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TRANSIENT STABILITY ANALYSIS IN MICROGRID

[1]M.Hema, [2]K. Sathish Kumar,

[1]PG Student, Priyadarshini Engineering College, Vaniyambadi

[2]Asst professor, Priyadarshini Engineering College, Vaniyambadi.

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ABSTRACT

The use of distributed generation in microgrid systems is becoming a popular way to provide a reliable source of electricity to critical loads. Inverters and synchronous generators in islanded micro-grids exhibit poor transient load sharing where the inverter initially picks up the majority of any load step. The emulator basically consists in a voltage source inverter with a second order output filter which voltage references are given by the model of the diesel generator. The generating voltage is low level but the current rating is high so the loss became very high because of that the generating ac power convert into dc then the dc convert into ac by seven level inverter. So the current ratting getting low and voltage is normal value because of that the loss should be reduced and also the frequency and voltage also the effectiveness of the proposed strategy is shown by means of simulation results.

1. INTRODUCTION

Most microgrid research focuses on inverter based micro-grids. This is in part because many new types of distributed generation (DG) interface to the grid through power electronic converters, such as wind, photovoltaic's (PV), micro turbines, fuel cells, and energy storage. However, synchronous generators are the most common type of DG [1], and are what industry is comfortable with. Thus, synchronous generators are expected to play a major role in microgrid installations. This research focuses on micro-grids with both synchronous generators and inverters.

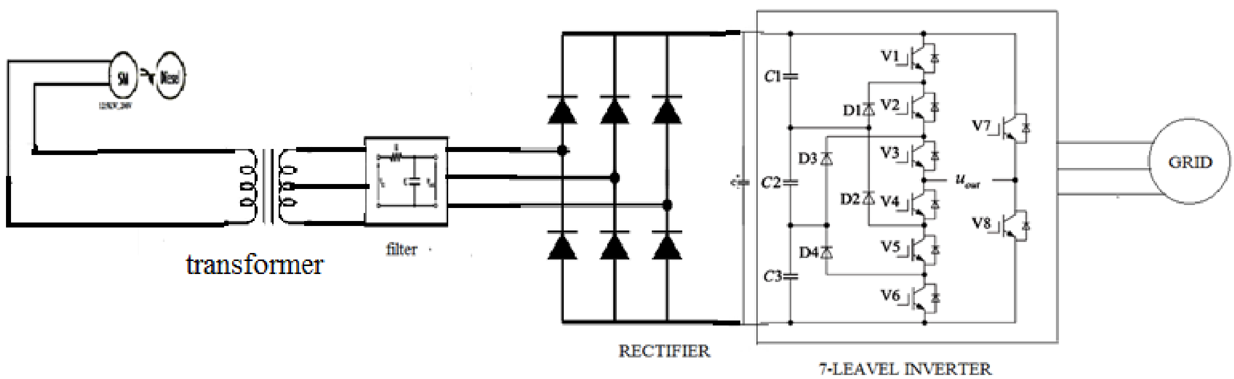
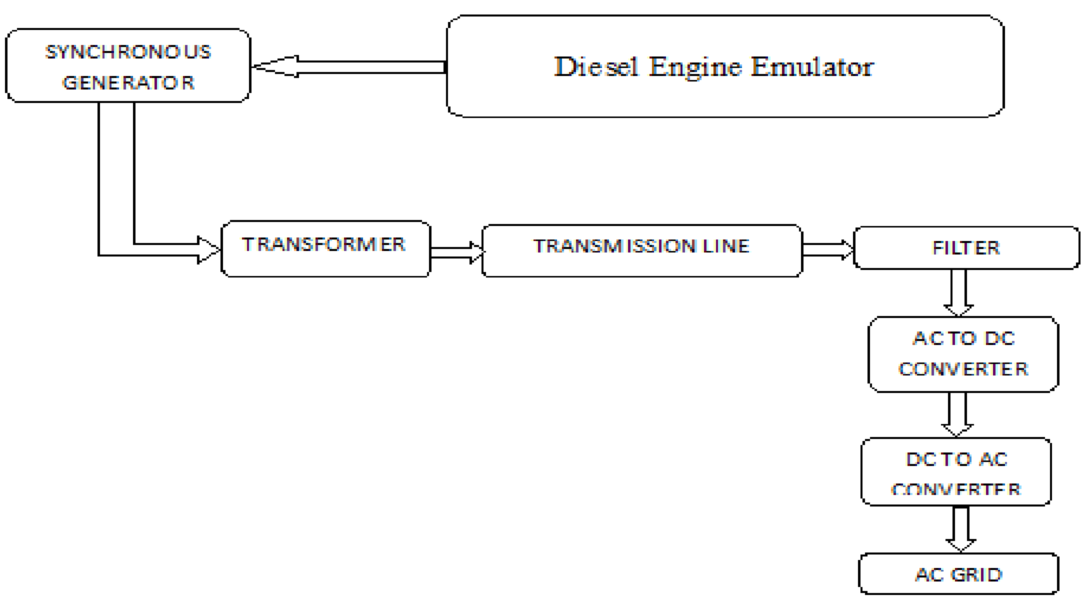


