e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

PERFORMANCE COMPARISON OF DSTATCOM USING CONTROL ALGORITHMS

Monisha Lenjhare*1, Shailendra Kumar Bohidar*2

*1M.Tech Research Scholar (Power Electronics), School Of Engineering & IT, MATS University, Raipur, C.G., India.

*2Associate Professor, School Of Engineering & IT, MATS University, Raipur, C.G., India.

ABSTRACT

The harmonics lead to overheating of the system, which deteriorates the insulation, impudently breaks down the equipment, and frequently intensifies the fault current. Utilising solid state controllers, which can occasionally draw harmonic currents and cause loads to behave non-linearly, also raises the device's power factor and lowers efficiency. Other negative effects of the current harmonics include tension distortion, spikes, unbalance, flickering, and system failure. Reactive power flow is a characteristic of an electric power system. Reactive power is required for the application of stationary or rotating load types. Reactive power efficiency and alignment in networks vary depending on power factor and setup phase. However, the reactive power flow has a number of unfavourable effects. By raising the drawn line for the same charge rate, it essentially raises the cost, service, and efficiency of the energy unit device. As a result, the percentage for energy stabilisation also drops. Many techniques for reactive energy compensation are mentioned in the literature. These devices can be as simple as a fixed condenser or switcher or as sophisticated as STATCOM, SSSC, and UPFC. Novel methods such as STATCOM, SSSC, and UPFC are solid state circuit devices that generate voltage and current compensation by utilising DC voltage and DC current. These systems differ from new advances in terms of fundamental methods like switched inducers and fixed condensers.

Keywords: Voltage Fluctuation, Frequency, Voltage Loss, DSTATCOM.

I. INTRODUCTION

1.1 POWER QUALITY ISSUES

In the words of the IEEE dictionary, "Power quality is the concept of achieving the desirable output for device service by supplying advantageous power and grounding to the sophisticated equipment". The electrical power network must overcome a number of challenges in order to offer consumers dependable performance. Condenser bank failure, overvoltage's, voltage loss, and increased current from harmonics are among the issues brought on by poor power quality.

Because solid state converters themselves are prone to power quality problems and frequently cause problems lowering the quality of power, using them in systems results in an increase in power quality problems. Because of the widespread use of solid state devices, power quality issues have grown in significance.One of the main problems in any system, however, is the presence of harmonics caused by multiple loads' nonlinear behavior.

Energy problems include variations in frequency, pressure, voltage, shifts in voltage, imbalances in voltage, frequency fluctuations, and frequency shifts. They can also include electrical disturbances, voltages, blackouts, and brownouts, as well as long and brief interruptions.

In today's culture, power quality is an important, crucial, or necessary issue. The poor quality of the power is causing a lot of electrical equipment to fail. In many industries, utility power efficiency can be recognised or met. DSTATCOMS supports DVRs and SSSCs (static synchronous compensator series) in power factor correction, voltage regulation, and load balancing and in mitigation of transient and stable state conditions prove satisfactory.

1.2 TERMS USED IN POWER QUALITY :

The different terms that quantify power quality issues are given as below. The IEEE specifications provide a detailed guide to the terminology.

- Flicker: A light stimulus whose brightness varies over time persuades the visual perception to be precarious.
- Voltage fluctuation:-Deviation of voltage cover series.

- Shift in voltage:-Increase in rms or voltage level for two consecutive measurements over a long period of time.
- Imbalance (can be voltage or current):- The ratio of the negative sequence element to the positive sequence portion.

The following terms are required for standardization purposes:-

- Ground: A large body conducting magnitude or a connection arrangement between the electrical equipment and the ground. Maintaining the ability to drive ground currents back and forth requires grounding.
- Harmonic: - The basic frequency integral multiple is the sinusoidal portion of voltage or current.
- Swell:-The voltage and current rms value is increased from 0.5 cycle to 1 min. The average value varies from 1.1 percent to 1.8 percent.
- Sag:-The voltage and current rms price is reduced from 0.5 cycle to 1 minute. Average values range from 0.1 percent to 0.9 percent.
- Voltage distortion:-The voltage deviation from the nominal sine wave form prescribed.
- Accuracy:-Accuracy in percentage form is referred to as the ratio of the assessed value to the true value.
- PCC (common coupling point):- Common consumer interface and electrical utility interface.
- Voltage distortion:-The voltage aberration from the nominal sine wave form prescribed.

II. LITERATURE SURVEY

Bhim Singh et al.-Offered a proposal outline, item selection and choice of relevant economic and technical variables for the monitoring of active filter (AF) settings. This intends to provide researchers and implementing engineers with a broad image of the state of the AF technologies while dealing with power quality issues. Also linked to a collection of over 200 research publications in this field for a fast comparison.

Bhim Singhet al. Article explores three distinct approaches to assess the current allowance for a DSTATCOM. Comparative methods are the theory of instantaneous reactive force, the concept of synchronous frame comparison and a fresh algorithm focused on Adaline.

Bhim Singhet al.proposed strategies include an instant reactive power principle, a synchronous comparison frame model and a fresh Adaline based algorithm. The Algorithm based on Adaline is an important tool for obtaining relative present signals. Performance of the system is done in the MATLAB setting using the toolboxes SIMULINK and PSB.

Bhim Singh et al.introduces topologies, state-of-the-art, performance, technological factors, future trends and potential applications to improve power quality. The objective of this study is to discuss a broad view of DSTATCOMs for researchers, technicians and community concerned in improving power quality. A categorized catalog of some recent study papers is also provided for quick comparison.

Kavitha V et al.presents the effect of power quality issues and also how these power quality issues and solutions can be overcome and how they can be tackled. The energy-enhancing devices also listed in this article. Probably only engineers, technicians and network managers have benefited from a great understanding of energy quality problems.

Vinay M. Awasthietalaims at developing a voltagesource-based D-STATCOM converter that injects reactive power into the manufacturing circuit. D-STATCOM's input voltage results in system voltage being implemented using the PI controller in MATLAB / Simulink for the purpose of controlling the output of VAR.D-STATCOM.

A.Sode-Yome et al provides a comparison of the FACTS instruments for static voltage stabilisation study. Different accounting methods are contrasted under ordinary and contingent circumstances, including PV curves, voltage profiles and energy loss.

Mohammed BarghiLatran et al. provides a detailed description of DSTATCOM single-phase (two-wire) and three-phase (three or four-wire) devices configurations, and control policies to resolve various storage system PQ issues. In addition, the DSTATCOM technology is performed with thorough explanation, comparison, and discussion. In addition, there is an in-depth overview of up-to - date technologies, practical issues and some future DSTATCOM research areas. This aims to bring a broad view of the state of DSTATCOM technology to scientists who are grappling with the payment of PQ problems in manufacturing devices.

Divya Nair et al.discusses the need for the synchronous regulating engine DSTATCOM for harmonic compensation. Simulation evaluates and checks performance dynamics. In Reality, power electronic devices and their evolving control systems are used to increase the power distribution in the transmission network and thus improve the power quality and performance of the low voltage supply network. The function of reactive power recompense and harmonic mitigation is a type of FACTS controller or DSTATCOM Distributed Static starter.

Ambrish Chandraet al. discuss the implementation of a new control strategy for an efficient three-phase shunt filter to regulate terminal load voltage, eliminate harmonics, correct allocation of power variable and balanced nonlinear structures. For a three-phase, independent bipolar gate transistor (IGBT), an efficient detector (AF) with a dc-bus-condenser is used. The AF command algorithm uses two closed loop PI controllers. The AF dc bus voltage and the three-phase storage voltages are being used as response inputs in the PI controllers. The AF command algorithm provides input streams of three-phase requirement.

