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A Novel UPQC Architecture for Power Quality Control

D. Jayanth Kumar & G. Rambabu
Assistant Professor, ADAMS Engineering College, T.S, INDIA

Abstract- *The series and parallel units don't have a typical dc interface, so their control systems are not quite the same as conventional UPQC control strategies. This gadget can accomplish general change in PQ, lessening the most well-known unsettling influences for all clients that are provided by the mains (PQ) by utilizing just the series unit. Extra increments in PQ (i.e., mains control intrusions), can be given to the clients who require it (custom power) by the shunt units. Thus, this new series arrangement joins a change in PQ for all end clients, with a cost lessening for those that need more power. The proposed strategy has been broke down and depicted, to assess the enduring state execution and working breaking points utilizing MATLAB/simulink.*

I. INTRODUCTION

Power Quality (PQ) is vital to specific clients. Therefore, numerous utilities could sell electrical vitality at various costs to their clients, contingent upon the nature of the conveyed electric power. Since most end clients are associated with auxiliary conveyance systems, at low voltage (LV), it could be vital to screen and remunerate the fundamental unsettling influences on the LV network. In particular, it has been accounted for in an overview [1] that, in the Southeastern district of the U.S., most checked modern clients and principle end clients did not endure long outages. Or maybe, they encountered various brief span voltage hangs and transient intrusions. In this manner, nearby service organizations needed to reconfigure their systems to keep their most vital clients on-line.

Different arrangements are accessible to make up for these disturbances. One series arrangement includes expanding the short out level of the dispersion organize, i.e., redoing all the LV circulation links or raising the energy of the MV/LV substation transformer, in this way expanding the power quality for all end clients. Along these lines, an approaching unsettling influence from a loads in a line is lessened at the purpose of regular coupling. Thus, this arrangement viably decreases the profundity of the voltage varieties, however does not ensure the loads against homeless people and short intrusions. A moment series that can remunerate any sort of disturbance, including intrusions, is establishment [2] of on-line, disconnected, line intuitive and crossover UPS systems. In these cases, just the end clients that choose to introduce them are secured, while the greater part of alternate costumers don't get any change in PQ. Frequently, these arrangements can't be embraced by the nearby service organizations or by the end clients, since they are excessively costly relative, making it impossible to the expansion in control quality that they deliver. Be that as it may, numerous less expensive arrangements are accessible. Specifically, a few electronic gadgets have been produced, contemplated and proposed to the universal academic group with the objective of enhancing provided control quality. In [3]– [8], different single contraption are examined. Diverse association topologies (arrangement or shunt sorts) are utilized to understand these gadgets. The series gadgets are associated upstream of the ensured lines, while the shunt gadgets are associated in parallel to the sensitive loads [9].

II. SYSTEM ARCHITECTURE

Fig.1 shows a simplified system architecture LV grid, used to validate the OPEN UPQC

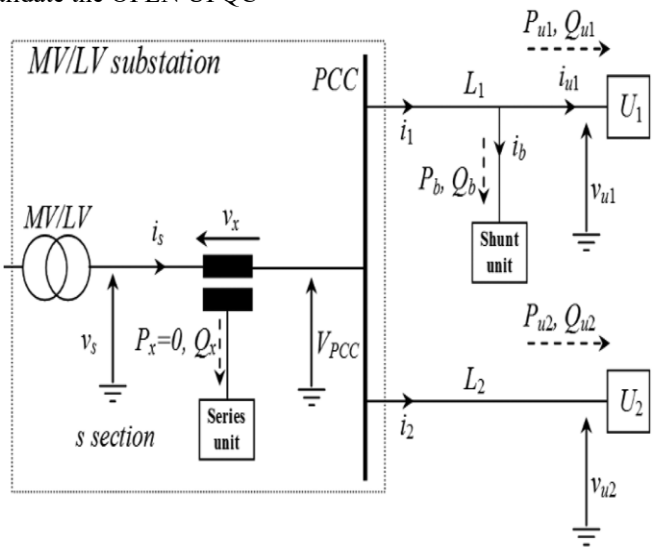

Fig 1: System compensation structure

The protected loads are grouped into the equivalent load, so all of the shunt units are represented by means of an equivalent unit. In the same way, all of the unprotected loads are grouped in the equivalent load U2. In each analysis, the correct 200-m cable is chosen as a function of the current needed to supply the equivalent load with a voltage drop of less than 3%, without considering the OPEN UPQC. In this way, it is possible to neglect power loss and the voltage drop on the LV grid.

