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Power Quality Improvement Using Two Level Voltage Source Inverter

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ABSTRACT: This paper reviews standard of the power quality with the causes and effects of harmonics in a power system and thus presents about improving the power quality using two level voltage source inverter. It comprises of a shunt dynamic channel and tuned inactive channels associated in parallel with the non-linear burden that are associated with ac supply. The two TPFs are intended to suck up fifth and seventh symphonious flows with the guideline of arrangement reverberation and remunerate balance symphonious. The STATCOM produces remuneration current (i_f) equivalent to symphonious burden current (i_{lh}) in inverse stage to and infuses it to the coupling point via interfacing inductor. In this manner source current (i_s) is required to be sinusoidal as well as in stage with source potential to get most extreme power factor. The STATCOM is a combination of VSI and capacitor associated on DC terminal and function as capacity component.

KEYWORDS*:* STATCOM, Harmonics, MATLAB.

I. INTRODUCTION

The three-stage Shunt compound APF configuration for symphonious mitigation in low and medium control dissemination frameworks comprises of VSI based three stage shunt dynamic channel and tuned inactive channels associated in parallel with the heap. This section examines the modelling of shunt dynamic channel considering the plan of channel interfacing inductor, DC capacitor, tuned inactive channels. The examination of synchronous reference outline hypothesis to assess the remuneration reference flow and hysteresis flow controller for exchanging signal production in STATCOM is also exhibited. Further the operating principle of asymmetric cascaded multilevel inverter used as STATCOM in medium voltage power distribution system and modulation strategy of MLI is also presented.

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II. OBJECTIVES OF THE PROPOSED WORK

The proposed work is undertaken in order to find a solution to overcome the drawbacks of existing methods

1. To design and develop a multilevel inverter based Active filter for the three- phase power system.
2. To achieve improvement in reactive power and current distortion elimination.
3. To enhance the DC bus voltage regulation capacity of a Shunt Active Power Filter (SAPF) with the proposed scheme.

III. LITERATURE SURVEY

Many technical studies are being done in power quality management by making use of power electronic devices for performance improvement some of which are discussed below.

Avik Bhattacharya et al [2012] et al presented a hybrid double inverter topology for the application of Active power filtering. They had used two inverters which operated in parallel with dissimilar switching frequency. Each inverter (hybrid APF) had a series combination of LC filter. The inverters eliminates, harmonics. The drawback of this system was high switching loss.

Renjun Dian et al [2016] designed a three phase, shunt active power filter based on a H-bridge three-level converter. The DC-link voltage control method is used to reduce the fluctuations. The ill effect of the negative sequence of load current was eliminated by, a proposed dual-dq axis harmonic detection algorithm implemented in this method. The current was unstable here.

IV. EXISTING SYSTEM

This project presents an innovative smart PV inverter control as STATCOM (PVSTATCOM) for obviating the need for a physically connected STATCOM in a distribution network for controlling steady state voltage and temporary over voltages (TOVs) resulting from unsymmetrical faults. Two 10 MW PV solar systems are already connected in the distribution feeder of a utility in Ontario, Canada. A STATCOM is installed to prevent the steady-state voltage and TOV issues arising from the connection of a third 10 MW PV solar farm at same bus. It is demonstrated from PSCAD electromagnetic transient studies that if the proposed PV-STATCOM control is implemented on the incoming third 10 MW PV solar farm, all the above voltage issues are mitigated satisfactorily as required by the utility Grid Code. This proposed smart inverter PV-STATCOM control therefore eliminates the need for the physical STATCOM, saving an enormous cost for utilities dealing with voltage rise and TOV issues with grid connected PV systems. Such a control can effectively increase the Distributed Generator hosting capacity of distribution feeders at more than an order of magnitude lower cost under similar network conditions. Moreover, this novel grid support functionality can open new revenue making opportunities for PV solar farms.

