|| Volume 6 || Issue 6 || June 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

DESIGN AND DEVELOP POWER QUALITY MONITORING SYSTEM

Sneha Dalvi[1], Sapana Mudhe[2], Rutuja Revadkar[3], Nikita Nikam[4], Prof. Sourabh Shingare[5]

[1]Member, Dept. of Electrical Engineering, AISSMS IOIT, Maharashtra, India
[2]Member, Dept. of Electrical Engineering, AISSMS IOIT, Maharashtra, India
[3]Member, Dept. of Electrical Engineering, AISSMS IOIT, Maharashtra, India
[4]Member, Dept. of Electrical Engineering, AISSMS IOIT, Maharashtra, India
[5]Professor, Dept. of Electrical Engineering, AISSMS IOIT, Maharashtra, India

-- ***--

Abstract: ***-The Power Quality measurement is developing in Industrial sector. For decades it was thought that power is power you have it or you don't, but today it is becoming clearer that there are distinctions regarding the Consistency and Quality of Power. . As a result many power quality monitoring options have emerged to meet the needs for PQ measurement and we consider the needs and ideal state of this Practice.***

The main purpose of this paper, is to provide information not just data. To solve power quality problem and provide safe energy, we are going to develop proactive power quality monitoring system from which it will be easy to monitor all parameter on regular basis .So that it will helps to analyses the problem on prior basis and find regarding mitigation technique. So that it will make industrial system more reliable and spent more amount on their production due to which system become more productive.

Our Designed system is a reliable, standard based and multifunctional power quality monitoring system which consist ClassA Power Quality, fault recording devices

, software based monitoring system.

Keywords: - *Power Quality, PQ, harmonics, Power Quality monitoring system, safe energy, fault recording, Monitoring. Analyser.*

--***--

I. INTRODUCTION

"Electric Power Quality (EPQ) is defined as maintaining the near sinusoidal waveform of power distribution voltage and current at rated magnitude and frequency"; Because of nonlinear load and power electronic devices disturbances occur in voltage and current waveforms and unsymmetrical harmonic distortion are introduced during normal operation in an electrical supply system. Due to load changes, disturbances generate by some equipment, and faults caused by external events. These power quality issues mainly affect industrial end-users, equipment, and system manufacturers. These issues introduce significant losses in industries. The electrical power quality is an important contributing factor that helps to provide secure supply to industrial sites. So with the help of continuous power quality monitoring can detect, record, and prevent problems. Power Quality Monitoring is a Process of gathering; analysing and interpreting raw measurement data into useful information in systematic manner, the site operator can constantly monitor and verify electrical system quality in accordance with the EN50160 standard.

This project is carried out at ANSOX INDUSTRIES PVT. LTD Pune. The main purpose of this paper is to develop a PQ monitoring system to reduce power quality-related problems of industry and increase their production per unit generation with the help of a permanent proactive PQ monitoring system Using the Janitza Power Quality Class-A Analyser, like UMG-512PRO, UMG-604PRO, UMG-96PA, UMG-96S2, If any power quality issue occurs the user will be alerted automatically and in real-time. With the GridVis- basic power quality software to manual report generation as well as comprehensive PQ analysis with individual graph report to analysis and benchmarking the local grid quality. ANSOX INDUSTRY PVT LTD, PUNE manufactures parts and accessories for motor vehicles.

The industry consists of different sections that include:

a) Tool room

b) Press shop and

c) Plastic mounding machinery section

II. LITERATURE REVIEW

Design of Power filters to improve Power Quality in Power system is recognize by Yogananda B.S, Dr. K Thippeswany International Conference on Energy , Communication, Data analytics And Soft Computing (ICEDS-2017) involves Uses of various Filter and find out the Active power , Reactive Power and THD of source current. Analysis and mitigation of Power Quality Issues in Distributed Generation Systems Using Custom Power Devices is authored by EKLAS HOSSAIN; MEHMET RIDA TUR;SANJEEVIKUMAR PADMANABAN ; IMTIAJKHAN on Received February 1,2018 , accepted March 8, 2018, date of publication March 12, 2018, date of current version April 18,2018 Introduces about the issues of the power quality distributed generation system using the renewable energy sources and also explain the various techniques on monitoring power quality and purposes of various equipment .The Importance of Power Quality Monitoring for Modern Network Operators and Industries in Zambia is authored by Enock

