ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

A Review on Conditioning and Monitoring of Non-Linear Load Electrical Load in the View of Power Quality

Bhagyashri S. Patil1[1], Prof. V.S.Pawar[2]

PG Student [EPS], Dept. of Electrical Engineering, SSBT COET, Jalgaon, India[1]

Assistant Professor, Dept. of Electrical Engineering, SSBT COET, Jalgaon, India[2]

ABSTRACT: This paper the harmonic distortion and losses in power distribution systems due to the dramatic increase of nonlinear loads. This paper tries to determine the amount of the harmonics generated by nonlinear loads in residential, commercial and office loads in distribution feeders and estimates the energy losses due to these harmonics.Over a range of influence factor such as input voltage magnitude and harmonic distortion. It seeks to provide definitive characterization of the all that in terms of harmonic and power factor performance over a range of input supply conditions. This aim is achieved through laboratory testing of different brands, construction types and rated power levels.

KEYWORDS: Harmonic, THD, Power quality, Power factor, Different Loads**.**

I. INTRODUCTION

In recent years, the use of nonlinear electronic loads such as compact fluorescent lamps (CFLs), computers, televisions, etc. has increased significantly. Nonlinear loads inject harmonic currents into distribution systems. When a combination of linear and nonlinear loads is fed from a sinusoidal supply, the total supply current will contain harmonics. The injected harmonic currents and the resulted harmonic voltages can cause power quality problems and affect the performance of the consumers connected to the electric power network [1]. Because electrical devices that act as nonlinear loads draw current non linearity, they are responsible for injecting harmonic currents into the electricity network. Harmonics is a more important issue for the industry, commerce and the home consumer now than it was a few decades ago. The equipments in laboratory are Compact Fluorescent Lamps (CFLs), Personal Computers, Laptops, Printers and Air Conditions where all of them can be similarly as harmonic significant [2].
Because electrical devices that act as nonlinear loads draw current non linearity, they are responsible for injecting harmonic currents into the electricity network. Harmonics is a more important issue for the industry, commerce and the home consumer now than it was a few decades ago. The equipments in laboratory are Compact Fluorescent Lamps (CFLs), Personal Computers, Laptops, Printers and Air Conditions where all of them can be similarly as harmonic significant [2].
Accordingly, harmonic analysis has become one of the most important studies of power system operation, planning and design.

Harmonics modelling and simulation is used in three main ways as follows:
[1] To estimate the harmonic impact of a new customer or load equipment,
[2] To evaluate the harmonic impact of existing equipment or customers and the supplying utility,
[3] To evaluate effectiveness of various harmonic mitigation techniques.

II.HISTORY

Power quality issues and remedies are relevant research topics and a lot of advanced researches are being carried out in this area. These issues are mainly due to increased use of power electronic devices, nonlinear loads and unbalance in

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

power systems. Dynamic loads cause power quality problems usually by voltage or current variations such as voltage dips, fluctuations, momentary interruptions, oscillatory transients, harmonics, harmonic resonance etc.

Power quality is defined as **"concept of powering and grounding sensitive equipment in a manner that is suitable for operation of that equipment."**

However, the power quality improving operations of the VSI such as the demand side management (DSM) and the uninterruptible power supply (UPS) including the power conditioning operation are affected by the VSI's control method and thus, the comparative study for the various operations and the control methods. Also the computer simulation for the suggested equipment controlled by either voltage or current control, the strong and the weak points of each control method for the various power quality improving operations were analysed and compared each other [3].

AlsoA superconducting fault current limiter (SFCL), which can perform fast fault current limiting and recovery operations without the help of additional equipment, has been identified as the most ideal FCL and is expected to overcome drawbacks of existing methods to limit short-circuit current or to disconnect the fault line [4].

Power sources act as non-linear loads, drawing a distorted waveform that contains harmonics. The summation of all harmonics in a system is known as total harmonic distortion (THD). This paper will attempt to explain the concept of THD and its effects on electrical equipment.

What is Total Harmonic Distortion?

Total harmonic distortion is a complex and often confusing concept to grasp. However, when broken down into the basic definitions of harmonics and distortion, it becomes much easier to understand. Imagine a power system with an AC source and an electrical load.

