Mitigation of Power Quality Issues using Hydrid Multilevel Inverter as UPQC

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Abstract- Power quality is related to the ability of utilities to provide electric power without interruption. One of the major concerns in electric industry today is power quality problems to sensitive loads. Power quality problems such as sag, swell, harmonic distortion, unbalance, transient and flicker may have impact on customer devices, cause malfunctions and also cost on loss of production. Unified Power Quality Conditioner is a series element and shunt element connected in the power system. In this project, a UPQC with cascaded multilevel inverter is proposed. Voltage sag, unbalance in generation system is mitigated using proposed multilevel UPQC. There is no need of using transformer and filter when multilevel UPQC is applied and it is one of its advantages. Conventional Fundamental switching scheme is used for pulse generation to control the switches in the multilevel inverter. The main objective of my project is to regulate the voltage at source side against any power quality issues like under voltages; over voltages. The total harmonic distortion was reduced by using Multilevel UPQC.

Key words- Power Quality, UPQC, Active power filter, Sinusoidal reference, Harmonic content

I. INTRODUCTION

Unified power internal control was typically reflected by various analysts as a attainable technique to reinforce the standard of power in electrical distribution network. The capability of UF-power quality conditioner is to get rid of the aggravations that influence the execution of the fundamental load in power framework. As it were, the UPQC has the capability of enhancing power quality at the aim of firm on power appropriation frameworks. The UPQC, hence, is needed to be a standout amongst the foremost effective answers for substantial limit hundreds touchy to provide voltage gleam/unevenness [2]. The UPQC, that has 2 inverters that share one dc association, will repay the voltage droop and swell, the harmonious current and voltage, and management the force stream and voltage solidness. moreover, the UPQC will likewise recompense the voltage intrusion within the event that it's some vitality repositing or battery within the dc be a part of [3] The UPQC contains of 2 dynamic channels, the arrangement dynamic channel (SAF). The PAF is often controlled as a none curved current supply, that is answerable of repaying the harmonious current of the heap, whereas the SAF is controlled as a non-sinusoidal voltage supply that is answerable of remunerating the network voltage. The references to each SAF and PAFs area unit curved, administering the consonant extraction of the matrix current and burden voltage. The point of this paper is to propose a system for a double 3 stage sure along power quality conditioner (i-UPQC) topology, that infuses streams and voltages at higher THD values into utility framework association

POWER QUALITY PROBLEM:

Power quality has distinctive implications to various people. institution of Electrical and Electronic Engineers (IEEE) customary IEEE1100 characterizes power quality as "the construct of powering and grounding sensitive equipment in a very manner appropriate for the equipment" [4]. there's a good scope of power quality problems connected with grid frameworks taking under consideration time, as an example, future varieties, transient time varieties and totally different unsettling influences.

Origin of poor power quality

Sources of poor Power Quality are recorded as takes after [5]:

- Adjustable –speed drives
- Switching Power supplies
- Arc heaters
- Electronic Fluorescent light weights
- Lightning Strike
- L-G deficiency

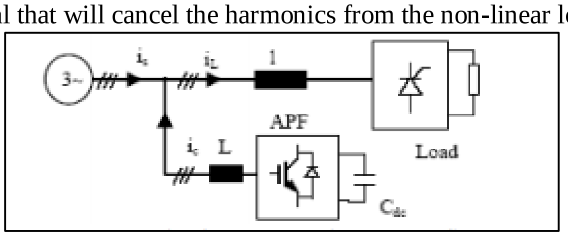
- Non- straight load
- Starting of extensive engines
- Power Electronic drives

ACTIVE POWER FILTER:

Filters are often the most common solution that is used to mitigate harmonics from a power system. Unlike other solutions, filters offer a simpler inexpensive alternative with high benefits. There are three different types of filters each offering their own unique solution to reduce and eliminate harmonics. These harmonic filters are broadly classified into passive, active and hybrid structures. The choice of filter used is dependent upon the nature of the problem and the economic cost associated with implementation. An active filter is implemented when orders of harmonic currents are varying. One case evident of demanding varying harmonics from the power system are variable speed drives. Its structure may be either of the series of parallel type. The structure chosen for implementation depends on the type of harmonic sources present in the power system and the effects that different filter solutions would cause to the overall system performance. Active filters use active components such as IGBTtransistors to inject negative harmonics into the network effectively replacing a portion of the distorted current wave coming from the load. Active filters can be classified based on the connection scheme as Shunt active filters, series active filters and Unified power quality conditioners.

