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"EXAMINING A HYBRID SOLAR WIND ENERGY SYSTEM AND CONTROLLING THE CONVERTER WITH MANY OBJECTIVES"

Purbasha Ghosh

Lecturer, Department of Electrical Engineering , Department, Government Polytechnic,, Gulzarbagh University, Patna, Bihar 800007

ABSTRACT

In this study, grid-tied photovoltaic systems—power-generating devices connected to power grids—are being designed as a grid-integrated solar wind hybrid energy system to drive loads and increase system efficiency and dependability. creating an inverter control that reduces the amount of distortion in both the voltage and current waveforms. When the system experiences abrupt changes in load, the controller ought to lessen the spikes at the transient loading point. In order to achieve energy efficiency, the system must also be connected with the fuel system. The fuel system and the solar/wind hybrid system's DC voltage output would be connected in parallel.

***Keyword**: Grid system, Solar System, hybrid system, DC, PV.*

I. INTRODUCTION

Wind solar hybrid companies use a variety of alternative energy sources, such as solar and wind power, to generate electricity. Photovoltaic cells and vertical axis wind turbine generator are used to generate electricity in this setup.

To comprehend the operation of a solar radiation hybrid power system, we must first comprehend the operation of a solar panel system and a wind energy system. A roof top solar systems are systems that harnesses sun energy to generate electricity using photovoltaic power. The graphic depicts a block schematic of a solar radiation hybrid power system with solar panels and a wind generator for generating electricity.

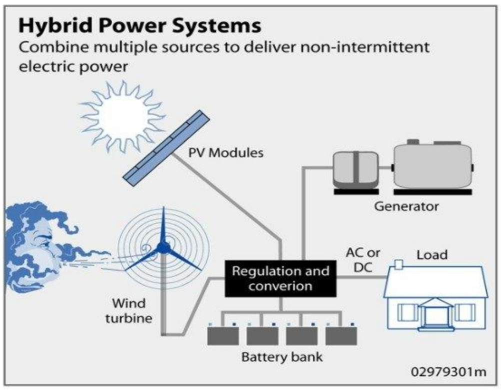

Fig. 1 Hybrid Energy System

Wind energy is a clean energy source that can be used to generate electricity through wind farms and generators. Wind turbines are fan-shaped fans that rotate in response to wind, with a pivot point oriented with the flow direction. Solar power systems consist of solar panels, photovoltaic modules, and a power storage battery. Offshore wind is available

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all day, while renewable radiation is only accessible during the day. The Winds Sunshine Hybrid Energy system combines wind and sun energy, generating energy virtually all year round. A transmission line or grid tie inverter (GTI) converts DC voltage to AC, connecting photovoltaic systems to the grid. GTIs work similarly to traditional stand-alone DC-AC SMPS, but with better control algorithms and safety features.

GTIs circuits typically contain one to three phases, dependent on power and incoming voltage levels. The fundamentals of functioning of a 3-grid tie converter are illustrated in the schematics picture below. Reduced input (such as 12V) in grounding circuits can benefit from this layout.

The boost converter, which consists of inductor L1, MOSFET Q1, diode D1, and capacitor C2, raises the voltage source first. According to the National Electric Code®, if a PV array is rated for greater than 50V, one of the input electric power buses must be grounded. The NEC®, on the other hand, provides for several exclusions, which we will describe further below. Although either of two buses can theoretically be attached to the earth, it is generally the negatives one. It's necessary to keep in mind that in distribution networks, if the DC input has a conductivity passage to grounding, the output AC conductor should be insulated from the DC.

II. METHODOLOGY

Individual elements effectiveness is modeled using either predictor - corrector methods. The basic mathematical components of a photovoltaic, as well as the modeling of conversion controllers, are provided in this chapter.

Boost converter Designing-The Voltage Source inverter block shows a conversion that boosts DC voltage using a microprocessor and entrance generation connected to it. Because they enhance output voltages, boost conversions are indeed known as step-up power systems.

The Boost Converter block lets you construct an asynchronously conversion with one shifting devices or a synchronously conversion with two semiconductor switches, such as a GTO (Gate turn-off Thyristor), IGBT, MOSFET or Thyristors.