GunjanVarshney et al.proposed an improved power efficiency for a three-phase wireless Static Distribution Compensator (DSTATCOM) that is supplied via the Photovoltaic (PV) network. The DSTATCOM is a three-legged source voltage with a DC Connection (VSI). The photovoltaic (pv) system serves to maintain the tension required for the DC connection. In reactive power compensation it is possible to achieve the improvement in power efficiency by adjusting the power factor. In this journal, the efficacy of DSTATCOM is demonstrated using Powing Factor Correction (PFC) and Zero Voltage Regulation (ZVR) d-q and P-Q equilibrium designs. The efficacy of DSTATCOM based on PV is confirmed with simulation tests.

AnantNaik et al.proposes a combination of three key techniques used to produce the present reference. The results are collected using these three methods for the same arrangement under safe and inconsistent circumstances of feed voltage. Shunting active power blocking is effective and the performance of these systems is primarily dependent on the control methods used to produce electricity comparison. MATLAB / Simulink is used to model and simulate the different device components.

III. METHODOLOGY

3.1 PRINCIPLE OF OPERATION OF DSTATCOM

The primary goal of DSTATCOM is to monitor energy efficiency issues currently. Reactive power, unstable currents, neutral current, and harmonic distortion are the most common power quality-dependent issues that DSTATCOMs mitigate. DSTATCOM technology has now developed into a workable technology within the AC gearbox systems to provide reactive control, load handling, static current, and resonance flow (if required).

Over the previous 25 years, this increased in tandem with advancements in solid-state devices, control techniques, and specialised systems. Based on the requirements, the method of control, and the suitable framework selection, these can be completed individually or collaboratively. To meet the requirements of three different types of customer charges for processing appliances, DSTATCOM is generally divided into three groups: one-phase two-wire, three-phase three-wire, and three-phase four-wire configuration. Various methods have been developed and explored for various applications since 1984. Current source converters (CsCs) with inductive power storage and power systems (VSCs) are both used in the development of single phase DSTATCOMs.

3.2 CLASSIFICATION OF D-STATCOM

DSTATCOMs can be categorised based on the number of phases, topology, and type of converter used. Either a voltage source or a current source converter may be utilised in the DSTATCOM. Phase count is the primary factor in the penultimate classification, which includes two single-phase wire, three-phase three-wire, and three-phase four-wire systems.

3.2.1 CONVERTER BASED CLASSIFICATION

Two types of converters are being used to construct the DSTATCOMs. In series with the self-commuting system (IGBT), a diode is used for reverse voltage prevention. The other conversor used in DSTATCOM is a voltage source converter. This is utilized more often to increase performance with reduced frequencies, as it is compact, inexpensive and extends to multilevel.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

3.2.2 TOPOLOGY BASED CLASSIFICATION

Topology can also be utilized without transformers, non-isolated transformer VSCs or remote transformer VSCs to categorize DSTATCOMs for VSCs. Only the DSTATCOMs are used in the power distribution network as specialized continuous VAR (STATCOM) transmitters to stabilize and improve the voltage signal.

3.2.3 SUPPLY SYSTEM BASED CLASSIFICATION

Based on the storage and/or charge system, this DSTATCOM rating is based on one-phase two-wire, three-phase tri-wire and tri-phase four-wire structures. Several separate components are connected to single application device like home appliances.

- **TWO WIRE D-STATCOM**

In both converter setups, twin-wire (single-phase) DSTATCOMs are used as well as a CSC bridge with inductive energy storage elements and a VSC bridge with capacitive DC bus energy storage elements.

- **THREE WIRE D-STATCOM**

The condenser-supported DSTATCOM has various parameters depending on the form of VSC and the derivative circuits utilized . The DSTATCOM three-phase, three-wire classification is composed of independent and non-isolated DSTATCOM VSC configurations.

- **FOUR-WIRE-D-STATCOM**

In a three-phase, four-wire storage scheme, there are three-phase loads and one-phase feeds based on the customer prerequisites. This happens jointly with the neutral current in a significant strain on the dispersed plant of unstable flows. A shunt compensator also recognized as DSTATCOM can be used to prevent unstable power bus flows. The primary role of DSTATCOM is to alleviate most of the current energy reliability issues, such as elastic power, unqualified YHQ fluids, neutral current and harmonics, and to supply the VSC with controlled sinusoidal outputs to its decentralized DC bus. COM DSTAT. In contrast, the PCC also achieves the Null Voltage Control (ZVR), by specifically modifying the energy technique.

3.3 PRINCIPLE OF OPERATION OF D-STATCOM

The main objective of DSTATCOMs is to alleviate the current-based power quality problems facing a manufacturing operation. A DSTATCOM alleviates most of the current performance issues such as elastic energy, unbalance, static flow, harmonics (if any) and adjustments inherent in the customer supply or otherwise in the scheme, and provides sinusoidal regulated supply constraints with its DC grid voltage power.

A DSTATCOM, in particular, has a VSC connected to a DC cable and, as seen in Figures 1 , its AC ends are typically linked in shunt over consumer charges or through the PCC. The VSC incorporates PWM power; thus, relatively small transient components are intended to minimize altering ripples. Usually the VSC is regulated in PWM current control technique to inject appropriate fluids into the system

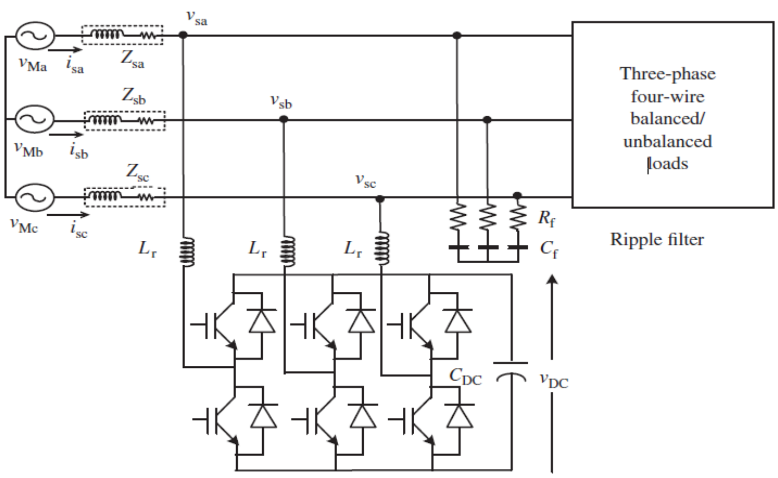

Figure 1: Block diagram of compensation by DSTATCOM

The DSTATCOM also includes many reactive parts, such as a DC bus condenser, opposing AC inductors, transformers for insertion and insulation, and small active filters.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

3.4 PRINCIPLE OF CONTROL ALGORITHM

The primary goal of a DSTATCOM control algorithm is to identify objective flows by using feedback responses. PWM current detectors use these reference currents in conjunction with corresponding sensed parameters to measure PWM gating from the VSC, which is used as a DSTATCOM for adjusting devices (IGBTs). The DSTATCOM Tests Literature 108 contains a number of control parameters that are divided into energy issues, mitigation techniques, and architectures of time- and frequency-domain energy. The DSTATCOM commands are available in multiple time-domain architectures. Here are a few of the subsequent control mechanisms:

- Unit template technique / P Icontroller-based theory
- Power balance theory (BPT)
- I cosθ-control algorithm
- Current synchronous detection (CSD) method
- Instantaneous-reactive power theory (IRPT), also known as P-Q theory or αβ theory
- Synchronous reference frame (SRF) theory, also known as d–q theory
- Instantaneous symmetrical component theory (ISCT)
- Singe-phase PQ theory
- Singe-phase D-Q theory
- Neural network theory (Widrow's LMS-based Adaline algorithm)

Such command optimizations are control architectures over time-domain. Some of these have been used to control reimbursement for DSTATCOMs and other devices. Likewise, the Frequency-domain has almost the same set of control algorithms. Few of them are:

- Fourier-series theory
- Discrete Fourier-transform theory
- FastFourier transform theory
- Recursive-discrete Fourier transform theory
- Kalman-filter based control algorithm

This section provides a new control method based on an understanding of instantaneous reactive power paradigm for three-phase wire STATCOM. Current harmonics and passive energy gain were developed and the observations analyzed using instantaneous passive energy principle. MATLAB / SIMULINK modeled the proposed scheme's technique and capability.

