DIT University
Event Report
2022-23

SDG-7

PREFACE

The biggest challenge in modern society is to achieve 'Net Zero Emission' and to stop global warming duet to Green House Gas (GHG) Emissions. The tremendous exploitation of non-renewable resources like fossil fuels is causing irrecoverable harm to nature by emitting all sorts of air pollutants and GHGs. The result is continuous increase of global average temperature, ice sheet melting, abrupt climatic consequences. One stop solution is to switch to alternative clean and green energy sources like Solar, Wind, Water etc. but not very easy with various economic, geologic and infrastructure reasons. However, society must continuously thrive to alternative energy resources through its technological advancement. UN SDG 7 promotes 'Affordable and Clean Energy' ensuring access to affordable, reliable, sustainable and modern energy. DIT University is in line with SDG 7 in making buildings with efficient energy rating appliances, using solar power at maximum usage, minimizing energy wastage and promoting new developments in green energy through research and collaboration activities.

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CONTENTS

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University Plan for Energy Efficiency, Energy Management and Energy Review

DIT University has an energy efficiency plan in place to actively reduce overall energy consumption across our campus. Our plan encompasses a range of strategies and initiatives aimed at optimizing energy use and minimizing our environmental impact. Key elements of our energy efficiency plan include:

- Energy Audits
- Energy-Efficient Technologies
- Behavioral Awareness Programs
- Sustainable Construction and Upgrades
- Regular Maintenance

Our comprehensive approach to energy efficiency, including educational and research components, aligns with our commitment to sustainability and environmental stewardship, reflecting our dedication to reducing overall energy consumption.

University conducts energy audit from 3rd party frequently and the suggested plans in the audit reports are discussed in statutory bodies for implementation.

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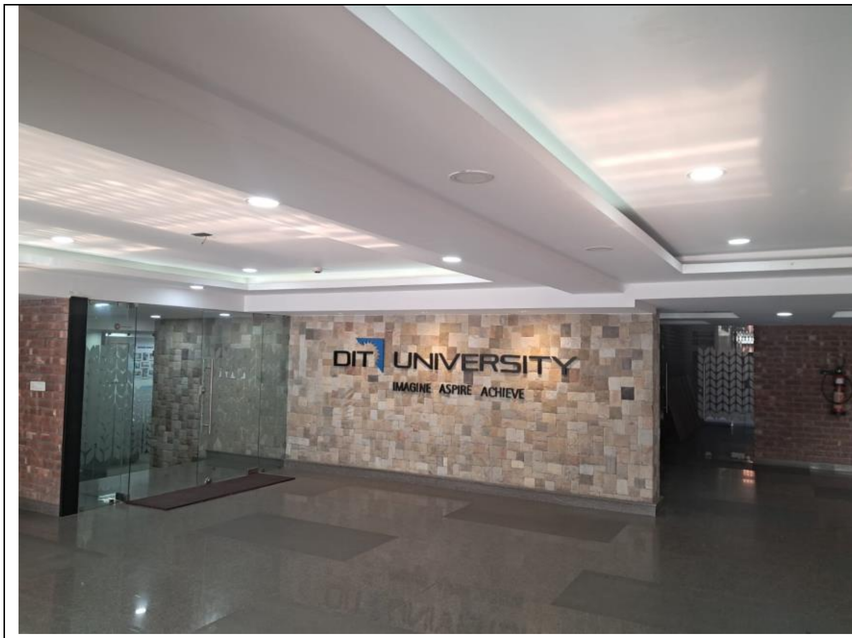
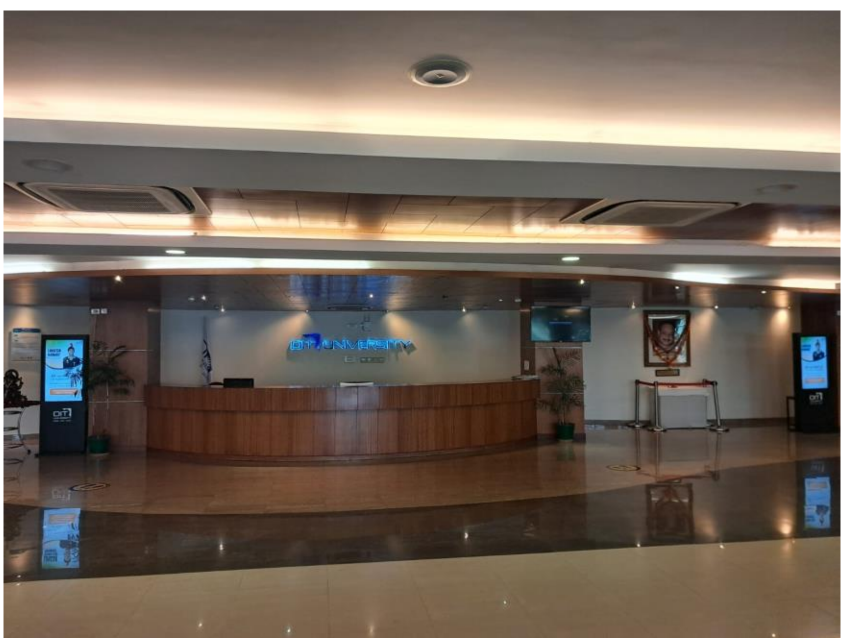
Sensor-based energy conservation & Use of LED bulbs/ power efficient equipment