In this study, all of the converters are represented as ideal controlled voltage or current sources. Moreover, the series unit is not equipped with a storage system. For these reasons, the OPEN UPQC limits are evaluated mainly in the normal operation mode in the following. Therefore, the series unit cannot exchange active power with the mains. The following figures and tables report the power factor and the mains current in the section as functions of the network voltage.

The reference current is expressed in per unit (p.u.), as the ratio between the power reference and the voltage reference. Since the network cables are correctly designed and their parameters are constant, the voltage drop variation when the OPEN UPQC is present can be neglected under maximum load conditions when the load power factor is equal to 0.9 and it is connected at the end of the line. Which allow the voltage to be fixed at the nominal value, were obtained by assuming the above hypothesis and that the maximum inject able voltage by the series unit is equal to 0.6 p.u..

In the following, the maximum nonactive power injected by all the shunt units can reach the apparent power. In this case, if the control strategy can keep the voltage equal to the nominal value, then these relations have to be true

It is possible to estimate the power of the series unit, given the maximum current value. This value is equal to the product between the maximum inject-able voltage (equal to 0.6 p.u) and the maximum line current. Therefore, with slight over-sizing of the series unit, good stabilization of the mains voltage is possible. The usual working conditions present an interesting case, when the power factor of load is between 0.9 and 1, and the mains voltage is inside of the contractual limits. The distribution power losses should be estimated, in order to understand the energy cost associated with this solution.

Under these conditions, it is always possible to compensate the voltage, without considering the power factor in section. In the case of smaller spread among the shunt units, it is always possible to compensate for the voltage by decreasing the power factor in the section. However, the power factor will always be greater than 0.8. When the power factor of the load is equal to one, the power factor in the section is always close to one, and the compensation limits previously mentioned can be maintained.

