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POWER QUALITY IMPROVEMENT USING D-STATCOM WITH SRF THEORY

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Abstract:. *This paper shows detail information about compensation of reactive power using D-STATCOM using SRF/DQ theory(Synchronous Reference Frame).It will mitigate the current based power quality problems by compensating the reactive power with the help of D-STATCOM.*

We are adding different loads to the source and calculating the reactive power it is compensated with the help of the D-STATCOM which act as a inverter by providing reactive power to the load and moreover it reduces the harmonics. In SRF we are performing ZVR mode of operation in order to extract the reactive power component. By performing this we able to achieve our SIMULATION/MATLAB results. We are reducing the power quality issues and performed under various kinds of loads.

Keywords: Distribution Static Compensator (DSTATCOM); SYNCHRONOUS REFERANCE FRAME(SRF)/DQ Theory; Total Harmonic Distortion (T.H.D).

I.INTRODUCTION

Present generation most of them loads in houses, industrial area, farm lands are inductive in nature like induction motors, washing machine motors, pump motors used in farm land etc. In this case they act as a inductive loads. The currents drawn by the various loads from the source is lagging in nature with respect to the voltage. By this the burden of the reactive power on the system drastically rises, which leads to the increase losses in the distribution system and moreover it will reduce capacity of active power flow through the distribution system. Due to the advancement of the power electronics, The nonlinear loads in the various system are rises, such as the inverters, rectifiers, UPS, computers, etc. Due these nonlinear loads a frequency component is produced. The frequency currents in the system are not the fundamental frequency components. Due to the harmonic component of the currents the power quality of the system got affected. Also, there is an impact of the unbalancing on transformers and generators operation. The answer for power quality improvement is the utilization of custom force gadget like DSTATCOM. Control plans announced in the writing for controlling of the DSTATCOM are simultaneous reference outline (SRF) hypothesis, current remuneration utilizing DC transport guideline, quick responsive power(IRP) hypothesis, a plan dependent on the neural organization method. Out of this load of procedures most normally utilized the hypotheses are coordinated reference outline (SRF) hypothesis and prompt responsive force (IRP) hypothesis.

In this paper MATALAB based reenactment of the DSTATCOM is completed utilizing momentary responsive force (IRP) hypothesis for pay of the receptive force, unbalance, decreasing absolute consonant mutilation (T.H.D) and improving force factor of the framework. lessens the symphonious defilement infused by the STATCOM into the force framework. The total reproduction of the Modular Multilevel Converter based STATCOM inside a force framework is acted in the MATLAB programming and the PI control is utilized for the controlling. The control circuit utilizes PWM

II. SYSTEM CONFIGURATION

The D-STATCOM for the most part comprises of a three-stage PWM controlled voltage source converter (VSC) of six IGBTs, DC capacitor and an inductor. Capacitor represents dynamic channel energy stockpiling. According to as per the exchanging calculation, inverter acquires bearing of communicating energy between DC capacitor and organization by inductor. Fig. 1 is showing the fundamental pay rule of an appropriation static compensator. It is made controllable to draw and supply the repaying current ic from/to the compensator, in order to wipe out current segments of sounds and responsive force on the source side, subsequently making the source side current absolutely sinusoidal and in stage with the source voltage also.

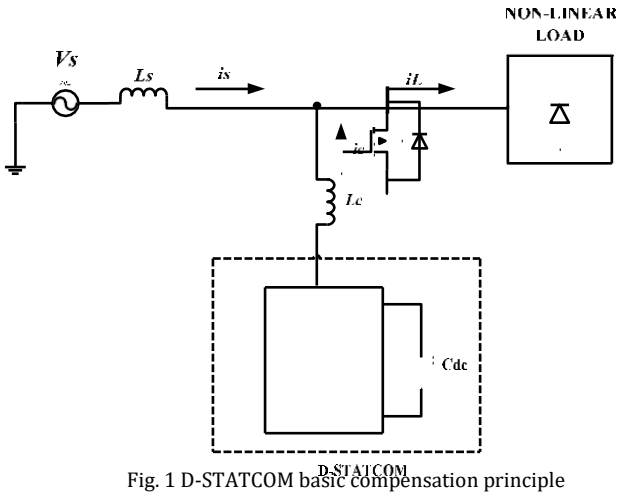

Fig. 1 D-STATCOM basic compensation principle

III. AN IMPROVED SRF BASED CONTROL ALGORITHM

The proposed improved SRF put together control calculation is based with respect to the change of reference outline. The improved SRF based control calculation makes fanciful even threephase voltage by utilizing one-stage voltage to bar blunders of location because of voltage hilter kilter and makes nonexistent even three-stage voltage by isolating per stage dynamic force drawn by the heap if there should be an occurrence of mutilated source voltage.