Mulenga, Math H.J. Bollen, Ola Karlsson on 13th April, 2018 Avani Victoria Falls Resort, Livingstone, Zambia Involves In Studied about the power quality system in the Zambia using the class A power analyzer. So, class A analyzer gives the detail parameters in the power system. Class A power analyzer is very important in the detailed case study of the particular industry.

SUMMARY OF LITERATURE SURVEY:

From the above literature survey, it concluded that power quality-related problems are not completely dependent on utility nor on industrial users but they arise. In the current system, more than ever, electronic equipment and computing devices are used in all types of industrial processes. This has been pivotal in making these processes more than types of industrial processes. This has been pivotal in making these processes more productive, efficient, and safe. However, this trend also makes manufacturing processes and equipment more vulnerable to real-world power quality conditions. Power quality is related to fluctuations in the electrical supply in the form of momentary interruptions, voltage sags or swells, transients, harmonic distortion, electrical noise, and flickering lights, among others. However, power quality events are largely untracked, and as a result, can take out a process as many as 20 to 30 times a year, costing industrial customers millions of dollars. To minimize these costs, it is critical for industrial customers to understand how power quality is impacting their system and how to mitigate its effects.

III INDUSTRIAL SURVEY

Industrial consumers are often concerned about the power quality as poor power quality leads to the loss of production and service quality leading to buying expensive new machineries which add up financially to the industry.

ANSOX INDUSTRIES PVT LTD.

Manufactured parts and accessories for motor vehicles and their engines brakes, gear boxes, axles, road wheels, suspension shock absorbers, radiators, silencers, exhaust pipes, steering wheels, steering Columns and steering boxes and other parts and accessories. In short it is purely an automobile industry which consists of 3 main business unit & they are,

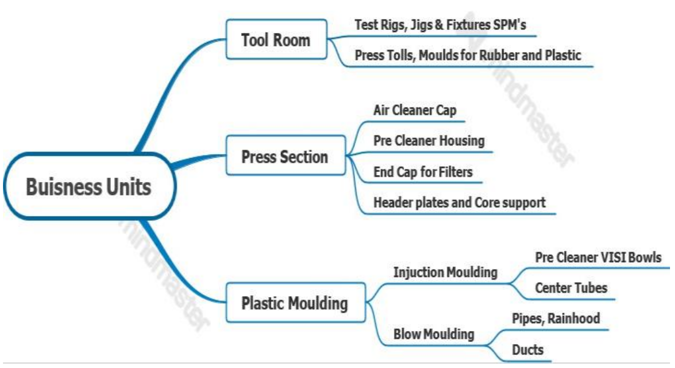


Figure 1: Detailed Industry Setup Diagram

For manufacturing this all, industry has different type of machines & some of they are:-

1. VMC milling m/c:

In contrast to machines with horizontal machining centers, such as HMC, CNC machines with vertical machining centers , such as VMC, have spindles that are vertically oriented. Work pieces for VMC machines are normally positioned on top of the table and execute normal 2.5 or 3 axis machine operations. VMCs are useful for producing parts, dies, and moulds that have high precision, repeatability, and surface finishes. VMCs can be used for a variety of tasks, including drilling, carving, engraving, tapping, countersinking, chamfering, and more.

