Innovative Journal for Opportunities and Development in Science & Technology, Volume 1, Issue 4, Sept. 2020
ISSN 2582-6026, Paper ID: – IJ2020VII4-2(ABC)

USE UPQC TO IMPROVE THE POWER QUALITY OF INDUCTION STOVE

Walke Vishal B,[1] Pawan C.Tapre,[2]Amit M. Solanki,[3]
[1]PG Scholar, Department of Electrical Engineering. SND COE & RC Yeola, Nashik
[2]Assistance Professor Department of Electrical Engineering. SND COE & RC Yeola, Nashik
[3]Assistance Professor Department of Electrical Engineering. SND COE & RC Yeola, Nashik
[1]walke.vishal1@gmail.com
[2]Pawan.tapre25@gmail.com
[3]Solanki.amit04@gmail.com

Abstract- Most of the loads involved in the operation, the steel industry has a non-linear nature. Induction stove is a typical example of non-linear load, its growth is a boon for the steel industry. Harmonics and The operation of the induction furnace when the load changes Cause huge power loss and negatively affect neighboring areas load. The purpose of this work is to use harmonics to eliminate harmonics. Inductive Unified Power Quality Conditioner (UPQC) The melting pot of the steel industry. One Designed the Simulink model of the induction furnace, which Performance matches real-time data measured from steel The factory induction furnace is running.
Index Terms — Induction Stove, THD, UPQC

I. INTRODUCTION

1.1 Power Quality Issues

As modern high-tech microprocessor technology is used in various applications in industrial systems, power distribution and power generation through renewable energy systems, power quality has been polluted. In order to produce high-quality products, the power supply should be high-quality. Power electronics-based equipment will present nonlinear load characteristics to the network and generate harmonics in the system. Harmonic current will increase the RMS value of the current and generate a neutral current to circulate in the distribution network. The presence of harmonics will reduce the distribution capacity and increase losses.

1.1.1 Power Supply Issues

The utility had to supply the good quality of power supply to the consumer with allowable limits of voltage and frequency variation, voltage harmonics, etc. But due to the increased gap between supply and demand and more and more usage of power electronic equipment, the power quality is being polluted. Various power quality issues are discussed below :-

a) Voltage change

Voltage changes are usually classified as short-term voltage changes, namely dips, swells, interruptions, and logarithmic voltage changes, namely undervoltage and overvoltage. Due to various reasons such as overloads of conductors, transformers, circuit breakers, etc., voltage changes vary greatly in many industries. This voltage change will cause more system losses. According to Indian Electricity (IE) Rule 54, for low voltage (LV) distribution, the voltage change should be kept within ±6%, for high voltage (HV) transmission, the voltage change should be kept at +6% and -9%, and +10 % And -12.5% are used for ultra-high pressure (EHT) transmission

b) Voltage sags and swells -

Any variation in the supply voltage for duration not exceeding one minute is called a short duration voltage variation. Usually such variations are caused by faults, energization of large loads that require large inrush currents and intermittent loose connection in the power wiring [1].

1.1.2 Mitigation of Voltage Sags:

Different mitigation methods are:

- Dynamic voltage restorer
- Active series Compensators
- Distribution static compensator (DSTATCOM)
- Solid state transfer switch (SSTS)
- Static UPS with energy storage
- Backup storage energy supply (BSES)
- Ferro resonant transformer
- Flywheel and Motor Generator set
- Static Var Compensator (SVC)

II. METHODOLOGY

2.1 Power Quality Measurement

The power quality analyzer is an instrument specially used to measure various types of power quality problems, such as voltage dips, voltage swells, voltage interruptions, THD, total demand distortion (TDD), etc. If it is an intermediate frequency, there is a change in the current during the melting of the waste material depending on its quality. In this case, the Fluke 435 series II power quality analyzer was used to record the experimental measurement value of an 8-ton, 12-pulse Megatherm make IF.