3.5 INSTANTANEOUS REACTIVE POWER THEORY BASED CONTROL ALGORITHM

The control schemes schematic diagram focused on the Instantaneous Reactive Power theory is depicted in figure 2. This segment presents a new control method based on the principle of instantaneous reactive energy for three-phase STATCOM cable.

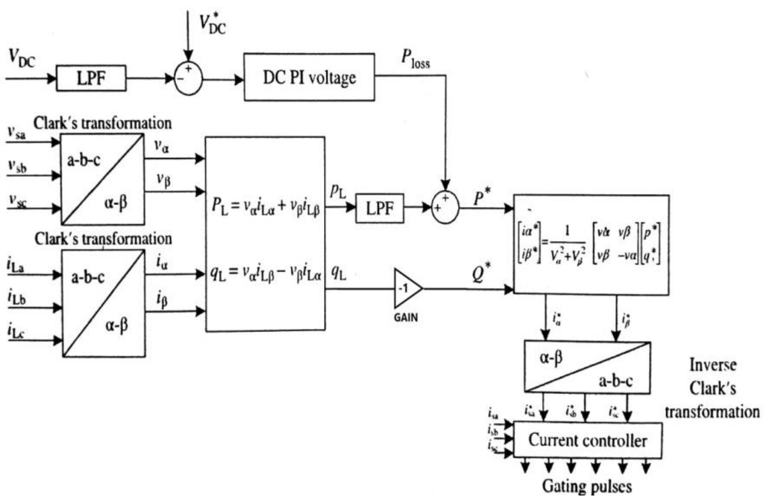

Figure 2: Instantaneous reactive power theory based control algorithm

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

At the point of common coupling, instantaneous active and reactive power is measured by sensing load currents (three stages) and voltage. Prior to this conversion, three-phase PCC voltages are detected and analyzed by BPFs to remove their ripple content, and are denoted as (vsa; vsb; vsc). A first order Butterworth filter is used as BPF.

The three phase load voltages filtered by Clark are converted into two phase α-β orthogonal coordinates given as((v_0, v_α, v_β).

$$\begin{pmatrix} v_\alpha \\ v_\beta \end{pmatrix} = \sqrt{\frac{2}{3}} \begin{pmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{pmatrix} \begin{pmatrix} v_{sa} \\ v_{sb} \\ v_{sc} \end{pmatrix}$$

Isa* Isb* Isc* are the reference three-phase storage signals

$$\begin{pmatrix} i_{sa}^* \\ i_{sb}^* \\ i_{sc}^* \end{pmatrix} = \sqrt{\frac{2}{3}} \begin{pmatrix} 1 & 0 \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{pmatrix} \begin{pmatrix} v_\alpha & v_\beta \\ -v_\beta & v_\alpha \end{pmatrix}^{-1} \begin{pmatrix} p^* \\ q^* \end{pmatrix}$$

This IRPT-based control algorithm can be readily altered to control the demand cycles for inherent present command. In this case , the three-phase transformed currents are reference supply currents for the DSTATCOM power factor correction mode, p*, P_L, P_{Loss} and Q*, Q_L, P_{vp} equation and after conversion from the $\alpha - \beta$ frame to the abc frame, they should be correlated with perceived supply currents in the PWM current controllers.

DSTATCOM's theory-based instantaneous reactive power control algorithm is required to change the PCC voltage to its reference value (this is accomplished using a PI controller identical to the above algorithm. $P_L$and Q_L are the extracted load fundamental active and reactive power components, respectively. In the case of ZVR at PCC (DSTATCOM's voltage control mode), a PI voltage controller over the PCC voltage is utilized similarly to above algorithms and its data is being used for estimating p * and q * as:

$$\mathbf{P^{*}=P_L + P_{loss}}$$

$$\mathbf{Q^{*}=Q_{vp} - \overline{Q_L}}$$

After the conversion, converted three-phase currents are reference supply currents and are correlated with perceived supply currents for DSTATCOM indirect current power.

IV. RESULTS AND DISSCUSIONS

4.1 Results

The PI controller-based DSTATCOM approach is used to simulate a nonlinear load configuration on the system. The primary goal is to reduce the odd harmonic components by applying the gravitational search algorithm and the Cuckoo search algorithm. Three criteria, namely IAE, ISE, and ITAE, can be used to run the aforementioned simulation

Waveform of Source Voltage

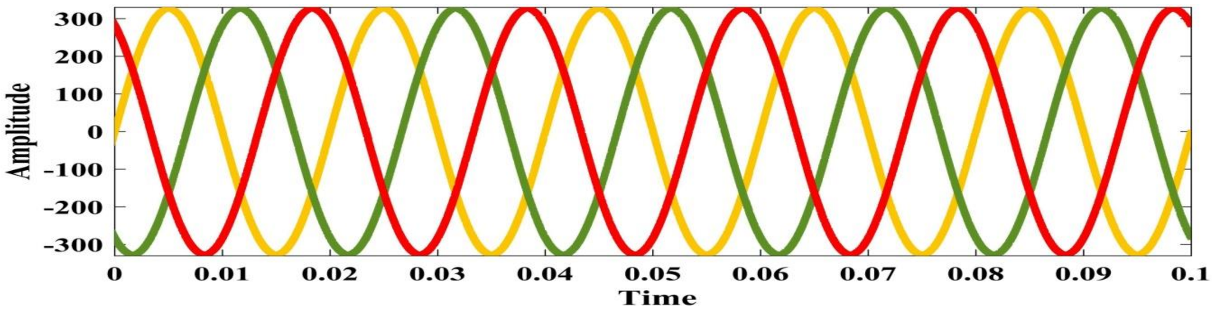

Figure 3: Waveform of source voltage

Figure 3 shows the waveform of source voltage when nonlinear load is only connected in the circuit and it is clear that there is no harmonics generated in the source voltage.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

Waveform of Source Current

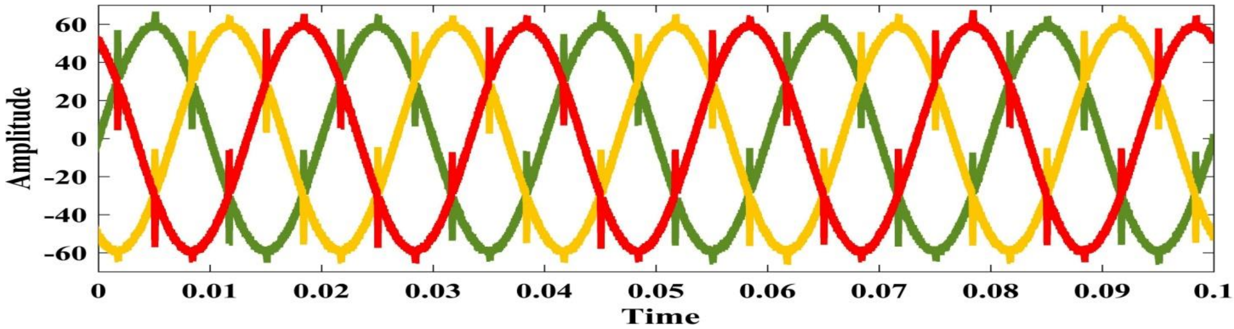

Figure 4: Waveform of source current

When a shunt active power filter—which filters out harmonic current components that may be produced by a nonlinear load—cannot be connected to the circuit, the source current waveform is displayed in Figure 4. It is evident from the above figure that the connected nonlinear load has the ability to generate the current harmonic.