SHUNT ACTIVE FILTERS:

The active filter concept uses power electronic equipment to produce harmonic current components that cancel the harmonic current components that cancel the harmonic current components from the non-linear loads. In this configuration, the filter is connected in parallel with the load being compensated. Therefore the configuration is often referred to as an active parallel or shunt filter. Fig. 3 illustrates the concept of the harmonic current cancellation so that the current being supplied from the source is sinusoidal. The voltage source inverter used in the active filter makes the harmonic control possible. This inverter uses dc capacitors as the supply and can switch at a high frequency to generate a signal that will cancel the harmonics from the non-linear load



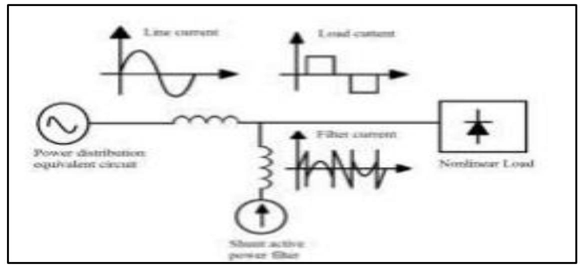


Fig.1: Block Diagram of Power Filter

MULTILEVEL INVERTER:

In general, increasing the switching frequency in voltage source inverters (VSI) leads to the better output voltage / current waveforms. Harmonic reduction in controlling a VSI with variable amplitude and frequency of the output voltage is of importance and thus the conventional inverters which are referred to as two-level inverters have required increased switching frequency along with various PWM switching strategies. In the case of high power / high voltage applications, however, the two-level inverters have some limitations to operate at high frequency mainly due to switching losses and constriction of device rating itself. Moreover, the semiconductor switching devices should be used in such a manner as problematic series / parallel combinations to obtain capability of handling high power

UNIFIED POWER QUALITY CONDITIONER:

The UPQC consisting of the combination of a series active power filter (APF) and shunt APF can also compensate the voltage interruption if it has some energy storage or battery in the dc link. The two types of UPQC are: 1. Right shunt UPQC. 2. Left shunt UPQC. In this paper right shunt UPQC configuration was selected. This UPQC consists of two voltage source inverters connected back to back with each other sharing a common dc link. One inverter is controlled as a variable voltage source in the series APF, and the other as a variable current source in the shunt APF. Fig.6 [2] shows a basic system configuration of a general UPQC consisting of the combination of a series APF and shunt APF

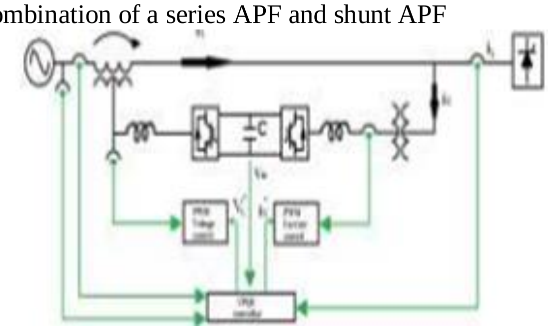


Fig.2: Block Diagram of UPQC

MULTILEVEL INVERTER:

It is generally accepted that the performance of an inverter, with any switching strategies, can be related to the harmonics contents of its output voltage. Power electronics researchers have always studied many novel control techniques to reduce harmonics in such waveforms. Up-to date, there are many techniques, which are applied to inverter topologies. In multilevel technology, there are several well-known topologies as follows: 1. Diode clamped multilevel inverter (DCMI). 2. Flying-capacitor multilevel inverter (FCMI). 3. Cascaded multilevel inverter with separate DC sources. A. Cascaded Multilevel Inverter Cascaded multilevel inverters are based on a series connection of several single-phase inverters. This structure is capable of reaching medium output voltage levels using only standard low-voltage mature technology components. Typically, it is necessary to connect three to ten inverters in series to reach the required output voltage. A basic structure of a cascaded multilevel inverter.

