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AC/DC Microgrid Involving Energy Storage Using PV-Wind Power

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Abstract-This paper proposes simulation modelling of AC/DC micro grid involving energy storage using pv-wind power micro grid concept introduce the reduction of multiple reverse conversion in an individual AC or DC grid, AC/DC power supply system with distributed generations(DGs). The DGs consist of photovoltaic (PV), wind generators (WG), and the main energy source of this system is the DGs and the UPS battery.we focused on the AC power supply and DC power supply from DGs. Then, the converters of DGs use two types, DC/AC type and DC/DC type. The power supply system has been operated with the actual load These pv-wind systems can be mainly operated either in a voltage control mode, when the DC side of the system is disconnected from the main AC grid, or in a maximum power point tracking (MPPT) mode

Index Terms- DC/AC systems, pv-wind systems, micro grid

1. INTRODUCTION

As we know now a days power system are gaining popularity due to increasing micro grid development featuring renewable power system connected to low voltage of AC distribution systems.now a days the wind power becoming a satisfactory alternative for electrical power generation.the wind turbine output make more commercial and reliable.The power requirements of such loads can range from kilowatts to megawatts with a charge interval on the order of sec to minutes DC grids are resurging due to development of new semiconductor technologies and sustainable DC power sources such as solar energy.there has also been an increase in DC loads,such as plug-in electric vehicles (pevs) and light emitting diodes (leds),connected to the grid to save energy and decrease greenhouse gas emissions. This growth has been motivated by environmental concerns caused by conventional fuel power plants.a variety of control strategies have been introduced for micro grids one of the major technical challenges in micro grids is the interconnection of loads the loads draw high currents during a short period of time, [3]which can causes considerable voltage and frequency these disturbances can trip other normal loads off-line, causing a serious outage.power converters opened new horizons for effective integration of AC and DC distribution networks in a micro grid operation concept[2]. Thus,several ideas and models of AC/DC micro grids have been proposed, but their systems operate without the influence of loads is still an open issue. At the same time,various utility grids and some hybrid micro grids are increasing the penetration of renewable energy resources. The intermittent nature of wind and solar generator to shut off altogether. Power systems face far more challenges when operating in is-landed mode than they do in grid connected mode. During is-landed mode, the AC side can no longer be viewed as an infinite bus, which results in load variations adversely affecting the frequency and voltage of the system.[4] If the system has a high penetration of renewable power. At any time, reactive and active power flow should be balanced between the AC and DC sides to maintain stability on both sides of the grid. AC/DC micro grid control considering load mitigation with energy storage. This grid can be viewed as PEV parking garage power system or a ship power system that utilizes sustainable energy and is filtered by load. Appropriate frequency and voltage control scheme for a AC/DC micro grid consisting of a synchronous generator, solar generation emulator and bidirectional (AC/DC and DC/DC) converters. A bidirectional controlled AC/DC converter with active and reactive power decoupling technique is used to link the AC bus with the DC bus, while regulating the system voltage and frequency. A DC/DC boost converter with a maximum power point tracking (MPPT) function is implemented to maximum the intermittent energy generation from solar and wind generators. Current controlled bidirectional DC/DC converters are applied to connect each lithium-ion battery bank to DC bus with the increasing concerns of the global warming, fossil source depletion and environmental pollution problems, the renewable power generations have been increasingly developed over the last decades.[3-5] However, the main challenge for utilizing the renewable resources is associated with the unpredictable and fluctuation of the power generated from these natural resources. Micro grid potentially has the ability of power management to mitigate power