Figure 2: VMC milling machine

2. Press shop:

An automobile plant's press shop is a fantastic location. A press shop may have a number of different press lines. The first press starts with the metal sheet blank being loaded into the ladder portion. At each press section, a coordinated dance of loading sheet metal, pressing, and unloading occurs to feed the next press. The press line is a complicated sequential machine with a huge dc drive and clutch. Due to a power quality issue, the entire line operation must stop for the Stamping section ac vector type drives for the convert controller, and typical control components of any section of the line shut down, the entire line operation must stop, resulting in downtime and potential scribe of the sheet Metal Part

Figure 3: Press machine

3. Injection moulding:

It is a manufacturing process for making parts by injecting material into a mould and injecting the material into the mould Moulding may work with a variety of materials, including metals, glassware, elastomers, confections, and thermoplastic and thermosetting polymers, which are the most typically utilized . The part's material is supplied into the heated barrel, where it is mixed and injected into a mould by a mold-maker. The metal is commonly steel or aluminium, and it is carefully machined to form the desired part's features. Injection moulding is commonly utilised to produce a wide range of parts, from the tiniest component to the full body panel.

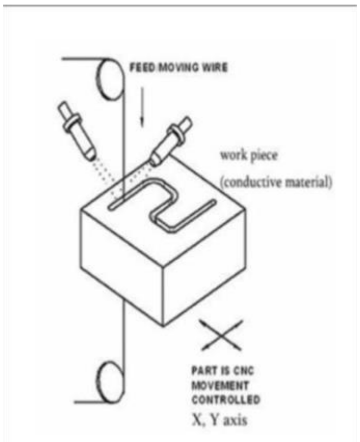


Figure 4: Injection Moulding machine

IV. Objectives

- To characterised the system performance.
- To characterize specific problem.
- To design proactive monitoring system to perform predictive or just-in-time maintenance.
- To study & observe the power quality events happening & estimate the loads responsible for it.
- To monitor the voltage & current harmonics as per IEC standards..
- Analysis and localization of disturbances in the noisy environment.
- Performance evaluation of the developed recognition systems

V. METHODOLOGY

I. Following are some steps that are followed while developing power quality monitoring system

- **Survey:** Do the survey of the Industry. Under this we visiting the industry and will be conducting walk through the survey.
- **Monitoring (Pre):** While doing the walk-through survey we will only doing only physical equipment installed. We will ensure proper operation of this equipment installed in this industry.
- **Selection**: After analysing the problems in the industry on the basis of that selection of the metering will be done.
- **Installation:** After selection of the meter we will ensure that there is proper space for these meter to be installed so that they can collect the parameters of that industry.
- **Dashboard Designing:** After collection of the all the parameters reading of the industry, we will represent these parameters in the tabular or graphical format.
- **Simulation** and actual analysis of all energy parameters with the help of Janitza software.
- **Monitoring (Post):** After simulation of the parameters that we have obtain from the industry this step will be carried out. From the Parameters or readings collected from the industry will be analyze.
- **Solution:** After the data collected form the post survey, we would be briefing them the problem related to power quality and Suggest them solution in order to overcome the power quality problem.
    - *While performing the above steps following are the some IEEE standards which should follow strictly*

    1. IEEE 1159 For the Monitoring the electrical Power Quality
    2. IEEE 519 for the harmonics limit, voltage distortion limit, current limit.

The purpose of IEEE -519 is to recommend limits on Harmonic Distortion according to two distinct criteria namely.

1) There is limitation on the amount of Harmonic current that a consumer can inject into Utility Network.

2) A Limitation is placed on the Level of Harmonic Voltage that a utility can supply to a consumer.

VI. BLOCK DIAGRAM OF DETAIL HARDWARE

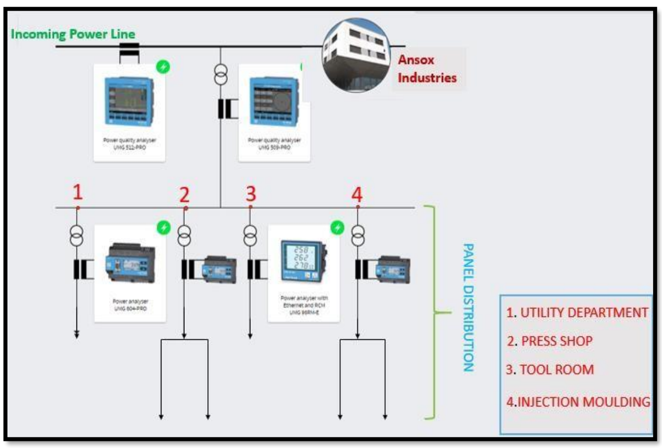


Figure 5: Detailed System Setup Design of hardware architecture Diagram

VII. MONITORING SOFTWARE

I.Introduction Software GridVis® We have software it can be used to configure pull back data and display data from devices (class-A PQ Analyser of Janitza company).out on the network. We have our devices in the middle is where it shows the data under most windows applications.