Fig.1 proposed circuit diagram

In order to improve the transient sharing, the inverter must allow the voltage and frequency to 'swing.' Any method that improves the transient sharing will do so at the expense of increased voltage and frequency dip. Increasing the inverter's droop slope would allow the inverter frequency and voltage to dip further, thus causing the generator to pick up more of the load transiently. However, changing the droop slope would alter the steady state power sharing. This leads to the idea of a transient droop, where the inverter frequency and voltage are allowed to dip further during a transient, but restore to the nominal (proportional) droop in steady state.

2. BLOCK DIAGRAM



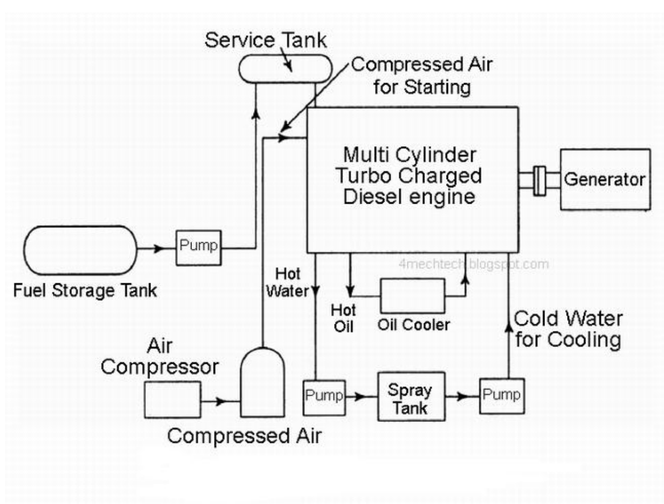
Fg.2.General block diagram

Inverters with grid-supporting-grid-forming control voltage controlled inverters where the voltage and frequency references are given by droop, have the advantage of being able to operate in any mode: grid-connected or islanded with or without other inverters or generators. Grid-supporting-grid-forming control avoids the need to transition from grid-feeding to grid-forming control mode when switching from grid-connected to islanded operation, or when the synchronous generator switches offline. Avoiding control mode transitions is beneficial, because experience suggests that most problems occur during mode transitions. Voltage controlled inverters require energy storage in order to be able to respond quickly to load changes, and using batteries for energy storage is common. Grid-supporting-grid-forming inverters and synchronous generators in islanded microgrids exhibit poor transient load sharing where the inverter initially picks up the majority of any load step [6-8]. This poor transient load sharing constrains the inverter rating relative to the largest load step, increases strain on the inverter, and negatively impacts battery life in battery energy storage inverters.

