International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

MODELING AND SIMULATION OF UPQC IN POWER SYSTEMS TO IMPROVE POWER QUALITY

Karansinh Narendrasinh Raj,Abinash Kumar

PG Scholar, EED, Dr. APJ Abdul Kalam University Indore, M.P., India

Assistant Professor, EED, Dr. APJ Abdul Kalam University Indore, M.P., India

ABSTRACT

Unified Power Quality Conditioner (UPQC) can improve the power quality by injecting a voltage in series with the line and also can supply harmonics to the non linear load. This work deals with the design and the simulation of the UPQC system to improve the power quality in multibus system. The two bus system is modeled using the elements of Simulink and it is simulated using MATLAB. A sag is created by applying a heavy load at the receiving end. The sag is compensated by using the UPQC. The harmonics required at the receiving end are supplied by the inverter part of UPQC. The DC required by the UPQC is supplied by Solar cell and Boost converter system. The simulation results are compared with the theoretical results.

This work also deals with design, modeling and simulation of UPQC in eight bus system to improve the power quality in multibus system. The UPQC system is modeled using MATLAB. A dip in voltage is produced by applying a heavy load at the receiving end. The sag is compensated by using the UPQC. The harmonics required at the receiving end are supplied by the active filter part of the UPQC. The simulation results of eight bus system are presented.

INTRODUCTION

Power electronics and power quality are irrevocably linked together as it Strives to advance both broad areas. With the dramatic increases over the last 20 years in energy conversion systems utilizing power electronic devices, it is seen that the emergence of 'power quality' and simple control algorithm modification to this same technology can often play an equally dominant role in enhancing overall quality of electrical energy available to end-users. Power electronics has given, as an industrial society, a plethora of new ways to manufacture products, provide services, and utilize energy. From a power quality impact viewpoint, applications such as 1. Switched-mode power supplies, 2. DC arc furnaces, 3. Electronic fluorescent lamp ballasts, 4. Adjustable speed drives, and 5. Flexible AC transmission components are often cause for concern. From a utility supply system viewpoint, these converter-based systems can lead to operational and life expectancy problems for other equipment, possibly not owned or operated by the same party. It was from this initial perspective that the field of power quality emerged.

In most cases, the same devices and systems that create power quality problems can be used to solve power quality problems. 'Problem solving' applications such as 1. Active harmonic filters, 2. Static and adaptive var compensators, and 3. Uninterruptable power supplies all utilize the same switching device technology as the 'problem causing' applications. As the number of potentially problematic power electronic based loads have increased over time, the attention is given to enhanced converter control to maximize power quality. Perfect examples of these improvements include: 1. Unity power factor converters, 2. Dip-proof inverters, and 3. Limited-distortion electronic lamp ballasts. While many studies suggest increases in power electronic-based energy utilization as high as 70-80% (of all energy consumed), it is equally clear that we are beginning to realize the total benefit of such end-use technologies. Power quality problems associated with grounding, sags, harmonics, and transients will continue to increase because of the sheer number of sensitive electronic loads expected to be placed.

The term 'power quality' means different things to different people. To utility suppliers, power quality initially referred to the quality of the service delivered as 'measured' by the consumer's ability to use the energy delivered in the desired manner. This conceptual definition included such conventional utility planning topics as voltage and frequency regulation and reliability.

Fortunately, a good working definition of power quality has not been a point of contention, and most parties involved consider 'quality power' to be that which allows the user to meet their end use goals. The working definition is not complicated by particular issues; engineers are well aware that topics from many aspects of power engineering may be important. Power quality can be roughly broken into a few categories as follows:

1. Steady-state voltage magnitude and frequency,
2. Voltage sags,
3. Grounding,
4. Harmonics,

5. Voltage fluctuations and flicker,

6. Transients, and

7. Monitoring and measurement.

The remainder of this section discusses each of the major categories in turn.

