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Energy Management in Microgrids with Renewable Energy Sources

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ABSTRACT- The Main objective of this project is to develop a power management system that will control the power flow and energy demand of an integrated renewable energy system with the focus on solar energy and wind energy. These storage systems are needed to provide high reliability and control systems are necessary for the stable and optimal operation of the whole system. The voltage and frequency of the line side converter are controlled with indirect vector control with droop characteristics. The setting of frequencies varies according to the battery energy level, which slows down when the battery is charged or discharged. The system can also work if the wind power source is not available. An Intelligent
Power Management System (IPMS) is developed to handle various changes in power supply and power demand by managing erratic power and providing a suitable control algorithm for the whole system. In order to test various power supply and power demand using a power system. The performed simulations confirm the ability of the IPMS to satisfy the load at all times using solar and wind power (which are unsteady renewables), through the support of batteries

KEYWORDS- Control system, IPMS, PV, Systems Power Energy.

I. INTRODUCTION

Today, many remote areas around the world are receiving electricity Diesel generator only as a power source. Such energy Sources are expensive and contagious. To solve these problems and improve people's needs, we need to generate electricity locally a lot the author is an independent PV system Autonomous wind turbine. However, a self-sufficient system requires a very large amount of storage and associated PE components with a single energy source. Solar power converter, Battery charge converter and battery discharge converter Usually required for PV systems. But the deadline This complex structure increases the mass and cost of the device. In addition, converting at several stages will reduce system performance. Two or more hybrid power supplies the system reduces the demand for BES and increases reliability. The natural allies of hybridization are wind and solar power. Both regular and annual activity trends are known Be complementary. Many authors have introduced it autonomously A hybrid solar wind system to understand the benefits of this combination. Permanent magnet synchronous generator the most common application unit for small wind turbines. In addition to for more expensive units, it is possible to achieve a gearless configuration PMSG. SCIG has a market advantage in machine cost, there is no speed control to meet the MPPT. In addition, some contributors used wind hybrid solar systems with SCIG generators. In addition, after completing speed control, a complete converter is required. Autonomous applications and solar are being discussed by various authors Industrial wind power and as their application, dual power induction generator (DFIG) The device has been applied. Low power converter can run DFIG Variable speed process. Shown here is a microgrid of a renewable energy system (REGS) from wind with a solar light source. High power point tracking control with diode characteristics PV system with multi-input DC-DC converter to convert Performance and cascade of various power supplies DC converter is considered.[3]

Photovoltaic (PV)-primarily based totally stand-by myself energy device is normally used to control the electricity provided [6] from numerous energies reasserts along with PV sun arrays and battery and supply a non-stop energy to the customers in the precise form. Traditionally, 3unique dc/dc converters might that been used. To lessen the fee and enhance the energy density of the energy device, an included answer [9] of PV remoted dc/dc 3-port converter (TPC) is proposed on this paper. A battery electricity garage device (BESS) is strengthened with inside the hybrid device to make sure energy levelling below wind,[10] sun and cargo fluctuations [11]. For acquiring the most energy from a sun PV array and to alter the output DC voltage, a DC-DC improve converter is managed the use of perturbation and statement high-voltage advantage converters allow using low-voltage PV and battery reasserts. This consequences in minimization of partial shading and parasitic capacitance consequences at the PV source. Series connection of a big range of battery modules is obviated, stopping the overcharging and deep discharging troubles that lessen the battery life. The proposed manipulate algorithms are modelled in MATLAB/Simulink and its overall performance is examined in actual time below presence of balanced/unbalanced, linear/nonlinear masses and alternate in weather conditions.[4]

The area of wind power of particular interest in recent years has focused on distributed generation with small wind turbines (200 kW power plants) due to its limited size. You can connect different power sources anywhere on the same power line, giving you the flexibility to expand your system. Considerable effort has been put into the development of active and reactive power and dump power controls. Analyse the operating characteristics of an independent wind-solar hybrid power system to improve energy conversion efficiency and system reliability. The results showed that the system was able to properly tune the energy flow under different weather conditions and loads, and that the amplitude and phase of the AC output voltage were properly tuned in the proposed hybrid system. If Microgrid (MG) are the general concepts discussed in several articles, global energy demand will increase by more than a quarter by 2040 [3]. Increasing demand for renewable energy sources is expected to account for 40% of the world's energy mix. The reliability of renewable energy sources is a major challenge, primarily due to the mismatch between supply and demand of energy [2]. Rethinking renewable energy sources, distributed generations (DGs), energy storage systems, and energy systems produces energy near where it is consumed. This energy comes from renewable energy sources.[12]

