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A NOVEL MICROGRID BASED DIESEL ENGINE PV HYBRID SYSTEM WITH POWER QUALITY USING SPACE VECTOR PULSE WIDTH MODULATION

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ABSTRACT

This project presents a secluded micro grid, with the synchronous generator(SG) based on diesel generator structure in combination with Solar PV. The DG supplies power to the load directly, and a battery maintained voltage source converter (VSC) is related in shunt at point of common coupling (PCC). The PV array is related at DC-link of the VSC through a boost converter. A Space Vector Pulse width modulation (SVPWM) is the best computational control technique because it provides less Total harmonic Distortions (THD). It minimize switching losses. At high shifting frequencies svpwm gives better results also provides greater overall performance as well as efficiency. MATLAB/Simulink based simulation results shows satisfactory execution of the given system.

1. INTRODUCTION

Consuming of petroleum derivatives for creating power has been a noteworthy reason for a worldwide temperature alteration [1]. In this way, specialists have been searching for elective hotspots for power generation, which are supportable & condition neighborly [2]. Additionally, nations are working towards influencing their entire vehicle to armada & power creation divisions free of consuming petroleum derivatives [3]. This has prompted ascend in renewable based energy framework, for example, PV, wind, hydro, biomass, sea warm energy, tidal energy, & so on. Of late, renewable energy based microgrids are winding up progressively well known to supply power to urban, country or remote zones. Such framework can be worked with or without grid [4]. These sources are long-lasting & make no mischief the earth, be that as it may, their variable & fluctuating nature makes the assignment of incorporating them a genuine test [5]. This offers ascend to the need of wise controllers which can manage the voltage, current & frequency of the system if there should arise an occurrence of essence/nonappearance of grid or linear/nonlinear load or unbalance in the

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three-phase framework, & henceforth, make the system more steady, solid & secure.

2. DESCRIPTION OF PV (PHOTOVOLTAIC) CELL

A photovoltaic device, moreover sun PV electricity device, or PV gadget, is a strength device meant to deliver usable solar strength with the aid of PV. It contains of a plan of some components, together with solar panels to ingest & trade over sunlight into power, a sun inverter to change the electric cutting-edge from DC to AC, & moreover mounting, cabling & other electric assistants to installation a running system. It would possibly likewise utilize a sun monitoring system to decorate the machine's fashionable execution & contain a coordinated battery association, as charges for garage gadgets are relied upon to say no. Entirely, a sun array just envelops the outfit of sun panels, the obvious piece of the PV gadget, & does exclude the diverse device, often condensed as adjust of system (BOS).In addition, PV framework change over mild directly into electricity & should not be wrong for unique improvements, for instance, focused solar strength or solar heat, used for warming & cooling.These days, solar PV modules represent not as a whole lot as half of the system's well known fee, leaving the relaxation to the remaining BOS-components & to sensitive costs, which contain customer procurement, allowing, examination & interconnection, status quo paintings & financing charges.

Fig.1: solar farm

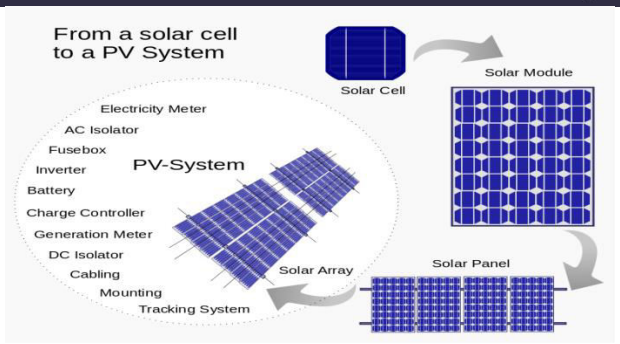

Fig.2:Diagram of the possible components of a photovoltaic system

3. SYNCHRONOUS MACHINE

Basic Operation of the Synchronous Machine:

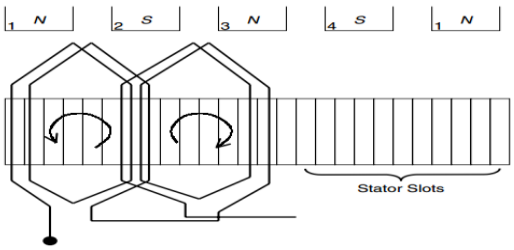

Fig.3: "Developed" view of a 4-pole stator, displaying the slots, the poles, and a phase of the winding.