3. MODULE DESCRIPTION

A. DIESEL ENGINE

A diesel engine is a type of internal combustion engine. In this simulation the engine block used to generate the rotating movement. This simulation block can be done by control system components. The output of diesel engine is given to the one of the input of synchronous generator. For generating electrical power, it is essential to rotate the rotor of an alternator by means of a prime mover. The prime mover can be driven by different methods. Using diesel engine as prime mover is one of the popular methods of generating power.



Fg.3.Diesel engine

When prime mover of the alternators is diesel engine, the power station is called **diesel power station.** The mechanical power required for driving alternator comes from combustion of diesel. Diesel power plants are also popularly used as standby supply of different industries, commercial complexes, hospitals, etc. During power cut, these diesel power generators are run to fulfill required demand.

B. SYNCHRONOUS GENERATOR

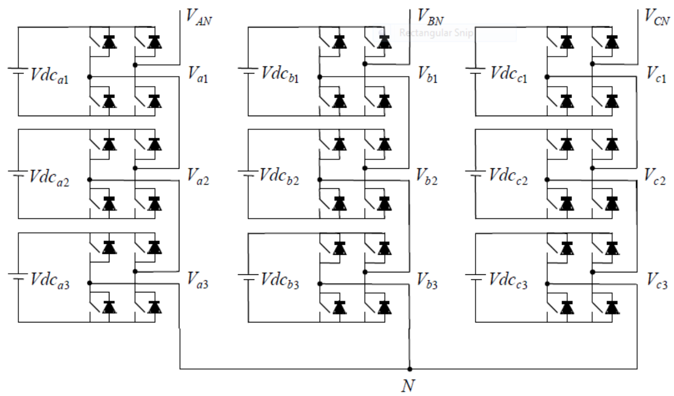
Synchronous generators are the majority source of commercial electrical energy. They are commonly used to convert the mechanical power output of steam turbines, gas turbines, reciprocating engines and hydro turbines into electrical power for the grid. Main parts of the alternator, obviously, consist of stator and rotor. But, the unlike other machines, in most of the alternators, field exciters are rotating and the armature coil is stationary. In Stator Unlike in DC machine stator of an alternator is not meant to serve path for magnetic flux. Instead, the stator is used for holding armature winding. The stator core is made up of lamination of steel alloys or magnetic iron, to minimize the eddy current losses. In rotor (i) Salient and (ii) cylindrical type Salient pole type: Salient pole type rotor is used in low and medium speed alternators. Construction of AC generator of salient pole type rotor is shown in the figure above. This type of rotor consists of large number of projected poles (called salient poles), bolted on a magnetic wheel. These poles are also laminated to minimize the eddy current losses. Alternators featuring this type of rotor are large in diameters and short in axial length. Cylindrical type: Cylindrical type rotors are used in high speed alternators, especially in turbo alternators. This type of rotor consists of a smooth and solid steel cylinder having slots along its outer periphery. Field windings are placed in these slots. The DC supply is given to the rotor winding through the slip rings and brushes arrangement. According to the Faraday's law of electromagnetic induction, whenever a conductor moves in a magnetic field EMF gets induced across the conductor. If the close path is provided to the conductor, induced emf causes current to flow in the circuit.

C. RECTIFIER

The synchronous generator output is low voltage but the current rating is high so that the losses is very high, because of that the output of the synchronous generator output should be convert the dc power through the rectifier. In this the diode is used to convert the dc power for that we here minimize the current ratting.

D. SEVEN LEVEL INVERTER

The 7-level multilevel inverter topology is introduced incorporating the least number of unidirectional switches and gate trigger circuitry, thereby ensuring the minimum switching losses, reducing size and installation cost. The new topology is well suited for drives and renewable energy applications. The performance quality in terms of THD and switching losses of the new MLI is compared with conventional cascaded MLI and other existing 7-level reduced switch topologies using carrier-based PWM techniques.



