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Original Research Article

COMPARISON OF ACTIVE AND PASSIVE FILTER IMPROVEMENT OF POWER QUALITY IN THREE PHASE AC SYSTEM

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Abstract: Comparison of Active and Passive Filter Improvement of Power Quality in Three Phase Ac System a Power System Harmonics Voltage Stability and Power Quality Improvement a coordinated control of power line the increasing of nonlinear loads in utility line, harmonic problem has been concerned ever more than before. Those nonlinear loads, such as diode rectifiers, thyristor converters and some electronic circuits, on industrial, commercial and residential equipments, active power filters operate as a controllable current source. Passive filters are consisted of tuned series L-C circuits. These filters should be applied as close as possible to the off ending loads, preferably at the farthest three phase point of distribution. The necessity to deliver cost effective energy in the power market has become a major concern in this emerging technology era. Therefore, establishing a desired power condition at the given points are best achieved using power controllers such as the well-known High Voltage Direct Current (HVDC) and Flexible Alternating Current Transmission System.

Keywords *:* Active and Passive Filter, HVDC, tuned series L-C circuits.

1.0 Introduction

One of the major concerns in electricity industry today is power quality problems to sensitive loads. Harmonics are one of the major concerns in a power system. In this paper presents on the power quality conditioner to enhance the electric power quality at distribution levels. This is intended to present a broad overview on the different possible. Power quality is very important term that embraces all aspects associated with amplitude, phase and frequency of the voltage and current waveform existing in a power circuit. Any problem manifested in voltage, current or frequency deviation that results in failure of the customer equipment is known as power quality problem. Passive filters are consisted of tuned series L-C circuits. These filters should be applied as close as possible to the offending loads, preferably at the farthest

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three to single phase point of distribution. This will ensure maximum protection for the upstream system, passive filters can be categorized as shunt and series filters. A shunt filter is characterized as a series resonant and trap-type exhibiting low impedance at its tuned frequency. Deployed close to the source of distortion, this filter keeps the harmonic currents out of the supply system. It also provides some smoothing of the load voltage. A series filter is characterized as a parallel resonant and blocking type with high impedance at its tuned frequency. It is not very common because the load can be distorted. Use the passive shunt filter to controls the propagation of harmonic currents. The increasing number of power electronics based equipment has produced a significant impact on the quality of electric power supply. The lack of quality power can cause loss of production, damage of Equipment or appliances, increased power losses, interference with communication lines.Harmonics cause distortion in current and voltage waveforms resulting into deterioration of the power system. The transmission and distribution of electrical energy started with direct current (DC) in the late 19th century, but it was inefficient due to the power loss in conductors. Alternating current (AC) offered much better efficiency, since it could easily be transformed to higher voltages, with far less loss of power. AC technology was soon accepted as the only feasible technology for generation, transmission and distribution of electrical energy. However, high-voltage AC transmission development of a technology for DC transmissions as a supplement to the AC transmissions. The invention of mercury arc rectifiers and the thyristor valves made the design and development of line commutated current sourced converters possible High Voltage Direct Current (HVDC).

2.0 Active Filter

The low voltage power distribution system of interest consists of a three phase, sinusoidal AC voltage source The source inductor is considered rectifier with R-L load is selected as the nonlinear load interfacing inductor provides isolation from the distribution line. A large interfacing inductor is preferable in small switching ripple. However, [1] the large interfacing inductor limits the dynamic response of the compensation current. Therefore, there is a compromise involved in sizing the interfacing inductor. This DC-bus capacitor as the supply source and switches at high-frequency to generates a compensation current that follows the estimated reference current. Therefore the voltage across the DC-bus capacitor (Vdc) must be maintained at a constant value that is higher than the amplitude of the source voltage.

3.0 Passive Filters

Passive filters are consisted of tuned series L-C circuits. These filters should be applied as close as possible to the offending loads, preferably at the farthest three phase point of distribution. This will ensure maximum protection for the upstream system, passive filters can be categorized as shunt and series filters. A shunt filter is characterized as a series resonant and trap-type exhibiting low impedance at its tuned frequency. Deployed close to the source of distortion, this filter keeps the harmonic currents out of the supply system. It also provides some smoothing of the load voltage. A series filter is characterized as a parallel resonant and blocking type with high impedance at its tuned frequency. It is not very common uses the passive filter to control the propagation of harmonic currents.

