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A NOVEL CASCADEDTWO-LEVELH-BRIDGEVOLTAGESOURCEINVERTERBASED STATCOM FOR HIGH POWER APPLICATIONS

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Abstract:

Inthisprojectpresentsavarcompensationbyacascadedtwo-levelH-BridgeVSIbasedmultilevelstatic compensator (STATCOM) usingSVPWM. Thetopology consists oftwovoltage source inverters areconnected in cascaded through a 3-phase transformer. The benefit of this topology is that by maintaining asymmetric voltages at the dccapacitors ofthe inverters, the levels in the waveformof output voltage can be increases. This results power quality (PQ) improved. The main object of this project is balancing the dc link capacitor voltages ofmultilevelinvertersduringbalancingandunbalancingconditions.Thiscontrolleriscontrollinginvertervoltage in such a way that either –vesequence current flowing into the inverteris eliminated or reduces the unbalancing in the grid voltages. The performance of the control scheme during balanced and unbalanced conditions is analysed through MATLAB/SIMULINK.

Keywords: Dc link capacitor voltage balance, Power Quality (PQ), Multilevel voltage source inverters (VSI), Static Compensator, (STATCOM), Volt-Ampere Reactive (VAR), space vector pulse width modulation (SVPWM).

I. INTRODUCTION

In Electrical power system the generation,transmission and distribution of power is a difficult process, it requires working of many components in the power system to produce maximize output. One of the most importantpartsisthereactivepowerinthesystem.Inordertodelivertheactivepowerthroughtransmissionlines it is required to be maintaining the voltage. The reactive power is required for the operation of inductive loads and other loads like motor loads. The efficient management of reactive power in the power system leads to improve the performance of the electrical power system network.

Theefficientcontrolofreactivepowerinthepowersystemisalsoknownasreactivepowercompensation. Theproblemofreactivepowercompensationisassociatedwith:voltagesupportandloadcompensation.Voltage support comprises of decrease in voltage fluctuation at a giventransmission line terminals. Similarly Load compensationcomprises ofimprovementinvoltageregulation,powerfactor,realpowerbalancedrawnfromthe supply system, etc. of large inconsistent or fluctuating loads.Generally two types of compensation techniques have been used: shunt compensation and series compensation. These compensation techniques change the parameters of the power system and provide better VAR compensation.

In modern years, STATCOM formally known as static VAR compensators are developed. These compensators either generates or absorbs the reactive power even with a fastertime response and which are come under Flexible AC Transmission Systems (FACTS). This creates an increased apparent power transfer through a transmission line, and considerably enhanced stability by changing the parameters such as voltage, current phase angle, impedance and frequency that govern the power system.

OBJECTIVES

1. ReactivepowercompensationbyusingmultilevelSTATCOMinderegulatedpowersystem especially in high power applications.
2. Reducethetotalharmonicdistortion(THD)intheoutputvoltage.Sothatthepowerqualityis improved.

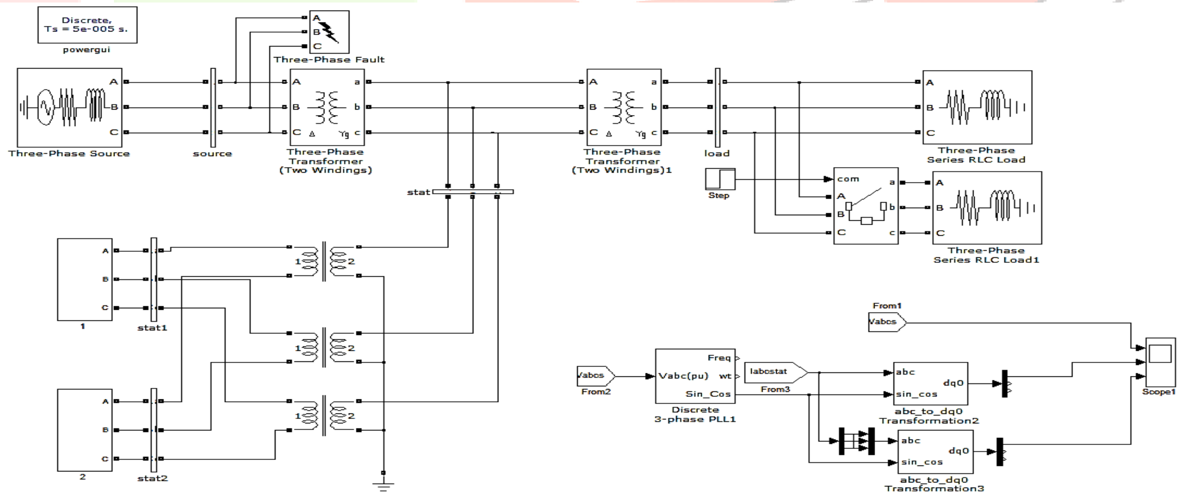
II.METHODOLOGY

1. Determiningtheneedofreactivepower compensation
2. Studyingdifferentcompensation techniques
   - Shunt compensation
   - Seriescompensation