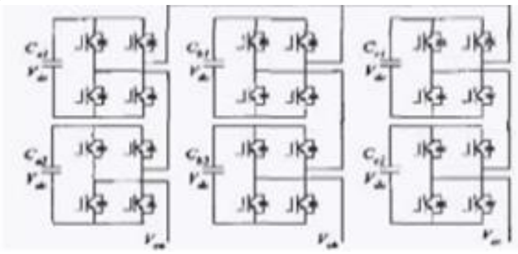
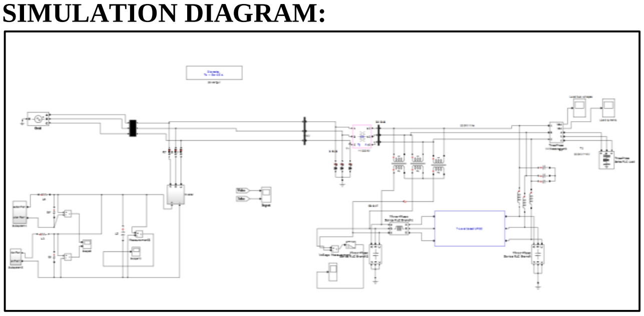


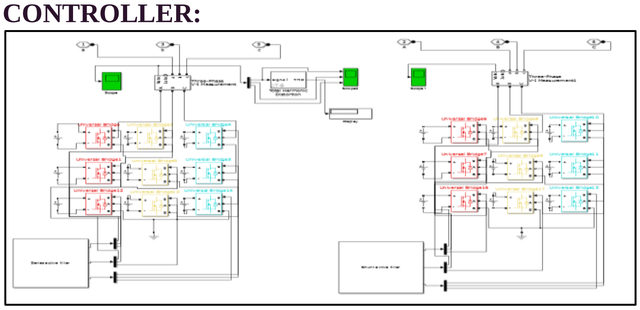
Fig.3: Three Phase Cascaded Multilevel

SIMULATION RESULTS:

SIMULATION DIAGRAM:

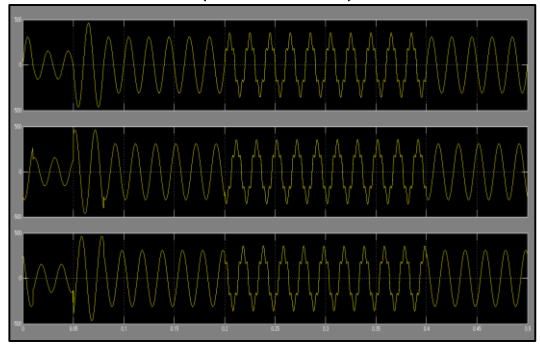


CONTROLLER:

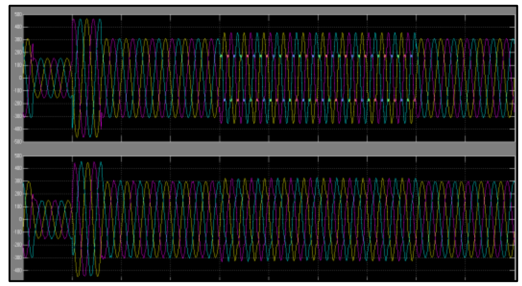


WAVEFORMS:

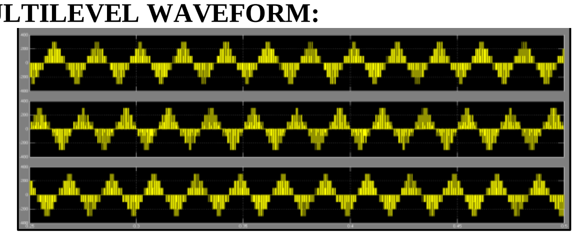
INPUT WAVEFORM (VA, VB, VC):