2.2 Harmonics generated by induction furnace

The power quality (PQ) analyzer is an effective tool for detecting various voltage and current related problems at the power supply and load ends. During a complete operating cycle of the induction furnace, the current THD is measured with a PQ analyzer. Since the load current varies greatly at each instant during the melting process, the total harmonic distortion (THD) of the harmonic current also varies greatly.

2.3 Modeling of Steel Plant Using UPQC

UPQC involves two IGBT converters coupled back to back through a collective DC link. The inverters of both compensators include IGBT power switches that can operate in voltage or current mode. It is actually a combination of series and parallel active power filters (APF). Therefore, the use of APF composed of two forms of APF (series APF and parallel APF) can well control power quality problems. The series APF is used as a controlled voltage source, and the parallel APF meets the load VAR requirement to improve the power factor of the high inductive load. It is the most effective CPD to alleviate voltage and current related problems at the same time.

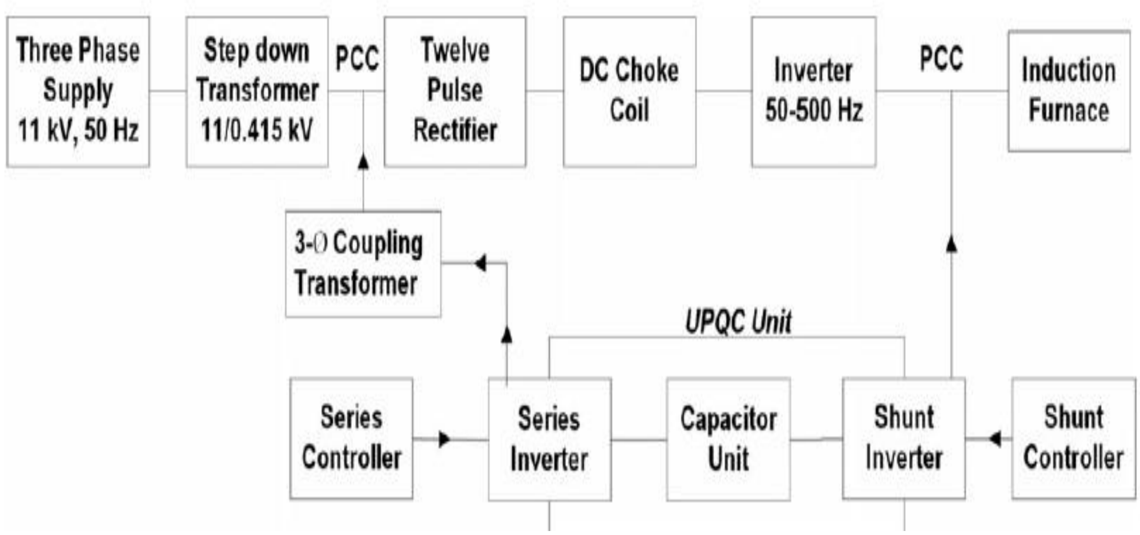

Fig 2.3 Block diagram of steel plant including UPQC

III. SIMULATION &RESULTANALYSIS

3.1 Case I- Without UPQC

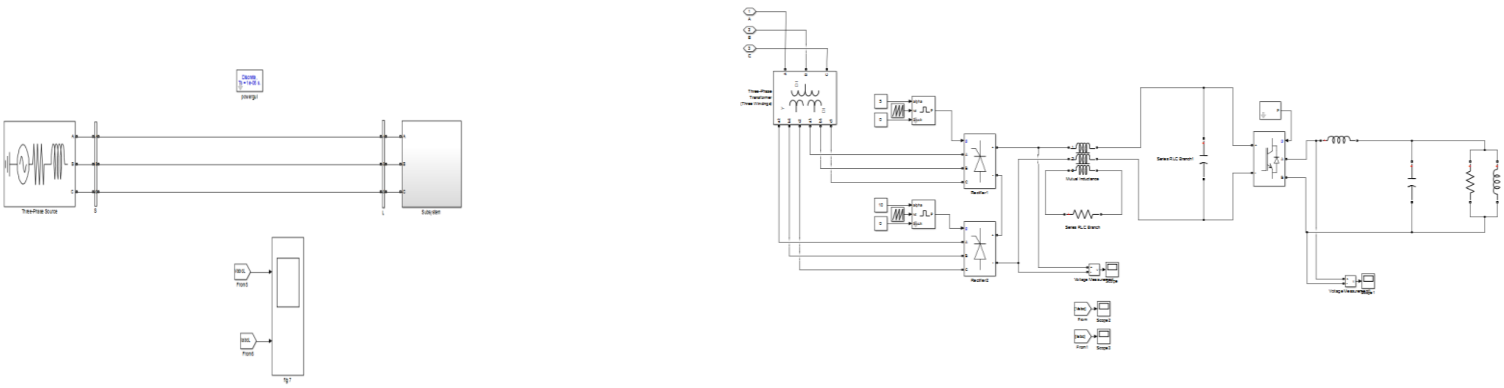

Fig 3.1.Induction Stove

3.2 FFT analysis of voltage and current without UPQC-

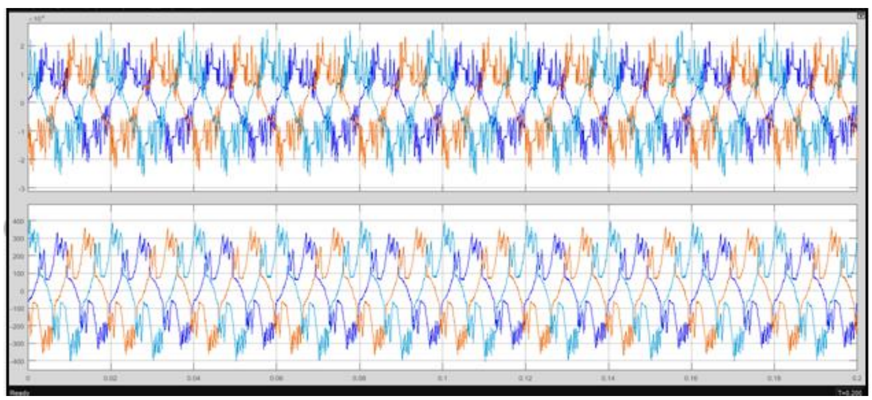

Fig 3.2.(a) Simulation result of Load Voltage and Load Current