3.1 Voltage harmonics in power systems

Nonlinear loads drawing no sinusoidal currents from three-phase sinusoidal voltages are classified into identified and unidentified loads. High-power diode or thyristor rectifiers, cyclo converters, and arc furnaces are typically characterized as identified harmonic producing loads, because electric power utilities identify the individual nonlinear loads installed by high-power consumers on power distribution systems in many cases. Each of these loads produces a large amount of harmonic current. The utilities

can determine the point of common coupling (PCC) of high-power consumers who install their own harmonic producing loads on power distribution systems. Moreover, they
can determine the amount of harmonic current drawn by an individual consumer. A "single" low-power diode rectifier produces a negligible amount of harmonic current if it is compared with the system total current. However, multiple low-power diode rectifiers can produce a significant amount of harmonics into the power distribution system. A low-power diode rectifier used as a utility interface in an electric appliance is typically considered as an unidentified harmonic-producing load. So far, less attention has been paid to unidentified loads than identified loads. Harmonic regulations or guidelines such as
are currently applied to keep current and voltage harmonic levels in check. The final goal of the regulations or guidelines is to promote better practices in both power systems and equipment design at the minimum social cost.

3.2 Improvement of power quality

This enables the operation of heavy industry such as steelworks and mines without violation of power quality requirements, without the need of reinforcing the grid just to meet power quality demands and without causing nuisance to other consumers in the grid. Other cases of growing importance are dynamic balancing of unsymmetrical loads emanating from high speed traction fed from AC grids, and conditioning of in feed from wind power. As a current example, the case recently commissioned for mitigation of voltage flicker

3.3 Increasing of voltage stability

This enables a maximizing of system availability as well as power transmission capability over existing as well as new lines. In other words, more power can be transmitted over existing lines, with a saving of money as well as of environmental impact of the power link.

3.4 HVDC Technology Overview: HVDC is a power transmission system that uses DC instead of AC as a means to transmit bulk power; DC is a constant current while AC alternates polarity at a targeted frequency. AC power is the standard format for end-point usage in the United States. Power is delivered to homes, businesses, and industries as AC, and most electrically powered devices are designed to operate from AC power. In contrast, electrical appliances that do not plug into a wall socket are generally powered by DC. For example, batteries generate DC power; common examples include flashlights, smoke detectors, and other battery-powered household devices. During the initial development of AC and DC power in the 1890's, the two standards were in competition for widespread deployment, a situation that came to be known as the "War of Currents". The history of the dominance of AC instead of DC power is discussed in greater detail in One of the practical reasons that AC won the "War of Currents" over DC is the ease and low cost with which power can be stepped down from high-voltage transmission lines and reduced to the desired end point voltage at delivery using simple AC transformers. High-voltage transmission is used to reduce line loss. During power transmission there is always some line loss, which is an electrical analog to mechanical friction. The amount of line loss is given by:

PLOSS = (PTRAN2R) / V2

Where *PLOSS* is the power loss in the transmission line, *R* is the electrical resistance of the line, and *V* is the voltage. *PTRAN* is fixed by the usage demands of the community. *R* is a property of the wire. While *R* can be improved by material selection and by using larger diameter wires, it can only be improved incrementally. The most effective way to reduce line loss is to use high voltages. Line losses decrease in proportion to voltage squared, so if the value of *V* doubles, the line loss decreases by one fourth, and so on. Thus, high-voltage transmission is necessary to keep losses from becoming prohibitively high. Both AC and DC transmission over long distances use very high voltages, typically on the order of 100s of kVs. At greater distances, DC transmission generally has lower overall losses than AC transmission at comparable voltages. This is because when an alternating current is present, the inductance (*L*) and capacitance (*C*) of the wires becomes nontrivial. Inductance refers to a conductor's accumulation of a voltage when a change in current is applied. Capacitance is the ability of a conductor to store static electric charge when a voltage is applied. In an AC circuit, the cycling currents and voltages result in the line having impedance which includes both real (resistance) and reactive (inductance and capacitance) components yielding real and reactive power loss, respectively.

