5th International Conference on Emerging Trends in Engineering, Technology, Science and Management
Institution of Electronics and Telecommunication Engineers, Ganganagar, Bengaluru, Karnataka, India (ICETETSM-17)
20th August 2017, www.conferenceworld.in ISBN: 978-93-86171-60-3

Investigation of Multilevel STATCOM System Behavior utilizing Cascaded Three-Level Inverter

Amit Kadani[1] ,Gopalaiah[2]

[1]*Mtech student, Dept. of E&IE, DayanandaSagar College of Engineering, Bengaluru, (India)*

[2] *Professor, Dept. of E&IE, DayanandaSagar College of Engineering, Bengaluru, (India)*

ABSTRACT

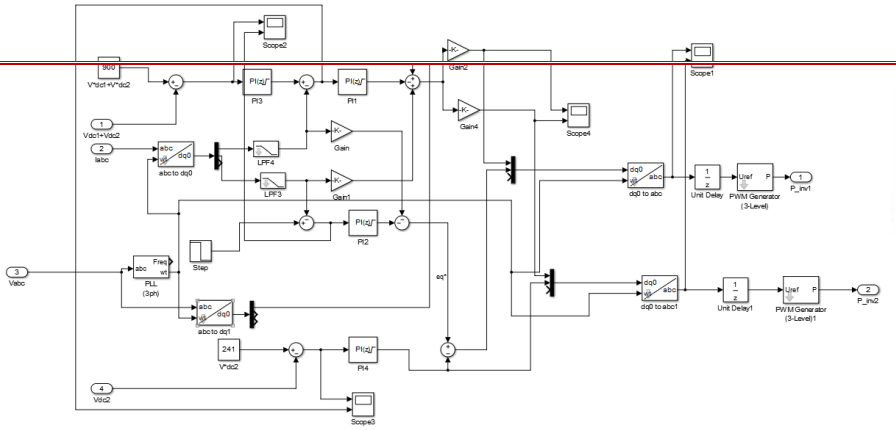
This paper presents fell three level inverter based multilevel inverter by a basic static var compensator plan. Here three stage transformers' open-end windings are associated parallel to two principles three level inverter. To get the four-level operation, the dc connect voltages of the inverter are set at the diverse levels. This strategy is re-enacted under adjusted and lopsided supply voltage conditions. This re-enactment is done utilizing MATLAB/SIMULINK. For approval of recreation comes about a lab model is handled. TMS320F28335digital flag processor is utilized for control plot advancement. Framework dependability of this model is broke down. Exchange capacities are determined and dynamic model is created. The security of the framework and conduct of the framework are seen under various working conditions.

Keywords:Three Level Inverter, Static Var Compensator, MATLAB/SIMULINK.

I .INTRODUCTION

In control hardware, the use of FACTS is to expanding in the power frameworks. Since they can enhance the power quality and settles transmission frameworks. Regular var compensators like thyristor controlled reactor and thyristor exchanged capacitor are supplanted with STATCOMs as these are solid receptive power controllers. These gadgets gives dynamic power swaying damping, voltage control, responsive power pay, flash lessening and so forth.

A few strategies have been proposed like transformerless static synchronous compensator system, Flying Capacitor Multilevel Inverter(FCMLI) method, fell three level inverter based multilevel inverter utilizing static var pay strategy, three stage transformerless course PWM static synchronous compensator(STATCOM) procedure, three stage static synchronous compensator control conspire, transformerless four leg system, little voltage esteems and multilevel procedure and so on, Here fell three level inverter based multilevel inverter utilizing static var pay method is more advantageous and simple to outline. This procedure has achieved the objective of enhancing power nature of a power framework. Utilizing this system multilevel STATCOM has been composed. This multilevel STATCOM with fell three level inverter configuration gives enhanced power quality as contrasted and two level inverter based multilevel STATCOM.



II. Methodology

2.1 Introduction to Three-Level Inverter based STATCOM

It has been apperceived that the transmittable power state can be expanded and close by this voltage controlled by appropriate responsive shunt settlement. The essential suggest of this responsive settlement is make the instalment to all the more great with winning weight ask for by transmuting the regular electrical power. In this way to restrict the line voltage under light load conditions, shunt related changed or mechanically traded reactors are associated. What's more, besides to keep up the voltage levels under solid load conditions, using shunt related, adjusted or mechanically traded capacitors are associated.