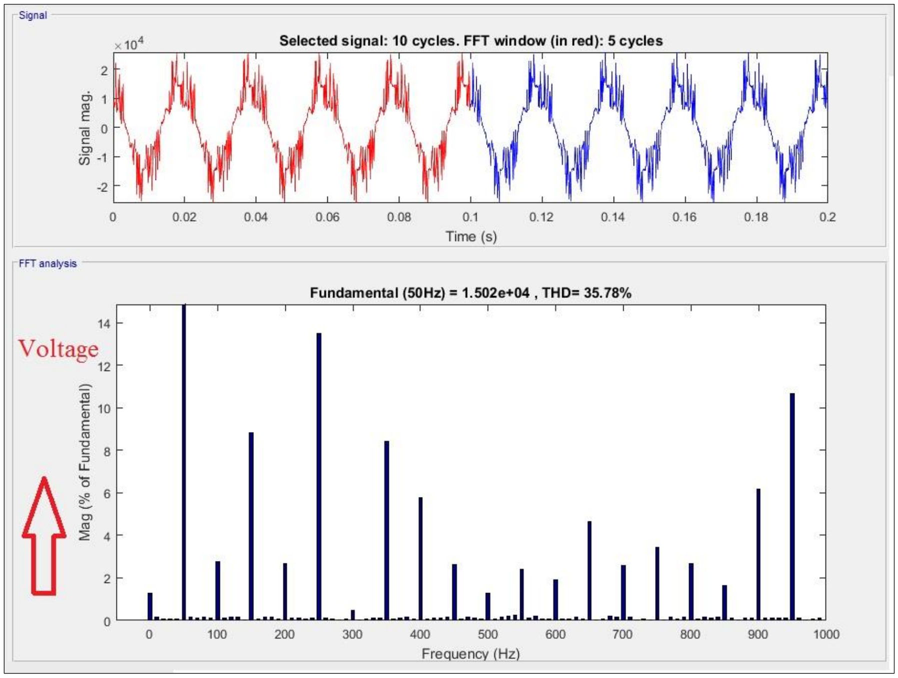

Fig. 3.2 (b): FFT analysis of voltage without UPQC

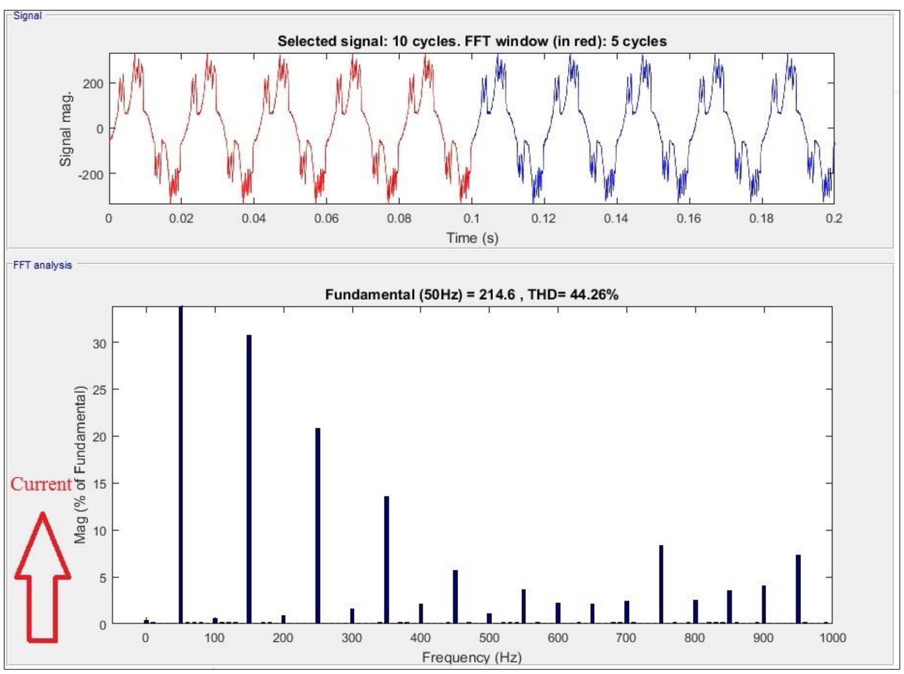

Fig. 3.2 (c): FFT analysis of Current without UPQC

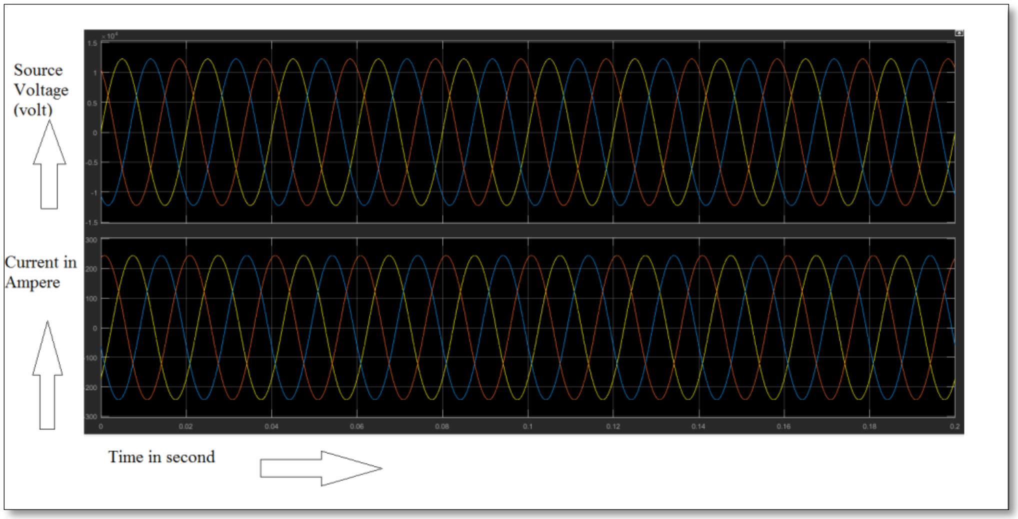

Fig.3.2 (d) Simulation Result of Voltage and Current

3.3 Case II- With UPQC -

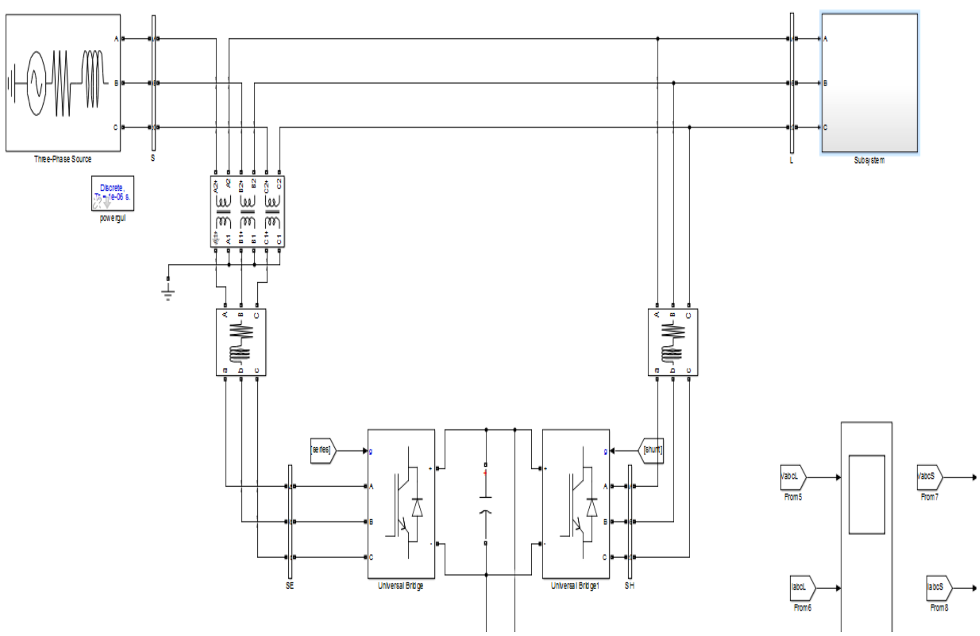

Fig. 3.3 (a) Simulink model of Proposed System

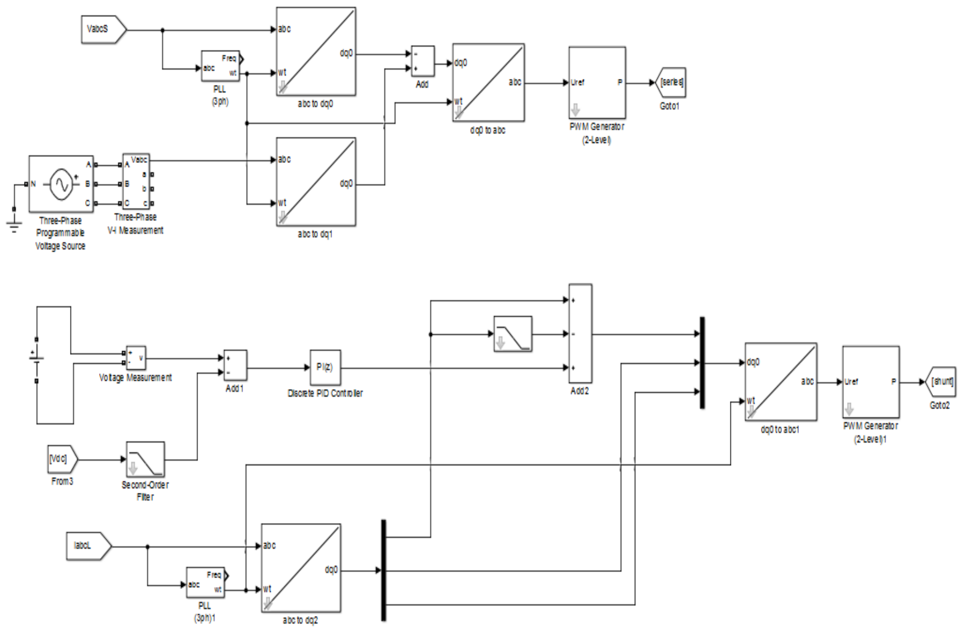

Fig.3.3(b) Simulink model of Control Circuit for Series and Shunt Controller of UPQC

