverter topology in the out put side improves the power quality, i.e. with minimum Total Harmonic Distortion (THD) [4]. Feasibility study of Hybrid wind solar system proves that this type of Hybrid Renewable Sources of Energy System (HRES) is most suitable for Distributed Generation (DG) for higher loading capacity [5]. Optimum combination of hybrid sources are evaluated on the basis of power reliability and system cost analysis the usual methods for evaluating reliability are Loss of power supply probability (LPSP) [6, 7],Loss of load probability (LOLP), and System performance level (SPL) [8]. In cost analysis Net Present Cost, Levelised cost of Energy [9] and Life cycle cost [10] are considered.

In this hybrid system consisting of wind solar power generation, proposed Honey Bee optimization algorithm along with a proportional integral controller is applying. Each of them are individually controlled by Honey Bee optimization algorithm (HBOA), which has an ability to adapt complex optimization problems. This method has been put into use to solve the daily voltage control, which not only has a better response but also converges more quickly than ordinary evolutionary methods like genetic algorithm. Least square error minimization approach is used in this optimization technique, i.e. optimizes the gain parameters under various operating conditions using the minimized Square Error (SE). It considers the actual voltage outcome of the buck converter and the set point voltage. By using the optimized gain parameters, the PI controller is operated. Each separate energy conversion system is controlled by the separate proposed hybrid voltage control model.

II. RELATED WORK

Efficient and cost effective method of hybrid power generation have been proposed [11] in 2010, S. Ali Pourmousavi et al. The solution of optimal energy management for a standalone hybrid system by the application of Particle swarm optimization algorithm (PSO) and proved that to minimize the cost of electricity generated, maximize the hybrid system efficiency with a reduced environmental emission and losses. The simulation results shows the effectiveness of PSO for the hybrid system consisting of wind and solar power sources.

[12].In 2011, Taher Niknamet al have presented a multi-objective optimization algorithm for various aspects of hybrid system like sitting and sizing of renewable electricity generators. The factors considered are the cost, minimization of emission and losses. The multi objective control on multi bus system was achieved by applying Honey Bee Mating Optimization (HBMO) algorithm. The simulation results show the suitability of the proposed algorithm.

[13].In 2010, E.S. Sreerajet al. have proposed a design based approach method to optimally size and to evaluate the cost of energy produced by a renewable hybrid system .More importance is given to the design of size battery for a given load demand and the availability and rating of sources used. The optimal system configuration in the entire design space was selected based on the lowest cost of energy, subjected to the given reliability criterion. The proposed method was demonstrated by designing an isolated power system for an Indian village utilizing wind–solar photovoltaic- battery system.

[14].In 2011, A.B. Kanase-Patilet al. have proposed a distributed generation system using locally available renewable energy sources in Uttarakhand state in India by Integrated Renewable Energy Optimization Model (IREOM) . The main aim of the proposed method is to optimize the cost of electrical energy while integrating different sources for generating electrical power. Study has been carried out for the different seasonal load profile and developed the model accordingly. The results of the proposed system , purely based on Renewable Energy System has been analyzed and found that the usefulness of the Renewable Energy System for the available size.

III. PROPOSED MODEL

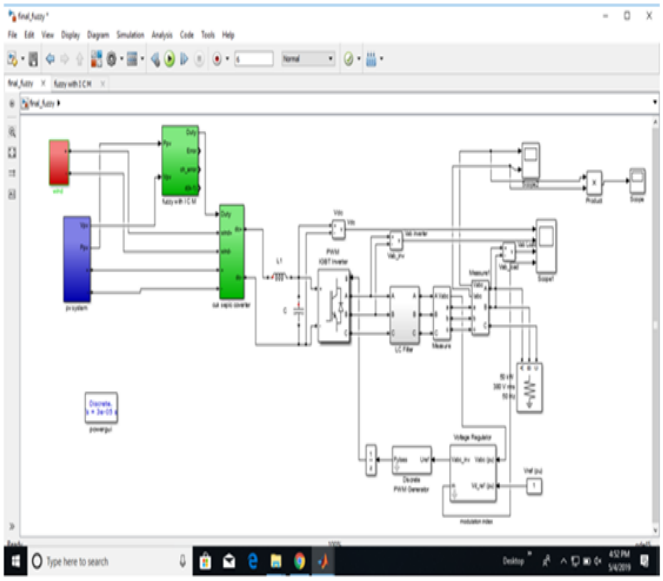

Fig.1: Structure of the HES

This HES consists of three major blocks such as wind energy conversion system, solar energy conversion system and full bridge inverter. The structure of the HES with proposed voltage control model is described in Figure 1.

The wind energy conversion system is comprised of permanent magnet synchronous generator, uncontrolled full bridge rectifier and buck converter proposed hybrid voltage control model. The solar energy conversion system contains solar panels and buck converter with proposed hybrid voltage controller. The energy obtained from both the systems is connected to the three phase full bridge inverter using the inter phase transformer. The Sinusoidal Pulse Width Modulation (SPWM) scheme gives the control pulses to the full bridge inverter. The output of the inverter is three phase sinusoidal AC voltage, which is then supplied to the load via three phase step up transformer. The wind turbine system helps in converting the wind energy into mechanical energy using wind turbines shaft of the generator. The hybrid voltage controller controls the buck converter of the wind energy conversion system. It monitors the reference voltage and adjusts the output voltage to the reference voltage. PV cells, which are electrical devices, convert light energy into electrical energy. The solar PV panels give a sustainable energy. This semiconductor panel absorbs photons from sunlight and releases electrons from atoms and as a result a potential difference is generated. And hence there is a current flow. The energy received from of both the systems are connected to the inter phase transformer, which is used to absorb voltage difference between DC voltages of two converters at any instant and ensures independent operation without any circulating current. The three phase full bridge inverter does the job of giving a three phase AC sinusoidal voltage to the load via three phase transformer. The three phase full bridge inverter comprises of six controlled switches, which have been controlled by the SPWM scheme.