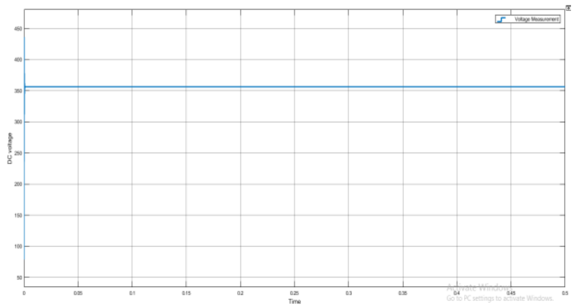

Fig.2 DC voltage waveform after the boost converter

The Boost Converter block lets you construct an asynchronously conversion including one changing gadget or a synchronously converters with two semiconductor switches, such as a GTO (Gate turn-off Thyristor), IGBT, MOSFET, or Thyristors. In our research, we used a charge controller to regulate and stabilize the DC link voltage over time. The DC output current from the device after employing the DC-DC charge controller is shown in the diagram. It was discovered that following boost conversions, it increased to around 390 volts. Using a met heuristic technique for process improvement controllers, this enhances the input power to the converter for DC/AC conversions.

PV Module modelling

PV systems classified as expressed in a formally and power system Stand-alone and efficiency or energy photovoltaic cells are the two types of photovoltaic panels. PV systems are classified according to their operational and strategic needs, constituent combinations, and connections to other load demand and forms of energy. Photovoltaic systems can either run independently or in conjunction with both the utility grid. They can be interconnected to energy storage devices and other renewable technologies, and they can provide AC and/or DC power. Grid-connected Photovoltaic systems, as already said, are built to operate in simultaneously and be attached to the electric power grid.

The major component of energy Photovoltaic system is the power conditioning unit (PCU), also known as an inverter,

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which directly convert the DC power produced by the Solar into AC power that meets the current and frequency performance standards of the transmission network, either for straightforward use on equipment or for sending to the transmission network to earn feed-in tariff recompense. The PCU immediately ceases sending electricity to the grid whenever the network is not powered.

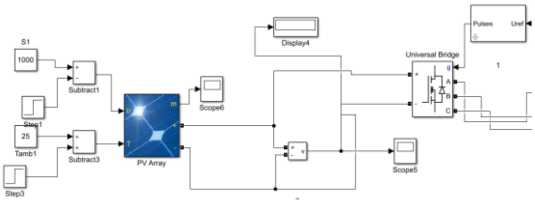

Fig.3 Modeled solar system

A concurrent mixture of cell photocurrent (Iph), exponential diode (D), and shunt resistance (Rsh) is arranged in series with such a cell series resistance (Rs), where I pv and Vpv are really the cells output current, including both. It can be stated as follows:

$$I_{pv} = I_{ph} - I_s\left(e^{q(V_{pv}+I_{pv}*R_s)/nKT} - 1\right) - (V_{pv} + I_{pv} * R_s)/R_{sh}$$

Eq (3.2.1)

Where:

I_{ph} - Solar-induced current

I_S - Diode saturation current

Q - Electron charge (l.6e^{-l9}C)

K - Boltzmann constant (l.38e^{-23}J/K)

n - Ideality factor (l~2)

T - Temperature ^{0}K

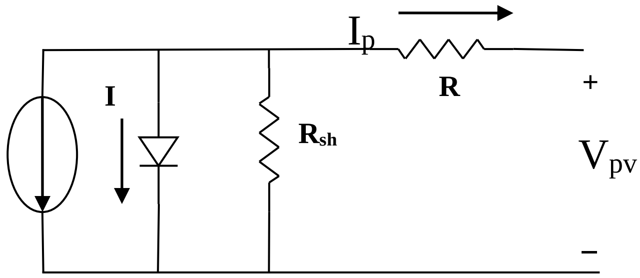

Fig.4 Equivalent circuit of solar PV cell

The solar PV cell's photovoltaic electromotive force is proportional to the solar irradiance and the operating temperature, and could be demonstrated as:

$$I_{ph} = I_{sc} - k_i(T_c - T_r) * \frac{I_r}{1000} \qquad \text{Eq (3.2.2)}$$

Where:

I_{SC}Short-circuit current of cell at STC

K_i Cell short-circuit current/temperature coefficient(A/K)

I_r Irradiance in w/m^{2}

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T_C ,T_r Cell working and reference temperature at STC

As shown in Fig. 4.4, a PV cell has an exponentially connection between voltages and currents, with the maximum power point (MPP) occurring at the knees of the curves.