3.4 FFT analysis of voltage and current with UPQC -

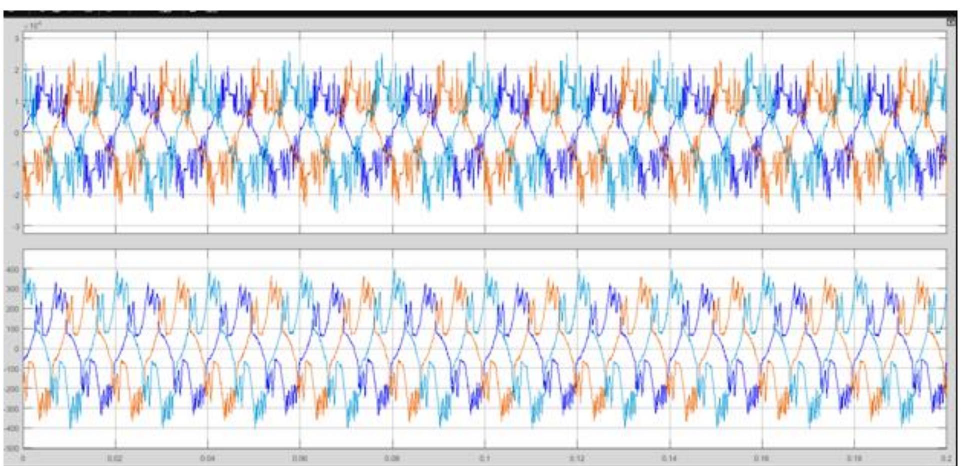

Fig.3.4 (a) Simulation Result of Load Voltage and Load Current

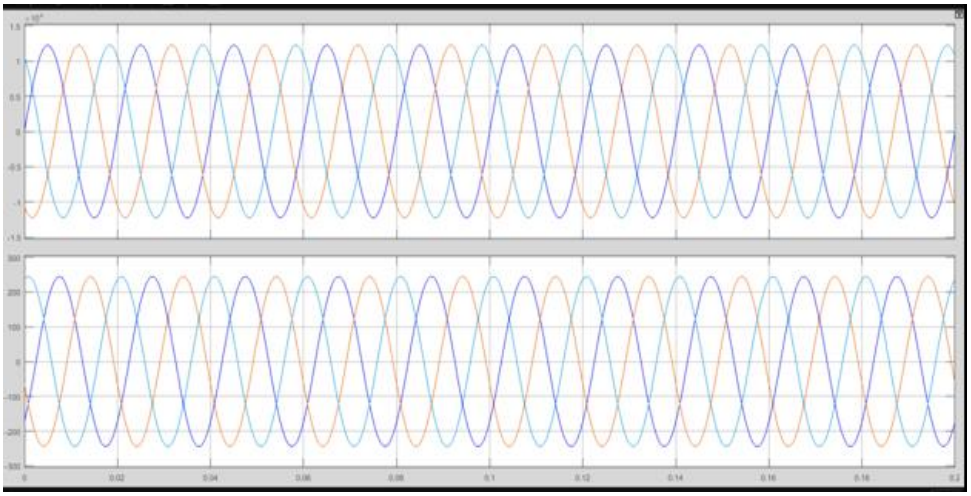

Fig.3.4 (b): Simulation Result of Source Voltage and Source Current

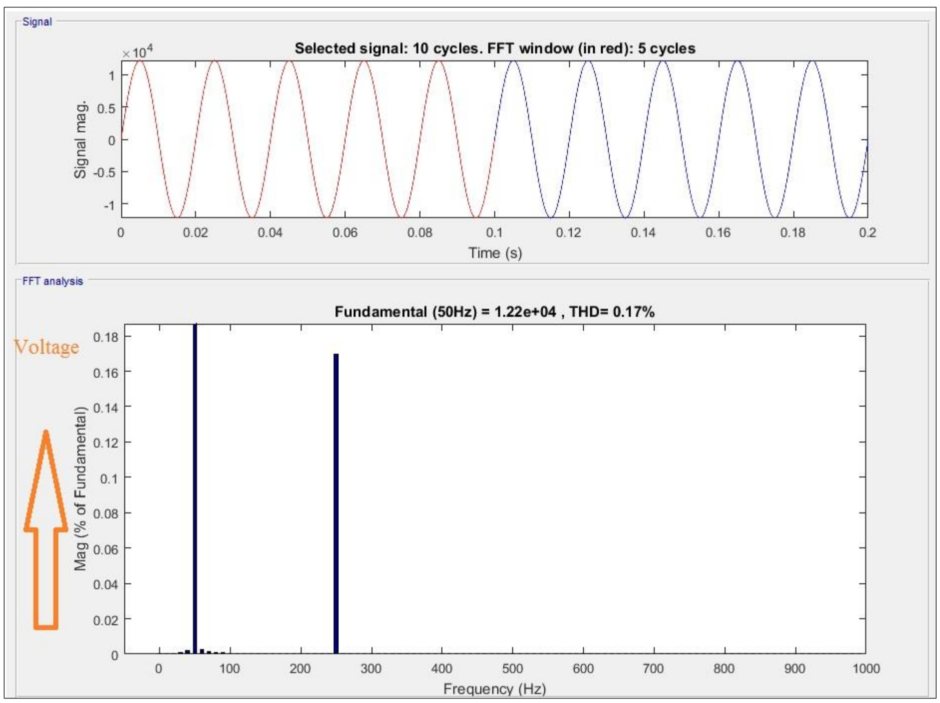

Fig. 3.4 (c): FFT analysis of voltage with UPQC

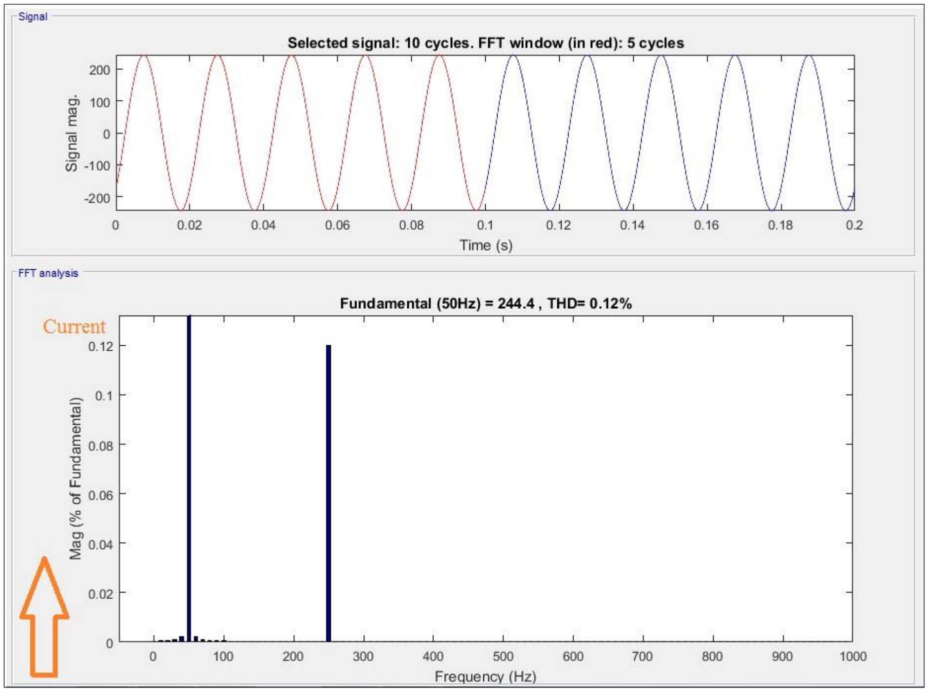

Fig.3.4 (d): FFT analysis of current with UPQC

IV. Conclusion

In the iron and steel industry using induction furnaces, power quality basically depends on the harmonics present in the system. These harmonics also describe the power quality level of the entire power distribution system connected to the induction furnace. In this project, experimental research will be conducted on one such industry. The industry's harmonic levels are actually measured using power quality analyzers. A Simulink furnace model is established, which is closely related to the performance of the induction furnace in operation. The solution method proposed by UPQC shows a significant improvement in the THD level of the system. The results of the proposed method are also compared with the results described in the literature. Based on these studies, UPQC seems to be an effective customized power supply device for improving power quality in the steel industry.

