ENERGY AUDIT - 2020

NAIPUNNYA BUSINESS SCHOOL

PONGAM, THRISSUR

EXECUTED BY

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PREFACE

Every institution should be imparting knowledge about the campus environment and its surroundings through activities that follows the principles of sustainability. An energy audit is essential first step to reduce energy cost and greenhouse emissions. Audit is defined as a systematic and implement examination of data statements, records, operations and performance of an enterprise for a purpose. Energy audits is a systematic study or survey to identify how energy being used in its own facility. And identifying the energy savings opportunities in the building Behavioural Change through the student education can provide greatest benefit at least cost. Even small savings in each house holds make dramatic change in the society and for nation. The idea of energy conservation and sustainability will be percolated to society through students will have long standing effect and successful too

This report is compiled by the BEE certified energy auditor along with the project engineers who are experienced in the field of energy, environment and management. The student volunteers made a mammoth contribution with data collection and preparing an initial skeleton for the report.

ACKNOWLEDGEMENTS

We express our sincere gratitude to the Naipunnya Business School (NBS) Pongam, Thrissur for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to all the staffs for their support to carry out the studies and for input data, and measurements related to the project of Green audit. Special thanks to Prf. (Dr) Jacob P M - Director of NBS who is helping lot for completion of this audit

Also congratulating our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

GREEN AUDIT TEAM

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Yours faithfully

Managing Director
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EXECUTIVE SUMMARY

I. ENVIRONMENT & ENERGY SUMMARY:

Sl no	Particulars	Annual Energy Savings	Annual Savings by replacement	Investment	Simple payback period	Carbon dioxide emission – Reduced
		kWh	Rs.	Rs.	Months	Tons/ year
1	Replacement of existing fluorescent lights with LED lights	2755	17357	35000	24	**1.62**
2	Replacement ceiling fans with BLDC fans	1,800	11,340	60,000	63	**1.06**
	Total	**4555**	**28697**	**95,000**	**-**	**2.64**

Table 1: EXECUTIVE SUMMARY –ENERGY

ENERGY AUDIT

An energy audit is a key to assessing the energy performance of an energy consuming facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In Naipunnya College as per the request from the institution, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Scope of Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.
5. Cost Benefit Analysis.

ABOUT NBS

NAIPUNNYA is set in a serene nature of 2.5 acres of landscaped gardens and aesthetically built buildings. The design is elevated by simplicity and full of flora and fauna. NBS is at Pongam and Nearby to National High way 544 and just 10 Kms away from CIAL airport

Naipunnya Business School, (NBS) Pongam, Koratty is a management institute, run by the Archdiocese of Ernakulam- Angamaly. NBS was launched in the year 2012, with a vision to create professionals, suitable for the industry. An offshoot of Naipunnya Group of Educational Institutions, NBS imparts premium professional education at an affordable cost. The institute provides an environment that is conducive to meet the needs of each student. NBS fosters in developing self-confidence and a positive self-image for Business Graduates. The Patron of the "Naipunnya Business School" is His Beatitude Cardinal Mar George Alencherry. The Co-Patrons is Archbishop Mar Antony Kariyil. The Executive Director is Rev. Fr. Dr.Paulachan K. J. and the coordinator of NBS is Rev. Fr. Varghese Assin. NBS is affiliated to the University of Calicut and recognized by AICTE.

Naipunnya Business School (NBS), an offshoot of Naipunnya Institute of Management and Information Technology (NIMIT) was set up in 2012 for creating Business professionals who meet the standards of the present industry and culture.

Transform students into business leaders.

Committed Holistic development of students

Immersive & Experiential Learning Process.

Regular winners in National Business Plan & Management fests

Student-centred Teaching

Global Exposure Program (GEP)

Eco-friendly green campus.

The MBA programme at NBS aims at holistic development of every student, which enables to explore the realms of professional life. The MBA programme at NBS is approved by ALL India Council for Technical Education (AICTE) and is affiliated to the University of Calicut.

Vision

To be a global academy, one of the world's leading institutes that moulds students for management practices, striving continuously for excellence in education and service to the society.

Mission

Our mission is to equip students with management skills so that they may function efficiently and effectively in the modern world. We strive to produce leaders who have an awareness and involvement in wider societal concerns, such as the protection of the environment, conservation of energy and

concern for social justice. At NBS, students will Experience the joy of learning, Explore new horizons and Excel in all fields.

Core VALUES

The mission of Naipunnya Business School is to educate students to become business leaders who make a difference in the world. For achieving this mission it requires an environment of trust and mutual respect, free expression and a commitment to truth, excellence, and lifelong learning. All our students, faculty, staff, and alumni are trained to accept these principles when they join NBS. This also enables them to foster values useful for the business and community. We practice these values in our daily interactions so that students are able to:

- Respect for the rights, differences, and have a cultural immersion the larger community
- Practice honesty, transparency in all their dealings with members of the community
- To be a person who is prepared to change behaviour, accept norms and be part of the community
- NBS strives to be a living model of these values. To this end, NBS community members have a personal responsibility to integrate these values into every aspect of their experience here. Through our personal commitment to these values, NBS will be able to change the economic and social for the good of all.

FIGURE 1: COLLEGE CAMPUS

BUILT UP AREA

The college premises cover for an area of land area. The collected details of the area distribution are given in table 2.

Sl.No:	Floor	Total Built Up Area
		m^2
1	MBA Block	3215
2	Chappel	500
3	Auditorium	1942
Total		**5657**

TABLE 2: BUILDING AREA - DISTRIBUTION

- The total buildup area covered by buildings come to be about 5657 **m^2**.

ENERGY ANALYSIS

The different type's energy usage is given in this section. The major source of energy to the college is electricity. Other forms come in the form of LPG, petrol and diesel.

ENERGY CONSUMPTION ANALYSIS

The major source of electricity to the college and hostel is the electrical connection from the KSEB. Separate connections are provided to the college and hostel. A diesel generator is provided in the college, but it is only used during the power failures in critical days like examinations or college events.

Note: The HT transformer connected to Naipunnya business school and Naipunny Institutions common. Hence we are taken same HT bills for the report.

I. DESCRIPTION OF ELECTRICITY BILL

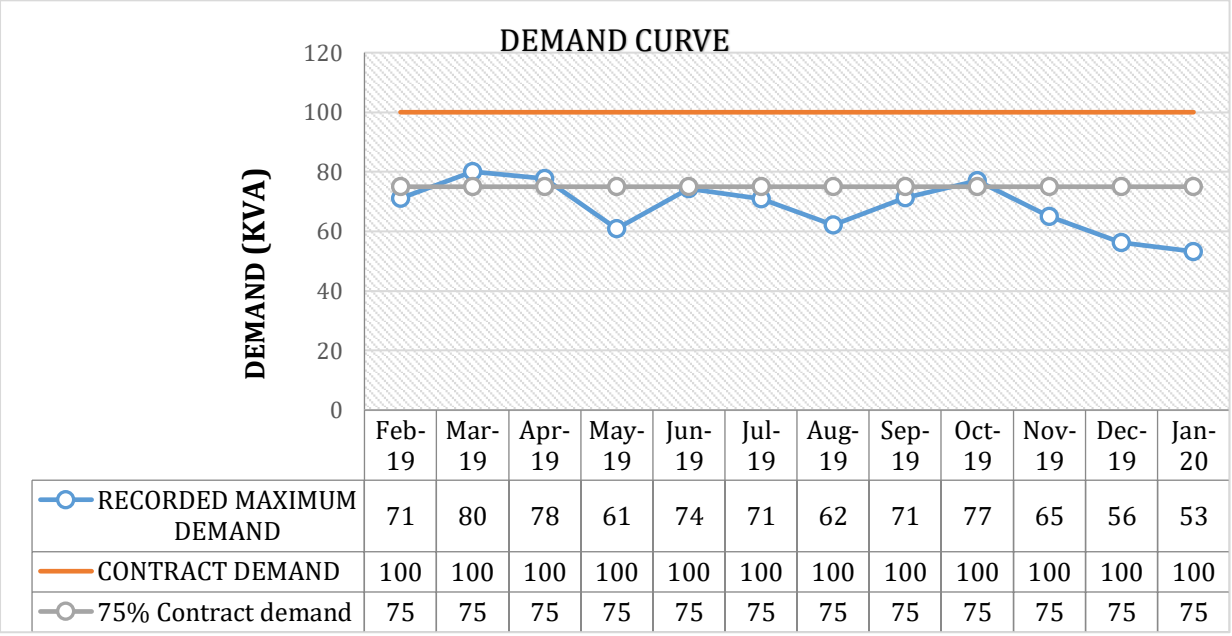
Base line data given below is based on the Electricity bill provided by the supplier of electricity to the College. Details obtained from the KSEB bill for the month of February 2019 to January 2020 is as follows in the Table.