3. ModellingofSTATCOM
4. CorrectionofvoltagesagbySTATCOM
5. DesignofVSIbasedSTATCOM**RESULTSANDDISCUSSION**

SIMULINKMODELOFCASCADEH-BRIDGEINVERTERBASEDSTATCOM

Thecompletesimulationdiagramofcascadeh-bridgeinverterbasedmulti-levelSTATCOMusing MATLAB/Simulink software is shown in and the control circuit is shown in



Simulationdiagramofcontrolcircuit

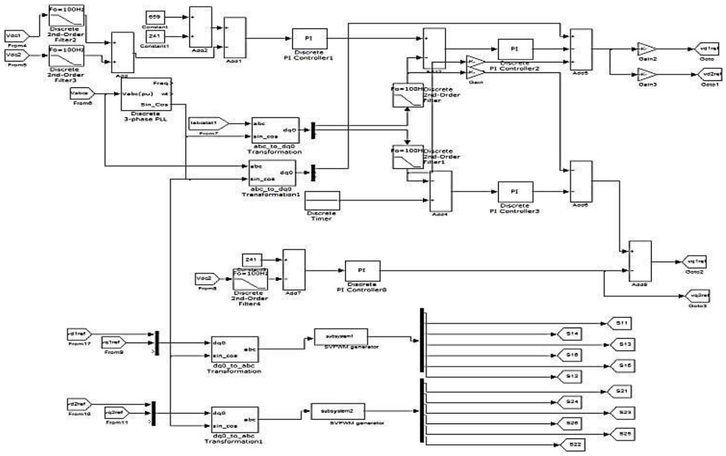


Fig.1.1Simulinkmodelofcontrolcircuit

A. REACTIVEPOWERCONTROL

Fig.1.2showsthewaveformsofsourcevoltageandinvertercurrent,DC-linkvoltageoftwoinvertersin the reactive power control case. In this case reactive power is controlled by setting i_q^* i.e reference reactive current component at a particular reference value. Initially $i_q^*$is set at 0.5 p.u. At t=2.0 s, i_q^* is changedfrom0.5to-0.5. Dc-linkvoltageoftwoinvertersareregulatedduringtheSTATCOMmodesare changed.

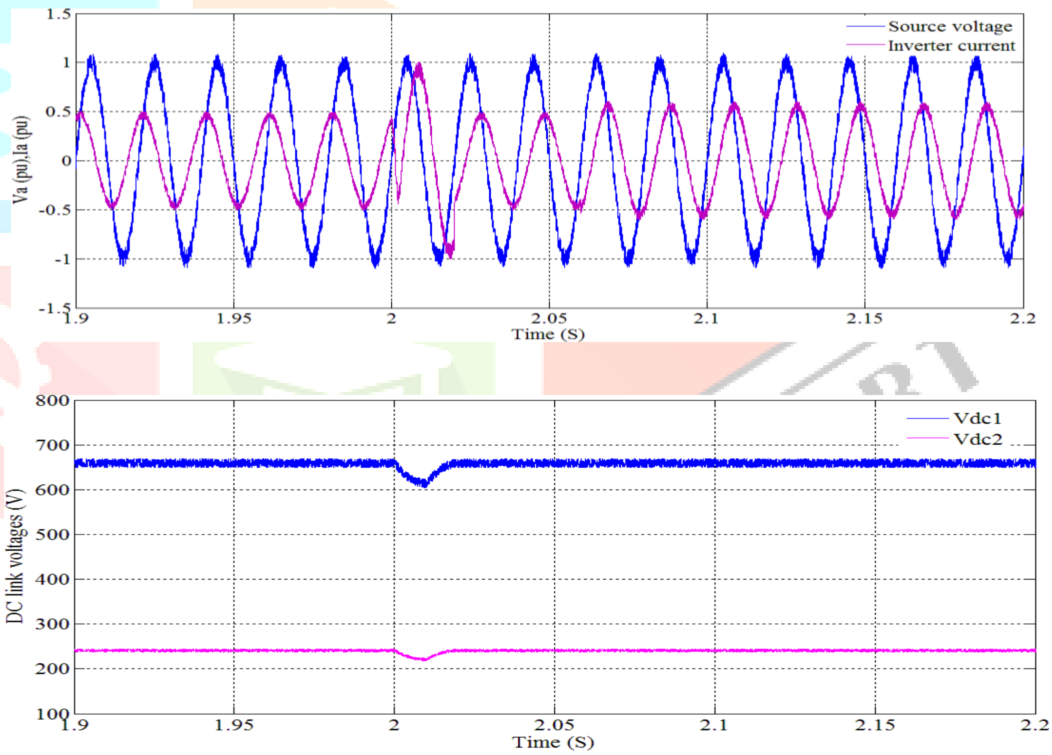
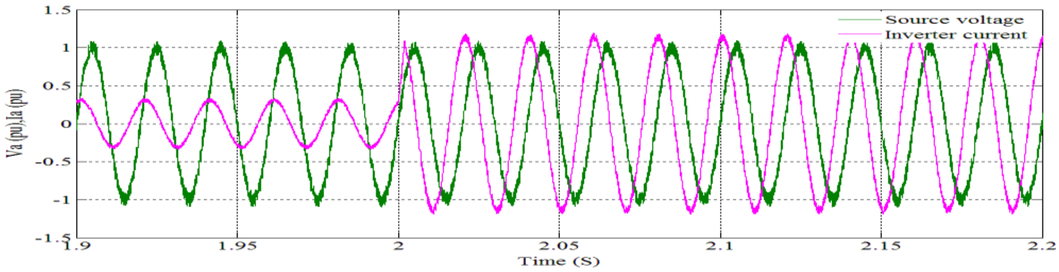


