ABSTRACT: This project presents literature review for improving the power quality by using the unified power quality conditioner (UPQC). There is a more complex network in the power system, in which generating station is connected with the load center through long transmission and distribution line. For improving the performance of distribution network the new concept came into existence known as custom devices. One of the custom power device is unified power quality conditioner is one of the custom power devices. The different configurations of UPQC system for single phase and three phases are well discussed in this project. The various researchers have given different names to the UPQC according to their function, topology and application. The various topologies of UPQC explained are, left shunt (UPQC-L), right shunt (UPQC-R), open UPQC, Interlined UPQC (UPQC-I), Modular UPQC (UPQC-ML).

KEYWORDS: UPQC, Power quality, Custom power device, Shunt.

I. INTRODUCTION: Nowadays the end users and electric utilities are focusing on the electric power quality. The power quality issues are not new, but the electric utilities are becoming aware of these quality problems [1]. The main reason for focusing on the quality of electric power is increase in use of electronic loads, which are nonlinear in nature. Mostly, the electronic equipment’s used are microprocessor based and they are much sensitive to the electric power quality. The various issues of power quality like voltage swell, sag, interruptions, harmonic current and voltage harmonics are becoming a challenge to the utilities [2]. The current harmonics results into several problems like, Increase in losses of the power system, over heating of conductor, burden of reactive power, malfunctioning of relays, poor power factor. The reason for focusing on the quality of electric power is the economic value. The automatic impacts on quality of electric power on the utilities, customers and suppliers are explained in [1]-[3]. Hence for maintaining the quality of power is always a
great task. For mitigating the voltage and current harmonic, voltage swell and voltage sag the active power filter (APF) is one solution. The extensive survey is collected on active power filter in [4].

II. VARIOUS CONFIGURATIONS OF UPQC

The classification of UPQC depends upon the-
1) Topology of converter
2) Supply system
3) Configuration of system
4) Voltage sag compensation

The classifications of UPQC above given are explained below: 1) Classification on topology of converter the classification on topology is divided into two types, i.e. Voltage source inverter and current source inverter.

1) Classification on topology of converter:

a) Voltage source inverter: One of the topology of UPQC is VSI i.e. voltage source inverter based UPQC. The VSI is controlled by pulse width modulation (PWM). There is the energy capacitor for storing the energy. The Fig. 2.1 Shows the UPQC based on VSI with 2018 International Conference on Control, Power, Communication and Computing Technologies (ICCPCCT) 978-

b) Current source inverter

The UPQC is developed by using the modulation of the Pulse width (PWM) current source inverter (CSI) [14]. The Fig. 2.2. Shows the UPQC based on the current source inverter. In this the inductor \( L_{dc} \) stores the energy, and it acts as a common DC link.
2) Classification on supply system

The Classification of UPQC depending on the supply system is further divided into single-phase and three-phase supply system [15]. Further the Single and three phase can be Classified as single phase two wire and three phase three wires or three phase four wire System.

For Minimizing the problems related to power quality are compensated by configuration of UPQC into the 1P2W system it consists of two inverters of H-Bridge with total eight switches. This Configuration is based on VSI [17], [18]. The reduction part in the configuration of single phase UPQC is described in [17] by using three, six and four switches as shown in Fig. 2.3 and Fig. 2.4.

3) Classification on configuration of system

As compared to other devices, UPQC performs the two activities at the same time i.e. minimizes voltage disturbances as well as the current disturbances. The system configuration is one of the classifications of UPQC. Different configurations of UPQC are explained in this section. a) Right and left shunt UPQC the two inverters are connected Back to back in UPQC. Hence we can classify the UPQC based on the location of a shunt inverter in connection with series inverter.
The shunt inverter placed at the right side is named as the right shunt UPQC (UPQC-R) [13], where as the shunt inverter placed at the left side called as the left shunt UPQC (UPQC-L) [19]. The configuration of UPQC-R is represented in Fig. 2.2.