An authoritative focus of applying responsive shunt installment in a transmission system is to expand the transmittable puissance. This may be required to enhance the persisting state transmission qualities and what's more the strength of the system. VAR settlement is thus utilized for voltage course at the midpoint (or some widely appealing) to divide the transmission line and toward the finish of the (winding) line to divert voltage instability, and furthermore for dynamic voltage control to expand transient soundness and moist power movements.

The proposed circuit demonstrates the Three level fell inverter utilized for the genuine and receptive power exchange with the framework. Three level inverter gives lesser THD contrasted with two level inverter. The fig 2.1 demonstrates the circuit for the Cascaded Three level Inverter based STATCOM. Here we are utilizing a 3 Phase transformer which the lower end is associated with the Inverter circuits 1 and 2 and furthermore the Higher end of the Transformer is associated with the Grid, as appeared in the fig 2.1.and Both the inverters are associated in arrangement mode, The exchanging segment of the circuit is IGBT.

Fig. 2.1 Proposed Three level Inverter Circuit

Fig. 2.2 Simulation Diagram For Three level inverter circuit

Fig 2.2. shows the Three level inverter circuit layout it is related with the control box which controls the whole circuit. IGBT's are used here as trading circuits, Multi-level Inverters have the upside of lessening the voltage step changes, and subsequently the size and the cost of the essential channel inductor for given current swell, to the impediment of extended unconventionality and cost of the power devices and control sections From this

three level inverter we are drawing three phase voltage and streams through that we can evaluate the bona fide and open vitality of the source.

ISBN: 978-93-86171-60-3

The Vabc and Iabc is measured at the network side and by utilizing ABC to DQ0 change is accomplished for straightforwardness. The Vdc reference is set (Vdc1+Vdc2). Vdc2 is likewise given as reference. At that point it is subtracted with measured (Vdc1+Vdc2) and Vdc2 independently. The blunder is given to PI controller then the D pivot current is contrasted and the PI controller yield which produced Q hub voltage. Q Voltage is subtracted with Q pivot. At that point it is changed over to voltage. So two distinctive DQ0 pivot voltage and two diverse DQ0 hub current is changed over back to ABC for inverter 1. At that point other one inverter is additionally converter. At that point beats are made for inverter. The fig 2.3 Shows the Control clock for STATIC Compensator.

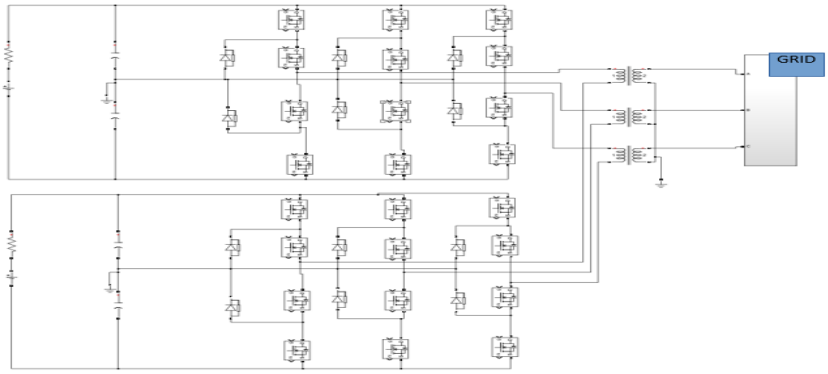
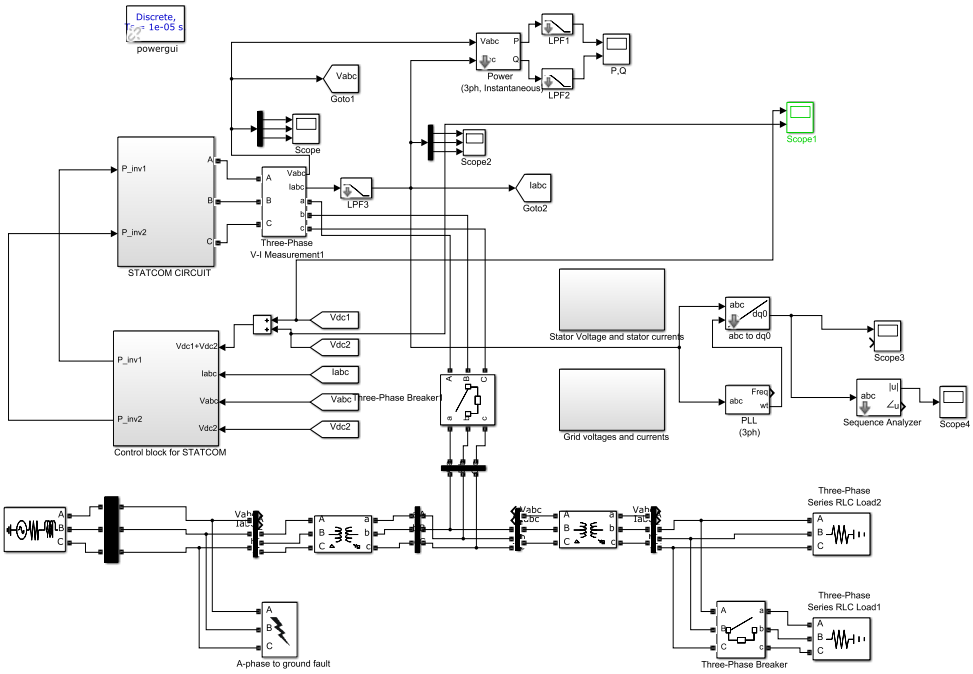


