Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 2, 2020

Review Article

HYSTERESIS CURRENT CONTROLLER BASED SHUNT ACTIVE POWER FILTER FOR POWER QUALITY IMPROVEMENT IN SYNCHRONOUS GENERATOR

[1]Ch. Samyuktha, [2]G. Mounika, [3]Jarupula Somlal, [4]D. Seshi Reddy

[1,2] UG Student, [3]Professor, [4]Associate Professor

[1,2,3,4] Department of EEE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A.P, India

Received:17.11.2019 *Revised: 07.12.2019* *Accepted: 27.01.2020*

Abstract
Active power filters are used to improve the quality of power and are normally connected to standard coupling(PCC) in parallel with the load. These are used to compensate for the harmonic structure of nonlinear loads to compensate for reactive energy and to balance main current. The result of using active power filter is to improve the quality of output power of simplified synchronous generator with distorted EMF back. To recreate active power filter and proposed generator, a Simulink mat lab for design for improved synchronous generator is being worked out. The results of the simulation of the active power filter will show significant changes in the output current of the generator and reduced THD in the process

Keywords: Power Quality, Hysteresis current controller, synchronous generator, shunt active power filter

DOI: http://dx.doi.org/10.31838/jcr.07.02.68

INTRODUCTION

The active power filters were used to enhance the quality of the power[2]. At the rising coupling point, they are connected parallel to the charge. The principal functions of the APF are to compensate for nonlinear load harmonics, balanced source currents and reactive power compensation [3]. In [4]-[6] The APF is utilized on account of mutilated key voltages, and the outcomes demonstrated a high limit in these papers for the proposed control procedures to evacuate and adjust the music in source current, paying little mind to the heap state and source voltage.

The Active Power Filter(APF) are usually utilized for standard single generators to build their dynamic execution, where the APF utilizes its own synchronous generator bolstering a nonlinear charge to diminish the present music and terminal voltages in the generator. The APF is mainly used to vary voltage for synchronous generator with different velocity for nonlinear load by controlling reactive power compensation for harmonics. Mechanical and electrical influence of synchronous generator will be cleared and apparent. Electrical impact will at last give twisted flow and voltage waveform in stator and rotor giving huge measure of warmth and loss of generator by diminishing force converter power productivity.

Specifically, this paper targets growing and supporting the use of dynamic force channels with synchronous generators. The generators are less snared by making them snappier and more affordable.They want higher basic EMF and can therefore generate more powerThe simplified generator designs often generate considerably more harmonics and therefore external methods to reduce the losses of excitation and thus improve efficiency; from this case, the active power filter is used for decreasing these and protect the amount of harmonics at charge remains constant.The extra costs that the implementation of The practical advantages that can be obtained can be decreasing by the APF. By the above Direct advantages of augmenting generator limit and lessening development expenses and intricacy The APF likewise found numerous utilizations in improving the generator's transient reaction and its ride-through limit;just as the capacity to permit the decreased force three stage yield under fault conditions.

The active power filter is used to increase quality of power which supplies to load or to decrease harmonics from load when the load is linear as well as it increases generator current.

SYSTEM CONFIGURATION

The system has four leg active power filter, L-channel interface and load which are linear, nonlinear and balanced load in three phase four wire system
Fig.1shows the proposed device block diagram.

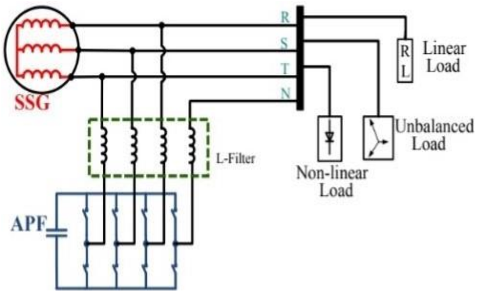

Fig.1 Block diagram of the proposed system

The commercial generator has 48 slots and two layer winding and have coils which are associated in arrangement called stator coil connection as shown in Fig.1

In this system the neutral wire will be take away to protect load form current harmonics. To single phase loads the converter(APF) must provide a load side neutral.

