Performance analysis of Power system after Implementation of FACTS Devices

Achiket Saurabh Singh*[1], Dr. Sanjay Jain[2]
*[1]M. Tech Student, Electrical Engineering Department, RKDF University, Bhopal, M.P.
achiket.saurabh@gmail.com[1]
[2]Professor& HOD, Electrical Engineering Department, RKDF University, Bhopal, M.P.
jain.san12@gmail.com[2]*

ABSTRACT

Many Optimization techniques and custom electrochemical capacitors are utilized to address these power quality issues; it is also enhanced by FACTS devices and custom power devices. Power electronics controllers for distribution systems are custom power devices. These power conditioning devices serve as power conditioners that assist in correcting the out-of-whack voltage and current. Devices like the DVR, DSTATCOM, and electronic ballasts are all employed in conjunction with customer requests to increase capacitance integrity. During times of low voltage, the voltage profile may be said to "be under-voltage." Sags that are present for a short amount of time, such as voltage sag, are known as instantaneous sag. There are a number of factors that lead to voltage sag, and the major ones are: faults in the power system, the electrical network being overloaded, and the current being taken by large electrical loads like motors and refrigerators. When there is voltage sag in the power system network, the relays and contactors break, resulting in a dark room and a variable power supply

Key words- Key words: FACTS devices, DSTATCOM, STATCOM

1. INTRODUCTION

Disruptive electronic devices are often described as "bad system reliability." Providers, on the other hand, providers are often aware of disruptive effects due to the major power system concerns that lead to cellular highs. The connection method between these electrical and mechanical standards is used to assess energy quality problems. What appears to be the "best" energy quality in one type of hardware may be the "terrible" power in an equally different device. If you have attractive technology, and you increase the ripple voltage to more consumers. This power transfer problem is often caused by the use of converters and electrolytic capacitors, such computers or motor controls, which act as small loads. With the increasing use of transformers, the current voltage / harmonic currents produced lead to higher pressures in the energy system, which in turn contributes to the production of active energy. A variety of industries have embraced the use of power appliances for a variety of reasons such as variable voltage, variable frequency, and current controls to achieve high control, high efficiency, and timely authorization. Fortunately, it has not yet reached the point where the device is very sensitive yet. In summary, the basic difficulty here is that the rectifiers and inverters these machines use all have a non-sinusoidal current that in addition includes additional harmonics. The main difficulty is that those same electronic system devices, such as MOSFET, BJT, SCR, IGBT, etc., show changing behavior including Capacitor, Jfet, SCR, Field effect transistor. Quasi booty is referenced by this reference signal on some of these devices. Lead / failure electricity and the electronic component are used, resulting in the introduction of oscillations in the dispersed generation. In this case, distortion of voltage, excess power, and output voltage occurs due to electronics harmonics moving off the lines or resisting the source.

1.2 INSPIRATION

Various monitoring techniques included controlling the electrical current from each electrical grid were designed, and proved to be very useful. There are a few very difficult methods, however the methods described here require smaller scales and therefore more straightforward, which was the goal of the project.

Energy levels must be maintained for the energy system to function economically. As a major source of energy quality, energy depletion has been affected. The following are the main objectives of the project:

1. Voltage sag/swell detection in the power system network.
2. To use D.STATCOM to alleviate the power quality issue.
3. Determine the most appropriate control strategy for D.STATCOM.
4. To operate the equipment in order to achieve the desired results.