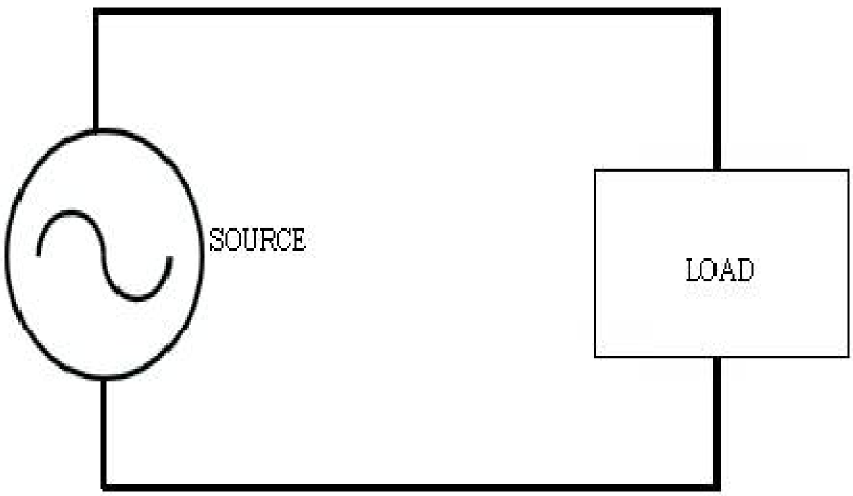

Fig. 1.1 Linear load

The type of load is going to affect the power quality of the system. This is due to the current draw of each type of load. Linear loads draw current that is sinusoidal in nature so they generally do not distort the waveform (Figure 1.1). Most household appliances are categorized as linear loads. Non-linear loads, however, can draw current that is not perfectly sinusoidal (Figure 1.2). Since the current waveform deviates from a sine wave, voltage waveform distortions are created.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

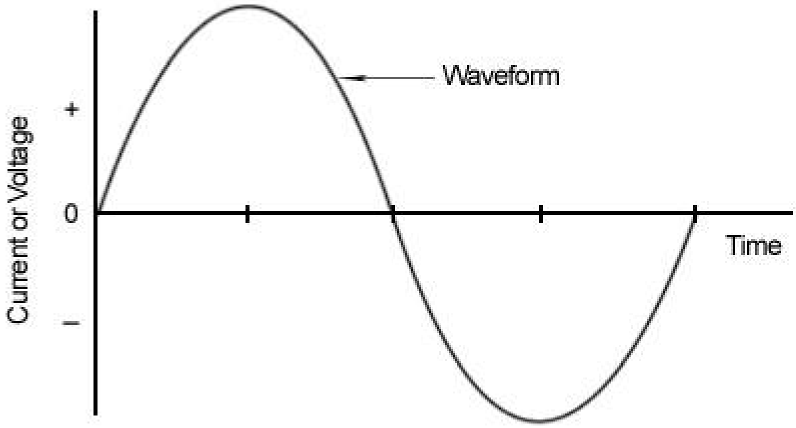

Fig.1.2 Non- linear load

III.NON LINEAR LOAD

Due to the changes in the operating conditions and the rapid growth of advanced power conversion devices, electronics equipments, computers, office automation, air-conditioning systems, adjustable speed heating ventilation can cause current distortions. This is due to increase in harmonics drastically. According to the Electric Power Research (EPR) in 1995, 35-40% of all electric power flows through electronic converters. This is expected to increase to 85% by the year 2012 [5].
All these devices are named as non-linear loads and become sources of harmonics. In this general objectives are:
[1] Identify the trends of harmonic distortion level present in the system,
[2] Identify the future trends of metering in the presence of non-sinusoidal current and voltage waveforms. And increased awareness and concern for customer's quality of service.

IV.METHODOLOGY

The research was measured with Fluke Power Quality Analyzer and the connection circuit instrument and switching board. Power Quality Analyzer has been used to record the harmonic data. Data that has been collected are frequency, voltage, harmonic distortion, voltage harmonic and current harmonic. All those data have been transferred to computer by using Universal Serial Bus and View software.
This part will present the result of the harmonic from four-five days data analysis taken from distribution board at laboratory. Data from these days of measuring are used to see the differential harmonic distortion due to non linear load equipment during laboratory operation. The loads for red phase are different unit of different HP and air conditioning, also eg.10 unit of 36 W fluorescent and 12 unit of computer. Similarly, for yellow and blue phase for fluorescent & for computer [6].

This investigates;
[1] Background issues relating to power quality.
[2] Non-linear load characteristics and effect on power quality.
[3] Techniques to locate and identify non-linear loads measure their effects.
[4] Mitigating power quality issues within the power distribution network.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

V. TESTING PROCEDURE

A combination of laboratory testing, field testing and mathematical analysis has been used to understand the behaviour of loads operating individually and with other loads.
For laboratory testing, the characteristics of each device have been examined for an undistorted 230 V supply voltage. In all cases, test voltages were applied using a California Instruments MX30-3PI programmable source. For undistorted waveforms, this device has a very low output voltage distortion level (0.24% THD) and high magnitude accuracy.
It is cost prohibitive to obtain many different brands and types of loads for testing in a laboratory environment. Accordingly, some of the appliances examined in this study have had their characteristics monitored in the field. The drawback of this type of examination is that there is no control over the voltage supply waveform. The magnitude and background harmonic distortion of the supply voltage waveform will have some impact on the currents drawn by the device connected to it. In general, however, voltage magnitudes and background harmonic distortion levels in Australia do not vary to such an extent as to have a large impact on the characteristics of the current waveform drawn by the devices under test.

VI. RELATED WORK

Accurate loss estimation plays an important role in determining the share of technical and commercial losses in the total loss. Researchers have tried to estimate the losses in distribution systems by different methods. Some works have used the simplified feeder models and curve fitting approaches to estimate the losses [7-9]. A comprehensive loss estimation method using detailed feeder and load models in a load-flow program is presented [10].
Simulation of distribution feeders with load data estimated from typical customer loads is performed in [11]. Ref. [12] applies some approximations to power flow equations in order to estimate the losses under variations in power system components. A fuzzy-based clustering method of losses and fuzzy regression techniques and neural network technique for modelling the losses is obtained [13].