The real power generation from a solar farm on a sunny day and the remaining unutilized invertercapacity over a 24-hour period is depicted in Fig. 4.1. The operating modes of the proposed PV-STATCOM aredescribed below:

i) Full PV mode: The PV solar farm operates at unity power factor with no reactive power control.

ii) Partial STATCOM Mode: The inverter capacity remaining after active power production is utilized for dynamic reactive power control as STATCOM.

iii) Full STATCOM mode: During a power system disturbance or fault in the day, when the need for reactive power support is high, the solar farm temporarily (for typically less than a minute) reduces its real power output to zero by varying the voltage across the solar panels. It further makes its entire inverter capacity available for dynamic reactive power control as STATCOM. After the grid support need is fulfilled, the solar farm returns to its pre-disturbance power output.

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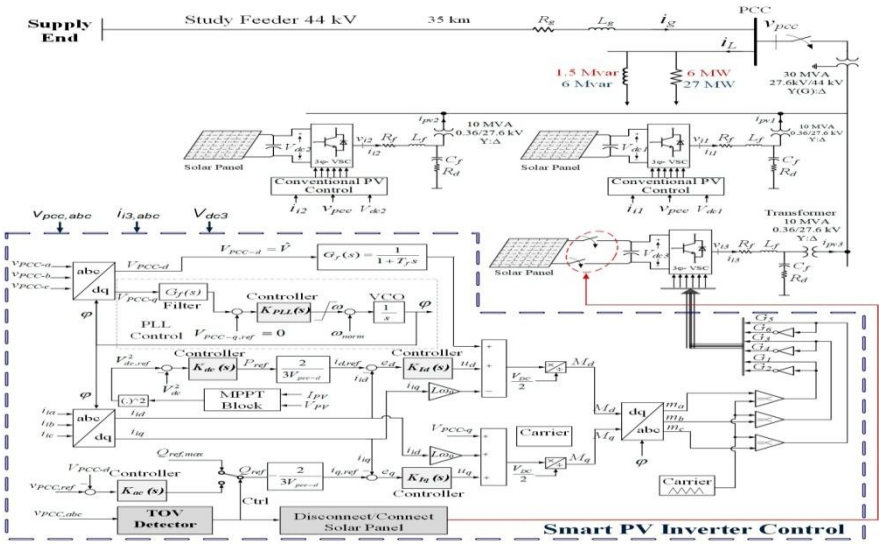

Fig 4.1 Existing system topology

The Full STATCOM mode can be activated at any time during the day depending upon system need. As an example, this Full-STATCOM mode is depicted by the thin rectangle around 8 am in Fig.3.1. The width of the rectangle is less than a minute but is shown over an exaggerated time period of an hour, just for ease of understanding.

V. PROPOSED SYSTEM

The activity of the shunt crossover APF is outlined in figure 5.1. It comprises of a shunt dynamic channel and tuned inactive channels associated in parallel with the non linear burden that are associated with ac supply. The two TPFs are intended to suck up fifth and seventh symphonious flows with the guideline of arrangement reverberation and remunerate balance symphonious. The STATCOM produces remuneration current (i_f) equivalent to symphonious burden current (i_{lh}) in inverse stage to and infuses it to the coupling point via interfacing inductor. In this manner source current (i_s) is required to be sinusoidal as well as in stage with source potential to get most extreme power factor. The STATCOM is a combination of VSI and capacitor associated on DC terminal and function as capacity component.