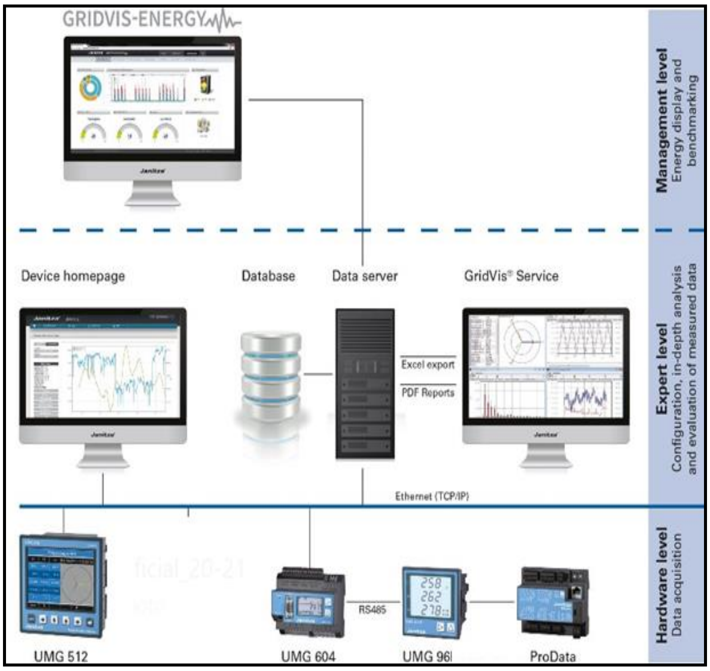


Figure6: Detailed Designed and Developed Software And Hardware Setup of system.

So we can click on trigger recording continuous recording or the overview and then down at the bottom is where we've got the communication back and forth to the device. So we can see what's going on with the software.one of the things that we can do which helps to gather the data itself is we can set up scheduled actions and here what we're telling the software to do is go to each device in the network and pull back all of this information and do it at a regular cadence. So we can set it up for every 24 hours or every hour or even faster and once that's set up we can walk away From the software it will every periodic time go to all of the devices and pull back all the relevant information that we need and when we have any issue we come to our software we take a look the data is all there automatically we don't have to go searching for it. Power quality overview here what we have is all of our devices listed down .we have across the top the parameters that we're monitoring. So we're monitoring events which are :

- L-L / L- N voltages .
- Active power, apparent power, reactive power and power factor.
- Harmonic coefficient up to 30th order with total harmonic distortion.

II. Monitoring Software Result:

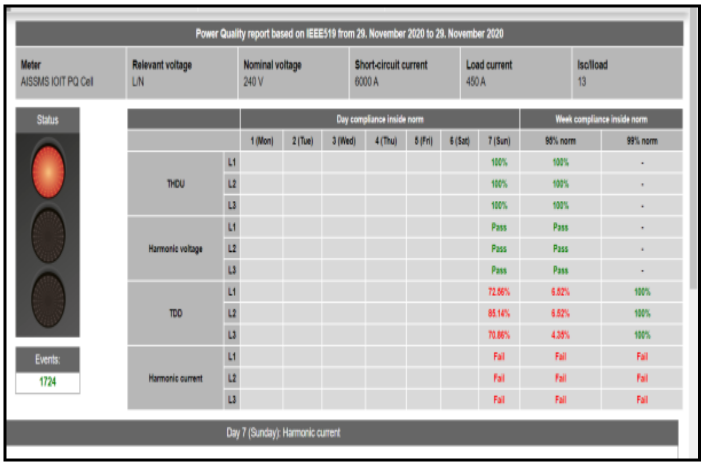


Figure 7: View of software simulator when system fails.