Particulars	Details
Consumer No	1356490049381
Contract Demand	100 kVA
Connected Load	229.596 kW
Tariff	HT 11B (General)
Recorded maximum demand (kVA)	80
Average monthly consumption (kWh)	12,118
Average Demand charges (Rs)	32,034
Average Energy charge (Rs)	75,678
Average PF	0.92

TABLE 3: KSEB BILL ANALYSIS

II. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over a 12-month period (February 2019 to January 2020).



	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
RECORDED MAXIMUM DEMAND	71	80	78	61	74	71	62	71	77	65	56	53
CONTRACT DEMAND	100	100	100	100	100	100	100	100	100	100	100	100
75% Contract demand	75	75	75	75	75	75	75	75	75	75	75	75

FIGURE 2: DEMAND ANALYSIS

Inference

i. Average annual demand charges came as **Rs. 3,84,403** and which is 27.75 **%** of the total electricity charge.

ii. The recorded maximum demand came in the range of 18% to 80 % of the contract demand with an average of 39.39%.

III. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

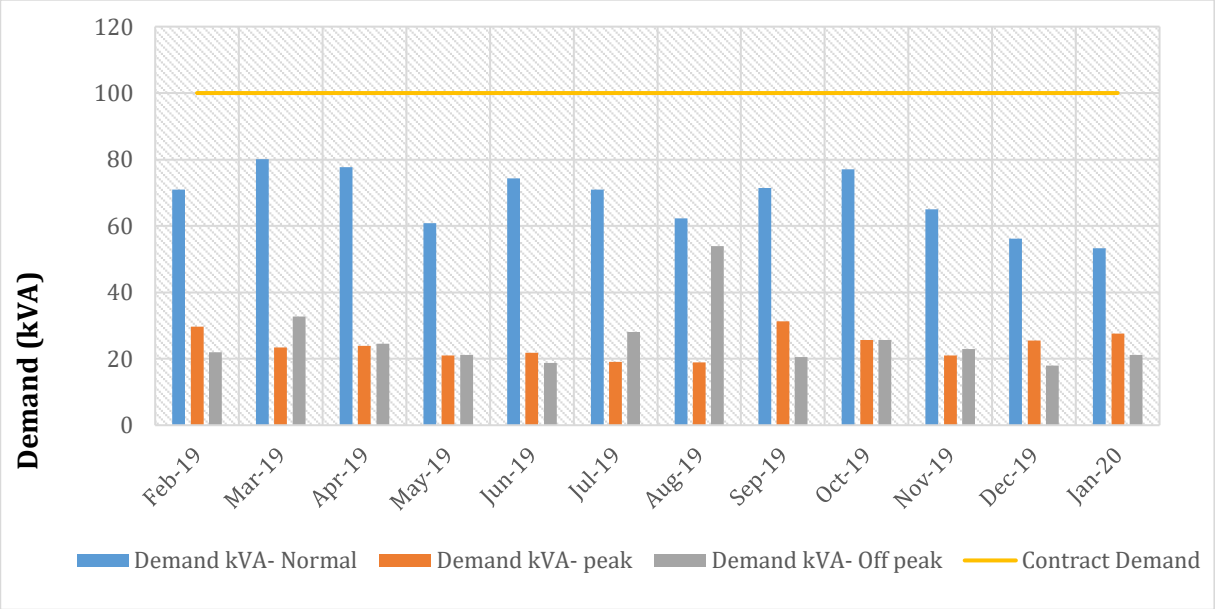


FIGURE 3: DEMAND IN VARIOUS TIME ZONE

Inference

i. The average maximum demand in the normal, Peak and off-peak period registered at NIMIT with respect to the contract demand is 68, 24, and 26% respectively.

IV. POWER FACTOR ANALYSIS IN KSEB BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF = Active\ energy kWh / Apparent energy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

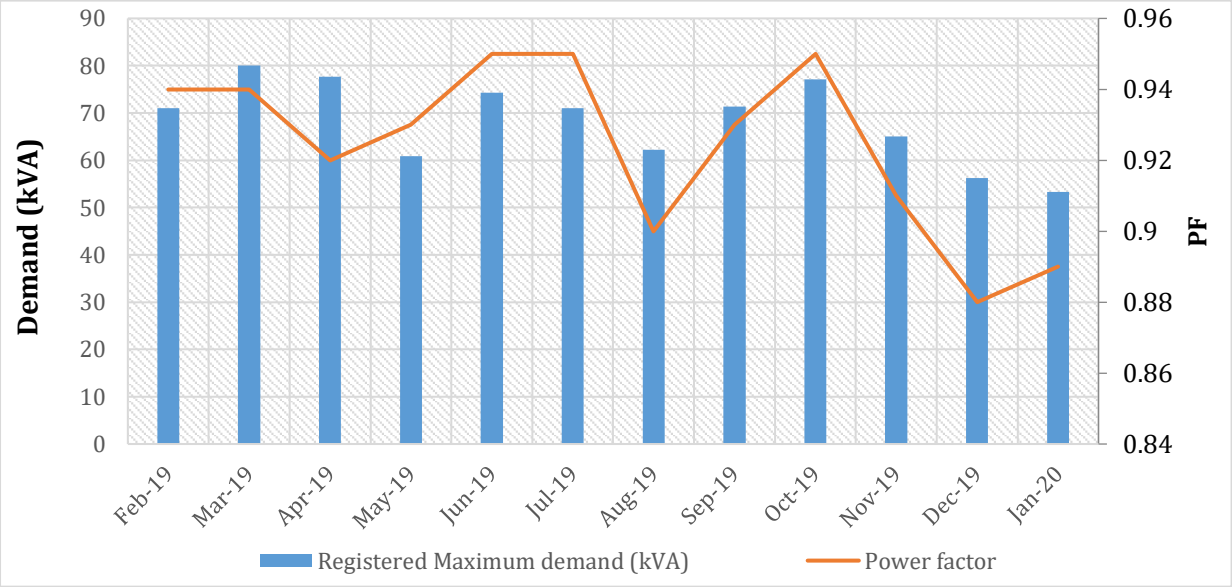


FIGURE 4: POWER FACTOR ANALYSIS

Inference

i. Average power factor during the past one year is found to be 0.92.
ii. The drop in the power factor either due to the deterioration of capacitors or leading effect can be clearly visible from the above figure.
iii. For last few months, there were penalties on low power factor.
iv. The calculations regarding the power factor improvement and incentives /Penalties are given in the Annexure.

V. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period February 2019 to January 2020 is represented in Fig.

