Energy Audit Report

of

ARYA Institute of Engineering and Technology, Kukas, JAIPUR (Rajasthan)

3E Solutions
Electrical • Energy Audit • Enviornment

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ACKNOWLEDGEMENT

Colleges are center for humanity where building services are meant more for giving soothing comfort and priority goes to tasks related to education and energy saving is rare a priority. Further, attention of service staff, and in particular electrical, is always to serve academicians, professors, HODs, students and staff. The electrical staff in Colleges is normally under heavy stress and we also cannot conduct energy audit without their support. However, Mr Rajesh Jaiswal and staff have been fully supportive and open to the queries whenever raised and hence I take this opportunity to thank Mr Rajesh Jaiswal and his staff.

We also would like to express our thanks to Mr Arvind Agrawal, President, Arya Group of Colleges, for showing confidence and for being fully supportive whenever asked for. His instructions to the team, to be transparent and open to explain without hiding any information made this audit a pleasing experience. I also take this opportunity to thank Ex CMD of prestigious Instrumentation Limited, the premiere technology undertaking under Public Sector of glorious past, Mr P.M. Bhardwaj for playing a catalyst role during this audit motivating to give best during Audit. Last but definitely not the least, we express our profound thanks to College staff for their best efforts & assistance extended to the auditing team.

FOR **3E Solutions**

(Rakesh Jain)
Dated: 28th December 2020

Arya Institute of Engg. & Technology KOOKAS JAIPUR

CONTENTS

CHAPTER-1

1.1 Introduction - College Profile

College Name:	Arya Institute of Engineering and Technology
Address:	SP-40, RIICO Industrial Area, Near Hotel Le-Meridian, Delhi Road, Kukas, Jaipur, Rajasthan - 302028
Duration of Visits:	28- 29 December, 2020
Energy Advisors:	Rakesh Jain- CEA-4445 Kamal Goyal-CEA - 27111 Vibhor Agrawal - Electrical Engineer

Brief History of College

Arya Institute of Engineering and Technology. is known for the quality education and stringent levels of discipline. Since inception, AIET has shown consistent performance in academics and extra-curricular spheres. The management strives constantly to develop this institution into a "CENTRE OF EXCELLENCE" imparting Engineering & Management Education to budding talent, grooming their overall personality with the highest emphasis on ethical values and honing them to face the challenges of the industry and the corporate world at images/gallery.

Ideally nestled in the lap of Aravali, the infrastructure of **Arya Institute of Engineering and Technology**. is designed to challenge & stimulate the finest minds. This temple of learning is most appropriately situated on the NH-8 'the Educational corridor of Rajasthan', in Kukas, Jaipur. The spacious & imposing setup of the campus with its architectural beauty provides the most invigorating environment to optimize the functional efficiency of the students.

Arya College is known as the Most Technically Advanced College of North India. The college support and promote the modern technologies coming up with the time.

The college gives you the 25 Acres of Serene WI-FI e-Campus. The college buildings are well-designed and attract the students. The college constitutes of a wide state of art laboratories. All the labs at the college campus are well equipped with modern technical equipment. The college

consists of 2500 Computers approximately. All the computers are running on LAN and WAN services with a positive state of art facilities.

There are 80 well-equipped labs for other departments including CNC & UTM.

The college has a well- furnished library in the college campus. The library consists of a wide range of books. It has a large space area for the student to sit and study. The college provides the facility of 24 hours assistance.

There are three AC Auditorium. Each auditorium has the seating capacity of almost 800 students. The auditoriums are equipped with the modern and latest audio-visual aids for the conferences, seminars, and events at the college.

The college is also providing the transportation facility to its students and staff. There are almost 25 college buses, which passes through almost every route enrooting towards the college.

The Cafeteria at the college has a wide range of variety food. There is a mess in the hostel for the hostellers of the college. The college takes care of the hygiene and cleanliness of the food.

The college has seven boys & five girls fully furnished hostels with the attached bath facility. The college has security guards for the 24 hours safety of the students at the college premises.

The college provides 100% study loan assistance at the premises for the students. The college believes in “Right to Education” for every student.

AIET is a Plethora of extracurricular activities, Workshops, and PD Sessions. The college conducts many technical fests to encourage and develop the skills of the students.

Regular Aptitude Tests, Mock Interviews, Seminars & Workshops etc. is a part of college activities. This preparation helps in the development of the student academically as well as personally.

Now, you can also follow Arya College on its Facebook, Instagram, LinkedIn, Twitter, and Google+ Share profile.

1.2 AUDIT OBJECTIVE

In addition to meet mandatory requirements of Power ministry, Govt of Rajasthan (Refer letter as attached here), the broad objective of the Energy Audit was to review the present energy consumption scenario, monitoring and analysis of the use of energy and explore the energy conservation options in College including submission of a report containing recommendations for improving energy efficiency with the cost benefit. The scope covers review of Electrical distribution system, Lighting system, HVAC system, DG sets, Water pumping system, Energy monitoring and Accounting system, Cost benefit analysis of each ENCON options etc.

The Energy Audit was carried out wherein present energy consumption scenario, monitoring and analysis of the use of energy was done and various energy conservation options were explored as mentioned in subsequent chapters and a no. of recommendations have been made based on the audit results.

The details of the methodology used for carrying out energy audit, audit activities carried out and analysis of the results as mentioned below:

Methodology Adopted for Carrying out Energy Audit

Energy audit was carried out in three phases as shown below: -

A. Pre-Audit Phase: This was done on 28th December, 2020 in which the audit schedule was planned and brief discussions were held with Sh. Rajesh Jaiswal, and others at working level. A walk-through audit was also conducted. The main purpose of this audit phase was to get familiarized with college activities, get first-hand information and assess the current operation level and practices.

B. Audit Phase: In this phase, field studies were made using audit instruments wherein primary data were collected, various load surveys were carried out and detailed trials were conducted. This phase was carried out from 28th December, 2020 to 29th December, 2020. After completing field activities, data were analyzed, Energy Conservations

Opportunities (ENCON) was identified, cost benefit analysis was done and this Report has been prepared.

C. Post Audit Phase: This phase will be carried out to guide in implementation of the ENCON recommendations furnished in this report whenever asked by their officials.

For the purpose of data and information collection, audit team had used several energy audit instruments as mentioned at annexure of this report and took readings at various sections with the help of Sh. Mamraj and others.

RAJASTHAN RENEWABLE ENERGY CORPORATION LIMITED
(Government of Rajasthan Undertaking)
E-166, YUDHISTHIR MARG, C-SCHEME, JAIPUR
CIN NO U40101RJ1995SGC009847
PHONE: 0141-2225859/2229341/2223966/2223965, FAX: 0141-2226028
Email: rrec_jaipur@yahoo.co.in, rrec_jai@yahoo.co.in Website: www.rrecl.com

Ref : RRECL/EC/17-18/D- 9943 Dt. 27/11/2017

To,

Building Owner/Engineer
Commercial Building (Contract Demand 120 KVA or Above)

Ref: notification No.F.20(6)Energy/98/pt /ECBC dated 30-3-2012

Sub: Request for submission of Energy Audit report

Dear Sir

RRECL is the State Designated Agency (SDA) of implementing the provisions of Energy Conservation (EC) Act 2001 and for promoting the EC measures in the State. The Dept. of Energy Govt. of Rajasthan has issued a notification No. F.20(6) Energy/98/pt/ECBC dated 30/3/2012 for getting an Energy audit conducted in commercial buildings which have a connected load of 100 KW or a contract demand of 120 KVA or a conditioned area of 1000 sq. mtr. and above.

In view of above notification and for ensuring the compliance of EC directives it is mandatory that your organization shall arrange to submit an energy audit report at the earliest to this office.

Enclose: - Notification

Yours sincerely

27/11/17

Sunit Mathur
General Manager (EC)

Scanned by CamScanner

Arya Institute of Engg. & Technology KOOKAS JAIPUR

CHAPTER-2

2.1 ENERGY SOURCES

Electricity is the main source of energy used. The electricity is supplied at 11 KV by Jaipur DISCOM which is step down to 440 V with the help of 400 kVA Transformer. PV Solar panels of capacity 280 kWp also supply electricity integrated with Jaipur DISCOM with net metering concept. One DG set of 250 kVA, also kept as back up source of supply catering the critical need arise due to the online examinations conducted by testing agencies very frequently. Critical supply like for Computer Lab / Server Room is through UPS.

It is not a practice to record the readings of the current drawn from Jaipur DISCOM or Solar Panels incomers and also current drawn by various feeders. No log books are practiced currently for such readings also for voltage and power factor readings.

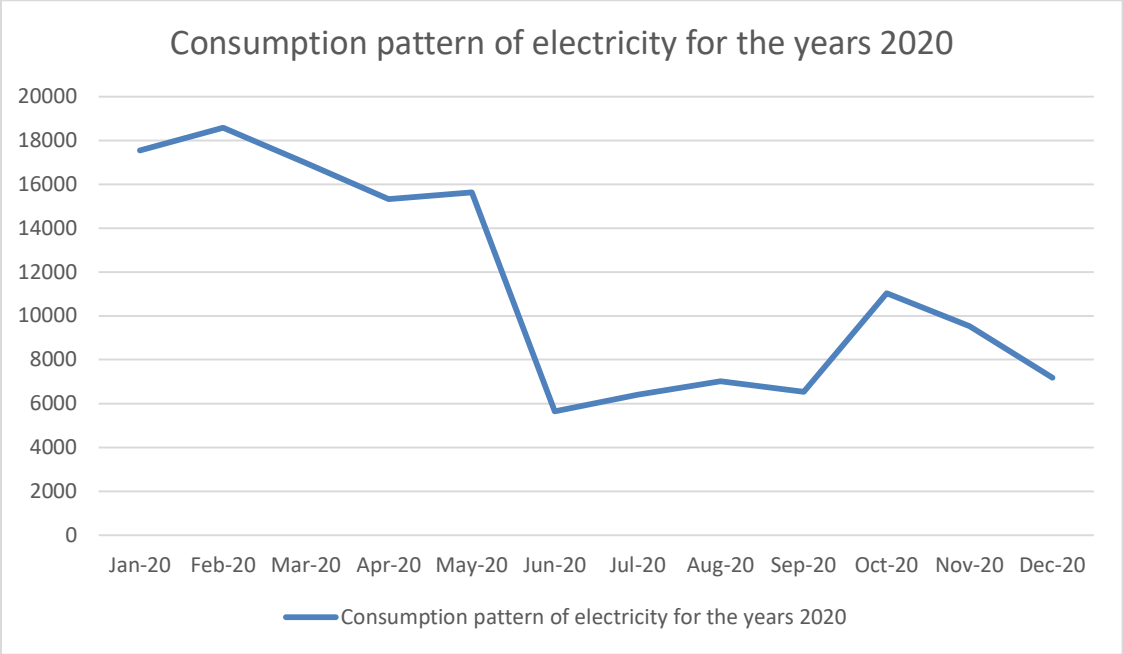
2.2 Verification of Monthly Energy Consumption (Sr.no.-0658950/03010358 / K No.-210524027388):

Electrical Energy Units are based on the electricity bills from JVVNL.

