Power Quality Improvement by UPQC Using Pi Controller

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Abstract - ***This paper presents a comprehensive review on UPQC to reinforce power quality. Typically this can be often speculated to gift a broad outline on varied possible intelligent controls used with UPQC. The purpose of UPQC is to control on voltage flicker or unbalance, reactive power and harmonics. In different words, UPQC has the potential of up power quality at purpose of installation in industrial power systems. The appliance of computing is growing quick within space of power electronics and drives. PI controller is used for power quality improvement in UPQC. It helps in mitigating power quality problems like harmonics, voltage swell, voltage sag etc. UPQC is an effective custom power device for enhancement of power quality because of quick response, high reliabiity, nominal cost etc. Conventional power quality mitigation equipment is providing to be inappropriate for increasing number of applications. Different methods for compensation and recent developments in fields include this. Single modern and very hopeful solution that deal with both load current and supply voltage imperfection is Unified Power Quality Conditioner.***

Index Terms - Active power filter (APF), Power quality, Unified Power Quality Conditioner, Voltage swell and sag compensation

1. INTRODUCTION

The word Power Quality is most important facets of any power delivery system . Low quality of power affects electricity consumers in many ways. The lack of quality power can create loss of damage of equipment, production or appliances, increased in losses of power, hindrance with communication lines . The widespread use of power electronics equipment has produced a significant impact on quality of electric power supply by creating harmonics in voltages and currents. Therefore, it is very important to maintain high standard of power quality. The word active power filter (APF) is a widely used term in area of a power quality improvement. Conventional power quality extenuation equipments use passive elements and do not always answers correctly as an attribute of power system condition change. One modern solution that deals with both supply voltage and load current imperfections is UPQC.

UPQC is one of the APF family members. UPQC is a combination of shunt and series active filters connected in cascade through a mutual DC link capacitor. The main function of UPQC helps to compensate the supply voltage power quality issues such as sag, swell, harmonics, imbalance, flicker, and for load current power quality problems as, unbalance, harmonics, neutral current and reactive current The word Power Quality is most important factor of any power delivery system . Low quality of power effects the electricity using consumers in many ways. The lack of quality power can produce loss of damage of equipment, production or appliances, increased in losses of power, interference with the communication lines . The widespread use of power electronics device has produced an important impact on quality of electric power supply by creating harmonics in voltages and currents. So, it is very essential to maintain high standard of power quality. Conventional power quality mitigation equipments use passive elements and they do not always give response correctly as a nature of power system condition change voltage imperfections.

With the invent of power semiconductor switching devices, like GTO's thyristor, IGBTs and many more devices, control of electric power has become a reality. Such controllers are widely used to give electric power to electrical loads, such as adjustable speed drives, furnaces, computer power supplies, HVDC system and many more.

The power electronic devices due to their inbuilt nonlinearity, draw harmonic and reactive power from supply. In three phase systems, they can also cause unbalance and take the excessive neutral currents. The injected harmonics, reactive power, unbalance, encumbrance and excessive neutral currents results in low system efficiency and poor power factor. In addition to this, the power system is subjected to many transients like voltage sags, swells, flickers etc. The above transients could affect voltage at distribution levels. Excessive reactive power of loads will increase the generating capacity of stations and increase the transmission losses in the lines. Hence it becomes essential to supply reactive power at the load.

Power Quality mostly deals with issues like maintaining a fixed voltage at PCC for various distribution voltage levels regardless of voltage fluctuations, maintaining unity power factor power drawn from the supply, obstructing voltage and current unbalance from moving upwards from various distribution levels, reduction of voltage and current harmonics in system and quelling of excessive supply neutral current. Conventionally, fixed compensating devices and passive LC filter with some degree of variation like thyristor switched capacitors. Such devices have the disadvantages of

fixed compensation, bigger size, ageing and resonance. Nowadays equipments using power semiconductor equipments, generally known as active power line conditioners, Active Power filter etc. are used for the power quality issues due to their dynamic and changeful solutions. Flexible AC Transmission Systems and Custom Power products like STATCOM, DVR etc. deal with the issues related to power quality using similar concepts and control strategies. Basically, they are not similar only in the location in a power system where they are distributed and the objectives for which they are deployed.

