2020

ENERGY AUDIT REPORT

AT

G.L.B Institute of Technology & Management

Plot no -2 Knowledge Park- III, G.Noida (U.P)

Month of Study: December- 2020

Conducted By:

Ecs

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GENERAL INTRODUCTION

ACKNOWLEDGEMENT

Energy consultancy services is thankful to the management of **M/s - G.L.Bajaj Institute of Technology&Management, G.Noida** for giving us an opportunity to study their institution for the Energy audit.

Our sincere thanks to **Dr.Mohit Bansal (H.O.D, E.E.E) for** his keen interest and co-operation extended towards the conduct of the Energy Audit.

We are indeed touched by the helpful attitude and co-operation of technical staff, which rendered their valuable assistance and co-operation during the course of study.

The study team constituted of the following officials from **Energy Consultancy Services.**

Er.Sanjeev Agarwal - Energy Auditor (BEE, Regd- No- EA-12761)

Er. A.R. Tripathi - Energy Manager (BEE, Regd- No- EM-0034)

ABOUT ENERGY AUDIT

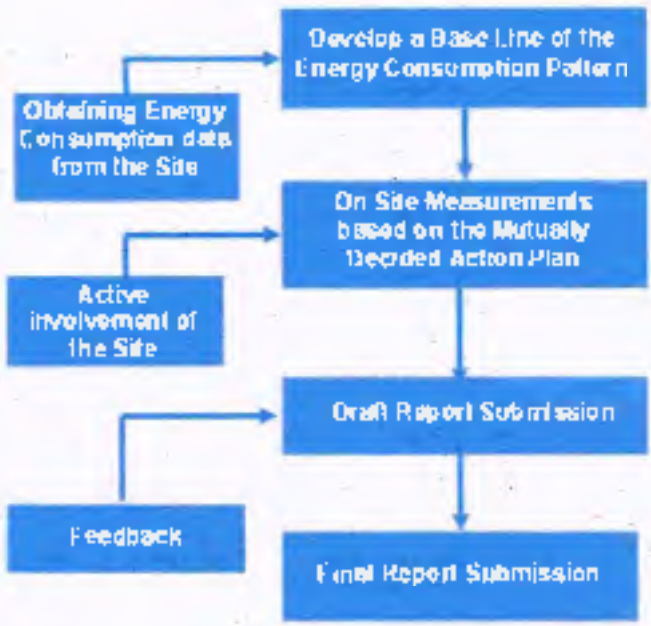
Energy is one of the most important tools in Industrial development, and as such acts as a key factor in determining the economic development of all countries. The Indian energy sector has witnessed a rapid growth. However, resource augmentation and growth in energy supply have failed to meet the ever-increasing demands exerted by industries. The higher energy consumption will also create serious environment issues, affect our ozone layer.

The Energy Audit will help to reduce the demand & supply gap in some extent and protect ozone layer as well as our environment. In general, Energy Audit is identifying the areas where waste can occur and where scope for improvement exists. Ultimately it will reduce the energy demand at same level of outcomes. With this objective, Energy Audit of **M/s- G.L.B Institute of Technology&Management, Plot no -2 Knowledge Park- III, G.Noida (U.P)** carried out. Based on our observations of the various areas, we have identified certain potential areas for energy conservation opportunities, which are summarize in respective chapters:-

METHODOLOGY

Methodology adopted for achieving the desired objectives viz. Assessment of the current operational status and Energy savings included the following:

- Discussions with the concerned officials of the unit for identification of major areas of focus and other related systems



- A team of professionals visited the plant and had discussions with the concerned officials/ supervisors to collect data/ information on the Load Distribution and Energy Consumption pattern. The data was analyzed to evaluate the specific power consumption and also to arrive at a base line energy consumption pattern.

- Measurements and monitoring with the help of appropriate instruments including continuous and/ or time-lapse recording, as appropriate and visual observations were made to identify the energy usage pattern and losses in the system.

- Computation and in-depth analysis of the collected data, including analysis and other techniques as appropriate was done and to evolve suitable energy conservation plan/s for improvement/s to reduce the Specific Energy Consumption.

ENERGY MANAGEMENT SYSTEM

1. With the advent of energy crisis and exponential hikes in the costs of different forms of energy, Energy Audit is manifesting its due importance in industrial units. Energy Audit helps to understand more about the ways energy and fuels are used in any industry and helps in identifying areas where waste may occur and scope for improvements.

2. Energy Audit is the key to a systematic approach for decision making in the area of energy management. It attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a facility.

3. An Energy Manager must be identified in the plant and time bound responsibility must be given to him in getting implemented the findings of the Energy Audit points, which the unit has planned to implement.

4. A record of Energy consumption both Electrical and Thermal of important processes must be kept and monitored on regular basis, to optimize the Energy consumption of the unit. For this, various meters and gauges shall be required to be installed. The data gathered can be centralized manually or through software on a computer for easy analysis.

5. Some facts and figures related with energy and production may be displayed on boards or posters in the premises, to create awareness among the workmen and staff. Training programme may be arranged for officers, workmen to educate them with the latest knowledge available in their fields. As incentives, new ideas and implementation of energy saving point must be recognized and awarded.

6. The findings and implementation status of Energy audits should be review periodically/annually for further action plan.

Executive Summary

1- Over all house keeping of electrical distribution system was found quite o.k even than there is some scope to improve it.

2- Power factor of the institution was running in between to 0.86-0.92 which is quite o.k but from energy saving point of view there is a some scope to improve it continuously more than 0.92 and an attractive amount may be saved for which the investment is not so much .Refer chapter Electricity bill analyses and performance evaluation of APFC panel.

3- Management may review and reduce its contracted demand if connected load is not proposed to increase in future. The existing maximum demand may be reduced up to 200 kva as the institution has installed the solar plant of 225 kwp so it is very easy to manage because it is not an industry. For details refer the chapter various energy savings & Bill reduction opportunities saving point no-1.

4- The power quality of the institution was not found as good as should be i.e the % thdi were found on higher side so the deration of capacitors may be increase.

5- The institution has installed two transformer of 630 kva each but out of them one was running on load and another one without load so the transformer running on no load is consuming the power and giving the loss of 76000/- per year in terms of no load losses, these losses may be saved by using both transformer on load alternativily for one-one month.

6- The voltage level of the institution was found on higher side i.e in between 410V-426V while required range should be 390V-400V as most of the connected is single phase so there is a need of servo voltage stabilizer of 750 kva, 340V-460V volt range keeping fix output voltage 390V-400V. As per the study it was noticed that an attractive amount may be saved by voltage optimisation as given in report.

7- The institution has taken a good step for replacing the conventional high wattage luminaries with LED and save a lot.(Refer the savings given in the report).

8-Existing old transformer was as per old IS 2026 specifications and consuming more power it should be replaced by the low losses five star rated transformer as per new IS 1180 specifications from energy saving point of view.

9- There were no fixed capacitors installed on transformer to improve its power factor at no load condition.Hence it is suggested that there should be install some fixed capacitor (by hit and trial method) so that PF may be further improve up to some extent during no load.

10- The quality of ups power found o.k but loading %age was found less so is advised that increase the %age loading on ups.

11-Maintenance and record keeping of the D.G sets found very poor it should be improve.It is advised that diesel consumption and unit generation for all individual D.G sets should be

measured & maintained to analyse their performance after calculating their specific fuel consumption i.e units per lits.

During the study audit team has conducted the load trial for D.G. Sets of 500 KVA Cummins Kirloskar make for one hour, team has also calibrated the Energy meter installed at L.T panel for 500 kva D.G feeder for its unit's generation & recorded the load profile and diesel consumption to calculate the specific fuel consumption i.e units per liter and found that it was very low . (Refer the chapter D.G sets). It is recommanded that increase the loading % age on D.G set to improve its specific fuel consumptios i.e units per lits and power factor ,as at present these are very poor.

12- The training programme should be conducted time to time for the technical staff as an awreness programm, it is very essential.

14- Audit team has collected few photographs for presenting the Specific findings regarding Electrical & Fire Safety (refer the chapter).

15- Earthing system of the institution was anlysed and found that it is o.k but there some places where the improvement is required.

REVIEW OF ELECTRICITY BILLS

REVIEW OF ELECTRICITY BILLS

Brief description of existing system and its operation

The electricity billing is at High Tension category (HV-1) and has been based on two-part tariff structure TOD metring. One part for capacity or demand drawn, the second part for actual energy drawn during the billing cycle in kvah.

The tariff structure includes the following components:

a) Fixed demand Charges

These charges relate to fixed / maximum demand registeved during month/billing period and corresponding rate of utility

b) Energy Charges

Tariff Structure :

1.Supply Authority	: N.P.C.L
2.Supply Voltage	: 11 kv
3.Contract Demand	: 1000 kva
4.Billable Demand	: 750 kva (75% of cotracted demand)
5.Demand Charges	: 430/- per kva
6.Unit charges	: 8.65/- per kvah

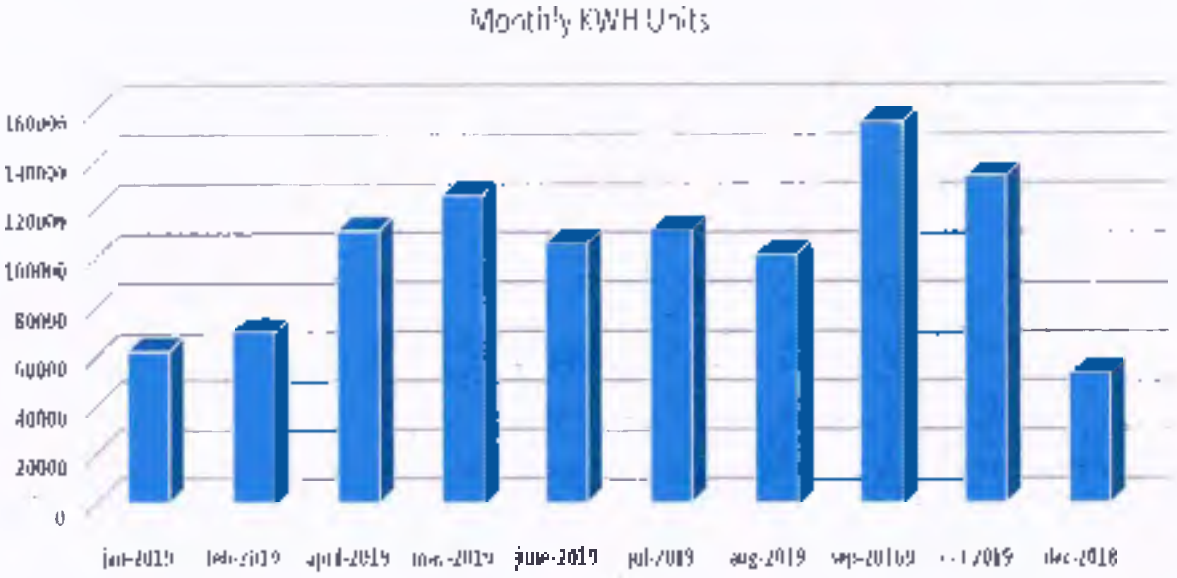
Review of electricity bills.

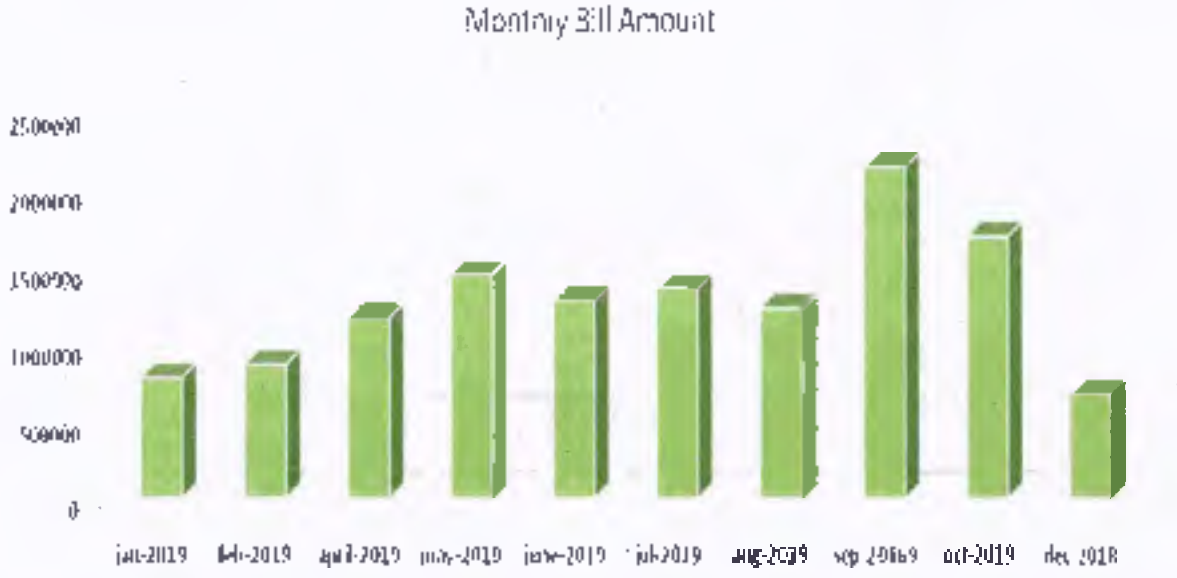
Audit team has analysed the electricity bills provided by the institution during the study for the months of October -2019 -November-2020 & Dec 2018-September 2019 (22 months) and found that.