	Sensor-based energy conservation • Fitment of light sensors • Light sensors have been installed in the campus • Manufacturer- Philips (Legrand)
	Use of LED bulbs/ power efficient equipment • Use of Led Bulbs / Power Efficient Equipment's • Manufacturer - Wipro Lighting • Total Lighting Load - 294.40 Kw • Total LED Lighting Load - 270.53 Kw Percentage of LED / Total Lighting Load - 91.90%

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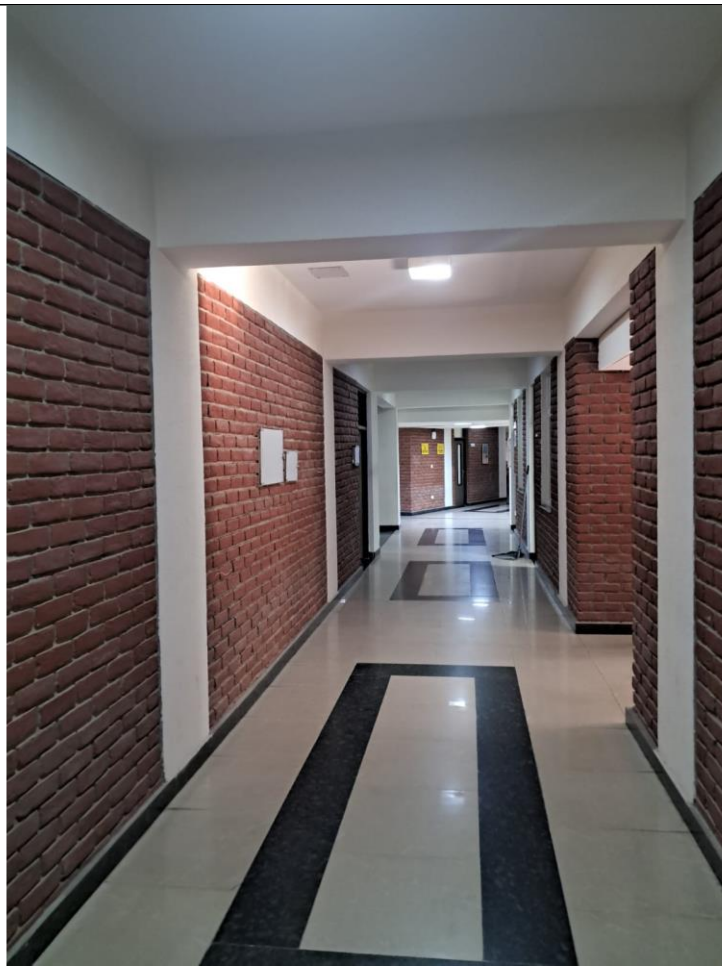