PV DC microgrids have strong non-linearity and time variation. Therefore, traditional dual voltage and current regulation strategies based on PI[14] controllers cannot effectively limit fluctuations and effects of DC bus voltage if the dynamic response of the system is improved. Voltage and frequency are managed via the diagonal vector control of the road facet converter included in the Droop property [15]. It changes the frequency reference based on the energy level of the battery and slows down the charging or discharging of the battery. This system also works when wind energy sources are not available. Each wind and solar energy block have maximum power point (MPPT) monitoring for its operating algorithm. The device has an external power source that charges the battery without any additional requirements. a MATLAB/Simulink model is developed for different conditions.

II. TOPOLOGY STRUCTURE

Figure. 1 shows a schematic diagram of the supplied REGS device micro mesh. The system is designed for the highest capacity locations The average power is 15 kW and respectively 5kW. REGS has rated wind capacity up to 15 kW with solar blocks. For both power blocks, 20% power the load factor is enough to supply the incubator for a day energy consumption. As shown in the diagram, the circuit breaker is protected against system in case the wind is not enough wind speed energy sources. CC side RSC and LSC are connected to HV side of solar system with battery storage. The system voltage as well as the frequency is regulated by the LSC. Absorption wind turbine kinetic energy of the wind and provides the DFIG with driving torque. The value of mechanical power is given by,

$Pm\ 0: 5Cp\pi r2\rho V^3_w$(1)

Here r and Vw are the radius and wind speed of the wind turbine corresponding. In the proposed system, the rated power of the generator is 15 kW for a rated wind speed of 12 m/s. Stator and rotor in DFIG is an external current. The DFIG clearance (Pag) rating is correlated with ignoring losses at maximum wind speed. Threated electrical power of the unit is equal to the maximum power of the entrance is assumed to be an air gap. When the wind turbine is in operation, RSC provides all required magnetization power of system. Therefore, the required DFIG power is sufficient to convert 15 kW of wind energy into electricity.

$Pe=Pag / (1+|S_{pmax}|)$ (2)

the poles of the load and stator are linked by a zigzag transformer to the LSC, which is also neutral for single-phase loads on the 415 V side. The voltage on the LV side of the zigzag is also selected is Vrmax. Therefore, the transformer is fixed to the stator and load voltage ratio 415/125 V as well as its HV winding. The internal resistance Rin connected in series may be suspected as a DC power supply having a capacitor Cb. Furthermore, another RB resistance is connected to the battery for the self-relaxation of the battery. The cell (NC) number in the system is based on DC voltage and open cell voltage VOCC. NC VDCM = VOCCð3þ RC filters in the stator connection are used to minimize voltage waves and lower than the fundamental frequency. In addition, half of the switching frequency needs to match.

Table 1: Technical details of solar block.

Open circuit voltage of PV cell, Vocc	0.64 V
Open circuit voltage of a module (voc)	23.04V
MPP voltage of PV cell, Vmpc	0.5223V
MPP voltage of module (Vmp)	18.83V
Short circuit current of module (Isc)	8.69A
MPP current of module (Imp)	8.04A
A Module Power Rating µIsc µVoc	151Wp
Pv modules in the solar block	0.04%/oC
String open circuit voltage (SOCV)	-0.36%/oC
	11 strings each are having 9 PV modules
	207.36V