Fg.4.Seven Level Inverter

Nowadays, multilevel inverters become more and more attractive and have obtained expansive foreground not only in the field of the high-voltage and huge-power system. But also in the low-voltage and small-power system, such as the photovoltaic generation system. Various multilevel topologies have been proposed over the recent years. Common ones are cascaded H-bridge, flying capacitor, and diode-clamped. Furthermore, asymmetrical topologies consisted of two kinds of half-bridge legs with different level numbers are presented. Compared with the symmetrical topologies, the asymmetrical ones significantly reduce the number of the power switches on the premise of obtaining the same level number of the output voltages. The reduction of the amount of power switches means that the overall loss, cost, and bulk can be further reduced. However, multilevel pulse width modulation (PWM) strategies such as the multicarrier-based multilevel sinusoidal PWM (SPWM), the selective harmonic elimination PWM, and the voltage space-vector PWM are difficult to be implemented only with a digital signal processor (DSP). In and, the multilevel SPWMs are implemented with the DSP + complex programmable logic device or DSP + field programmable gate array (FPGA) platforms. The attached controller increases the cost and decreases the reliability as well. A single-carrier and multi-modulation-wave (MW)-based multilevel SPWM (SCMM-SPWM) strategy is proposed in and. However, this kind of SPWM uses the same waveforms in the positive and negative half cycles of the MWs; in the negative half cycle, the compare logics between the MWs and the carrier need to be inversed against the positive ones to implement overall multilevel output PWM waveforms. The DSP can only implement the same compare logic in the positive half cycle and the negative one; thus, the attached digital logic circuits and dead-time generation circuit or controllers are still needed to switch the control signals of various power switches. In the low-voltage and small-power system, e.g., in the photovoltaic grid-connected generation system, some control algorithms, including the grid current close-loop control, the maximum power point tracking control of the photovoltaic cells, and the dc link voltage close-loop control, are all needed to be performed. If some kind of multilevel PWM strategy suitable for being implemented with a DSP is developed, all of the former control algorithms and the multilevel PWM strategies can be performed with only one DSP chip; thus, the FPGA or the logic circuit is no longer indispensable. Unfortunately, none of the presented multilevel PWM strategies can be implemented only with a DSP if without any modification. This paper proposed a seven-level SCMM-SPWM strategy based on MW reversed during negative half cycle. Furthermore, the reason for generating the zero-crossing voltage pulse disturbance (ZCVPD) in SCMM-SPWM is analyzed, and the elimination is proposed. Finally, the spectral characters of the single-carrier and multi-MW-based multilevel SPWM, including the conventional and proposed ones, are originally derived and are compared with each other by simulation. The proposed SCMM-SPWM has the following advantages. The cancelation of the attached logic circuit or controller makes the implementation platform more concise and cheaper and also indirectly improves reliability. As a result, the competitiveness of the multilevel inverters against the two-level ones applied in the field of the low-voltage and small-power system is further enhanced. A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. For a three-phase system, the output of three identical structure of single-phase cascaded inverter can be connected in either wye or delta configuration. A V_{AN} is voltage of phase A, which is the sum of Va1, Va2, and Va3. The same idea is applied to phase B and phase C. To synthesize seven-level phase voltage, three firing angles are required. The same three switching angles can be used in all three phase with delaying 0, 120, and 240 electrical degree for phase A, B, and C, respectively. The advantage of three-phase system is that all triple harmonic components in the line voltage will be eliminated by one-third cycle phase shift feature. Therefore, only non-triple harmonic components need to be eliminated from phase voltage. In single-phase nine-level waveform, for example, the 3rd, 5th, and 7th harmonics will be eliminated from output phase voltage. Compared to single-phase inverter, in three-phase nine-level inverter, the 5th, 7th, and 11th harmonics will be eliminated from output phase voltage. Thus, the 9th harmonic is the lowest harmonic component in phase voltage in single phase system, while the 13th harmonic is the lowest harmonic component appearing in line voltage of three-phase system.