Waveform of Load Current

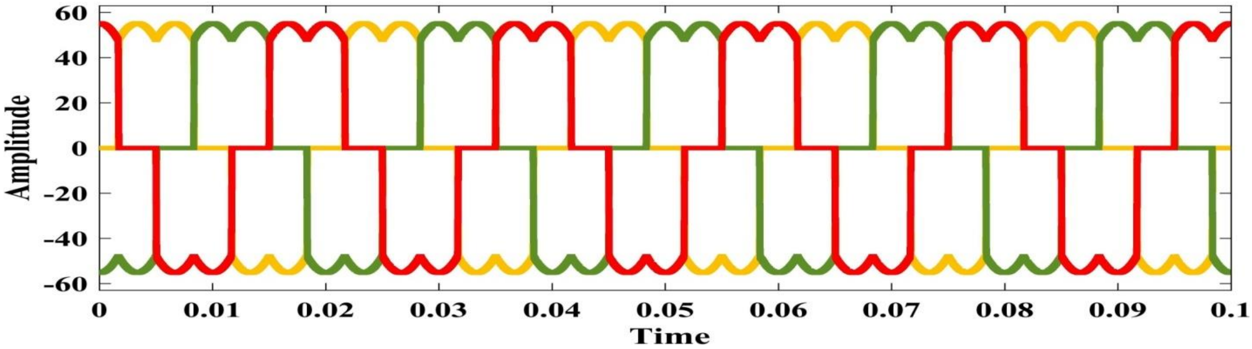

Figure 5: Waveform of load current

Figure 5 shows the waveform of Load Current. From the above figure it is clear that the current harmonic can be generated by the connected nonlinear load.

Waveform of Load Current Phase A

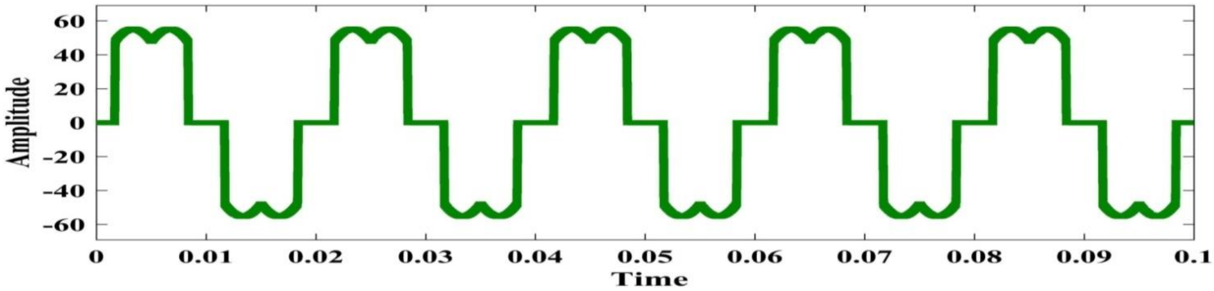

Figure 6: Waveform of load current Phase A

Waveform of Load Current Phase B

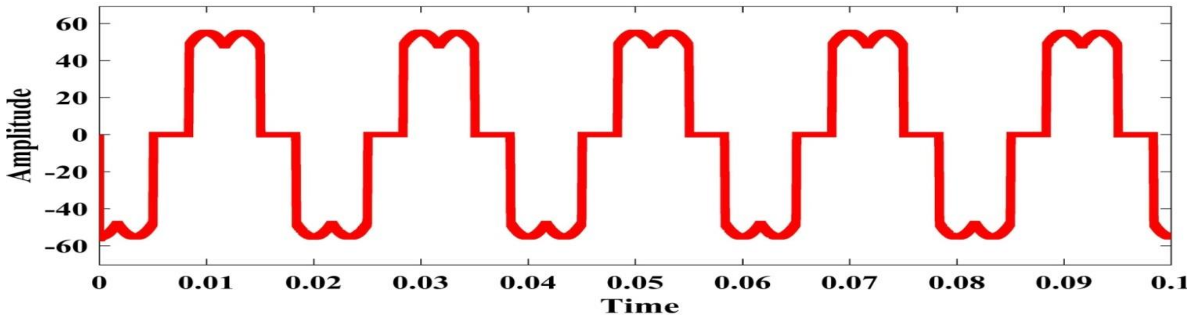

Figure 7: Waveform of load current Phase B

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

Waveform of Load Current Phase C

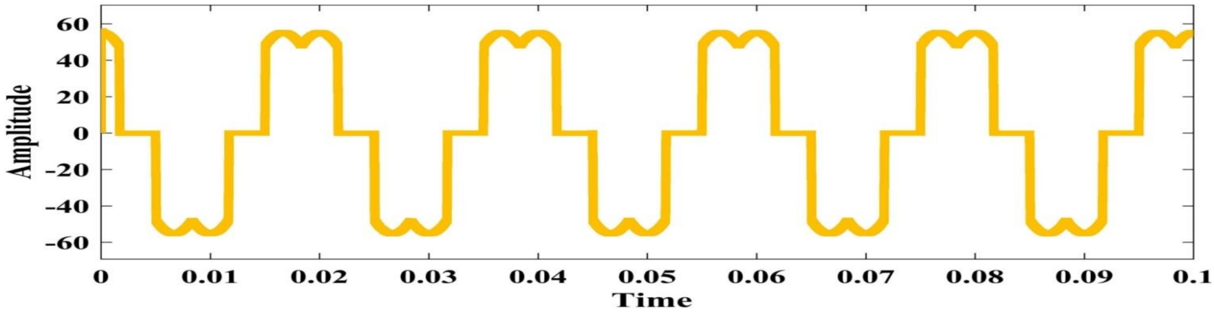

Figure 8: Waveform of load current Phase C

Figures 6–8 depict the different phases of the load current; the distorted current waveform, or non-sinusoidal nature, is depicted above. Therefore, we aim to reduce the harmonic component in our system that may arise from nonlinear load.

