INTERNATIONAL JOURNAL OF SCIENTIFIC PROGRESS AND RESEARCH (IJSPR) ISSN: 2349-4689
Issue 132, Volume 45, Number 04, March 2018

Efficient Power Factor Controlling of PQ Based Predictive Control DSTATCOM

Priya Raj[1], Prof. Anurag Soni[2]

[1]M. Tech. Scholar, [2]Guide

Department of Electrical Engineering, LNCT, Bhopal

Abstract - Every electrical system works better only if its power delivering capacity is reliable and better, in other words power factor is good. Various devices and methods have been implemented like mechanical switches, reactor banks, capacitor banks of different static compensators in distribution system for power factor improvements. Many customizations has been done to improve the quality of power delivering to the load by distribution system some of them which were based on DSTATCOM performs better. So in the same context this work is also working towards improvements in the power factor by utilizing the PQ based predictive control DSTATCOM. From the simulation waveforms the reliability of proposed system is clearly better than previous systems.

Keywords - PQ Based Predictive System, DSTATCOM, Power Factor.

I. INTRODUCTION

A centralized grid for instance, aids much transmission and distribution congestion that makes it more inefficient and unreliable. Additionally, there is a contentious risk for failure to meet peak demand periods often served by inefficient power plants operating over a very short period of time (a few hours-per-year). These factors, added to increased power consumption due to population growth further stretch the traditional grid to its limits, raising serious concerns on economic impact of blackouts and interruptions being witnessed today.

In fact, the grid transformation blend has already started with the rise of a large group of brilliant energy devices and systems, prepared to do drastically upgrading grid proficiency, unwavering quality and security at lessened taxes, and additionally advance green (clean) power era. Savvy energy, involves digital data innovation application to electrical power network advancement. Though keen grid is the consequence of applying such innovation to create, transmit, and disseminate electrical power to the client through its different building squares to be specific: regular and front line designing facilities, shrewd meters, sensors and clever control devices, data innovation, a two way communication system that empowers the client re-deal overabundance energy request back to the grid, a rechargeable point for electric vehicles (EVs). It has been assessed that, the potential advantages feasible from such transformation throughout the following 20 years would generously build profitability and GDP development, cut carbon emanation and enhance national security.

The distribution system is generally seen as an interface between the mass and the custom powers, whose control objective is to strike a harmony between the two for keeping up consistent solid operation of the system. A decent dissemination control system is in this way anticipated that would upgrade the general system proficiency through misfortune decrease and power quality control. By and by, dissemination system hardware, for example, the tap evolving transformers, synchronous machines, capacitor banks, static volt-ampere-reactive compensators (SVCs), and numerous other adaptable ac transmission systems (FACTS) controllers at device level, including DSTATCOM are being connected for such control.

To comprehend this phenomenon, the losses with respect to distribution lines and transformers have been characterized into resistive and reactive parts. While, resistive load losses are unavoidable, reactive load losses which exude from capacitive and inductive circuit properties (wiping out each other) can be maintained a strategic distance from. In a vast amount, the reactive power expands distribution line streams being in charge of further energy losses. The distribution transformers regularly work at proficiency higher than 98%, in this manner making their center losses insignificant. Be that as it may, transmission and distribution system losses together constitute 9% of the aggregate from era to the customer's feeder. Out of this figure just 2-3% of the losses is inferable from the feeder lines and coupling transformers. These are presently for the most part viewed as the fundamental driver of waveform distortions coming about into the purported power quality (PQ) issues.

There are different academic researchers on the across the globe directly exploring into DSTATCOM control of power quality issues. Specifically, with the present influx of shrewd grid development, various multinational power organizations are actively putting into DSTATCOM advances with the expectation of incorporating such inside the savvy grid setting. These organizations incorporate Hitachi Europe, S and C Electric Company, ABB, Siemens, Schneider, and GE. Addressing the issue of the Volt-VAR compensation in connection to taking care of the PQ issue at the distribution network is the topic of this theory.

II. DISTRIBUTION STATIC COMPENSATOR

DSTATCOM is a shunt associated device intended to control the voltage either by producing or retaining the reactive power. The schematic outline of a D-STATCOM is as appeared in Figure 2.1 which contains DC capacitor, Voltage Source Inverter (VSI), coupling transformer and reactor.

