Challenges, Issues And Solution For Hybrid Solar Pv And Wind Power Generation With Off-Grid Integration

Vijayalakshmi R[1], Pratheeba C[2], Sathyasree K[3], Ravichandran V[4]

Assistant Professor, Department of Electrical and Electronics Engineering
Nandha Engineering college , Erode [1,2,3 & 4]

ABSTRACT

This paper presents the challenges, issues and solution associated with hybrid PV and wind power generation. The hybrid power generation output is integrated with off- grid. AC-DC and DC-AC converters are used to synchronize the frequency of the hybrid system with common bus bar. The analogous operation of the system enhances continuous supply to the load. In offshore areas, (HAWT) Horizontal axis wind turbine mechanical contact reliability has broken due to high speed rotations. In proposed system, (VAWT) Vertical axis wind turbine is used to generate low power in low speed. In this proposed system sunny island, sunny remote control and battery bank are used.

Keywords *- Photovoltaic, Horizontal axis wind turbine, vertical axis wind turbine, converters, sunny remote control, battery bank*

I. INTRODUCTION

In recent days, the availability of conventional energy sources are decreasing and environment is polluted. So the alternate solution is to use the renewable energy sources. Renewable energy that produces no greenhouse gas emissions from fossil fuels and reduces some types of air pollution. To increase energy supply and reducing dependence on imported fuels. The most common renewable power technologies are: Solar (photovoltaic, solar thermal), Wind, Biogas (e.g., landfill gas/wastewater treatment digester gas), Geothermal, Biomass, Low-impact hydroelectricity and emerging technologies - wave and tidal power. The main advantage of using renewable energy is safe, abundant, and clean to use when compared to fossil fuels. Renewable energy source inculcates positive impact on natural environment and human well being.

In this system, solar PV and wind energy is used for power generation to integrate with off-grid. Solar power that is available every day of the year, even cloudy days produce some power. Practically no maintenance as solar panels last over 30 years. Surplus power can be sold back to the power company if grid intertied. Wind is an unlimited, free, renewable resource. Even though wind is an intermittent energy source, it supports to maintain clean and pollution free environment.

II. SOLAR PHOTOVOLTAIC

A solar Photovoltaic (PV) uses the light energy from the sun and converts into electricity with help of semiconductor materials. Electric current is generated through PV cell, when the light rays from the sun strikes the semiconductor. Solar PV consist of number of arrays are formed as panel. The exclusive cell design leads reduction in electrodes resistance, shading area and raise in conversion efficiency. Residual stress distribution can be more even, reducing the micro cracks risks.

Silicon is the widely used material for PV electricity generation. Some other materials are also used such as.

- Monocrystalline Silicon
- Polycrystalline Silicon
- Amorphous Silicon
- Cadmium Telluride (CdTe)
- Copper Indium Gallium Selenide (CIGS)

In general the efficiency of solar PV technologies varies, ranging between 6-18% at the moment.

III. WIND

A wind turbine is a machine which converts the rotational motion of wind blades in to mechanical energy. This mechanical energy shall be utilized directly by machinery such as, a pump or grinding stones, the machine is usually called a wind mill. Wind generator converts mechanical energy into electrical energy. The wind energy provides power generation by two methods i.e., constant speed operation and variable speed operation using power electronic converters. Variable speed power generation as maximum efficiency for all wind velocities.

Wind power is converted into electricity by a wind turbine. The power in wind can be extracted by allowing it to blow past moving wings that exert a torque on rotor. The blade rotor is the most important and most visible part of wind turbine. Depending upon the blade positions, wind turbines can be classified into two.

1. Horizontal axis wind turbine (HAWT)
2. Vertical axis wind turbine (VAWT)

Horizontal axis wind turbines generally have either one, two or three blades or else a large number of blades. Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator.

Vertical axis wind turbines (VAWT) have the main rotor shaft arranged vertically. Key advantages of this arrangement are that the turbine does not need to be pointed into the wind to be effective. This is an advantage on sites where the wind direction is highly variable. With a vertical axis, the generator and gearbox can be placed near the ground, hence avoiding the need of a tower and improving accessibility for maintenance.

IV. OFF-SHORE INTEGRATION

Higher wind speeds are available offshore compared to on land, so offshore wind power's electricity generation is higher, so the wind is hybrid with solar PV. In horizontal axis wind turbines, the number of blades used for electric power generation typically varies between 1 and 3. Turbine blades are made rigid to put off the blades from being pressed into the tower by high winds. Additionally, the blades are located a substantial distance in front of the tower and are sometimes tilted forward into the wind a small amount. In general, the wind speed velocity is very high in off-shore areas. Due to this mechanical strength of the blades are broken instantaneously. Hence vertical axis wind turbine is preferred for off-shore areas. The vertical axis wind turbine produces high power in high speed as well as low power in low speed.

V. RELATED WORKS

Solar PV is connected to an inverter which is to convert DC-AC and connected to bus bar as shown in Fig 1.