Total energy consumption pattern is shown below since June-2020

	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
KWH from Utility	5640	6404	7022	6540	11030	9524	7184
Actual Maximum demand - KVA	162.18	170.74	171.62	161.06	212.18	191.46	187.22
Billing Minimum demand – KVA	262.5	262.5	262.5	262.5	262.5	262.5	262.5
Power factor	0.977	0.973	0.981	0.984	0.986	0.983	0.983
Amount in Rupees	12140	166104	165172	88277	90521	89768	88652

Total Grid Electricity Consumption is approx 11526.75 of electricity Units per month. Consumption pattern of electricity for the years 2020-21 is shown below:



Highest Electricity is consumed in the month of January & February, however in the month of June and July 2020, the billed units came down due to commissioning of lockdown due to Covid-19.

2.3 Diesel Generator Running Hours – Month wise

DG Set 250 kVA, make – Cummins 415 V, I- NR, PF-0.80, KW-200, RPM-1500

DG has very less running hours as used for back up.

DG running trial (28.12.2020) couldn't be taken due to some Electrical fault in it.

Units in KWHr of Electricity Consumption

Months	2020-21
May	15640
Jun	5640
Jul	6404
Aug	7022
Sep	6540
Oct	11030
Nov	9524
Dec	7184
Jan	8660
Feb	9398
Mar	16448
Apr	21558

2.4 APFC Panel – 158 KVAR

S.No.	RATED KVAR	Rated Voltage	Actual Voltage	Actual Current			Actual kVAR	Remarks
				R-Phase	Y-Phase	B-Phase		
1	1	440	433	1.38	1.37	1.39	1.03	Healthy
2	2	440	433	2.34	2.35	0	1.17	Faulty
3	15	440	433	18	17.9	17.9	13.45	Healthy
4	15	440	433	18.2	18.2	18	13.60	Healthy
5	15	440	433	18.3	18.2	18.1	13.65	Healthy
6	15	440	433	18.7	18.6	18	13.82	Healthy
7	5	440	433	2.98	3	0	1.49	Faulty
8	10	440	433	5.5	5.61	5.6	4.18	To Check
9	20	440	433	9.68	0	9.67	4.84	Faulty
10	20	440	433	26.1	25.6	25.5	19.30	Healthy
11	20	440	433	26.3	26	25.9	19.55	Healthy
12	20	440	433	26.2	26	25.7	19.47	Healthy

Average Power factor 0.982 is maintained throughout the year but which can be further improved the with the help of replacing 3 nos of Capacitors of 27 kVAR in APFC panel. We expect a saving of 12-15000 per month due to this.

2.5) Transformers

2.5.1) Specifications of transformer:

Make – UTTAM (Bharat) - Jaipur; Type- Dyn-11, ONAN,

No.	Capacity	*Voltage Rating in KVolts*		Amp. Rating		TAPS	% age impedance
	kVA	Primary	Secondary	Primary	Secondary	Off load	
1	400	11	0.433	20.99	533.35	5	4.5

General Operating Parameters of Transformer.

Item	No.1
Condition of Silica gel	**Not Good**
Oil in Breather	**No**

Oil level % in Conservator	**< 20 %**
TAP position-	**3 / 5**
Winding Temp. ^{0}C	**Not Available**
Oil Temperature ^{0}C	**53°C**
Ventilation	**Open Air**
Oil Leakage	**No**

LT voltage is above 433 Volts so TAP setting to be changed.

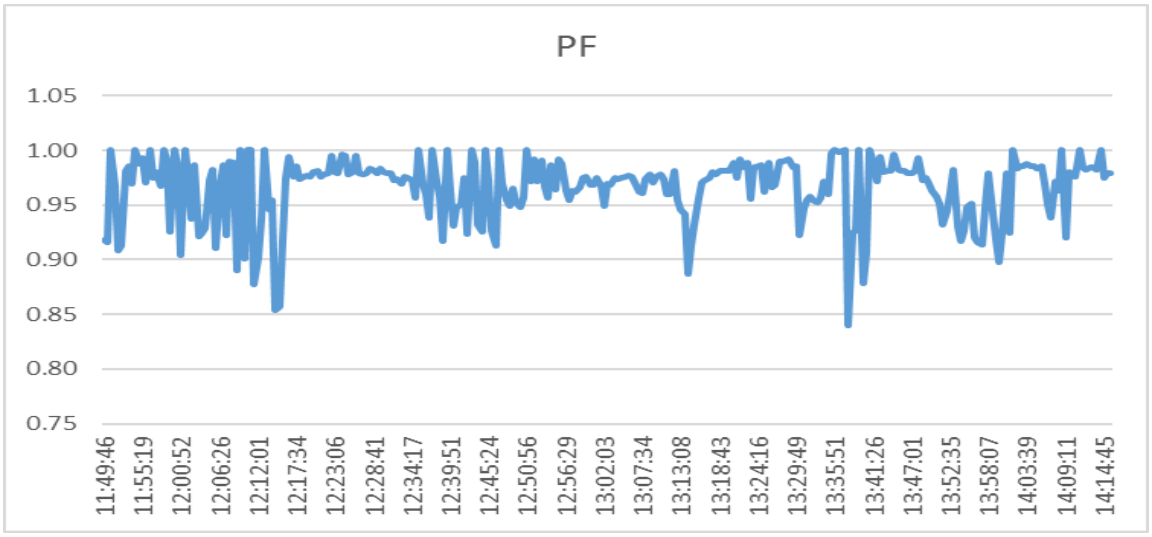
Safety Observation: It is recommended to spread Coarse Stone - Gitti surrounding to transformer in open to reduce the step potential due to increased surface soil resistivity and reduce the chances of electrical accident and damage due rise in potential at the time of dissipation of possible earth fault.

2.6 Grid Power Quality:

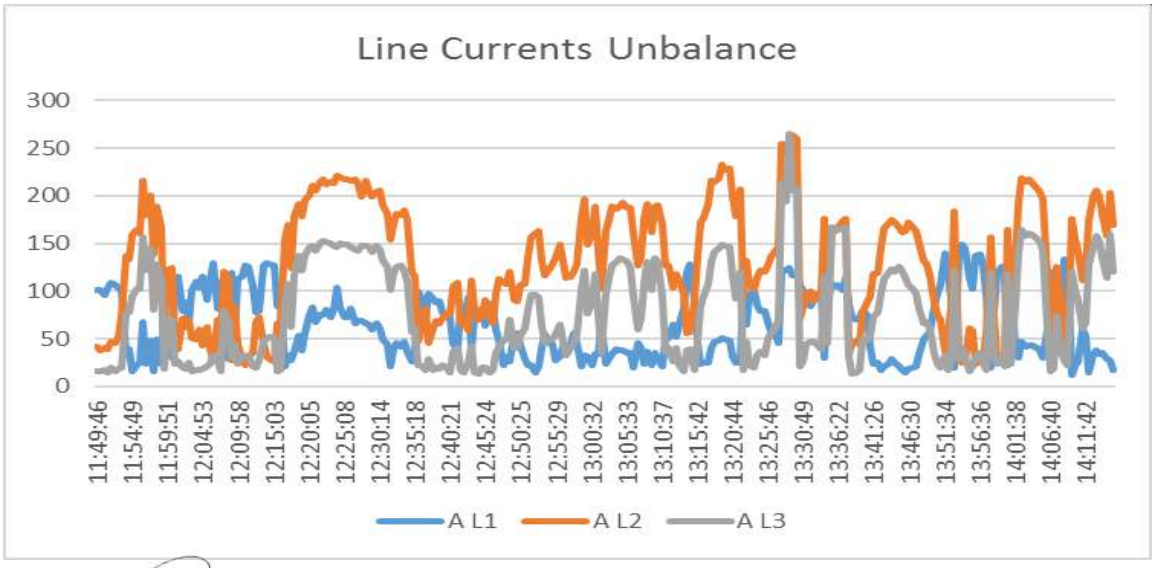
Power quality was observed at selective places like Main panel incomer, Solar sources, UPS room to understand the current unbalance and harmonic distortion. The following are the observations:

2.6.1 Power factor at Main Panel Incomer:

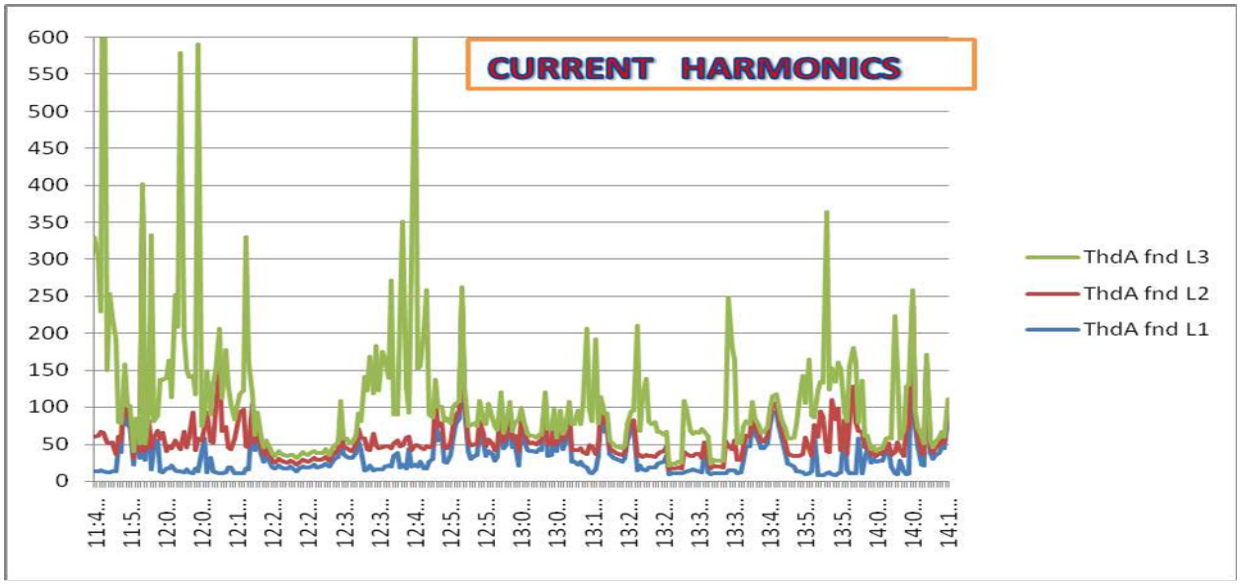
The power factor varies from 0.84 to 1.0 and average approx 0.98 which will improve after faulty capacitor removed from Auto to manual. Pl replace as soon as possible.



2.6.2 The Line currents L1 varied from 12 Amp to 149 amp with average 65 amp, L2 varied from 22 Amp to 263 Amp with average 128 Amp and L3 varied from 13 amp to 264 amp with average 77 amp. The variation is not acceptable practice in electrical engineering and efforts must be made to bring it down.