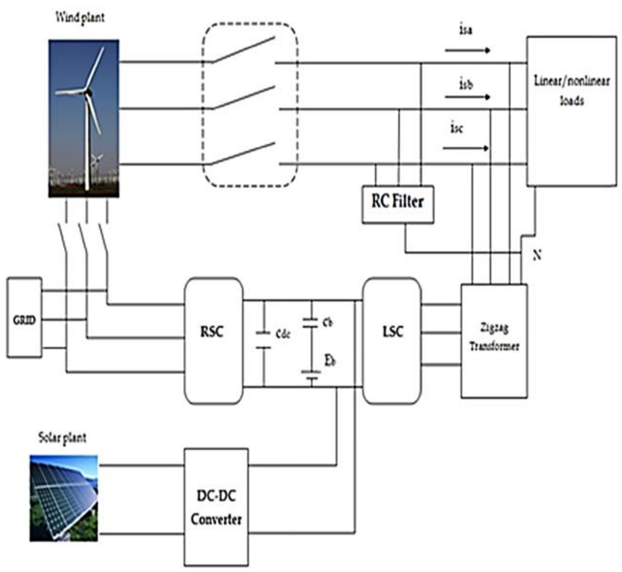

Figure 1: Schematic diagram of a hybrid microgrid of renewable energy sources

III. CONTROL STRATEGY

DC-DC converter for solar energy extraction with integrated SMPPT logic for incremental conductance solar converters. SMPPT controls us by intelligently switching to MPP while the solar system is in operation. Onshore wind turbines generate only 60-70% of the time to be able to operate when wind is not available. The control strategy is shown in Figure 2. I*qs consists of two elements. When the wind turbine is up, the first component, iqs1, corresponds to DFIG's current power component. The second part iqs2 used when the DFIG stator is not connected to the load terminal. DC I*ds refer to the demand for reactive power at the end where the generator and filter are interconnected. The I*qs and I*ds values provide a current reference stator and help maintain voltage and frequency during indirect vector control, as described below.

$I^*_{ds}=I_{ds(k-1)}+K_{pv}(v_{err(k)}-v_{err(k-1)})+K_{iv}v_{err(k)}dt$ (3)

$I^*_{qs}=I^*_{qs1}+I^*_{qs2}$ (4)

The RSC regulates the turbine pace in order that the gadget operates withinside the MPP. It additionally materials the magnetizing energy to the generator. The manipulate concept proven in Figure three consists of the orthogonal manipulate the direct rotor thing currents Iqr, Idr, and transition perspective h slip. The Idr is attached to the gadget`s magnetization electricity with the aid of using Field Oriented Vector Control (FOVC). Kp and Ki are proportional to the included benefit of the PI pace controller. Those adjustments the wind pace putting to house MPP and allows to regulate for voltage spikes while call for is low and manufacturing is high. From the 2 relays k1 and k2, the cost of okay is calculated.