ENERGY AUDIT REPORT

For additional reference, please find the Energy Audit Report – View Document

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MANDATORY ENERGY AUDIT

DIT UNIVERSITY

JUNE - 2022

Village-Makkawala, Mussoorie Diversion Road
Dehradun-248009 (U.K)

CONDUCTED BY:

A-Z ENERGY ENGINEERS PVT. LTD.
PLOT NO. 12, 4860-62, HARBANS SINGH STREET, KOTHI NO. 24,
WARD NO. II, DARYA GANJ, NEW DELHI-11002
011-23240541, 9811402040 pp_mittal@yahoo.com

Contents

ABBREVIATIONS

A	Ampere
AC	Alternating Current
Avg.	Average
CFL	Compact Fluorescent Lamp
CFM	Cubic feet minute
DTL	Double Tube Light
DG	Diesel Generator
FAD	Free Air Delivery
FTL	Florescent Tube Light
GT	Generator Transformer
DTL	Double Tube Light
KL	Kilo Liter
KV	Kilo Volt
kVA	Kilo Volt Ampere
kW	Kilo Watts
kWh	Kilo Watt Hour
LED	Light Emitting Diode
Lit	Liters
M or m	Meter
Max.	Maximum
Min.	Minimum
MT	Metric Ton
MW	Mega Watt
No.	Number
PF	Power Factor
STL	Single Tube Light
TR	Ton of Refrigerant
V	Voltage

Acknowledgement

M/s. A-Z Energy Engineers Pvt. Ltd., expresses sincere thanks to the Management of **"DIT University,"** for their kind assistance and co-operation for carrying out the Energy Audit of their **DIT University, Dehradun (H.R)**. The site visits for the Energy Audit have been conducted from June. 2022.

The Management is highly conscious about its Energy Efficiency Levels and they have initiated several measures to reduce the energy consumption, which include amongst others the use of LED lights, Star Rated AC, Solar Pv, Solar water & APFC Panel etc. **A-Z Energy Engineers Pvt. Ltd., acknowledges and appreciates the commitment of the management towards conservation of Energy.**

The Audit team of A-Z Energy Engineers Pvt. Ltd. conveys their gratitude and thanks to the management of DIT University, for their positive attitude in safety, reliability and energy conservation program through energy efficiency improvement and better utilization of available energy system infrastructures followed by their proactive role in conducting the energy audit study.

The Audit team would like to register their hearty thanks to DIT University, Dehradun for their guidance, coordination, active support, participation during the audit and motivating the audit team.

Official from DIT University, Dehradun

- Mr. Alok Saxena – Site Incharge M.No. 8449669966
- Mr. Dinesh Singh - Electrical M.No. 9927067044

Audit Team Members

- Dr. P.P. Mittal- Accredited Energy Auditor-AEA-0011
- Mr. I.C Mittal - Certified Energy Auditor-CEA-21615
- Mr. Pankaj Chauhan – Sr. Engineer
- Mr. Alok Kumar Tiwari– Engineer

(Dr. P.P Mittal)
Accredited Energy Auditor- AEA-0011

Highlights of the Energy Audit

M/s. A-Z Energy Engineers Pvt. Ltd. expresses sincere thanks to the Management of **"DIT University, Dehradun"** for their kind assistance and co-operation for carrying out the Energy Audit of their University. The site visits for the Energy Audit have been conducted from June, 2022.