3.5 Power Quality Improvement in AC –DC-System

Power electronic devices are non-linear loads that create harmonic distortion and can be susceptible to voltage dips if not adequately protected. [2] The most common economically damaging power quality problem encountered involves the use of variable-speed drives. Variable-speed motor drives or inverters are highly susceptible to voltage dip disturbances and cause particular problems in industrial processes where loss of mechanical synchronism is an issue. Three-Phase Ac–Dc conversion of electric power is widely HVDC systems There are many different reasons as to why HVDC is to chosen instead of ac transmission. A few of them are listed below. Cost effective HVDC transmission requires only two conductors compared to the three wire ac transmission system. One-third less wire is used, thus readily reducing the cost of the conductors. This corresponds to reduced tower and insulation cost, thereby resulting in cheaper construction. However, the ac converters stations involve high cost for installation; thus the earlier advantage is offset by the increase in cost. If the transmission distance is long, a break-even distance is reached above which total cost [20] of HVDC transmission is less than the ac. Asynchronous tie HVDC transmission has the ability to connect ac systems of different frequencies. Thus it can be used for intercontinental asynchronous ties. The six-pulse converter bridge used as the basic converter unit of HVDC transmission rectification where electric power flows from the ac side to the DC side and inversion where the power flow is vice versa. Thyristor valves conduct current on receiving a gate pulse in the forward biased mode. The thyristor has unidirectional current conduction control and can be turned off only if the current goes to zero in the reverse bias. This process is known as line commutation. Inadvertent turn-on of a thyristor valve may occur once its conducting current falls to zero when it is reverse biased and the gate pulse is removed. Too rapid an increase in the magnitude of the forward biased voltage will cause the thyristor to inadvertently turn on and conducted the design of the thyristor valve and converter bridge HVDC transmission systems

4.0 Result

By suitable system control, this modulation of the reactance is made to counteract the oscillations of the passive filter power in order to damp these out Due to the development of power converters' output signal harmonic control is currently becoming extremely important in medium and high-power applications. a new method to generate switching three-level pulse width-modulation (PWM), which is named selective harmonic mitigation PWM, generates switching three-level PWM patterns with high quality from the point of view of harmonic content, avoiding the elimination of some specific harmonics and studying all harmonics and the total harmonic distortion as a global problem by using a general-purpose random-search This fact leads to a drastic reduction or even avoidance of the bulky and costly grid connection tuned filters of power systems. Any harmonic shaping can be considered due to the flexibility of the Power devices switching constraints are considered to obtain The results obtained with this new method greatly improve power quality.

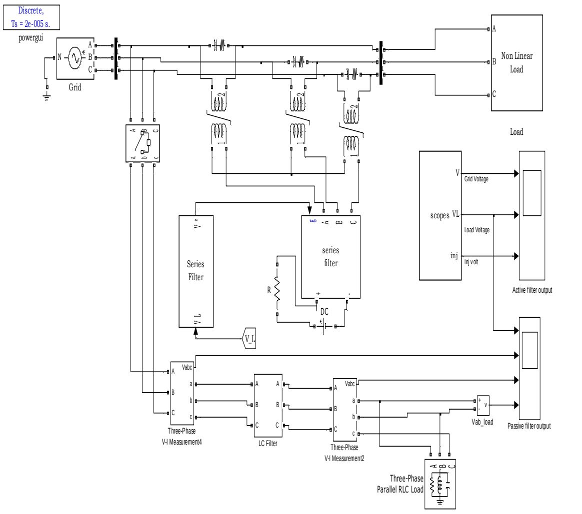

Fig.1: *A simulink model of THD analysis for the improvement of power quality in three phase AC system by using active passive filter.*

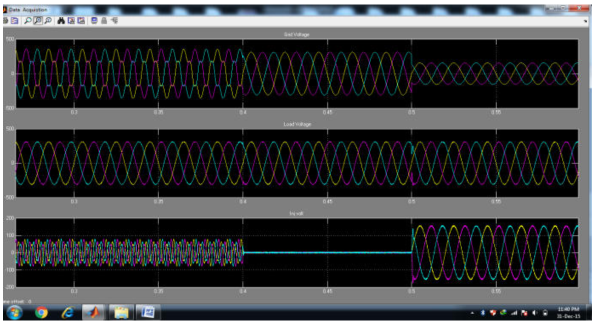

Fig.2: *A power system harmonics voltage stability and power quality improvement results using active filter output.*