Waveform of Compensated Current Phase A

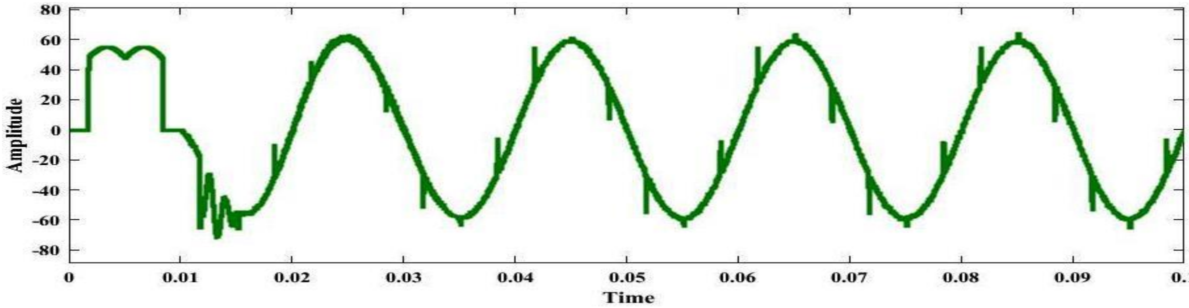

Figure 9: Waveform of compensated phase A current

Waveform of Compensated Current Phase B

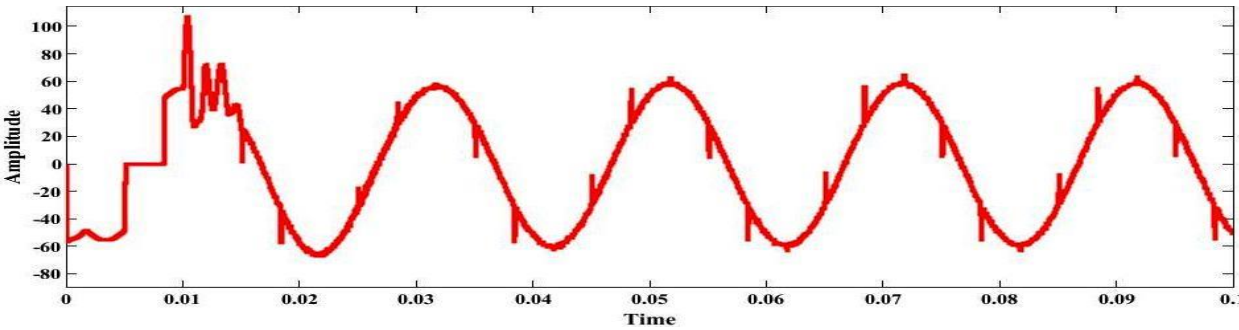

Figure 10: Waveform of compensated phase B current

Waveform of Compensated Current Phase C

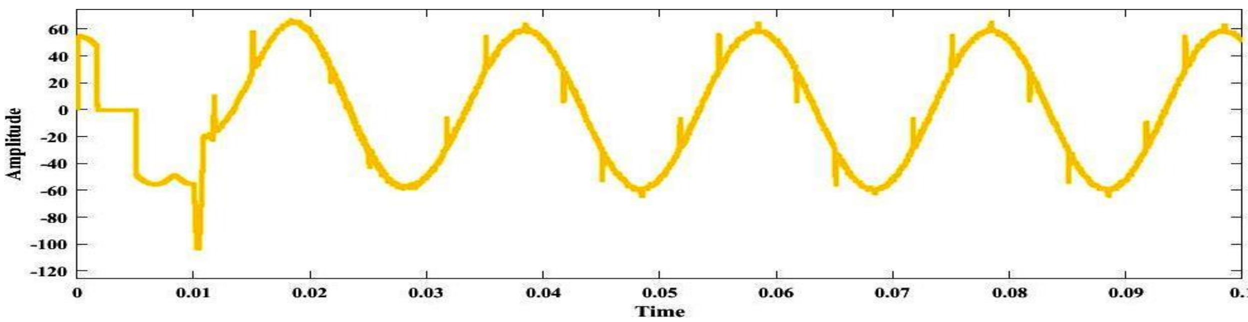

Figure 11: Waveform of compensated phase C current

Figures 9–11 depict the individual compensated phase current. As can be seen, the hybrid filter can become active after 0.01 seconds to compensate for equal and opposite harmonics produced by the system's nonlinear

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

load. The P-Loss and Active power waveforms are displayed. In order to minimise the harmonic, we wish to eliminate the active portion of the current.

Waveform of P-Loss and Active power

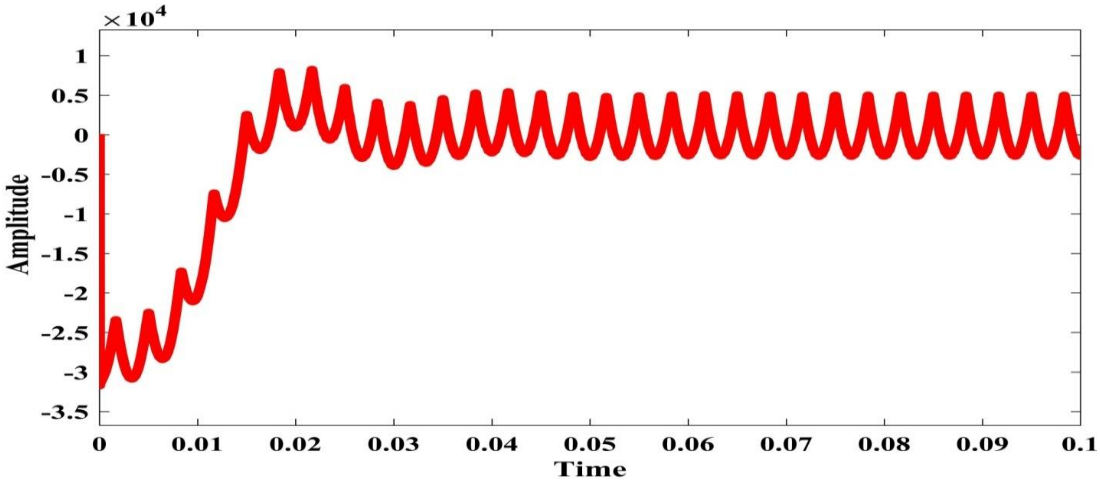

Figure 12: Waveform of P-Loss and Active power

Waveform of V-Alpha

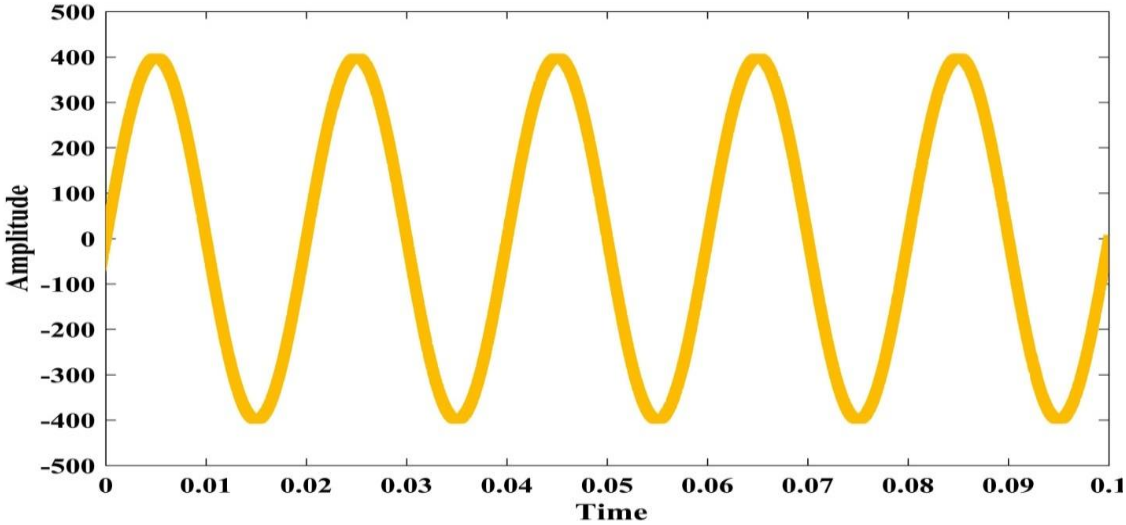

Figure 13: Waveform of V-Alpha

Figure 6.1 and fig 6.2 shows the waveform of two phase controlled voltage waveform which can be converted by the help of Clark and Park transformation in the synchronous reference frame theory.

Waveform of V-Beta

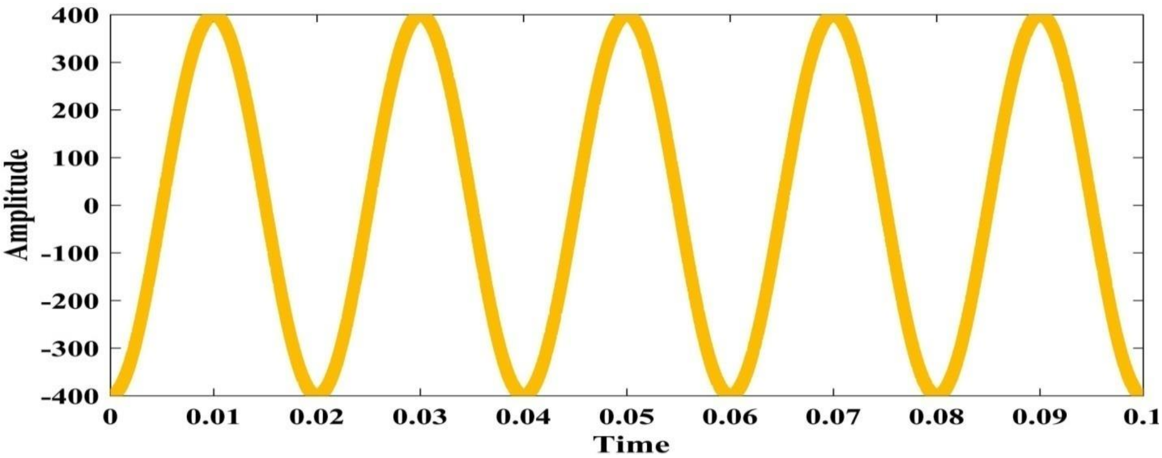

Figure 14: Waveform of V-Beta

In SRF 1stly we convert a three phase voltage as well as current in two phases by the help of Clark transformation after conversion and after generated the controlled voltage waveform in two phases we can again convert in three phases via inverse Clark transform i.e. Park transform. Figure 12 – 14 shows the FFT Waveform of the generated source current.