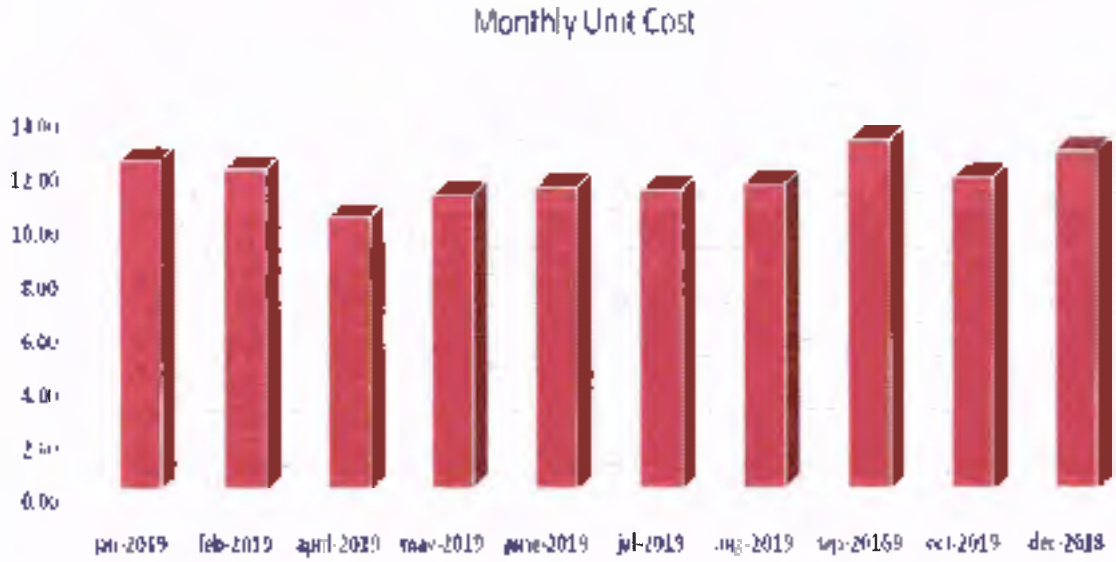
1. Contract demand	- 555-1000 kva
2. Billable demand	- 416-750 kva
3. Billed Demand	- 155 - 820 kva
4. P.F. level	- 0. 86-0.97
5. Unit Charges	- 7.54 – 17.24

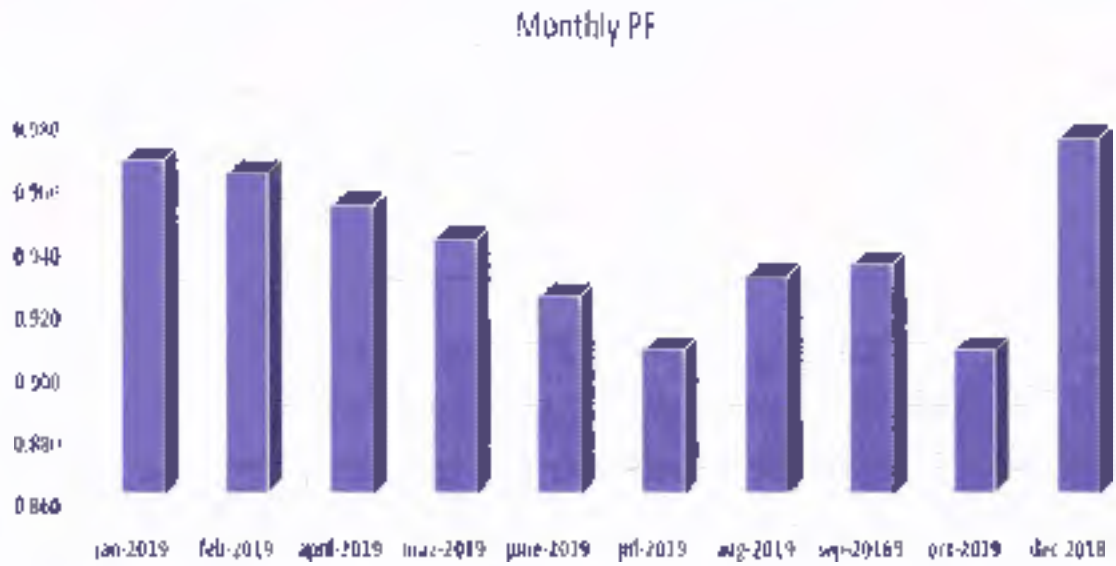
ELECTRICAL BILLS ANALYSIS

Month	Contract Demand	MDI	Billable Demand	KWH	KVAH	PF	Energy Charges	Fixed Charges	Bill Amount	Net Unit Cost
Dec-18	555	271	416	53600	55100	0.973	453729.00	158745.00	687731	12.48
Jan-19	555	274.5	416	61865	64040	0.966	527425.95	169693.15	785105	12.26
Feb-19	555	288.5	416	70415	73190	0.962	602913.45	169693.15	869892	11.89
April-19	555	498.5	416	110840	116455	0.952	959767.20	203224.11	1378994.0	10.32
May-19	555	494	416	125530	133410	0.941	1099757.50	194893.15	1457799	10.93
Jun-19	555	488	416	106335	115200	0.923	949495.00	199147.40	1290764	11.20
Jul-19	555	504	416	111870	123455	0.906	1017628.00	199035.00	1369428	11.09
Aug-19	555	486	416	101565	109280	0.929	900655.95	198128.00	1234953	11.30
Sept-19	555	820	416	155210	166355	0.933	1405111.40	344804.38	2148591	12.92
Oct-19	1000	295	750	133190	147005	0.906	1275103.00	318082.00	1695211	11.53
Total				1030420	1103490				12718468	
Average				103042	110349	0.939			1271847	11.57

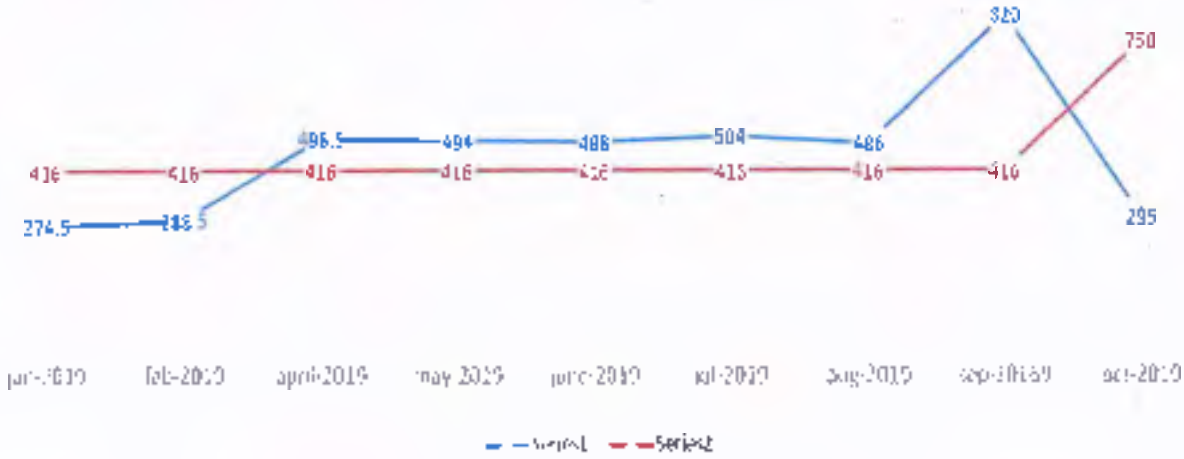

Monthly KWH Units
160000
140000
120000
100000
80000
60000
40000
20000
0
jan-2019
feb-2019
april-2019
june-2019
jul-2019
aug-2019
dec-2018


Monthly Bill Amount
2500000
2000000
1500000
1000000
500000
0
jan-2019
feb-2019
april-2019
june-2019
jul-2019
aug-2019
oct-2019
dec 2018

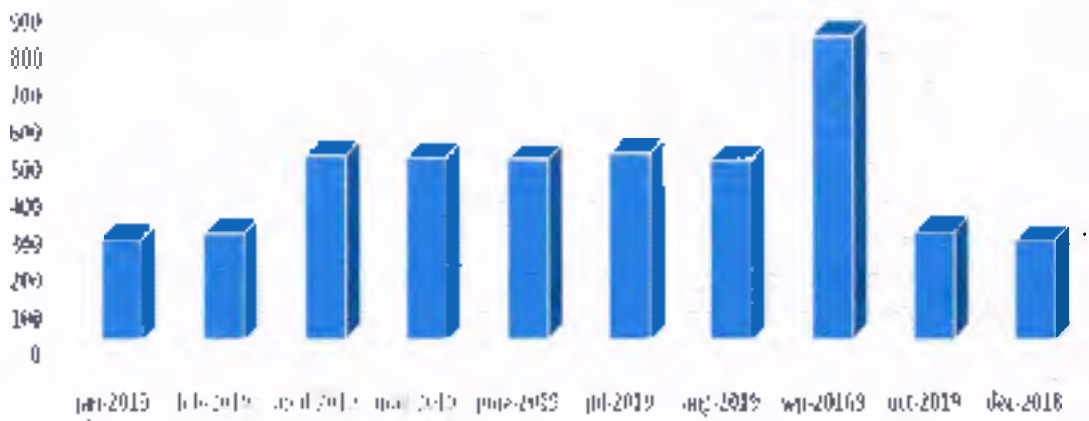

Monthly Unit Cost
jan-2019
feb-2019
april-2019
may-2019
june-2019
jul-2019
aug-2019
sep-20169
oct-2019
dec-2018

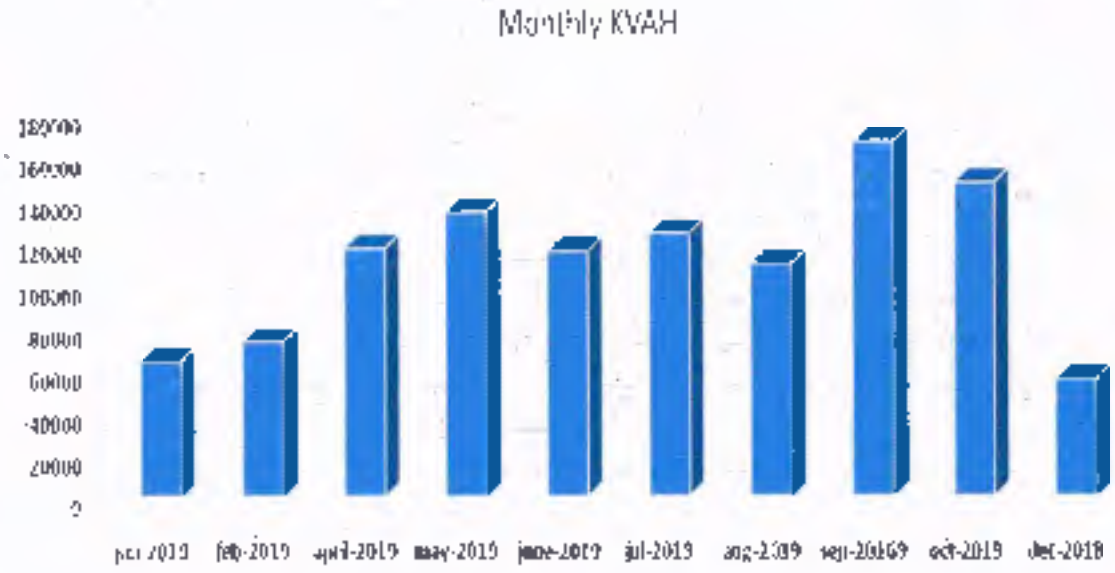

Monthly PF
jan-2019
feb-2019
april-2019
may-2019
june-2019
jul-2019
aug-2019
sep-20169
oct-2019
dec-2018

BILLABLE DEMAND V/S ACTUAL DEMAND



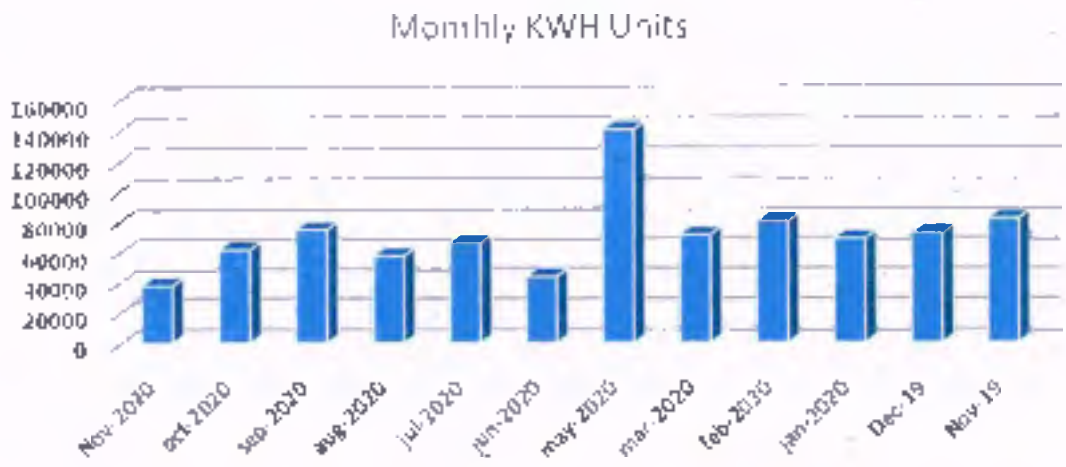
Monthly Demand




Monthly KVAH
160000
140000
120000
100000
80000
60000
40000
20000
0
feb-2019
april-2019
may-2019
jul-2019
dec-2018