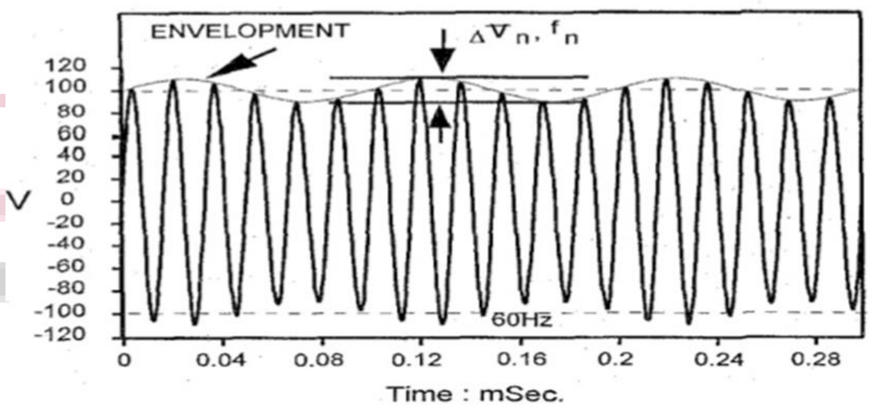

Fig. 1.1 Voltage Flicker Waveform, f1=10Hz,ΔV1=20V

2. DSTATCOM CONTROLLER PRINCIPLES

Due to the rapid development of energy technologies, the use of electrical energy in power systems at various levels of electricity is becoming increasingly common. STATCOM is one of the tools that can be used at the transmission level in the context of flexible AC transmission systems (FACTS). Distribution STATCOM (DSTATCOM) is a widely used power device operating in the STATCOM concept at the distribution level. This gadget can also be used for power outages for high-end users. At the distribution level, potential applications include power control, power factor adjustment, load reconciliation, and harmonic filtering.

This chapter summarizes DSTATCOM's management concepts for a number of operating systems. DSTATCOM has a voltage source converter (VSC) at its heart, which can be used for a variety of applications using the appropriate control algorithms. DSTATCOM is modeled on power management systems using SPWM-controlled PI algorithmic and, as a result, SVPWM algorithmic code. A two-level VSC is used in this simulation study to test DSTATCOM. The bus voltage is controlled by attracting or providing active power to the bus. DSTATCOM performance is investigated by SPWM and therefore SVPWM algorithms for power management applications.

The distribution system is shown in Figure 2.1, where DSTATCOM is immediately connected to the system via a star-delta transformer in PCC. The distribution bus is represented by a diagram form of the electrical potential of venin and the equivalent Resistivity of venin and connected to the distribution line. Three completely different masses are connected to the system by transformer on bus B4. The specified voltage in the PCC is one Pu according to the grid requirement. The voltage profile in the PCC is characterized by a high degree of change within the load. Acceptable control of DSTATCOM keeps the voltage at the PCC at 1 Pu. An integrated frame-based PI controller is used to control a two-level VSC to minimize the effects of voltage sag or overheating. The torture program is modeled on MATLAB. Set of semolina power system blocks.

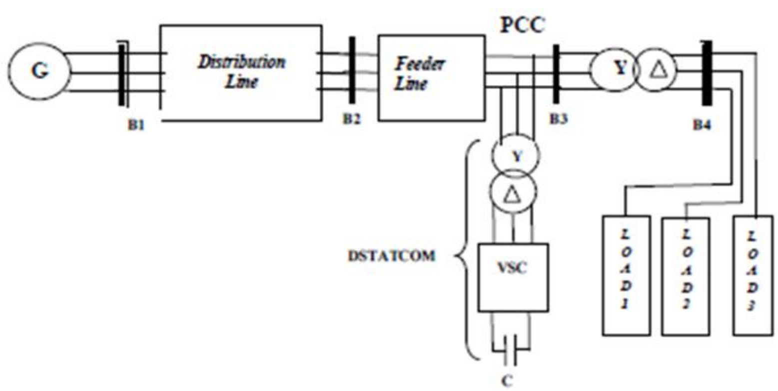

Fig 2.1 Schematic of a DSTATCOM

The cascade control of the power control system is shown in Figure 2.2. In terms of power control, two voltages are controlled in DSTATCOM. One is that the AC voltage of the power system on the bus, wherever DSTATCOM is connected, so the other is that DC connects the voltage across the entire capacitor. Each controller is in the form of a proportional integral (PI) form. The current output from the VSC is converted to d-axis and q-axis segments using the Park conversion method.