FFT Waveform

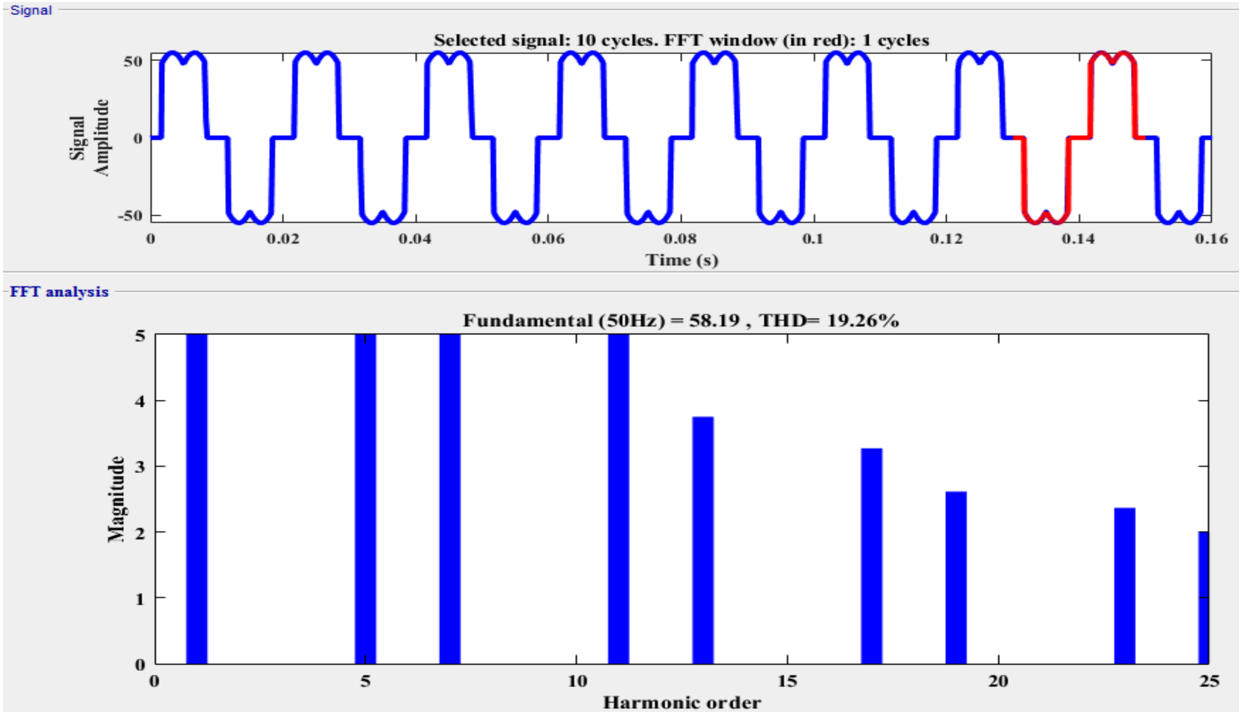

Figure 15: FFT analysis of Source current without any filter

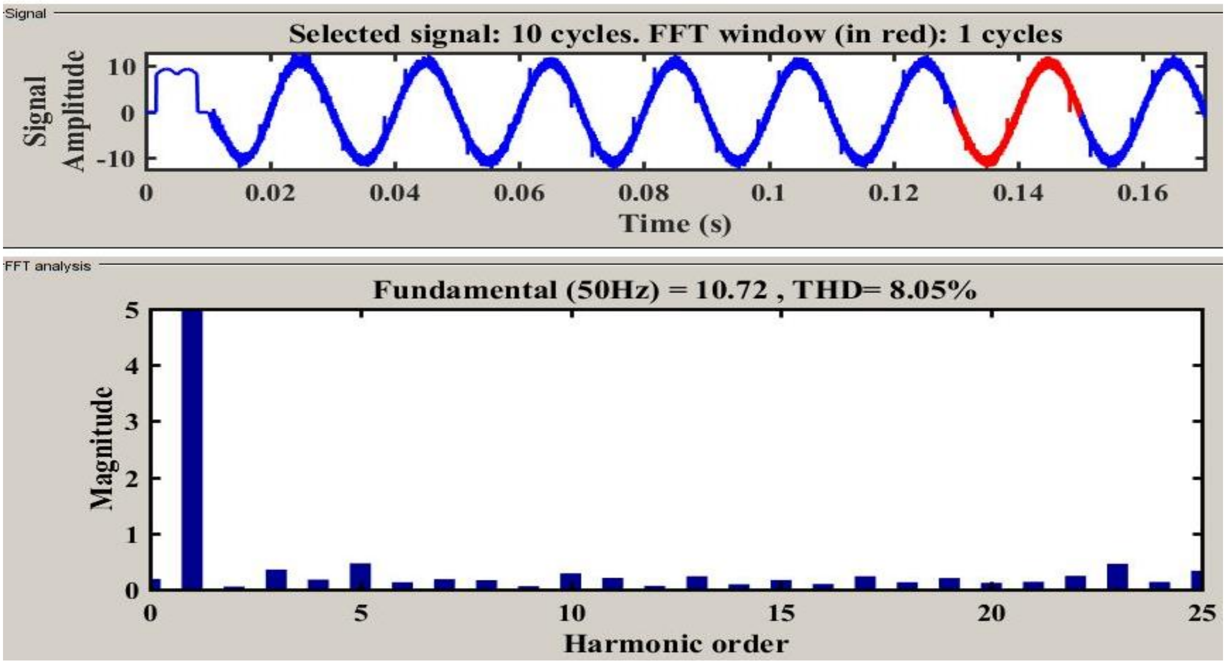

Figure 16: FFT analysis of Source current via Cuckoo Search (IAE Criteria)

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

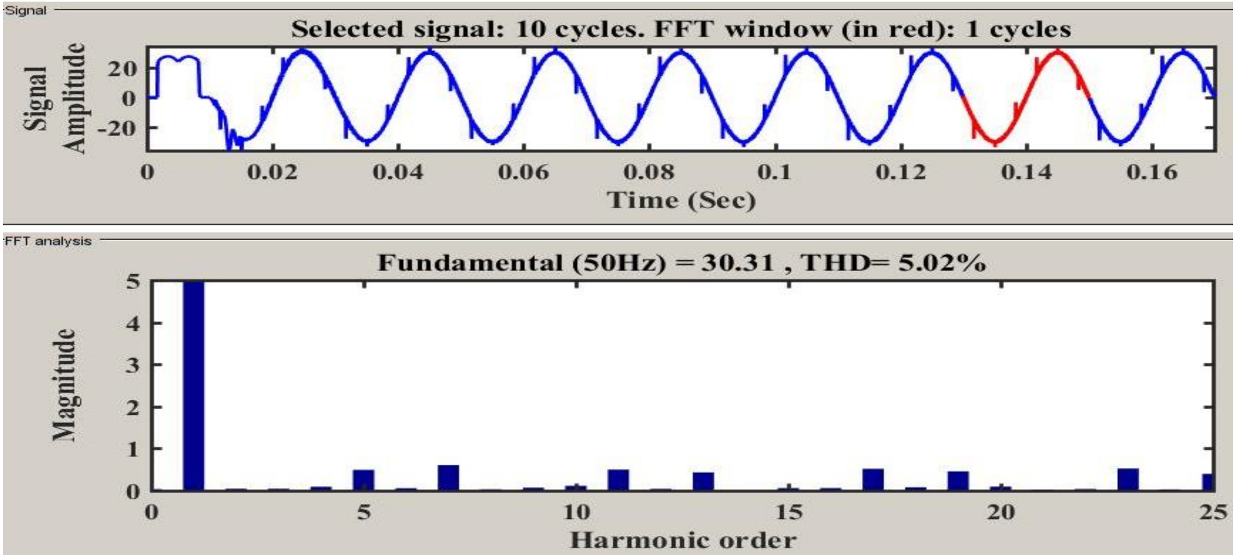

Figure 17: FFT analysis of Source current via Cuckoo Search (ISE Criteria)

