ADVANTAGES OF UPQC ON POWER QUALITY PROBLEMS: A REVIEW

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Abstract— In recent years there are a number of methods are suggested by the various researchers to improve the quality of electrical power. The use of active power filters has changed the controlling mechanism of power quality issues and these methods have played vital role. UPQC is a method which is now universally adopted and well recognized in power industries due to its appropriate results. In past few years a number of researchers worked on it to examine and improve the result of various techniques of UPQC. Now there are various methods for proper and effective working of power quality conditioners. This paper shows a review of use UPQC to overcome the power quality problems. This paper is a comprehensive study of various research papers and the methodologies used in it to find, how this method is effective and widely used.

***Keywords*—Power Quality, UPQC, Active Filters, Cycloconverters, Unified Power Conditioner.**

I. INTRODUCTION

In the era of 90's the concept of UPQC was introduced. It can compensate the different types of power quality problems like sags, reactive currents, swags, voltage imbalance, harmonics, flicker etc. UPQC generally has two VSC (Voltage Source Converters), one is Shunt APF and second is Series APF.

IEEE power and energy magazine has been referred which gives the basic concepts of the FACTS devices such as shunt APF, series APF, and UPQC.

Kartik et al. in [1] have presented the UPQC with the combination of DVR and DSTATCOM. He suggested the Dynamic voltage restores as a Series Active Filter which is used for the regulation of voltage with minimum VA loading at the PCC (point of common coupling). Distribution Static compensator plays the role of Shunt active filter for the elimination of current harmonics, and to control the reactive power.

Sindhu et al. in [2] have introduced the concept of photovoltaic with integration of unified power conditioner. A control algorithm is suggested for the operations of inverters of UPC with the help of photovoltaic generation at PCC. The proposed approach is designed in MATLAB and results are discussed.

Yunbo et al. inn [3] have presented the use of Modular Multilevel Converter with UPQC for the suppression of all kind of voltage, harmonics and reactive power problems. The operation of MMC is based on the d-q-0 theory. He developed the 13-level MMC and did the simulation in time domain.

Vadirajacharya et al. in [4] have presented the concept of use of CSI in 3-phase 4 wire system. Unit vector template is the compensation strategy. Hysteresis band logic will be used for the working of CSI and it will eliminate the current and voltage related harmonics from the system.

Moghadasi et al. in [5] have proposed the joint venture of UPQC with SMES. The suggested algorithm based on Superconducting magnetic energy storage is best suited for the compensation of voltage sag, harmonics and voltage interruption problems. It has the dc-dc chopper and a SMES coil. Fig 1.1 shows the electric circuit diagram of SMES system.

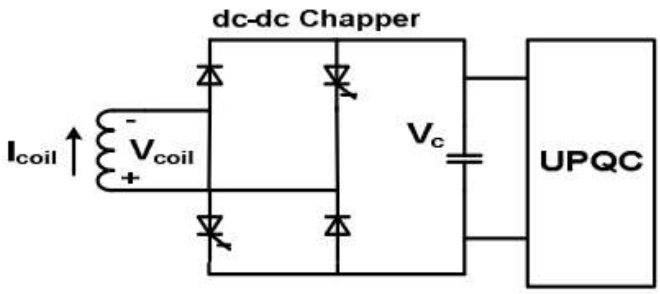

Fig 1.1 Electric Circuit Diagram of SMES system

Saimon et al. in [6] have suggested the concept of dual unified power quality conditioner for sharing the reactive power equally in between filters as per the load demand. This is achieved by the help of power angle control (PAC).

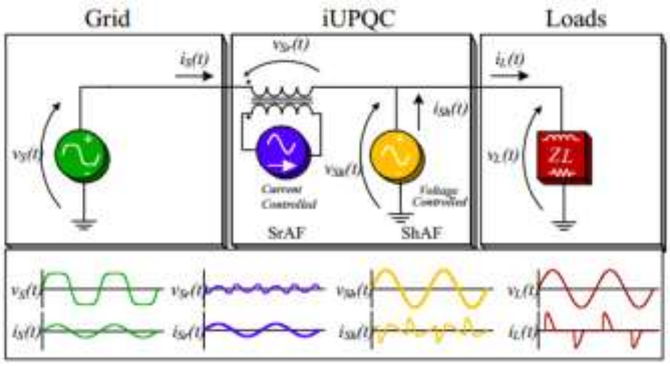

Fig 1.2 Dual unified power quality conditioner and its wave forms

Circuit diagram of Dual-UPQC is shown in fig 1.2 with its waveforms.

Fang et al. in [7] have proposed the combination of direct control algorithm with the UPQC. In this hybrid topology the series filter is controlled by the help of 3-phase full bridge VSI and the shunt filter is controlled by the help of 4-leg VSI. The series filter has the sinusoidal current source while the shunt filter has sinusoidal voltage source.