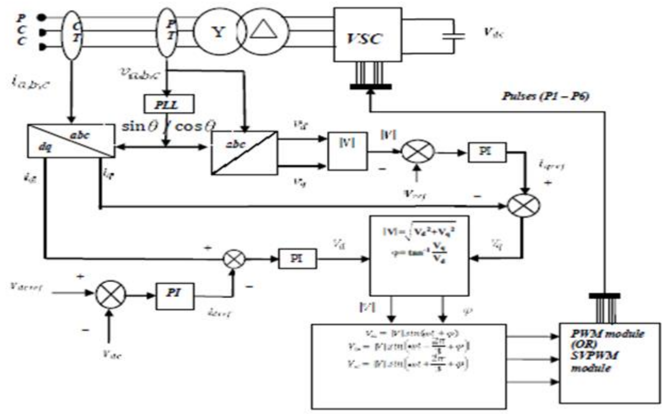

Fig 2.2 Block diagram for the complete control of the D-STATCOM

3. *UNIVERSAL BRIDGES*

A three-phase global power device called the Universal Bridge block has up to 6 switches on the bridge system. has the ability to set the power switch and device settings in the panel When the electrical equipment is changed naturally, the device list is completely different; when forced to change, the device list is completely different. The conversion follows the formation of a diode and the thruster of a three-phase converter.

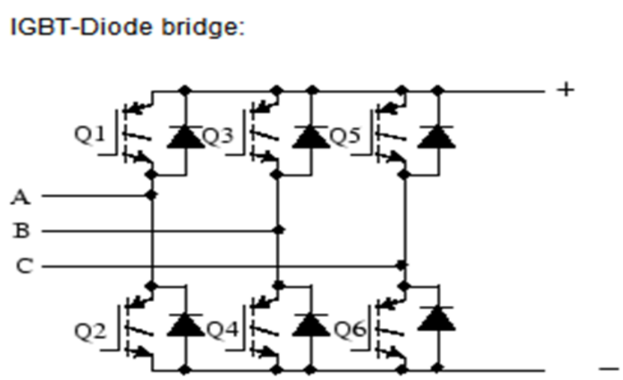

Fig. 3.1 Bridge structure of proposed D-STATCOM

3.1 THREE PHASE RLC LOAD BLOCK

Choose which of the following branch voltages will allow you to save 3 volts in all three-phase RLC block blocks. To turn the Y-connection downwards or indirectly, these are the phase-to-bottom or phase-to-medium voltages. These can be phase voltage to one of the delta connections. Make a total of 3 currents (total R, L, and C) in the 3-Phase Parallel RLC Load block: Select branch currents to live 3 total currents. This flows the waves flowing in all the branches of the delta delta organization. For 3 volts and 3 currents of the Three-Phase Parallel RLC load block, select the Voltage Branch option and Currents.

(a) Serial RLC load network (b) Parallel RLC load network

Fig. 4.7 RLC load serial and parallel

4. RESULTS

4.1 RESULT PARAMETERS

The Power Block calculates the active force (P), in watts, and the active power (Q), in the voltage-current mix at harmonic. To perform this calculation, the first block determines the critical values (magnitude and phase) of the voltage of the two input signals and the current. Like this active window, one simulation cycle must be completed before the output can give the correct value. With the main simulation cycle, the output is to control the constant misalignment values such as the first Voltage input and the current input parameters.

4.2 THD RESULT ANALYSIS BASED FREQUENCY

In this section discuss a complete analysis of harmonics. In the previous base paper operation at a frequency of 50 Hz, if you mimic the function of the base paper at a frequency range of 50 Hz the THD effect obtained 78.28%. To improve THD preform frequency version shown below.