The essential thought is, above all else to figure the absolute normal dynamic force part conveyed from source to stack at the place of regular coupling. Then, at that point normal dynamic force of each stage is isolated by basic or dynamic segment of misshaped load current of particular stage to discover the greatness of fanciful three stage arrangement of voltage to be made. Size of voltage for three stages is determined as,

$$V_K = \sqrt{2} \times P_{K \div (i_{RMS})} \text{k=a,b,c} \quad \text{.....(1)}$$

Presently further turning co-ordinates are framed by utilizing fanciful even three-stage voltage vector framework. Again fanciful even three-stage vector framework is made by utilizing extent of voltage of any stage from condition (1), for instance A stage.

Let A phase voltage

$V_a = V_m \sin(wt + \phi)$ ....(2)

Where V_m is amplitude of A phase, ϕ is initial phase angle. Let A phase voltage delay 60°, then get the reversed-phase to structure C phase voltage:

$V_c = -V_m \sin(wt + \phi - 60°)$

$V_c = V_m \sin(wt + \phi + 120°)$ ...(3)

B phase voltage can be obtained from A phase and C phase voltage:

$$V_b = -V_a - V_c$$

$$V_b = V_m \sin(wt + \phi + 120°) \quad (4)$$

After structuring the imaginary symmetrical three-phase voltage V_{abc} by using A phase voltage, V_{abc} and i_{abc} are $\alpha\beta$ coordinate converted correspondingly according to equation

(5) and (6), and hence the voltage vector-V and current vector-i on αβ plane are

$$\begin{bmatrix} V\alpha \\ V\beta \\ Vo \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -1/2 & -1/2 \\ 0 & -\sqrt{3}/2 & -\sqrt{3}/2 \\ 1/\sqrt{2} & 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix} \begin{bmatrix} Va \\ Vb \\ Vc \end{bmatrix} \quad (5)$$

$$\begin{bmatrix} i\alpha \\ i\beta \\ io \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -1/2 & -1/2 \\ 0 & -\sqrt{3}/2 & -\sqrt{3}/2 \\ 1/\sqrt{2} & 1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix} \begin{bmatrix} ia \\ ib \\ ic \end{bmatrix} \quad (6)$$

After dq-change each vector pivots at the speed of precise recurrence [10]. Presently if the d-hub of dq arranges is in same period of changed voltage vector of fanciful framework then static directions can be moved in to pivoting dq facilitates as indicated by the fig. 2. STATCOM a minimal plan, or little impression, just as low commotion and low attractive effect. The force exchange in the STATCOM is appeared in the fig.1.

The trading of receptive force between the converter and the air conditioner framework can be constrained by shifting the abundancy of the 3-stage yield voltage of the converter. That is if the abundancy of the yield voltage is extended over that of the utility vehicle voltage then a current course through the reactance from the converter to the climate control system structure and the converter makes capacitive-open power for the forced air system structure. In the event that the plentifulness of the yield voltage is diminished beneath the utility transport voltage, then, at that point the current streams from the air conditioner framework to the converter and the converter ingests inductive-receptive force from the air conditioner framework. In the event that the yield voltage rises to the air conditioner framework voltage, the responsive force trade gets zero, in which case the STATCOM is supposed to be in a middle state. Then, at that point the stage shift between the converter-yield voltage and the air conditioner framework voltage can be changing correspondingly control genuine - power trade between the converter and the air conditioner

framework. As such, the converter can supply genuine capacity to the air conditioner framework from its DC energy stockpiling if the converter-yield voltage is made to lead the air conditioner framework voltage. Then again, it can retain genuine force from the air conditioner framework for the DC framework if its voltage lingers behind the air conditioner framework voltage. A STATCOM gives the ideal receptive force by trading the momentary responsive force among the periods of the air conditioner framework.

IV.PROPOSED SYSTEM

STATCOM is comprised of a coupling transformer, a VSC and a dc energy stockpiling gadget. STATCOM is equipped for trading receptive force with the transmission line due to its little energy stockpiling gadget for example little dc capacitor, if this dc capacitor is supplanted with dc stockpiling battery or other dc voltage source, the regulator can trade genuine and responsive force with the transmission framework, broadening its district of activity from two to four quadrants. A practical model of a STATCOM is appeared in Fig.1.

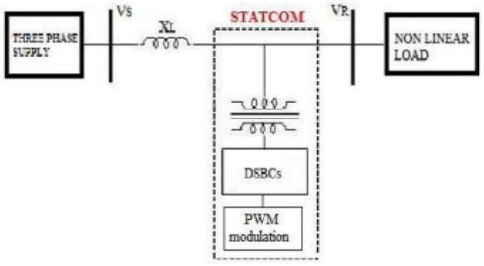

Figure.1. Overview diagram of STATCOM

In the event that the amplitudes of the air conditioner framework and converter yield voltages are equivalent, there will be no air conditioner current stream in/out of the converter and henceforth there will be no responsive force age/assimilation the air conditioner current greatness can be determined utilizing the

$$I_{ac} = \frac{V_{out} - V_{ac}}{X}$$

accompanyingequation.