OBJECTIVE OF THE WORK

The above literature does not deal with modeling of UPQC based eight, fourteen, thirty and fifty bus systems using MATLAB / SIMULINK. This work proposes models for 14, 30 and 50 bus systems employing UPQC. The effects on real power, reactive power and voltage are investigated. This work deals with the control of real and reactive power in power system using UPQC. The above mentioned papers do not deal with the use of multiple UPQCs in thirty/fifty bus systems. This work proposes multiple UPQCs for medium scale power systems to improve the power quality.

METHODOLOGY

The objective of this chapter deals with modeling, simulation and implementation of UPQC system. The Two Bus System with UPQC is modeled and simulated using the blocks of Simulink. Sending end acts as one Bus and receiving end acts as another Bus. The function of UPQC is to compensate the sag and supply the harmonics using UPQC. In a transmission system, the independent control of real power and reactive power is essential to maintain the desired voltage level in a transmission system. In this chapter two bus system is considered and it is modeled by using the blocks of simulink. The UPQC is connected in this system to achieve the independent control of real and reactive power. The real power is independently controlled by varying the angle of voltage injection of the UPQC. The reactive power is controlled by varying the magnitude of shunt voltage injected by the UPQC. Harmonic distortion originates in the nonlinear characteristics of devices and loads on the power system. The harmonic distortion is measured in single quantity as Total Harmonic Distortion (THD). Voltages and currents having frequency components that are not integer multiples of the frequency at which the supply system is designed to operate are called interharmonics

RESULT:-

Standard eight bus system is considered for simulation studies. Eight bus system with and without UPQC are studied and the corresponding results are discussed in this chapter. Eight Bus System with and without UPQC is modeled and simulated using the blocks of Simulink. There are three generator buses and five load buses. In this chapter Eight bus system is modeled using the blocks of simulink. The UPQC system is connected in a Eight bus system to control the real power, reactive power and voltage. The real power, reactive power and voltage is observed without connecting the UPQC in a Eight bus system and connecting the UPQC system . The readings are tabulated.

Standard Fourteen bus system is considered for simulation studies. Fourteen bus system with and without UPQC are studied and the corresponding results are discussed in this chapter. Fourteen Bus System with and without UPQC is modeled and simulated using the blocks of Simulink. There are three generator buses and five load buses. In this chapter Fourteen bus system is modeled using the blocks of simulink. The UPQC system is connected in a Fourteen bus system to control the real power, reactive power and voltage. The real power, reactive power and voltage is observed without connecting the UPQC in a Fourteen bus system and connecting the UPQC system . The readings are tabulated.

Standard IEEE-30 bus system is considered for power flow Analysis. The thirty bus system with and without UPQC is studied and the results of simulation are presented in this chapter. The effect of multiple UPQC in thirty bus system is also studied. In this chapter Thirty bus system is modeled using the blocks of simulink. The UPQC system is connected in a Thirty bus system to control the real power, reactive power and voltage. The real power, reactive power and voltage is observed without connecting the UPQC in a Thirty bus system and connecting the UPQC system . The readings are tabulated.

Standard IEEE-50 bus system is considered for power flow Analysis. The fifty bus system with and without UPQC is studied and the results of simulation are presented in this chapter. The effect of multiple UPQC in fifty bus system is also studied. In a transmission system, the independent control of real power and reactive power is essential to maintain the desired voltage level in a transmission system. In this chapter Fifty bus system is considered and it is modeled by using the blocks of simulink. The UPQC is connected in this system to achieve the independent control of real and reactive power. The real power is independently controlled by varying the angle of voltage injection of the UPQC. The reactive power is controlled by varying the magnitude of shunt voltage injected by the UPQC.