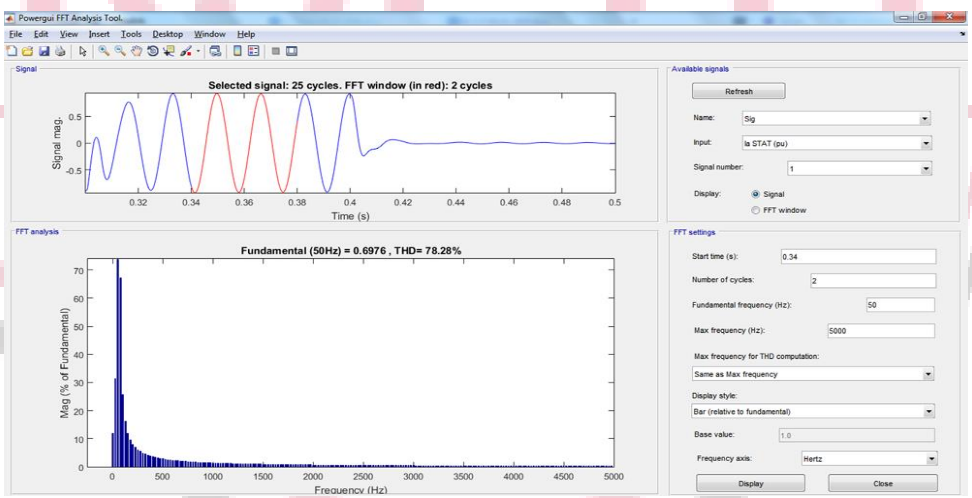

Fig. 4.1THD at 50Hz frequency (IEEE 2017)

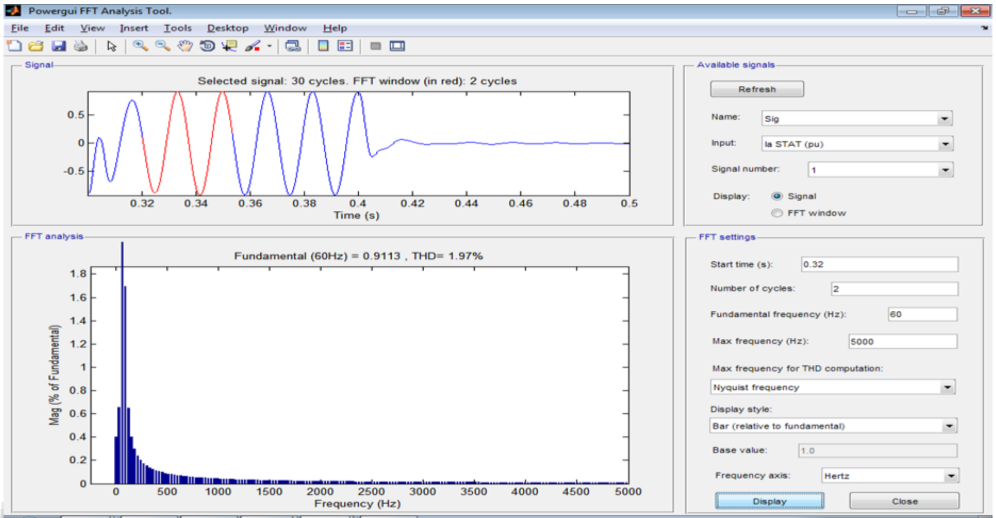

Fig. 4.2 D-STATCOM output with Reduced THD

Last to show the proposed output in terms of harmonic distortion (THD), D-STATCOM wave-generated THD is only about 1.92 and the sine wave is low. That is the overall result of the proposed project; now discuss the conclusion and future work of the method presented in the next chapter.

4.3 RESULT COMPARISON

In this section discuss the result comparison of proposed work with previous method on the basis of active and reactive power that is shown in the below figure 4.2.

Fig . 4.3 Base Method's Active and Reactive Power

In the above figure 4.2 shows the active and reactive power of base method that is higher fluctuation and instability as compare proposed method shows lower fluctuation show's in the next figure that 4.3.

REFERENCES

[1] Akagi, Hirofumi, Edson Hirokazu Watanabe, and Mauricio Aredes. The instantaneous power theory. John Wiley & Sons, Inc., 2007.

[2] Kumar, SV Ravi, and S. Siva Nagaraju. "Simulation of D-STATCOM and DVR in Power Systems." ARPN Journal of Engineering and Applied Sciences 2, no. 3 (2007): 7-13.

[3] Blazic, Bostjan, and Igor Papic. "Improved D-StatCom control for operation with unbalanced currents and voltages." IEEE Transactions on Power Delivery 21, no. 1 (2006): 225-233.

[4] Haque, M. H. "Compensation of distribution system voltage sag by DVR and D-STATCOM." In Power Tech Proceedings, 2001 IEEE Porto, vol. 1, pp. 5-pp. IEEE, 2001.