REFERENCES

[1] G. K. Singh, "Power system harmonics research: A survey", Euro. Trans. Elect. Power, vol. 19, pp. 151–172, 2009.

[2] A. Tan, M. Tumay, "Analysis of Power Quality Problems of Coreless Induction Melting Furnace with exact Simulation Model Based on Field Measurements", The Proc. IEEE Int. Conf. Power Engg. Energy and Electrical Drives, Turkey, pp. 13–17, 2013.

[3] L. Merabet, S. Saad, D. O. Abdeslam, A. Omeiri, "A comparative study of harmonic currents extraction by simulation and implementation", Int. J. Electrical Power Energy System, vol. 53, pp. 507–514, 2013.

[4] M. Shivaie, A. Salemnia and M. T. Ameli, "Optimal multi-objective placement and sizing of passive and active power filters by a fuzzy- improved harmony search algorithm", Int. Trans. Electrical Energy Systems, vol. 25, pp. 520–546, 2015.

[5] E. Pouresmaeil, D. Montesinos-Miracle, O. Gomis-Bellmunt and A. Sudrià- Andreu, "Instantaneous active and reactive current control technique of shunt active power filter based on the three-level NPC inverter", Euro. Trans. Elect. Power, vol. 21, pp. 2007–2022, 2011.