fluctuation and variation as well as contributing to the stabilization of the integrated power grid, it is therefore considered as a prospective way to facilitate the expanded use of distributed renewable resources. Furthermore, where the grid access is not possible, micro grid may be the only choice to provide stable power supply by use of locally available renewable resources. Micro grid provides improved electric service reliability and better power quality to end customers and can also benefit local utilities by providing flexibility in load control during peak power conditions, especially for the local utilities with extremely weak grid. In the early stage, most of the developed micro grids were AC based, this is because that the major existing power grid is AC based network and the conventional loads are using AC power. However, in the recent years, due to the benefits such as higher efficiency and resilience of DC power distribution and application, DC based grids are being developed. Meanwhile many researches are being carried out on DC and AC micro grid. The DC voltage is effectively DC micro grids alone is, however, not realistic, since as mentioned earlier,AC distribution is presently dominant, and would be so for many more decades. Therefore, a more likely scenario would be the presence of both DC and AC sub grids with sources, storages, and loads appropriately distributed between them. The sub grids can subsequently be tied together by interlinking converters to form hybrid AC/DC micro grid. The accompanied challenge is then to design a coordinated droop control scheme for controlling the hybrid micro grid so that power is shared among the sources in proportion to their power ratings rather than physical placements The elimination of unnecessary DC/AC or AC/D/AC power conversion circuits installed in the power supplies, meaning the significant reduction of power conversion losses. The improved unsymmetrical current control capability since negative and zero sequence current problems caused by the unbalanced loads in AC grid can be handled by the DC grid

