Research Paper Engineering

Simulation of A Solar and Wind Hybrid System Representating Distributed Fed Generators In Evolving Grids For Renewable System

Kishan patel

Department of Electrical Engineering, Merchant Engineering College, Basna.

ABSTRACT

we use the conventional method for generating the power but there are many advantages of using the renewable energy sources within them. In parallel to developing technology, demand for more energy makes us seek towards new renewable energy sources. The most important of this is solar energy and wind energy. Renewable sources are popular due to, easy of availability, freely available and also eco-friendly. They are considered as promising power generating source. Solar and wind energies are usually available at most of the areas as a renewable sources. However, it is prudent that neither a stand-alone solar energy nor a wind energy system can provide continues supply of energy due to periodical and seasonal variations. Therefore we use the Hybrid power System. Solar energy and wind energy have been widely used as Hybrid combination for electricity supply in isolated or far location from the distribution network, due to advancement in renewable energy technologies. This dissertation will presents the simulation and cost optimization for the stand-alone wind system, Standalone solar power system and Hybrid solar and wind power system with battery storage system. Simulation will be done using MATLAB/ Simulink software.

KEYWORDS : Renewable energy, photo-voltaic, mppt, wind energy system, hybrid system

INTRODUCTION

We know that over the last decade it become apparent that the world's resources of fossil fuel are beginning to come to an end. The estimate source of oil and gas are reserves to come end in roughly 50 to 60 years respectively and coal reserves could only be able to last another 200 years. Of course fossil fuel are the part of the energy source that human has in his daily disposal and are called non renewable energy sources. The reason is they require special condition of pressure and temperature for their creation over an immense time period. The rapid depletion of fossil fuel recourse in the word has necessitated an argent search for alternative energy sources. Another reason for reduce use of fossil fuel is global warming.

The potential of renewable energy source is enormous as they can in principle meet many times the energy demand of world. The renewable energy sources such as biomass, solar, wind, geothermal, tidal and hydroelectric can provide sustainable energy. Service based on use of routinely available individual resources.

From many alternatives photo-voltaic and wind energy have been considered as the promising towards meeting the continually increasing demand of energy. The wind and photovoltaic sources of energy are freely available, inexhaustible and it does not cause greenhouse effect in contrary to the fossil fuels. Solar and wind energy are good complementary to each other. They have been widely used as hybrid combination for electricity supply. So properly sized photovoltaic, wind turbine and storage unit provide high reliability, low maintenance cost, maximize performance while minimizing the cost.

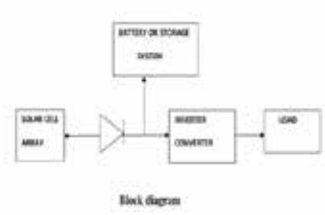
The main disadvantage of stand-alone power system using renewable energy sources are that it output is depends on the various conditions. Renewable sources are seasonal and it is difficult to regulate the output power to cope with the load demand. Also, a very high initial capital investment cost is required. Combining two or more renewable energy generation will enable the power generated from a renewable energy sources to be more reliable, affordable and used more efficiently. Sufficient, the Wind turbine can meet the load demand.

When there is enough energy from the sun, the load demands can be supplied from the PV-array system. When-ever there is excess supply from the RESs, the energy storage bank stores energy which will be used at times when there are insufficient supplies from the RESs. This report focuses on the combination of Wind, Solar and energy storing systems for sustainable power generation. The Wind turbine output power varies with the wind speed at different conditions. The Solar energy also varies with the hourly, daily and seasonal variation of solar irradiation. Thus, a Battery bank (energy storage bank) can be integrated with the Wind turbines and PV-system to ensure that the system performs under all conditions.