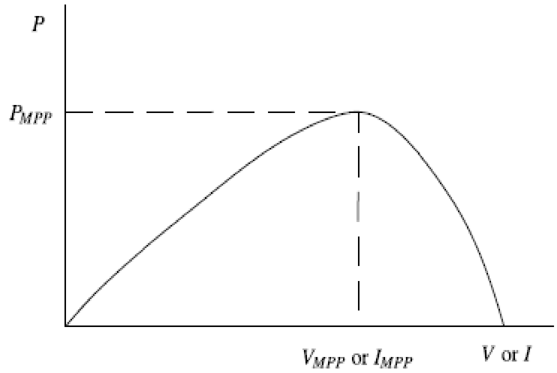

Fig.5 Characteristic PV array power curve

Model	1Soltech 1STH
Maximum Power	213 Watts
Number of parallel strings	42
Number series modules	12
Open circuit voltage	36 Volts
Shot circuit current	7.94 Ampere
Irradiation	1100 wb/m^2

Proposed inverter modeling and controlling algorithm The three - phase power grid linked three leg IGBTs powered converter technology presented in this study is extensively utilized in decentralized generating interfaces. The inverter was controlled by an officially endorsed Conventional pi controller.

DC-AC converters are required whenever the power generation is sent to the grid or utilized by AC loads (inverters). The output of inverters might be single phase or three phase. The industrial plant converter technology, the multilevel inverter framework, the number of co converter framework, and the micro grid inverter (AC modules) framework are the four most typical grid connected inverter for solar power systems.

The previous technique, the central air conditioning inverter, was controlled by a centralized inverters that connected a large generated from Pv panels to the grid. Photovoltaic cells are linked in a series (called a string). To achieve high power levels, these threads are interconnected with thread diode. The technological development is string converters, which are a smaller version of the central air conditioning inverter with each strand attached to the converter. Multi-string inverters feature multiple strings that are connected to a central DC-AC inverter via their own DC-DC converter. Because of their own independent maneuverability, power supplies are preferable to industrial plant multilevel inverter. Figure 3.8 shows a three-phase grid-connected DC-AC inverter graphical representation.

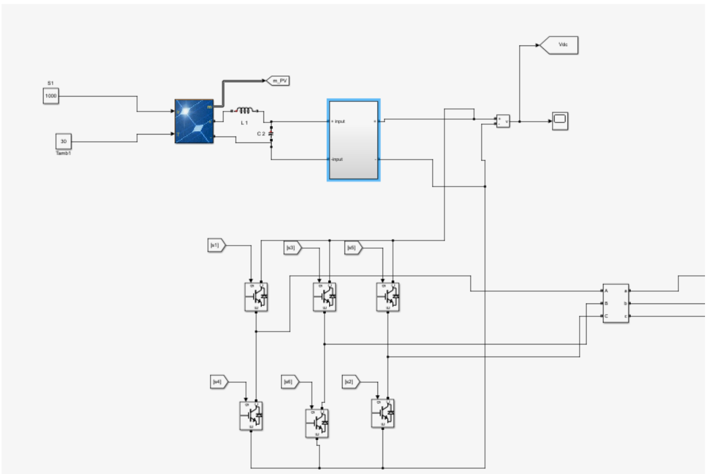

Fig.6 MATLAB/SIMULINK designing of three phase converter

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Multilevel Inverter

The multilevel inverter design was made with the goal of improving system configuration. To make studying the elemental pieces and their modifications easier, the design was done in the dq0 stationary frame. The system monitors the changeable variables on a regular basis and changes them as needed.

The converter, which is a three-leg, six-pulse inverter, receives pulses from the microcontroller below. Grid characteristics, load specifications, and inverters expected outputs are all inputs to the microcontroller. The current and voltage requirements have been examined and are expected to improve as a result of the improvements. The reference voltage control is essential for controlling switching frequency by modifying phase and load need by adjusting the PI control's gain parameters. First before signal is delivered to the Pwm inverter for pulse creation, it is corrected for harmonics. This multi-objective adaptable restrictions performance improvement controller is designed to function and upgrade for each moment of systems fluctuation in order to provide the best pulses and improved quality characteristics.