2.6.3 Current and Voltage Harmonics (THD) on 28.12.20 from 11.50 am to 02.15 pm.

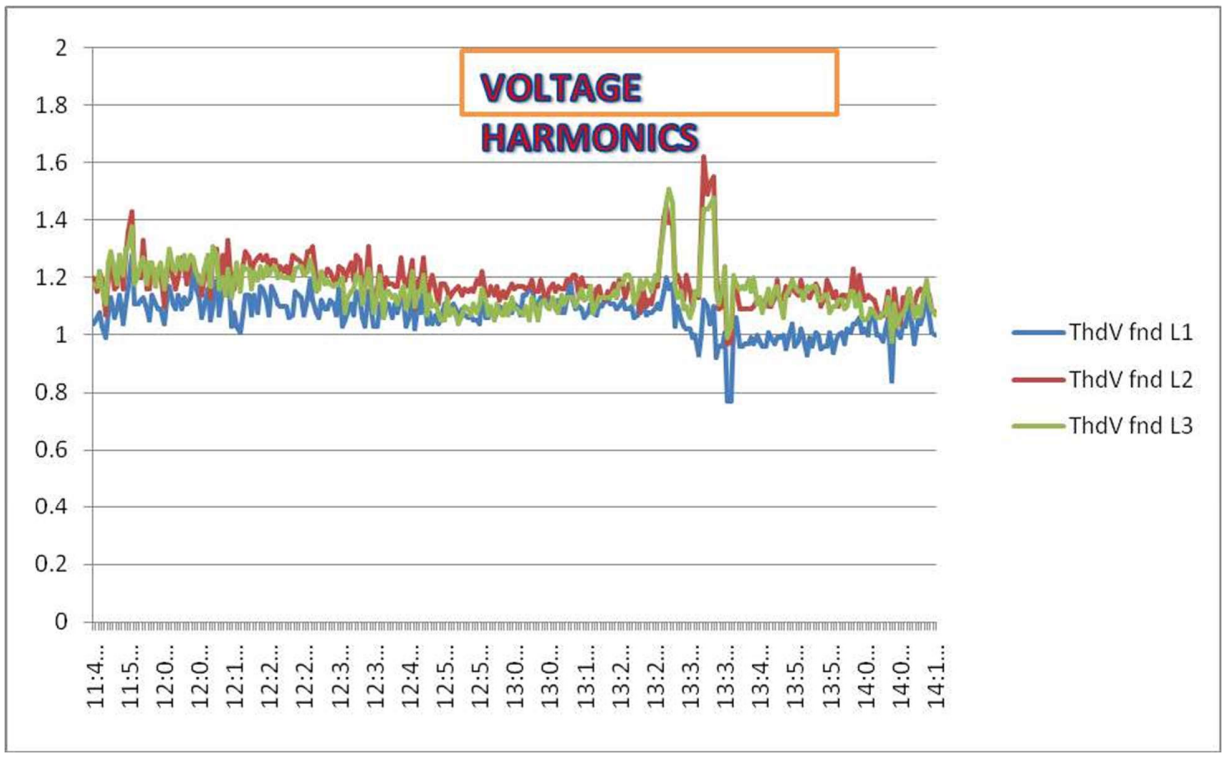


CURRENT Distortion Limits as per IEEE-519-1992

Rating of Transformer in kVA	Rated Amps	Impedance %	SC Current	Max. Load Current	Ratio (I_{sc}/I_L)	Current Harmonic Limit	Present Harmonic Level	Remarks
400	533.34	4.5%	11852	133	88.90	12%	13.6 %	Above limit

The harmonic distortion during the period was observed 13.6%, 22.8% and 155% however, the fundamental currents with this line were 99.1 Amp, 71.7 Amp and 10.6 Amp only. The unbalance is too high, however, the solar system was at peak during this time and supplied major current and current shown here was only current drawn from the grid at that point of time. The 155% harmonic component of L3 phase was sourced from third harmonic 10.6 Amp and fifth harmonic also 4.8 Amp which contribute roughly 100% and 50% of fundamental current.

2.6.4 Voltage Harmonics are in order.



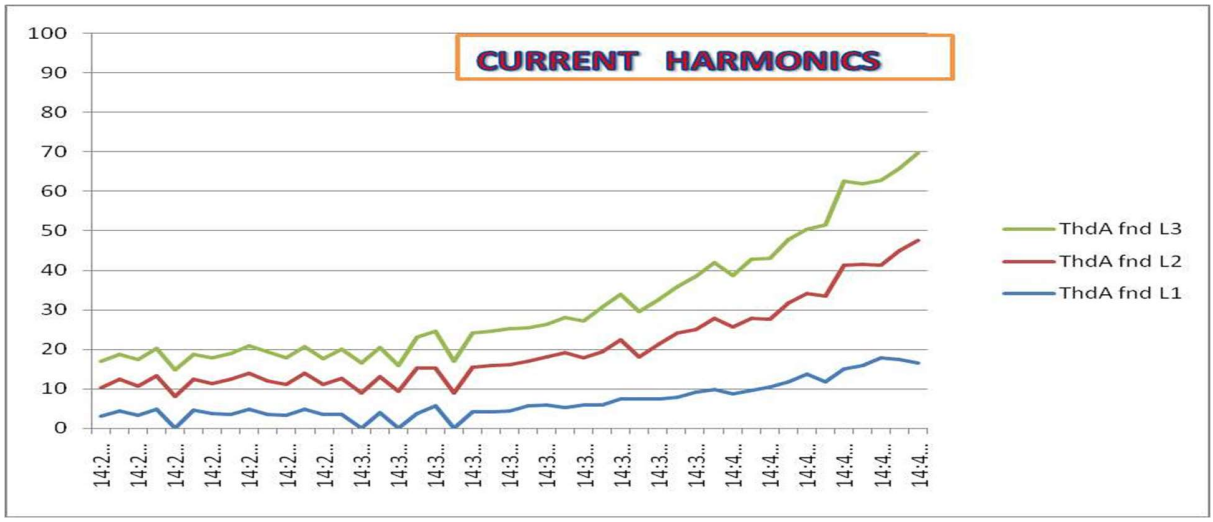
Voltage Distortion Limits as per IEEE-519-1992

Bus Voltage at PCC	Individual Voltage Distortion (%)	Total Voltage Distortion THD (%)
69 KV and below	3.0	5.0

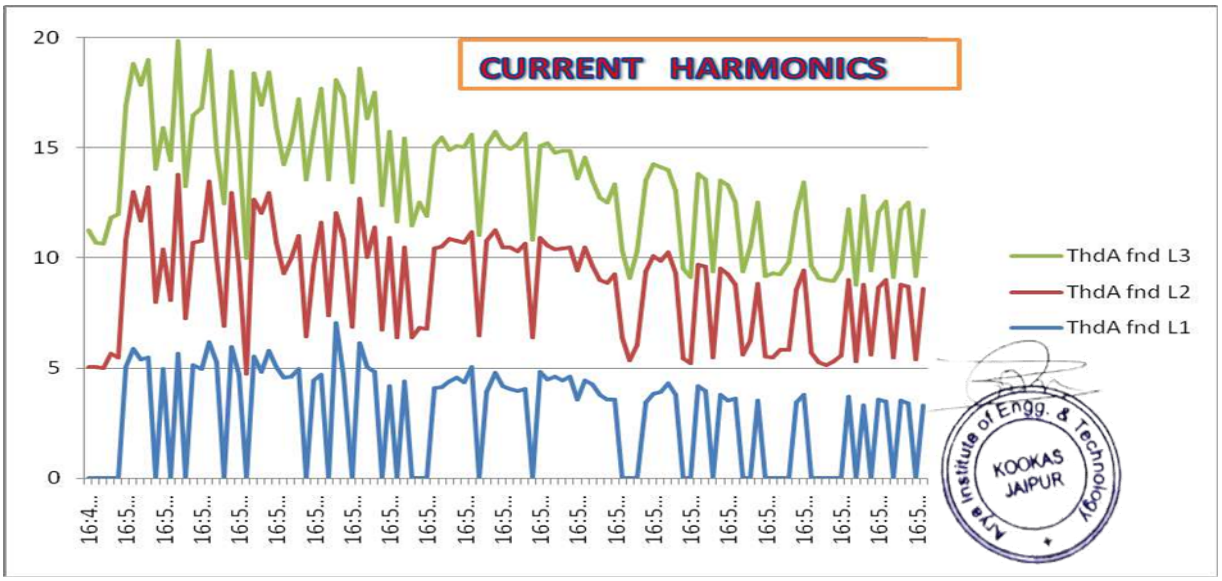
Voltage THD is under limit.

2.7 Solar Power Quality:

2.7.1 Current (THD) on 28.12.2020 from 2.23 pm to 02.45 pm of SOLAR panels connected to main LT bus bar. Graph shows that it is on higher side. Other electrical parameters were within range.

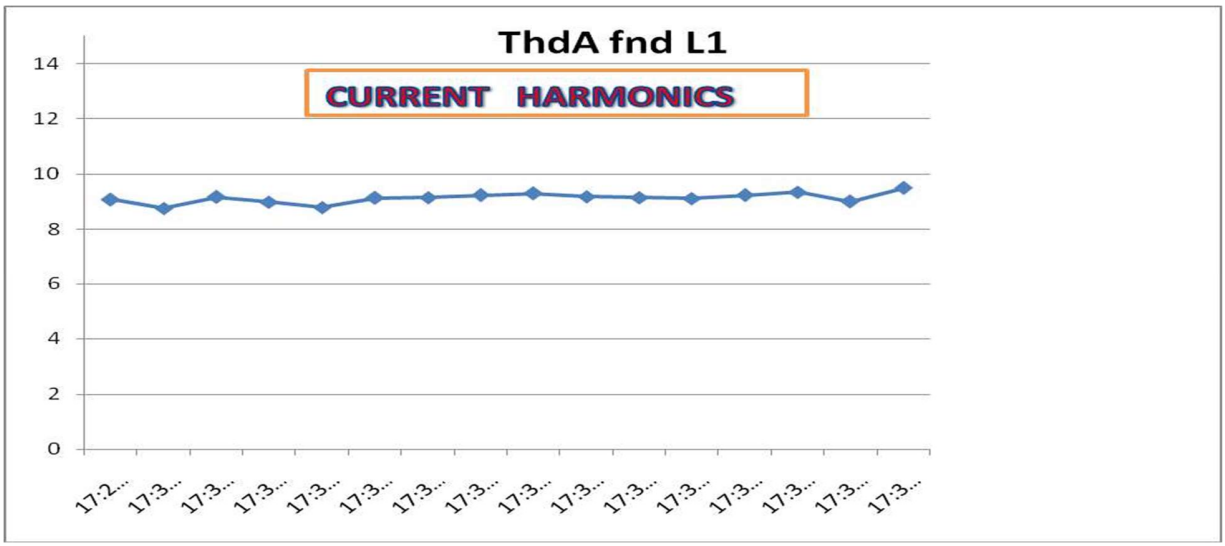


2.7.2 Current (THD) on 28.12.2020 from 04.49 pm to 04.59 pm of SOLAR panels connected to feeder near hostel. Graph shows that it is on higher side. Filters should be installed. Other electrical parameters were within range.