4. RESULT ANALYSIS

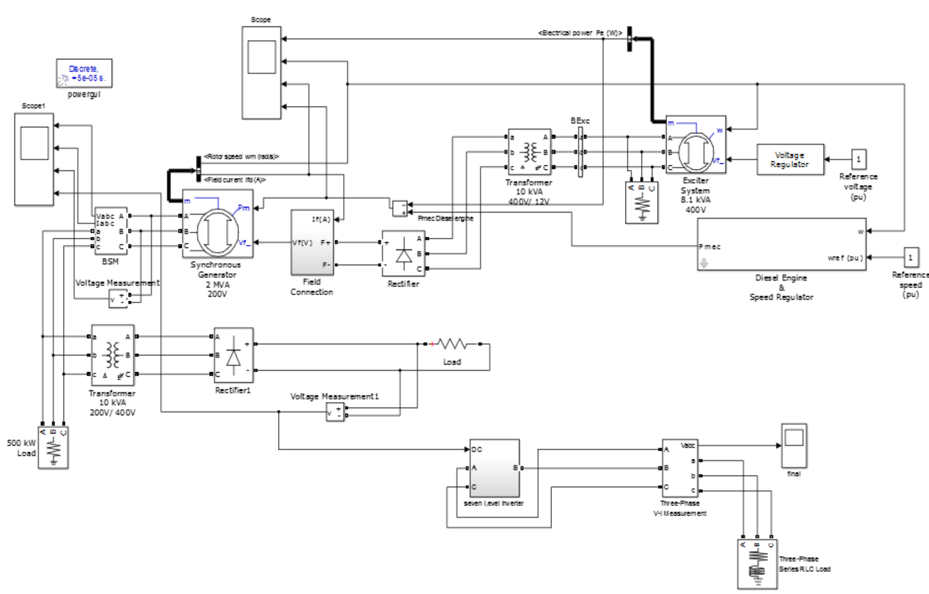


Fig.5. Simulation Diagram

In figure 5, 6, 7 and 8 shows the simulation diagram and graph of the seven level inverter transient stability analyses. In the graph results shows the exact output waves of the converter.The simulation and experimental results confirm to verify the feasibility of the proposed converter. The simulation and output waveform s are done by MATLAB software.