The segment shown is of one of the three stages. It may be effectively visible that the winding runs clockwise beneath a north pole, and counterclockwise under a south pole. This sample repeats itself until the winding covers the four poles. A comparable pattern is accompanied through the other levels, but positioned at 120 electric stages aside.

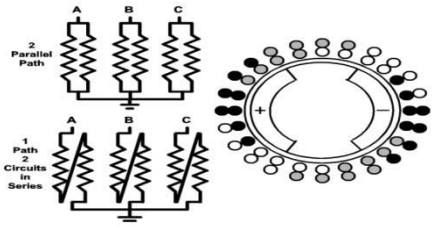

Fig.4: Schematic view of a two-pole generator with possible winding configurations

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GENERATOR OPERATION

We should accept that the machine is running at no load and a positive torque is connected to the pole; that is, the rotor transition edge is progressed in front of the stator motion point. As on account of motor operation, the stator currents will change to make the new states of harmony appeared in Figure 4, under generator. In the event that the machine is at first under excited, condition (an) in Figure above. Then again, if the machine is overexcited, condition in Figure above results.

Equivalent Circuit:

When handling 3-phase adjusted circuit, electrical architects utilize the only-line or single-line portrayal. This development is allowed in mild of the reality that in 3-segment adjusted Circuit, all currents and voltages, and moreover circuit additives are symmetrical. Along those strains, "appearing" only a single segment, it's far attainable to talk to the three-section gadget, insofar as care is taken in making use of the high-quality possible elements. For example, the three-phase adjusted system of Figure above may be spoken to as appeared in Figure underneath. Hereinafter, at the same time as portraying a three-segment generator by an electrical diagram, the only-line method may be connected.

The maximum helpful approach to determine the execution traits of synchronous machines is by using similar Circuit.

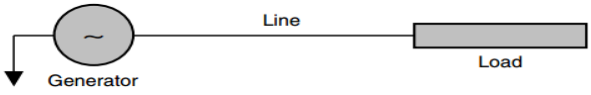

Fig 5: One-line representation of circuit shown in Figure above

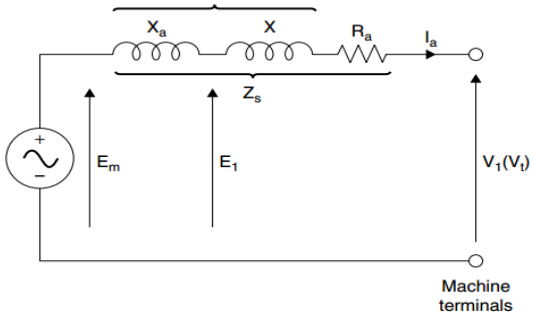

Fig6: Steady-state equivalent circuit of a synchronous device.

X = leakage reactance, Xa = armature response reactance, Xs = Xa + X = synchronous reactance, Ra = armature resistance, Zs = synchronous impedance, V1(Vt) = terminal Vtg, and Em = magnetizing voltage.