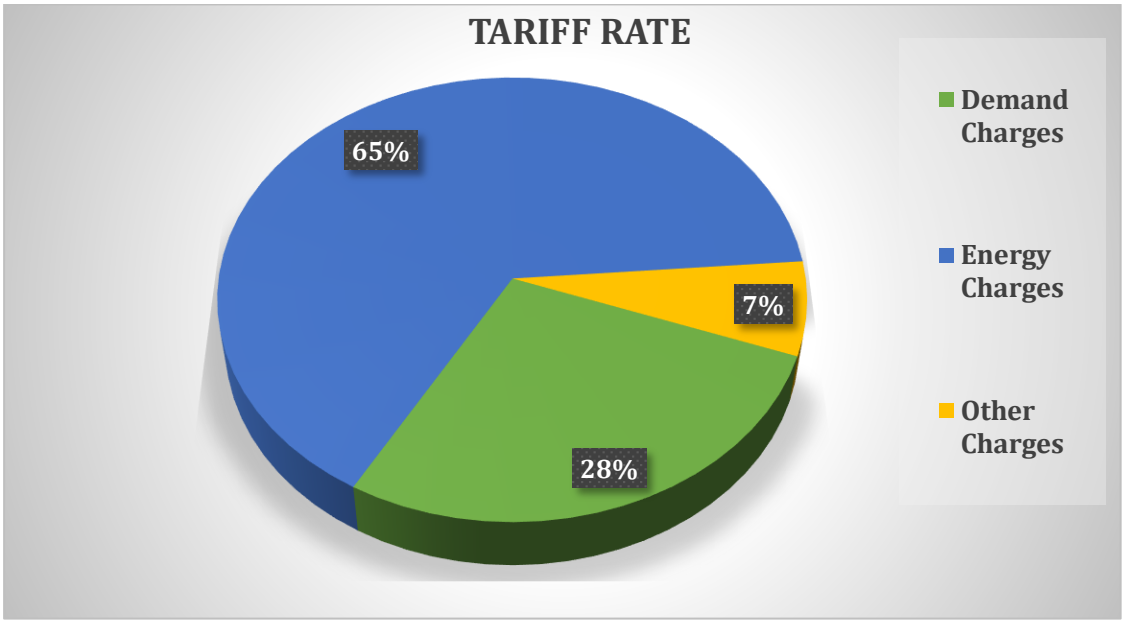


FIGURE 5: TARIFF RATE ANALYSIS

Inference

i. Average demand charges for the past one year was **Rs 32,034/** per **month** and energy charges was **Rs 75,678/** per month**.**

ii. The energy charges come about **65%** of the total bill.

iii. For last year the PF incentives and Penalties comes about **Rs 8,112** and **Rs 8,042** respectively.

VI. LPG CONSUMPTION ANALYSIS

The LPG is the main fuel in canteen and college hostel. The details of the LPG consumption in the last academic year is given in the Table below.

Particulars	Annual consumption(Kg)	Calorific value(TOE)
Canteen	990	107.8
Kitchen in HM block	160	18.91
Total	**1050**	**124.95**

TABLE 4: ANNUAL WOOD CONSUMPTION

- Calorific value of LPG is 12000Kcal.Kg and 1 TOE means 100000Kcal.

VII. DIESEL CONSUMPTION ANALYSIS

The Diesel is the fuel which is used for the DG. The details of the Diesel consumption in the last academic year is given in the Table below.

Month	Diesel consumption
	Litres
Jan-19	210
Feb-19	210
Mar-19	20
Apr-19	350
May-19	210
Jun-19	140
Jul-19	217
Aug-19	210
Sep-19	65
Oct-19	280
Nov-19	140
Dec-19	210
Total	**2262**
Average	**188.5**

TABLE 5: DIESEL CONSUMPTION

ELECTRICAL MEASUREMENT ANALYSIS

I. TRANSFORMER SECONDARY LOGGING

The LT side of the transformer was logged using power quality analyser Krykard ALM 35 for 24 hours and given in following table. The Measurement details are given below:

Measurement values – LT side				
Actual Energy for 24 Hrs	kWh		**1606**	
Apparent Energy for 24 Hrs	kVAh		**1689**	
Power Factor			**0.95**	
Particulars	**Units**	**Minimum**	**Maximum**	**Average**
Active Power	kW	42.26	88.60	68.84
Apparent Power	kVA	47.13	92.60	72.38
Reactive Power	kVAr	2.14	35.61	18.63
Voltage phase	Volts	221.90	247.90	236.74
Current	Amps	56.60	156.60	101.89
THD V	%	0.60	2	1.34
TDD A	%	3.40	12	6.92
Voltage Imbalance	%	0	0.50	0.25
Current Imbalance	%	0.70	30.30	14.69

TABLE 6: TRANSFORMER LOGGING

Inference

i. The maximum demand registered during the period of measurement is 92.60 kVA, in 10 minutes' interval, and the corresponding PF was 0.95 that shows the importance of PF improvement.

ii. The variation of voltages found at the time of audit. (221.9 to 247.9V)

iii. The average loading of transformer is only about less than 30%.

iv. Current imbalances were found to be higher (Maximum of 30.30%)

I. ANALYSIS: VOLTAGE VARIATION

The Voltage profile at the LT side is plotted below in figure.

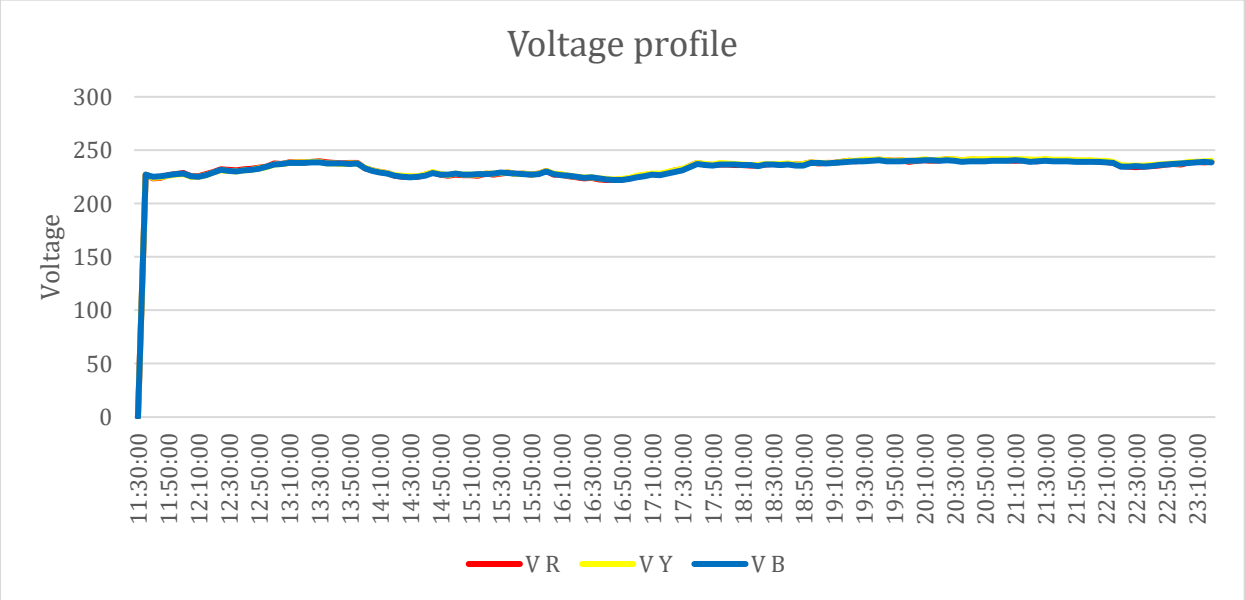


FIGURE 6: VOLTAGE PROFILE

Inference

i. The figure shows the minimum voltage imbalance and supply voltage variation.

ii. The maximum and minimum supply voltage were during the normal operational period, excluding the power failure, is 247.90 and 221.90 respectively with an average phase voltage of 236.74 V.

iii. The high voltage will increase the power consumption and increases the capacitance value in the system.

II. ANALYSIS: CURRENT VARIATIONS

This section carries the current variations during the 24-hour measurement period with the power analyser.

The figure below gives the current profile of the phases at the LT side.