$\theta_{slip}=\int_0^t (w_e^* - (\frac{p}{2})w_r)dt$

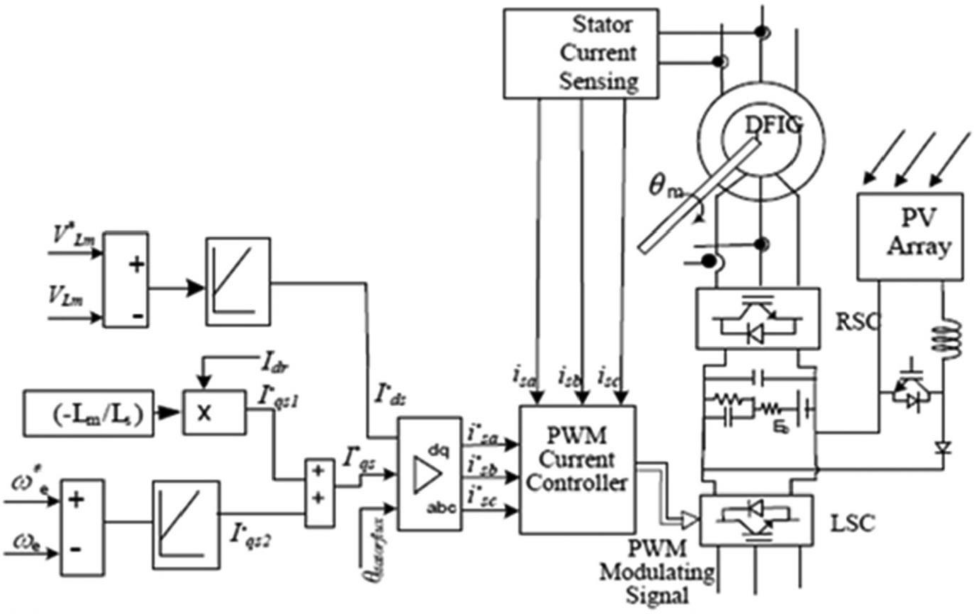

Figure 2: Control strategy of LSC

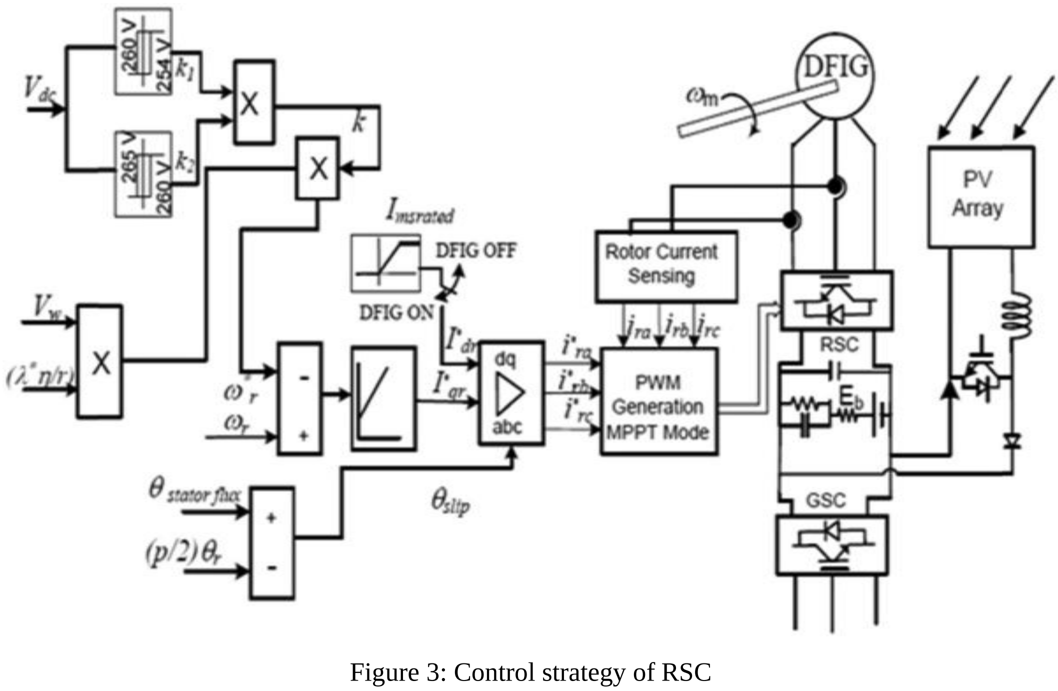

Figure 3: Control strategy of RSC

IV. SIMULATION RESULTS

Case-A: System performance at cut in and cut out of wind power

10kW and 6kVAR loads are given without starting, as shown in Figure 4.Any source of wind or solar energy. The wind power generator operates at a wind speed of 7 m / s at t = 0.05 s. This will result in Device voltage that fluctuates for a short time. Turbine wind at t = 0.5 seconds Velocity increases from 7 m / s to 8 m / s, followed by wind speed It decreases in t = 1.0 seconds. Rotor control operation remains optimal Rotational speed according to the WMPPT algorithm. Or Wind turbines shut down in t = 1.4 seconds.

Case-B: System performances at cut in and cut out of solar power

The device boots without wind or solar energy10kW and 6kVAR loads. As shown in Fig. 5, we use a solar system that irradiates 800 W / m2 at t = 0.05 s. Illuminance from t = 0.34s increased to 900W / m2, t = 0.52s ~ 800W / m2. The solar system turns off in t = 1.08 seconds. At each transition point. Significant changes in device voltage are observed.

Case-C: System performances at unbalanced and nonlinear load

Unbalanced nonlinear tool performance may be visible in Fig.6. In order to offer the unbalanced nonlinear load, the micro-grid have to be sufficient. The load is related to a linear power of two kW and a non-linear electricity of eight kW. At t = 3.25 s, a-section load will be eliminated from the community and the b-section load at t = 3. forty-six is eliminated. The consequences display that withinside the occasion of uneven, as well as nonlinear load the tool can offer best electricity to its customers.