Can turn out to be extraordinarily complicated whilst saturation, armature reaction, harmonic reactance, and other nonlinear affects are provided. In any case, the rearranged circuit in Figure is beneficial for acquiring the essential execution attributes of the gadget underneath steady-country conditions.In Figure over the reactance Xa speaks to the polarizing or demagnetizing impact of the stator windings on the rotor. It is additionally called the charging reactance. R a speaks to the compelling opposition of the stator. The reactance X speaks to the stator leakage reactance. The entirety of Xa and X is used to speak to the total reactance of the machine, and is known as the synchronous reactance (Xs). Zs is the synchronous impedance of the machine. Remember that the proportional circuit portrayed in Figure above speaks to the machine just under steady-state condition. The basic identical circuit of Figure above gets the job done to decide the steady-state execution parameters of the synchronous machine associated with

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a power grid. These parameters incorporate voltages, currents, power factor, and load edge (see Fig. below). The regulation of the machine can be effectively found from the proportional circuit for various load conditions by utilizing the regulation equation:

$$\Re(\%) = 100 \times V_{no-load} - V_{load} / V_{load}$$

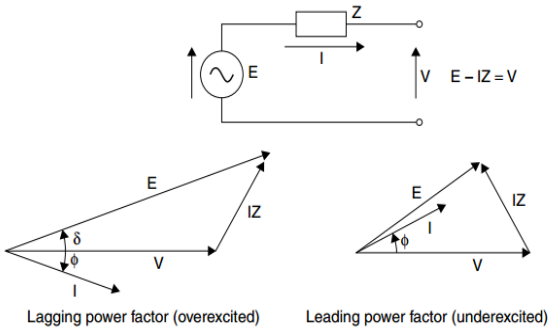

Fig7: Steady-state equivalent circuit and vector diagram in generator operation

4. DIESEL GENERATOR

A diesel generator is the combination of a diesel motor with an electric generator (frequently an alternator) to create electrical energy. This is a particular instance of motor generator. A diesel pressure start motor is generally intended to keep running on diesel fuel, yet a few sorts are adjusted for other fluid energizes or gaseous petrol.

Diesel creating sets are used as a part of spots without association with a power grid, or as crisis power-supply if the grid flops, and in addition for more perplexing applications, for example, crest hacking, grid support and fare to the power grid.

Appropriate estimating of diesel generators is critical to stay away from low-load or a lack of power. Measuring is convoluted by the qualities of current electronics, particularly non-linear loads. In size ranges around 50 MW or more, an open cycle gas turbine is more proficient at full load than an array of diesel engines, and unquestionably minimal, with tantamount capital expenses; however for general part-loading, even at these power levels, diesel arrays are sometimes wanted to open cycle gas turbines, because of their unrivaled efficiencies.

5. SPACE VECTOR PWM

The Space Vector PWM era module accepts modulation index instructions and generates the perfect gate force waveforms for each PWM cycle. This segment describes the operation and configuration of the SVPWM module.A three-phase 2-level inverter with dc link configuration can have eight conceivable switching states, which produces output voltage of the inverter. Every inverter switching state produces a voltage Space Vector (V1 to V6 active vectors, V7 and V8 zero voltage vectors) shown in fig:8. The extent of every active vector (V1to V6) is 2/3 Vdc (dc bus voltage).The Space Vector PWM (SVPWM) module inputs modulation index instructions (U_Alpha and U_Beta) which are orthogonal signals (Alpha and Beta) as proven in Figure. The gain function of the SVPWM module is given in Figure . The vertical axis of Figure represents the normalized peak motor segment voltage (V/Vdc) and the horizontal axis represents the normalized modulation index (M).The inverter essential line-to-line Rms output voltage (Vline) can be approximated (linear variety) with the aid of the following equation:

$$Vline = Umag * Mod\_Scl * Vdc / \sqrt{6} / 2^{25} \quad \text{.....(1)}$$

Where dc bus voltage (Vdc) is in volts

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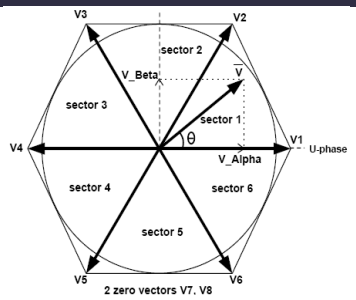


fig.8: Space Vector Diagram

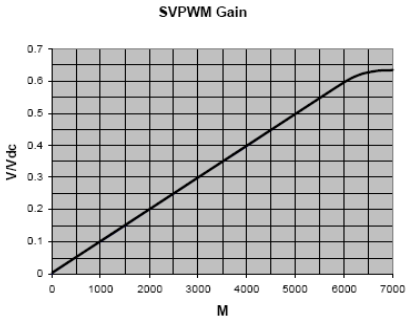


fig.9: Transfer Characteristics

The maximum achievable tweak (Umag_L) in the linear working reach is given by:

$$Umag\_L = 2^{25} * \sqrt{3} / Mod\_Scl$$

…….. (2)