2. PROPOSED SYSTEM

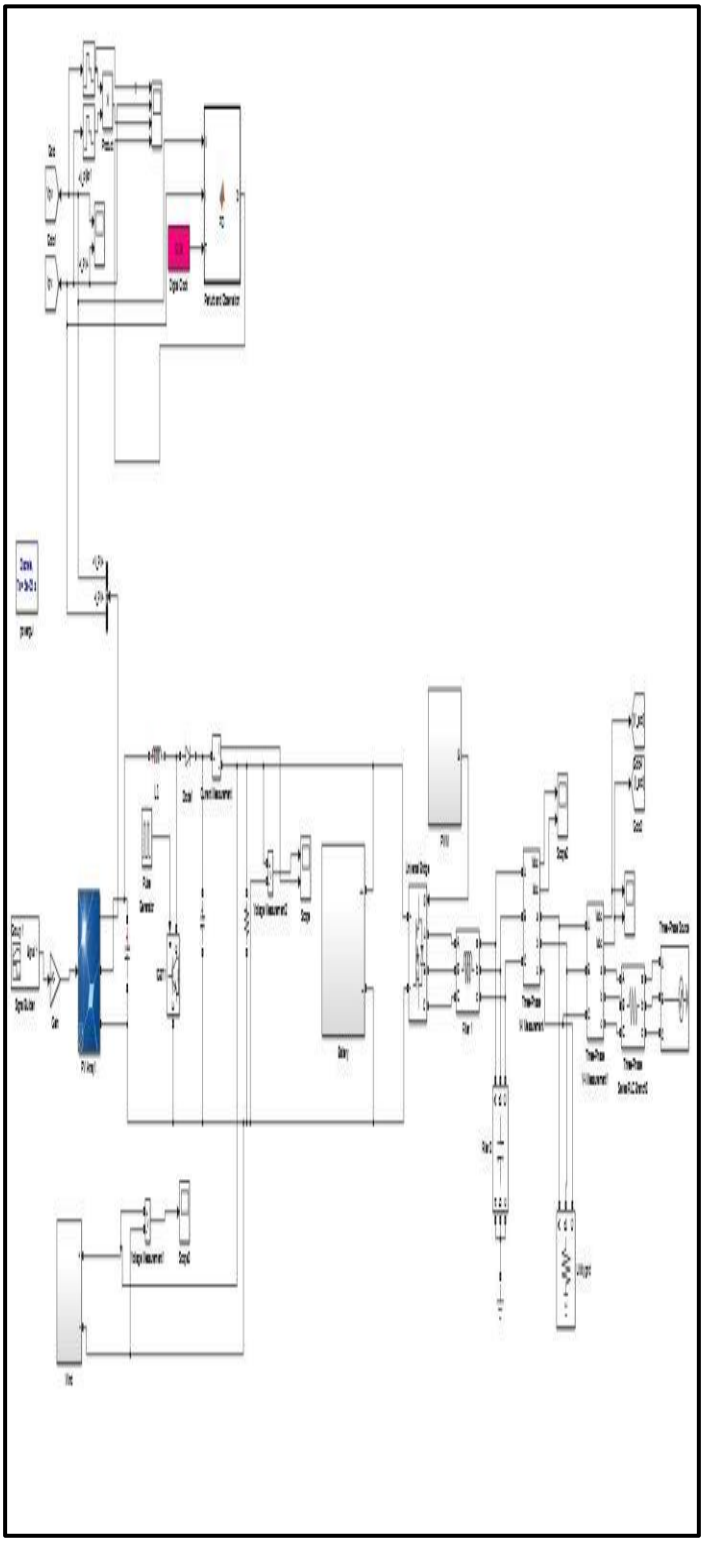

Fig: 2.1.Proposed model

3. SYSTEM MODELLING AND CONTROL

3.1 BOOST CONVERTER

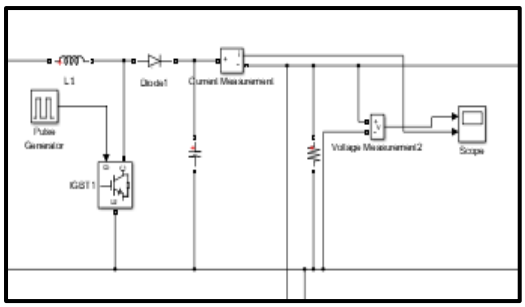

Fig.3.1 simulation module of boost converter

In a boost converter, the output voltage is greater than input voltage - hence the name "boost". Energy is handled by controlling the DC/DC boost converter. In grid connected mode, the proposed system can be viewed as a pevs car park system. Micro grid can limit the pevs' charging impact to the utility grid, and at the same time, provide some ancillary support to the utility grid. The bi-directional AC/DC converter can take control of the AC side frequency and voltage amplitude. The DC bus voltage is regulated by controlling the charging and discharging of the battery banks, which also means controlling the current flow through the bidirectional DC/DC converter Gate driver circuit is circuit integral part of power electronics converters which is used to drive power semiconductors devices like BJT's, IGBT's and mosfets. Output of DC DC converters depend on behaviour of driver circuits. Its mean if gate driver circuit doesn't drive gate of MOSFET device properly, your designed DC DC converter output will not be according to your requirement. Therefore design of gate driver circuit is critically important in designing of power electronics converters. It is used to create the isolation between the input supply and pulse and pulse which is given to the switches. The purpose of a driver circuit is to switch a power semiconductor device from OFF- state to the ON-state and vice versa. To reduce instantaneous power dissipation during switching, the turn-on and turn-of must be minimized. So, that power device spends little time in the active region. In the on-state the drive circuit must provide adequate drive power to keep the power switch in the on state where the conduction losses are losses are low. The drive circuit is needs to provide reverse bias to the gate to minimize turn of times and to ensure that the device remains in the off state and is not triggered on by stray transient signals generated by the switching of other power devices.

3.2 Bi-Directional DC/DC Converter Control

The bi-directional converters of the batteries play an important role in is-landing mode to regulate the DC bus voltage. A two closed-loops controller is used to regulate the DC bus voltage The outer voltage controlled loop is used to generate a reference charging current for the inner current controlled loop. The error between the measured DC bus voltage and the system reference DC bus voltage is set as the input of the PI controller, and the output is the reference current. The inner current control loop will compare the reference current signal with the measured current flow through the converter and finally generate a PWM signal to drive the IGBT regulate the current flow in the converter. For example, when the DC bus voltage is higher than the reference voltage, the outer voltage controller will generate a negative current reference signal, and the inner current control loop will adjust the duty cycle to force the current flow from the DC bus to the battery, which results in charging of the battery. The energy transfer from DC bus to the battery and the DC bus voltage will decrease to the normal value. If the DC bus voltage is lower than the normal value, the outer voltage control loop will generated a positive current reference signal, which will regulate the current flow from the battery to the DC bus, and because of the extra energy injected from the batteries, the DC bus voltage will increase to the normal value. Bidirectional AC/DC inverter control the frequency and voltage amplitude of the three phase AC side is not fixed during is landing operation so a device is needed to regulate these variables. A bi-directional AC/DC inverter is used with the active and reactive power decoupling technique to keep the AC side stable.

