# Mitigation of Sag Using UPQC

Tushar T. Balpande
Electrical (Electronics & power) Engg, SGBAU/DES's COET, Dhamangaon Rly, Maharashtra, India.

Namrata R. Thakur
Electrical (Electronics & power) Engg, SGBAU/DES's COET, Dhamangaon Rly, Maharashtra, India.

B. S. Rakhonde
Electrical Engg, SGBAU/DES's COET/, Dhamangaon Rly, Maharashtra, India.

**Abstract – Nowadays power quality problem is observed an unbalance voltage and current means sag and swell created. This effect to the electrical system. So to reduce sag Unified Power Quality conditioner (UPQC) device is used and maintain good quality of power and improve the power quality. UPQC is combination of DVR and STATCOM, It inject current and voltage to week transmission line in case of power quality problem. UPQC is compensating the voltage and current related problem. By using UPQC in transmission line mitigates the voltage sag and reduces the harmonic in the system and better result is obtained. The simulation is performed in MATLAB/Simulink R2013 and result is obtained.**

**Index Terms – UPQC, Power Quality, Active Filter, Sag Voltage and Current imbalance, Power Conditioner.**

## 1. INTRODUCTION

Everyone know that more that more power quality problem are effecting to the power quality and it's not economical to power system many problem have to face to transmission line such as sag, swell, harmonics in Shorty imbalance voltage and current like that in power system. This power quality problem can be mitigate or compensate using many device DVR, STATCOM, STCSC, VAR and also UPQC. UPQC is an electronics device to settle or mitigate the power quality problem. It is combination of series and shunt active filter or converter for improving power quality. Generally sag problem is occurred in wind generation transmission line. It fluctuates power generation its a not constant generation to wind farm, in stable condition wind farm must provide ancillary services, like the conventional power plant, wind farm must face several type of disturbance coming from the grid, such as voltage sags and swell etc. Keeping the connection to the power system once disappeared such disturbances to avoid power unbalance and even system collapse [1].

Sudden change in voltage decrees in generation or lag phase jump of generation or any distortion are create in input side of generation that case sag are create, in that case reactive power providing to week transmission line in from of voltage and current to maintain the power quality. So UPQC used to maintain a voltage and current of a week transmission line. UPQC injecting a voltage and current in using shunt active and series active filters to mitigate or compensate the power quality problem. UPQC is more effective device to more capability of improving power quality at the point installation on power transmission system. DC link used in UPQC to voltage regulator thus are leading the significant reduction of capacity of DC capacitor [2].

## 2. GENERAL CONFIGURATION OF UPQC

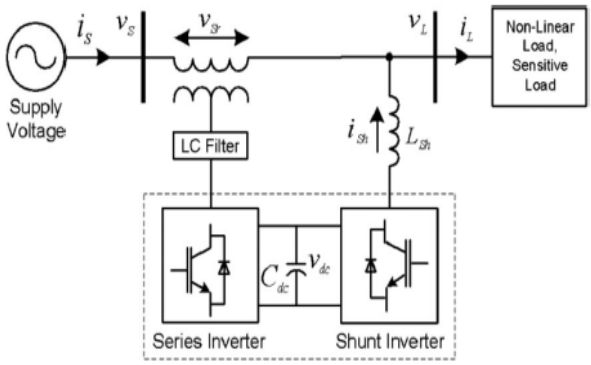


Figure 1 General configuration of the UPQC

UPQC is an electronic base power quality improving device. Its inject voltage and current in week transmission line. It's a integrating of series and shunt active power fitters are providing DC side, sharing of DC capacitor. Series active filter are work to the mitigate the voltage sag of power system. UPQC is a power full solution to large capacity load of supply voltage imbalance. In UPQC series inverter are the injected voltage and shunt inverter are injected current in transmission line. And DC capacitor is used to voltage regulator to controlling the voltage of series and shunt inverter to providing to transmission line.

## 3. SYSTEM DESCRIPTION AND MODELLING

Generally sag problem is occurred in wind generation plant in large quantity in transmission line. System under study is

composed by wind farm connected in week transmission network. Fig.2. shows single line system diagram.