Fuel system integration

PEMFC is an electrochemical device that converts the chemical energy contained in a reaction between a fuel, hydrogen and an oxidizing agent, oxygen, into electrical energy. A bias voltage is applied to the electrochemical cell to induce electrochemical reactions on the two electrodes. Water is introduced into the anode and dissociated into oxygen, protons and electrons. Protons are driven by an electric field through the PEM to the cathode, where they combine with the electrons that come from the external circuit to form hydrogen gas.

Fuel cells are compact, low-noise energy generators that use hydrogen and oxygen to generate electricity. The transport sector is the most important potential market for fuel cells and car manufacturers invest heavily in research and development. However, energy production is seen as a market in which fuel cells can be marketed much faster. Fuel cells can achieve high efficiency (35% -60%) compared to conventional technologies. The figure shows the approach that has been followed to integrate the system with solar /wind energy system.

III. RESULT & DISCUSSION

Two or more renewable energy sources, power conditioning, and/or storage devices are used in a hybrid power system (HPS). HPS' major goal is to combine numerous forms of energy and/or storage systems that are complementary to one another. As a result, high performance can be attained by maximizing the benefits of each form of energy and/or device while addressing their constraints. The assessment of a combination solar panel system including basic dc power supply management for the inverters is done and the results. The actual output is then contrasted to some other software that involves a hybrid of solar, windy, and alternative fuel energy supplies, with the converter regulated by an identity evolutionary algorithms approach to improve all output parameters over the previous regime.

In this chapter, we looked at the output of a hybrid system with a stabilization in the following circumstances:

5.1 CASE 1: With a basic input voltage management, a hybrid Power system system can be interconnected with the grid.

5.2 CASE 2: Hybrid PV/wind/fuel system connected to the grid, with such a recommended met heuristic strategy for improving transformer performance.

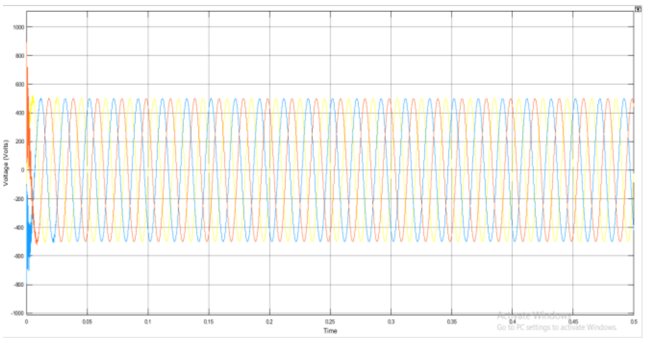

Fig.7 Voltage output from the solar/wind hybrid system with voltage source controller

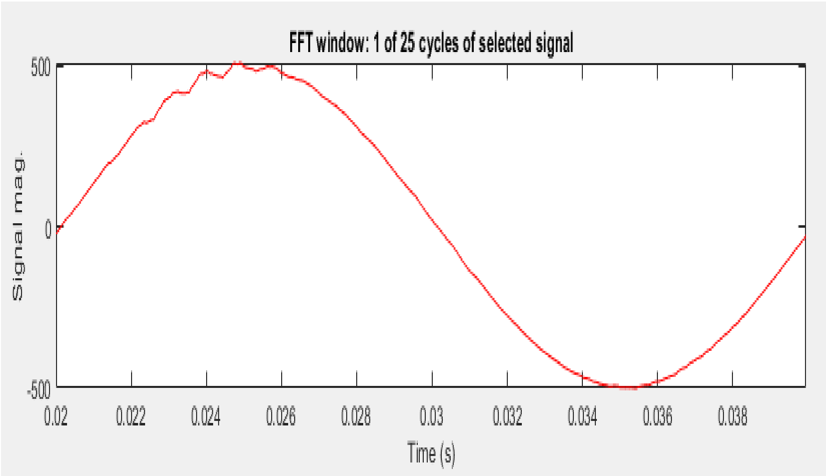

Fig.8 FFT analysis of voltage output from the solar/wind hybrid system

IV. CONCLUSION

Hybrid methods, such as solar and wind energy, are becoming increasingly popular for producing electricity. A multilevel inverter for a hybrid windy photovoltaic energy and resource cell program was developed using a Boost Converter and a meta-heuristic optimization approach for transformer quality management. The inverters regulator was created considering various aspects of the electricity system. The research found that the proposed solution decreased current and voltage waveform deformation, increased active power with transformer input, and minimized frequency deviation in the hybrid power system, including hydrogen fuel incorporation.

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