3.3 Bi-Directional AC/DC Converter and Load

The bidirectional AC/DC consist of six IGBT diode switches (S1-S6), which is connected with three phase AC supply in bidirectional AC/DC converter operates in two modes. In first mode it operates in rectifier and in second mode it operates as inverter.the bidirectional AC/DC converter works as a voltage source inverter during inverter mode, which allows the power transfer from the DC voltage bus to the three phase AC voltage end. The main aim of bidirectional AC/DC inverter is to regulate the active and reactive power Battery and loads A battery cell model is needed to regulate the DC bus voltage in is-landing mode. The battery terminal voltage and SOC need to be estimated the load can usually be viewed as a purely resistive load on the AC side, the load can be either a resistive or inductive load such as an induction load, the inductive loads are commonly connected to the AC side with power electronics devices such as bi-directional converter due to which the inductive load can converted and acts as resistive load.

3.4 Wind Module

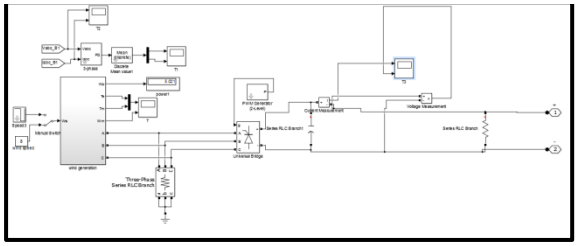

Fig.3.2 simulation module of wind power

wind energy conversion system (WECS) the technologies includes wind turbine technology, power electronics technology, and system control technology. The wind turbin**e** is based on two axis one is vertical and other is horizontal wind turbines which reduces the cost of converter while preserving the capability to control the speed This system can be operated in either grid or is-landed mode to maximize the utilization of the renewable sources, the WIND can be operated in on/off maximum power point modes based on the system power.energy balancing in handled by controlling the car parking in is-landed mode,the proposed system can be viewed as a ship power system with wind power.the bi-directional AC/DC converter can take control of the AC side frequency and voltage amplitude.the DC bus voltage is regulated by controlling the charging and discharging of battery banks, which also means controlling the current flow through the bidirectional DC/DC converter. DC/AC micro grid is proposed in this projects to reduce processes of multiple reverse conversion in an individual AC or DC grid and to facilitate the connection of renewable AC or DC sources and loads. the converters are proposed for maximum power from renewable power sources, to minimize power transfer between AC and DC grids so need to maintain stable operation for both AC and DC grids under different load condition

3.5 Storage (Battery)

The most common medium of storage are the lead acid batteries. The researches are going in the field of Li-ion batteries and to implement the concept in PV-WIND system one of the costly component in pv is battery hence the cost size and capacity matters in pv-wind power. The maximum amount of current that can be safely withdrawn from the battery to provide adequate back up and without causind damage.