Electricity Bill Analysis

Month	Contract Demand	MDI	Billable Demand	KWH	KVAH	PF	Energy Charges	Fixed Charges	Bill Amount	Net Unit Cost
Nov-2020	1000	179.4	750	37630	43575	0.86	377301.12	328684.93	751252	17.24
Oct-2020	1000	319.4	750	61245	70100	0.87	607568.00	318082.19	984631	14.05
Sep-2020	1000	374.8	750	74520	82550	0.90	715604.00	328684.93	1113795.0	13.49
Aug-2020	1000	362.8	750	57220	63805	0.90	552897.28	328684.93	922599	14.46
Jul-2020	1000	374.4	750	66865	73040	0.92	633087.20	318082.19	1014879	13.89
Jun-2020	1000	226.4	750	43625	50125	0.870	434155.00	328684.93	797487	15.91
May-2020	1000	155.2	750	140330	151570	0.926	1312957.00	943643.84	1143533	7.54
Mar-2020	1000	324	750	70938	78548	0.903	680952.42	296876.71	1039894	13.24
Feb-2020	1000	307.6	750	80665	90880	0.888	787878.28	339287.67	1202164	13.23
Jan-2020	1000	323.4	750	68490	74580	0.918	646484.28	307479.45	1015260	13.61
Dec-19	1000	294.8	750	72830	80335	0.907	696377.92	328684.93	1090318	13.57
Nov-19	1000	526.6	750	81620	94940	0.860	823119.08	339287.67	1233655	12.99
Total				856078	954048				12309467	
Average				71340	79504	0.894			1025789	13.60


Monthly KWH Units
160000
140000
120000
100000
80000
60000
40000
20000
0
Nov-2020
oct-2020
sep-2020
aug-2020
jul-2020
jun-2020
may-2020
mar-2020
feb-2020
jan-2020
Dec-19
Nov-19


Monthly Bill Amount
1400000
1200000
1000000
800000
600000
400000
200000
0
Nov-2020
oct-2020
sep-2020
aug-2020
jul-2020
jun-2020
may-2020
mar-2020
feb-2020
jan-2020
Dec-19
Nov-19

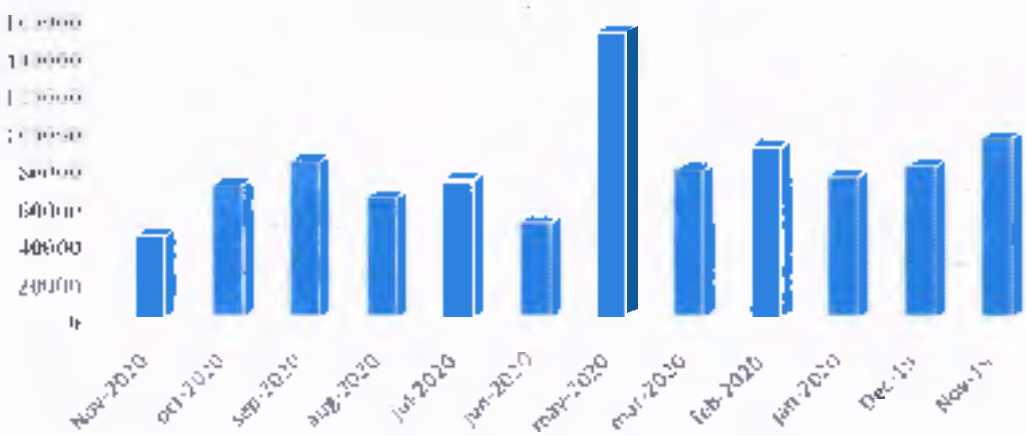

Monthly Unit Cost
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Nov-2020
oct-2020
sep-2020
aug-2020
jul-2020
jun-2020
may-2020
mar-2020
feb-2020
jan-2020
Dec-19
Nov-19


Monthly PF
Nov-2020
oct-2020
sep-2020
aug-2020
jul-2020
jun-2020
may-2020
mar-2020
feb-2020
jan-2020
Dec-19
Nov-19


Monthly Demand
600
500
400
300
200
100
0
Nov-2020
oct-2020
sep-2020
aug-2020
jul-2020
jun-2020
may-2020
mar-2020
feb-2020
jan-2020
Dec-19
Nov-19

BILLABLE DEMAND V/S ACTUAL DEMAND

Monthly KVAH



POWER FACTOR ANALYSIS:

The power factor is an essential parameter in the determination of the overall units on which the electricity bills is charged. The relation between the actual consumption (KWH) and the billed consumption (KVAH) is as follows:

$$KVAH = \left(\frac{KWH}{PF}\right)$$

The detailed analysis of the electricity bills indicates that the average power factor of the electrical system is 0.90-0.97 & 0.86 - 0.91 which is quite o.k but further there is some scope to improve it.

The reason for this is that the APFC panel is not designed properly and few capacitors are derated & out of working and the condition of the panel. its contactor and MCCB is not as good as should be so it needs more attention. redesigning and proper preventive maintenance.

PERFORMANCE EVALUATION OF A.P.F.C PANEL

Study of A.P.F.C.Panel

During energy audit to evaluate the performance of the APFC panel audit team has taken the load in ampere for all the capacitors connected with the panel in auto mode and tabulted as below.

S.No	Kvar connected	Mode of connection	Load in amps.			Remarks.
A.P.F.C	Total connected capacitors are 225 kvar		R	Y	B	
1.	10	Auto	6	6	6.2	o.k
2.	15	-do-	8.8	11.3	6.7	o.k
3.	25	-do-	30	30.5	31	o.k
4.	25	-do-	31	33.9	30.2	o.k
5.	50 (25+25)	-do-	0	0	0	off
6.	50 (25+25)	-do-	28.2	28.1	28	50% derated

Observations:

Following points were observed during the ampere loading of the capacitors

1- CTR was found of higher size i.e 1600/5A but its loacation was o.k.

2- Harmonics level for current was found on higher side.

3- There are two transformers but capacitor panel was one.

Recommandations:

On the bases of above observations it is recommanded that-

1- Rectify/Replace the defactive capacitor banks, its contactors, fuses etc and increase the capacity of A.P.F.C panel. On the other hand as there are two transformers so there should be two APFC panel.

2- As current harmonics level is very high so harmonics reactors are to be connected with the high voltage capacitors to save the life of capacitors and maintain the good power factor level.

3- A.P.F.C C.T also needs replacement it should be of 600/5A.

STUDY OF POWER QUALITY

Brief description of existing system and its operation

The electricity billing is in High Tension (HT) category, and has been based on two-part tariff structure. One part for capacity (or demand) drawn, the second part for actual energy drawn during the billing cycle in kvah.

Measurement and Observations

During the energy audit complete load profiling was carried out at mains supply, power control centre and to record the Voltage, %THD V, Current, %THD I, KW, KVA and Power Factor . The power quality and harmonics levels were recorded at main supply feeder. The actual recorded details are as under:

Study of electrical distribution system

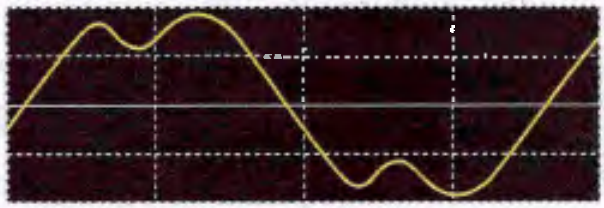
1. During the energy audit the electrical distribution system was studied thoroughly.
2. Current harmonics are on higher side and varring in betweene 26%-130 % and avg. 50% against permissible limit of IEEE norms of 10%.
3. Voltage harmonics are well with in permissible limit against the IEEE norms of 5%)

Recently, electricity consumers have shown increasing concern for power quality. Indeed, power quality standards have become higher than before due to sensitivity of electronic gadgets and automation devices. **Power Quality** is the key to successful delivery of quality service of an IT industry. It is now even more critical to the industry because of increasing application of electronic loads and electronic controllers, which are sensitive to the quality of power supplied.

In this study, the consumers are provided with the basic knowledge of power quality, while on the other hand, the existent regulations are evaluated in terms of consumers' rights so that poor power quality costs and loss are identified and amended. There are so many regulations in relation to the rights of electrical power consumers in legislation that regulates the relations between distribution companies and the consumers, whereas, in this study, only the issue of power quality is dealt with.

Power quality indices viz total voltage & current harmonics distortion (THD), Power Factor (pf), unbalancing in voltage & in current. If their values remains under limits and that allows utilities to function in their intended manner without any interruption. Similarly, power quality also helped to ensure that plant remain operational at all times.

Harmonics are generated by semi-conductor control devices in the power supply of equipment because of distorted voltage and current waveforms. When the harmonic component is big, it may cause serious accidents such as overheating or noise in motors or transformers, burn out reactors in phase compensation capacitors. etc,



Harmonic Current causes overheating of conductors and their insulation, overheating of transformers with increased losses. overloaded Neutral conductors. Neutral to Earth potential, overheating of capacitors and ultimately premature ageing or failure of equipment.

Harmonic Voltage – causes linear loads to draw non-linear current resulting in current distortion effects, torque pulsation in motors, capacitor dielectric failure, insulation breakdown, server and network equipment power supply failure. electronic lighting failure, malfunction of sensitive electronic equipment and, again, excessive distortion in distribution supply networks.

The Institute of Electrical & Electronic Engineers (IEEE), various government agencies and other organizations have been studying these problems and effects for several years. As a result, they have issued design guidelines and recommended practices

The Institute of Electrical and Electronics Engineers (IEEE) & International Electro technical Commission (IEC) has published different standards time to time in this regards to improve the quality of power. IEEE 1159 describes recommended practices for monitoring of power quality. Comparison of different standards given below in table

Parameter	IEEE 519	IEC 61000-2-2 (for equipment's)
Harmonics	a) THD voltage1.5 - 5.0% THD current 5 - 20% at PCC	THD<8%
Voltage Unbalance	NA	2%

POWER QUALITY TERM

- **Voltage Variation Compliance**

Voltage is relatively small deviations of voltage characteristics around their nominal or ideal values. The two basic examples are voltage magnitude and frequency

Voltages must be maintained within +-6% of the nominal supply. The nominal voltage for the purposes of the Electricity Act and the Code is 240 V single-phase and 415 V three-phase. According to the Technical Rules, the steady state voltage must be within the following limits:

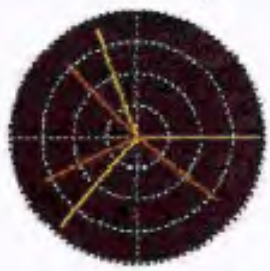
+-6% of the nominal voltage during normal conditions;

+-8% of the nominal voltage during maintenance conditions; and

+-10% of the nominal voltage during emergency conditions.

- **Voltage Unbalance Compliance**

Power is distributed to customers by way of 3 phase electricity, in which each phase is initially transmitted at 120° before and after the proceeding and preceding phase and this is known as a balanced supply. However, differing loads on each of the phases causes imbalances between phases and amplitudes and can cause problems that may risk damage to connected equipment and in extreme cases could pose electric shock risks.



Where such unbalances are identified, appropriate work is done either within the customer's installation or by balancing of the customer connections on the LV or the High Voltage (HV) distribution networks.

- **Harmonics Compliance**

Harmonics are certain characteristics of voltage and current on a power system that arise from particular types of equipment that are connected to the system. Harmonics can result in extra strain on the network and devices connected to the network.

- **Crest factor**

The **crest factor** or **peak-to-average ratio (PAR)** or **peak-to-average power ratio (PAPR)** is a measurement of a waveform, calculated from the peak amplitude of the waveform divided by the RMS value of the waveform.

$$C = \frac{|x|_{\text{peak}}}{x_{\text{rms}}}$$

The minimum crest Factor is 1.0

- **Flicker (Pst)**

The power supply network voltage varies over time due to perturbations that occur in the processes of electricity generation, transmission and distribution. Interaction of electrical loads with the network causes further deterioration of the electrical power quality.

High power loads that draw fluctuating current, such as large motor drives and arc furnaces, cause low frequency cyclic voltage variations that result in:

Flickering of light sources can cause significant physiological discomfort, physical and psychological tiredness, and even pathological effects for human beings, Problems with the stability of electrical devices and electronic circuits.