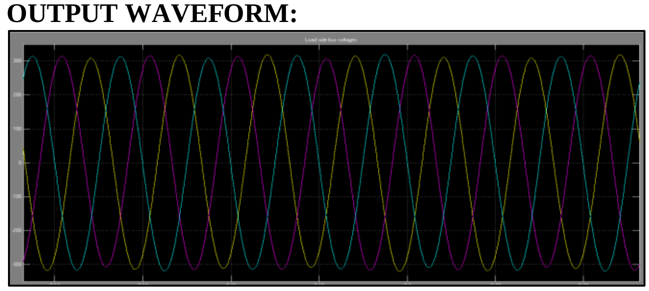
INPUT WAVEFORM:



MULTILEVEL WAVEFORM:



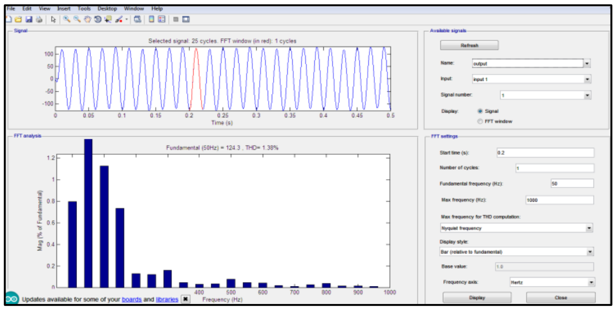
OUTPUT WAVEFORM:



RESULTS (THD):

THD	SAG	SWELL	LINE TO LINE	OUPUT THD
VA	20.62%	14.51%	8.71%	1.36%

THD WAVEFORM:



II. CONCLUSION

The UPQC reduced harmonics in the system. Also voltage sag / voltage swell characteristics due to sudden application / removal of load is compensated. It does this well than that of shunt and series active power filters. Its cost is also less compared to other inverter topologies [11]. And the load power factor tends to unity. This paper has used a new configuration of UPQC, applying multilevel inverter. The proposed UPQC can be directly connected to the distribution system without any injection transformer as it struggles with core saturation and voltage drop

III. REFERENCES

[1]. Hirofumi Akagi, ―New trends in active filters for power conditioning‖, IEEE transaction on industry applications, vol. 32, no 6, nov/dec 1996.

[2]. Mauricio Aredes, Klemens Heumann, Edson H. Watanabe, ―An Universal Active Power Line Conditioner‖ , IEEE Transactions on Power Delivery, Vol. 13, No. 2, April 1998.

[3]. Hideaki Fujita, Hirofumi Akagi, ―The Unified Power Quality Conditioner: The Integration of Series- and Shunt-Active Filters‖,IEEE transactions on power electronics, vol. 13, no. 2, march 1998.

[4]. N.Farokhnia, S.H.Fati, H.R.Toodeji, ―Voltage sag and unbalance mitigation in distribution systems using multi-level UPQC‖IEEE.

[5]. Vinod Khadkikar, ―Enhancing Electric Power Quality Using UPQC: A Comprehensive Overview‖, IEEE transactions on power electronics, vol. 27, no. 5, may 2012.

[6]. Walid G.Morsi, M.E.El-Hawary, ―Defining power components in non-sinusoidal unbalanced polyphase sustems: the issues‖, IEEE power delivery, October 2007.

[7]. Fang Zheng Peg, ―Application issues of active filters‖.

[8]. Fang Zheng Peng, George W. Ott, jr., and Donald J.Adams, ―Harmonic and reactive power compensation based on the generalized instantaneous reactive power theory for three-phase four-wire system‖, IEEE power electronics v-13 n-6, 1998.

[9]. Joao Afonso, Mauricio Areds, Edson Watanabe, Julio Martins, ―Shunt active filter for power quality improvement‖, international conference UIE 2000 – electricity for a sustainable urban development.

[10]. B.P.McGrath, Donald G.Holmes, ―Multicarrier PWM strategies for multilevel inverters‖, IEEE industrial electronics, August 2002.

[11]. Mariusz Malinowski, Jose Rodriguez, ―A survey on csascaded multilevel inverter‖, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 57, NO. 7, JULY 2010

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