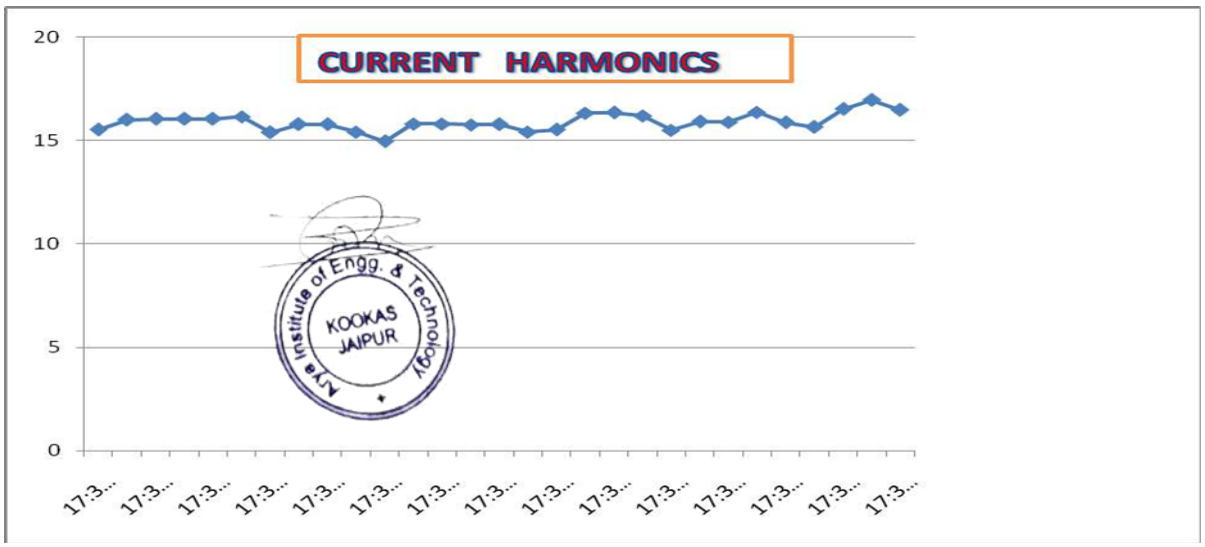


2.8 UPS Power Quality :

2.8.1 Current (THD) on 28.12.2020 from 05.30 pm to 05.32 pm of UPS for Computer Lab 5, 6, 8. Load on UPS were very less. Graph shows that it is on higher side. Other electrical parameters were within range. Current unbalance of 6 % is observed between the phases.

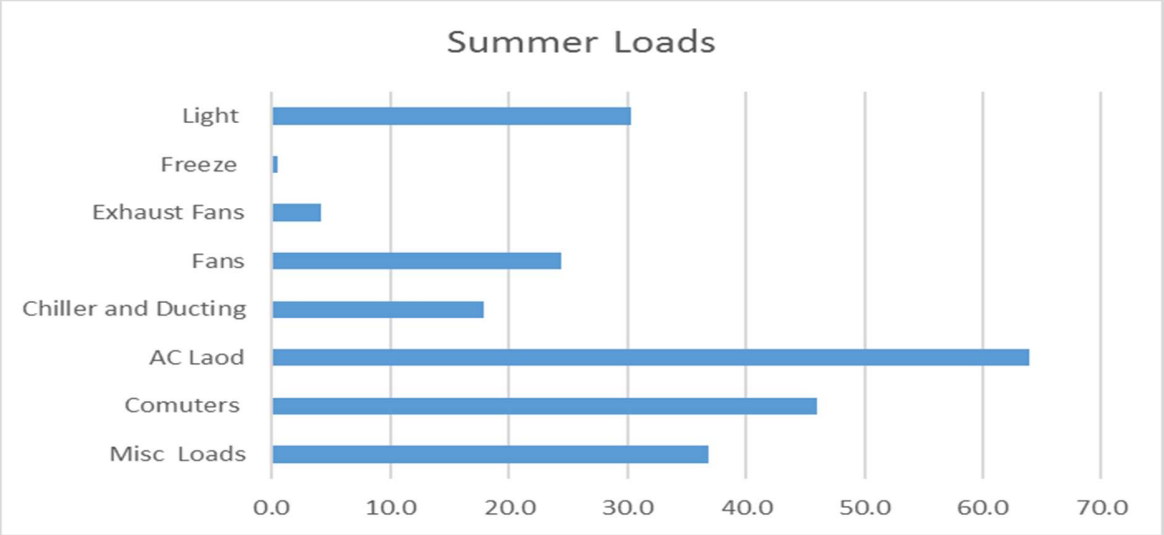


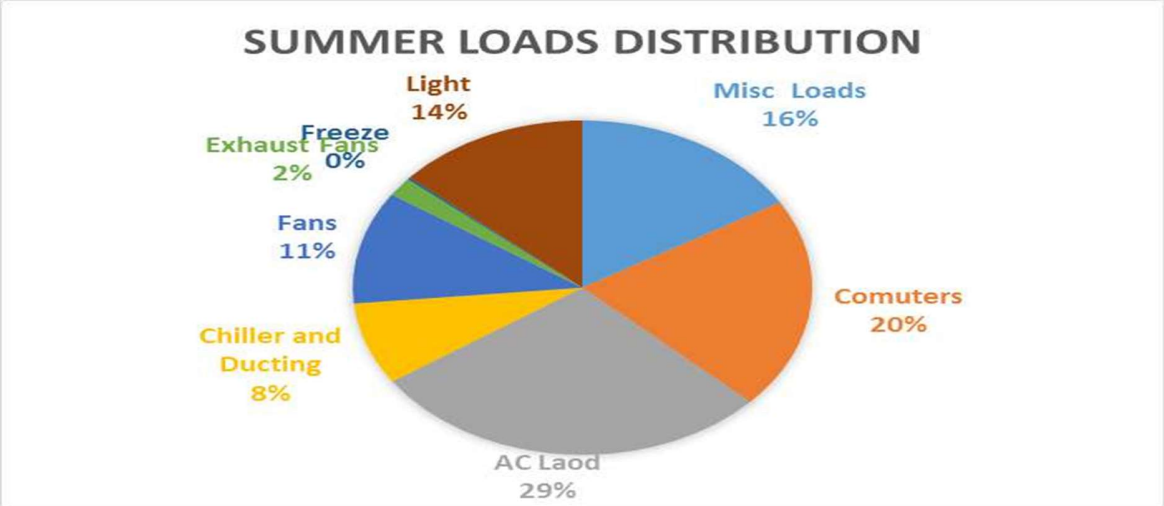
2.8.2 Current (THD) on 28.12.2020 from 05.34 pm to 05.37 pm of UPS for Computer Lab 7. Load on UPS were very less. Graph shows that it is on higher side. Other electrical parameters were within range. Current unbalance of 8 % is observed between the phases.



2.9 LOAD STUDIES

2.9.1 Summer Load -



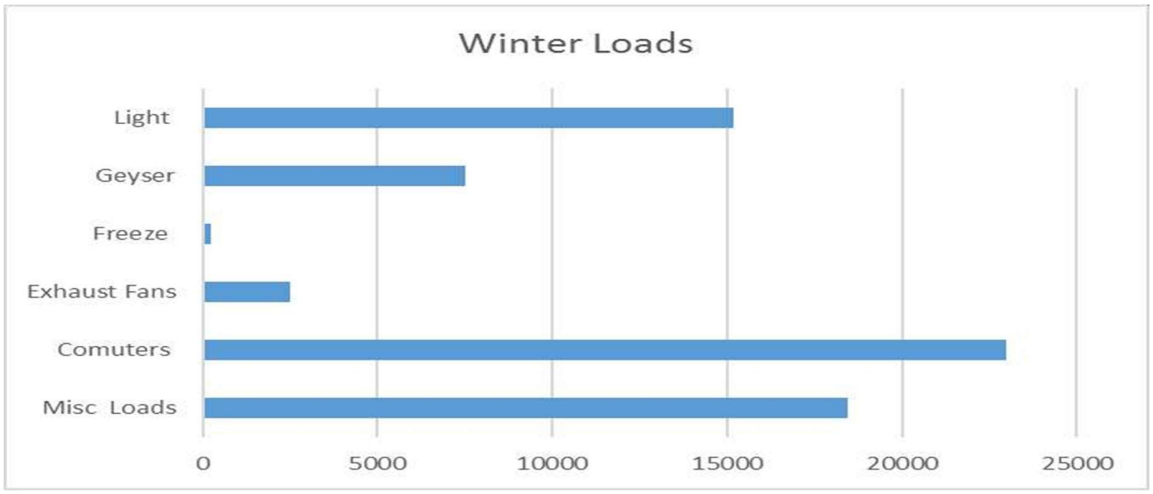


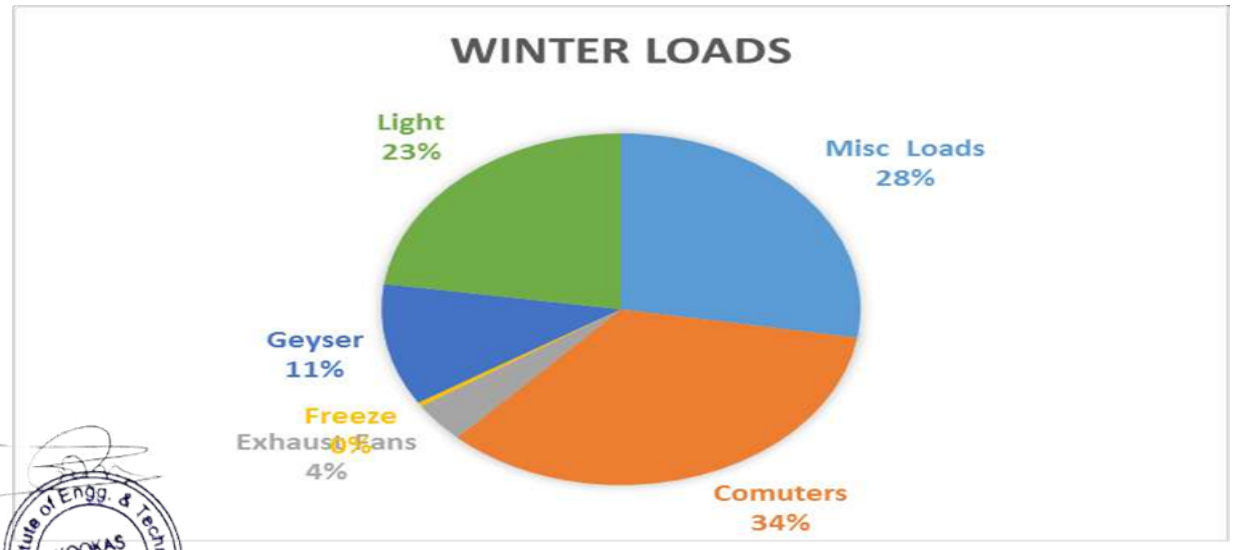
During Summer, the major loads are Air Conditioning and Computers. It was observed that mostly windows AC have been used for cooling and on top floor and hostel, the evaporative cooling has been used. We recommend to increase the evaporative cooling as much as possible whenever the cooling is required. The college is conscious at energy consumption and have formulated the practices of starting and stopping of coolers at predefined times. Further, the rooms of faculties and classrooms are occupied depending

upon periods and hence not continuously occupied so major investment on Cooling Towers, Chillers and AHUs is not recommended.