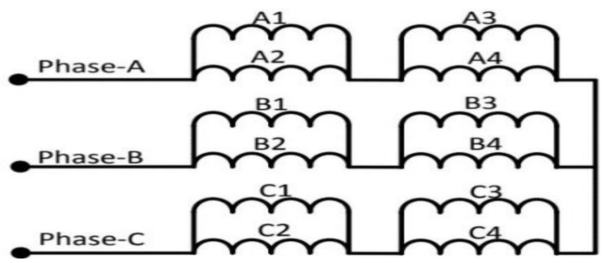

Fig.2 stator coil connection diagram

HARMONIC COMPENSATION

The active power filter is power electronic segment of the proposed system, and relies upon a voltage source inverter at this moment). APF's ability right presently to compensate for the load and network current harmonics.

ACTIVE POWER FILTER TOPOLOGY

Right now four wire framework it has four leg dynamic force channel where unbiased wire is associated with fourth wire. Four leg was picked to diminish DC interface size by diminishing the evaluated current. however, four leg dynamic force channel has just a single capacitor with midpoint and two voltages will equivalent to one another

DESIGN OF CONTROLLER

Templates of the utility grid voltage (Va, Vb, Vc) and the grid synchronizing angle are created using the phase locked loop (PLL).

$$Va = \sin\theta \quad (1)$$

$$Vb = \sin(\theta - \frac{2\pi}{3}) \quad (2)$$

$$Vc = (\theta + \frac{2\pi}{3}) \quad (3)$$

The contrast between the genuine voltage of the DC association and the reference DC interface voltage gives the mistake of the DC contact voltage. To keep up steady DC interfacing voltage, this blunder is given to PI controller.

$$Vdc\ error = Vdc * -Vdc \quad (4)$$

The reference grid currents are calculated as

$$Ia *= Im * Va \quad (5)$$

$$Ib *= Im * Vb \quad (6)$$

$$Ic *= Im * Vc \quad (7)$$

Where Im is the multiplication of active current component.

The reference neutral current as the grid is considered as zero.

$$In *= 0 \quad (8)$$

The error currents in a system is calculated by comparing the reference grid current and actual grid currents.

$$Ia\ error = Ia * -Ia \quad (9)$$

$$Ib\ error = Ib * -Ia \quad (10)$$

$$Ic\ error = Ic * -Ic \quad (11)$$

Hysteresis controller is given these error flows to create the switching pulses for the inverter interfacing the network.

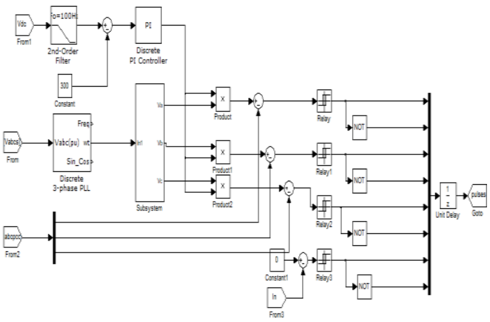

Fig.3 Design of hysteresis controller

SIMULATION RESULTS AND DISCUSSION

In Fig.1 the simulation was conducted for the system with interface filter and various load types. The simulation time was 5sec in all simulations, with the APF enabled and t=0.5sec providing a remove indication of framework conduct with and without the Active Power Filter(APF). The current grid, load, and Active power filter(APF) waveforms were analyzed.

A 3 phase 4 wire grid interfaced DC system is connected to verify the proposed control approach. A 4 leg voltage source inverter is controlled to accomplish a reasonable grid current with unity power factor.

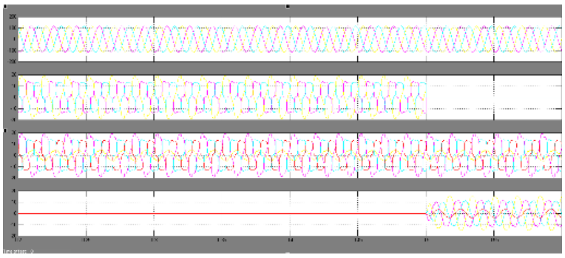

Fig.4 grid voltage, current at the point of common coupling, neutral current, line current and inverter current

The Fig.4 shows

a) grid voltage
b) current at the point of common coupling,
c)neutral current, line current
d)inverter current.