SYSTEM DISCRIPTION AND MODELING

SOLAR (PHOTO-VOLTAIC) SYSTEM

We know that the sun is the largest energy source. The sun has 2×kg of mass and 7,00000km of beam length. Its surface temperature is about 5800k and internal temperature is approximately 15,000,000k. This is due to the process transformation of hydrogen into helium. Solar energy can be used to generate the electricity in a direct way with the use of photovoltaic panels. When sunshine is incident on Solar cells, they generate DC electricity without the involvement of any mechanical generators that is in these systems of energy conversion there is direct conversion of solar radiation into electricity. In it the stage of conversion into thermodynamic form is absent. The Photo voltaic effect is defined as the generation of an electromotive force as a result of the absorption of ionizing radiation. Energy conversion devices which are used to convert sunlight to electricity by the use of photovoltaic effect are called Solar cells. In actual usage, the Solar cells are interconnected in certain series /parallel combinations to form modules. These modules are hermetically sealed for protection against corrosion, moisture; pollution and weathering .A combination of suitable modules constitute an array. A general data for $1m^2$ of a fixed array kept facing south yields nearly 0.5 kWh of electrical energy on a normal sunny day. During the non-sunshine hours it requires the storage system.



Block diagram

Figure.1 block diagram

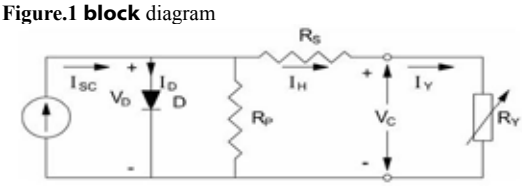


Figure.2 Equivalent circuit of photovoltaic module

WIND SYSTEM

As we know wind energy is an indirect form of solar energy is an indirect form of solar energy. As the sun heats different parts of the earth at different rates then air circulates from the cold to the warm areas producing winds. The wind recourse is extremely large and varies with the locations and the time. Wind energy is the renewable source and also eco-friendly and there are no pollution problems. In this Wind turbines are used to convert the Wind power into electric power. Electric generator inside the turbine converts the mechanical power into the electric power. Wind turbine systems are available ranging from 50W to 2-3 MW. The energy production by wind turbines depends on the wind velocity acting on the turbine

Wind power is used to feed both energy production and consumption demand, and transmission lines in the rural areas. It is used to run a windmill which in turn drives a wind generator or wind turbine to produce electricity. Practically it is observed that the flexible three blades propeller about 35 m in diameter, in a 60 Km/hr wind pressure with a rotation speed of 47 rpm produce maximum power 12 MW. For small wind power generation system, multiple blade type (3 to 5 number blades) or Darrius type (Curved Blade 3 to 5 numbers) is highly suitable. The main drawback of the wind system is that it depends on speed of wind and it is not constant so the output is varying nature. So it is better to feed the output to the battery or storage system.

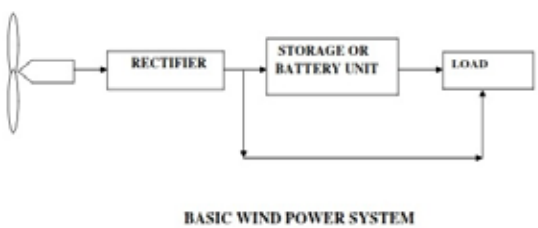


Figure.3 Basic wind power system

SOLAR AND WIND COMBINE SYSTEM

Power in the time way, Wind-solar Hybrid Generating System is considered to take full advantage of renewable energy so greatly as to improve the stability and reliability of the power system, and save the cost of the electricity to a certain extent by reducing the capacity of the battery and extending the life of the battery. Wind solar hybrid power generation system can be broadly divided into two types: network-based and o -grid. The main difference between the two is whether the use of external grid power. The system is mainly made up by the wind turbine, solar photovoltaic batteries, controllers, batteries, inverter, DC load as well as the exchanger of DC/AC parts. DC was generated from wind turbines and solar panels, respectively, then changes to AC by the inverter for users. In order to meet the regulation of the electricity in different time the batteries charging in peak period and discharging in trough. There is many advantages and features of hybrid system over the conventional one.

Solar and wind both combine system's diagram is as shown below.

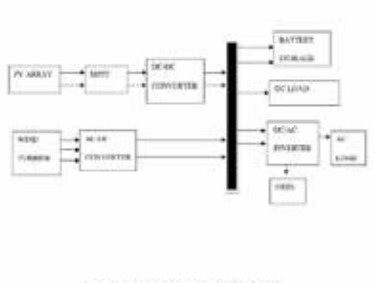


Figure.4 Solar and wind combined hybrid system

- This system is most eco-friendly and clean source of power.
- It did not require any fuel so no fuel cost.
- Easy to operate and maintain
- This system is highly reliable and gives consistent power supply.
- Long life span for SPV modules and modular design
- Very few moving parts: negligible maintenance required,
- by using this system we can reduce the pollution so improving health

D SIMULATION OF PHOTO-VOLTAIC MODULE

A model of PV module with moderate complexity that includes the temperature independence of the photocurrent source, the saturation current of the diode and a series resistance is considered based on the equation.