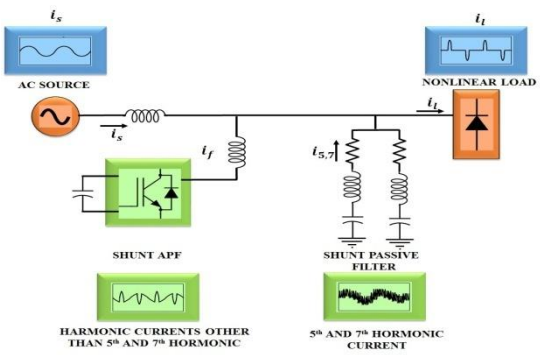

Fig. 5.1
(Operation of the proposed Shunt Hybrid A)

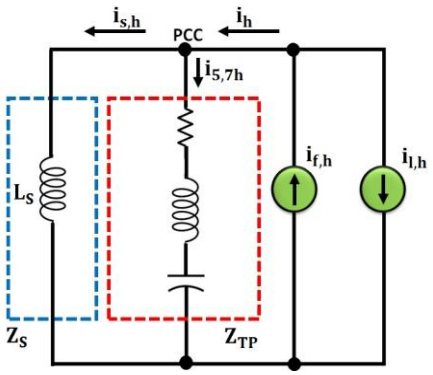

Fig. 5.2
(Model of the proposed shunt hybrid APF)

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Figure 5.2 depicts an equivalent circuit of the proposed shunt cross breed APF for symphonious separating, here ZTP is the comparable impedance of TPF and Zs is the proportional impedance of dispersion source thought to be a straightforward inductor (Ls). The shunt APF is expected to go about as a perfect flow supply which delivers the pay flow that pursues the pay flow reference, while the non-linear burden is treated as symphonious flows supply. This is on the grounds that the supply potential is expected to contain just the essential recurrence part.

VI. SIMULATION RESULTS AND DISCUSSION

SIMULATION PARAMETERS

Voltage Source **:** 415 V L-L,50 Hz.

Source resistance **:** 0.06 m. Ohm

Source inductance : 2 μH

Nonlinear Load : Three-Phase rectifier with R-L load

The proposed work has verified using MATLAB simulation, the figure shows the Simulink model of D-Q theory-based Shunt active power filter.