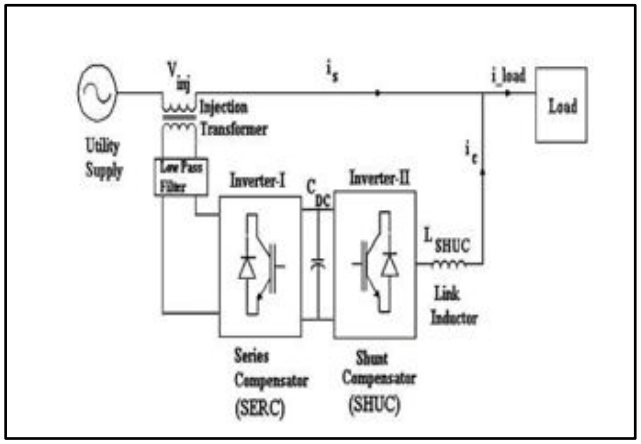

Figure 1 : Block diagram of UPQC

2. Need Of The Power Quality

There is an increased concern of power quality due to the following reasons:

1) New-generation loads which uses microprocessor and microcontroller based controllers and power electronic devices, are highly sensitive to power quality variations than that equipments used before.
2) The demand for increased overall power system efficiency resulted in continued growth of devices such as high-efficiency shunt capacitors and adjustable-speed motor drives for power factor correction to bring down losses.
3) This is resulting in increasing harmonic level on power systems and has many people having concern about the future impact on system capabilities. End users have an increased knowingness of power quality issues. Utility customers are getting better informed about these issues as interruptions, switching transients and sag are provoking the utilities to improve the quality of power delivered.

Most of the networks are interconnected these days. Integrated processes mean that the failure of any component has much more important consequences temperature.

3. UPQC

Active Power Filters can be classified, based on converter type topology and the phases. Converter types are Current Source Inverter with inductive energy storage or Voltage Source Inverter with capacitive energy storage. The topology can be series, shunt or combination of both. The third classification is based on number of phases, such as the single phase systems, the three phase systems or three phase four wire systems.

Unified Power Quality Conditioner ,that can be used at the PCC for improving power quality, is designed and simulated using proposed control strategy and the performance is observed for various nonlinear loads .Unified Power Quality Conditioner using PLL with PWM Control changes the resonances of other filter. The Unified Power Quality Conditioner is a device that is employed to mitigate disturbances in the distribution system that affect the performance of sensitive and critical load. It is a kind of hybrid APF and is the only device which can remove or solve several power quality problems related with voltage.

4. Simulation Results

The performance of UPQC with PI and without PI is as shown below:

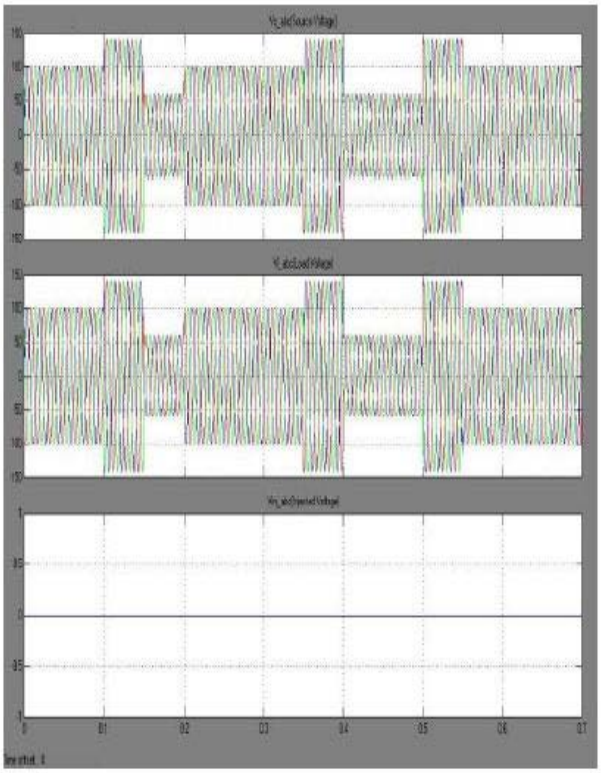

Figure 2 : PI without UPQC at Load Voltage, input Voltage, and Injected Voltage.

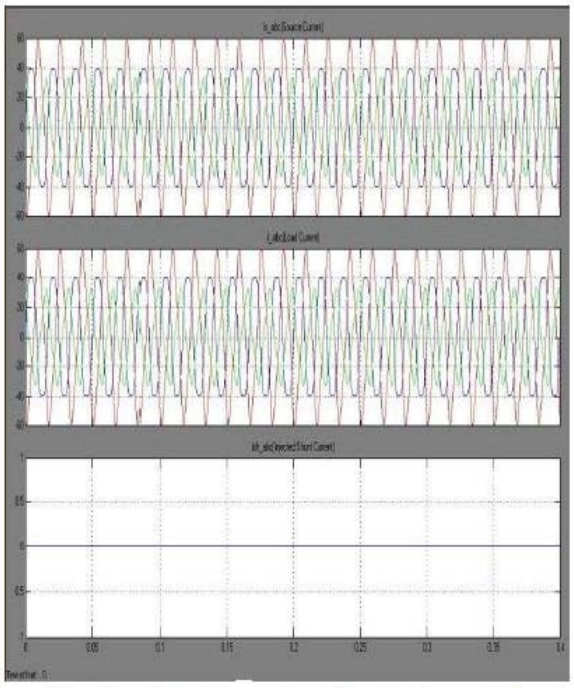

Figure 3 : PI without UPQC at Load Current, input Current, and Injected Current.

Figure 5 :.PI controller with SAG condition at Load Current, input Current, and Injected Current.

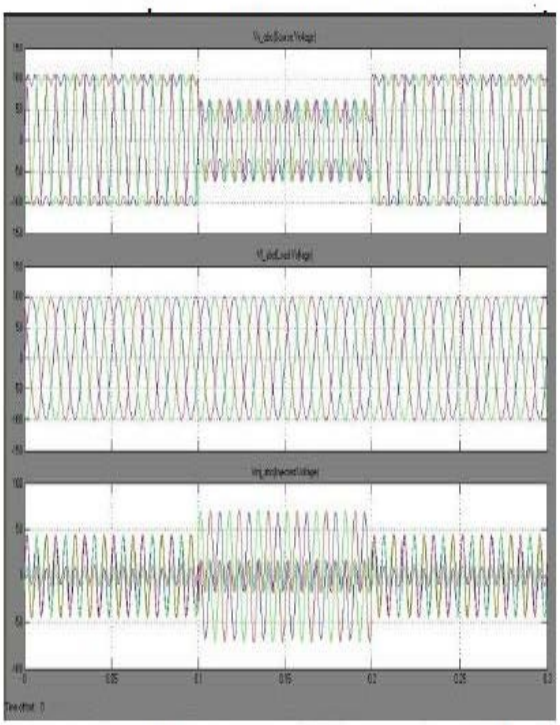

Figure 4 : PI controller with SAG condition at the Load Voltage, input Voltage, and, Injected Voltage