Fig.1.2Reactivepowercontrolwaveforms.(a)Sourcevoltageand Inverter current (b) DC-link voltages of two inverters

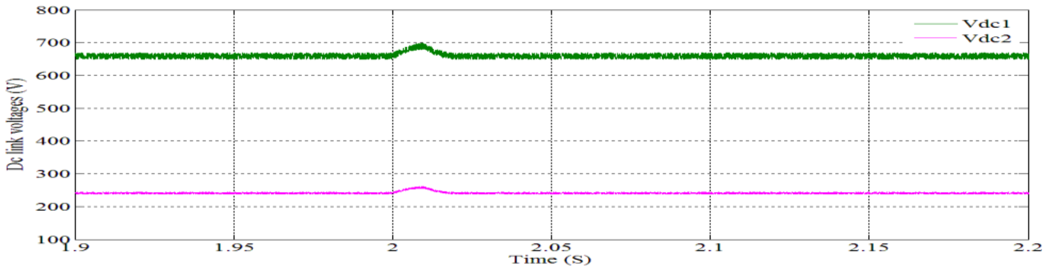
B. LOAD COMPENSATION

Fig. 1.3 shows the waveforms of source voltage and inverter current, DC-link voltage of two inverters in the load compensation case. In this case, reactive power of the load is compensated by the STATCOM. Initially STATCOM supplies the current of +0.5 p.u. When load current increases at t=2.0 s, STATCOM supplies more than +0.5 p.u. therefore load compensation is effectively achieved by the STATCOM.

The DC-link voltages of twoinvertersV_{dc1} andV_{dc2}areregulatedattheirrespectivevalueswhenSTATCOMoperatingmodesarechanged.



(a)

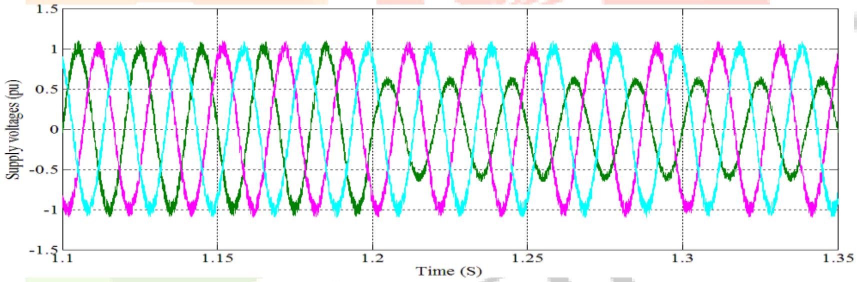


(b)

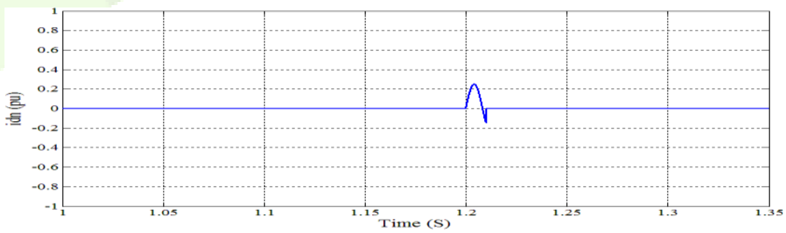
Fig.1.3Loadcompensation(a)Sourcevoltageandinvertercurrent
(b)DC-link voltagesof two inverters