Fig 2.3 Control Block for STATCOM



ISBN: 978-93-86171-60-3

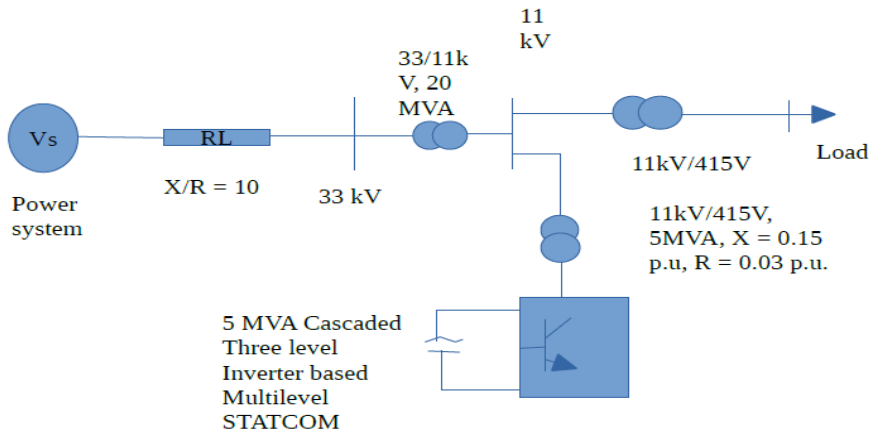


Fig 2.4 Test System (Power system model for Three level Inverter based STATCOM)

The above fig 2.4 exhibits the Power system which related with the proposed STATCOM appear, through the power structure commitment here and this circuit familiarizing a ground fault with check the execution of the system in Balanced and the Unbalanced modes. By using the STATCOM appear in inverter circuit it will vanquish the ground accuse which has been added to the circuit and keeps up the yield waveforms unfaltering

III .RESULTS AND ANALYSIS

STATCOM Circuit with two level inverter and with three level inverter is recreated in MATLAB Simulink condition. The circuit is given with some predefined parameters. Those are appeared in underneath table 1. Where Vdc1 and Vdc2 are the DC interface voltages, X1 is the spillage reactance of transformer, R is resistance of transformer, C1 and C2 are the capacitences of DC connect, f is the recurrence of AC supply.

Table 1. Parameter Specification

Rated power	5MVA
Transformer voltage rating	11kV/400
AC supply frequency, f	50Hz
Inverter-1 dc link voltage, V_{dc1}	659 V
Inverter-1 dc link voltage, V_{dc2}	241 V
Transformer leakage reactance, X_1	15%
Transformer resistance, R	3%
DC link capacitance,C_1, C_2	50mF
Switching frequency	1200Hz

 ISBN: 978-93-86171-60-3

The underneath figure 3.1shows the current and voltage of the STATCOM with two level inverter. For responsive power supply and ingestion the stage move amongst voltage and current is made.