Recurrent small changes of network voltage amplitude cause flickering of light sources. The effect is popularly referred to as 'flicker' and is a significant power quality parameter

The value flicker severity index PST=< 1.0

- **K-Factor**

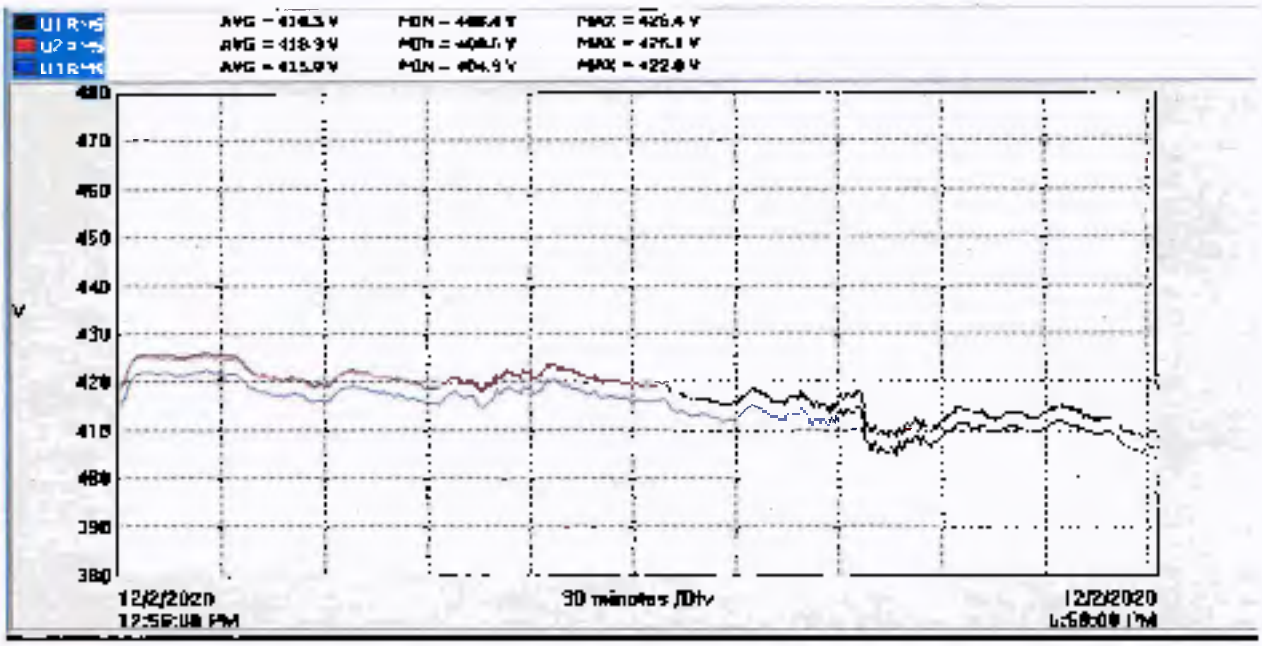
K-factor is a weighting of the harmonic load currents according to their effects on transformer heating, as derived from ANSI/IEEE C57.110. A K-factor of 1.0 indicates a linear load (no harmonics). The higher the K-factor will be the greater the harmonic heating effects (IEEE Standard 1100-1992).

LOAD PROFILE

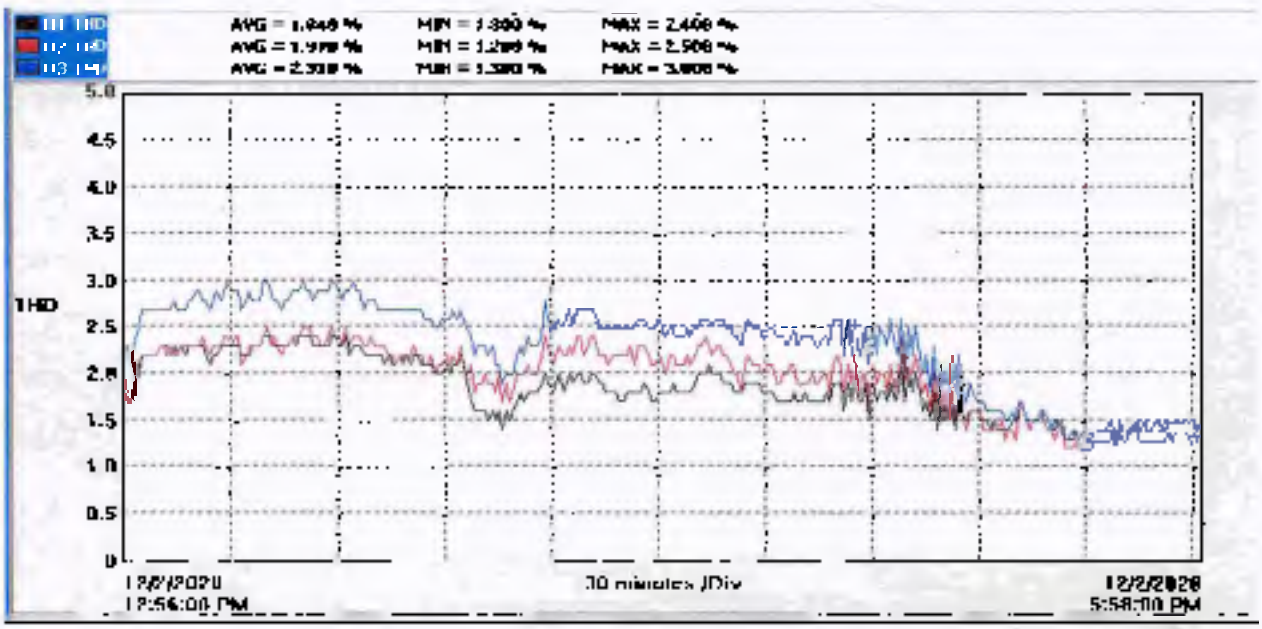
Load profile for 630 kva 11KV/0.433KV Transformer:

During the study audit team has taken the load profile at Main 0.433kv side of the 630 kva Transformer i.e L.T side to asses the power quality and other electrical parameters on load , the same were found as below.

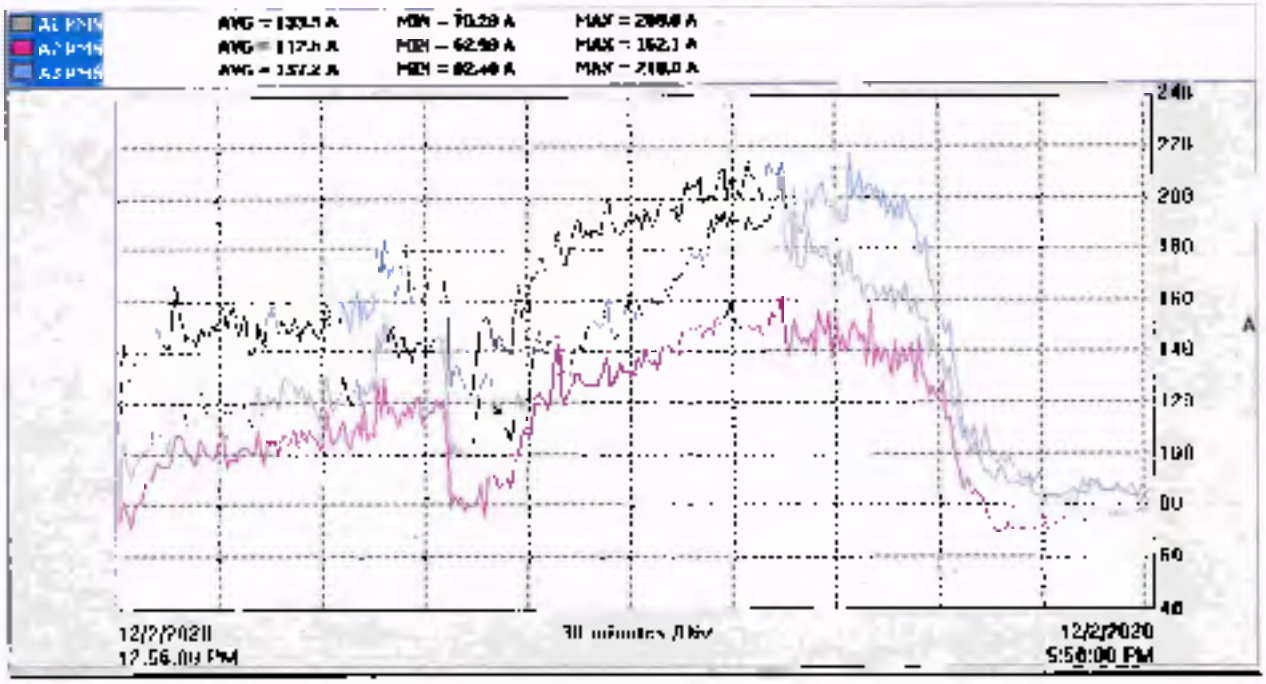
Voltage:



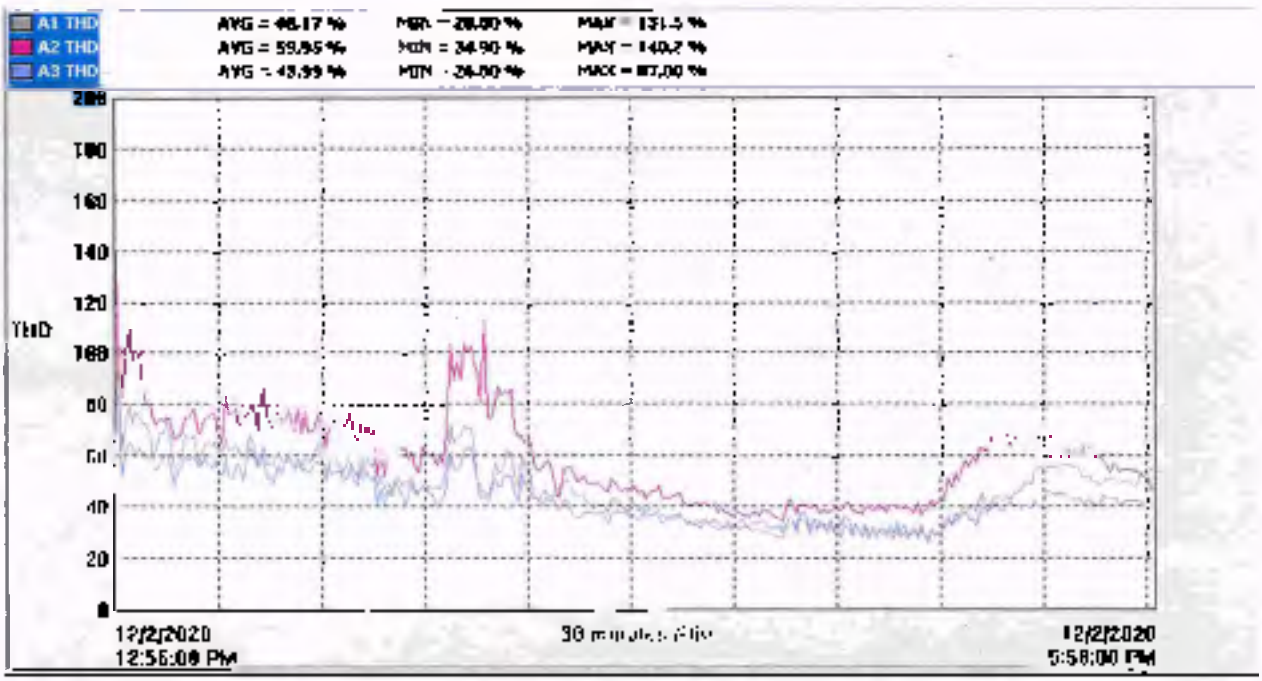
%thdv:



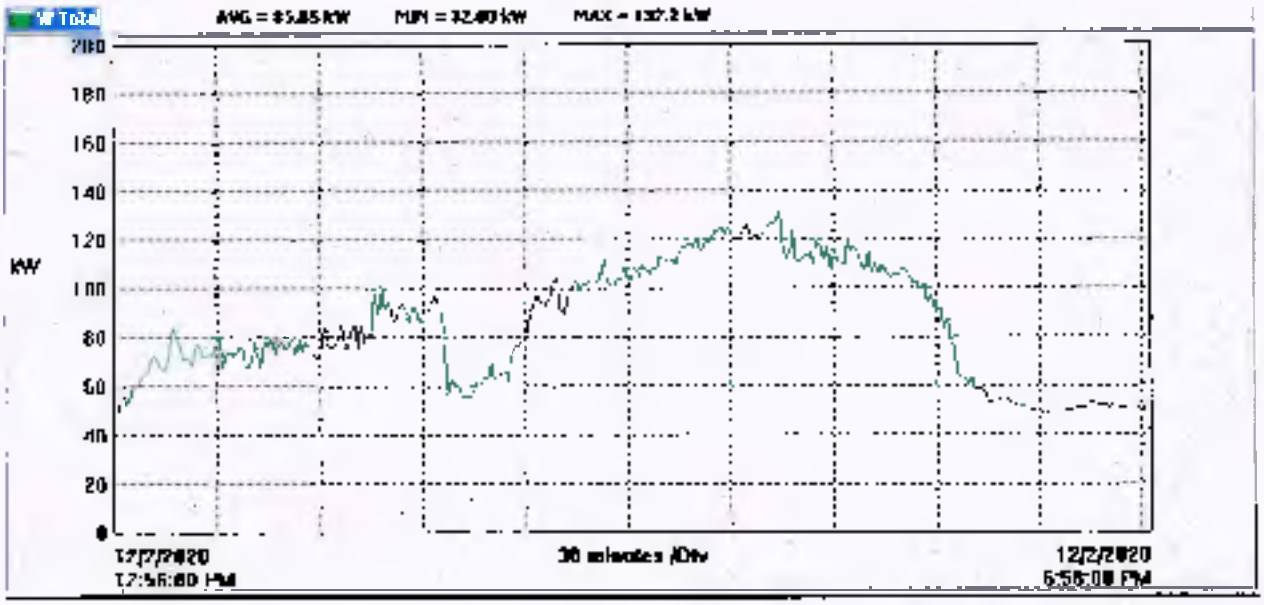
Current:



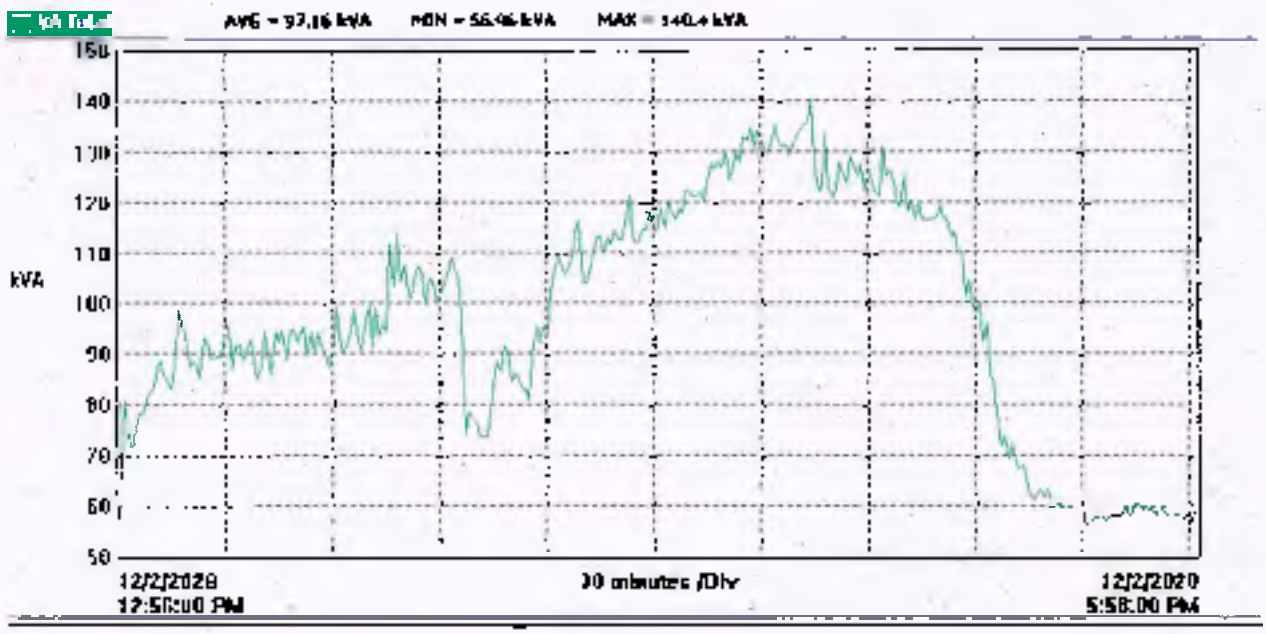
%thdi:



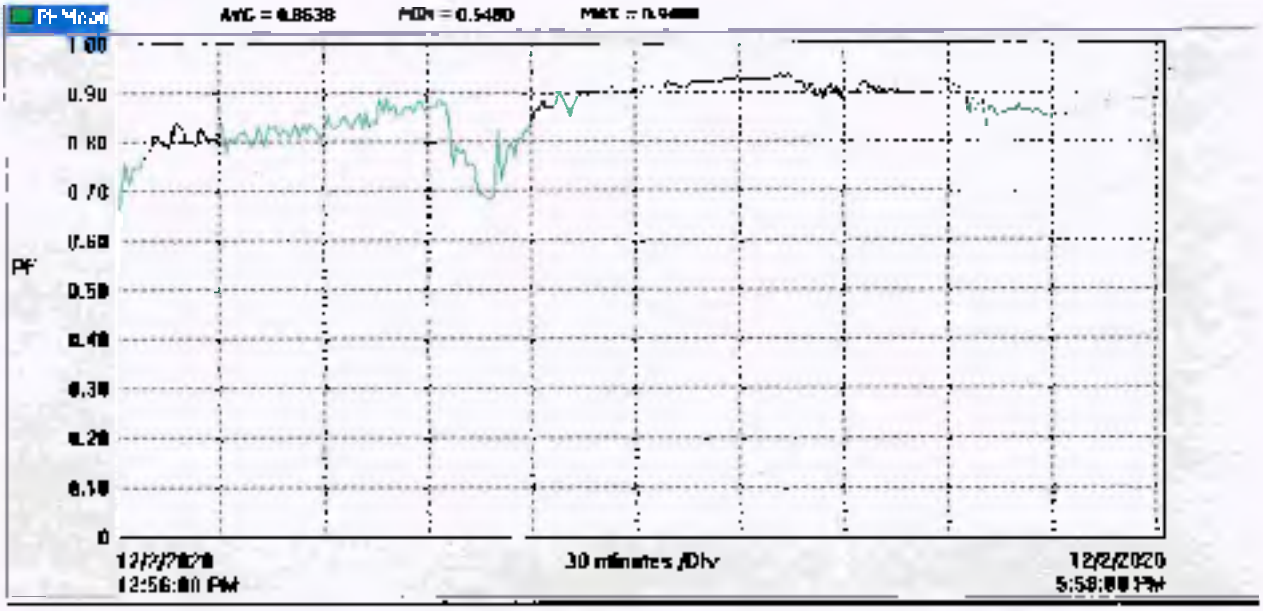
Kw:


W Total
AVG = 85.85 kW
MIN = 32.40 kW
MAX = 137.2 kW
200
180
160
140
120
100
80
60
40
20
0
kW
12/2/2020
12:56:00 PM
30 minutes /Div
12/2/2020
5:56:00 PM

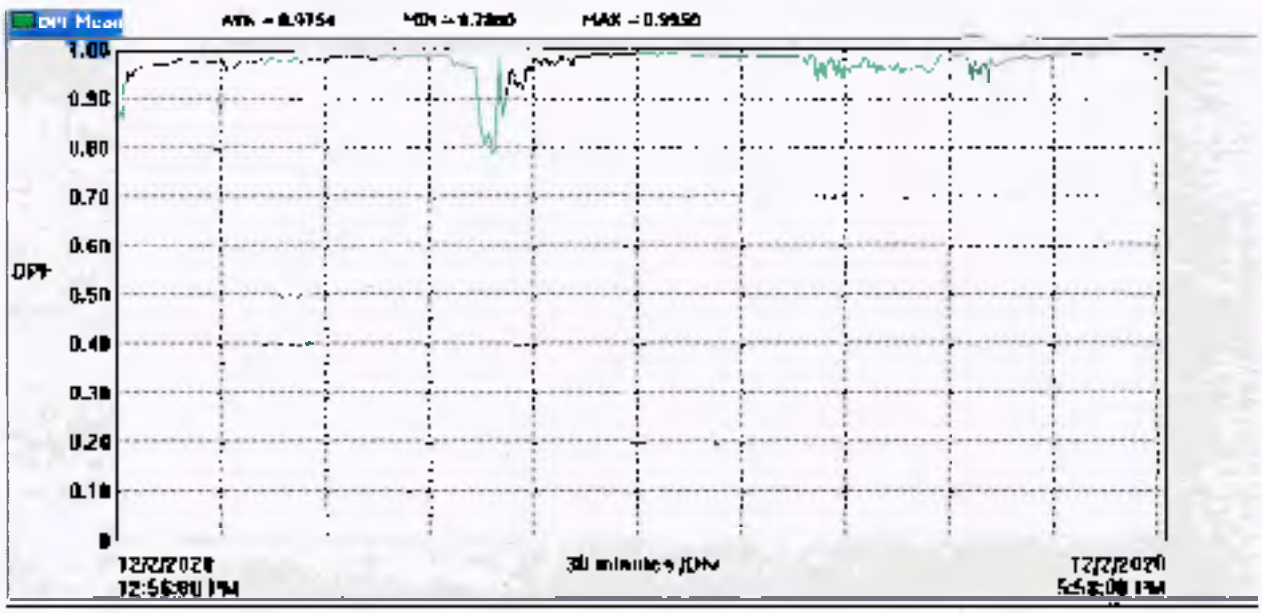
Kva:


VA Total
AVG = 97.16 kVA
MIN = 56.46 kVA
MAX = 140.4 kVA
150
140
130
120
110
100
90
80
70
60
50
kVA
12/2/2020
12:56:00 PM
30 minutes /Div
12/2/2020
5:56:00 PM

Power factor:



D.P.F:



VARIOUS ENERGY SAVING & BILL REDUCTION OPPORTUNITIES

(SAVING-1)

Saving by Surrendering the Contracted Demand

On the basis of electricity bills analyses for the 2 years i.e Dec-2018 - Nov-2020 for both sanction demands 555 kva (old) &1000 kva (Present) and observed that

1- Only once in the month of Sept 2019 the demand sudden increase upto 820 kva against the sanction demand 555 kva but never before that it was recoeded more than 527 kva it means the demand is always below the sanction but above the level of 75% of the sanction demand so in this way the Institution has paid penality only once and at that time power factor level was also less i.e 0.93.

2- For 527 kva avg recorded demand the max. Demand should not be more than 750 kva because at this level the 75% of the sanction demand will be 562.5kva which is much more than the avg recorded demand till date.

3- At 1000 kva sanction demand the 75% will be 750 kva so the institution will pay always extra amount for 187.5kva (750-562.5) @ 430/- per kva which is app.80, 000/- per month and equivalent to 9.6 lakh per year.

On the bases of above observations it is recommanded that

1- Institution should maintain its power factor 0.98 and above at every load condition.

2- Institution should observed one year its recorded demand if it not cross the limit of 75% of the sanction then should rethink for contracted demand and reduce it up to750 kva from the level of existing sanction demand 1000 kva when full load starts and run upto one year for all the seasons (i.e summer, winter and rainy). Institution has already installed a solar plant of 225 kwp so there should be no issue.

Saving potential:

As given in point no-3, **app. 9.6 lakh per** year may be saved by reducing/surrendering the maximum demand.

(SAVING-2)

Saving by maintaining PF level 0.99 at every load condition:

During the study audit team has collected the load parameters at the output of the 630 kva transformer for few hours and found that at every load condition the power factor of the institute was maintaining avg 0.86 (refer P.F graph for transformer load profile) and on the bases of electricity bills it was maintained in between 0.90-0.97 & 0.86 - 0.91 and avg 0.91 so there is a scope of 8%-10% for power saving.Hence on avg bases app. 8 % power may be saved as given below.

Avg monthly kvah units' consumption is	- 1, 10,000 units
Avg monthly power factor	- 0.91
Proposed power factor level	- 0.99
Avg monthly kvah units' consumption,	
at proposed power factor will be	- 8889 units
Net saving in units per month	- 8889 units
Annul saving in units will be @ 8.55/- per unit	-- 8889 x12 x 8.65
	= 9, 22,678/-

Investment:

For improving the power factor of the institution the investment will be app. 4.0 lakh as the existing panel is normal type while there is a requirement for de-tunned reactor type panel with high voltage capacitors because harmonics level is high.

Pay back:

The pay back period for the above investment will be 4-5 months.

(SAVING-3)

Saving by using only one transfomer of 630 kva at a time as running load of the Institution was quite low:

During the audit it was noticed that all the time both the transfomers are on and one at load while another at no load, in this way the transformer running on no load condition un-necessarily takes the power of 1.0 kw as a transformer No Load Losses. This power may be saved by keeping one transfomer OFF at a time alternativily for 30 -30 days i.e at a time only one transformer should be ON and other one OFF.

Saving potential:

Annual loss for power by keeping one transformer on at no load – 1.0 kW x24 hrs x365 days

= 8760 units

Annual monetary losses @ 8.65/- per unit - 8760 x 8.65

= 75,774/-

(SAVING-4)

Saving by voltage optimization:

Audit team has recorded the load profile and found that the load in kw was running 132 kw max., voltage range 408V- 426V with avg voltage 418 V which is on higher side. Institution has installed no servo voltage stabilizer& nature of load is single phase so required voltage range is 380-400 volts only.

Suggestions:

On the bases of nature of connected load it is suggested that institution should installed a servo voltage stabilizer of 750-800 kva of the range 340 v – 460 v and set its out put voltage at 390-400 v

Saving potential:

Existing working load in kw	- 132 kw
Working voltage level	- 426V
Proposed voltage level	- 390V
%age reduction in voltage	- 9 %
Saving expected	- 7.5%
Net annual saving	- 132 x 0.075 x 10 hrs x 300 days x 8.65/-per unit
	= 2, 56,905/-
Investment:	**App. 7, 50,000/-**
Pay back:	**3 years.**

Note:

1-Apart from above saving the life of single phase equipments will increase.

2-If load is increasedin kw then saving will be more and pay back period will reduce accordinghly.

(SAVING-5)

Saving in lighting by replacing the conventional 40 w Tube lights from 20w LED lights:

Saving potential:

Existing lighting load in kW for 55 w, (40 w+15w choke)	
For 1792 nos. conventional tube lights	- 98.560 kW
Proposed lighting load for, 20 w, 1792 nos. led lights will be,	– 35.840 kW
Net saving in kW saving will be	- 62.72 kW.
Annuanl monetary saving@8.65/- per unit for 10 hrs working will be	- 62.72 x10 x 300 x8.65.
	= 16, 27,584/-
Investment for the led lights will be @ 190/-each	**- 1792x190**
	= 3, 40,480/-
Pay back period	- 3 Months.

(SAVING-6)

Other General Power Saving Points

1-Existing old transformer was as per old IS 2026 specifications and consuming more power it should be replaced by the low losses five star rated transformer as per new IS 1180 specifications from energy saving point of view.

2- There were no fixed capacitors installed on transformer to improve its power factor at no load condition.Hence it is suggested that there should be install some fixed capacitor (by hit and trial method) so that PF may be further improve up to some extent.