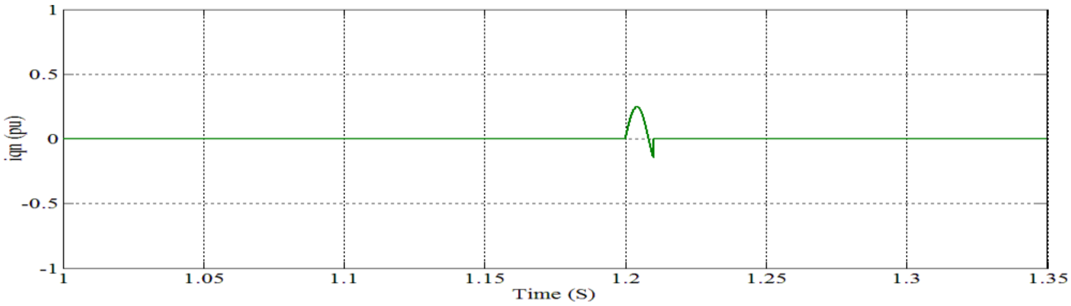
C. OPERATING DURING THE FAULT CONDITION

Fig.1.4showsthewaveformsofgridvoltagesonLVsideofthetransformer,duringthefaultcondition.Inwhich, a single line to ground fault is created at 1.2s and cleared after 200 ms on A phase of HV side of the 33/11 kv transformer. The corresponding d-q axis currents of the inverter are shown. The fault currents are regulated at their respective values i.e at zero.



(a)





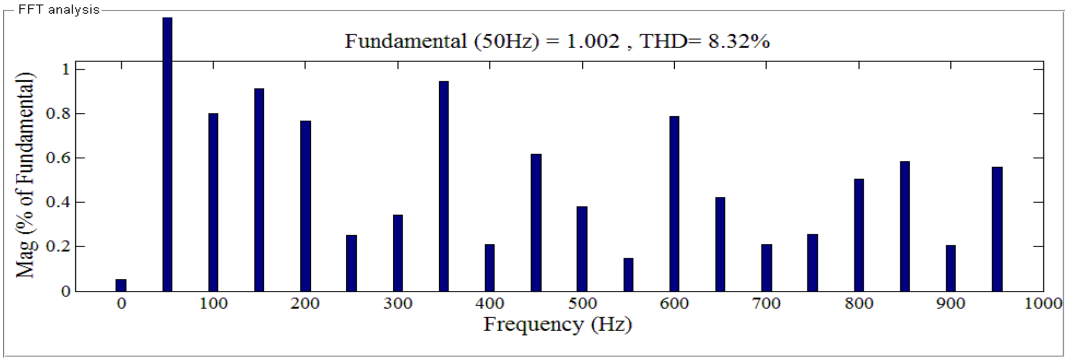
(c)

Fig.1.4Operationduringthefaultconditiona)GridvoltagesontheLVsideofthetransformerb)d-axisnegativesequencecurrent component c) q-axis negative sequence current component

FFT ANALYSIS

ThefrequencyspectrumofdifferentsignalsisobtainedbythisFFTanalysis.Powerguiblockcanbeusedtoobtain the frequency spectrum of any signal directly. The bar graph shows the order of harmonics and its magnitude.

FFT analysis is carried out to study the harmonics pectrumo floadvo



voltageandloadcurrentbeforeandafterusingSVPWM.ByusingSVPWMtheTHDloadvoltagereducedfrom 8.32% to 1.69%.The THD of load voltage with SPWM and SVPWM is shown in figure.

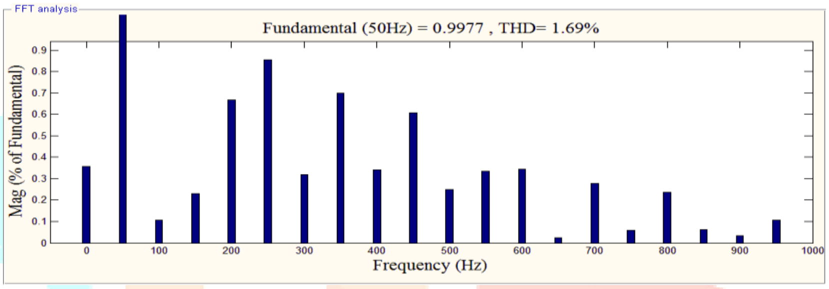


Fig.1.5 THDofloadvoltageusing SVPWMtechnique

Invertermodulation technique	**THDinLoad voltage(%)**
SinusoidalPulsewidth modulation	8.32
SpaceVectorPulsewidth modulation	1.69