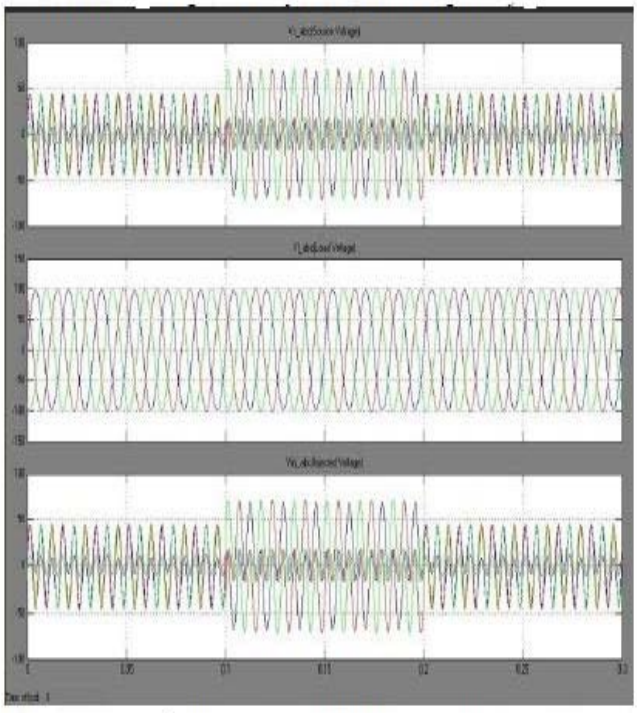

Figure 6 :. PI controller with swell condition at Load voltage, input voltage, and the Injected voltage.

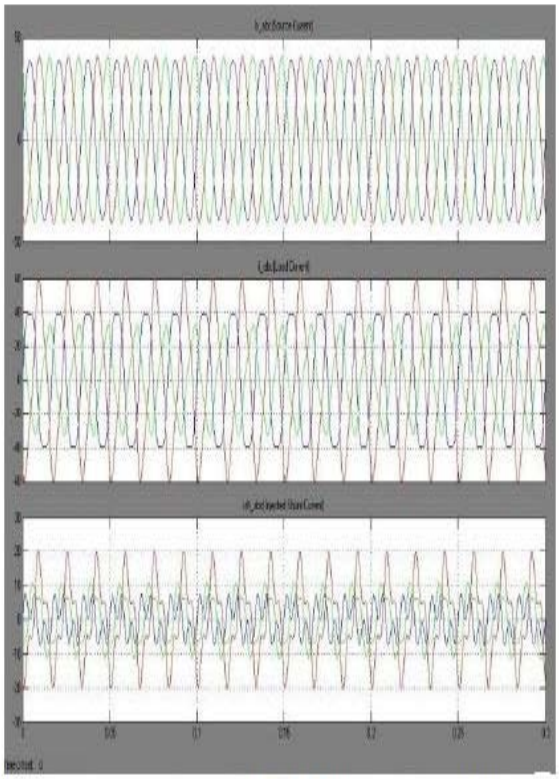

Figure 7 : PI controller with sag and swell condition at Load current, input current, and Injected current.

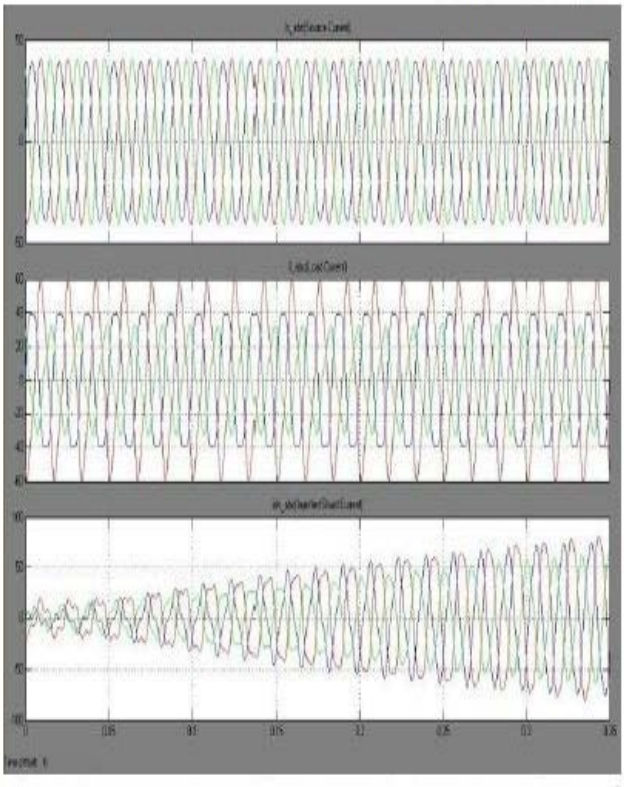

Figure 9 :. PI controller with sag and swell condition at Load current, input current, and Injected current.