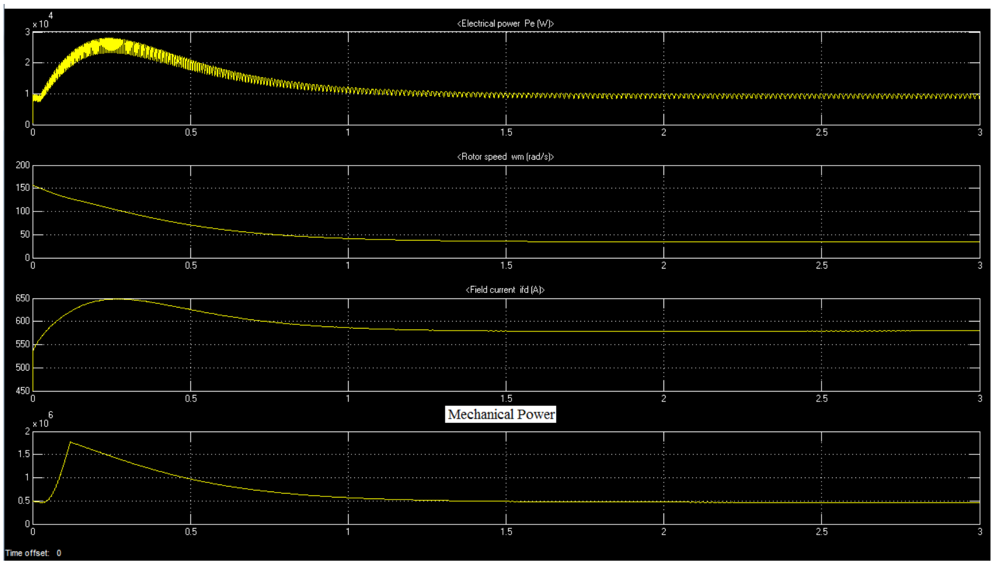


Fig.6. Simulation Graph

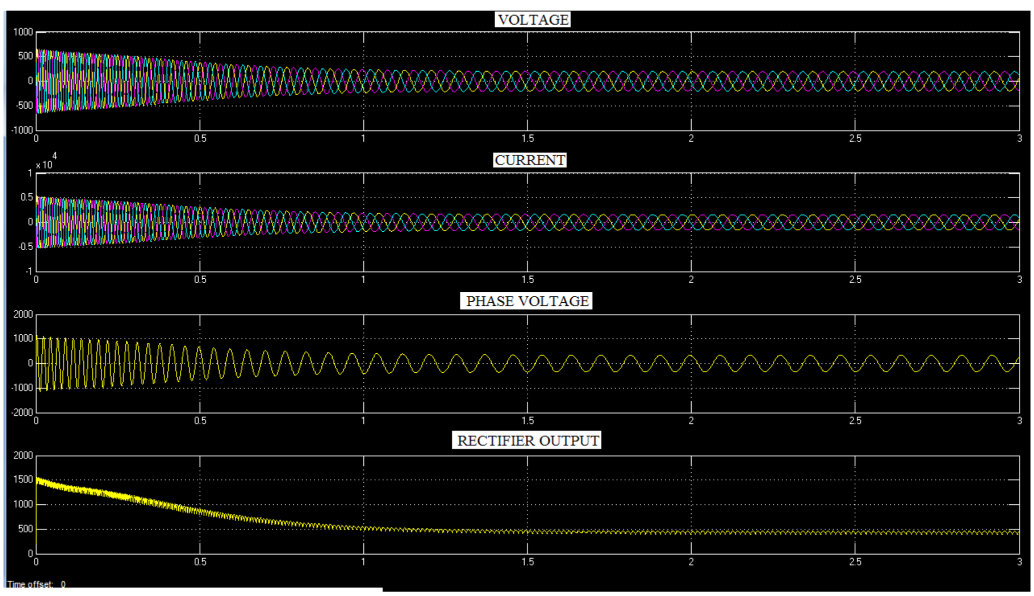


Fig.7. Simulation Graph

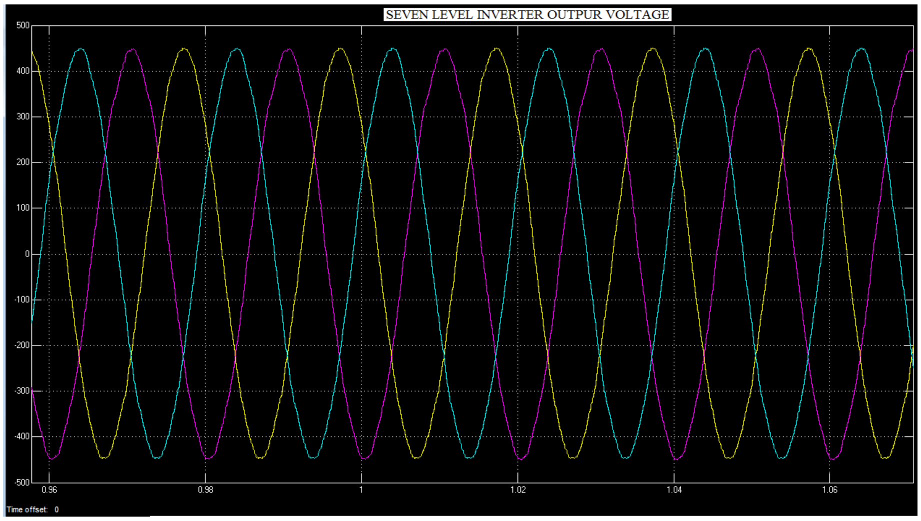


Fig.8. Simulation Graph

CONCLUSION

An improved control strategy for a droop controlled grid connected inverter has been presented. The transient response has been improved by measuring the average power using the integration method rather than using the traditional low pass filter. The seven level inverter has been found to improve the grid disturbance rejection and thus improve the output current THD. A small signal model based on transfer function approach has been developed to aid the controller design. The controller effectiveness has been validated by simulation and experiments.

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