Table1.5 ComparisonofTHD withSPWMand SVPWM

TheTotalHarmonicDistortion(THD)ofloadvoltagebyusingbothSPWMandSVPWMaretabulated. The harmonics are reduced in the load voltage by using a SVPWM inverter

IV CONCLUSION

Thebalancingdc-linkcapacitorvoltageofthecascadedH-Bridgemultilevelinverterbasedstatcom is a major issue. In this paper simple var compensation using a cascaded two level H-Bridge voltage source inverter based multilevel static compensator(STATCOM)is proposed**.** The scheme ensures regulation of dclink voltages of inverter at a asymmetrical levels and reactive power compensation. The main object of this paper is balancingthedclinkvoltagesofmultilevelinvertersduringbalancingandunbalancingconditions.Thiscontroller iscontrollinginvertervoltageinsuchawaythateither–vesequencecurrentflowingintotheinverteriseliminated or reduces the unbalancing in the grid voltages. SVPWM technique reduces the THD value of load voltage from 8.32%to1.69%.ThuspowerqualityisimprovedwithVarcompensation.Theperformanceofthecontrolscheme during balanced and unbalanced conditions is analysed through MATLAB/SIMULINK.

V REFERENCES

1. A. Shuk1a, A. Ghosh, and A. Joshi, “Hysteresis current contro1 operation off1ying capacitor mu1ti1eve1 inverter and its app1ication in shunt compensation of distributionsystems,”IEEE Trans. Power De1., vo1. 22, no. 1, pp. 396–405, Jan. 2007.
2. H. Akagi, S. Inoue, and T. Yoshii, “Contro1 and performance of a transformer1ess cascaded PWM STATCOM with star configuration,”IEEE Trans.Ind.App1.,vo1.43,no.4,pp.1041 – 1049, Ju1./Aug. 2007.
3. Y. 1iu, A. Q. Huang, W. Song, S. Bhattacharya, and G. Tan, “Sma11signa1 mode1-basedcontro1 strategy for ba1ancing individua1 dc capacitor vo1tages in cascade

mu1ti1eve1 inverter based STATCOM," IEEE Trans. Ind. E1ectron., vo1. 56, no. 6, pp. 2259–2269, Jun. 2009.

4. X. Kou, K. A. Corzine, and M. W. Wie1ebski, "Overdistention operation of cascadedmu1ti1eve1 inverters,"IEEE Trans. Ind. App1., vo1. 42, no. 3, pp. 817– 824, May/Jun. 2006.
5. B. B1azic and I. Papic, "Improved D-statcom contro1 for operation with unba1ancedcurrents and vo1tages,"IEEE Trans. Power De1., vo1. 21, no. 1, pp. 225–233, Jan. 2006.
6. A.1eon,J.M.Mauricio,J.A.So1sona,andA.Gomez-Exposito,"Softwaresensor-basedSTATCOM contro1 under unba1anced conditions," IEEE Trans. PowerDe1.,vo1.24,no.3,
7. pp.1623–1632, Ju1. 2009.
8. Y. Suh, Y. Go, and D. Rho, "A comparative study on contro1 a1gorithm for active front-end rectifier of 1argemotor drives under unba1anced input," IEEETrans. Ind. App1., vo1. 47, no. 3,pp.825– 835, May/Jun. 2011.
9. B. Singh, R. Saha, A. Chandra, andK. A1-Haddad, "Static synchronouscompensators (STATCOM):Areview,"IET PowerE1ectron.,vo1. 2,no.4, pp. 297–324, 2009.
10. H. Akagi, H. Fujita, S. Yonetani, and Y. Kondo, "A 6.6-kV transformer1ess STATCOMbasedon afive-1eve1 diode-c1amped PWM converter: System design and experimentation of a 200-V 10- kVA 1aboratory mode1," IEEE Trans. Ind. App1., vo1. 44, no. 2, pp. 672–680, Mar./Apr. 2008.
11. H.P.Mohammadiadiand M.T.Bina, "A transformer1ess, medium-vo1tage STATCOMtopo1ogy based on extended modu1ar mu1ti1eve1 converters," IEEE Trans. Power E1ectron., vo1. 26, no. 5, pp. 1534-1545, May 2011.