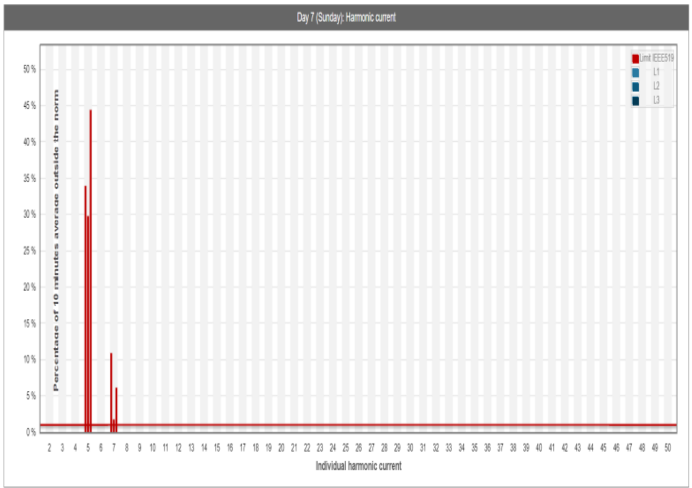
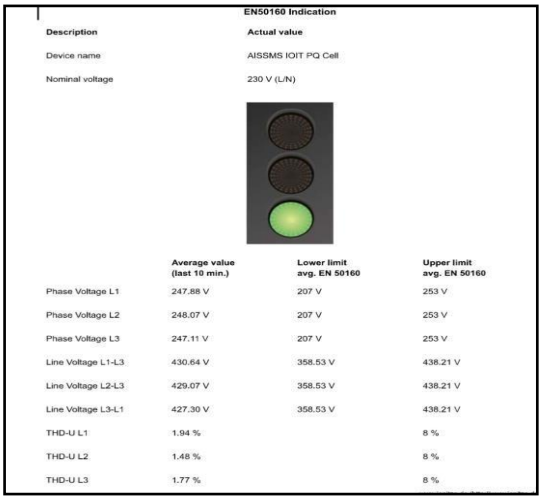


Figure 8: View of Various section to select the option simulation



EN50160 Indication

Description	Actual value		
Device name	AISSMS IOIT PQ Cell		
Nominal voltage	230 V (L/N)		
	Average value (last 10 min.)	Lower limit avg. EN 50160	Upper limit avg. EN 50160
Phase Voltage L1	247.88 V	207 V	253 V
Phase Voltage L2	248.07 V	207 V	253 V
Phase Voltage L3	247.11 V	207 V	253 V
Line Voltage L1-L3	430.64 V	358.53 V	438.21 V
Line Voltage L2-L3	429.07 V	358.53 V	438.21 V
Line Voltage L3-L1	427.30 V	358.53 V	438.21 V
THD-U L1	1.94 %		8 %
THD-U L2	1.48 %		8 %
THD-U L3	1.77 %		8 %

Figure 9: View of EN indication option form the simulation.

VIII. Simulation Report Generated By GridVis Software.

12/20/2020 Janitza : AISSMS IOIT PQ Cell

Current Effective

	Actual value	Average value	Avg. max. value	Maximum value
L1	276.25 A	239.40 A	367.60 A	619.33 A
L2	267.90 A	247.66 A	369.18 A	575.10 A
L3	274.46 A	239.85 A	363.02 A	693.82 A
L4	0.00 A	0.00 A	0.00 A	0.00 A
Sum L1..L3	31.63 A	29.51 A	64.98 A	254.52 A
Sum L1..L4	31.63 A	29.51 A	64.98 A	254.52 A

Three-phase Values

	Actual value	Average value		Maximum value
Unbalance Current	0.00 %	1088.15 %		60980.51 %

Figure 10: CURRENT Report Generated By GridVis Software.