Being illuminated with radiation of sunlight, PV cell converts part of photovoltaic potential directly into electricity with both I-V and P-V output characteristics.

The model mainly contains four blocks representing four equations.

(1) MODULED PHOTO CURRENT

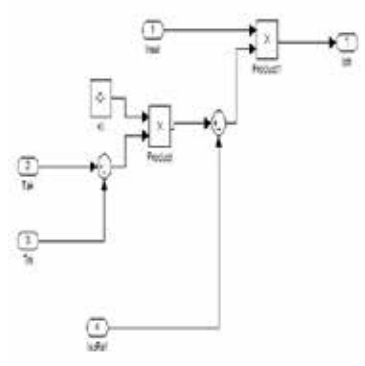
It is given by the equation

Iph = [Iscr + Ki (T-298)]* λ/1000]

Where Iph is photocurrent

- Insolation G = (λ/1000)=1 kW/m^2=1
- Module Operating Temperature Tak = 30ºC to 70ºC
- Module Reference Temperature Trk = 25ºC

Short Circuit Current Isc at reference temperature = 2.55 amp



PHOTON CURRENT

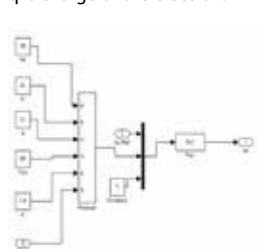
(2) REVERSE SATURATION CURRENT

The reverse saturation current for the pv module is given by the equation

$$I_{rs} = \frac{I_{scr}}{\left[e^{\frac{(q*V_{oc})}{(N_s*K*A*T)}} - 1\right]}$$

Where K is Boltzmann's constant.

q is charge of the electron.

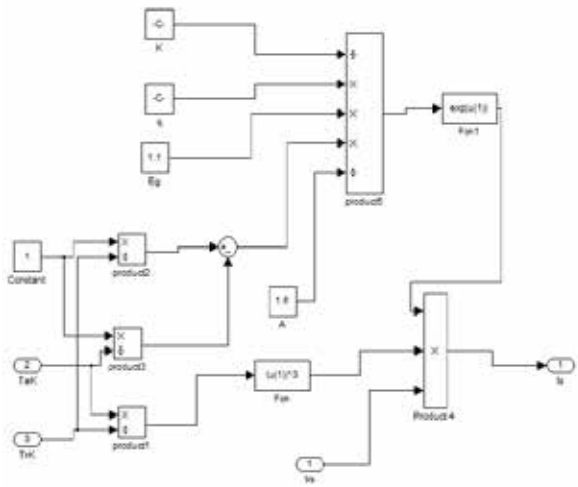


REVERSE SATURATION CURRENT

(3) SATURATION CURRENT
Saturation current is given by

$$I_o = I_{rs} * [\frac{T}{T_r}]^3 * [e^{(\frac{q*E_{go}}{B*K})*(\frac{1}{T_r}-\frac{1}{T})}]$$

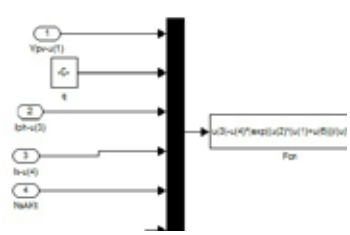
Here
T = absolute temperature
Tr = reference temperature
Irs =reverse saturation current
Io = saturation current
Ego = Band gap energy = 1.6 ev



(4) SATURATION CURRENT
MODULED OUTPUT CURRENT

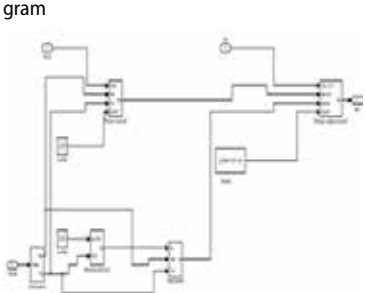
$$I_{pv} = N_p * I_{ph} - N_p * I_o[e^{(\frac{q\times(V_{pv}+I_{pv}\times R_s)}{N_s\times K\times A\times T})} - 1]$$