Over change happens when alteration Umag>Umag_L. This identifies with the condition where the voltage vector in (Figure: voltage vector rescaling)increases past as far as possible. Under such condition, the Space Vector PWM figuring will rescale the significance of the voltage vector to fit inside beyond what many would consider possible. The significance of the voltage vector is restricted inside the Hexagon; in any case, the phase point (θ) is constantly shielded. The transfer get (Figure: transfer qualities) of the PWM modulator reduces and advances toward getting to be non-linear in the over adjust locale.

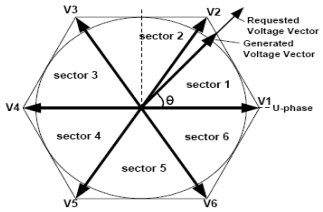


Fig.10 :space vector diagram

6.SYSTEM DESIGN AND MODELING

This circuit depics the configuration of the system. PV system is supplying power to the nonlinear loads. The battery is associated directly at the DC-link. A SG based DG is associated at PCC if there is an occurrence of low or non appearance of insolation.

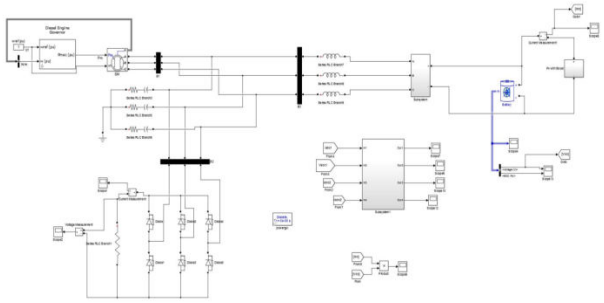
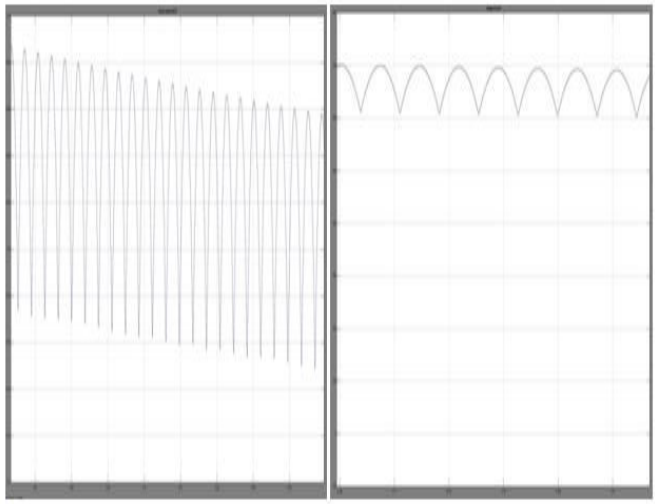


Fig 11: system design



Current in series with R voltage across R

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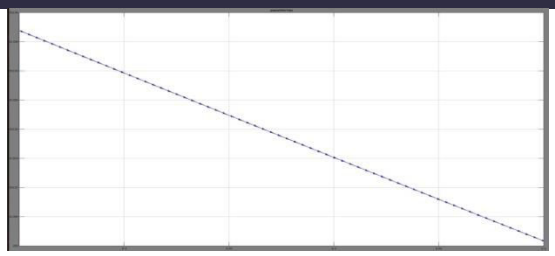