12/20/2020 AISSMS IOIT PQ Cell

Voltage Effective

	Actual value	Average value	Minimum value	Maximum value
L1	254,6 V	253,1 V	154,8 V	258,9 V
L2	254,6 V	253,3 V	150,3 V	258,8 V
L3	253,6 V	252,6 V	154,2 V	257,2 V
L4	70,2 V	68,3 V	17,0 V	81,7 V
L1-L2	441,5 V	439,2 V	263,6 V	449,8 V
L2-L3	440,8 V	438,7 V	262,5 V	446,9 V
L3-L1	439,0 V	436,8 V	269,4 V	445,4 V

Three-phase Values

	Actual value	Average value	Minimum value	Maximum value
Voltage unbalance	0,3 %	0,3 %	0,0 %	9,0 %

Frequency

	Actual value	Average value	Minimum value	Maximum value
Frequency	50,0 Hz	50,0 Hz	49,7 Hz	50,3 Hz

Figure 11: VOLTAGE Report Generated By GridVis Software.

12/20/2020 Janitza : AISSMS IOIT PQ Cell

Active Power

	Actual value	Average value	Avg. max. value	Maximum value
L1	54.03 kW	57.77 kW	88.56 kW	132.34 kW
L2	63.96 kW	59.84 kW	89.40 kW	128.71 kW
L3	53.57 kW	58.25 kW	86.17 kW	152.54 kW
L4	0.00 kW	0.00 kW	0.00 kW	0.00 kW
Sum L1..L3	171.56 kW	175.86 kW	262.24 kW	374.56 kW

Reactive Power (fundamental comp.)

	Actual value	Average value	Avg. max. value	Maximum value
L1	4.75 kvar	6.92 kvar	42.36 kvar	103.50 kvar
L2	5.77 kvar	7.81 kvar	40.83 kvar	101.92 kvar
L3	3.37 kvar	1.28 kvar	37.10 kvar	97.98 kvar
L4	0.00 kvar	0.00 kvar	0.00 kvar	0.00 kvar
Sum L1..L3	13.88 kvar	16.02 kvar	120.14 kvar	303.40 kvar

Apparent Power

	Actual value	Average value	Avg. max. value	Maximum value
L1	54.96 kVA	58.81 kVA	92.13 kVA	133.01 kVA
L2	64.66 kVA	60.78 kVA	91.98 kVA	135.51 kVA
L3	54.33 kVA	58.89 kVA	89.34 kVA	162.28 kVA
L4	0.00 kVA	0.00 kVA	0.00 kVA	0.00 kVA
Sum L1..L3	173.95 kVA	178.48 kVA	272.34 kVA	404.16 kVA

Distortion Power

	Actual value	Average value	Avg. max. value	Maximum value
L1	9.00 kvar	8.45 kvar	17.66 kvar	79.46 kvar
L2	7.69 kvar	7.13 kvar	14.25 kvar	81.85 kvar
L3	8.60 kvar	8.39 kvar	14.86 kvar	80.34 kvar

49.248.9.198:8008/overview.html 1/2

Figure 12: POWER Report Generated By GridVis Software

12/20/2020 AISSMS IOIT PQ Cell

Voltage Effective

	Actual value	Average value	Minimum value	Maximum value
L1	254,6 V	253,1 V	154,8 V	258,9 V
L2	254,6 V	253,3 V	150,3 V	258,8 V
L3	253,6 V	252,6 V	154,2 V	257,2 V
L4	70,2 V	68,3 V	17,0 V	81,7 V
L1-L2	441,5 V	439,2 V	263,6 V	449,8 V
L2-L3	440,8 V	438,7 V	262,5 V	446,9 V
L3-L1	439,0 V	436,8 V	269,4 V	445,4 V

Three-phase Values

	Actual value	Average value	Minimum value	Maximum value
Voltage unbalance	0,3 %	0,3 %	0,0 %	9,0 %

Frequency

	Actual value	Average value	Minimum value	Maximum value
Frequency	50,0 Hz	50,0 Hz	49,7 Hz	50,3 Hz

12/20/2020 Janitza : AISSMS IOIT PQ Cell

Real energy

	Sum
L1	66927 kWh
L2	67077 kWh
L3	65725 kWh
L4	0 kWh
Sum L1..L3	199729 kWh
Sum L1..L4	199729 kWh