Out of approx. 1200 Tube lights, almost 300 tube lights have been changed to LEDs and balance can be changed as early as possible. The UPS room and computers are major investments where only recommendation is distribution of phases for limiting unbalance in system. Fans runs the most be identified and replaced by BLDC technology fans. Motors which run more than 12 hours per day and approx. 5 years old can be changed to Energy efficiency motors.

2.9.2 Winter Load :





CHAPTER -3

3.1 Study of Air conditioning Units:

Energy efficient air conditioner system must condition the air in the room by maintaining the desired temperature, humidity and freshness by removing the dust and dirt along with minimising the energy requirement of the system. Proper installation and maintenance of air conditioner system conserves energy. The inventory of air conditioners are as below in the institution:

S.No	Type of AC	Load	Nos	Running Hours	Monthly Units
1	Window AC 1.5 Tonne	1.8 kW	50 Nos	6 Hours	14250
2	Split AC 1.5 Tonne	1.5 kW	5 Nos	6 Hours	1425
3	Split AC 2 Tonne	2 kW	5 Nos	6 Hours	1800
Total			107.5 kW		14775

Looking to the above, the total contribution of 14775 units in auditing month is of Air Conditioner load.

The AC load is constant nature of load and does not reduce much upon reduction of voltage. However, some reduction of core losses and copper losses upon reduction of voltage may occur but max 3 to 4% only. By regular cleaning of filters and heat exchangers and clean drain is good and conserves the power. It is suggested that proper set temperature reduces load on compressors. It is also suggested not to position heat producing appliances near thermostat. We should select the room air conditioners having high EER (Energy Efficiency rating).

Here most of the AC Units are window. The running hours of the AC, installed in rooms and other places, can't be predicted precisely and depends on college running duration per days.

Few of the AC was found running at 16 deg C set point and it was told to staff that we should set it at 24/26 Deg C. It was also explained to them the reason and possible saving which will not be there, due to very cold room temperature. The AC of most of the rooms was found running with doors open. **The door closures are not there**.

Filter are also not cleaned regularly.

3.1.1 Performance Checking-

A/CRecord

S.no.	Make	Cooling Capacity - TR	Type	Dept./Locatation	Set Point	Current Measured	Volts	Power Taken	Air I/L Temp	Air O/L Temp	O/L Area	Velocity- m/sec	Actual Running TR
1	ONIDA	1.48	Window	Robotics Lab	17	9.72	254	2.173	31.1	9.9	0.0387	4.02	1.116
2	Videocon	1.48	Window	ICQ Room	17	12.1	248	2.641	30.3	12.6	0.0387	4.9143	1.139
3	LLYOD	1.44	Split	Accounts Room	20	6.73	245	1.566	23	5.9	0.0413	2.2	0.5255
4	Voltas	1.37	Window	Server Room	17	6.86	240	1.613	20	8.3	0.0387	5.9857	0.9171

Actual running TR is less than the Cooling Capacity TR. Condensor Cleaning / Filter cleaning and Insulation to be checked.

3.1.2 Air Conditioning Units –


Set Point - 16° C. It should be 24°C. Placement of outdoor units is not proper.

Outdoor units should be under shed. Tube insulation also missing.

3.1.3 Observations and Suggestions

1. Air Conditioners are fitted on Section windows having leakages. Heat Resistance film is also not there on glasses. Double Pane glasses should be there to avoid heat losses.
2. Few Air conditioners checked for their performance. It is noticed that their TR is <75 % of the rated. This is due to either low quantity of refrigerant or their filter / condenser cleaning is not done on regular basis. Copper tubing insulation has damaged and needs to be reinsulated. Condenser units are also not covered with shed. Find the photo as attached.
3. Clean air filters and cooling pins for proper operation at regular interval Presently, the air-conditioners are not under any maintenance contract. The air filter in air-conditioners should be cleaned once in fifteen days, especially for the public uses like laboratories. In majority of the air conditioners, the air filters are not cleaned regularly. This leads to dust deposited in the cooling pins of the air conditioners and the filters are choked.
4. We recommend training the local technician on the aspects of cleaning air filters and cooling pins of the split air-conditioners.
5. Prefer split air conditioners It has been the universally accepted fact that the split air conditioners are more efficient than the window air conditioners, since the condenser is away from the fan coil units and subject to free air flow. There is a potential to reduce energy consumption approximately by 10 to 15% by using Split air conditioners instead of window air conditioners.
6. Marking of Switch Control for Lights, Fans and Air conditioners. Presently the students find difficulties in Identify the switch for a tube light or fan in Classrooms and laboratories. Hence, their tendency is switched ON all the switches and do the work even one or two students sitting in the classroom and laboratories.
7. Number the Light, Fan and A/C, marking should be done on Switch point as well as near the fluorescent light, Fan and Air conditioners. This will helpful to the students to switch ON the required Tube light, Fan and A/C alone.

3.2 AHU / Air Washers –

DUCT											
S.no.	Capacity - CFM	Details	Dept./Locatation	Current Measured	Volts	Power	O/L Area	density	Velocity- m/sec	Flow - CFM	Remarks
1	20000.00	15 HP MOTOR- V BELTS DRIVE	Main Bldg - Third Floor	10.6	416	5.1935	3.2981	1.184	2.8188	19698	One belt used.
2	22000.00	15KWMotor-V belt drive		23.4	432	16.633	3.9019	1.184	2.8188	23305	

Motor of Item at Sr.no.1 to be checked as voltage and power factor are low.

Air cooling ducts operates in summer season only, averagely for 4 / 5 hours per day.

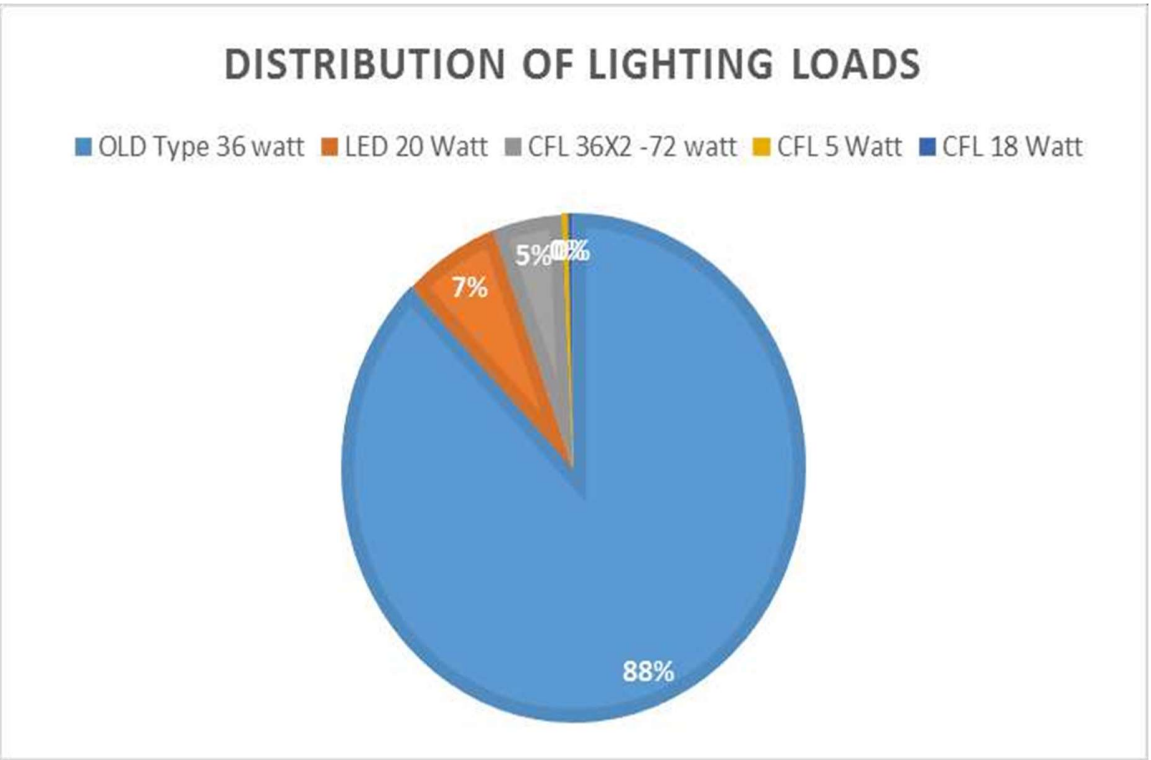
3.3 STUDY OF LIGHTING

The management has initiated many initiatives that show commitment to energy efficiency like changing major lighting load to LED tube lights. The CFL 36 Watts X2 fixtures are installed in rooms but the tendency is not to replace these with new lights in case CFL goes out. We assume the CFL Lights shall be automatically phased out in time. We have recommended LED Tube lights whenever Lux level demands introduction of more fixtures.

Lighting Load

Type of Fixtures	Use	Nos	Hours	Units in Month
OLD Type 36 watt + 12 watt Ballast	Mainly in Hostel	400 Nos	12 Hours	6912
OLD Type 36 watt + 12 watt Ballast	Offices	100 Nos	8 Hour	1152
OLD Type 36 watt + 12 watt Ballast	Labs plus Class room	369 Nos	8 Hours	3188.16
OLD Type 36 watt + 12 watt Ballast	Corridor	100 Nos	4 Hous	576
LED 20 Watt	Offices	50 Nos	8 Hours	240
LED 20 Watt	Corridor	50 LED	4 Hours	120
LED 20 Watt	Others	150 LED	6 Hours	540
36X2 Watt CFL	Offices	50 Nos	6 Hours	648
5 Watt CFL(200 not working)	MISC	50 Nos	8 Hours	60
18 Watt CFL	Offices and Misc	10 Nos	8 Hours	43.2
TOTAL Units				13480

Approximately 88% of total monthly contribution of lighting loads in auditing month represents the Old type 36 watt + 12 watt Choke load consumption.



Under this representative case, if all such lights are changed to LED lights, lighting load is reduced from 12600 electrical units per month to 5850 units i.e. 6750 Units savings in terms of rupees Rs 54000/ per month in a approx. investment of Rs 2.50 lacs only capable of recouping investment in less than 5 months.

