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A Performances Evaluation and Modelling of Solar and Wind Hybrid Power Generation Source

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Abstract- The recent upsurge in the demand of PV and wind systems is due to the fact that they produce electric power without hampering the environment by directly converting the solar radiation into electric power. However the solar radiation, wind never remains constant. It keeps on varying throughout the day. The need of the hour is to deliver a constant voltage to the grid irrespective of the variation in temperatures, wind pressure and solar isolation. We have designed a circuit such that it delivers constant and stepped up dc voltage to the load. We have studied the open loop characteristics of the PV array and wind system with variation in temperature and irradiation levels. Then we coupled the PV array and wind system with the boost converter in such a way that with variation in load, the varying input current and voltage to the converter follows the open circuit characteristic of the PV array and wind system closely. At various isolation levels, the load is varied and the corresponding variation in the input voltage and current to the boost converter is noted. It is noted that the changing input voltage and current follows the open circuit characteristics of the PV array and wind system closely.

Keywords- Electricity, hybrid, solar, power, wind, perturbation and observation (P&O) algorithm.

I. INTRODUCTION

The Conventional sources of energy are rapidly depleting. Moreover the cost of energy is rising and therefore photovoltaic system is a promising alternative. They are abundant, pollution free, distributed throughout the earth and recyclable. The hindrance factor is it's high installation cost and low conversion efficiency. Therefore our aim is to increase the efficiency and power output of the system. It is also required that constant voltage be supplied to the load irrespective of the variation in solar irradiance and temperature. PV arrays consist of parallel and series combination of PV array and wind system that are used to generate electrical power depending upon the atmospheric conditions (e.g solar irradiation and temperature). So it is necessary to couple the PV array and wind system with a boost converter. Moreover our system is designed in such a way that with variation in load, the change in input voltage and power fed into the converter follows the open circuit characteristics of the PV array and wind system. Our system can be used to supply constant stepped up voltage to dc loads.

II. WORK SUMMARY

We have discussed about the renewable energy, solar energy, distribution of solar radiation reaching the earth's surface. The details regarding the PV cell have been discussed in chapter 3. The PV array and wind system has been designed in MATLAB environment. The open-circuit characteristic of the PV cell has been studied in depth. The boost converter design, the coupling of the PV array and

wind system with the converter has been described. The deals with the simulation results and discussions part. The P-V, I-V, P-I curves have been obtained at varying irradiation levels and temperatures. The generation of the PWM signal has been shown. We get constant voltage across the load resistance of the boost converter. Output load of the boost converter is varied and the variation in the input voltage and current fed into the boost converter is noted. The various values of the voltage and current have been plotted in the open loop curves of the PV array and wind system. The voltage and current values lie on the curves and thereby prove that our coupling of the boost converter with the PV array and wind system is proper.

Wind energy is the energy which is extracted from wind. For extraction we use wind mill. Ii is renewable energy sources. The wind energy needs less cost for generation of electricity. Maintenance cost is also less for wind energy system. Wind energy is present almost 24 hours of the day. It has less emission. Initial cost is also less of the system. Generation of electricity from wind is depend upon the speed of wind flowing.

III. RENEWABLE ENERGY

Renewable energy sources also called non-conventional type of energy are the sources which are continuously replenished by natural processes. Such as, solar energy, bio-energy - bio-fuels grown sustainably, wind energy and hydropower etc., are some of the examples of renewable energy sources. A renewable energy system convert the energy found in sunlight, falling-water, wind, sea-waves, geothermal heat, or biomass into a form, which we can use in the form of heat or electricity. The majority of the renewable energy comes either directly or indirectly from sun and wind and can never be fatigued, and therefore they are called renewable [1].

However, the majority of the world's energy sources came from conventional sources-fossil fuels such as coal, natural gases and oil. These fuels are often term non-renewable energy sources. Though, the available amount of these fuels are extremely large, but due to decrease in level of fossil fuel and oil level day by day after a few years it will end. Hence renewable energy source demand increases as it is environmental friendly and pollution free which reduces the greenhouse effect [1].

IV. DESIGN OF HYBRID ENERGY SYSTEM

For design of the hybrid energy system we need to find the data as follows

1. Data required for Solar System:

- Annual mean daily duration of Sunshine hours
- Daily Solar Radiation horizontal (KWH/m2/day)

2. Data required for Wind System

- Mean Annual Hourly Wind Speed (m/sec)
- Wind Power that can be generated from the wind turbine

Above figure shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes following blocks.

- Solar panel
- Wind turbine
- Charge controller
- Battery bank
- Inverter

Solar Panel

Solar panel is use to convert solar radiation to the electrical energy. The physical of PV cell is very similar to that of the classical diode with a PN junction formed by semiconductor material. When the junction absorbs light, the energy of absorbed photon is transferred to the electron proton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as current through an external circuit. Solar array or panel is a group of a several modules electrically connected in series parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into the electrical power.

Wind Turbine

Wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically wind turbine has two types one is vertical and another is horizontal. As the wind speed increases power generation is also increases. The power generated from wind is not continuous its fluctuating. For obtain the non-fluctuating power we have to store in battery and then provide it to the load.

Charge Controller

Charge controller has basic function is that it control the source which is to be active or inactive. It simultaneously charge battery and also gives power to the load. The controller has over-charge protection, short-circuit protection, pole confusion protection and automatic dump load function. It also the function is that it should vary the power as per the load demand. It add the both the power so that the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

Battery

Bank We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size we need to find following data

- Find total daily use in watt-hour (Wh).
- Find total back up time of the battery For increase in battery bank size we need to connect cell in series so that we can get the larger battery bank size.

