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Power Quality Audit at SAEC Using the Fluke 435 II Series

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ABSTRACT: This paper presents a case study of power quality audit done at S.A Engineering college at Chennai. FLUKE 435-ii Series is used to do the analysis of power quality behaviour. There are many power quality issues like voltage sag, voltage swell, harmonics, frequency fluctuation, voltage unbalance, poor power factor etc. harmonic is one of the major problem. This problem causes damages to sensitive equipments. In this paper, the power quality problems are identified through the readings obtained by the experiment and suggestions are provided.

KEYWORDS: Power quality,harmonics,voltage spikes,frequency variations,Total harmonic distortions.

I.INTRODUCTION

Each electricity distribution system can be considered as unique. A distribution system is considered as a set of circuits fed from a common bus. Distribution systems vary by type of load (residential, commercial or industrial, or a mix thereof), load density (urban, rural), type of construction (radial, network) and voltage level, among others.Power quality is closely related issue of distribution system most directly affect nowadays. It can be clear that electrical power quality is the degree of any deviation from the nominal rate of the voltage magnitude and frequency. harmonic is one of the most significant power quality problem challenging at present.

Power Quality (PQ) related issues are of most concern nowadays. The widespread use of electronic equipment, such as information technology equipment, power electronics such as adjustable speed drives (ASD), programmable logic controllers (PLC), energy-efficient lighting, led to a complete change of electric loads nature. These loads are simultaneously the major causers and the major victims of power quality problems. Due to their non-linearity, all these loads cause disturbances in the voltage waveform.

In our SAEC, the loads used are rotating machines, stationary machines, UPS, watercoolers, laboratory equipments, lighting loads, CPU & monitor and the power to these loads are got from both Electricity Board and solar power plant. Because of electronic equipments and some non linear loads used in our college,there is existence of power quality problems.harmonics are the major problems in our college. in this paper we are going to analyze the power quality behavior in the departments EEE &ECE by using fluke 435-II series.Although many efforts have been taken by utilities, some consumers require a level of PQ higher than the level provided by modern electric networks. This implies that some measures must be taken in order to achieve higher levels of Power Quality.

This Fluke 435 II series power quality analyzer is used to measure the voltage, current, power, energy, Total Harmonic Distortion (THD), current harmonics, voltage harmonics, power factor and frequency. The Fluke 435 II series power quality analyzer have several advantages.

They are

i) it will records output in analog as well as digital format.
ii) it will records at every 0.25 sec.
iii) it will also measure all the electrical parameter at a time.

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FLUKE 435-ii SERIES

The wide range of measurement functions and measurement methods of fluke 435-ii make it useful tool for analyzing the power quality behaviour. fluke 435-ii is an ideal and portable power quality instrument which giving advanced power quality functioning and energy analysis capabilities.

Fig.1 fluke 435 ii power quality analyzer.

Fluke 435-ii is mainly to calculate the energy loss,power inverter efficiency,power wave data capture,view graphs and to get reports to do the analysis and to detect the power quality issues.

It consists of 2 sets of cables.

- Current measurement cables
- Voltage measurement cables

CURRENT MEASUREMENT CABLES

The current measurement cables consists of 4 wires named as R,Y,B,Neutralwire. These wires are connected to R,Y,B,Neutral wire of the busbar where the power quality behavior is to be observed respectively.In current measurement cables there are two types of cables which are used depends upon the current rating.To measure the current below 5A, current clamp rated as 0-5A is used. To measure high range 0-10,000A rated clamp is used.

VOLTAGE MEASUREMENT CABLES

voltage measurement cables consists of 5 wires namely R,Y,B,Neutral and earth wire.The maximum voltage range available in power quality analyzer is 1000V.

THE FLUKE METER PROVIDE FOLLOWING MEASURES:

- Vrms
- Arms
- Wfund
- VAfund
- Afund
- Vpeak
- Apeak
- THDvolt
- THDamp
- Hz
- KW
- KVA
- Power factor
- KWh

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POWER QUALITY MEASUREMENTS

- Voltage sag
- Voltage swell
- Flicker
- Voltage unbalance
- Harmonics

FEATURES

- Power quality analyzer has battery backup.
- Fluke 435-ii meter work without any power supply up to 8 hours.
- Memory capacity is about 16GB
- The meter records every measurements automatically without any setup.
- The current and voltage in each and every phases can be measured separately.
- Measurement can be done for both star and delta connection.
- These measurements can be viewed in the form of graph and we can also record this graph.
- Used for load studies.
- It can be used for long term analysis.
- Reports can be formed.

POWER LOGGER:

Power logger is the software used on fluke meter which is used to download the recorded data to our personal computer. By using this software we can analyse RMS values for both voltage and current, frequency harmonics, power, energy.