A. FORMULIZATION FOR HARMONIC POWER

If a signal contains harmonics, the Individual Harmonic Distortion (IHD) for any harmonic order is defined as:

$$V_h\,\% = 100.\frac{\mathrm{Vh}}{\mathrm{V1}} \qquad (1)$$

$$I_h\% = 100.\frac{Ih}{I1} \qquad (2)$$

Where I1/V1 is the current/voltage harmonic of order h, and Ih/Vh is the fundamental current/voltage component.
"Total Harmonic Distortion" (THD) of the current and voltage signals are widely used. The current and voltage THD of a harmonic polluted waveform can be expressed as:

$$THD1 = \frac{\sqrt{\sum_{h=2}^{\infty} I^2 h}}{I1}.100 \qquad (3)$$

$$I^2 = I_1^2(1 + THD_1^2) \qquad (4)$$

Where I and V are the current and voltage rms values. The separation of the rms current and voltage into fundamental and harmonic terms resolves the apparent power in the following manner.

$$S^2 = (VI)^2 = (V_1^2 + V_H^2)(I_1^2 + I_H^2) = (S_1^2 + S_N^2) \qquad (5)$$

$$S_N = \sqrt{S^2} - S_1^2 \qquad (6)$$

Where S1 is the fundamental apparent power. The presence of harmonics causes the presence of a new type of non-fundamental apparent power (S_N).

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

VII.CONCLUSION

In this project a comprehensive investigation has been done to determine the impacts of harmonic distortions on power system distribution networks. Individual assessment of odd harmonics in current; significant in magnitudes are represented by mathematical modelling and proved theoretically the decrease in THD in current with the increase of electronic/nonlinear loads connected to the distribution network.

REFERENCES

[1] M. JawadGhorbani, H. Mokhtari, “Impact of harmonic on power quality & losses in power distribution system”, International Journal of Electrical and Computer Engineering (IJECE) Vol. 5, No. 1, February 2015, pp. 166~174.

[2] Risnidar C12, I. Daut3, Syafruddin H12, N. Hasim, “Influence of Harmonics in Laboratory due to Nonlinear Loads”, International Journal of Power Electronics and Drive System (IJPEDS) Vol.2, No.2, June 2012, pp. 219~224.

[3] Sung-Hun Lim, Su-Won Lee, Young-Hyun Moon, Jae-Chul Kim, and Tae-KukKo, “Power quality improving operation of flux-lock type SFCL integrated with voltage or current control voltage source inverter”, IEEE transactions on applied superconductivity, vol. 18, no. 2, June 2008, pp 644-647.

[4] Kyung-Il Min, Su-Won Lee, Sung-Hun Lim, and Young-Hyun Moon, “Design and operational characteristic analysis of voltage-controlled VSI”,IEEE transactions on applied superconductivity, vol. 19, no. 3, June 2009,pp 1839-1842.

[5] A.Priyadharshini, N.Devarajan, AR.Umasaranya, R.Anitt, “Survey of harmonic in non linear load”, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-1, Issue-1, April 2012, pp 92-98.

[6] Ryan Liu, Luther Dow, Edwin Liu, “A Survey of PEV Impacts on Electric Utilities”, IEEE PES innovative smart grid technology conference, January 2011.

[7] M.W. Gustafson, J. S. Baylor, and S. S. Mulnix, “Equivalent hours loss factor revisited,” IEEE Trans. Power Syst.,vol. 3, no. 4, pp. 1502–1507, Nov. 1988.

[8] M.W. Gustafson, “Demand, energy and marginal electric system losses,” IEEE Trans. Power App. Syst., vol. PAS-102, no. 9, pp. 3189–3195, Sep. 1983.

[9] M.W. Gustafson and J. S. Baylor, “Approximating the system losses equation,” IEEE Trans. Power Syst., vol. 4,no. 3, pp. 850–855, Aug. 1989.

[10] D. I. H. Sun, S. Abe, R. R. Shoults, M. S. Chen, P. Eichenberger, and D. Ferris, “Calculation of energy losses in a distribution system,” IEEE Trans. Power App. Syst., vol. PAS-99, no. 4, Jul./Aug. 1980.

[11] R. Céspedes, H. Durán, H. Hernández, and A. Rodríguez, “Assessment of electrical energy losses in the Colombian power system,” IEEE Trans. Power App. Syst., vol. PAS-102, no. 11, pp. 3509–3515, Nov. 1983.

[12] C. S. Chen, M. Y. Cho, and Y.W. Chen, “Development of simplified loss models for distribution system analysis,” IEEE Trans. Power Del., vol. 9, no. 3, pp. 1545–1551, Jul. 1994.

[13] O.M. Mikic, “Variance Based Energy Loss Comptation in LV Distribution Networks”. IEEE Trans. Power Syst.,vol. 22, no. 1, pp. 179-187, Feb. 2007.