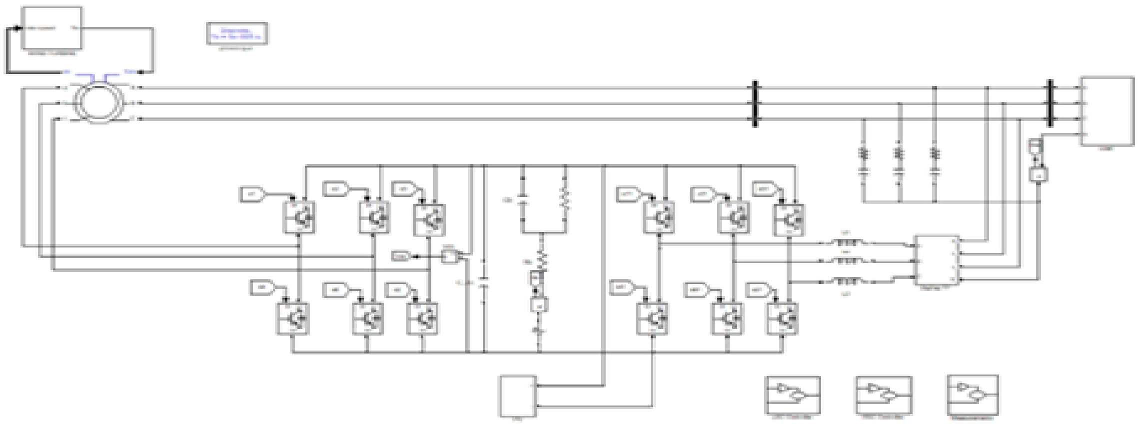

Figure 4: Performance of a system at constant load and cut-in and cut-out of wind power

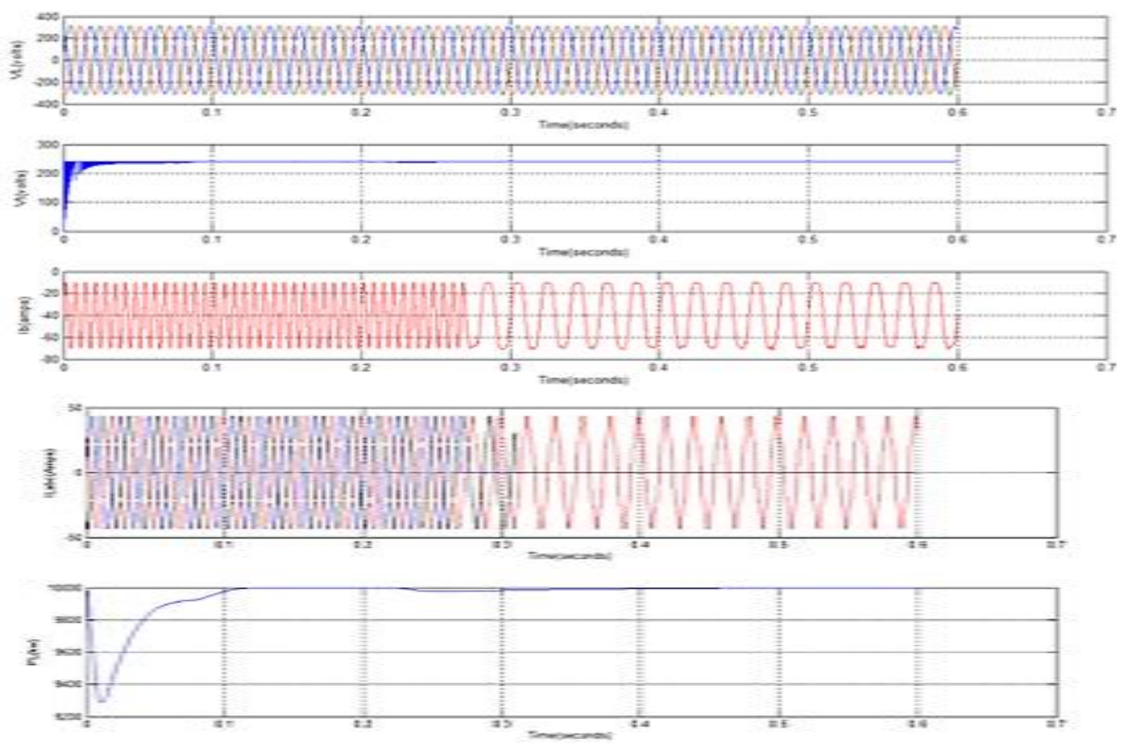

Figure 5: System performance at unbalanced and non-linear load

V. CONCLUSION

The proposed REGS microgrid system proved to be satisfactory. It is in a remote location with few household load requirements. REGS includes wind and solar blocks designed for harvesting, supplying electricity for consumers in parallel maximum energy from renewable energy sources. Completely automatic operation of the device is planned. The study also shows the sizes of the key components. About changing the input condition of various load profile types was the output of the system presented. Power quality stays within reasonable limits all conditions of the load terminal. MATLAB / SIMULINK results method reliability.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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