Further slowly all CFL lights will automatically eliminated leading to an additional savings.

Apart from these savings, further savings can be possible by introduction of human sensors/ light sensor/ motion sensors in areas like class rooms, computer rooms, laboratory, all bathrooms switching lights plus exhaust only with such sensors, corridors of first floor and above etc.

3.4 COMPUTERS

At AIET, the population of computers have been taken feeder wise as below:

	Nos	Average Wattage	Hours	Connected Load in kW	Units per month
Feeder 1	840	150	6	126	18900
Feeder 2	8	150	6	1.2	180
Feeder 3	56	150	6	8.4	1260
Feeder 4	15	150	6	2.25	337.5
Total	919			137.85	20677.5

However, the management and staff rightly think not to disturb the existing set up running well for them even at some cost of efficiency. The total electricity consumption, assumed on higher side is approx. 20000 units per month. The connected load is approx. 137kW.

RECOMMENDATIONS:

1. The computers runs in idle mode consume 90 – 200Watts of power depending upon the size of the monitor. Generally, there is a provision available in the computer system to set the computer to sleep mode. In the sleep mode of operation the monitor power consumption is very less and systems will consume a little bit of power to restore the earlier status. The recommended time for the sleep mode is 3 minutes.

   Note: The screen saver mode of operation only saves the life of the screen, but the sleep mode saves the power and life of screen.
2. Switching ON UPS system as and when require Present Status - The Uninterrupted Power Supply (UPS) system is switched ON in the morning and switched off in the evening. The number of computer systems used in during non-regular laboratory class hours are less than one third. A 3KVA UPS will consumes 150Watts power at no-load. There is a good scope to minimize no-load power consumption by switching OFF of UPS running idle.
3. Students may be advised to sit on adjacent computers to avoid switch ON of all the UPS. Avoid idle running of UPS system.

3.5 MISC LOADS

The college has total 18 motors for misc use like borewell, mud pump, STP, RO Plant etc and total connected load approx. 14 kW. The monthly energy units is approx. 7452 units as detailed below:

Sno	Use	HP	Watts	Nos	Hrs	Units/month
1	Tube well	7.5	5595	1	20	3357
2	General	1	746	4	8	716.16
3	STP	2	1492	4	8	1432.32
4	Mud Pump	3	2238	1	4	268.56
5	RO Plant	3	2238	2	4	537.12
6	RO Plant	1.5	1119	3	6	604.26
7	RO Plant	1	746	3	8	537.12
			14174	18		7452.54

The recommendation is to change one motor of Tube well motor which runs for approx. 20 hours a day. Normally, after opening of motor, the efficiency reduces significantly and looking to the 20 hours use, we recommend replacement of this motor to energy efficient motor. As per our estimate we expect to save approx. 1000 units per month thereby savings of Rs 8000/ per month. And payback period only 3 months.

3.6 STUDY OF CEILING FANS

Of a total approx 850 ceiling fans which consume 60 to 80 watt electricity on a average 70 watt., approx. 350 fans run 14 Hours whereas the rest runs approx. 8 Hours a day.

Use	Watts	Nos	Running Hours	Connected Load	Units per month
Hostel running	70	350	14	343	8575
Normal running	70	500	8	280	7000
Total		**850**		**623**	**15575**

If we change 350 fans to energy efficient BLDC fans, the power chart shall modify as below:

Use	Efficient Fan use	Nos	Running Hours	Connected Load	Units per month
Hostel running	32	350	14	11.2	3920
Normal running	70	500	8	35	7000
Total		850		46.2	10920

This is a savings of 4655 units per month or in rupees terms, Rs 37240/ is saved which can payback the cost in approx. 24 months if we change 14 hours running fans only at an investment @ Rs 2500/ per fan of total Rs 875000/-

In market such fans are available in Surya, Atomberg etc make.

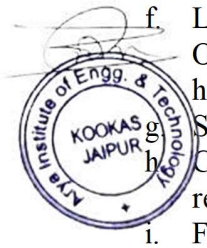
- **Data for Ready Reference only:**

Speed	Power consumption in Watts	
	Ordinary Ceiling Fan	Super fan*
Low	12	4
Medium	39	14
High	75 (worst)	35

CHAPTER – 4

4. Suggested Opportunities for Energy Savings / Miscellaneous maintenance works

a. Though, a drive has been initiated for conversion of normal lights to LED Lights, still approx 900 Tube lights need to be changed. In most areas, it was observed that illumination is normal. Even then occupancy sensors may be considered for extra lights which need to be lighted only when area is occupied. Till such time a manual drive be initiated to explain people to save energy. May be that Internal wiring needs to be checked and corrected so that few set of lighting fixture can be switched off manually in night or in day time when not occupied.
b. All outer wall Glass window should be of double pane.
c. Door closer for all area wherever central air conditioning / AC is there.
d. The first step towards energy saving is Monitoring. Until we can't measure the consumption, we will not be able to control it. We therefore should initiate the energy monitoring. It is noticed that energy monitoring initiatives has yet not been initiated as Energy Meters are also not there on any of the panel. In all panel sections, Energy parameters should be recorded on auto by online measurement system so affordable now days. In this way, many faults can be examined for pre fault and post fault parameters helpful to identify problem and remedies.
e. Apart from main feeders data recorded on auto, certain readings should manually recorded in register like
   - Panel voltage once a day
   - Energy meter readings of different areas (Energy meters be installed in areas which can help to incentivize individual/departments for their efforts)
   - Solar generation readings at predefined time
   - DG meter readings after shutdown of DG, start and stop times of DG, Diesel filling date and quantity, voltage(s) of all phases and currents



f. Lights, air conditioners and fans, area where no work is going on, should be put OFF. Occupancy Sensors and manual segregation for peak hours, off peak day hours.
g. Setting of AC should be kept around 25 plus / minus 2 degree centigrade.
h. Ceiling Fan should be kept running with AC running. False ceiling wherever required, should be provided.
i. Faulty capacitors identified for replacement. It was identified that
j. AC outdoor Units should be covered with shed and hot air exhaust path should be clear.
k. AC – Copper tubes – Insulation needs to be replaced.
l. Ensure that AC room temperature sensor should be in working condition and compressor should cut ON / OFF with it.
m. Change ordinary fans to Super fan - Cost approx Rs 2500/-.
   Super fans consume 32 w only at full speed, instead of 60 to 80 w of ordinary fan.
n. Other recommendation highlighted in respective chapters / photo pages.

o. Pest control required in all panel rooms, Server room and UPS room.
p. Electrical staffs should have license like wireman / supervisor etc. PPE should be used by them.
q. The main pathways need be illuminated with min 12/15 W solar street light without or least maintenance at an interval of 12 meter or LED street Light with DG back up.
r. Other Renewable energy: It is stated that Government of India is laying great stress on harnessing renewable energy sources. Already Rooftop Solar PV energy resource has been tapped. However , we suggest to consider following green energy sources also:
   i. **Solar water heating system:** Should install for Hostel and Guest House.
   ii. **Solar cooking system:** Should install for mess.

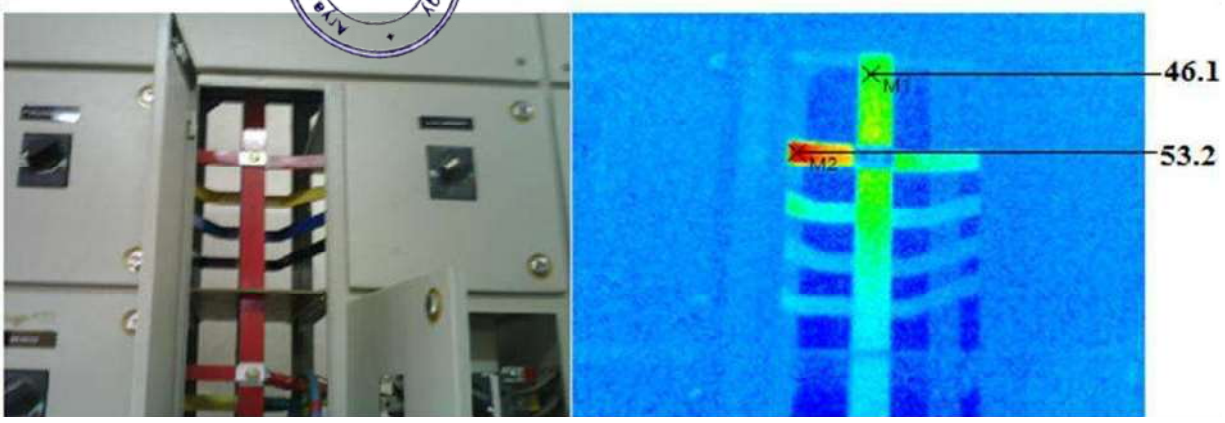
Outside Ducts can be insulated.

Lights found ON in day time in the morning.

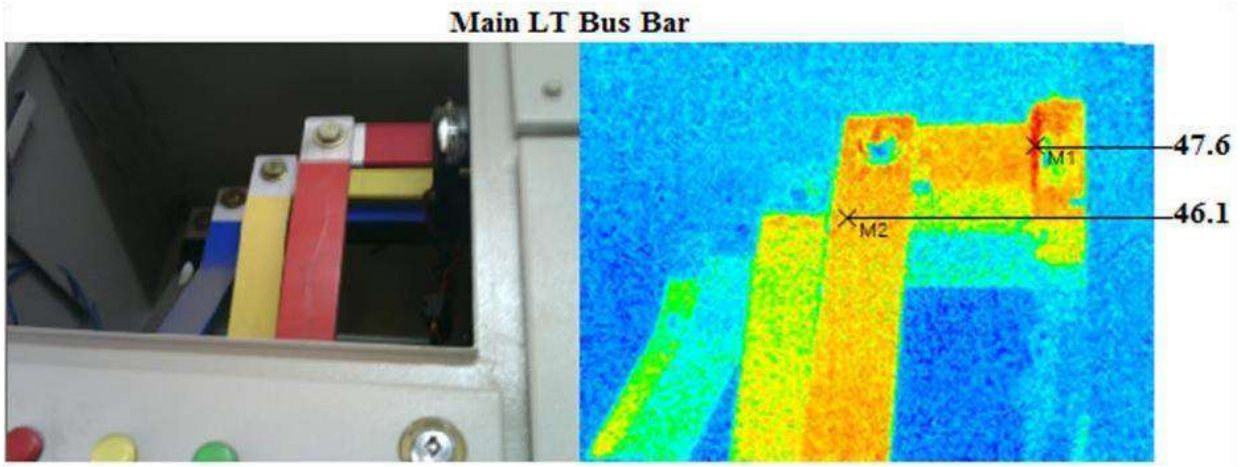
5.0 Thermography Results:

We carried out thermographic study at important locations. The results are as shown here:

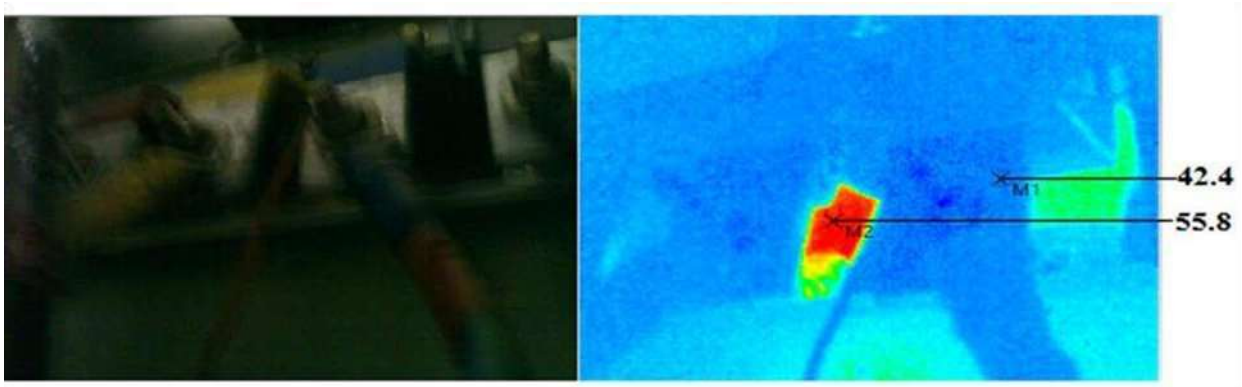
Location	Temperature	Remarks
Main Panel Bus Bar - AEIT Basement	53.2°C	
Main Panel Bus Bar Front Top Left	47.6°C	Healthy
Main Panel Bus Bar Rear Side	55.8°C	Hot
APFC Capacitor Terminal-Rear Side	74.5°C	Hot
APFC- Front - Contactor / MCCB	53°C	Slight Hot
APFC- Front - Contactor/MCCB	54.5°C	Slight Hot
Lift Top Area	50.7°C	Slight Hot
Transformer Bushing	50.7°C	Healthy
Transformer Bushing	53.1°C	Healthy
Transformer Oil Conservator	54.1°C	Healthy