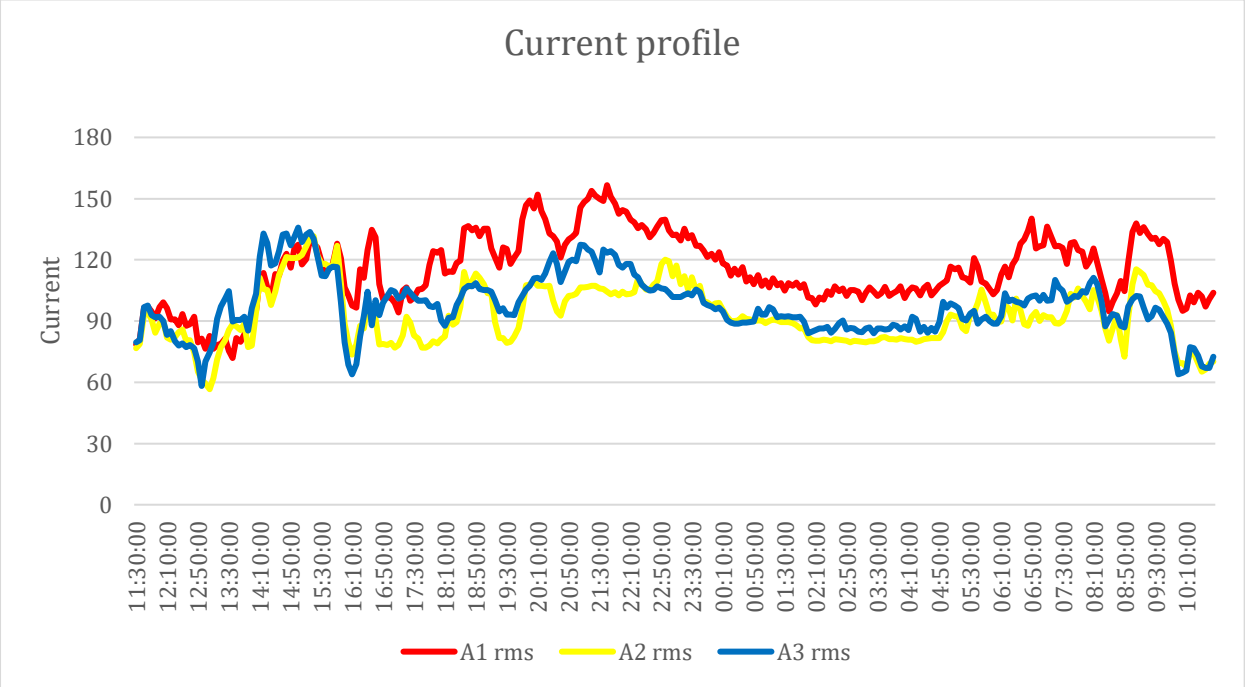


FIGURE 7: CURRENT VARIATIONS

Inference

i. Figure denotes current variations at the LT side.

ii. The maximum current occurred during the Peak period at 153.70A and minimum during normal period with 58.20A.

iii. The current varies between 13.86 to 36.60% of the rated current of the transformer at the secondary side.

III. LOAD FACTOR

The load factor is the ratio of the energy consumed during a given period (in the audit period or in last 12 months) to the energy, which would have been consumed if maximum demand had been maintained throughout the period.

$$\text{Load factor (\%)} = \frac{\text{Energy used during the period (kWh)} \times 100}{\text{Maximum demand (kW)} \times \text{Time under consideration (hr)}}$$

Load factor calculated from the 24-hour logging at the LT side during the period of audit is given in table below:

Total kWh	Max kW	Time (Hrs)	Load factor (%)
1606	88.60	24	75.52

TABLE 7: LOAD FACTOR – TRANSFORMER

Inference

i. The higher the load factor means higher utilisation efficiency of the electrical system.

IV. ANALYSIS: POWER FACTOR

The section provides an overview of the power factor variations at the LT side. The Power factor variation with respect to the active and reactive power are given in table.

	Time	PF	kW	kVA	kVAr	Remarks
Normal period						
Minimum PF	10:35:00	0.851	46.08	54.10	27.69	Lagging
Maximum PF	06:05:00	0.995	67.75	68.07	4.22	Lagging
Peak period						
Minimum PF	21:15:00	0.95	87.32	91.87	27.87	Lagging
Maximum PF	18:35:00	0.982	82.73	84.19	14.33	Lagging
Off peak period						
Minimum PF	22:05:00	0.956	83.63	87.42	24.70	Lagging
Maximum PF	00:45:00	0.995	70.31	70.61	2.40	Lagging

TABLE 8: PF VARIATIONS

Inference

- There is no leading found at the time of audit.
- The PF was found to be very low in some time intervals.

Recommendations

Replace the faulty capacitors with new capacitors to improve the power factor.

The below figure shows the kW and PF variations.

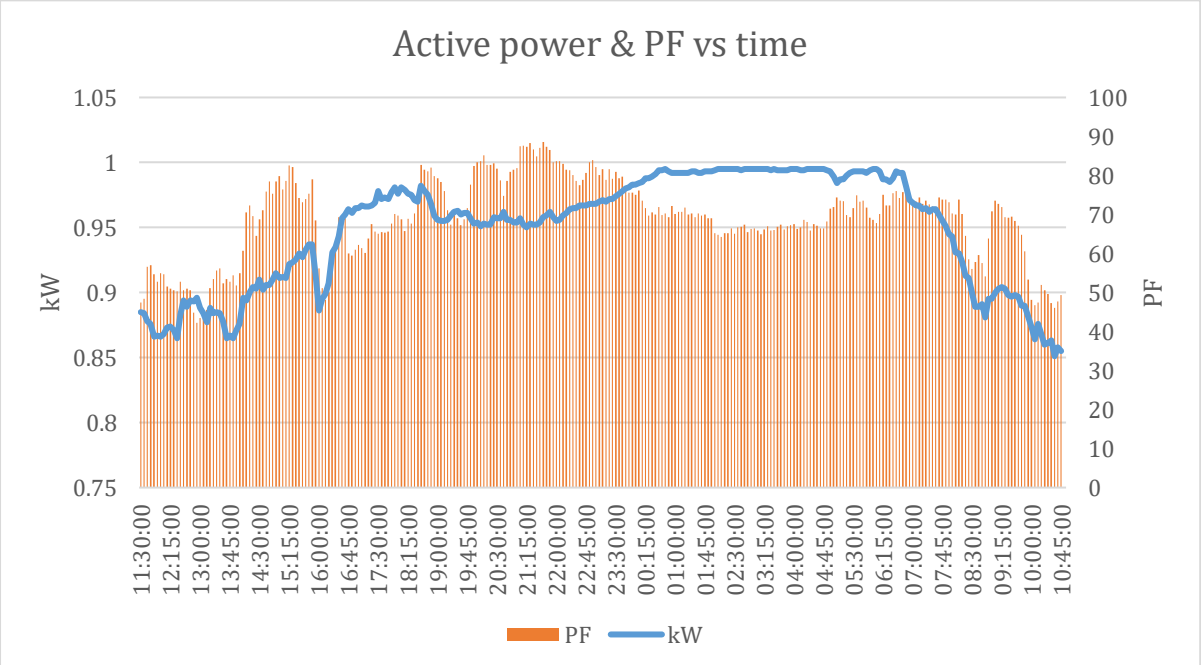


FIGURE 8: KW, & PF VARIATIONS

V. ANALYSIS: CURRENT IMBALANCE

This section carries out the current imbalance at the LT side during the logging period. The current imbalance with respect to the ampere in three phases are given below:

	TIME	R PHASE	Y PHASE	B PHASE	UNBALANCE
NORMAL TIME					
MAX. CURRENT	15:15:00	**129.9**	**130.6**	**133.7**	1.8
MIN. CURRENT	12:55:00	**81.4**	**61.2**	**58.2**	21.6
CURRENT AT MAX. UNBALANCE	10:30:00	102	65.1	67.7	**30.3**
CURRENT AT MIN. UNBALANCE	15:40:00	115.6	116.8	115.6	**0.7**
PEAK TIME					
MAX. CURRENT	21:20:00	**153.7**	**107.4**	**124.1**	19.7
MIN. CURRENT	18:10:00	**113.3**	**82.4**	**87.7**	19.9
CURRENT AT MAX. UNBALANCE	19:30:00	125.4	79.2	93.1	**26.4**
CURRENT AT MIN. UNBALANCE	20:25:00	132.8	107.3	119	**10.9**
OFF PEAK TIME					
MAX. CURRENT	22:55:00	**139.7**	**120.2**	**105.6**	14.7
MIN. CURRENT	02:10:00	**98.1**	**80.3**	**85.7**	11.4
CURRENT AT MAX. UNBALANCE	04:35:00	107.7	81.3	84.3	**18.2**
CURRENT AT MIN. UNBALANCE	05:50:00	108.4	98.8	92	**8.7**

TABLE 9: CURRENT UNBALANCE

Inference

- The current imbalance (30.30%) occurred on Normal period. I.e. at 10.30 hrs morning which is above the standard of 10%.
- The average current imbalance measured was 14.69%, which is well within the specified standard limit (10%).
- The variation of current unbalance in Normal time zones are given below:

The current imbalance at the Transformer secondary side are given below:

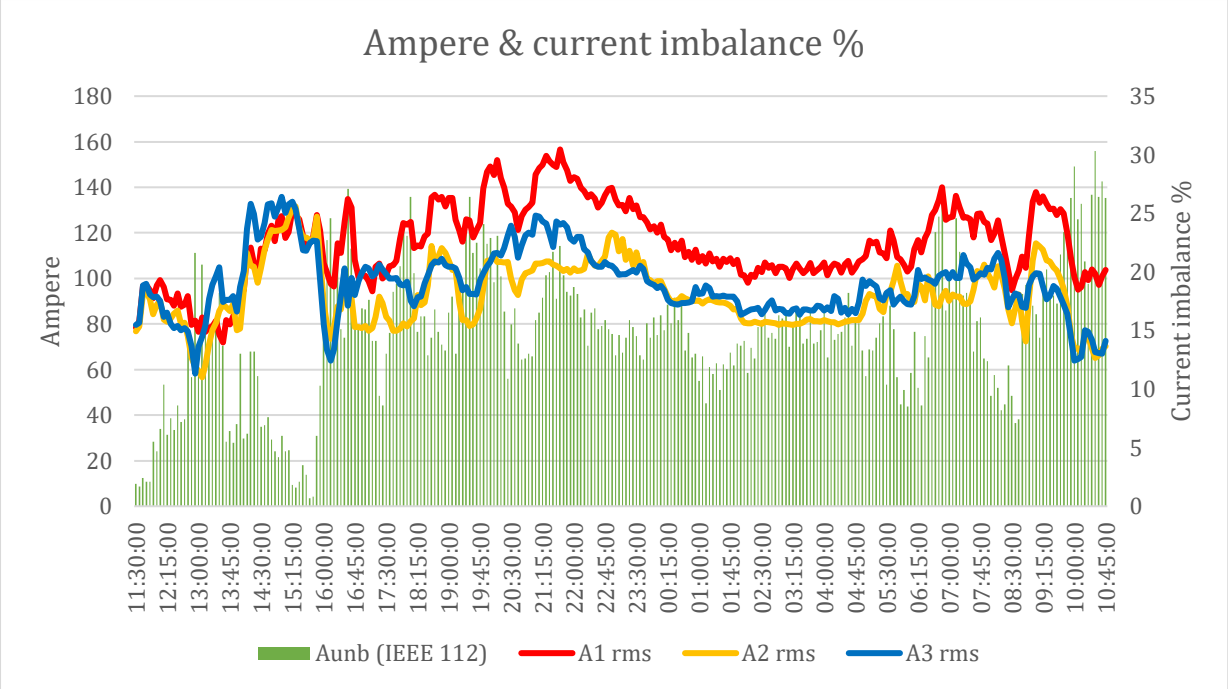


FIGURE 9: AMPERE VS IMBALANCE GRAPH

Suggestion:

- The current unbalance is creating in morning time and in R-phase current rating is more. Check the routine of switching on of the electrical system for reducing the unbalance.

VI. ANALYSIS: COMPARISON OF LOADS IN DIFFERENT TIME ZONES

This section provides an overview of the total electricity consumption, split across the 3 different time zones as defined by the Kerala State Electricity Board (KSEB):

Time Zone 1: Normal: 6.00 Hrs. to 18.00 Hrs.

Time Zone 2: Normal: 18.00 Hrs. to 22.00 Hrs.

Time Zone 3: Normal: 22.00 Hrs. to 6.00 Hrs.

Electricity consumption according to the time of use, as calculated from the 24-hour logging.

Particulars	Zone-1 (6am - 6pm) (kWh)	Zone -2 (6pm-10pm) (kWh)	Zone-3 (10pm-6am) (kWh)	Total (kWh)
	Normal	**Peak**	**Off-peak**	
Unit consumption	716.43	316.52	573.05	**1606**
Average kWh in each period (normal/12, peak/4, off peak/8)	**59.70**	**79.13**	**71.63**	

TABLE 10: ZONE WISE KWH CONSUMPTION

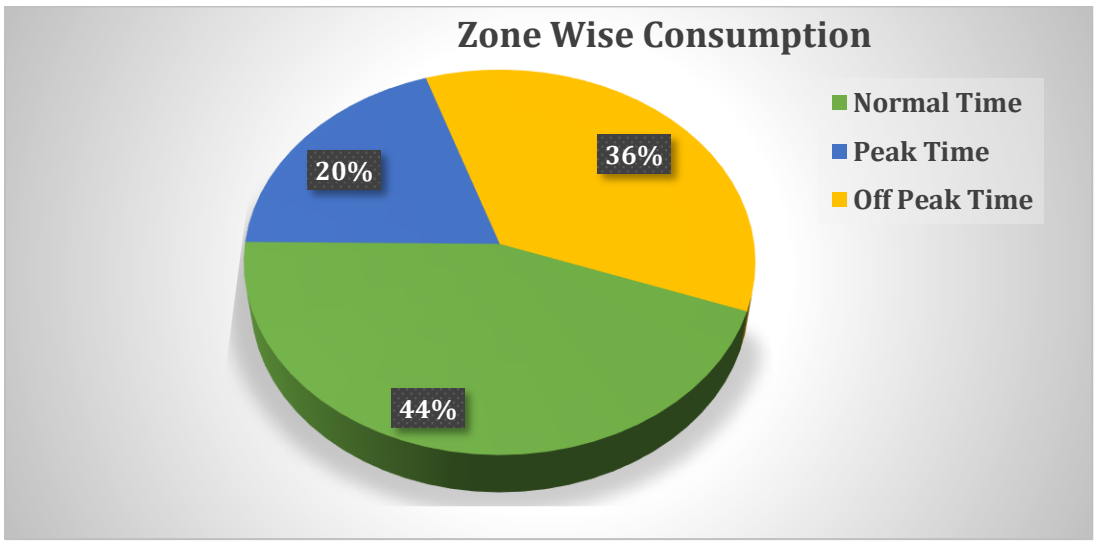


FIGURE 10: ZONE WISE KWH CONSUMPTION

According to KSEB, the energy charges in each time zone is calculated as follows:

In Time Zone 1(EC1): Consumption in Zone 1* Rate

In Time Zone 2(EC2): Consumption in Zone 2* Rate* 1.5

In Time Zone 3(EC3): Consumption in Zone 3* Rate* 0.75

Majority of the unit consumption occurs during the normal period, which is **44%**.