Fig. 2.5. System configuration of UPQC-L

The Fig. 2.5 shows the configuration of UPQC-L. Out of these two configurations, the UPQC-R is used significantly. The sinusoidal current flows from the series transformer in UPQC-R. This sinusoidal current is not same as that of load current. In this configuration, the shunt inverter minimizes the current harmonics. In some cases, the UPQC-L is used, such as for minimizing a difficulty between passive filter and shunt filter.

a) UPQC Interlined (UPQC-I)

Joshi A.et al. [20] explained one of the interesting configurations of UPQC. In this configuration, the shunt and series inverter are placed in the middle of two distribution feeders. This is known as UPQC interlined (UPQC-I). In this configuration, one feeder is joined with series inverter, and second feeder is joined with shunt inverter. In this configuration the regulation of the two feeders is simultaneous.

b) UPQC Multi converter (UPQC-M)

The improvement in performance of a system, the researchers have evaluated of adding the third unit of a converter for supporting the DC bus. M.C. Wong et al have done research on use of battery storage and super capacitor for improving the capacity. The connection of third converter can be done in different ways like it can be connected in parallel with the feeder, or adjacently it can be connected in series with the feeder.
c) **UPQC Modular (UPQC-M)**

The Fig. 2.7 shows the configurations of UPQC Modular (UPQC-M). This configuration was introduced by the researcher. [22]. This configuration is obtained by connecting numerous H-bridges i.e. several UPQC in cascade for each phase. In [23] by use of multi terminal winding transformer the modules of H-bridge of shunt side of the UPQC are lined in series, whereas the modules of H-bridge of series side the UPQC is linked directly in series without using the series transformer. If the number of modules goes on increasing, the voltage of each H-bridge will get reduced.

**d) UPQC Distributed Generator (UPQC-DG)**

The renewable-energy sources such as wind, solar are preferred nowadays as alternate sources. The DG sources can be combined to the UPQC [23]. This total topology is called as UPQC-DG. In this configuration, the DG sources are connected to DC link. The voltage and current harmonics are mitigated and also the regulation of DG power is done by UPQC. The generated power by DG can be stored in battery as the backup in DG bus. One more benefit of giving power to the load during voltage interruptions is done by the UPQC integrated with DG. Next the power of DG is given in interconnected mode, i.e. to the load as well as to the grid or islanded mode in this the power is transferred to the selective loads.
3) Compensation of voltage sag

One of the big problems of power quality is the voltage sag. For mitigating the sag in voltage the various methods by using UPQC is explained. 1. Control of active power (UPQC-P) for minimizing the sag in voltage, the active power is in use with the help of UPQC. Therefore, the name is UPQC-P. For minimizing the sag of voltage, series inverter of UPQC supplies the component of voltage in series [24]. The supplied voltage is equal in phase and opposite in direction for minimizing the voltage sag. 2. Control of reactive power(UPQC-Q) The control of reactive power leads to minimize the voltage sag. As it injects the reactive power from UPQC, it is called as UPQC-Q. The control of power which is reactive in the voltage of quadrature there is injection of voltage from UPQC through a series inverter [25]. 3. Loading of less Volt-ampere(UPQC-VA min) There is need of reducing the load of VA for compensation of Voltage sag. Besides the injection of series voltage in phase or in quadrature, in the minimum VA, loading voltage of optimal angle is injected. Hence, the compensation of voltage with minimum VA ampere is known as (UPQC-VA min) 4. Active and reactive power simultaneously (UPQC-S) The working is same as that of UPQCVA min. It injects the both active and reactive power [25]. The voltage sag as well as voltage swell is done simultaneously by controlling series inverter. The name is given as UPQC-S as it gives active as well as reactive power (Complex power- S).

III.SIMULATION RESULTS
IV. CONCLUSION

This paper presents a review of UPQC for improving the quality of electric power. Now after overall review of UPQC, the Distributed generation integrated with UPQC is main concern. In this the solar and wind i.e. renewable sources can be used, by keeping quality of power in acceptable limits. UPQC is one of the devices, which eliminates the voltage and current harmonics simultaneously. Different configurations of UPQC are briefly discussed in this paper.

REFERENCE