[6] A. M. Al-Zamil, D. A. Torrey, "A passive series active shunt filter for high- power applications", IEEE Trans. Power Electronics, vol. 16, pp. 101–109, 2001.

[7] B. Singh, V. Verma, A. Chandra, K. Al-Haddad, "Hybrid filters for power quality improvement", IEE Proc. Generation. Transmission. Distribution, vol. 152, pp. 365-378, 2005.

[8] P. Thirumoorthi, N. Yadaiah, "Design of current source hybrid power filter for harmonic current compensation", Simulation Modelling Practice Theory, vol. 52, pp. 78–91, 2015.

[9] B Singh, S. R. Arya, and P. Verma, "An implementation of double- frequency oscillation cancellation technique in control of DSTATCOM", Int. Trans. Electr. Energy System, vol. 24, pp. 796–807, 2014.

[10] K. V. Kannan, N. Rengarajan, "Photovoltaic based distribution static compensator for power quality improvement", Int J Electric Power Energy System, vol. 42, pp. 685–692, 2012.

[11] Chung I Yop, Won Dong-Jun, Park Sang-Young, Moon Seung, "The DC link energy control method in dynamic voltage restorer system", Int J Electric Power Energy System, vol. 25, pp. 525–531, 2003.

[12] H. M. Wijekoon, D. M. Vilathgamuwa, S. S. Choi, "Interline dynamic voltage restorer: an economical way to improve interline power quality", IEE Proc. Generation Transmission Distribution, vol. 150, pp. 513-520, 2003.