VII. HARMONIC STUDY

Harmonics study revolves around the use of non-linear loads that are connected to electric power systems including static power converters, arc discharge devices, saturated magnetic devices and to a lesser degree, rotating machines. Static power converters of electric power are the largest non-linear loads and are used in industry for a variety of purposes such as electro- chemical power supplies, adjustable speed drives, and uninterruptible power supplies. These devices are useful because they can convert ac to dc, dc to dc, dc to ac, and ac to ac. Non-linear loads change the sinusoidal (a succession of waves or curves) nature of the ac power current (and consequently the ac voltage drop) thereby resulting in the flow of harmonic currents in the ac power system that can cause interference with communication circuits and other types of equipment. Classification, effects and standards are given below:

	1st order	2nd order	3rd order	3rd order	4th order	5th order	6th order
Frequency Hz	50	100	150	200	250	300	350
Sequence	+	-	0	+	-	0	+

TABLE 11: HARMONICS CLASSIFICATION

Effect on - Motor & generator	-Transformers	- Cables	- Electronic equipment	- Metering
Rotor heating, causes Reverse rotating magnetic field, causes pulsating torque output, Mechanical oscillations, increases Cogging & Crawling	Increase in copper & stray losses, increase in iron losses, transformer heating	Voltage stress & corona, I^2R losses increases	Voltage notching, Electromagnetic interference, Shifting of the voltage zero crossing	Erroneous reading

TABLE 12: EFFECTS OF HARMONICS (IEEE 519)

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	$3 \le h < 11$	$11 \le h < 17$	$17 \le h < 23$	$23 \le h < 35$	$35 \le h \le 50$	TDD
< 20[c]	4.0	2.0	1.5	0.6	0.3	5.0
$20 < 50$	7.0	3.5	2.5	1.0	0.5	8.0
$50 < 100$	10.0	4.5	4.0	1.5	0.7	12.0
$100 < 1000$	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a]Even harmonics are limited to 25% of the odd harmonic limits above.

[b]Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

[c]All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

where

I_{sc} = maximum short-circuit current at PCC

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions

TABLE 13: CURRENT HARMONICS LIMIT (IEEE 519-2014)

Voltage distortion limits		
Bus voltage at PCC	**Individual voltage distortion %**	**Total voltage harmonics distortion %**
V ≤ 01 kV	**5.0**	**8.0**
01 kV < V ≤ 69 kV	3.0	5.0
69.001 kV < V ≤ 161 kV	1.5	2.5
161.001 kV and above	1.0	1.5

TABLE 14: VOLTAGE HARMONICS LIMIT (IEEE 519-2014

HARMONICS DATA SHEET

Location:	**Main Control Panel (LT Side)**						
Total harmonic distortion as per CEA standard TDDi limit is 8% and THDv limit is 8% at 400V level as per Short circuit analysis							
Total Harmonic Distortion - TDD %		**Voltage %**	**Current %**	**Remarks**			
		2	12	Voltage harmonics is within limit But Current Harmonics' is more			
Individual Harmonic%							
Particulars	3rd	5th	7th	9th	11th	13th	15th
Voltage %	0.6	1.3	1.5	0.3	0.6	0.4	0.1
Current %	8.4	6.1	5.4	3	3.1	3.7	1.6

TABLE 15: HARMONICS ANALYSIS

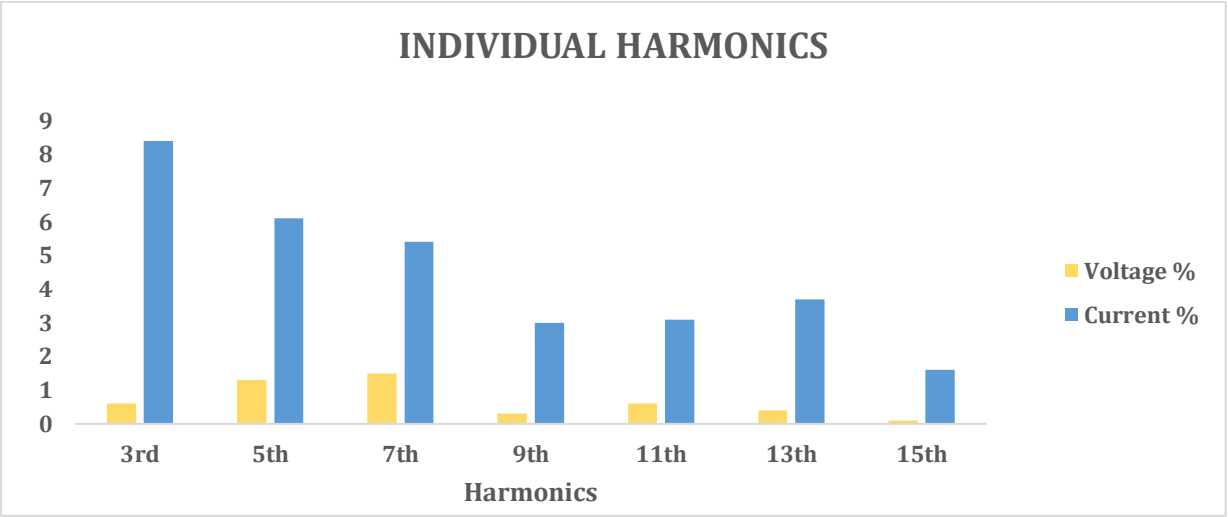


FIGURE 11: HARMONICS ANALYSIS

Inference

i. The table gives the input that the individual and total current harmonics are higher than the specified limit of 8%.

ii. The table also gives the fact that the voltage harmonics are within the limit of 8%.

Suggestions

i. While purchasing nonlinear controlling devices such as UPS and loads such as LED, DC fans, more care should take to ensure the output harmonics values and specification should contain the IEEE/CEA standard limit which mentioned in the above table.

ii. This will reduce the overall effect of harmonics in the equipment and supply system.

LUX MEASUREMENTS

According to National Lighting code-2010 BIS to determine the overall energy efficiency of lighting system using measurements and methods, which is applicable to all commercial buildings. One of the methods is Illuminance method, which is the most practicable one. Details are given in the section. Lux levels of some areas are given in the Table below. The lux levels mentioned as satisfactory need to be improved.

Sl. No.	Area	Measured Lux	Required Lux	Remarks
		Main Block		
1	Administrative Office	273	250	Good
2	Directors Room	265	200	**Good**
3	Classroom	330	250	**Good**
4	Computer Lab	260	250	**Good**
5	Corridor	155	100	**Good**
6	Front Office	260	150	**Good**
7	Toilets	100	100	**Good**
		Church and Auditorium		
9	Main hall	220	250	**Good**
10	Sides of church	210	250	**Good**
11	Auditorium Hall	320	150	**Good**
12	**Podium area Of Auditorium**	**260**	**150**	**Good**

TABLE 16: LUX MEASUREMENTS

ANNEXURE 1

I. CONNECTED ELECTRICAL LOADS

I. LIGHT LOADS

The light details in the college building are given below:

Particulars	LED		Tube	CFL		T5	T8	T12
	5W	9W	22W	9W	15W	28W	36W	40W
Ground Floor	02	11	28	06	06	18	08	18
First Floor	0	17	11	02	0	03	12	36
Second Floor	0	05	15	40	0	0	22	02
Total No:	02	33	54	48	06	21	42	56
Total load in kW	**0.01**	**0.297**	**1.188**	**0.432**	**0.09**	**0.588**	**1.512**	**2.24**
Total	**6.357 kW**							

Table 17: Light loads

II. UPS LOAD

Particulars	UPS Batteries		**Battery Details**			
	Make	**Capacity**	**Volt**	**Capacity of battery (AH)**	**Number of batteries**	**Make**
Ground Floor	Emerson	6	12	100Ah 100	13 05	Exide Beacon
Ground Floor	Voltek	5	12	100 60	02 10	Standby Beacon
Second Floor	Hycon	20	12	40	20	Taurus
Total UPS Load		**31**	**12**			