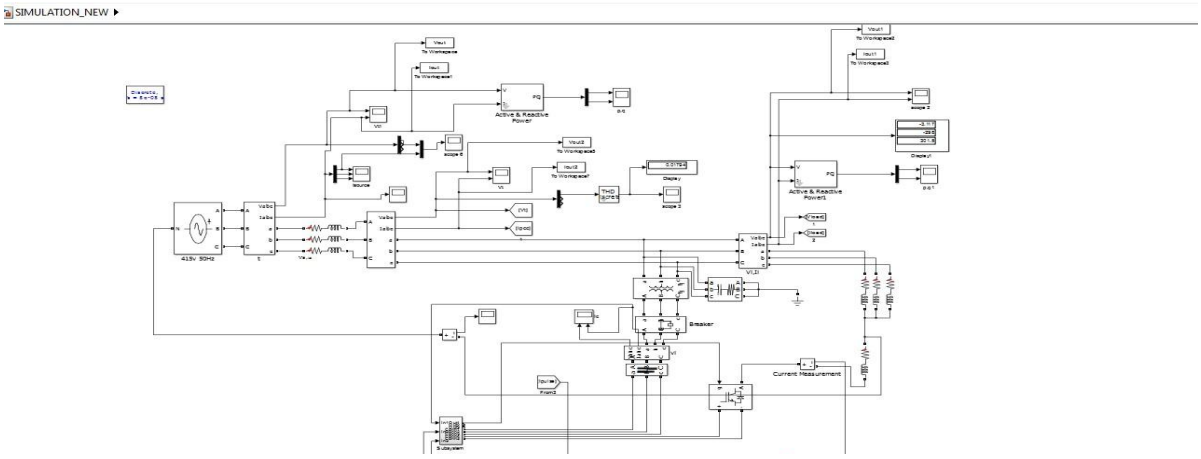

Fig 6.1 Simulink diagram for two level inverter based STATCOM

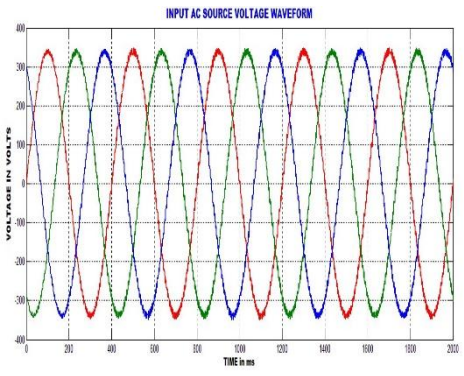

Fig 6.2

Three phase Source voltage waveform

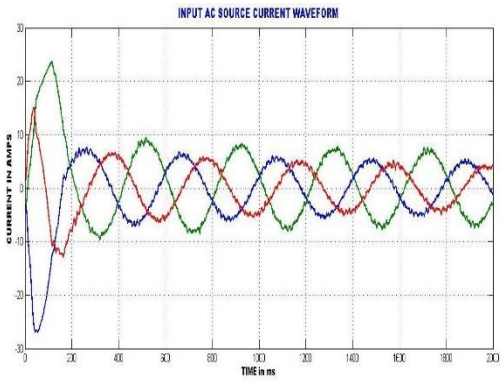

Fig 6.3

Three phase Source current waveform

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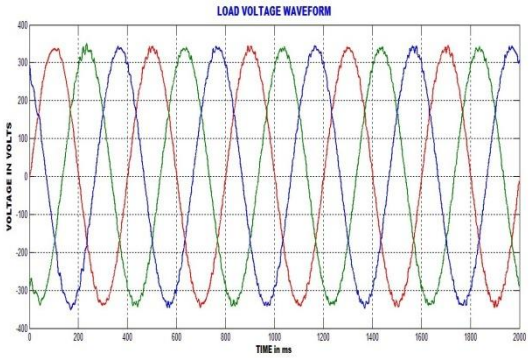
The figure 6.2 shows three phase ac source voltage waveform, which is supplied to the linear as well as nonlinear load, due to nonlinear load voltage has affected by harmonics, these harmonics is reduced byproposed two level inverter-based shunt active power filter.

The figure 6.3 shows source current waveforms, due to lens law back emf from load is heavily affects the source voltage and current, in order to rectify the problems proposed reference current theory is used. This theory-based hysteresis current controller reduces the source current harmonics.



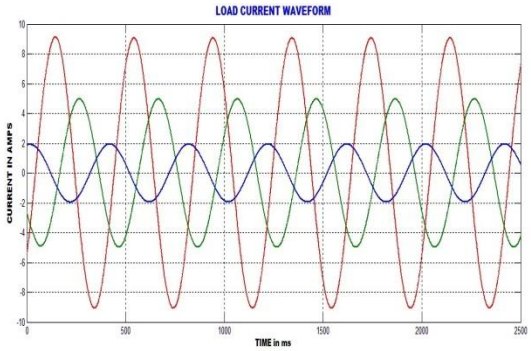


Fig 6.14 **Fig 6.15**

Three phase load voltage waveformThree phase load current waveform

Figure 6.14 shows three phase AC voltage waveform, the nonlinear load-based power quality problems are solved by proposed D-Q theory and Fuzzy logic controllers.

Figure 6.15 shows three phase AC current waveform, the power quality problems were reduced by hysteresis current controllers. The output load current seems as pure sinusoidal nature. Hence this system reduces the source voltage and current THD.

VII. CONCLUSION AND FUTURE SCOPES

A STATCOM topology using two level inverter was presented in this project. The main aim of this work is to mitigate the harmonic effect caused by non-linear loads in this system. The proposed systems operations were verified in MATLAB simulation. A hybrid algorithm which uses SRF concepts were used for the generation of current reference for the proposed systems control. The THD result for the proposed system was less than 5 % which is much lesser than the IEEE THD standards. Thus, the effective harmonic cancellation capability of the proposed SAPF system was verified.

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