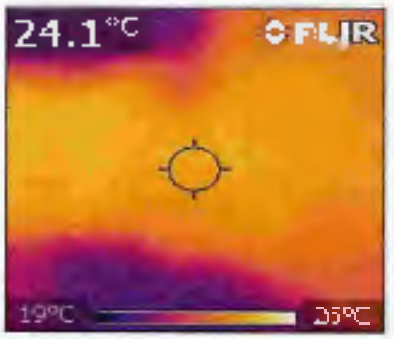
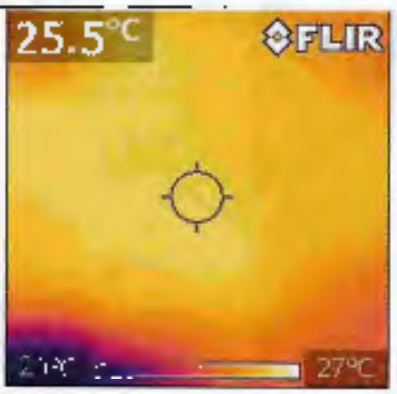
SUMMARY OF SAVING OPPORTUNITIES

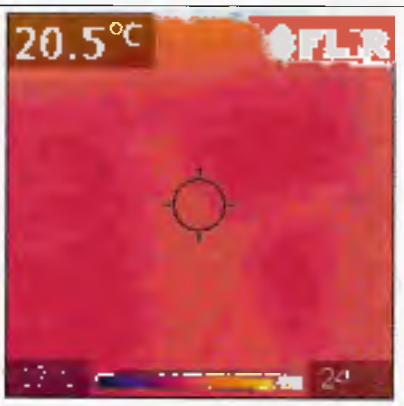
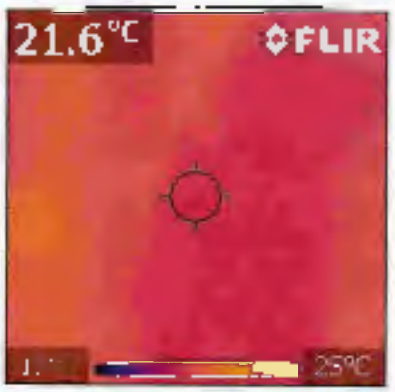
S. No.	Description	Annual power savings	Annual Monetary Savings
Saving 1	Saving by Surrendering the Cotracted Demand	-	9,60,000/-
Saving 2	Saving by maintaining 0.99 P.F at every load condition ,	**1,06,668 units**	**9,22,678/-**
Saving 3	Saving by using only one transfomer of 630 kva at a time.	**8760 units**	75,774/-
Saving 4	Saving by voltage optimization.	**29700 units**	2,56,905/-
Saving 5	Saving in lighting by replacing the conventional 40 w Tube lights from 20w LED lights:	**188160 units**	16,27,584/-
Saving 6	Other General Power Saving Points	**Lot**	**Lot**
Total		**3,33,288 units**	**38,42,941/-**

THERMOGRAPHY TO LOCATE HOT SPOTS

THERMOGRAPHY OF ELECTRICAL DISTRIBUTION SYSTEM

During the audit we have taken the working temprature of the electrical switch gears, their connection terminals with FLIR make thermographic Camara at various places and found that most of the equipments and cables are working at normal temprature as shown in remarks infront of them against the atmopheric temprature not hot spot observed.

S.NO.	LOCATION	THERMAL IMAGE	REMAKS.
1-	1600 A ACB R Phase		o.k
-do-	-do- Y Phase		o.k
-do-	-do- Y Phase		o.k

2-	APFC Main incomming R phase		o.k
-do-	Y phase		o.k
-do-	B phase		o.k
3-	New building basement panel side of basic electrical lab.		o.k

4-	New building basement panel side of civil lab.		o k
5-	8th floor Light D.B		o k
6-	Old building lighting D.B		o k
7-	Old building Electiral panel main cable side Directors office		o.k
8-	Old building Electiral panel main cable opposite side Directors office		o.k

EARTHING SYSTEM

EARTHING SYSTEM

During the study we have checked the earth resistance values for all the earth pits of the institute building and tabulated as below.

Recommandations:-

It is recommanded that those earth pits which are showing values open loop and more than 8 ohm should be replaced by new earth pits.

Note:- Voltage between Neutral and Earth was found 1.2 V -1.5 V which is quite o.k.

S.No.	Location	Earth resistance values in ohms	Remarks
A-	**Machine earthings**		
1-	630 kva , 11 kv / 0,433 kv old Transformer		
	A- Body		
	Pit no-1	2.5	o.k
	Pit no-2	2.8	o.k
	B-Neutral		
	Pit no-1	2.9	o.k
	Pit no-2	2.4	o.k
2-	630 kva , 11 kv / 0,433 kv New Transformer Energy Efficient Level-2 Transformer		
	A- Body		
	Pit no-1	23.2	High
	Pit no-2	2.8	o.k
	B-Neutral		

	Pit no-1		
	Pit no-2	O/I	High
		3.4	o.k
3-	RMU &Meter room		
	New earthing (Out Side)		
	Pit no-1	65	Too much high.
	Others Pit no-2	0.11	o.k
	Pit no-2	0.15	o.k
4-	1010 kva D.G set.		
	A- Body		
	Pit No- 1	18	High
	Pit No-2	0.14	o.k
	B-Neutral		
	Pit No- 1		
	Pit No-2	1.5 for both pits	o.k
5-	500 kva D.G set.		
	A- Body		
	Pit No- 1	0.027	o.k
	Pit No-2	0.025	o.k
	B-Neutral		

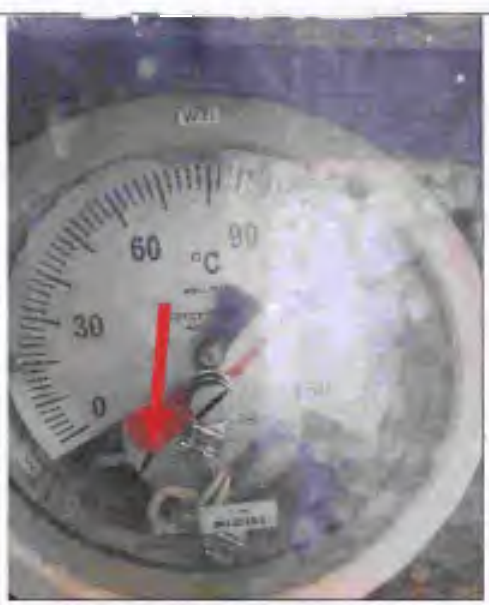
	Pit No- 1 Pit No-2	6.9 for both pits	o.k
6-	320 kva D.G set. A- Body Pit No- 1 Pit No-2 B-Neutral Pit No- 1 Pit No-2	1.8 1.4 4.8 for hoth pits	o.k o.k o.k
7-	250 kva D.G set. A- Body Pit No- 1 Pit No-2 B-Neutral Pit No- 1 Pit No-2	3.8 2.4 Open loop for both pits	o.k o.k o.k **Note:** D.G under breack down.

8-	L.T.Panel	0.94	o.k
9-	A.P.F.C Panel	1.5	o.k
B-	**Building earthings**		
10-	New building	3.2- 5.0	o.k
11-	Old building	2.5- 4.0	o.k
C-	**Solar Earthing**		
12-	Solar Earthing old building.		
	A- For Roof Structure	0.55,4.5,2.9&3.8	o.k
	B- For A.C System.	12 , 4.6. 0.49 &5	o.k
			Note:
			No L.A installed.
13-	Solar Earthing New building.		
	A- For Roof Structure	5.5,4.5,6.9&4.8	o.k
	B- For A.C System.	6 0 , 6.4, 4.9 &5	o.k
	C- L.A	Open Loop	To be checked
14-	**UPS Earthing.**		
	NO-1	4.4	o.k
	NO-2	3.2	o.k

SPECIFIC FINDINGS REGARDING ELECTRICAL & FIRE SAFETY

SPECIFIC FINDINGS REGARDING ELECTRICAL AND FIRE SAFETY.

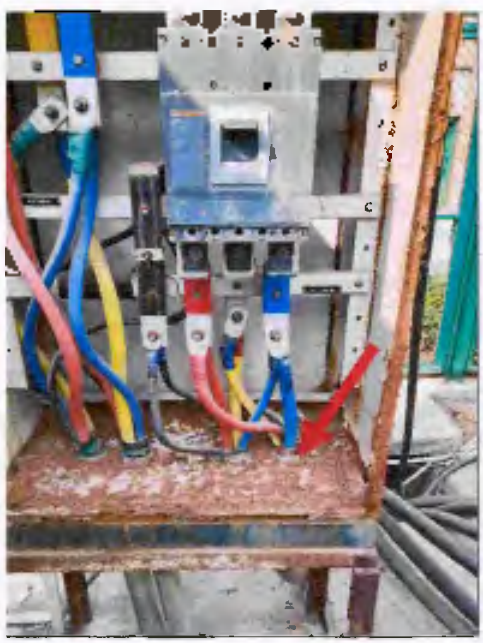
s. no.	Immages	Observations	Recommandations
1.		Earth pit was full of dust no earth strip and watering pipe visible	Pit should be empty, watering pipe and earth electrode connection should be visible so that during summer watering could be done to reduce the earth resistance values and status of conection may be seen.
2.		Cable trench was found open. It is a hazard and may be a cause of accedent.	The cable trench should be properly covered.

3.		Transformer breather silica jal became voilet so it is full of moistureand out of fuction for old 630 kva transformer.	Replace it so that moisture may not enter inside the transformer on the other hand its color should be blue.
4.		Transformer oil was found fill up to full scale its glass indication also shows full .	As per rule oil level should be in between lower and upper level of indicator.
5.		Winding temprature indicator found out of order for 630 kva old transformer.	Replace it.

6-		Cable was not dressed, trench was uncoverd and earth pit chamber found damage.	Dress the cable, cover the trench by putting slabs on it and repair the earth pit chamber as theave are hazard and may be a cause of an accident.
7-		Winding temprature indicator and oil temprature indicator for new 630 kva transformer were neither found connected nor set.	Set and connect them.

8-		Transformer breather silica jal became voilet and out of fuction for new 630 kva transformer.	Replace it.
9-		11kv RMU units are used for both 630 kva transformer which is not o.k. Cable trench also found open.	11kv veb should be used with full protection as RMU units are not much reliable.Trench should be covered as it is hazardous and may be a cause of accedent.

10-		This is not a proper way for maintaining the earth pit:	**Make a proper earth pit .**
11-		Fire buckets are empty and not maintained.	These **should be** full of sand and properly decorated, painted and **should be written** fire on them.

12-		D.G set's electrical panels are kept in open space near each D.G and being rusted due to rain water while these are ment in door type.	Either shifts the panels inside under the roof or febricate a canopy for them.
13-		Body is more or less got damaged due to rust and nut & bolts are also rusted.	-do-

14-		D.G electrical panel is tied with rope so due to this it is very difficult to protected the water entering in it.	Either shifts the panels in side under roof or febricate a canopy for them.
15-		Diesel pipe was kept on electrical panel	There should be a seprate hook to support diesel pipe &immidiately remove the pipe from here.
16-		Ladder and other unwanted material were kept near D.G set which is HAZARD.	Keep clear space surrounding the D.G sets othewise any casuality may occure.

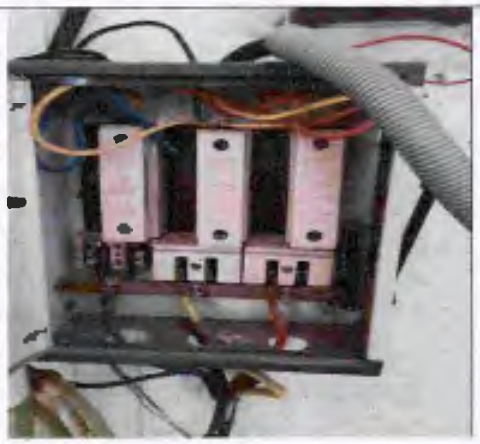
17-		Ordinary motor terminal box was fitted on diesel pumping motor.	It should be fire proof so immidiate replace it.
18-		NO fencing found for diesel storage tank there was thorough fare.	This is inflammable area so should be fenced throughly.
iv		In panel room near APFC panel cable trench was open and used as peakdan	Cover the trench properly with checkered plate.

20-		In L.T panel room the cable trench was not covered so it may be a cause of accedent.	Cover the trench properly with checkered plate.
21-		-do-	do-
22-		-do-	-do-
23-		Cables are terminated without the cable glands.	Cables should be connected after using proper cable gland to reduce the tentions from the cable connection terminals.

24-		In D G area cables used for D.G sets are not dressed properly they laid in hapazard manner.	Dressed the cable properly.
25-		Fire extinguishers are kept hidden i.e not properly installed.	Install them in proper way in easy access.
26		Cables are terminated without the cable glands. It is in new building basement panel a side of civil lab.	Cables should be connected after using proper cable gland to reduce the tention from the cable connection terminals.

27-		Cables are terminated without the cable glands.	Cables should be connected after using proper cable gland to reduce the tention from the cable connection terminals.
28-		Cables are entering in panel without glands and top portion was open and inviting the entry of Lizards and Mouses.	Close the openings.
29-		-do-	-do-
30-		Over size thimbles are used and not crimped properly.	Use proper size thimbles and crimp properly.