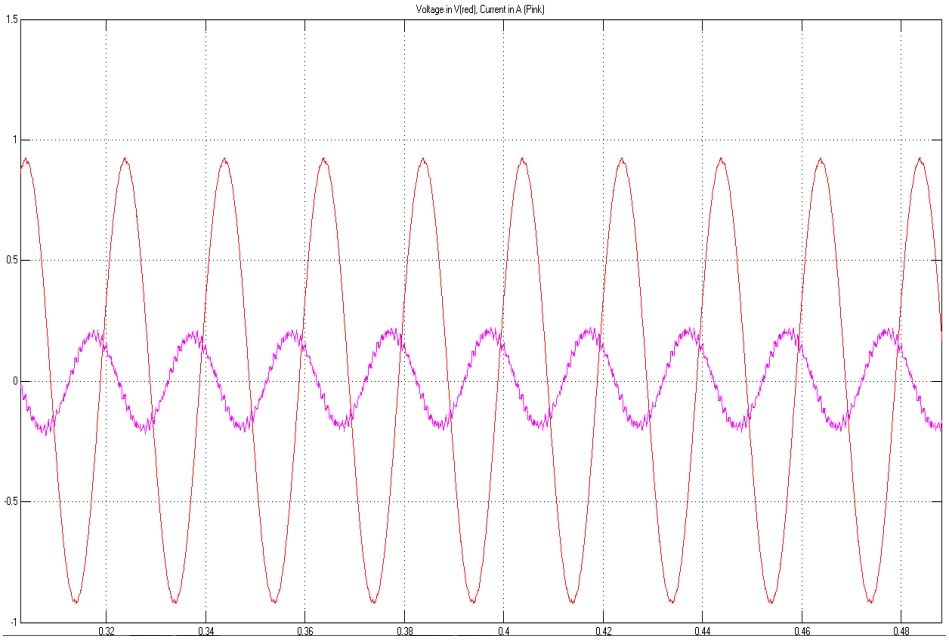


Fig 3.1: STATCOM voltage and current with two level inverter

The underneath figure 3.2 demonstrates the current and voltage of the STATCOM with three level inverter. For receptive power supply and retention the stage move amongst voltage and current is made.

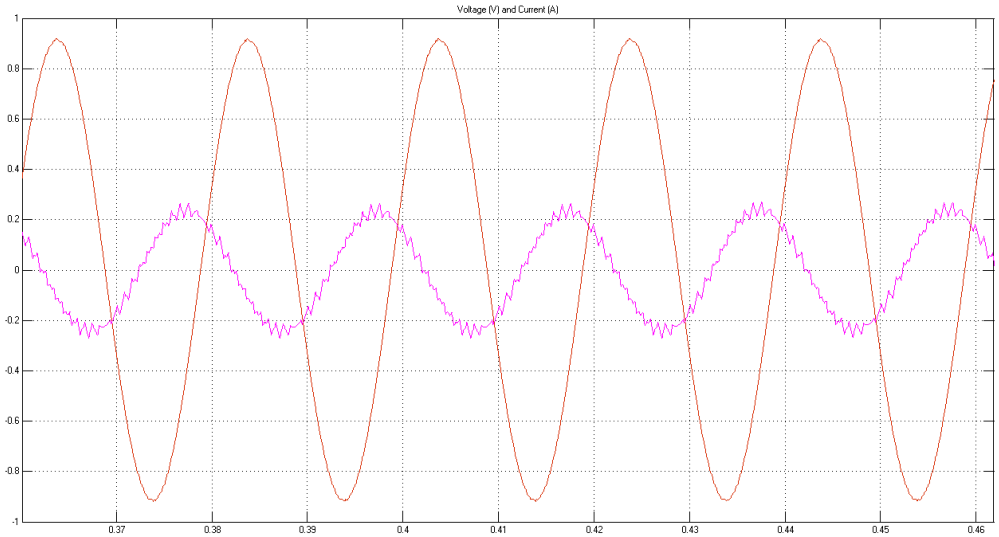


Fig 3.2: STATCOM voltage and current with three level inverter

ISBN: 978-93-86171-60-3

The underneath figure 3.3 demonstrates the genuine and responsive energy of the STATCOM with two level inverter. At 0.5 sec blame is connected so responsive power is made zero due blame. The responsive power is consumed by the network.