Inverter

We have to choose greater rating inverter than the desired rating .The pure sign wave inverter is recommended in other to prolong the lifespan of the inverter. Inverter is need to convert DC power into AC power. As our load working on the AC supply so we need to convert DC power. The input voltage Output voltage and frequency, and overall power handling depends on the design of the specific device or the circuitry. The inverter does not produce any power. The power is provided by the DC source.

V. PROJECT BACKGROUND

The escalation in costs and environmental concerns involving conventional electric energy sources has increased interest in renewable energy sources. Wind, Solar PV and Biomass power generations are viable options for future power generation. Besides being pollution free, they are free recurring costs. They also offer power supply solutions for remote areas, not accessible by the grid supply. Today, around 30,000 wind turbines and more than 1, 00,000 off-grid Solar PV systems are installed all over the world. Hybrid systems can address limitations in terms of –

- Fuel Flexibility
- Efficiency
- Reliability
- Emissions
- Economics

- The hybrid system of solar/wind is environmental friendly.
- Uses conventional energy resources.
- Need of the hour to use conventional energy resources.
- Efficient way of supplying electricity.
- Wind speed and sun shine is different in different parts of the world.

VI. GRID-CONNECTION NEEDS FROM OUR POWER SYSTEM

Currently, requirements for connecting distributed generation systems—like home renewable energy or wind systems—to the electricity grid vary widely. But all power providers face a common set of issues in connecting small renewable energy systems to the grid, so regulations usually have to do with safety and power quality, contracts (which may require liability insurance), and metering and rates.

You will need to contact your power provider directly to learn about its specific requirements. If your power provider does not have an individual assigned to deal with grid-connection requests, try contacting your state utilities commission, state utility consumer advocate group (represents the interests of consumers before state and federal

regulators and in the courts), state consumer representation office, or state energy office.

Differnce between Previous and Proposed Structure of Grid Connection System

This focuses on the overall design of a wind/pv hybrid power system interfaced with a grid/stiff grid or utility. In the design, we give a description of each of the components of the PV system, namely the PV module, the boost converter, the inverter, and the grid. This description helps to understand the functionality of each component of the system, leading to its detailed mathematical design, the results of which are shown in the following chapters.

In this part of the thesis, a detailed description of the parts of the two-stage grid connected wind/pv hybrid power system is provided. The research conducted for each of these major parts of the wind/pv hybrid power system has helped us understand why each particular component is required in the system. We also mention the type of photovoltaic cell, DC-DC converter, and DC-AC converter model that has been selected as part of this research.

The chapter has been organized as follows: section 2.2 speaks of the overall system architecture, providing a glimpse of the architecture of the two-stage wind/pv hybrid power system connected to a grid. It is followed with sections describing the wind/pv hybrid power system, the MPPT controller, the DC-DC converter, the DC-AC converter, and finally the phase lock loop PLL.

Contractual Issues for Grid-Connected Systems

When connecting your small renewable energy system to the grid, you will probably need to sign an interconnection agreement with your power provider. In your agreement, power providers may require you to do the following:

Carry Liability Insurance

Liability insurance protects the power provider in the event of accidents resulting from the operation of your system. Most homeowners carry at least $100,000 of liability through their homeowner insurance policies (although you should verify that your policy will cover your system), which is often sufficient. Be aware, however, that your power provider may require that you carry more. Some power providers may also require you to indemnify them for any potential damage, loss, or injury caused by your system, which can sometimes be prohibitively expensive.

In P&O method, the MPPT algorithm is based on the calculation of the wind/pv hybrid power system output power and the power change by sampling both the PV current and voltage. The tracker operates by periodically incrementing or decrementing the solar array voltage. If a given perturbation leads to an increase (decrease) in the output power of the PV, then the subsequent perturbation is generated in the same (opposite) direction. So, the duty cycle of the dc chopper is changed and the process is repeated until the maximum power point has been reached. Actually, the system oscillates about the MPP. Reducing the perturbation step size can minimize the oscillation. However, small step size slows down the MPPT. To solve this problem, a variable perturbation size that gets smaller towards the MPP.

VII. RESULT AND SIMULATION

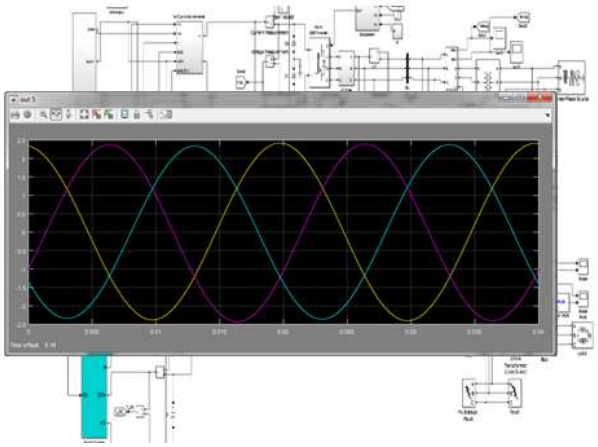

Fig 1: Vabc Voltage Waveforms.

V. CONCLUSION

Finally, among the compared MPPT Method, Perturb & Observe Method seems the most use.

Indeed, the P&Ob is the fastest and stable, due to his variable perturbing value. Furthermore, the Three-Point Weighted (P&Oc) is the most robust, due to an equivalent 2nd order Gradient approximation. Precisely, even if the P&Oc responses are very slow compared to P&Ob, simulation results show that only the P&Oc is able to obtain the Maximum Power Point, if two panels are connected in series with different solar irradiance.

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