CONCLUSION

The UPQC system is successfully designed and modeled using the circuit elements of simulink. The sag in the voltage is created by applying an additional heavy load at the receiving end. This sag is compensated by using the DVR part of UPQC. The simulation results are in line with the predictions. The THD in the output is reduced by operating the inverter at 250 Hz. The hardware is fabricated and tested using PIC micro controller. The experimental results closely agree with the simulation results. The eight bus system with UPQC is successfully designed and modeled using the circuit elements of simulink. The sag in the voltage is created by applying an additional heavy load at the receiving end. This sag is compensated by using DVR.The simulation results are in line with the predictions. The THD in the output is reduced by UPQC. The fourteen bus system is drawn by using the corresponding data. This is simulated and the results are presented. The results indicate that the power quality is improved by introducing UPQC. The thirty bus system is simulated and the corresponding results are given. Multiple UPQCs are proposed to maintain the required voltage. The fifty bus system is also simulated and the corresponding results are given. Multiple UPQCs are proposed to maintain the required voltage.

REFERENCES

1.Akagi, H., and Fujita, H., "A new power line conditional for harmonic compensation in power systems," IEEE Trans. Power Del., Vol.10, No.3, pp:1570-1575, Jul, 1995.

2. Akagi, H., Watanabe, E.H., and Aredes, M., Instantaneous Power Theory and Applications to Power Conditioning. Wiley-IEEE Press, April 2007.

3. Aredes, M., "A combined series and shunt active power filter," in Proc. IEEE/KTH Stockholm Power Tech Conf., Stockholm, Sweden, pp.18-22, June 1995.

4. Akagi, H., and Fujita, H., 1995. A new power line conditional for harmonic compensation in power systems IEEE Trans power delivery, 10, 1570-1575.

5. Akagi, H.Y., Kanazawa and Nabae, A., 2007 instantaneous reactive power compensator comprising switching devices without energy storage components. IEEE Trans. India Appl.20: 625-630.

6. Aredes, M., and Watanabe, E.H., 1995. New control algorithms for series and shunt three-phase four wire active power filters. IEEE Trans. Power delivery 10: 1649-1656.

7. Aredes, M., Akagi, H., Watanabe, E.H., Salgado, E.V., Encarmacao, L.F., "Comparisons between the p-q and p-q-r Theories in Three Phase FourWire Systems," IEEE Transactions on Power Electronics, vol.24, no.4, pp.924-933, April, 2009.

8. Alkas, I.H., and sharaf, A.M., 2007, A Photovoltaic Array simulation model for Matlab – simulink GUI environment, clean Electrical power, ICCEP'07 – International conference PP 341 – 345.

9. Ahed. Kazemi and Ali Azhdast, "Implementation of a Control Strategy for Dynamic Voltage Restorer (DVR) and Dynamic Voltage Compensator (DVC)", IEEE Power System Conference, pp. 1-6, 2009.

10. Ahmed, A., Helal and Mohamed, H., Saied, "Dynamic Voltage Restorer Adopting 150% Conduction Angle VSI", IEEE Electrical Power and Energy Conference, pp. 1-6, 2008. 132

11. Ben-Brahim, L., and Tadakuma, S., "A novel multilevel carrier- based PWM- control method for GTO inverter in low index modulation region", IEEE Transactions on Industrial Applications, Vol 42 No 1 pp.121-127, 2006.

12. Banaei, M.R., Hosseini, S.H., and Gharehpetian, G.B., "Interline Dynamic Voltage Restorer Control using a Novel Optimum Energy Consumption Strategy", Simulation Modelling Practice and Theory 14, pp. 989-999, 2006.

13. Bingsen Wang, G., Venkataraman, and Illindala, M., "Operation and Control of DVR using Transformer Coupled H-bridge Converter", IEEE Transactions on Power Electronics, Vol. 21, No. 4, pp. 1053-1061,2006.

14. Basu, M., DAS, S.P., and Dubey, G.K., 2008 "Investigation on the performance of UPQC – Q for voltage sag, "IET Generation, Transmission and Distribution-2, 414 – 423.

15. Barker, P.P., and De Mello, R.W., 2000. Determining the impact of distributed generation on power systems. Part Radial distribution systems. Proc.IEEE power Eng.Sec.Summer Meeting, 3: 1645-1656