3.1 Solar PV Subsystem Model

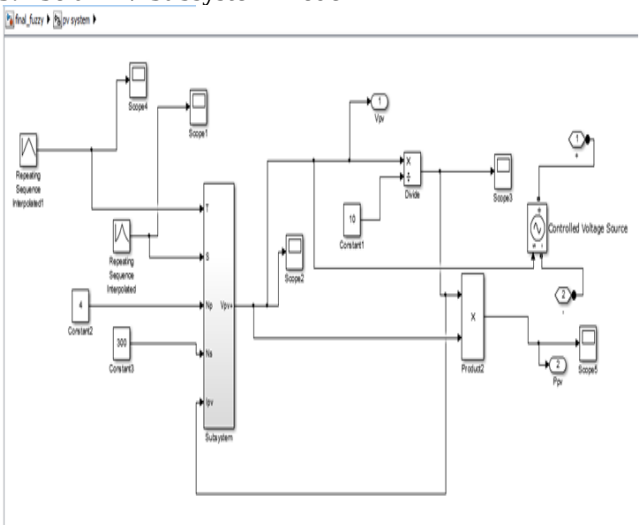

Fig.2: Shows the interconnection of 36 solar cell for achieving the desire ratings.

After series and parallel connection diode connected to solar cell power output for avoiding the back power or reverse bias condition. That diode is called as revere blocking diode which

avoid the reverse current of reverse polarity of solar cell during rainy or cloudy season due to shading effect.

3.2 Wind energy subsystem model

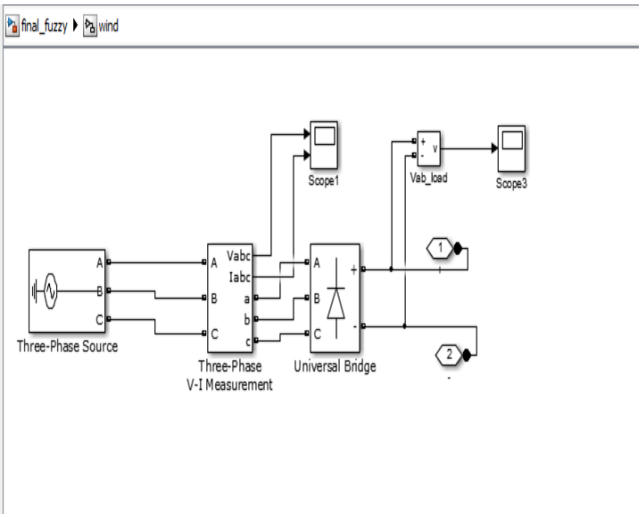

Fig.3: shows a wind energy turbine system in which wind turbine generates the AC three phase power then transfer to rectifier circuit for conversion of AC power to DC power.

Because solar power system output becomes in DC form but wind energy generator power in AC form then for coupling both the solar and wind energy system we need to convert wind energy AC power into DC power with equal magnitude.

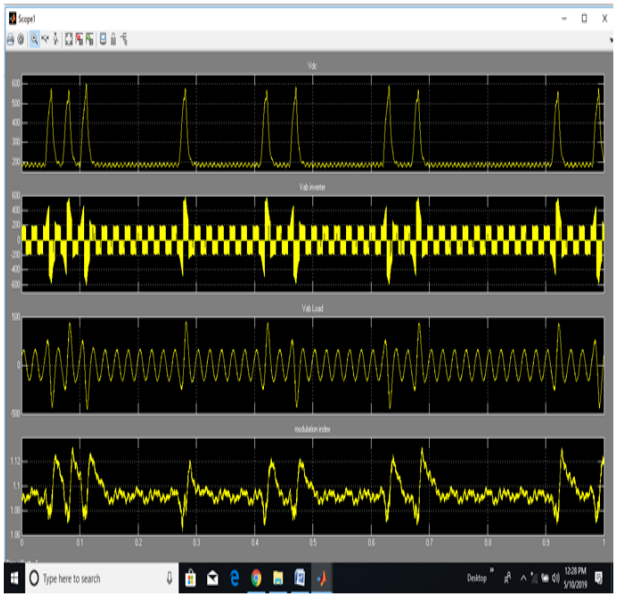

Fig.4: shows the battery power output utilized during emergency condition or utilized in DC application.

Also in fig. 4, the state of charging (SOC) is shown and the charging and discharging behavior of battery system can be seen. The battery discharges from 60V to 35 V in 20 second time duration. It means that, if the loss charging of battery is 20 second then the loss potential of 25 Volts.

IV. CONCLUSION

A renewable energy hybrid power system is presented in this paper based on photovoltaic (PV) and wind. The hybrid power system solely depends on the intermittent renewable energy sources generates a fluctuating output voltage that leads to damage to the machines that operate on a stable supply. The modeling of the hybrid system with Cuk converter, three phase inverter and LC filter are built using MATLAB Simulink. We have used different irradiance value and varying wind speed as the input parameters for the project simulation. The results show that hybrid system has greater reliability in terms of output voltage generation. In addition, Diode Clamped Multi-Level Inverter and LC filters that are installed in the hybrid system are able to reduce the fluctuation output voltage.

V. REFERENCES

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