Real energy consumed

	Sum	High Tariff	Low Tariff
L1	66927 kWh	66927 kWh	0 kWh
L2	67077 kWh	67077 kWh	0 kWh
L3	65725 kWh	65725 kWh	0 kWh
L4	0 kWh	0 kWh	0 kWh
Sum L1..L3	199729 kWh	199729 kWh	0 kWh
Sum L1..L4	199729 kWh	199729 kWh	0 kWh

Real energy delivered

	Sum	High Tariff	Low Tariff
L1	0 kWh	0 kWh	0 kWh
L2	1 kWh	1 kWh	0 kWh
L3	0 kWh	0 kWh	0 kWh
L4	0 kWh	0 kWh	0 kWh
Sum L1..L3	0 kWh	0 kWh	0 kWh
Sum L1..L4	0 kWh	0 kWh	0 kWh

Reactive energy

Sum

49.248.9.198:8008/overview.html 1/3

Figure 12: ENERGY Report Generated By GridVis Software.

12/20/2020 Janitza : AISSMS IOIT PQ Cell

Flicker

	L1	L2	L3	L4
Actual Flicker	0.01	0.02	0.02	0.03
Short term flicker	0.18	0.20	0.19	0.32
Long term flicker	0.24	0.26	0.25	0.40

Figure 13: FLICKER Report Generated By GridVis Software

12/20/2020 Janitza : AISSMS IOIT PQ Cell

Total Harmonic Distortion - Voltage (THD-U)

	Actual value	Average value	Minimum value	Maximum value
L1	2.0 %	2.1 %	0.3 %	9.0 %
L2	1.6 %	1.7 %	0.3 %	8.1 %
L3	1.9 %	1.9 %	0.3 %	10.4 %
L4	8.1 %	8.0 %	6.1 %	39.1 %

Total Harmonic Distortion - Current (THD-I)

	Actual value	Average value	Avg. max. value	Maximum value
L1	12.7 %	14.2 %	539.6 %	3591.0 %
L2	10.7 %	11.6 %	111.6 %	195.2 %
L3	13.1 %	14.1 %	228.7 %	1247.1 %
L4	504.4 %	549.7 %	1053.8 %	22077.2 %

Total Demand Distortion (TDD)

	Actual value
L1	7.0 %
L2	5.9 %
L3	7.1 %
L4	–

Individual Harmonics Overview

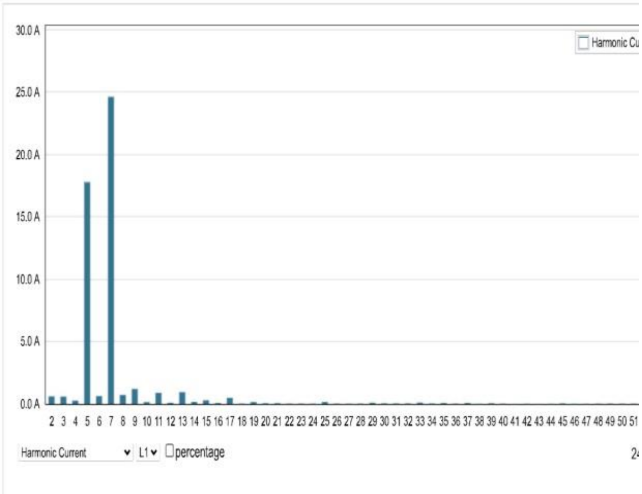


Figure 14: HARMONICS Report Generated By GridVis Software

IX RESULT

The parameters that we're monitoring events which are triggered dip swells and interrupts. we're looking to see is it a compliant or not across the three phases. We are looking at total harmonic distortion flicker and lots of other things and we can add and remove pieces of information's. It is easy to figure out where the problems are and if we dig down and click on any one of those it loads up that information another piece in the software, which we look at, are reports and this is automatically generated every week. so these are all the quick methods of changing that data into Information.