31-		Nomenclature are not properly written so it is very difficult to identify the feeder locations.	Write the proper feeder name.
32-		Fire extinguishers pressure needle in red zone but it valid up 2021 this is kept in old building alley.	Check it and rectify the issue otherwise it will not work during fire.
33-		Old slip for validity was not changed.	Test the condition and change the validity slip.
34-		ELCB /RCCB are not installed, only isolater is connected in lighting D.B for both the buildings so during any fault the isolater will not trip.	Install a proper size ELCB OR RCCB from safety point of view.

35-		Now a days these main switches are not reliable from safety point of view so do not use them.	Use proper size MCB OR MCCB only.
36-		The cable armor is used as earth it violation of I.E rules.	Use poper earth connetion wire duly connected with earth pit.
37-		Openings were observed in lighting and power D.B.	Do not leave the openings in lighting D.B, use the blankers to cover the openings.
38		Fire fighting line main valve handle at roof found boroken.	Attent it immidiatly.

39-		For old building panel Over size thimbles are used and not crimped properly and found jumbling of wires.	Use proper size thimbles ,crimp pruperly and dress the cables properly.
40-		In old building basement panel cables are used without cable glands.	Use proper size cable gland otherwire pressure from the connection terminals can not be refeased
41-		In old building panel cables are connected in this manner that cover was not closed properly.	Connect the cable in decent manner and close the cover properly.

Study of UPS:

Institute has installed 10 kva single phase input and output on line ups for the smooth operation of the computers, lab's and other equipments at floors of new and old building.Audit team has measured the all electrical parameters for 10 kva ups including the harmonics generated by it during the load and unload condition to evaluate its performance.

The detail of load parameters is as follows at different load pattern:

10 kva ups loading:

Location	UPS detail	Voltage	%thdv	Current	% Thdi	kw	kva	P.F
8th floor room no-809	single Phase In put at partial load	236	4.8	3.8	150	0.34	0.91	0.37
-do-	single Phase Out put partial load	217	3.8	1.1	54.9	0.26-0.115		0.23-0.59
-do-	single Phase In put at load of 10 computers.	234	4.9	9.2	107	1.0	2.19	0.45
-do-	single Phase Out put at load of 10 computers.	215	5.1	4.6	120	0.66	0.91	0.69
8th flour office UPS	10 kva UPS single Phase In put	232.2	5.1	4.9	165	0.384	1.134	0.34
-do-	single Phase Out put	210	2.8	10	109	0.138-0.145		0.65-0.72

Observations:

During the audit, auditor has observed the folling points which show the performance of the UPS.

1- Ups of 10 kva are running under load.

2-Power factor of ups was running very low.

3-Inside the ups of 10 kva losses were found avg. 0.230 kW

4- Harmonics % age is high in current.

Suggestions:

1- There should be an ups power D.B so that during no load condition for a long period 10 kva ups power may be given to other load .

2- Increase the loading % age on the ups.

Lighting System

During the study Institution has provided us the detail for existing connected tube lights. conventional as well as led as tabulated below.It was also reported that for both the buildings institution has changed app 2200 conventional lights in to led lights till date batance app1800 conventional ligts are to be changed in to led lights in phase manner.

Section	Conventional Tube Lights 40 w +15w choke each	Load in kw	Led Lights 20 w	Load in kw	Remarks
New Building	272	14.960	857	17.14	
Old Building	1520	83.600	1313	26.260	
Total nos. of Lights	1792	-	2170	-	
Total Load in kw	-	98.560	-	43.400	

Saving potential:

Existing lighting load in kW for 55 w, 1792 nos. conventional lights - 98.560 kW

Proposed lighting load for, 20 w, 1792 nos. led lights will be. – 35.840 kW

Net saving in kW saving will be - 62.72 kW.

Annual monetary saving@8.65/- per unit for 10 hrs working will be - 62.72 x10 x 300 x8.65.

= **16, 27,584/-**

Investment for the led lights will be @ 190/-each - **1792x190**

= **3, 40,480/-**

Pay back period - **3 Months.**

-

Study of D.G Sets

Intitution has installed four D.G sets of different capacity and make i.e 1010 kva Catter pillar, 500 kva Cummins kirlosker, 320 kva Jakson &250 kva Jakson so total capacity as a captive power was 2080 kva to use during power cut and emergency purpose. Most of the time during power cut either 500 kva & 320 kva or 1010 kva D.G sets are used.During the study audit team has conducted the load trial for D.G. Sets of 500 KVA Cummins Kirloskar make for one Hour to evalute the specific fuel consumption the results are as follows. team has also calibrated the Energy meter installed at L.T panel for 500 kva D.G feeder, during the trial consumption of diesel also taken to calculate the specific fuel consumption i.e units per liter.Results are as follows along with the relavent graphs for electrical parameters.

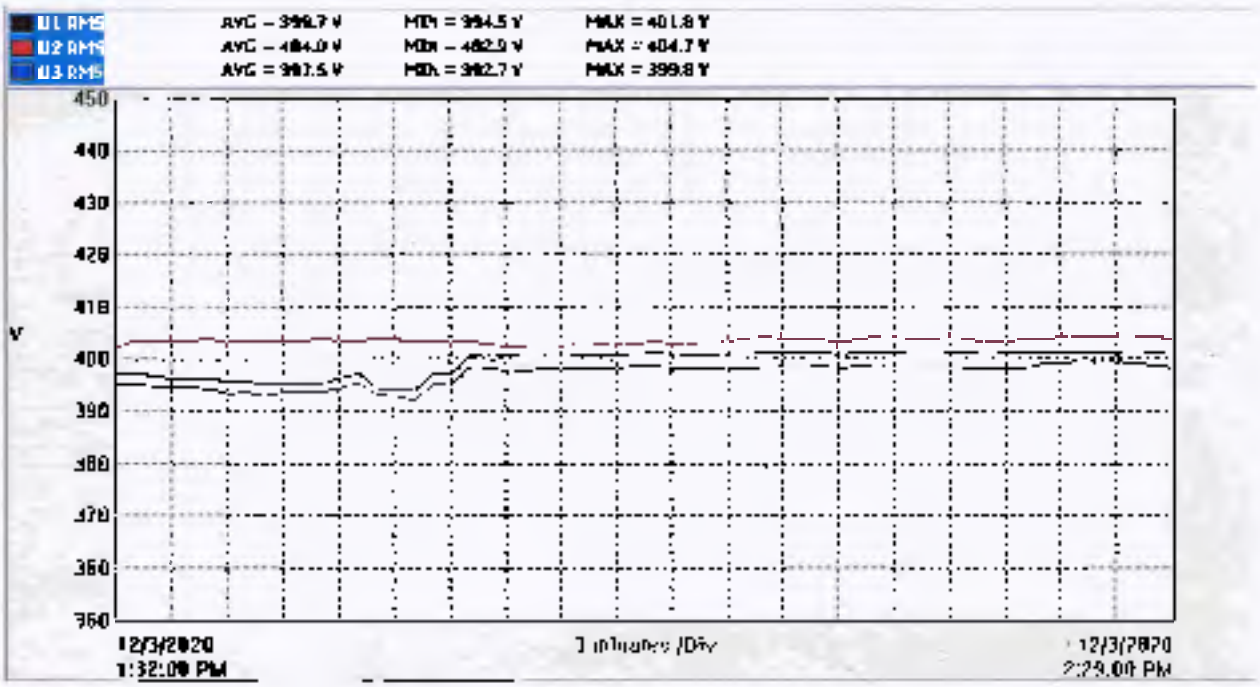
Recommandations: It is recommanded that increase the loading % age on D.G set to improve its specific fuel consumption i.e units per lits and power factor as at present these are very poor.

Load Trial for 500 kva D.G set:

Make	Cummins Kirloskar
Capacity	500KVA
Trial	1 hour
Generated KWH by auditors calibrated meter ALM 30	52.735 kwh
MWH recorded by D.G KWH at L.T panel M.F meter	(601.67992 - 601.73192) = 52 kwh
Power factor of D.G sets	0.53
H.S.D. consumption	45 Ltrs
Landed cost of diesel	74/- Per Lits
Specific fuel consumption i.e Units/liter	
A- By ALM 30	1.17
B- By D.G Meter	1.15
Unit Cost	63/-
% age Loading	13%
Status of D.G. MKWH meter	o.k

Load profile for 500 kva cummins kirloskar D.G sets:

Voltage:



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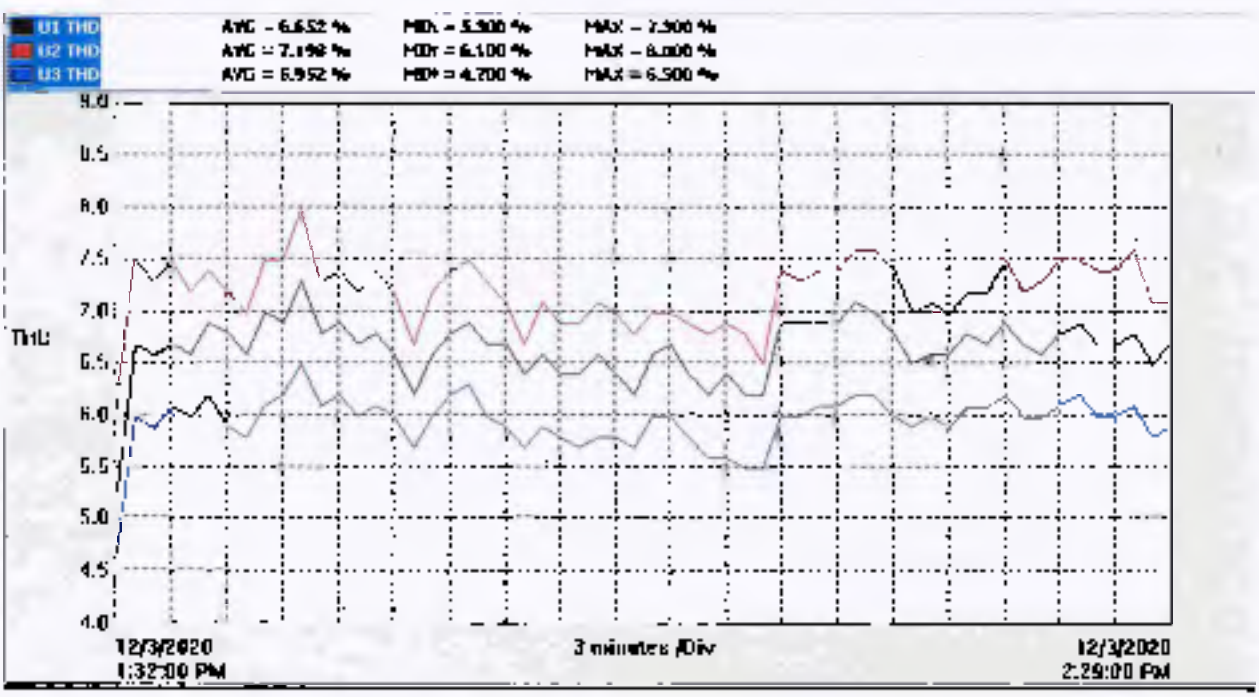
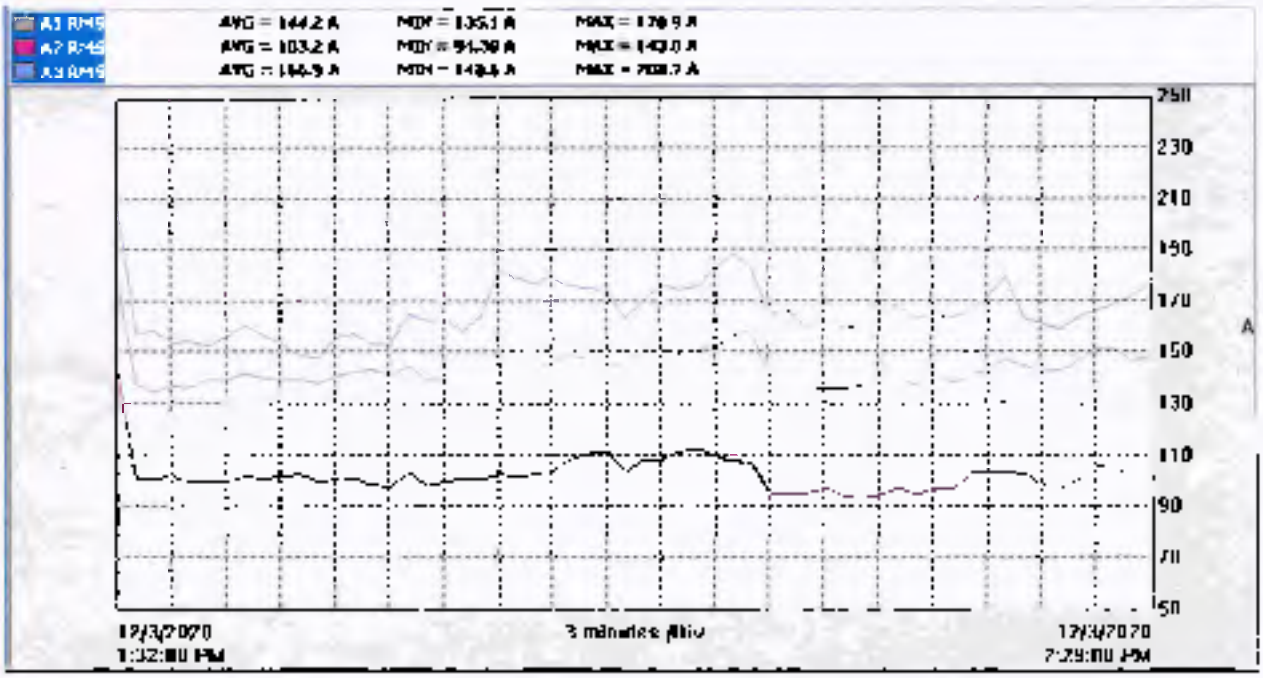