The Broad Scope of work and Key Systems/ Equipment's covered during the Energy Audit was as follows:

- **Review of Electricity Bills**, Contract Demand and Power Factor: for the last one year in which possibility will be explored for further reduction of contract demand an improvement of P.F.
- **Electrical System Network:** which would include detailed study of all the transformers of various rating / capacities their operational pattern, loading, no load losses, power factor measurement on the main power distribution boards and scope for improvement if any. the study would also cover possible improvement in energy metering systems for better control and monitoring
- **Study of Motors Pumps Loading** Study of motors above 10 KW in terms of measurement of Voltage (V), Current (I), Power (kW) and P.F. and thereby suggesting measure for energy saving like reduction in size of motors or installation of energy saving device in the existing motors. Study of Pumps and their flow, thereby suggesting measures for energy saving like reduction in size of Motors and Pumps of installation of energy saving device in the existing motors, optimization of pumps.
- **Chiller & Cooling tower:** Performance shall be evaluated as regards; their input power vis-à-vis TR capacity and performance will be compared to improve to the best in the category.
- **Lighting System: -** Study of type and fitting of lighting and suggest measures for improvements and energy conservation opportunity wherever feasible.

- **RO System: -** Study of type and fitting of R.O and suggest measures for improvements and energy conservation opportunity wherever feasible.
- **UPS System: -** Performance shall be evaluated of UPS System, improvements and energy conservation opportunity wherever feasible.

Key Points

- *The Detailed Energy Audit of DIT University, Dehradun was carried out from June, 2022 to find out the energy saving potential and the performance level of DIT University The report provides the major highlights on potential energy saving opportunities available in the University.*
- *DIT University, Dehradun draws power from the Uttarakhand power Corporation Limited, at 11 kV; subsequently the voltage is stepped down by one transformer 11 KV to 0.433 KV by 1000 KVA transformer. The Contract demand of plant is 824 KVA. Billing is done on 11 KV.*
- *During the site visit, measurements were made to record the load profile of the building, which included the variations in the voltage, current, power factor, harmonics etc. Analysis of the recordings indicated that the average voltage level was around 244 Volts. This may be an adequate voltage for motive loads like motors etc, but for the lighting systems normally, the voltage should be around 220 volts (phase to neutral). A reduction of around 15% in the lighting voltage can reduce the power consumption by around 20%.*

  As the conventional light is replacing with LED lamps in phase manner, the effect of voltage reduction in terms of power saving will be almost negligible. However, reduction and stabilization of voltage will improve the life of lamps. Light saver transformer is already installed in plat used for control light load voltage.

- *The plant is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. There is one capacitor bank panel (420 kVAr,) is installed in the substation at LT Side. The building is being billed on KVAh basis; During the Year, the operating power factor varied from 0.922 to 1.00. However, if we look at the overall average power factor is around 0.993, which is good. The effect of power factor is inbuilt in the billing structure so to be improves power factor is 0.999*

  APFC Panel or the capacitor banks wherein the delivery is poor (less than 70%) or out of order may be replaced, so that the overall system power factor is maintained at around 0.99 (lag). Improvement in the power factor would subsequently reduce the KVAh consumption, the resultant benefits in terms of energy savings. Most of the capacitor is de-rated & not in operation. The details of measurement in given Capacitor chapter.
- *The measured efficiency of transformer-1000KVA is 97.44, which is good.*
- *The harmonics levels measured in main incomer. The details is given below table.*

Particulars	***TR-1000 KVA) (Average)***
THD Phase1 (V)	*1.5*
THD Phase2 (V)	*1.6*
THD Phase3 (V)	*1.6*
THD Phase1 (A)	*7.4*
THD Phase2 (A)	*7.8*
THD Phase3 (A)	*7.2*

  The average voltage harmonics levels were around below 1.5 to 1.6%, which is under limit. The current harmonics levels were around below 7.2 to 7.8% for Transformer, which is under limit.
- *The Building Management is highly conscious about its Energy Efficiency and cost and has initiated several measures to reduce the energy consumption, which include replacement of conventional lamps with LEDs*