III. SIMULATION RESULTS

CASE: I

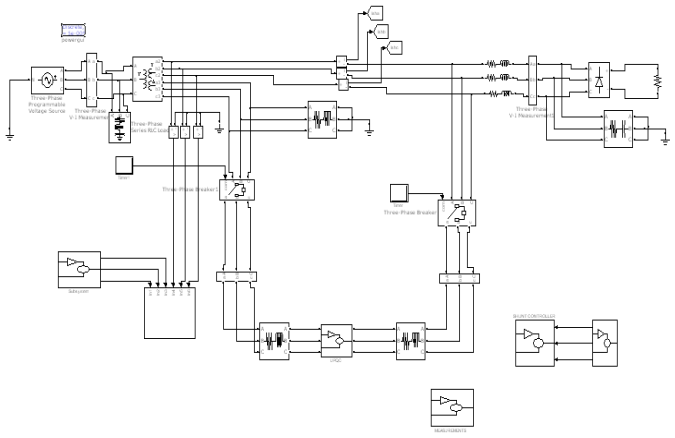

Fig.2: Simulink model of OUPQC

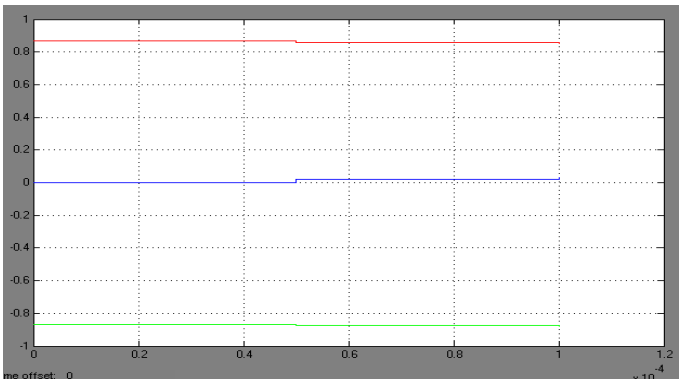

Fig.3: Voltage vectors

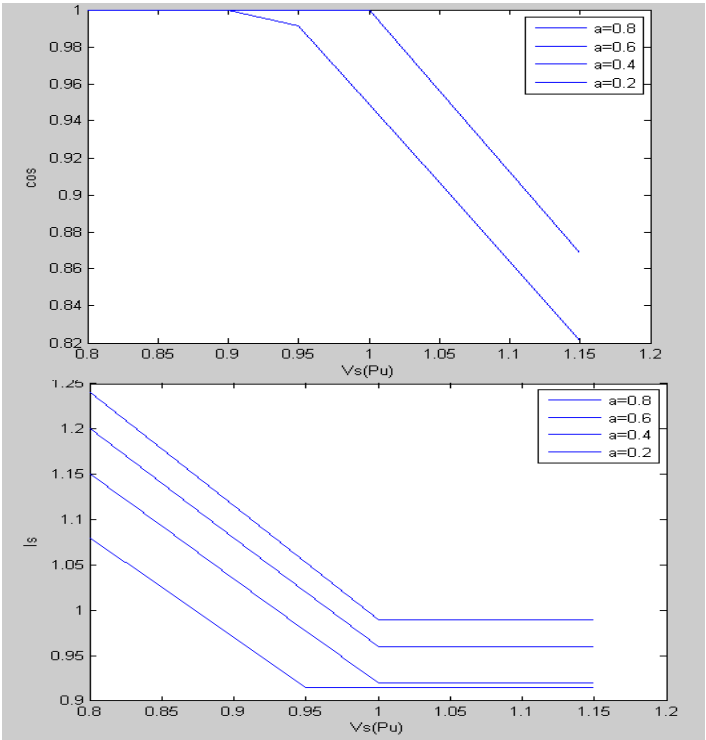

Fig.4: Power factors of the system and maximum line currents in case 1, for different α values

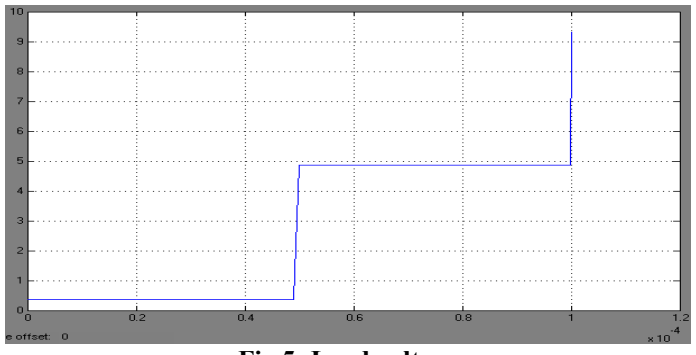

Fig.5: Load voltage

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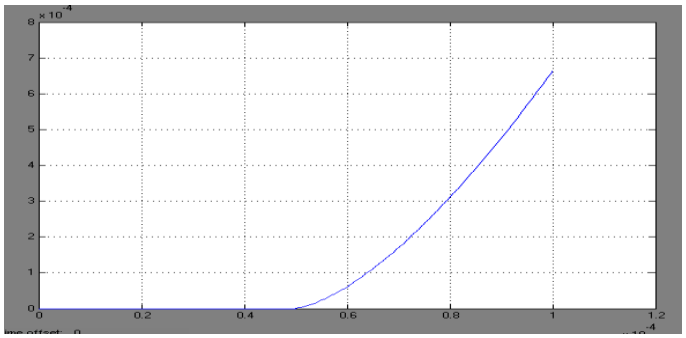