Hareesh et al. in [8] have proposed the concept of ISGOI (improved dual second order generalized integrator) for UPQC. This is the combination of series and shunt filters to compensate the power quality issues under distorted conditions. The algorithm is based on phase locked loop (PLL). Basic diagram for the dual ISGOI based on PLL is shown in Fig 1.3.

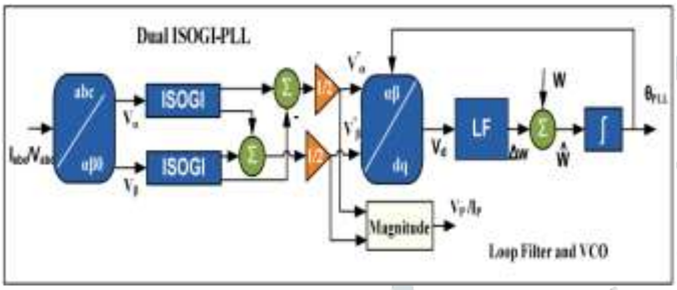

Fig 1.3 Dual ISOGI based Phase locked loop (PLL)

Vijayasamundiswary et al. in [9] have proposed the nine switch unified power quality conditioner. Now a days lots of semiconductor devices are used due to which switching losses are increased. He used this logic and reduced the number of switches in UPQC. He is using only nine switch instead of 12 switches in UPQC. The control algorithm for this is based on Particle Swarm Optimization (PSO).

Dapeng et al. in [10] have proposed the decoupling control mechanism to reduce the interaction of series and shunt active power filter. For compensation of power quality problems in low power applications can be improved by using single phase three leg UPQC. In this approach output voltage obtained of a leg will be controlled by the help of grid voltage and optimization of proportional coefficient will be done so that no interaction will work between series and shunt active power filter.

Hojo et al. in [11] have suggested the simplified power quality conditioner i.e. known as SPQC for the improvement of system reliability and it will also optimize the overall cost. The algorithm says that the two diode bridge rectifier will be used in place of shunt converter. So the series converter will provide the power conditioning and diode rectifier will control the dc voltage. The series converter will also regulate the active power amount.

Hagh et al. in [12] have presented the UPQC with reduced number of power switches. The half of the switches will be eliminated due to which overall cost and weight will be optimized. This control algorithm will be effective for the compensation of voltage related issues like voltage sag/swell, harmonics. The witching mechanism of the shunt active filter will be maintained by hysteresis control method. In this mechanism only one full bridge rectifier will be used with two capacitors. Fig 1.4 represents the UPQC circuit diagram.

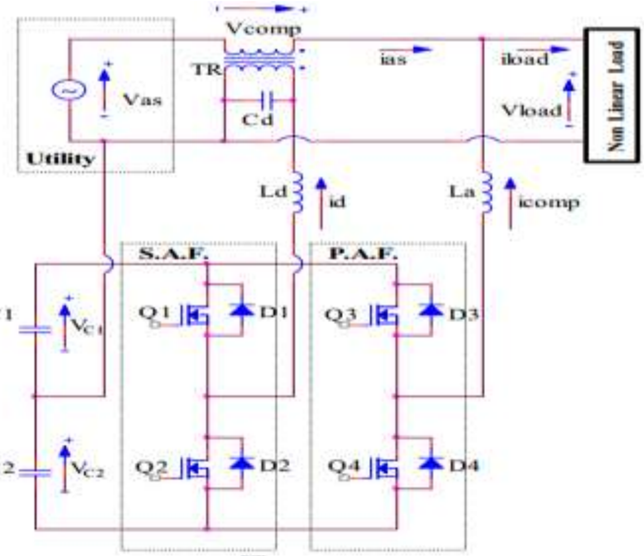

Fig 1.4 proposed model of UPQC with circuit diagram

II. Conclusion

From the literature review it is followed that it is a big task to fully compensate the undesirable current harmonics and also nullify reactive power requirement in power system. The drawback of traditional LC filter discussed above creates a doorway for the active power filters to make the task easier with better advanced topology suggested by researchers. These control strategy plays an important role in better performance of APF. From the above literature review it has been seen that hybrid APF is a multidisciplinary research area. There are various types of problem arising due to nonlinear/sensitive loads in power system. To deal with these problem and also guarantying that the system remains stable is a challenging for any researcher. Lots of techniques are invented for the optimization of transmission line losses and improvement of the supply. Active methods for power quality control having quick response, tiny in size with high performance. Due to these advantages they are most common in use rather than passive methods. Individual compensators have the different quality to improve the power factor, suppression of current harmonics, compensating unbalanced currents, limiting the neutral current. For the power factor improvement we can use SVC (Static VAR Compensator) and PFC (Power Factor Correctors). If we want to compensate unbalanced currents and also wants to limit the neutral current we can use active circuits. The voltage quality controlling can be done by Series APF (Active Power Filter). The current quality controlling can be done by Shunt APF (Active Power Filter). If we want to control both current and voltage quality then we require the association of Series and Shunt APF (Active Power Filter) i.e. known as UPQC (Unified Power Quality Conditioner).

III. References

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