[5] Twining, E., M. J. Newman, P. C. Loh, and D. G. Holmes. "Voltage compensation in weak distribution networks using a D-STATCOM." In Power Electronics and Drive Systems, 2003. PEDS 2003. The Fifth International Conference on, vol. 1, pp. 178-183. IEEE, 2003.

[6] Ledwich, Gerard, and Arindam Ghosh. "A flexible DSTATCOM operating in voltage or current control mode." IEE Proceedings-Generation, Transmission and Distribution 149, no. 2 (2002): 215-224.

[7] Reed, G. F., J. E. Greaf, T. Matsumoto, Y. Yonehata, M. Takeda, T. Aritsuka, Y. Hamasaki et al. "Application of a 5 MVA, 4.16 kV D-STATCOM system for voltage flicker compensation at Seattle Iron and Metals." In Power Engineering Society Summer Meeting, 2000. IEEE, vol. 3, pp. 1605-1611. IEEE, 2000.

[8] Reed, G. F., J. E. Greaf, T. Matsumoto, Y. Yonehata, M. Takeda, T. Aritsuka, Y. Hamasaki et al. "Application of a 5 MVA, 4.16 kV D-STATCOM system for voltage flicker compensation at Seattle Iron and Metals." In Power Engineering Society Summer Meeting, 2000. IEEE, vol. 3, pp. 1605-1611. IEEE, 2000.

[9] Etminan, S., and R. H. Kitchin. "Flicker meter results of simulated new and conventional TSC compensators for electric arc furnaces." IEEE Transactions on Power systems 8, no. 3 (1993): 914-919.

[10] Alves, Mario Fabiano, Zelia Myriam Assis Peixoto, Celso Peixoto Garcia, and Deilton Goncalves Gomes. "An integrated model for the study of flicker compensation in electrical networks." Electric Power Systems Research 80, no. 10 (2010): 1299-1305.

[11] Kagalwala, R. A., S. S. Venkata, M. A. El-Sharkawi, N. G. Butler, A. Van Leuven, A. P. Rodriguez, I. Kerszenbaum, and D. Smith. "Transient analysis of distribution class adaptive VAr compensators: simulation and field test results." IEEE transactions on power delivery 10, no. 2 (1995): 1119-1125.

[12] Morgan, Larry, James M. Barcus, and Satoru Ihara. "Distribution series capacitor with high-energy varistor protection." IEEE transactions on power delivery 8, no. 3 (1993): 1413-1419.

[13] O'Neill-Carrillo, E., G. T. Heydt, E. J. Kostelich, S. S. Venkata, and A. Sundaram. "Nonlinear deterministic modeling of highly varying loads." IEEE Transactions on Power Delivery 14, no. 2 (1999): 537-542.

[33] Sannino, A., Svensson, J., & Larsson, T. (2003). Power-electronic solutions to power quality problems. Electric Power Systems Research, 66(1), 71-82.

[14] Mienski, R., R. Pawelek, and I. Wasiak. "Shunt compensation for power quality improvement using a STATCOM controller: modelling and simulation." IEE Proceedings-Generation, Transmission and Distribution 151, no. 2 (2004): 274-280.\

[15] Mienski, R., R. Pawelek, and I. Wasiak. "Application of STATCOM controllers for power quality improvement-modeling and simulation." In 10th International Conference on Harmonics and Quality of Power. Proceedings (Cat. No. 02EX630), vol. 2, pp. 620-625. IEEE, 2002.

[16] Elnady, Amr, and M. M. A. Salama. "Mitigation of the voltage fluctuations using an efficient disturbance extraction technique." Electric power systems research 77, no. 3-4 (2007): 266-275.

[17] Wagner, R., M. Schroeder, T. Stephanblome, and E. Handschin. "A multifunctional energy-storage system with high-power lead–acid batteries." Journal of power sources 78, no. 1-2 (1999): 156-163.

[18] Singh, Bhim, Maulik Kandpal, and Ikhlaq Hussain. "Control of grid tied smart PV-DSTATCOM system using an adaptive technique." IEEE transactions on smart grid 9, no. 5 (2016): 3986-3993.