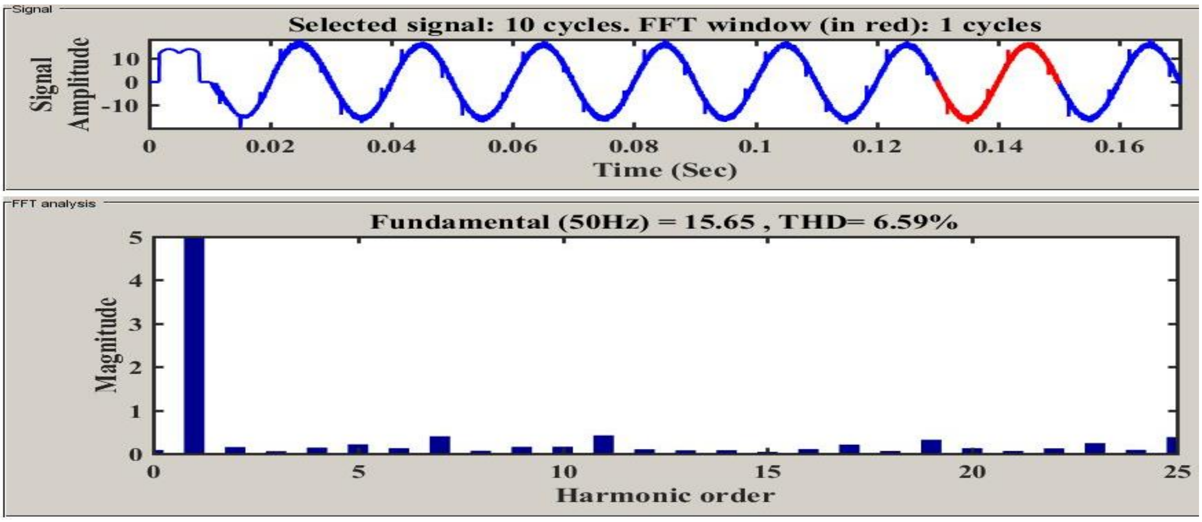

Figure 18: FFT analysis of Source current via Cuckoo Search (ITAE Criteria)

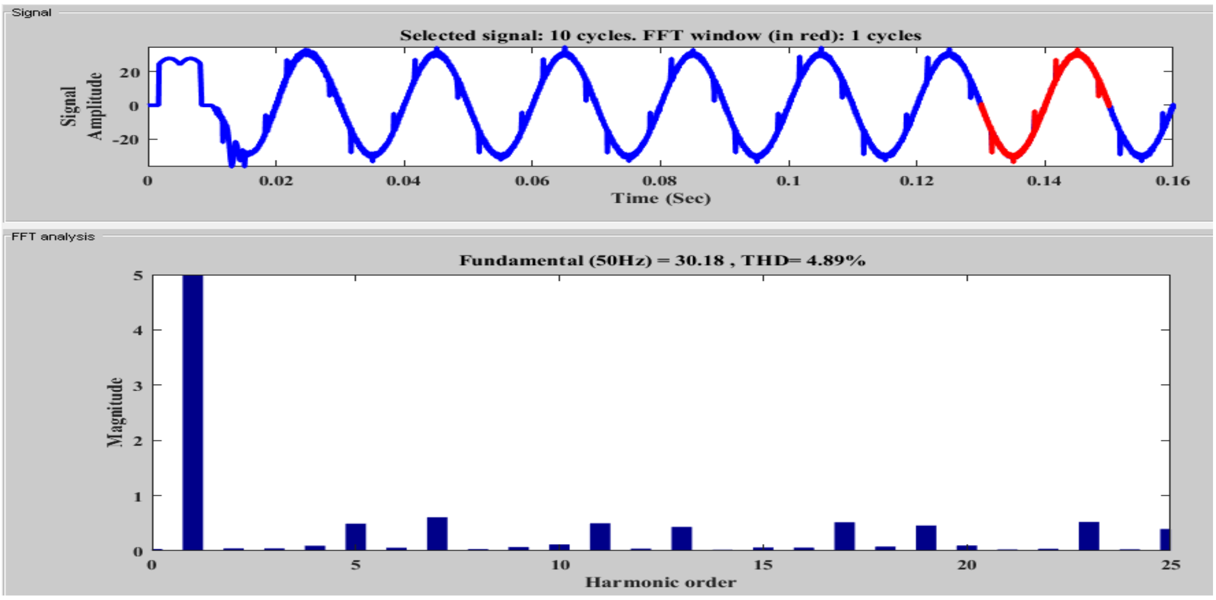

Figure 19: FFT analysis of Source current via Gravitational Search (ISE Criteria)

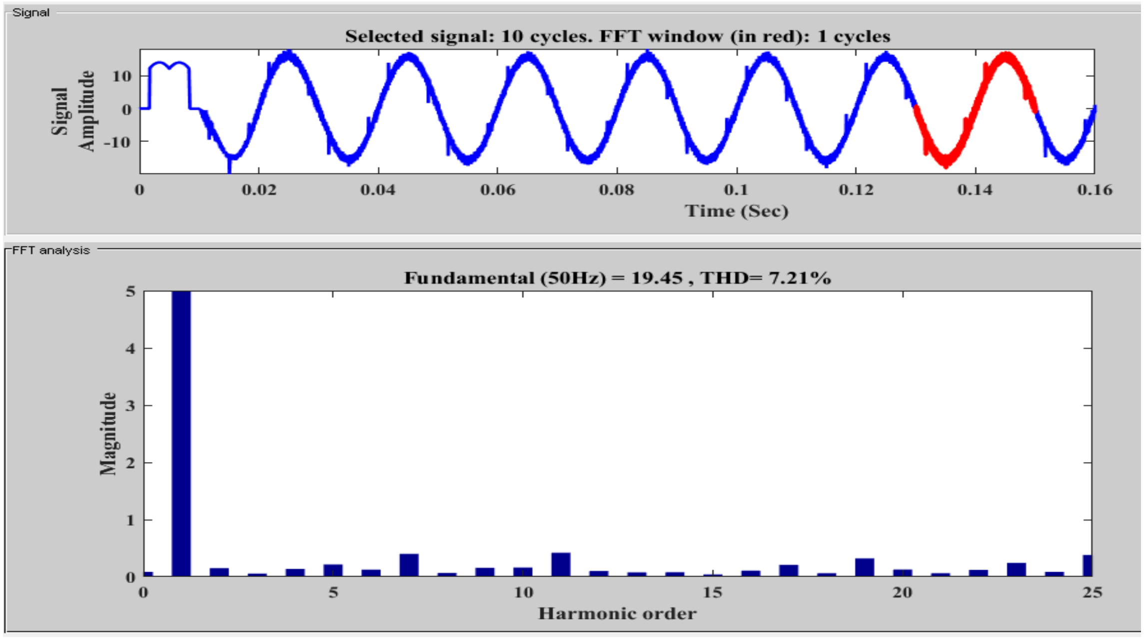

Figure 20: FFT analysis of Source current via Gravitational Search (IAE Criteria)