Fig.6: UDC

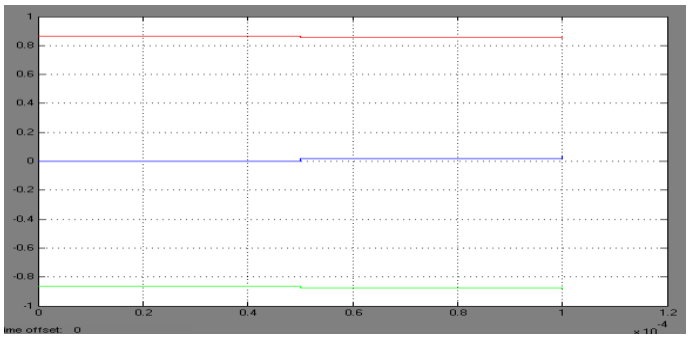

Fig.10: Voltage vectors

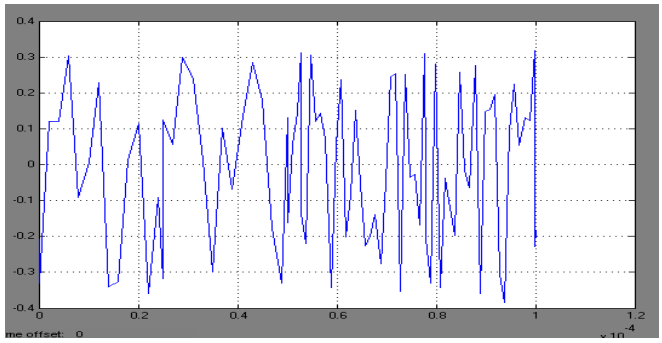

Fig.7: Load current

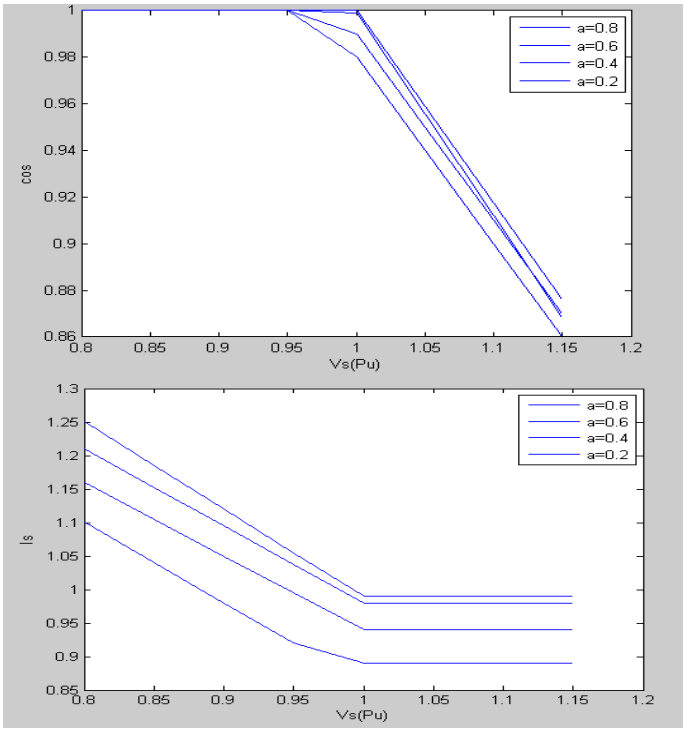

Fig.11: Power factors of the system and maximum line currents in case 2, for different α values