Here Np = number of cell connected in parallel



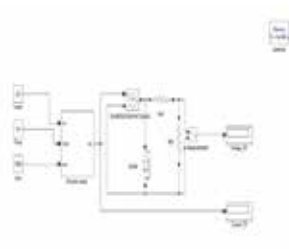
MODULED OUTPUT CURRENT

INTERCONNECTION
Interconnection of the all currents for pv module is as shown in diagram



INTERCONNECTIONS

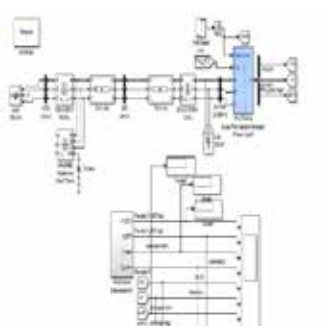
(6)CIRCUIT MODEL OF P-V PANEL



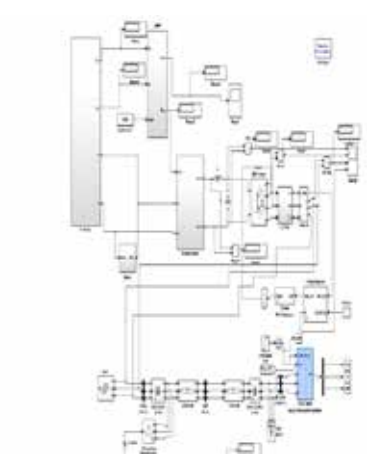
We know that the output of pv module is depended on the solar irradiation, temperature and material of module. In pv module the light energy is converted into the electrical energy. The equations indicate that PV voltage is a function of the junction voltage of diode, the physical equations governing the PV module is elaborately presented with numerical values of module saturation current at various temperatures.

(7) MPPT MODULE
The output voltage of the photo-voltaic module is depends on the temperature and the solar radiation so output is not constant so mppt controlling is very popular method and use the po algorithm.

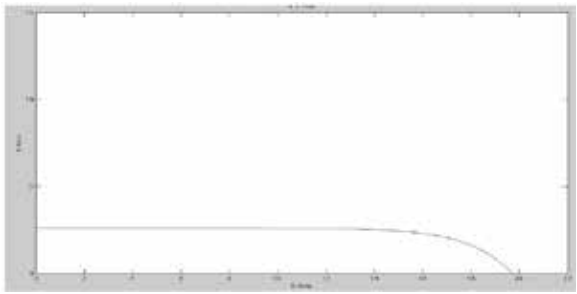
(8)WIND SYSTEM
Simulation of wind system with doubly fed generator is as shown below.in wind system output power is depend on the speed of the wind, turbine speed.



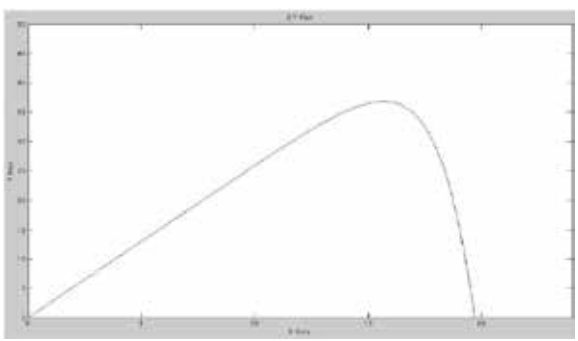
(9) COMBINED HYBRID SYSTEM
Combined circuit of all the component listed aas shown below.



GRAPHS
I-V CHARACTERISTICS



P-V CHARACTERISTICS



The I-V and P-V Characteristics under constant irradiance with varying temperature are presented respectively. When the operating temperature increases, the current output increases marginally but the voltage output increases rapidly, which results in power output with a rise in temperature.

CONCLUSIONS

We can use the solar system and wind system standalone plants but it suffering from the many problems like seasonal variation. It is better to use the hybrid system and it is better than the stand alone plants.

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