Main Panel Bus Bar - AEIT Basement

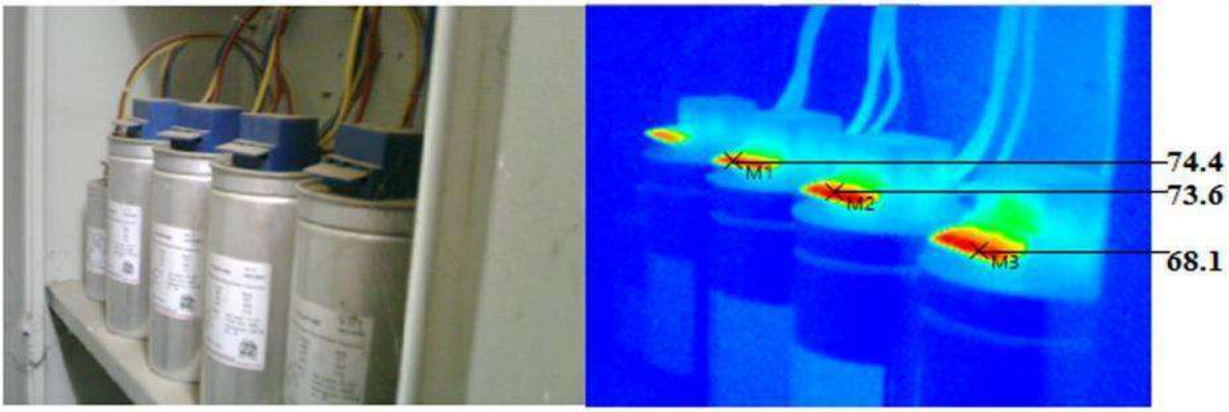


Main Panel Bus Bar Front Top Left



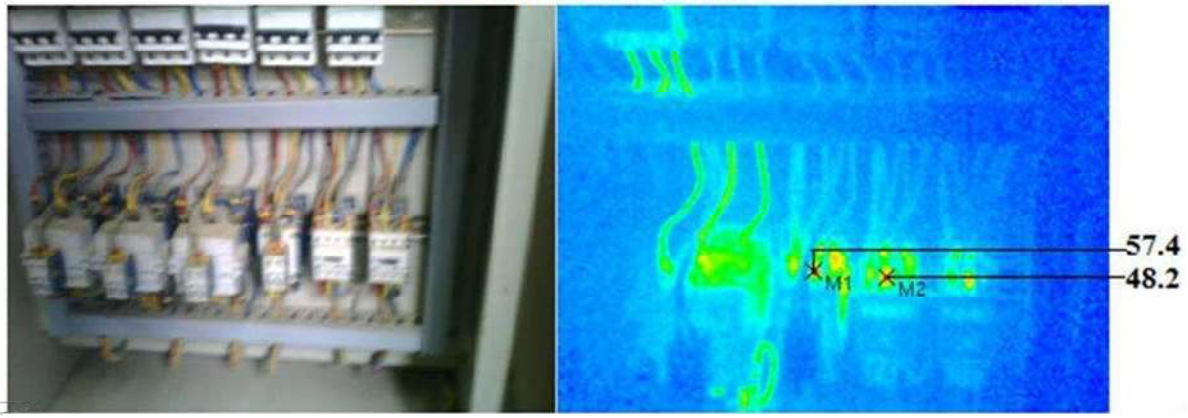
Main Panel Bus Bar Rear Side

	APFC Capacitor Terminal-Rear Side	

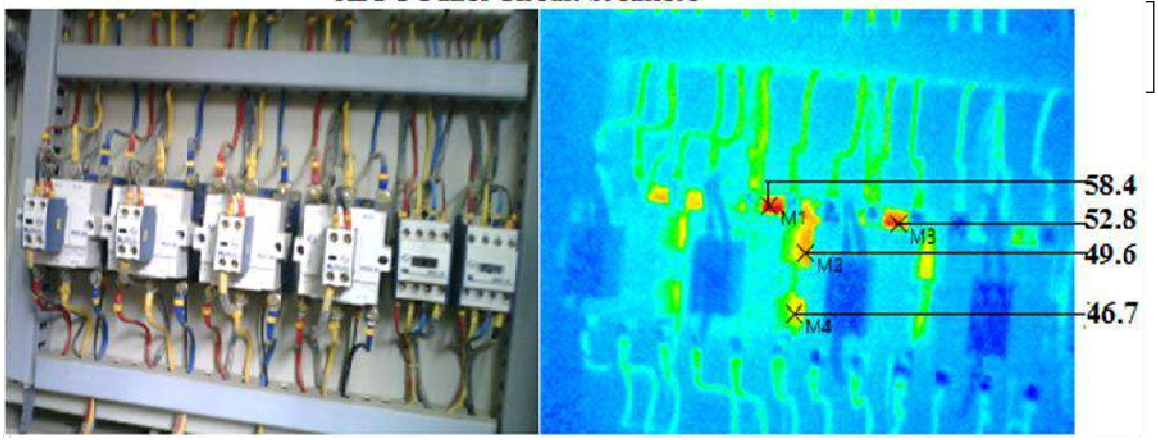


	APFC Capacitor Terminal-Rear Side	

APFC Panel circuit breakers

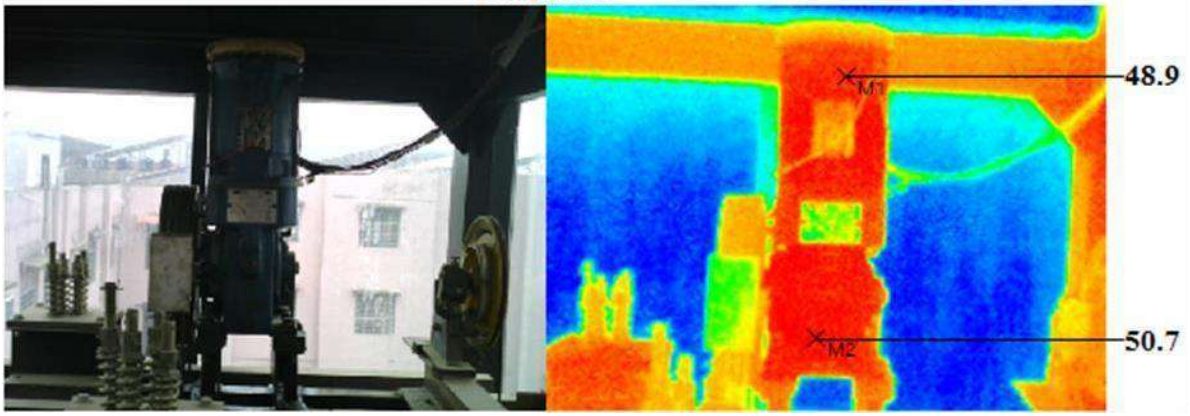


APFC Panel Circuit breakers



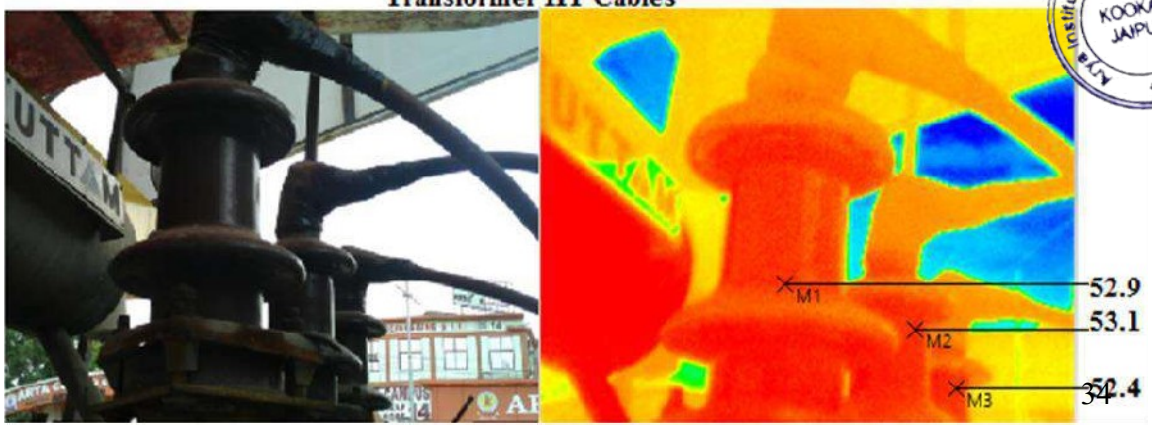
APFC- Front - Contactor /

Lift Motor

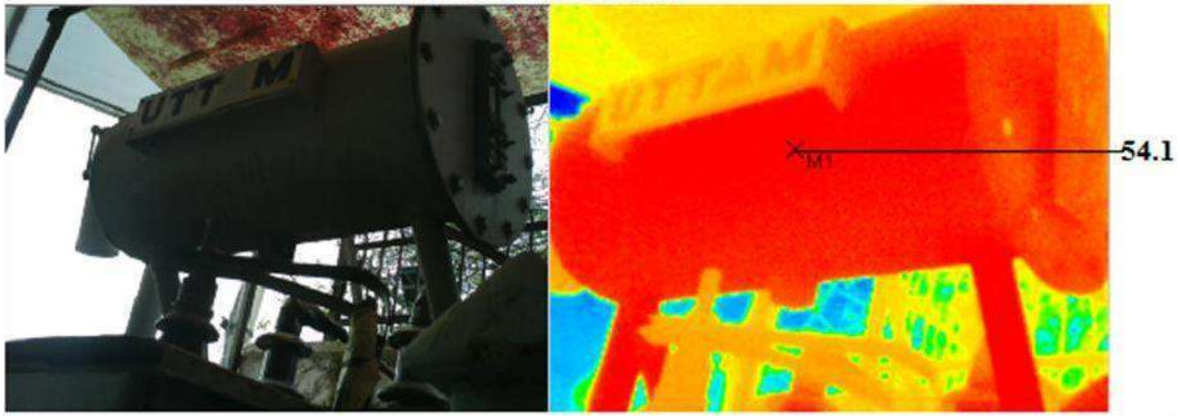


Lift Top Area

Transformer HT Cables



Transformer Oil tank



Transformer Oil Conservator

6.0 General Electrical safety and steps to be taken to improve

6.1 General

Poor maintenance conditions pose a larger scope for accidents. If used carelessly, electricity can burn, shock or even kill. Safety precautions are necessary when working with or near electricity so as to significantly reduce the risk of electrical injury to self and others. Looking into the risks and dangers arising from dealing with installation, maintenance or use of electricity, various safety related provisions are enacted & regulations are made.

Do's and Don'ts (Ref IS: 5216 (Part II) – 1982

S. No.	DO's	Don'ts
1	Preach and practice safety at all times. Good work can be spoiled by an accident	Do not wear loose clothing, metal watch straps, bangles or finger rings while working on electrical appliances. Do not hang clothes and other such things on electrical fittings.
2	Work carefully. Haste causes many accidents. Be sure of what you are doing	Do not use a ladder without a lashing rope, otherwise the ladder should be held firmly by another person.
3	Examine before use of safety devices such as mats, rubber gloves, ladders, insulated pliers for their soundness	Do not work on a pole or other elevated positions if there is a live part on it without a safety belt and rubber gloves unless a competent person stands on the ground nearby to direct operations and give warning.
4	Always report immediately to the person in charge any dangerous condition or practice observed	Do not remove danger notice plates or other signs or interfere with safety barriers or go beyond them
5	Warn others when they seem to be in danger near a live conductor or apparatus.	Do not allow visitors and unauthorized persons to touch or handle electrical apparatus or come within the danger zone of high voltage apparatus

6	Attend at once to all injuries however slight they may be	Do not touch a circuit with bare fingers or hand or other makeshift devices to determine whether or not it is alive.

6.2 Accident prevention method

1) Accidents are caused they do not happen.
2) If proper attention is given to the safety aspects and the laid down procedure, majority accidents and consequential damages to the personnel and property can be avoided.
3) Safety is studied at the start of training and forgotten subsequently.
4) Safe work practices have not been accepted to be a force habit.
5) Laxity on the part of personnel actually engaged in the work.
6) Not following safety instructions.
7) Complacent approach of supervisory personnel.
8) Non availability and improper maintenance of safety gadgets.

Causes of accidents:

1) Accidental contact with live electric wire / equipment.
2) Defective appliances / apparatus / tools.
3) Inadequate / lack of maintenance.

1) Reasons for accidental contact with live electric wire / equipment:

a) This is one of the most common reasons for accident with the employees / operating staff of the utilities.
b) Staff not properly skilled / trained.
c) Similarly, the work is not being supervised by qualified personnel.
d) Inadequate ground clearance / operational clearance of the live parts.
e) Ignorance about the discharging line / equipment before starting of maintenance work / repair works.
f) Error in isolation of supply.
g) Non-availability of safety tools & devices like safety shoes, gloves, helmets
h) Absence of clear instructions and supervision i.e. standard codified maintenance manuals should be prepared which will guide the maintenance personnel to follow the standard instruction including line clearance / return procedure.

General precautions to be taken:

1) Consider safety aspects during planning of work
2) Explain the area which is safe to work & ensure that entire team has understood the same
3) Restrict entry of unauthorized persons
4) Nominate one among the team exclusively for close watch during the work
5) Only authorized work men should be allowed to climb the pole, structure, work on line.
6) Work on live line should be done with due permission from the competent authority and under the supervision of a qualified officer.
7) Before switching on any equipment, check that equipment is in perfect working order and t is properly earthed.
8) Use rubber hand gloves, rubber boots, aprons, safety helmets etc while operating circuit breaker, GOD etc
9) Do not bring food or snacks into the working area like control room, switch yard
10) Live wire should never be exposed
11) Use correct size and quality of fuse wire
12) Do not use sub-standard material
13) Always ensure that all blades of GOD are operated
14) In case of HT UG cable, before starting the work ensure that the cable is discharged
15) In case of cable loop system, the cable shall be identified with source and destination
16) Ensure that fire extinguishers are in good condition
17) Fire extinguishers shall have marking for the specific class of fire

6.3 Safety Practices

6.3.1 Shock

1) Act at once - delay is Fatal.
2) Death from electric shock is rarely instantaneous.
3) Heart Fibrillations (Heart Muscle Tremors) persist as long as 30 minutes after Shock. Therefore life can be saved by Immediate Artificial Respiration.
4) Call the Doctor.

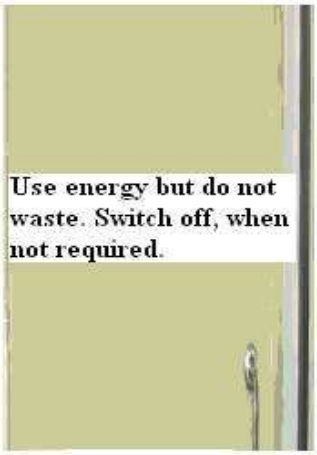
6.3.2 Release from contact:

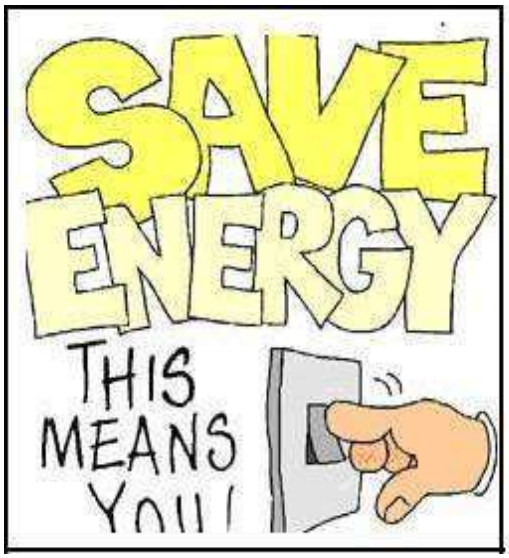
Switch off current immediately or send someone to do so. Do not attempt person from contact with high voltage unless suitable articles insulated for voltage are used for this purpose. When attempting to force a person from contact or medium voltage, use rubber gloves, boots, mat or insulated stick, but if available, use a loop of rope, cap or coat to drag the person free. Whatever it may be but it should be dry and non conducting.

6.3.3 After release:

Lay the victim on a dry firm surface and remove any foreign material from the breathing. If there is no sign of breathing or restlessness start artificial immediately. Do not lose any time, and if possible send for the Doctor and Check that the jaws are lifted and head tilted back so that the mouth and throat Check the pulse and continue respiration till the pulse is felt. Keep the patient allow him to get the fresh air.

Few Slogan and posters can also be displayed to motivate for energy saving.





Three Pin Sockets are not being used at many places.

7.0 List of Instruments

Following Portable and Online instruments used as per the requirement.

S. No	Instrument Name & features	*Make & Model*
1	Hygro meter	5°C to 120° C
2	Digital Infrared Pyrometer	TES 1326
3	Digital Anemometer Rotating Wane Type	Lutron AM 4201
4	Digital industrial Multimeter	Rishabh Rishimax 12
5	Power Analyzer (HP,KW, Volt, Amps, PF, KWH, KVAH, KVARH, Frequency, Harmonics, Ac/ DC 1 phase, 3 wire.	Neno VIP M/s. Elcontrol Energy, Italy
6	Lux Meter	Lutron LX 101/ TES13322
7	Thermovision camera	Fluke, Germany
8	Ultrasonic Flow Meter (Doppler & Transit Time) suitable for all liquids	1010WP M/s. Controlotron, USA
9	Digital Temperature Indicator(Contact type)	CIE 5°C to 120° C

8.0 PROPOSED ENERGY CONSERVATION POLICY

We, the employee of AIET, Jaipur are committed and pledge to use energy judiciously and efficiently, in all activities and services across the College. We shall endeavor to transform energy conservation into strategic business goal fully aligning with technological advancements by improving the skill and knowledge of our employees for sustainable development.

To achieve excellence, our objective therefore will be:

1. To reduce energy consumption by 1% every year till 2021.
2. To adopt efficient technologies and equipment.
3. To ensure energy conservation awareness programme in the College.
4. To recognize efforts of our employees and their team in energy conservation initiative.
5. To control energy consumption by periodic review and improve use of our Air Conditioners / lighting etc. by training and motivation.
6. To monitor energy consumption and carry out internal and external audit to identify areas for further improvement.

EXECUTIVE SUMMERY

S. No.	Description	Potential Electrical Units Savings /yr	Potential Savings in Rs/yr @ 8/-/Unit	Approx. Cost of implementation in Rs.	Simple pay-back period
1	Reduce the Voltage setting of Transformer setting approx. 10% phase to phase voltage at panel between 400 to 415 V	3 to 8 percent of total electrical consumption approx. 1500 units per month	Rs 144000/	Nil	NA
2	**Replacement of 969 Non LED Luminaire to LED luminaires, prioritizing in order of more nos of hours of use, whenever they are faulty.**	6800 Units per month (Average use 8.4 Hours)	Rs 437500/	Rs 2.42 Lacs	7 Months
3	350 Ordinary Fans with Super Fans- First Phase	4655 units per month i.e. 27900 units per annum (6 months fan use)	Rs 223000//	Rs 8.75 Lacs	4 Years
4	Online Monitoring of energy meters of feeders, initially 8 Nos crucial by installing in Panel and viewing on mobile/desktop through Cloud server.	3600 units per annum	Rs 28800/	1.00 Lacs	4 Years
5	**Replacement of Faulty Capacitors as identified and their by improving Power Factor**	1 percent of energy use as incentive to raise PLF from 0.98 to 0.99	Rs 28800/	0.07 Lacs	3 Months
	Total				

Environment Audit

DR CBS CYBER SECURITY SERVICES LLP

Cyber Security Audit Report

For

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