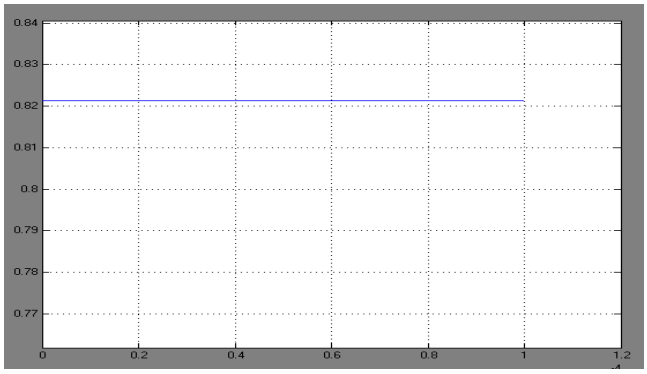

Fig.8: Power factor

CASE: II

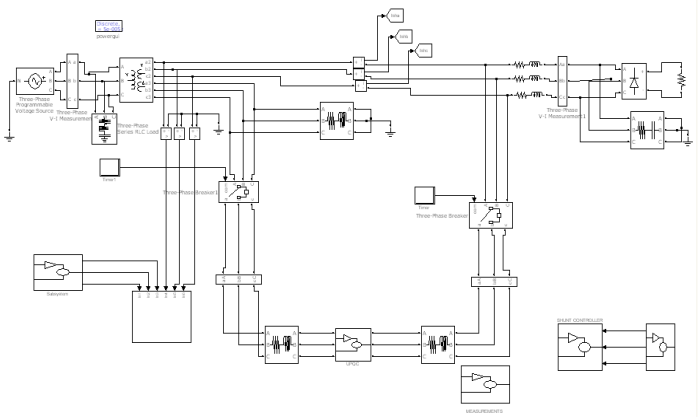

Fig.9: Simulink model of OUPQC

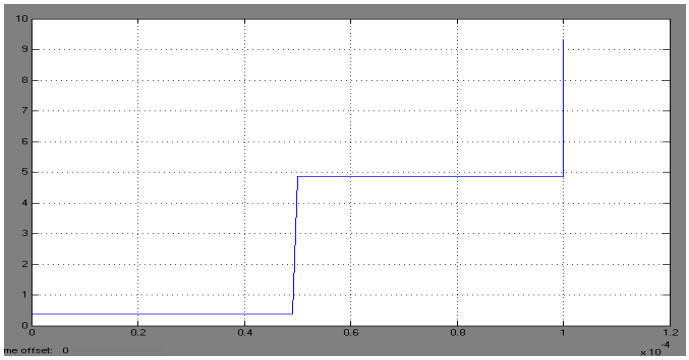

Fig.12: Load voltage

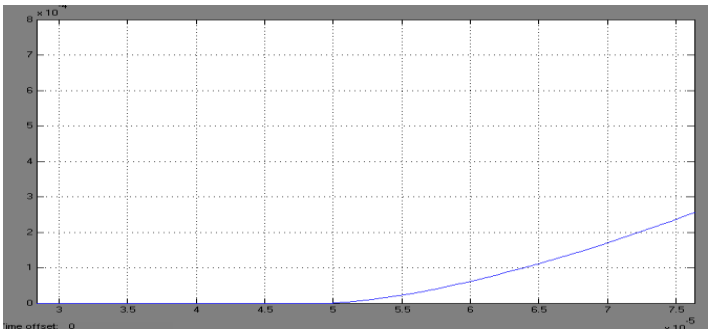

Fig.13: UDC

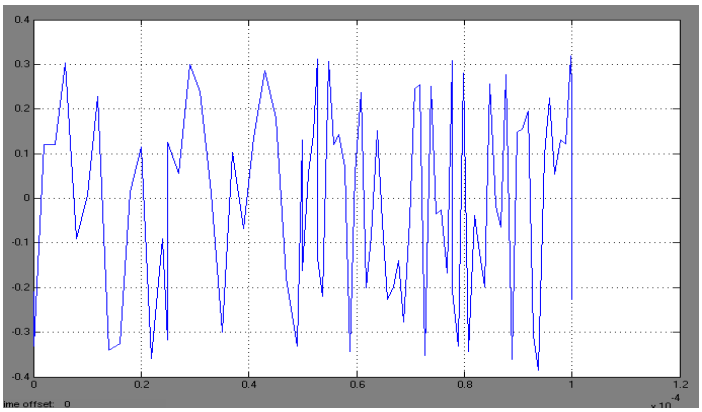

Fig.14: Load current

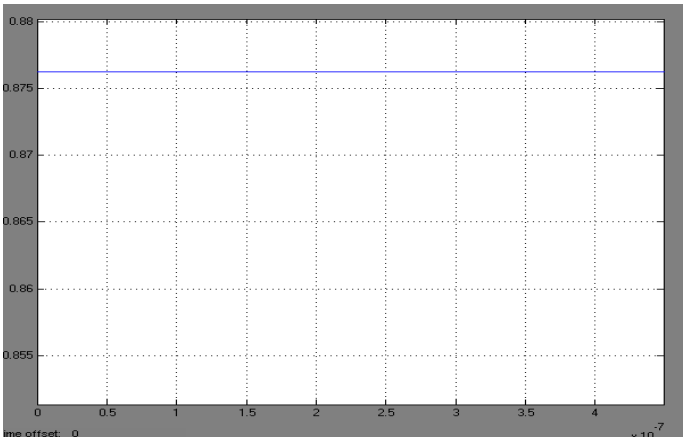

Fig.15: Power factor

IV. CONCLUSION

The OPEN UPQC setup is a decent compensation system if wide establishment of shunt units is required. An expansion in the level of the secured stack upgrades the voltage adjustment interim over which the OPEN UPQC can essentially enhance the power quality, particularly if the load control factor takes a high esteem. In the event that the power factor of load is short of what one, the power factor in area increments, to maintain a strategic distance from nonnative power ingestion from the mains. For low estimations of the parameter, the OPEN UPQC winds up plainly costly if there are few shunt units. For this situation, it is smarter to introduce other remuneration gadget typologies (as UPS, UPQC, and so on.) close to the delicate loads, and a nonnative compensator framework close to the non-sensitive loads if vital.

It is conceivable to reason that establishment of the series unit is a economically less effective path for distributors to enhance the power quality level in the circulation organizes with a specific end goal to accomplish the norms forced by the specialists. Compensation change for the sensitive end clients can be accomplished by introducing a shunt unit close them, rather than the more costly UPS gadget. Right now, the OPEN UPQC examine is still under scrutiny. The dynamic conduct, considering changing working modes, of a 5 kW model shunt unit is created. The large investments are needed to analyze the completed solution, and availability of electrical distribution operators for an infield test will be required.

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Author's Profile

D. Jayanth Kumar
Assistant Professor, ADAMS Engineering College, T.S, INDIA

G. Rambabu
Assistant Professor, ADAMS Engineering College, T.S, INDIA