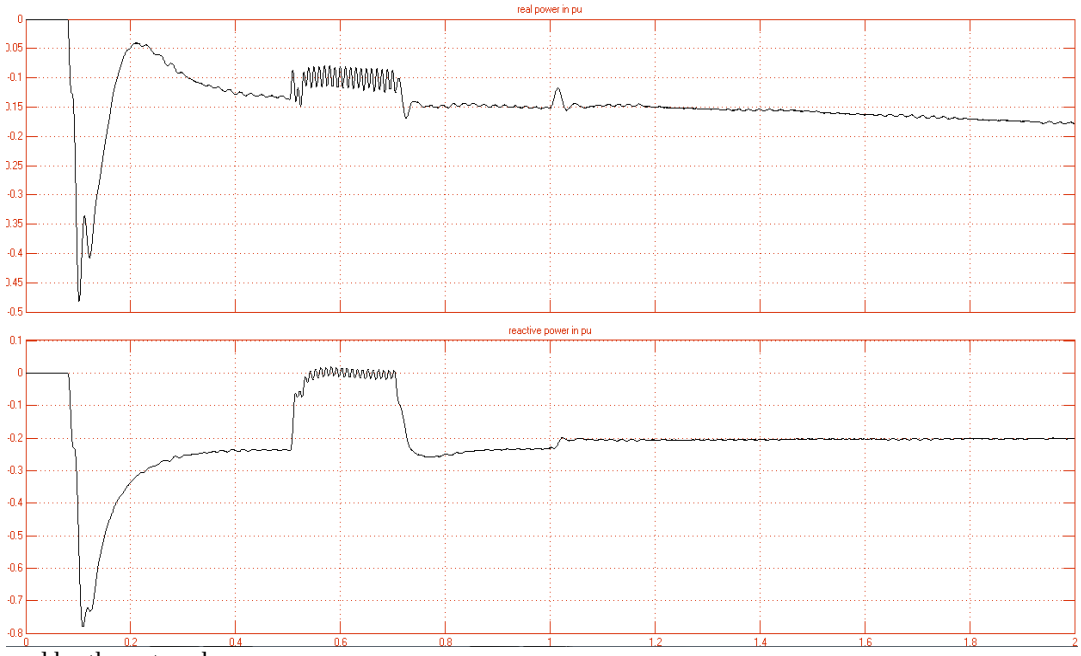


Fig 3.3: STATCOM real and reactive power with two level inverter

The below figure 3.4 shows the real and reactive power of the STATCOM with three level inverter. At 0.5 sec fault is applied so reactive power is made zero due fault. The reactive power is absorbed by the grid.