Assuming that the ac current flows from the converter to the ac system. The corresponding reactive power exchanged can be expressed as follows.

$$Q = \frac{V_{2out} - V_{out}\, V_{ac}\, cos\, \alpha}{X}$$

The real power exchange between the voltage-sourced converter and the ac system can be calculated as follows.

$$P = \frac{V_{ac}\, V_{out}\, sin\, \alpha}{X}$$

V.PRPOSED SYSTEM DESCRIOTION

A) D-STATCOM

The DSTATCOM innovation is presently a full grown innovation for giving responsive force remuneration, load adjusting, and additionally nonpartisan current and symphonious current pay (whenever needed) in AC appropriation organizations. It has advanced in the past 25 years with improvement as far as changing designs, control techniques, and strong state gadgets. These remunerating gadgets are additionally used to control the terminal voltage, stifle voltage flash, and improve voltage balance in three-stage frameworks. These goals are accomplished either exclusively or in blend contingent on the prerequisites and the control methodology and setup that should be chosen properly. This part depicts the historical backdrop of improvement and the current status of the DSTATCOM innovation..

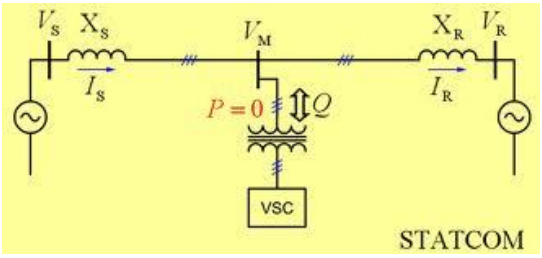

Fig.3: Line diagram of DSTATCOM

B)POWER QUALITY

Present-day AC conveyance frameworks are confronting various force quality issues, particularly because of the utilization of touchy hardware in the majority of the modern, private, business, and footing applications. These force quality issues are named voltage and current quality issues in dispersion frameworks. The custom force gadgets (CPDs), in particular, DSTATCOMs (conveyance static compensators), DVRs (dynamic voltage restorers), and UPQCs (bound together force quality conditioners), are utilized to relieve a portion of the issues relying on the prerequisites. Out of these CPDs, DSTATCOMs are broadly utilized for relieving the current-based force quality issues. There are various current-based force quality issues, for example, helpless force factor, or helpless voltage guideline, uneven flows, and expanded impartial current. Subsequently, contingent on the issues, the design of the DSTATCOM is chosen in the training. With the target of moderating the current-based

force quality issues particularly in circulation frameworks, this section centers around the arrangements, plan, control calculations, displaying, and illustrative instances of DSTATCOM**s**