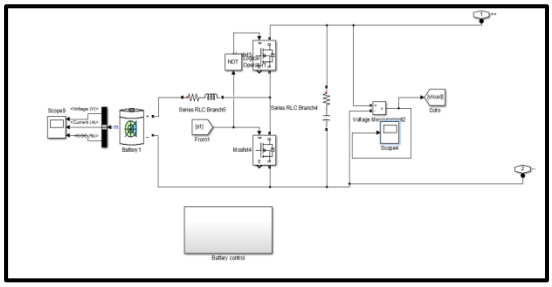

Fig.3.3 simulation module of battery

4. SIMULATION RESULT

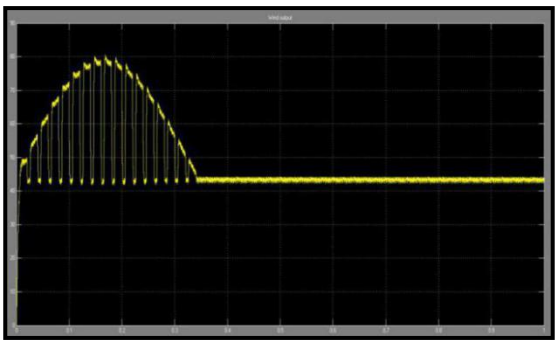

Fig:4.1. wind power output

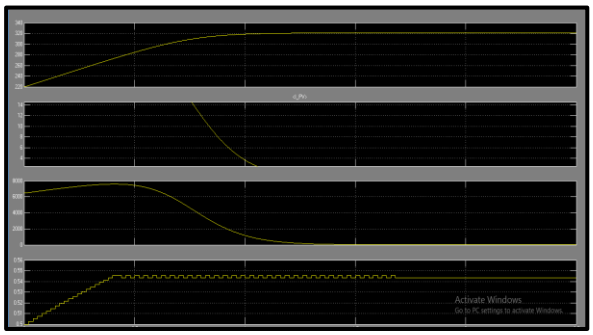

Fig:4.2.solar output

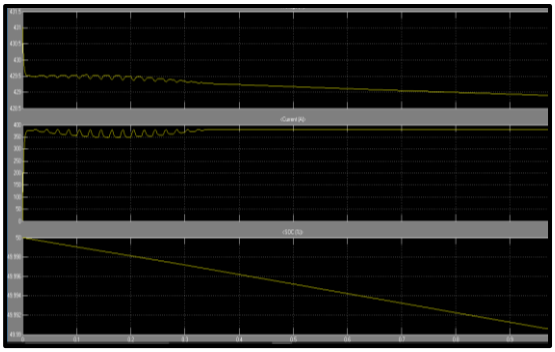

Fig: 4.3.battery output

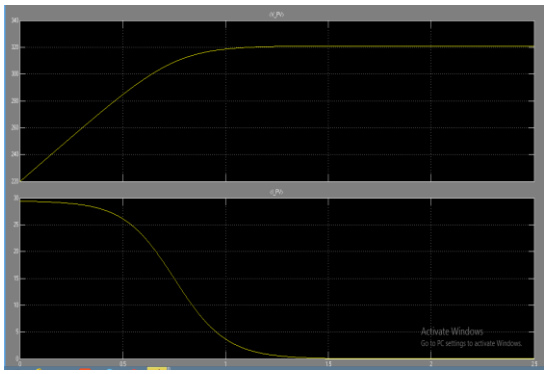

Fig:4.4 solar output (V,I)

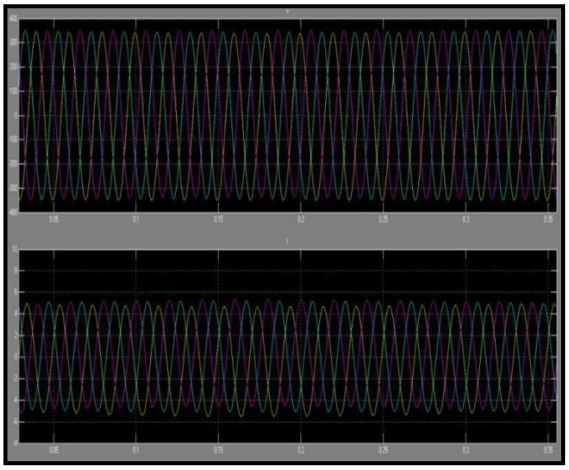

Fig.4.5. grid output

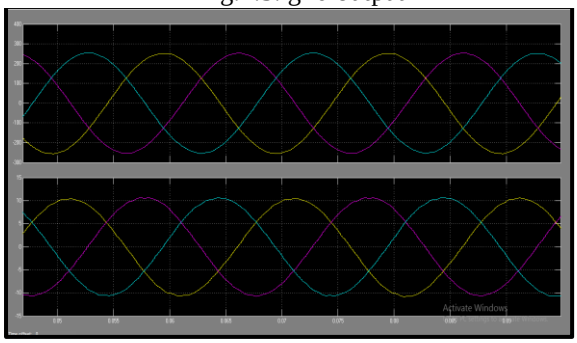

Fig:4.6. load output

5. CONCLUSION

AC/DC micro grid is proposed and simulated in both grid and is-landing mode. The micro grid having pv -wind power for providing supply for AC/DC sides one of side battery bank is connected for DC bus through bidirectional DC-DC converter depending on load demand we use renewable sources which is connected across the is-landing Mode.which provides reliable to the system. Under AC side the bidirectional AC/DC is connected for regulated output hence the reliability of system can also increased by adding number of batteries to the system grid mode can also reduces the conversion of AC-DC-AC in an individual AC or DC grid

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