Figure 2.1 Schematic diagram of D-STATCOM.

As on account of Dynamic Voltage Regulator (DVR), the VSI creates voltage by taking the contribution from the charged capacitor. It utilizes Pulse Width Modulation (PWM) exchanging system for this reason. This voltage is conveyed to the system through the reactance of the coupling transformer. The voltage contrast across the reactor is utilized to deliver the active and reactive power trade between the STATCOM and the transmission network [8]. This trade is done significantly more quickly than a synchronous condenser and enhances the execution of the system.

A D-STATCOM is equipped for remunerating either transport voltage or line current. It can work in two modes based on the parameter which it manages [9]. The operation methods of DSTATCOM are:

A. Voltage Mode Operation:

In this mode, it can make the transport voltage to which it is associated a sinusoid. This can be achieved independent of the unbalance or distortion in the supply voltage.

B. Current Mode Operation:

In this method of operation, the D-STATCOM powers the source current to be an adjusted sinusoid regardless of the load current harmonics. The essential working standard of a D-STATCOM in voltage sag relief is to control the transport voltage by creating or retaining the reactive power. Along these lines, the DSTATCOM works either as an inductor or as a capacitor based on the greatness of the transport voltage.

C. Inductive Mode Operation:

If the transport voltage greatness is more than the appraised voltage then the D-STATCOM acts as an inductor engrossing the reactive power from the system.

D. Capacitive Mode Operation:

In the event that the transport voltage size (VB) is not exactly the appraised voltage then the D-STATCOM acts as a capacitor producing the reactive power to the system.

III. PROPOSED SYSTEM MODEL

Proposed work is based on D-STATCOM sub system for power quality controller has given in figure 3.1. Figure 3.2 Shows the Simulink model of DSTATCOM which consists of two Voltage Source Converters (VSC) connected in cascaded form by a DC link which acts as a voltage source for the two inverters. Proposed work is an Efficient Power Factor Controlling of PQ Based Predictive Control DSTATCOM .

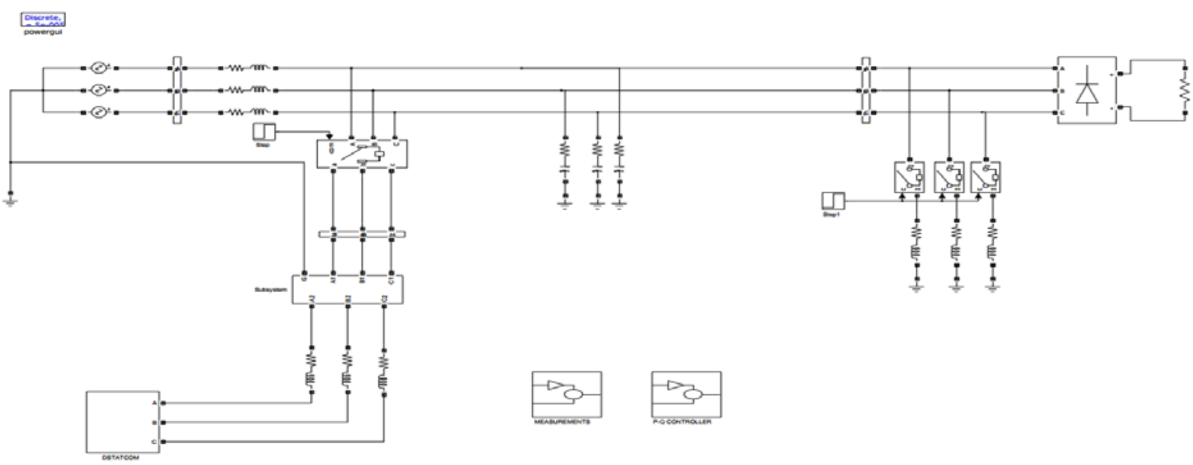

Figure 3.1 SIMULINK Modeling of Proposed work.

In the average model of a Distribution STATCOM, the IGBT Voltage-Sourced Converters (VSC) are represented by equivalent voltage sources generating the AC voltage averaged over one cycle of the switching frequency. This model does not represent harmonics, but the dynamics resulting from the control system and power system interaction are preserved.