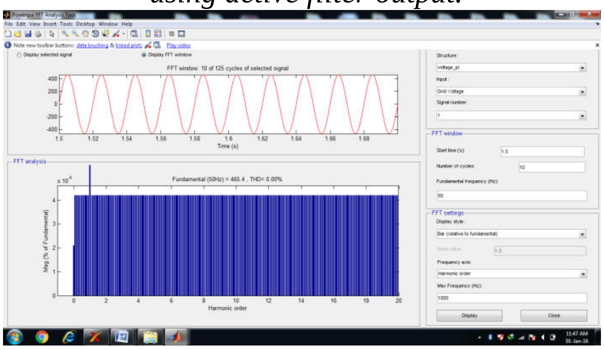

Fig.3: *FFT Harmonics distortion Improve*

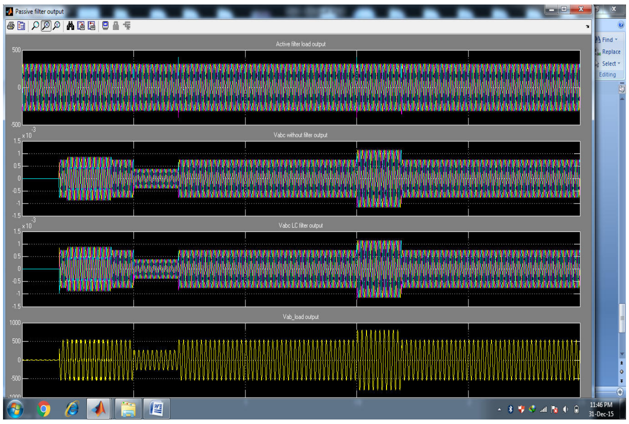

Fig.4: *A simulink model of THD analysis for the improvement of power quality in three phase AC system by using passive filter output*

Comparison of Proposed Scheme with Various Existing Schemes:

Power electronic filters, the expansion of the use of power electronic circuits in order to eliminate harmonics which is generated mainly from switching converters. This can lead to the fact that the source of the harmonic problem can be solved using the power electronic circuit itself in the case of active filters. Although active filters, including hybrid configurations, have many.

Table 1: *Comparison of Active Power Passive Filter Transmission Systems*

Power Filter	Type	Main Components
Passive Filter	**Series PPF** **Shunt Tuned PPF**	Inductor, Resistor Inductor, Resistor, Capacitors
Active Filter	**Series APF** **Shunt APF**	Semiconductor Switches

Three major multilevel inverter structures which have been mostly applied in industrial applications have been emphasized as the diode clamped, the flying capacitor, and the cascaded Hbridge inverters with separate DC sources. In addition to this, various hybrid multilevel inverters have been developed by using the three basic types mentioned above. Voltage source inverters (VSIs) are widely used in AC motor drives, AC uninterruptible power supplies (UPS), and AC power supplies with turbine, active harmonic filters. VSI topologies are constituted in accord with power demand of application areas and output voltages are either single phase for power demands.

5.0 Conclusion

Comparison of active and passive filter improvement of power quality in three phase ac System active filters for phase and neutral currents harmonic compensation in three phase wire system used in the regulation of the continuous voltage at the boundaries of the capacitor the dc bus voltage has been maintained as a constant value. So, the problem of the dc-bus voltage control in three-phase wire active filter active power filters are capable to better compensate the current harmonics in three phase wire electrical networks. A dual instantaneous power theory based on instantaneous power theory for hybrid power filters is studied, a Simulink model is designed and total harmonic distortion is calculated using FFT analysis. Hybrid power filter which has been used here monitors the load current constantly and continuously adapt to the changes in load harmonics. The performance of three phase power filter using Active and Passive Filter dual instantaneous power theory applying the superposition principle. The harmonic generation modeled by positive-, negative-, and zero-sequence harmonic sources. The system represented models at each harmonic frequency. The precise evaluation of harmonic distortion must have accurate load modeling. This simulation is also applied to active and passive filter, and comparative study has been done. Simulations have been carried out on the MATLAB SIMULINK platform results are presented.

Future Work

Electrical power systems have been traditionally designed taking energy from high-voltage levels, and distributing it to lower voltage level networks. There are large generation units connected to transmission networks. in the future there will be a large number of small generators connected to the distribution networks. Efficient integration of this distributed generation requires network innovations. A development of distribution network management, from multi Sores input power system centralized to more distributed system management, is needed. Information, communication, and control infrastructures will be needed with increasing complexity of system management. Some innovative concepts such as will this configuration can be tested in hardware. Multi-pulse rectifier can be added to the load as 12 pulses or 32 pulse ac-dc rectifiers with R-L load Induction motor can also be the load instead of R-L load can be introduced to it for better performances.

References

[1] C.Nalini Kiran,Power Quality Improvement Using Active and Passive Power Filters, Vol.2, Issue.1, pp-076-079 ISSN: 2249-6645 IJMER,2014.

[2] P. Salmerón and S. P. Litrán, Improvement of the Electric Power Quality Using Series Active and Shunt Passive Filters, IEEE TRANSACTIONS ON POWER DELIVERY, IEEE**,**2010.