FLUKE-435II SERIES CONNECTION

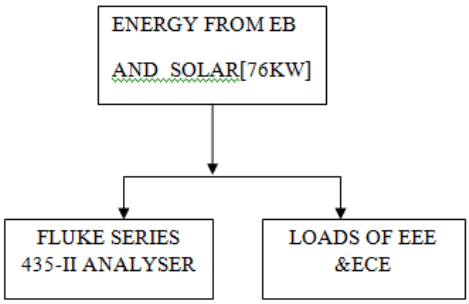

Fig 2 connection of fluke 435 ii power quality analyzer with dynamic loads at the common coupling.

SAEC is in Veeraraghavapuram near Thiruverkadu, Chennai, Tamilnadu. The college is officially attached to Anna university, Chennai.it has been awarded ISO 9001:2008 certificate for academic standard .
The FLUKE 435-II SERIES analyzer is connected between the power supply and the loads. the powersupply required for both EEE&ECE IS obtained from both EB and SOLAR. The loads present are stationary machines(transformers), rotating machines (motor, generator), lighting loads, CPU&monitor and etc.

II. STEPS OF ANALYSIS

- Connect the current and voltage probes of fluke 435-ii series to the respective phases of the section whose power quality behavior is to be noted.
- POWER ON the analyzer.

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- Press the start button.
- Go to setup mode and do the required setup for the analysis like setting the voltage ratio and time interval at which the readings are noted.
- By pressing power logger button we will able to view all type of measurements of the connected section.
- Note down the required readings for particular time period.
- After the completion of required time period, save the file.
- If you want any particular waveforms in between, then just press graph button. we can view the analog waveforms of voltage, current, harmonics and all the measurements.
- After analysis the fluke meter have to be switched off by using stop button.
- Remove the connections carefully.

Fig 3 fluke 435 ii series with current and voltage probe and connection with panel

Table:1 values recorded by fluke 435-II power analyzer

	R	Y	B	N	TOTAL
Vrms(Y)	231.41	232.2	234.05	0.54	
Vrms	401.86	405.8	403.45		
Arms	72.6	75.2	78.2	10	
Afund	79.2	77.8	81.8	8.3	
Hz	50.074				
Kw	18.41	18.08	19.12		55.63
Pf	0.99	0.99	0.99		0.99
THD volt	4.2	5.5	4.2	74.6	
THD amp	5.3	11	6.2	100	

1.VOLTAGE AND CURRENT WAVEFORM

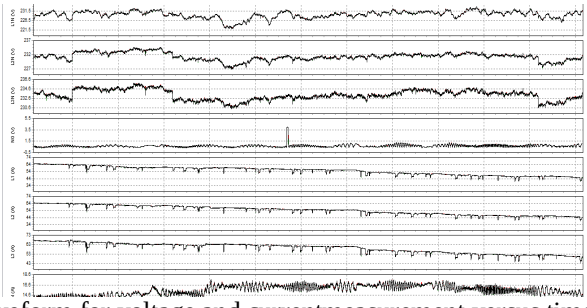

Fig4 waveform for voltage and currentmeasurement versus time.

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From the analysis of the graph there is some neutral current due to the non linear loads in the system.Due to this neutral current harmonics distortions may occur on the system.

2.FREQUENCY AND UNBALANCE

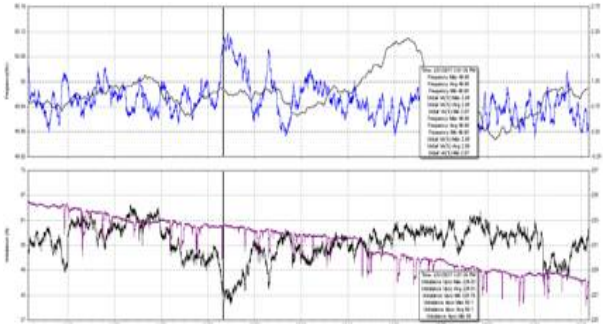

Fig 5 waveform of frequency and unbalance versus time.

In this fig it is clearly shows that the frequency and unbalance are minimum but at certain time there is fluctuation in the frequency and unbalance due to usage of single phase loads and the maximum frequency is 40.08 and the maximum unbalance positive voltage is 226.83 in percentage and the minimum unbalance voltage is 226.79.