As demonstrated in figure 3.1 for a three phase AC power supply there are major blocks are AC supply, subsystem, DSTATCOM, measurement unit and P-Q Controller.

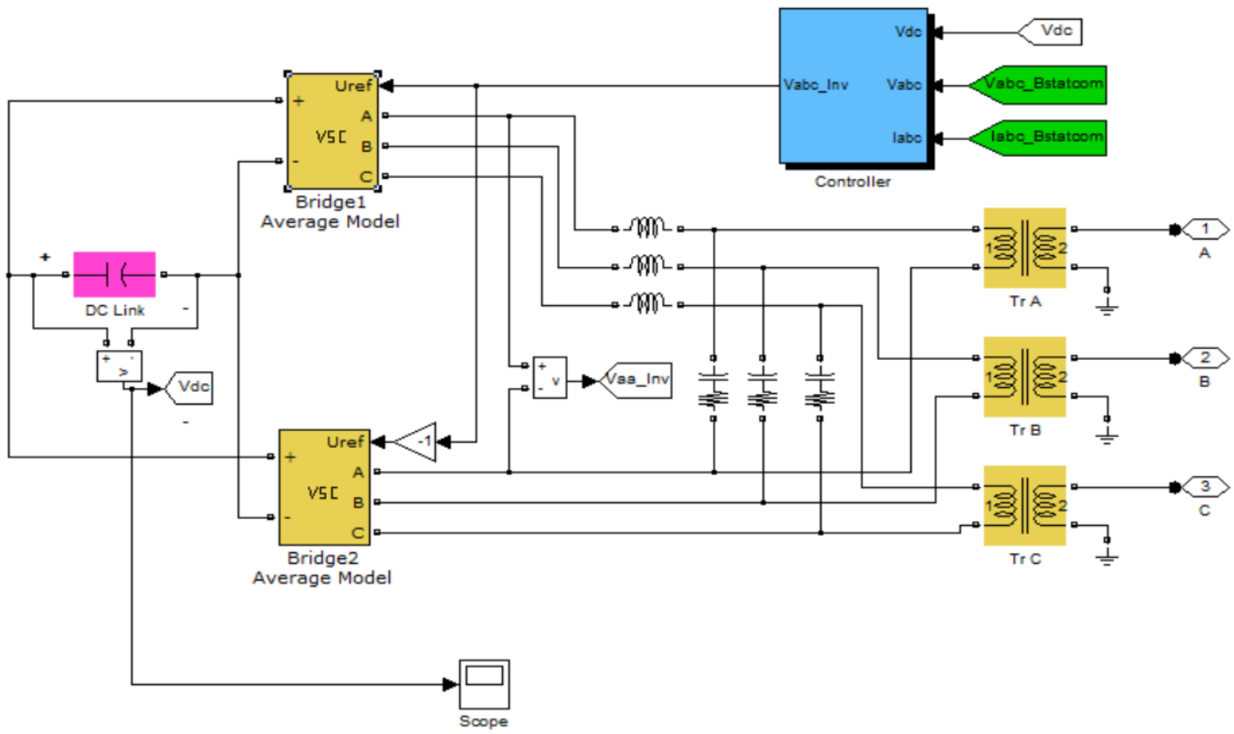

Figure 3.2 Simulink model of DSTATCOM.

IV. SIMULATION OUTCOME

The proposed test system was implemented in MATLAB /Simulink. Simulation waveform of proposed work on various conditions is given. Proposed system outperforms for power quality control issues.

The traditional distribution system design parameters would normally include analysis of the system's voltages, currents, and active and reactive power RMS quantities at the PCC through ordinary control systems.

Identification of PQ issues is basically done either from the perspective of the disturbances caused by the supply voltage quality or load current quality. Voltage sag or voltage swell represent an example of the first category. These kinds of disturbances can lead to tripping of sensitive computing and medical equipment, which often translate into industrial shut-down. Figure 4.1 demonstrated variation of DC bus voltage.

Figure 4.2 shows the Power Factor of proposed work compared with previous work [1] Without DSTATCOM with DSTATCOM. Figure 4.3 shows the waveform of Power Factor of proposed model Active and reactive power.