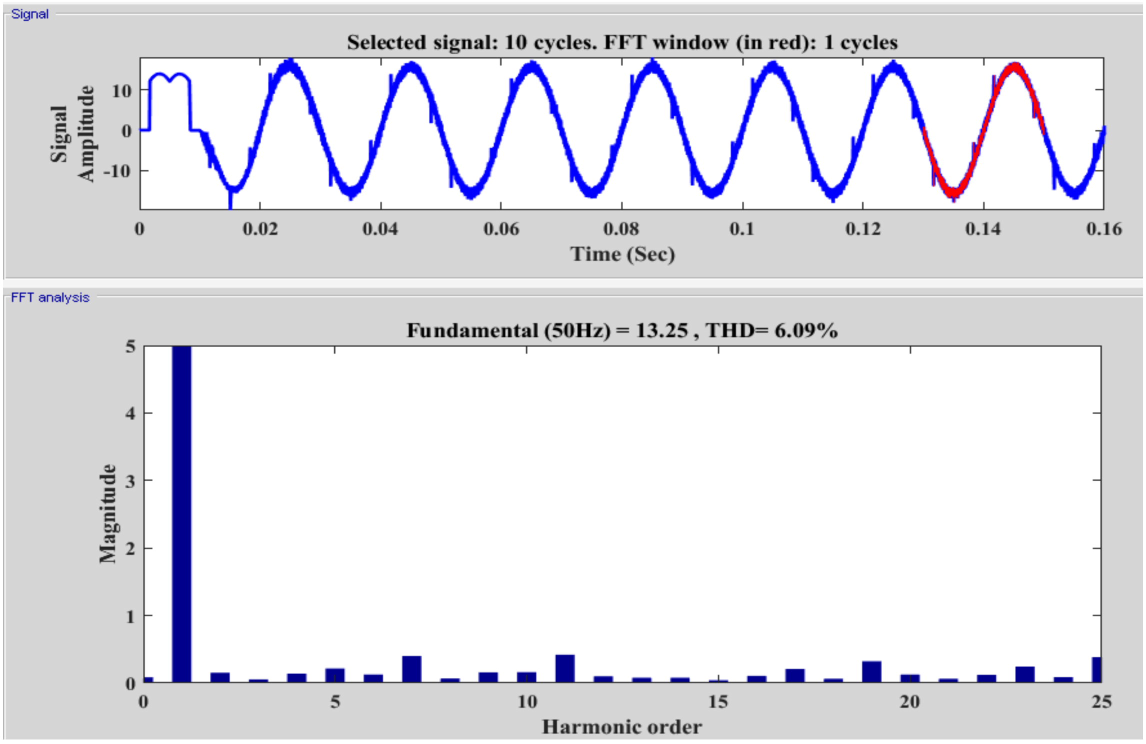

Figure 21: FFT analysis of Source current via Gravitational Search (ITAE Criteria)

V. CONCLUSION

Important manufacturing processes are undergoing significant changes as a result of the power quality problem caused by changed charges in electrical power systems. The disturbance of essential operational procedures in electrical equipment due to load distortion has resulted in power quality issues. It is required of static VAR compensators to address these problems with the utility and charge parties. The benefits of faster reactions, less harmonic material, and smaller device dimensions are provided by STATCOM strategies, which provide respectable substitute methods for reactive power impairments.

D-STATCOMs are characterised by their exceptional capabilities, including faster response times, lower system intensities, and the capacity to deliver a specific reactive power regardless of necessary voltage shifts. The VSC

3 leg 6 pulse converter is being used in this research project to supply reactive power to the PCC on the line. Prior to compensation, the overall harmonic distortion was 19.26%; following compensation, it is 4.89%. Benefits of reduced device dimensions, minimum harmonic, and quicker reaction Technologies like STATCOM are a good substitute.

VI. REFERENCES

[1] Bhim Singh, Kamal Al-Haddad, "A Review of Active Filters for Power Quality Improvement", IEEE Transactions on Industrial Electronics, VOL. 46, NO. 5, October 1999.

[2] B. Singh and J. Solanki, "A Comparative Study of Control Algorithms for DSTATCOM for Load Compensation," 2006 IEEE International Conference on Industrial Technology, Mumbai, 2006, pp. 1492-1497.

[3] BhimSingh, Jitendra Solanki "A Comparison of Control Algorithms for DSTATCOM" IEEE Transactions On Industrial Electronics, Vol. 56, No. 7, July 2009.

[4] Bhim Singh, , P. Jayaprakash, D. P. Kothari, Ambrish Chandra, Kamal Al Haddad, "Comprehensive Study of DSTATCOM Configurations" 854 IEEE Transactions On Industrial Informatics, VOL. 10, NO. 2, May 2014.

[5] D. Nair, M. Raveendran, A. Nambiar, N. P. Mohan and S. Sampath, "Mitigation of power quality issues using DSTATCOM," 2012 International Conference on Emerging Trends in Electrical Engineering and Energy Management (ICETEEEM), Chennai, 2012, pp. 65-69.

[6] V. M. Awasthi and V. A. Huchche, "Reactive power compensation using D-STATCOM," 2016 International Conference on Energy Efficient Technologies for Sustainability (ICEETS), Nager coil, 2016, pp. 583-585.

[7] A. Sode-Yome, N. Mithulananthan and K. Y. Lee, "A Comprehensive Comparison of FACTS Devices for Enhancing Static Voltage Stability," 2007 IEEE Power Engineering Society General Meeting, Tampa, FL, 2007, pp. 1-8.

[8] Mohammed BarghiLatran, AhmetTeke, YelizYoldaş "Mitigation of power quality problems using distribution static synchronous compensator a comprehensive review" ISSN 1755-4535,2015.

[9] D. Nair, M. Raveendran, A. Nambiar, N. P. Mohan and S. Sampath, "Mitigation of power quality issues using DSTATCOM," 2012 International Conference on Emerging Trends in Electrical Engineering and Energy Management (ICETEEEM), Chennai, 2012, pp. 65-69.

[10] Ambrish Chandra Bhim Singh, B. N. Singh, and Kamal Al-Haddad, "An Improved Control Algorithm of Shunt Active Filter for Voltage Regulation, Harmonic Elimination, Power-Factor Correction, and Balancing of Nonlinear Loads", IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 15, NO. 3, MAY 2000.

[11] Anant Naik, Udaykumar Yaragatti "Comparison of Three Popular Control Strategies Used in Shunt Active Power Filters" Asia Pacific Conference on Postgraduate Research in Microelectronics & Electronics (PRIMEASIA) 2012.

[12] Gunjan Varshney, D.S. Chauhan ,M.P. Dave "Performance Analysis of Photovoltaic based DSTATCOM using SRF and IRP Control Theory" 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015.

[13] M. F. Shousha, S. A. Zaid and O. A. Mahgoub, "Better performance for shunt active power filters," 2011 International Conference on Clean Electrical Power (ICCEP), Ischia, 2011, pp. 56-62.

[14] P. Rao, M. L. Crow and Z. Yang, "STATCOM control for power system voltage control applications," in IEEE Transactions on Power Delivery, vol. 15, no. 4, pp. 1311-1317,Oct.2000.

[15] Y. Xu and F. Li, "Adaptive PI control of STATCOM for voltage regulation," 2014 IEEE PES General Meeting | Conference & Exposition, National Harbor, MD, 2014, pp. 1-1.

[16] A. Ahirwar and A. Singh, "Performance of DSTATCOM control with Instantaneous Reactive Power Theory under ideal and polluted grid," 2016 Second International Innovative Applications of Computational Intelligence on Power, Energy and Controls with their Impact on Humanity (CIPECH), Ghaziabad, 2016, pp. 129-133.