3.HARMONICS IN EACH PHASE

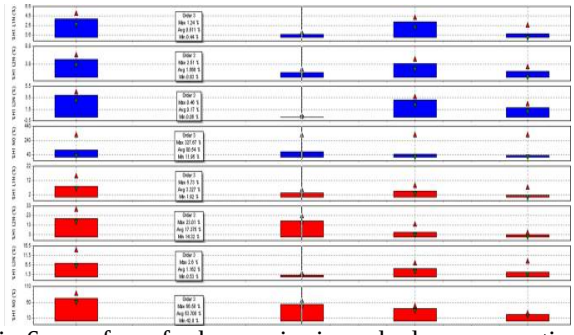

Fig 6 waveform for harmonics in each phase versus time

If there is a presence of odd harmonics in a system which leads to severe harmonic distortion in a system but from the fig it is clearly seen that there is less 3rd order harmonic distortion when compared to 1st,2nd,5th order harmonics which does not produce any severe causes in the sytem.

4.POWER WAVEFORM

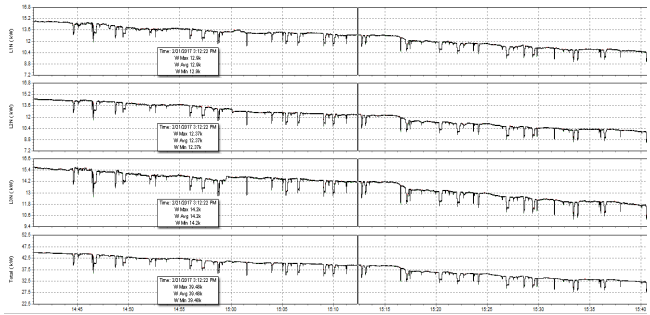

Fig7 waveform for power versus time.

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From the graph it is clearly known that the when the load increases,power decreases therefore thus the power decreases linear manner due to the usage of non liner loads,electrical equipment usage in machines lab,lighting loads, system etc.which consumes more power due to which power decreases in a linear manner.

5.TOTAL HARMONIC DISTORTION

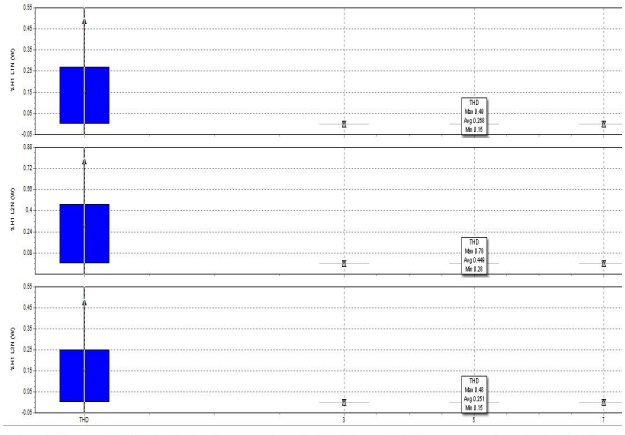

Fig8 waveform for Total harmonic distortion versus time

From the graph it is clearly shown that the THD is maximum in Y phase when compared to R and B phase.the maximum THD is 0.78 ,average value is 0.449 and the minimum THD in Y phase is 0.28.

OBSERVATIONS AND SUGGESTIONS

1. HARMONIC
   There is a presence of neutral current from the observed reading so, we conclude that there is a presence of harmonic problems due to non linear loads in the system
   .
2. UNBALANCE
   The voltage in all the phases R,Y,B should be equal for an balanced system.from the observed reading the voltages in all 3 phases is not equal this may be due to the usage of 1phase loads and capacitor banks.

3. THD VOLTAGE AND THD CURRENT
   THD ampere and THD voltage contents are exceeding the limit provided by IEEE Standard.

4. POWER FACTOR
   Power factor is near to unity.so there is no power factor problem in the system.

III. SOLUTION AND SUGGESTIONS

1. Active filters or passive filters or hybrid filters(combination of active and passive filters) can be used to solve the harmonic problem.

2. We can avoid unbalance by redistributing the load to make the equal in all three phases.

3. The equipmentthat having unbalanced three phase reactance can be removed.

4. voltage unbalance can be reduced by reducing harmonics.

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5. In case the equipment that havingunbalanced three phase reactances can't be removed then it can be connected in high voltage side.

IV. CONCLUSION

The analysis of behavior of PV connected grid system in SAEC is done by using FLUKE-II Series Power quality analyser. The major problems noticed are harmonics, voltage unbalance, the reasons for this power quality issues are usage of CFL's , computer, electronic kits in lab, SMPS, UPS. These loads are not distributed uniformly on all three phases. So that they producing unbalance problem and presence neutral current .and we can note that when labs using electronic eqiupments are on, there is a domination of reactive power problem. And also THD voltage and THD current are exceedind the limit provided by IEEE standard. We can use filters to avoid harmonic problem.

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