Reactive current injected by DSTATCOM existing work and figure 4.4 shows the Source voltage (Vsabc) and current (Isabc). Waveform screen shot of proposed work.

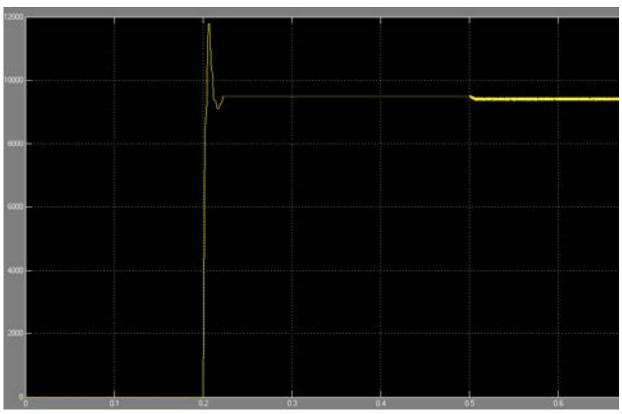

Figure 4.1 Variation of DC Voltages.

Thus, giving DSTATCOM an edge over the passive filtering which so much depends on the wavering distribution and load structures. Hence, the DSTATCOM employed here is expected to neutralise the harmonic content of the feeder involved by injecting reactive current in phase with the harmonics induced by the load current in accordance with the level allowed in IEEE Std.

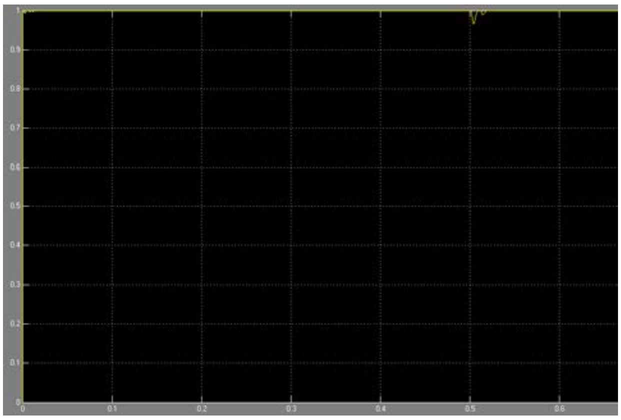

Figure 4.2 Power Factor.

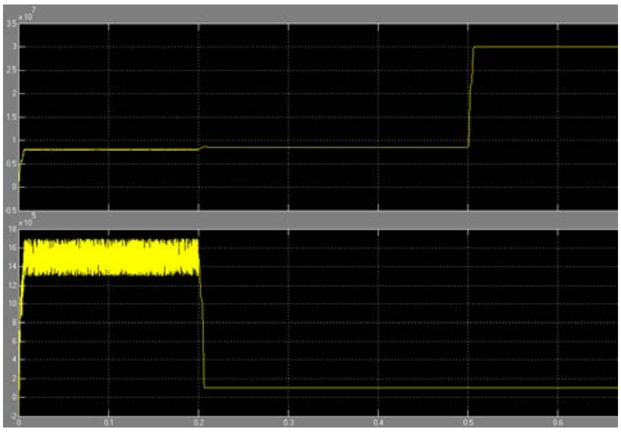

Figure 4.3 Three Phase Active and reactive power.

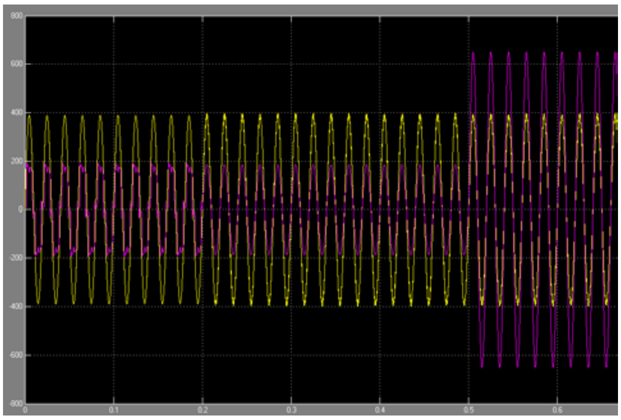

Figure 4.4 Source voltage (Vsabc) and current (Isabc).