On the continuous recording, We have that voltage rms for this time period that we selected and we can see currents, harmonics we get screen to take the detail but there's not just one graph that we looked at or chart parts that can help us identify where the problem areas are and that brings us probably to the end of a high level overview of our PQ devices and there are many different reports customer reports that we can generate and have those automatically sent to users that are requiring the reports and it just makes for an easy and to understand with there is so much data involved in PQ devices and making it understandable at a glance helps save so much time and getting to the problems and correcting as quickly as possible**.**

X CONCLUSION

Literature review of power quality monitoring system And its effectiveness is conducted.

Designed and develop of power quality monitoring that provides critical PQ analysis at the click of single button.

Cumulative process savings.

Scalable, Future proof equipment for saving down the road . This system configured as Power Quality Monitor a simplified digital fault recorder or a fully integrated .Full functioned PQ digital fault recorders.

ACKNOWLEDGEMENT

It is my great pleasure in expressing sincere and deep gratitude towards my guide **Prof. P.P. Mahajan ,** Assistant Professor Electrical Engineering Department for her/his valuable guidance and constant support throughout this work and help to peruse additional studies in regular academics.

We take this opportunity to thank Head of Department **Dr. A. D. Shiralkar** and all staff members of department of Electrical Engineering AISSMS, IOIT, Pune for cooperation provided by them in many ways.

The motivation factor for this work was the inspiration given to me by our Hon. Principal **Dr. P. B. Mane**

Lastly I am thankful to those who have directly or indirectly supported for our work.

REFERENCES

[1] A.de Almeida, L. Moreira. J. Delgado IEEE Paper “Power Quality Problems And New Solutions”

[2] Don O. Koval, Fellow, IEEE, Romela A. Bocancea, Kai Yao, and M. Brent Hughes, Member, IEEE, IEEE Paper, IEEE transactions on industry applications, “Canadian National Power Quality Survey”.

[3] SR. LamedicaG. Esposito, E. Tironi, D. ZaninelliA. Prudenzi, IEEE paper, “A Survey on Power Quality Cost In Industrial Customer”,

[4] P. Vamsi kumar reddy, M. Rajesh, K. Palanisamy, S.Umashankar, S. Meikandasivam, S. Paramasivam, IEEE paper, “Power Quality Survey And Analysis At Educational Institution Loads”.

[5] Bruce Rogers, Mark Stephens, P.E., Mark McGranaghan, Senior Member, IEEE “Power Quality Issues and Solutions in the Automotive Industry”, 2004 lnternational Conference on Power System TechnologyPOWERCON 2004 Singapore, 21 - 24 November 2004

[6] Rajashekar P. , School of Electrical & Electronics Engg, Dept. of Elect. & Electronics Engg. REVA University. Mandi Udaykumar R. Yaragatti, Bangalore, India National Institute of Technology Karnataka, Surathkal, India Power Quality Issues in Electrical Distributionsystem and Industries.”, National Conference on Recent advances in control strategies for integration of Distributed Generation sources to grid and control of their power quality issues, at REVA University, Bangalore, during 22-23rd July 2016, pp. 64 - 69

[7] Abhinay Gupta1, Smita Satarkar1, Suvida Naik1 , Prof. Jayesh Priolkar1 1 Goa College of Engineering/Electronics & Electrical department, Ponda, Goa “Energy Audit of a Manufacturing Industry: A Case Study” Proceedings of National Conference on Energy Conservation and Managemen.

[8] https://apqi.org/archives/2443 Next Gen Power Quality improvement with Industry 4.0 Solutions.

[9] Pablo D. Donolo , Member, IEEE, Carlos M. Pezzani , Member, IEEE, Guillermo R. Bossio , Senior Member,IEEE, Cristian H. De Angelo , Senior Member, IEEE, and Marcos A. Donolo , Senior Member, IEEE “Derating of Induction Motors Due to Power Quality Issues Considering the Motor Efficiency Class” IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 56, NO. 2, MARCH/APRIL 2020

[10]. https://aissmsioit.org/kvah-billing-system/

[11]. Meter selection: https://www.janitza.com/umg-live-devices.html

[12]. https://shodhganga.inflibnet.ac.in/

[13]. https://standards.ieee.org/standard/519-2014.html