Table 18: UPS load

III. FAN

Particulars	Ceiling fan	Exhaust fan		Water cooler
	60 W	Toilet (15W)	Other Areas	150 W
Ground Floor	32	4	40W	1
First Floor	27	4	0	1
Second Floor	26	2	150W	1
Total No:	85	10	0	3
Total Connected Load	5100	150	190	450
TOTAL			**5.890 kW**	

Table 19: Fan loads

IV. MISCELLANEOUS AND OFFICE EQUIPMENT

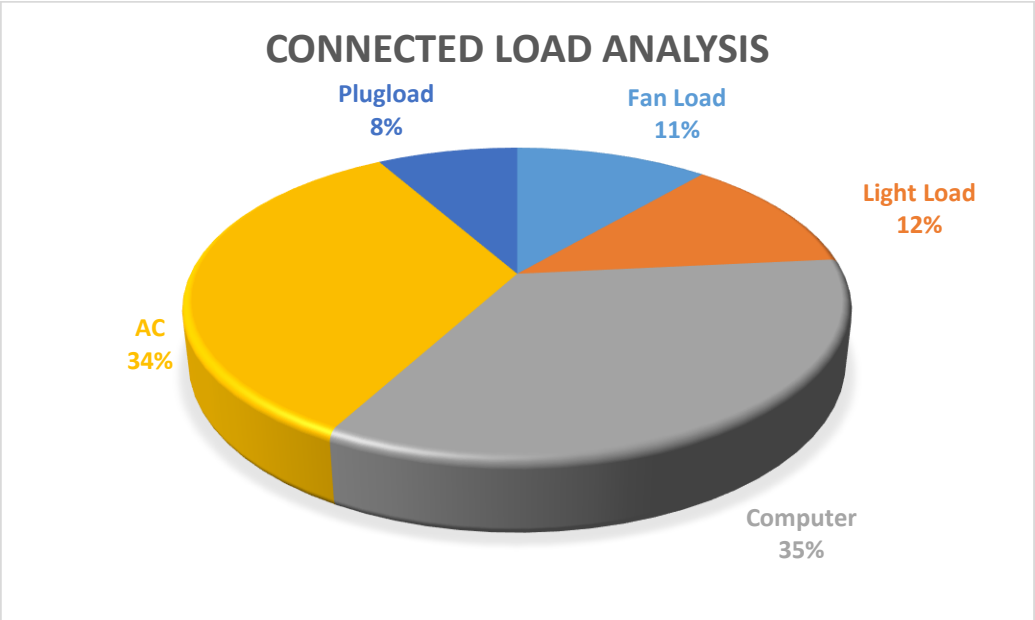
Particulars	Projector	Computer	3 in One Printer	Laser Printer	Water Cooler
Watts	485	200	450	200	500
Ground Floor	02	05	01	01	01
First Floor	04	05		04	01
Second Floor	02	45	0	01	01
Total No:	08	55	01	06	03
Total load in kW	**3.88**	**11**	**0.45**	**1.2**	**1.5**
TOTAL	**18.03 kW**				

V. AIR CONDITIONERS

Particulars	Ceiling fan			Water cooler
	1TR	1.5TR	5.5TR	8.5TR
	1077	1728	5500	8300
Ground Floor	02	0	0	0
First Floor	0	0	00	
Second Floor		01	01	01
Total Connected Load	2154	1728	5500	8300
TOTAL			**17.582 kW**	

VI. CONNECTED LOADS IN CHAPEL AND AUDITORIUM

Area	Equipment	Wattage	Number	Total Wats
Auditorium	LED Spotlight	90	15	1350
	HVLS Fan	1000	2	2000
Chappel	LED Bulb	9	20	180
	Ceiling Fan	60	9	540
	Wall fan	60	1	60
	Pedestal Fan	60	1	60
Sports Students Dressing Room	T12	40	1	40
	T8	36	1	36
	T5	28	1	28
			TOTAL	**4.294 kW**


CONNECTED LOAD ANALYSIS
Plugload
8%
Fan Load
11%
Light Load
12%
AC
34%
Computer
35%

ANNEXURE 2

I. REPLACEMENT OF FLUORESCENT TUBES WITH LED LIGHTS.

At present LED lights are used in very few areas. Replacement of Fluorescent lights to be done in phase manner with LED lights.

Calculations:

Particulars	Unit		Data	
		T5	T8	T12
Existing Fluorescent lights	W	28	36	40
Proposed LED light	W	20	20	20
Difference in Wattage	W	8	16	20
No: of working hours/day	Hrs	8	8	8
No: of working days per year (Average)	Days	210	210	210
No: of working hours per annum	Hrs	1680	1680	1680
Number of Lights operating for2000 Hrs./Annum	Nos	20	30	50
kWh Saving per Annum	kWh	**269**	**806**	**1680**
Cost per kWh (Average Rs /kWh)	Rs.	6.3	6.3	6.3
Annual Financial Savings	**Rs.**	**1695**	**5078**	**10584**
Cost of LED light	Rs.	350	350	350
Investment for LED (30x350)	Rs.	7000	10500	17500
Simple Payback period	Months	**49**	**25**	**20**

TABLE 20: ENERGY CONSERVATION MEASURES-2

Particulars	Unit	Data
Total Annual energy Savings	kWh	2755
Total Financial Savings	Rs	17357
Total Investment	Rs	35000
Simple payback Period	Months	24

Note:

- Replacement areas are to be preferred as per working hours (Office, canteen Hostels security cabin etc.),
- Replacement and maintenance cost of luminaries is not considered in the above calculation.
- The maintenance cost of luminaries is drastically reduced because the life span of LED lights is 3 times more than normal luminaries.

Reasoning for change of lamps

Type of lamp	Typical life in Hours	Cost per lamp	No: of lamps required during LED lifetime (led 60,000 Hours)	Replacement cost per lamp	Approximate maintenance expense for replacement	Total cost per lamp
T12	5000	45	12	540	500	1040
T8	5000	45	12	540	500	1040
T5	5000	100	12	1200	500	1700
LED	60000	800	1	800	0	800

Reason for change in the lighting system

- Lighting quality can have a dramatic influence on the attitude and performance of working persons, if they have an environment that with proper uniform lighting.
- In addition to the lumens per watt which is a lighting quantity calculation lighting quality and life of lighting system is also to be considered.
- Lighting quality can be divided into Uniformity, Glare, Colour rendering Index, coordinated colour temperature.
- In case of consistency and in uniformity, the life time of LED is far better than CFL s and FTLs.
- Deterioration of lumens or lux level in FTLs and CFL are more as compared with LED which is consistent during in its life time.
- Considering VCP (Visual Comfort Probability) LED is better option than FTLs and CFL because the glare value is lesser.
- The LED are whitish in colour than FTLs which is giving a better feeling of brightness to the persons occupied or working
- CCT of LED is 5000k which is white as compared with lesser CCT for FTLS of 4500 k
- There is no mercury content in the LED as compared with CFL and FTL s hence it is environmentally supportive.

Specification for purchasing LED

• COLOR	=	Cool white
• Watts	=	5, 8 and 18
• Lumen	=	400, 500 and1200 lm
• Dimmable	=	Yes
• Life span	=	25000 hrs.
• Power factor	=	> 0.92
• Lighting efficiency	=	85%
• CRI –	=	>75
• Work frequency	=	50 Hz
• Constant circuit error	=	-< 2%
• Micro wave /Noise	=	-<240mV
• Short circuit protection	=	OK
• Operation temperature	=	20- 65^0C
• Lighting source	=	SMD3528Episar
• Efficiency	=	100 lm/w
• Beam angle	=	120 degree
THD V and THD i	=	As per IEEE standard 519 or CEA standard

II. REPLACEMENT OF CEILING FANS WITH BLDC FANS

At present conventional ceiling fans are used. Replacement of ceiling fans to be done in phase manner with BLDC Fans.

Replacement of ceiling fans with BLDC fans to be done in phase manner. Priority as per the working hours per day. Security rooms, office rooms, staff rooms and then hostel.