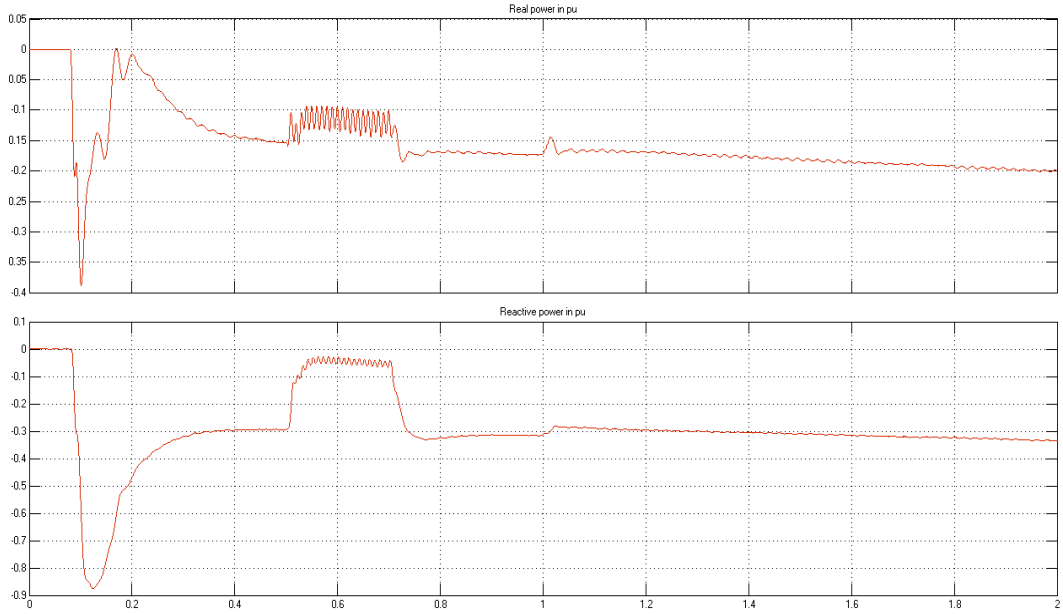


Fig 3.4: STATCOM real and reactive power with three level inverter

ISBN: 978-93-86171-60-3

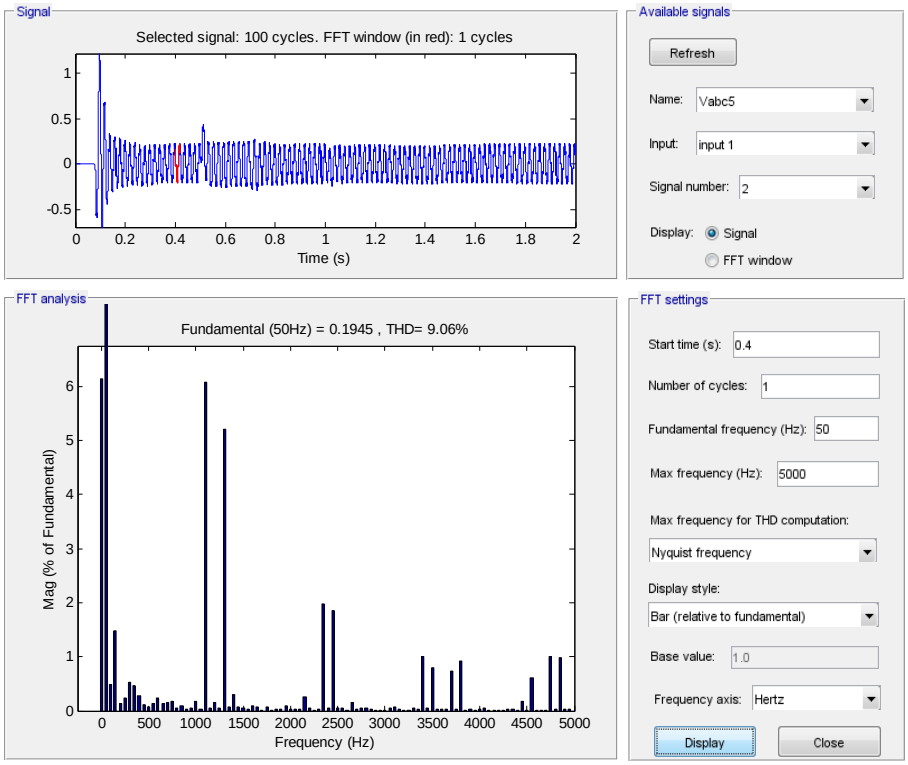


Fig 3.5: THD value of Statcom with two level inverter

Above figure 3.5 demonstrates the calculation of Threshold Harmonic Distortion estimation of STATCOM with two level inverter. The two level inverter current gives 9.06% THD. This can be lessened by utilizing three level inverter. Those outcomes are demonstrated as follows.

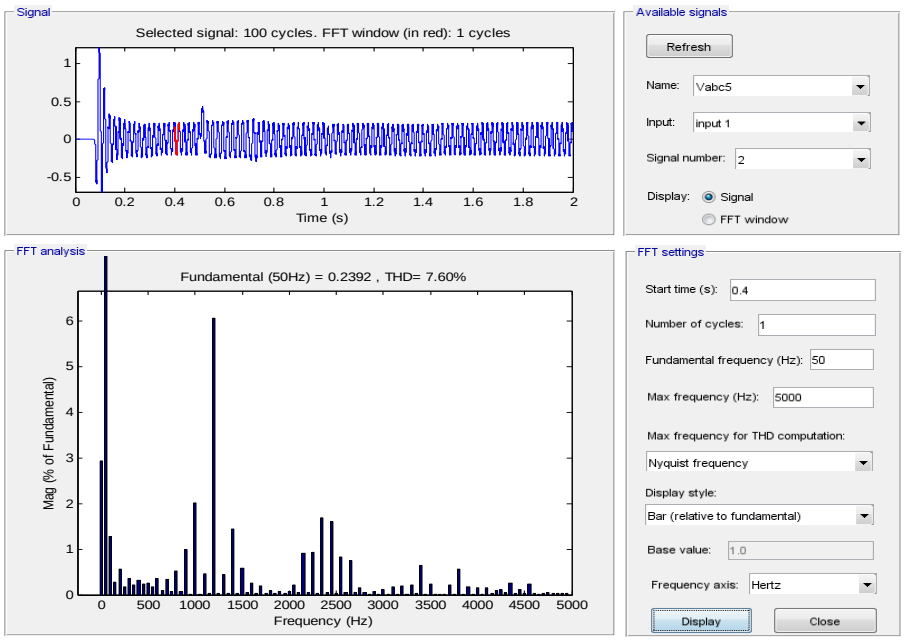


Fig 3.6:THD value of Statcom with three level inverter

Above figure 3.6 demonstrates the calculation of Threshold Harmonic Distortion estimation of STATCOM with three level inverter. The three level inverter current gives 3.60% THD. Thd investigation with three level inverter is moved forward. It can be seen that the various waveforms are same. Be that as it may, the thd esteem lesser. i.e. 3.60% so the power quality is progressed.