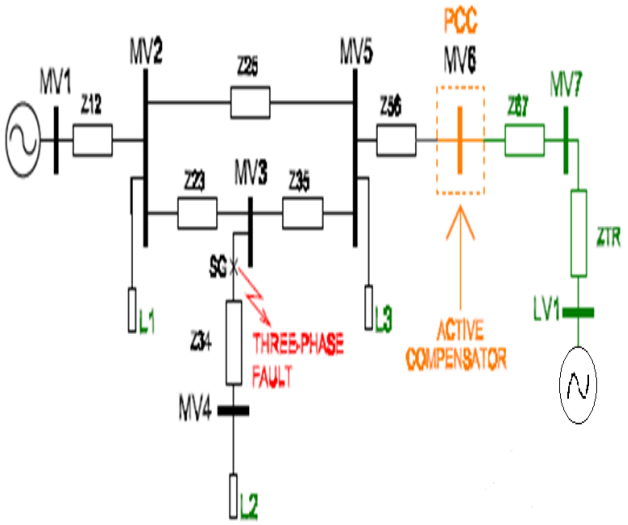


Figure 2 Single line diagram of power system study

In this fig finite bus are connected these are 3 load are connected L1, L2, L3 ARE IN M2, M4, M5 buses. MV6 is PCC point of common coupling. This considering that value of sag is occurs in week transmission line. Thus considering that the value of short circuit power in MV6 is Ssc =120MVA this ratio is calculated:

$$r = Ssc / Pwf = 5.5$$

Values of r < 20 are considered as a “weak grid” connection [1].Thus considering that case voltage and current level are decrying to transmission system in 0.1 p.u to 0.9 p.u. lasting from 0.5 cycles in 1min. in bus MV3. So UPQC is mitigating the problem. The shunt inverter injects the current at PCC and Thus considering that case voltage and current level are decrying to transmission system in 0.1 p.u to 0.9 p.u. lasting from 0.5 cycles in 1min. in bus MV3. So UPQC is mitigating the problem. The shunt inverter injects the current at PCC and series inverters inject the voltage and maintain the generator speed and recovery of voltage and sag is eliminated.

## 4. IMPLEMENTATION AND SIMULATION

### 4.1 Simulation model of UPQC

This figure shows the simulation model of UPQC. UPQC connect the MV6 of PCC. In this fig.3. Capacitor is connected in series with the interfacing inductance of the shunt filter and fault is introduced between 0.5s to 0.9s. That condition UPQC is act as a mitigation or power quality improvement device. UPQC is injecting voltage and current to the week transmission line in help of DC-link, to mitigate the sag of transmission line and reactive power control. The capacitor has the capability to supply required reactive power to the active power will compensate the harmonics present in the load [5].

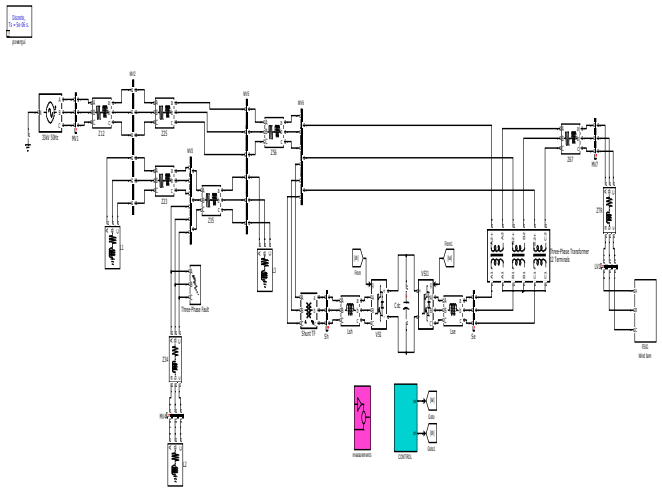

Figure 3 Simulation model of 3 phase 3 wire 3 phase short circuit fault with UPQC

### 4.2 Inverter Controller Series

Series inverter of UPQC is inject a voltage to the PCC point of common coupling and load such that load voltage become balance, distortion free and have desire magnitude. Two UPQC act as a power balancing of transmission line UPQC-P and UPQC-Q. UPQC-P is inject the voltage is maintain 90 degree angle and UPQC-Q the injected voltage in phase both supply [4].

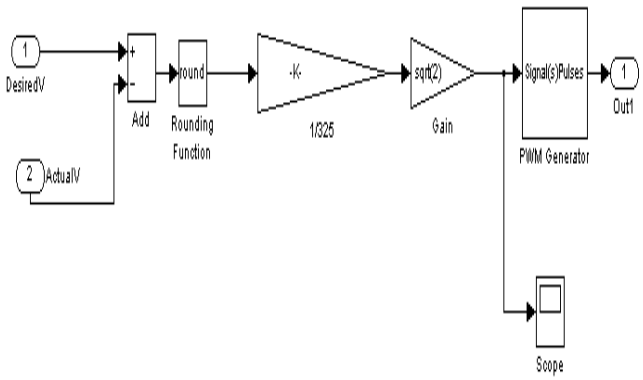


Figure 4 Series Inverter Controller

### 4.3 Shunt inverter controller

It is control by tracking the shunt converter reference current. Tracking of the DC voltage. Main proposes of shunt controller to absorb a harmonics of current and compensate the reactive power and regulate the dc- link voltage between two filters [3].