V. CONCLUSION

A novel model-PQ subsystem and DSTATCOM based system is a smart solution to power quality (PQ) problems. Clear exploration was made of its advantages over existing controllers as an advanced control methodology with safety and constraints handing ability with regards the way it was grossly under-utilized. Consequently, an extensive study of the dynamic behaviour of the power quality control issues carried out. Particularly, the tuning effects of some specific parameters were initially established to guide proposed design and the ways these influence the design process. These comprise of weights, filter coefficients, and horizons and power factor. The waveform screen of proposed work demonstrates the level of distortion cancelation achieved by the various control strategies investigated here using the Predictive Control DSTATCOM simulation model described.

REFERENCES

[1] N. Henini, F. Benzerafa and A. Tlemçani, "Design and simulation of five-level inverter based DSTATCOM using fuzzy logic," IREC2015 The Sixth International Renewable Energy Congress, Sousse, 2015, pp. 1-6.

[2] Deepmala and A. Kumar, "Impact of load models on distribution system performance and impact of D-STATCOM," 2014 6th IEEE Power India International Conference (PIICON), Delhi, 2014, pp. 1-6.

[3] A.Jain, A. R. Gupta and A. Kumar, "An efficient method for D-STATCOM placement in radial distribution system," 2014 IEEE 6th India International Conference on Power Electronics (IICPE), Kurukshetra, 2014, pp. 1-6.

[4] V. M. Hrishikesan, K. Venkatraman, M. P. Selvan and S. Moorthi, "Application of D-STATCOM in SCIG based windfarms during normal and abnormal grid conditions," 2014 Eighteenth National Power Systems Conference (NPSC), Guwahati, 2014, pp. 1-6.

[5] Y. Deng, Y. Wang, K. H. Teo and R. G. Harley, "Space vector modulation method for modular multilevel converters," IECON 2014 - 40th Annual Conference of the IEEE Industrial Electronics Society, Dallas, TX, 2014, pp. 4715-4721.

[6] T. Durán and J. Pereda, "Novel continous space vector modulation in cascaded multilevel converters," IECON 2014 - 40th Annual Conference of the IEEE Industrial Electronics Society, Dallas, TX, 2014, pp. 1629-1635.

[7] N. Jarutus and Y. Kumsuwan, "Phase-shift space vector pulse width modulation for nine-switch inverter," 2014 17th International Conference on Electrical Machines and Systems (ICEMS), Hangzhou, 2014, pp. 3382-3385.

[8] D. Masand, S. Jain, G. Agnihotri "Control Strategies for Distribution Static Compensator for Power Quality Improvement", IETE Journal of Research,. Industrial Electronics, Vol. 54, 2008, pp. 421-428.

[9] R. Coteli, B. Dandil and F. Ata, Fuzzy-PI Current Controlled D- STATCOM, Gazi University Journal of Science 24-1 (2011), pp.91-99.

[10] R. Madhusudan and G. Ramamohan Rao, “Modeling and simulation of distribution STATCOM (DSTATCOM) for power quality problems voltage sag and swell based on sinusoidal pulse width modulation (SPWM),” in Proc.IEEE Int. Conf. on AESM., 30-31 March 2012, pp. 436-441.

[11] A. Shukla, A. Ghosh, and A. Joshi, “A hystereis current controlled flying capacitor multilevel inverter based DSTATCOM,” in Proc. IEEE Power Eng. Soc. General Meeting, San Francisco, Jun. 12-16, 2005, pp. 1801-1808.

[12] Y. Liang and C. O. Nwankpa, “A power-line conditioner based on flying-capacitor multilevel voltage-source converter with phase-shift SPWM,” IEEE Trans. Ind. Appl., vol. 36, no. 4, pp. 965-971, Jul./Aug. 2000.

[13] J. Rodriguez, J. S. Lai, and F. Z. Peng, "Multilevel inverters: A survey of topologies, controls and applications," IEEE Trans. Ind. Electron., vol. 49, no. 4, pp. 724-738, Aug. 2002.

[14] D. Masand, S. Jain and G. Agnihotri, Distribution Static Compensator Performance under Linear and Nonlinear Current Regulation Methods, Journal of Electrical System 4-1 (2008), pp.91-105.