Fig.4 shows the waveforms of grid voltages (Va, Vb, Vc), network current (Ia, Ib, Ic, In) unbalanced load flows (Ila, Ilb, Ilc, Iln) and inverter current (Iinva, Iinvb, Iinvc, Iinvn)

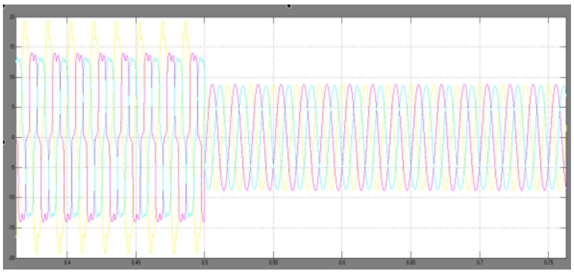

Fig.5 Grid current

x-axis= time
y-axis=amps

The grid is not attached to the network in the first place. Hence the grid current profile is shown in the above figure 3 before t=0.5 sec. The grid interfacing the inverter to the network is connected at t=0.5sec. The inverter will begin injecting the current .In such a way that the grid current profile begins to change from nonlinear unbalanced to balanced sinusoidal currents as shown in Fig.5

As the inverter supplies the load unbiased current interest, the grid neutral current(In) gets zero after t=0.5sec.

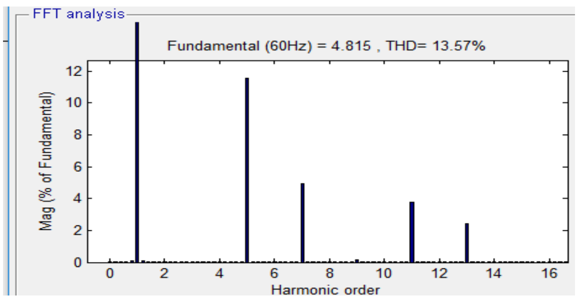

Fig.6 FFT analysis before activating the APF

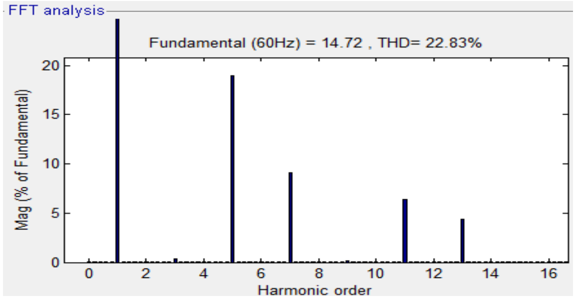

Fig.7 FFT analysis after activating the APF

Table.1 Shows simulation results for the THD and current values before and after activating the APF

Before enabling the Active power filter(APF)	After enabling the Active power filter(APF)
THD%	THD%
13.57	22.83

CONCLUSION

The result of utilizing an APF (Active power filter) in order to recompense the simplified synchronous generator's poor harmonic output has been examined by simulation. Upon validating the output results of simulation shown that the APF could be unified with an improved synchronous generator to come up with a tolerable level of power to the load through simple generator from a low quality output waveform at PCC. Hence, successfully this system was able to pull off an adequate level of power as far as THD. But, for the systems like micro grids which requires more restricted THD values this proposed system THD can be increased by utilizing an LCL-interface filter as a substitute in the place of L-filter, making use of some other types of controllers or by switching the frequency more than 10KHz.

The unconventionality of this work is to make use of APF in order to reduce the complexity in designing the simple synchronous generator, this can increase the capacity of the generator and/or efficiency and further more permitting the most simplified design or system which can be of both high speed in generating accurate outputs by maintaining a suitable power quality level at the load and also that is of low cost. This system is fitting for the utilization of slots concentrated windings.

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