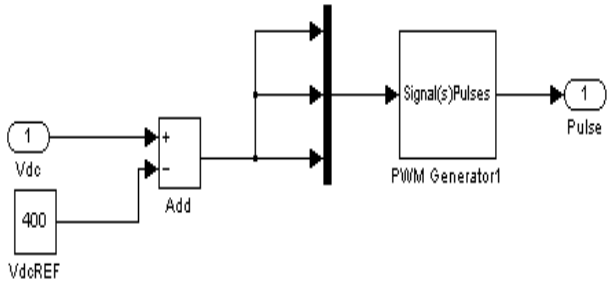


Figure 5 Shunt Inverter Controller

## 5. SIMULATION AND EXPERIMENTAL RESULTS

The simulation mainly use MATLAB/Simulink software to build a 3 phase 3 wire UPQC with fault, which combines with the improved the power quality method by using UPQC by mitigating the sag, the structure is shown in Fig.6. Terminal voltage after fault with and without UPQC.

### 5.1 Result of simulation

The result of with and without UPQC of sag mitigation is given below.

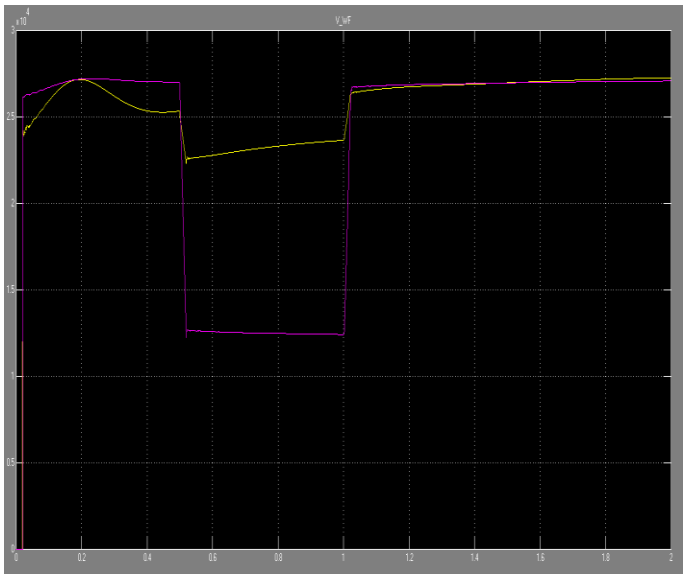

Figure 6 Terminal voltages after fault with and without UPQC

## 6. CONCLUSION

In this work, for voltage sag mitigation or compensation is presented with magnitude restoration and phase jump compensation. Results know a better wind generation and transmission power quality using UPQC. UPQC its help to improvement power quality and mitigation of sag of transmission system.

## REFERENCES

[1] M.F. Farias, P.E. B attaiotto, M.G. Cendoya, "Investigation of UPQC for Sag Compensation in Wind Farms to Weak Grid Connections", 978-1-4244-5697-0/10/$25.00 ©2010 IEEE.

[2] C. Benachaiba, O. Abdelkhalek. S. Dib, M. Allali and D. Dib, "The Unified Power Quality Conditioner (UPQC): The Principle, Control and Application" Quatrième Conférence Internationale sur le Génie Electrique CIGE'10, 03-04 Novembre 2010, Université de Bechar, Algérie.

[3] S.Thirukkovai , J.Venkatesan , Dr.S.M.Girirajkumar, "Voltage Sag/Swell Mitigation Using UPQC" International Journal of Scientific & Engineering Research, Volume 5, Issue 4, April-2014.

[4] Amirnaser Yazdani, Prajna Paramita Dash," Implementation of UPQC for Voltage Sag Mitigation" International Journal of Computer Communication and Information System ( IJCCIS)– Vol2. No1. ISSN: 0976–1349 July – Dec 2010.

[5] Sneha jose, Sreehari . S, "Synchronous Reference Frame Based Control Method for UPQC", International Research Journal of Engineering and Thchnology (IRJET) volume:2 Issue:04| july-2015.

[6] K.N.Kasat, M.S.Ali M.D.Bobade, "Design of UPQC for the Improvement of Power Quality",Special Issue of International Journal of Electronics, Communication & Soft Computing Science and Engineering, ISSN: 2277-9477.

Authors

**Tushar Balpande** was born in Maharashtra, India in 1991. He receive her diploma in electrical engineering in 2013 from CPC, chandrapur Maharashtra**.** He is currently pursuing B.E. in Electrical ( E & P ) in DESSCOET, Dhamangoan rly, Maharashtra. His current research interests in power quality improvement.

**Namrata Thakur** was born in Maharashtra, India in 1994. She currently pursuing B.E. in Electrical (E & P ) in DESSCOET, Dhamangoan rly, Maharashtra. Her current research interests in power quality improvement.