VI. SIMULATION RESULTS

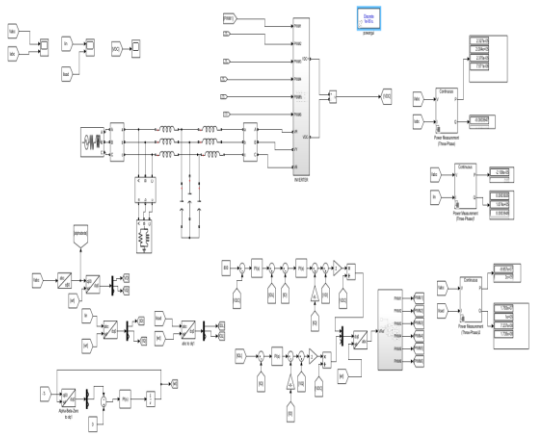

Fig.4 MATLAB/SIMULINK circuit diagram OF SRF theory Based D-STATCOM

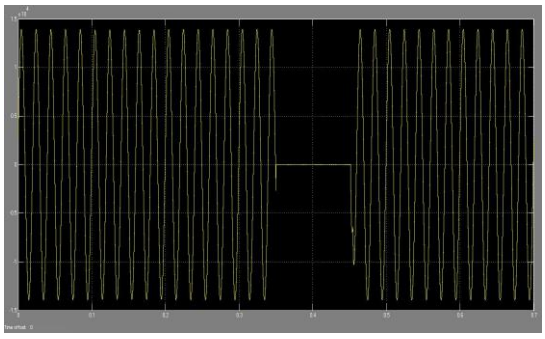

Fig 5.Grid voltage and current relation without DSTATCOM

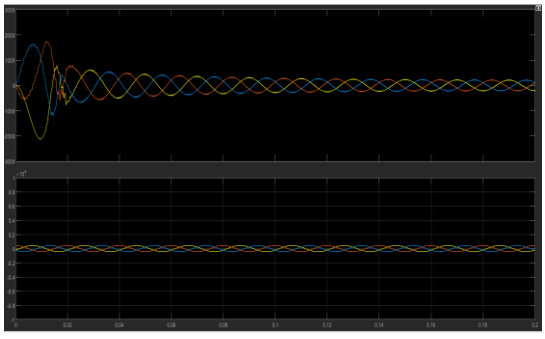

Fig 6.Relationship between source voltage and current with DSTATCOM

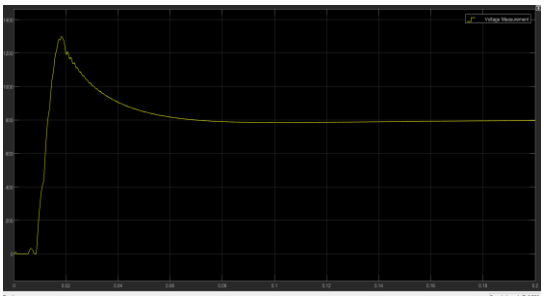

Fig 7.Control of dc bus voltage DSTATCOM

VII. CONCLUSION

The presentation investigation of proposed DSTATCOM with SRF control hypothesis is discovered to hush up acceptable for symphonious end and responsive force remuneration for straight and non direct loads. The DSTATCOM successfully remunerate the responsive force and music for straight cases. For non straight burden case the impact is remunerated by DSTATCOM and force factor is kept up at solidarity

VIII. FUTURE SCOPE

- The power request is continually expanding step by step. The force quality issues are additionally following a similar pattern and expanding step by step
- So there is need to lessen such force quality issues like voltage hang and swell and make the inventory framework effective.
- STATCOM is one of the promising innovations to upgrade the force nature of framework.
- The power quality can be as yet improved by utilizing delicate registering strategies like Bound together force stream regulator, Dynamic Voltage Restorer and so on

REFERENCES

[1]. Chandan Kumar, and Mahesh K. Mishra, A Voltage Controlled DSTATCOM for Power-Quality Improvement, IEEE transactions on power delivery, vol. 29, no. 3, june 2014

[2]. A. Elnady and M. Salama, Unified approach for mitigating Voltage sag and voltage flicker using the DSTATCOM, IEEE Transactions. Power Del,vol. 20, no. 2, pt. 1, pp. 9921000, Apr. 2005

[3]. S. Rahmani, A. Hamadi, and K. Al-Haddad, A. Lyapunov-function based control for a three-phase shunt hybrid active filter, IEEE Trans. Power Del., vol. 24, no. 4, pp. 22912299, Oct. 2008

[4]. M. K. Mishra and K. Karthikeyan, A fast-acting dc-link voltage controller for three-phase DSTATCOM to compensate ac and dc loads, IEEE Trans. Power Del., vol. 24, no. 4, pp. 22912299, Oct. 2009

[5]. M. K. Mishra, A. Ghosh, A. Joshi, and H. M. Suryawanshi, ?A novel method of load compensation under unbalanced and distorted voltages, IEEE Trans. Power Del., vol. 22, no. 1, pp. 288 295, Jan. 2007

[6]. M. K.Mishra, A. Ghosh, and A. Joshi, Operation of a DSTATCOM in voltage control mode, Trans. Power Del., vol. 18, no. 1, pp. 258 264, Jan. 2003

[7]. A. Jain, K. Joshi, A. Behal, and N. Mohan, Voltage regulation with STATCOMs: Modeling, control and results, IEEE Trans. Power Del.,vol. 21, no. 2, pp. 726 735, Apr. 2006

[8]. R. Gupta, A. Ghosh, and A. Joshi, Switching characterization of cascaded multilevel-inverter-controlled systems IEEE Trans. Ind. Electron., vol. 55, no. 3, pp. 1047 1058, Mar. 2008 International Journal of Engineering Science and Computing, March 2017 5383 http://ijesc.org/

[9]. S.H. Ko, S. Lee, H. Dehbonei, and C. Nayar, Application of voltageand current-controlled voltage source inverters for distributed generation systems, IEEE Trans. Energy Convers., vol. 21, no. 3, pp. 782 792,Sep. 2006.

[10]. A. Yazdani, M. Crow, and J. Guo, An improved nonlinear STATCOM control for electric arc furnace voltage flicker mitigation, IEEE Trans. Power Del., vol. 24, no. 4, pp. 2284 2290, Oct. 2009 [11]. I. Nagrath and M. Gopal, Control Systems Engineerin.