Simulation waveform of power

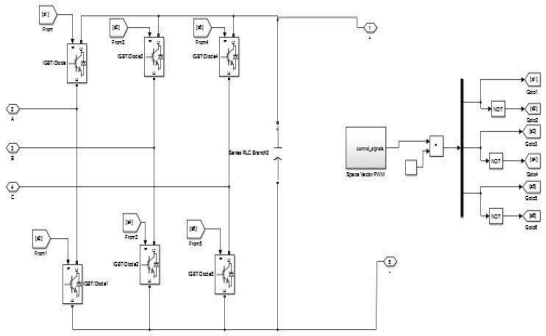
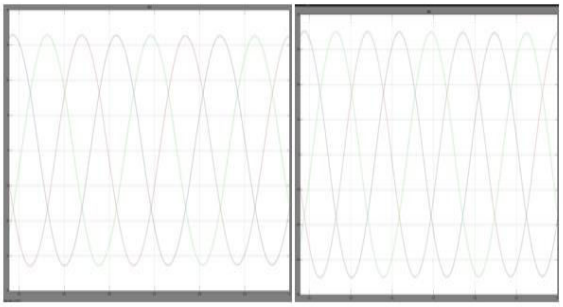
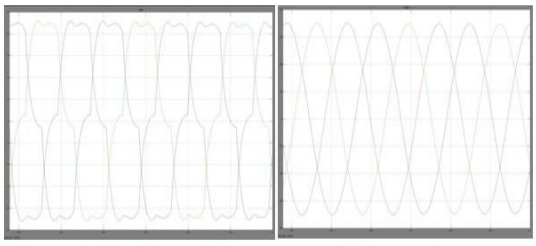


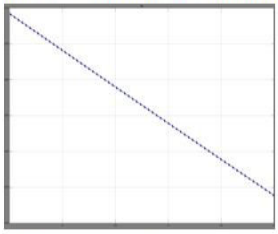
Fig 12: space vector modulation circuit



Simulation waveform of synchronous current (Iabc1) and synchronous voltage(Vabc1) of 3phase svpwm



Simulation waveform of synchronous current (Iabc2) and synchronous voltage (Vabc2) of 3phase svpwm



simulation waveform of Idc

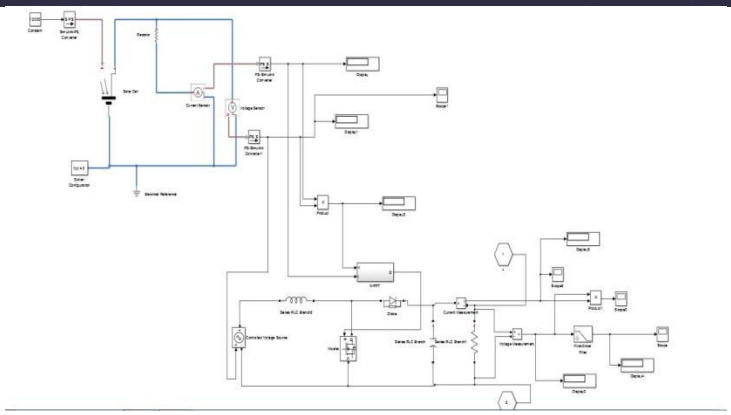


Fig 13: pv with boost converter

simulation waveform of pv voltage and current

6. CONCLUSION

A SG based DG and PV hybrid micro-grid has been exhibited here, with a battery supported VSC associated at PCC. Three-phase adaptive control is used for power quality improvement through VSC.A boost converter connects solar panel , dc link of VSC and executes the mppt for pv array. As power supplied by the array is not always constant & fluctuating in nature. Then mppt is utilized to track the maximum power through photo voltaic cell furthermore supplied when deserved.Space vector pulse width modulation (svpwm) is the best computational control technique because it provides less Total Harmonic Distortions (THD) . It minimize switching losses.

At high shifting frequencies svpwm gives better results. Here provides greater overall

performance and efficiency. The given system and control have been mimicked in MATLAB/Simulink condition and results show their satisfactory execution in both steady state and dynamic conditions.

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