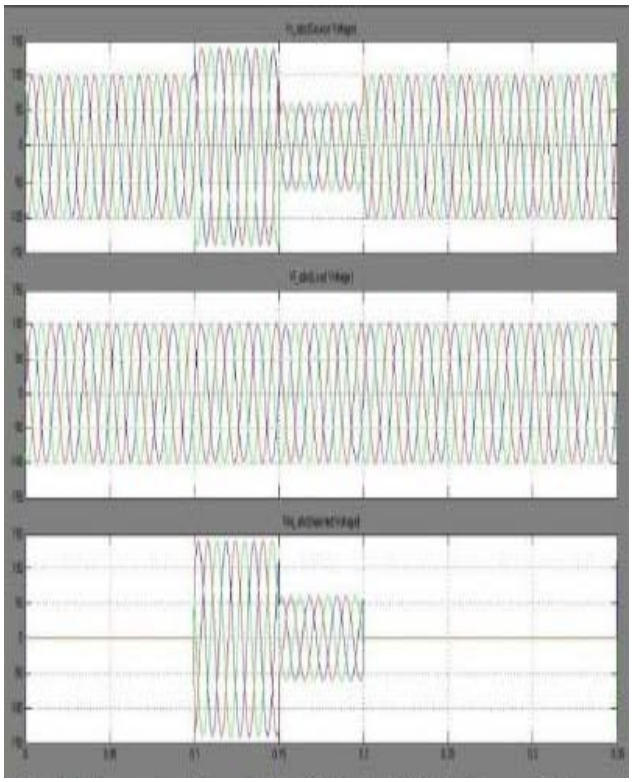

Figure 8 : PI controller with sag and swell condition at Load voltage, input voltage, and Injected voltage.

converters, rectifiers, voltage and current unsteady because of arc in arc furnaces, swell and sag because of the shift of the loads etc. one in every of the number of solutions is that the use of a combined system of active series and shunt filters like Unified power quality conditioner . This device combines a shunt active filter beside a series active filter in an increasingly consecutive configuration, at the same time compensate the voltage and also the load current or to mitigate any kind of voltage and current fluctuations and power issue correction in an exceedingly power distribution network. The management methods are modeled victimization MATLAB/SIMULINK.

5. CONCLUSION

In the research, the main objective is utilization of the studied equipment for reducing the distortion level coming in cases of harmonics generating loads in distribution network and highly improving the power quality of the system. In order to protect critical loads from more voltage harmonics and current harmonics in the distribution network, UPQC i.e., series connected voltage-source converter known as Dynamic Voltage Restorer and shunt connected voltage-source converter known as Dstatcom is suitable and satisfactory. Due to its reliability it was adopted as the best solution for the compensation of voltage and current conditioner is capable of reducing the level of THD in case of networks which are connected to harmonics generating load (like ASD).

All type of faults (single line to ground, double. using UPQC and simulated properly with result. The UPQC performance mainly depends upon how quickly and accurately reference

signals are derived. Then the conventional compensator is replaced with PI controller. Proposed model for UPQC is to compensate supply voltage and load current imperfections such as sags, swells, voltage imbalance, flicker, and current imbalance, interruptions. This work can be extended to compensate current harmonics and input voltage harmonics caused by non-linear load. Proposed Nine Switch UPQC can be implemented using a simple analog hardware, because it is having Hysteresis blocks and PLL.

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