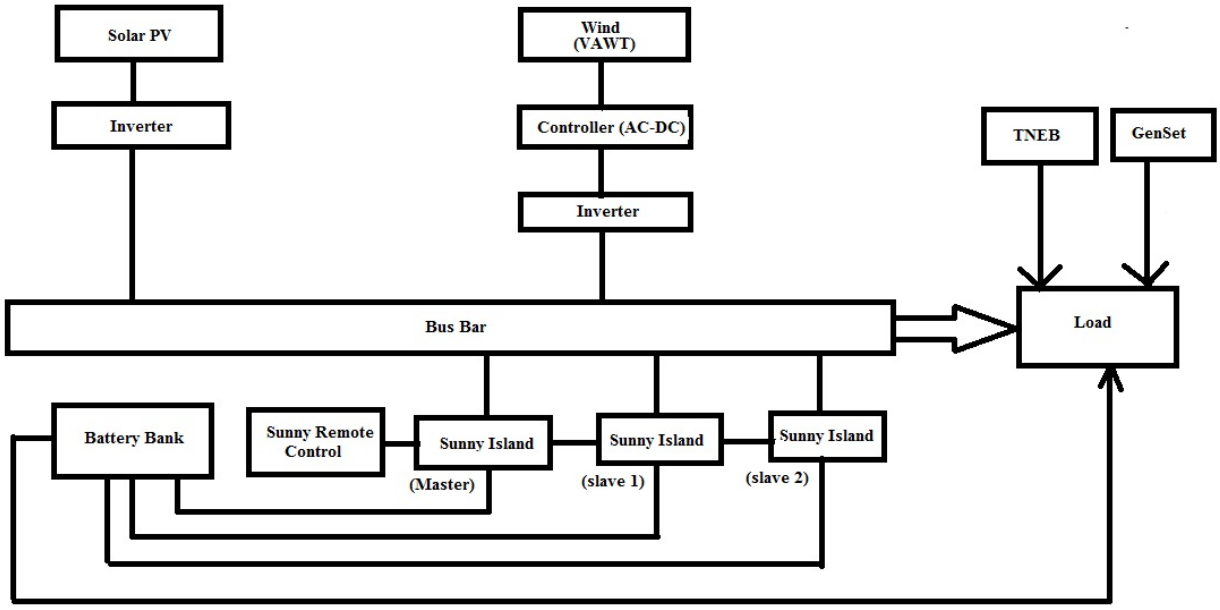

Fig 1: Block Diagram of Proposed System

Vertical axis wind turbine is connected to controller which converts AC-DC and connected to bus bar through inverter. The need of inverter is to synchronize the both output of solar PV, wind power and that output is given to the bus bar. The proposed systems consist of busbar with three phase five wires supply. The loads are connected to a busbar The R, Y & B phases are connected to a converter which is mentioned as master, slave 1 & slave 2. To overcome the unbalanced load conditions three individual converters are connected to each phases and the converter output is stored in a battery bank. The intermittent nature of solar power is succeeded with the help of battery. Once the battery gets drained to a percentage level of 30 or below, the required supply to the loads will be supplied by Electricity Board (EB). In case of interrupted supply source from the EB, Generator provides the supply to the load.

The changeover of supply from the source such as solar, wind, EB & generator is monitored and controlled by remote control system.

VI. EXPERIMENTAL RESULTS

Solar panels also known as photovoltaic solar modules are made up of polycrystalline Silicon. A photovoltaic module consists of multiple PV cells connected in series to provide a higher voltage output. PV modules are manufactured in standard sizes such as 36-cell, 60-cell and 72-cell modules. The proposed setup has 72 –cell modules and the operating module temperature is -40^0 C to 85^0 C. The total power generated from solar PV is 20KW as shown in Fig 2.

Fig 2: Solar PV module Setup

The setup carries two wind mills, which consist of six blades. The total wind power generated is 10KW as shown in Fig 3.

Table 1: Vertical Axis Wind turbine Technical Data

S.No	Description	Technical Data
1	Generator type	PMSG
2	Rotor diameter	2.5 metres
3	Rated wind speed	7 m/s
4	Startup/cut in wind speed	2 m/s
5	Height of blade	3.6 metres

The Sunny Island 6.0H / 8.0H supports a wide range of on-grid and off-grid applications with compelling product features – from operation in remote off-grid areas to home energy management as shown in Fig 4.

Fig 3: Wind Module Setup

Fig 4: Sunny Remote Controller

Table 2: Battery Range

S.No	Description	Technical Data
1	DC Voltage Range	48V/41V to 63V
2	Charging Current	110A/90A/103A
3	Battery type/range	Li-lan/100Ah - 10000 Ah
4	Nominal Voltage	2V
5	Ah Capacity	3050Ah

VII. CONCLUSION

A hybrid solar PV/Wind power generation has been installed in the proposed setup. A real time model is implemented in the offshore area. The renewable energy source is utilized effectively for producing desired output power. To this aim, the proposed system also supports to reduce the green house gas emission and off grid integration technologies adds complementing efforts to avoid power outages. It full fills the energy access gap in rural areas.

VIII. REFERENCES

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