Existing Ceiling Fans	**Watts**	**60**
Proposed BLDC Fans	Watts	30
Difference in Wattage	Watts	30
Avg No: of working hours/day	Hrs	8
No: of working days per year (Average)		250
No: of working hours per annum	Hrs	2000
Number of Fans operating	Nos	30
kWh Saving per Annum	**Rs**	**1800**
Cost per kWh	Rs	6.3
Annual Financial Savings	**Rs**	**11340**
Cost of BLDC Fans	Rs	3000
Salvage value of fan(30*1000)	Rs	30,000
Investment for BLDC Fans	Rs	60,000
Simple Payback period	Months	63

TABLE 21: ENERGY CONSERVATION MEASURES-2

Actual savings and comparison chart with normal, star rated and BLDC fans. Actual savings and simple payback period will be less for BLDC fans.

Type	Power at Various Speeds					
	1	2	3	4	5	Max (M3/Min)
Regular Ceiling Fan	14	25	39	48	76	230
5 Star rated Fan	13	24	30	40	55	210-220
BLDC Fan	3.8	7.7	13.8	22.7	35.8	230
% Variation of BLDC fan with Ceiling fan in power	72.85	69.2	64.62	52.71	52.89	
% Variation of BLDC fan with 5 Star rated fan in power	70.77	67.92	54	43.25	34.91	
Saving in power for Ceiling fan and BLDC	10.2	17.3	25.2	25.3	40.2	
Saving in power for 5 Star rated Ceiling fan and BLDC	9.2	16.3	16.2	17.3	19.2	

ANNEXURE-3

I. LIST OF INSTRUMENTS

SL.NO	EQUIPMENT DESCRIPTION	MAKE & MODEL
1	POWER ENERGY & HARMONIC ANALYSER	**KRYKARD ALM 30**
2	POWER ENERGY & HARMONIC ANALYSER	**FLUKE 1730**
3	AIR QUALITY METER	**TESTO 480**
4	**LUX METER**	**LM 100**

II. ABBREVIATIONS

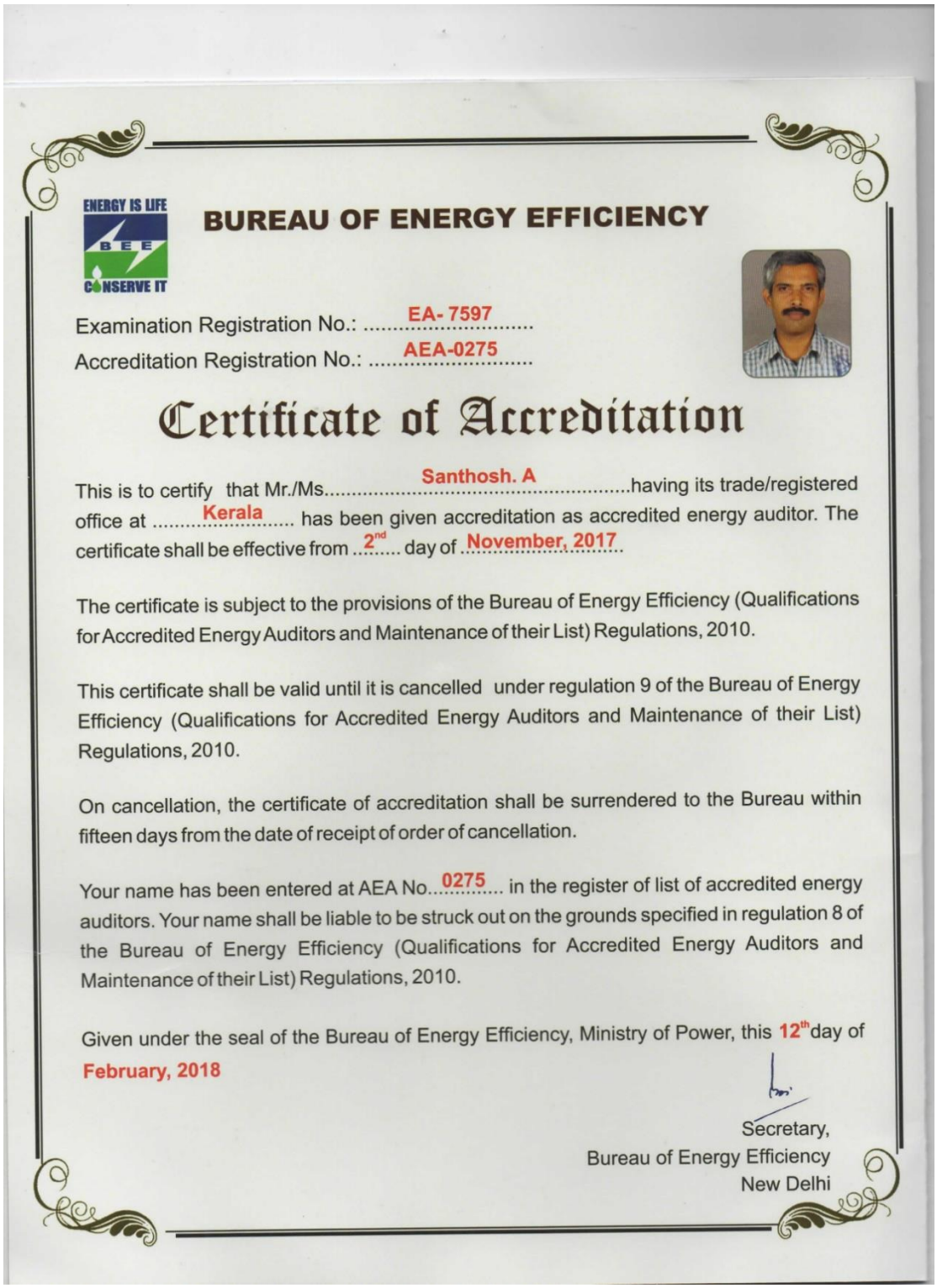
AVG	:	Average
BEE	:	Bureau of energy efficiency
CO_2	:	Carbon dioxide
KSEB	:	Kerala State Electricity Board.
DB	:	Distribution Board
EC	:	Energy Conservation
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
kL	:	kilo Litre
KVA	:	kilo Volt Ampere
kVAh	:	kilo volt Ampere Hour
kVAr	:	kilo volt ampere
kW	:	kilo Watts
kWh	:	kilo watt hour
LT	:	Low tension
MAX	:	Maximum
NSS	:	National Service Scheme
SLD	:	Single Line Diagram

III. REFERENCES:

- Handbook on energy audit and environment management by TERI.
- Bureau of Energy Efficiency (BEE) books for certification of Energy Auditors & Managers.

IV. CERTIFICATES

I. BEE Accreditation Certificate



ENERGY IS LIFE
BEE
CONSERVE IT

BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: EA- 7597
Accreditation Registration No.: AEA-0275

Certificate of Accreditation

This is to certify that Mr./Ms. Santhosh. A having its trade/registered office at Kerala has been given accreditation as accredited energy auditor. The certificate shall be effective from 2nd day of November, 2017

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 0275 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 12th day of February, 2018

Secretary,
Bureau of Energy Efficiency
New Delhi

II. EMC Empanelment certificate

Energy Management Centre - Kerala
(Department of Power, Govt of Kerala)

CERTIFICATE OF EMPANELMENT

This is to certify that ***M/s. Athul Energy Consultants Pvt Ltd*** *(4/2, Capital Legend, Korapath Lane, Round North, Thrissur – 680 020) is empanelled as Energy Audit firm in Energy Management Centre Kerala to conduct mandatory energy audit as per Government of Kerala G.O (Rt) No.2/2011/PD dated 01.01.2011.*

Empanelment No:
EMCEEA- 0811F-2

Scope/Area	Building	Industry -Electrical	Industry Thermal
	Yes	Yes	Yes

This empanelment is valid up to 20th December 2020
Issuing Date: 01/01/2018
Place: Thiruvananthapuram

Director,
Energy Management Centre Kerala