[3] Meera S Nair, Deepa Sankar, A Review of Hybrid filter topologies for power quality compensation, (IRJET) e-ISSN: 2395 -0056, Volume: 02 Issue: 04 ,July-2015.

[4] M.Senthilkumar, K.Sameeullah, An Inductive Active Filtering Method for Power Quality Improvement in Grid Connected PV System, (ICETS'14) ISSN (Online) : 2319 – 8753, Volume 3, Special Issue 1, February 2014.

[5] Hakim Elahi Tooraji 1 and Nekoubin Abdolamir,by, Improving Power Quality Parameters in AC Transmission Systems Using Unified Power Flow Controller, Research Journal of Recent Sciences, ISSN 2277-2502 Vol. 2(4), 84-90, April 2013.

[6] Ritwik Majumder,by,Reactive Power Compensation in Single-Phase Operation of Microgrid, IEEE TRANSACTIONS ON

INDUSTRIAL ELECTRONICS, VOL. 60, NO. 4, APRIL 2013.

[7] Hassan El-Kishky, Hadi Ebrahimi, by, On modeling and control of advanced aircraft electric power systems System stability and bifurcation analysis, The University of Texas at Tyler, 3900 University Blvd., Tyler, TX 75799, United States Elsevier, 2014.

[8] M. S. Hamad, M. I. Masoud, and B. W. Williams, “Medium-voltage 12-pulse converter: Output voltage harmonic compensation using a series APF,” IEEE Trans. Ind. Electron., vol. 61, no. 1, pp. 43–52, Jan. 2014.

[9] Y. Tang, P. C. Loh, P. Wang, F. H. Choo, F. Gao, and F. Blaabjerg, “Generalized design of high performance shunt active power filter with output LCL filter,” IEEE Trans. Ind. Electron., vol. 59, no. 3, pp. 1443– 1452, Mar. 2013.

[10] G. Cerrada, O. Pinzon-Ardila, V. Feliu-Batlle, P. Roncero-Sanchez, and P. Garcia-Gonzalez, “Application of a repetitive controller for a threephase active power filter,” IEEE Trans. Power Electron., vol. 22, no. 1, pp. 237–246, Jan. 2007.

[11] S. A. Gonzalez, R. Garcia-Retegui, and M. Benedetti, “Harmonic computation technique suitable for active power filters,” IEEE Trans. Ind. Electron., vol. 54, no. 5, pp. 2791–2796, Oct. 2007.

[12] S. Rahmani, N. Mendalek, and K. Al-Haddad, “Experimental design of nonlinear control technique for three-phase shunt active power filters,” IEEE Trans. Ind. Electron., vol. 57, no. 10, pp. 3364–3375, Oct. 2010.

[13] T. Quoc-Nam and L. Hong-Hee, “An Advanced Current Control Strategy for Three-Phase Shunt Active Power Filters,” IEEE Trans. Ind. Electron., vol. 60, no. 12, pp. 5400–5410, Dec. 2013.

[14] M. Aredes, H. Akagi, and E. H.Watanabe, “Comparisons between the p-q and p-q-r theories in three-phase four-wire systems,” IEEE Trans. Power Electron., vol. 24, no. 4, pp. 924–933, Apr. 2009.

[15] S. Mariethoz and A. C. Rufer, “Open loop and closed loop spectral frequency active filtering,” IEEE Trans. Power Electron., vol. 17, no. 4, pp. 564–573, Jul. 2002.

[16] J. Svensson and R. Ottersten, “Shunt active filtering of vector currentcontrolled VSC at a moderate switching frequency,” IEEE Trans. Ind. Appl., vol. 35, no. 5, pp. 1083–1090, Sep./Oct. 1999.

[17] Z. Chen and D. Xu, “Delayless harmonic detection based on DSP with high-accuracy for active power filter,” in Proc. 20th IEEE APEC, Mar. 6–10, 2005, vol. 3, pp. 1817–1823.

[18] J. Zhao and B. K. Bose, “Neural-network-based waveform processing and delayless filtering in power electronics and ac drives,” IEEE Trans. Ind. Electron., vol. 51, no. 5, pp. 981–991, Oct. 2004.

[19] J. H. Marks and T. C. Green, “Predictive transient-following control of shunt and series active power filters,” IEEE Trans. Power Electron., vol. 17, no. 4, pp. 574–584, Jul. 2002.

[20] M. S. Hamad, S. M. Gadoue, and B. W. Williams, “Harmonic compensation of a six-pulse current source controlled converter using neural network-based shunt active power filter,” IET Trans. Power Electron., vol. 5, no. 6, pp. 747–754, Jul. 2012.