Current:



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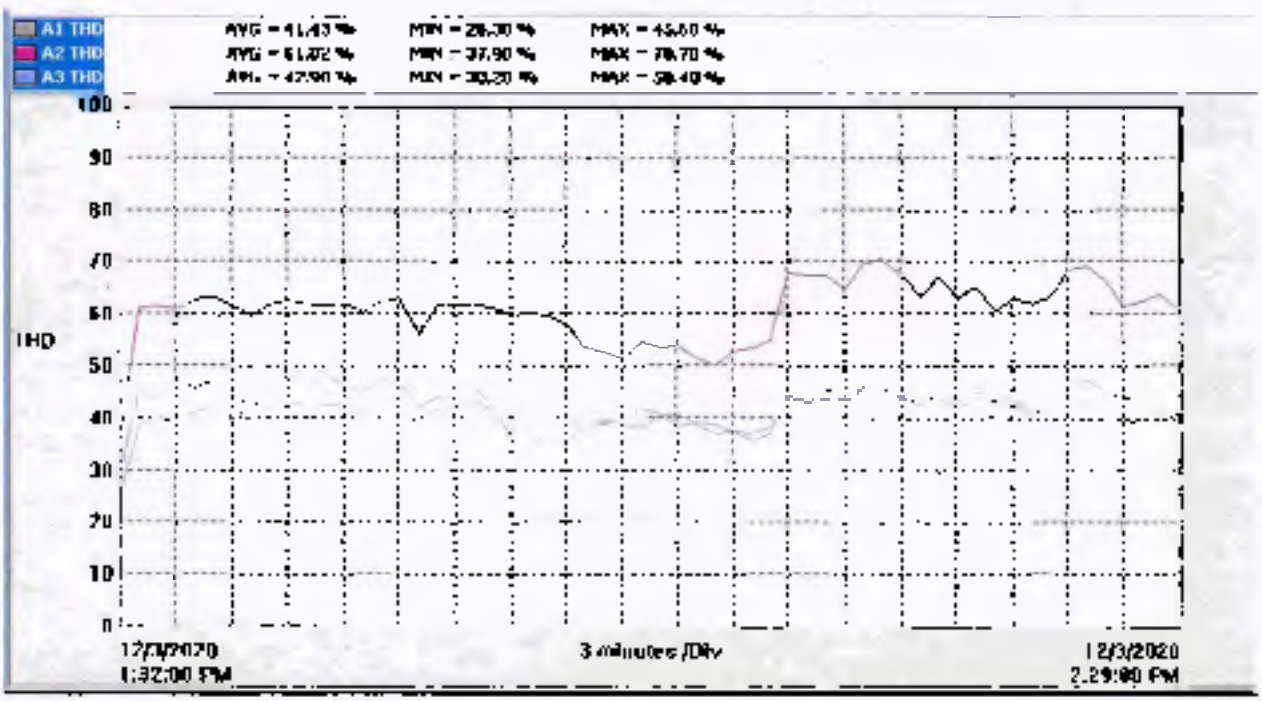
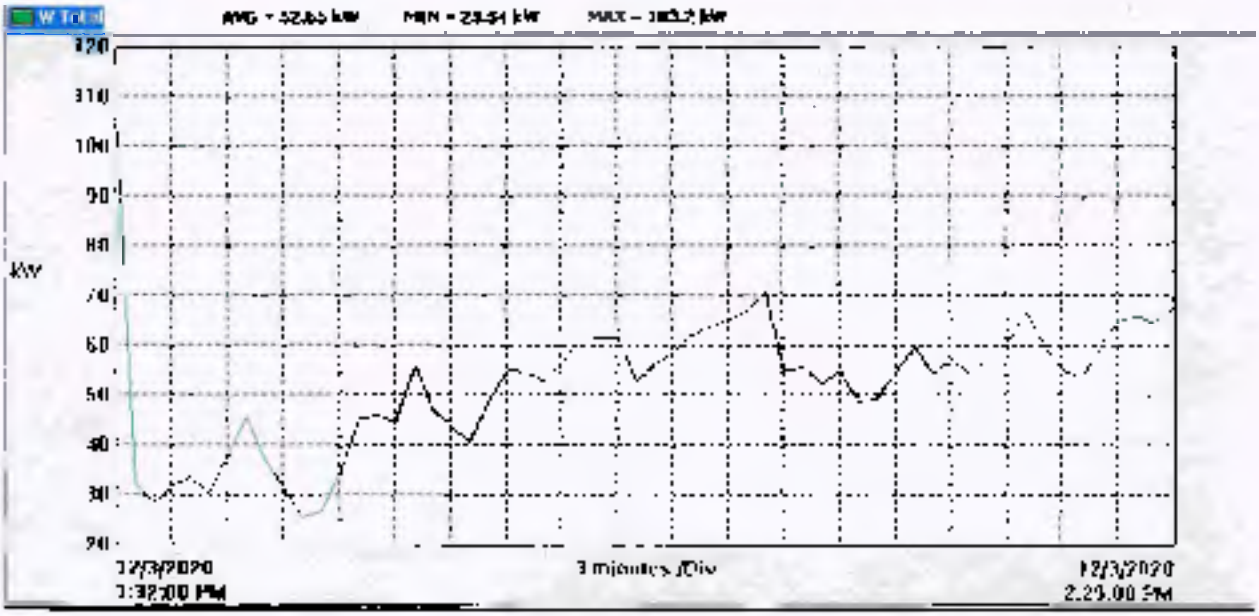
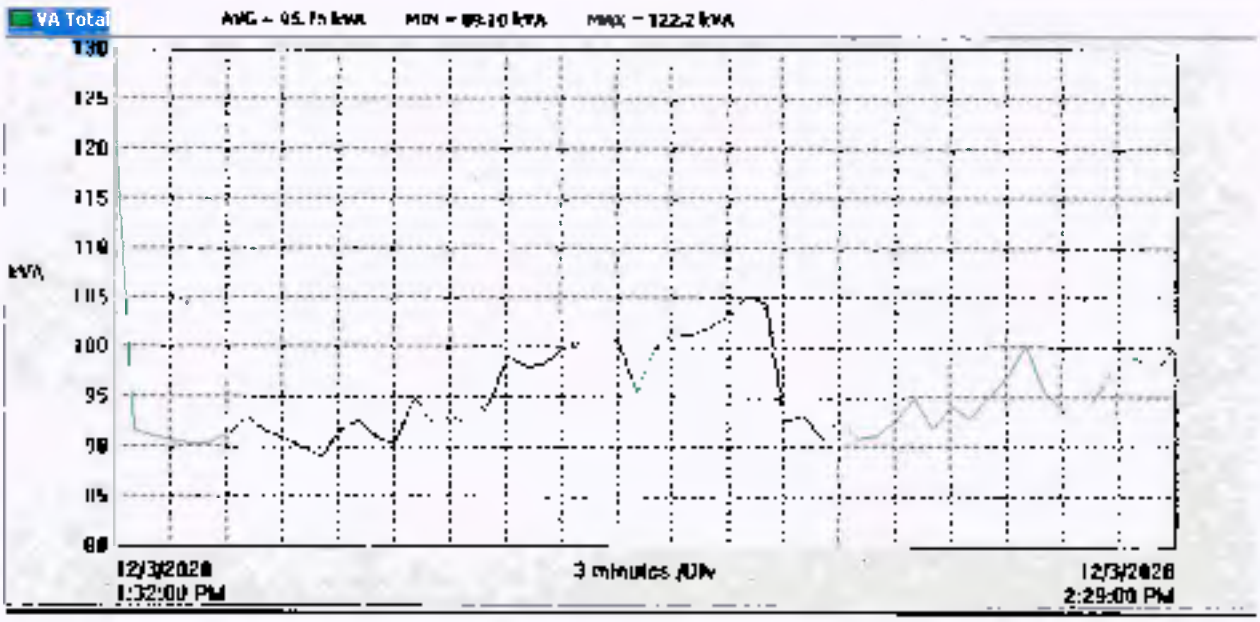


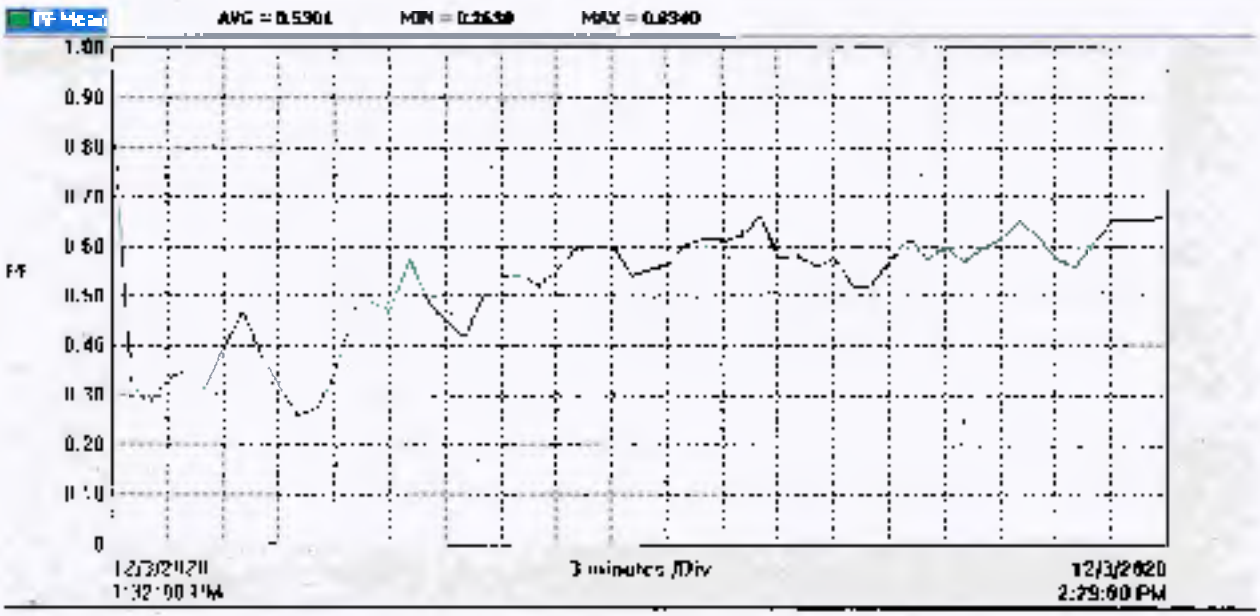
Kw:


W Total
kW
3 minutes /Div
12/3/2020
1:32:00 PM
12/3/2020
2:29:00 PM

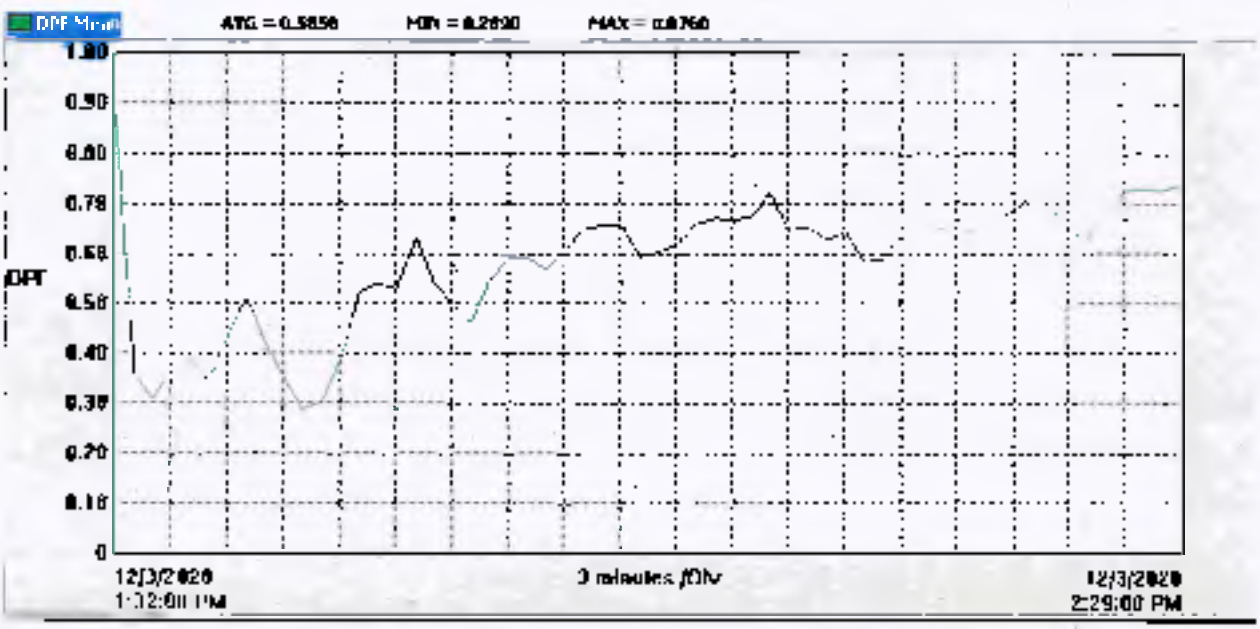
Kva:


VA Total
kVA
3 minutes /Div
12/3/2020
1:32:00 PM
12/3/2020
2:29:00 PM

Power factor:



D.P.F:



********** END OF THE REPORT **********