IV. CONCLUSION

DC-interface voltage alter is one of the main problems in Cascaded inverter-based STATCOMs. In this paper, a direct var compensating plan is proposed for a Cascaded two-level inverter based multilevel inverter. The arrangement ensures control of dc-interface voltages of inverters at unbalanced levels and responsive power pay. Here, a Cascaded three level inverter based multilevel inverter is reimbursed by the fundamental var plot, the huge issue is to modify the dc interface inverter by using this arrangement this can be overcome easily. The execution of the arrangement is affirmed under the balanced and uneven condition of the voltages. Further, the purpose behind instability when there is a modification in reference ebb and flow is inquired about. The dynamic model is created and trade limits are gathered. System lead is poor down for various working conditions. THD in proposed strategy is 7.60% and THD in past technique is 9.06%. Power quality is enhanced in proposed strategy utilizing three level inverter as contrasted and the past technique utilizing two level inverter. Circuit is reproduced in MATLAB Simulink condition. Results are tried and confirmed.

REFERENCES

[1] B. Singh, R. Saha, A. Chandra, K. Al-Haddad, ―Static synchronous compensators (STATCOM): a review, IETPower Electron., 2009, Vol. 2, Iss. 4, pp. 297–324,22nd April 2008

[2] Hirofumi Akagi, Hideaki Fujita, ShinsukeYonetani, Yosuke Kondo, ―A 6.6-kV Transformerless STATCOM Based on a Five-Level Diode-Clamped PWM Converter: System Design and Experimentation of a 200-V 10-kVA Laboratory Model‖ , IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 44, NO. 2,pp. 672-680, MARCH/APRIL 2008

[3] Anshuman Shukla, Arindam Ghosh, Avinash Joshi, ―Hysteresis Current Control Operation of Flying Capacitor Multilevel Inverter and Its Application in Shunt Compensation of Distribution Systems‖ , IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 22, NO. 1, pp. 396-405, JANUARY 2007

[4] Hirofumi Akagi, Shigenori Inoue, Tsurugi Yoshii, ―Control and Performance of a Transformerless CascadePWM STATCOM With Star Configuration‖ , IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL.43, NO. 4, pp. 1041-1049, JULY/AUGUST 2007

[5] Yu Liu, Alex Q. Huang, Wenchao Song, Subhashish Bhattacharya, Guojun Tan, ―Small-Signal Model-Based Control Strategy for Balancing Individual DC Capacitor Voltages in Cascade Multilevel Inverter-Based STATCOM‖ , IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 56, NO. 6, pp. 2259-2269,JUNE2009

ISBN: 978-93-86171-60-3

[6] H. Mohammadi P, M. TavakoliBina, ―A Transformerless Medium-Voltage STATCOM Topology Based on Extended Modular Multilevel Converters‖ , IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 26, NO. 5, pp 1534-1545, MAY 2011

[7] Xiaomin Kou, Keith A. Corzine, Mike W. Wielebski, ―Overdistention Operation of Cascaded Multilevel Inverters‖ , IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 42, NO. 3, pp 817-824, MAY/JUNE 2006

[8] Krushna K. Mohapatra, K. Gopakumar, V. T. Somasekhar, L. Umanand, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 50, NO. 6, pp 1187-1198, DECEMBER 2003

[9] Yoshitaka Kawabata, Naok Yahata, Miwa Horii, EmenikeEjiogu, Takao Kawabata, ―SVG using Open winding Transformer and Two Inverters, 35th Annual IEEE Power Electronics Specinlists Conference, 2004

[10] E. G. Shivakumar, K. Gopakumar, S. K. Sinha, A. Pittet, and V. T. Rangathan, ―Space vector PWM control of dual inverter fed open—End winding induction motor drive,‖ in Proc. IEEE APEC, pp. 399–405, 2001.