- *Although there is no simpler way to reduce the amount of energy consumed by lighting system than to manually turn OFF whenever not needed, this is not done as often as it could be. In response, automatic lighting control strategies like installation of occupancy sensors can be considered to Control light in response to the presence or absence of people in the space. Quantification of energy savings on this account is not possible.*
- *During the audit we measured the specific fuel consumption (kWh/Ltr) of DG sets. The load profile of the electrical parameters was recorded by using a portable 3-phase power analyzer. The analysis of the different parameters recorded at the L.T incoming main supply and during this period the diesel consumption was also recorded empty tank method. The standard specific fuel consumption (SFC) of DG sets is in the range of 3.0 to 4.0 kWh/ltr and present SFC of DG-1 & 2 is 3.0 to 3.3 kWh/Ltr, which is good.*
- **The Management is highly conscious about its Energy Efficiency Levels and they have initiated several measures to reduce the energy consumption, which include amongst others the use of LED lights, Star Rated AC, Renewable solar energy & Energy monitoring etc. A-Z Energy Engineers Pvt. Ltd., acknowledges and appreciates the commitment of the management towards conservation of Energy.**

CHAPTER-1 INTRODUCTION

1.1. The Project

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 every establishment. Energy Audit helps to understand more about the way's energy is used in any establishment and helps in identifying areas where waste may occur and scope for improvement exists.

It was with this objective that "**M/s. A-Z Energy Engineers Pvt. Ltd.,** Plot No.12, 4860-62, Harbans Singh Street, Kothi No. 24, Ward No. II, Darya Ganj, New Delhi-11002, was entrusted with the job of conducting Energy Audit of "DIT University, Dehradun".

1.2. Scope of Work

The Broad Scope of work was to:

1. **Analysis of the Electricity bills**
   (i) Analysis of the different section of the electricity bills.
   (ii) Study of the fixed charges and variable charges and comments on the same.
   (iii) Calculation of the load actor.
   (iv) Comments on the contract demand and suggestions to reduced them
2. **Power factor and Harmonics Analysis**
   (i) Measured of power factor/ harmonics analysis at the major loads.
   (ii) Suggesting methods to improve the present power factor.
   (iii) Suggesting method for improving power quality and reduction of Harmonics if any.
3. **Metering and Monitoring Status**
   (i) Review of exiting metering system of the plant
   (ii) Suggesting need and methods to improve the metering system, if required.
4. **Transformers**
   (i) Study of major transformer in the plant.
   (ii) Measuring of loading pattern and current efficiency of the transformer.
   (iii) Data shall be collected using portable power analyzer and energy meter installed in plants.
   (iv) Snapshot study for similar equipment.
5. **Water Pumps**

   Study of water pumps (15 KW and above) would be carried out:-
   (i) Measured of flow and head using plant instruments if available.
   (ii) Measured of power consumption.
   (iii) Checking running hours of the pumps and optimization of the same.

(iv) Recommend measure to reduce the power consumption.
(v) Application of flow control methods.
(vi) Application of retrofit for energy savings.

6. **Lighting System**

Detailed audit in lighting system normally results in considerable saving. illumine readings with lux meter should act as a basis for comparative purpose. The study should cover measurement of lux level at works place and at various points of light usage. Application of retrofits such as: -

(i) Timer Control
(ii) Photocell control for street lighting
(iii) Use of energy efficient lighting

7. **DG Sets**

(i) Specific electricity generation ratio evaluation (based on the data).
(ii) Performance evaluation i.e., Energy balance efficiency calculations (based on the data).

1.3. OBJECT OF STUDY

The purpose of this study is to demonstrate the technical and financial feasibility of implementation of energy efficiency measures in M/s. DIT University, Dehradun. The purpose of this report is: –

(i) to analyze the present energy consumption pattern
(ii) to investigate for energy conservation measures without compromising the production level
(iii) to assess the techno-economic feasibility of the energy conservation measure

1.4. METHODOLOGY

Methodology adopted for achieving the desired objectives viz: Assessment of the Current operational status and Energy savings include the following:

- Discussions with the concerned officials for identification of major areas of focus and other related systems.
- A team of engineers visited the Site and had discussions with the concerned officials/ supervisors to collect data/ information on the operations and Load Distribution within the Building. The data was analyzed 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 utilization of computerized analysis and other techniques as appropriate were done to draw inferences and to evolve suitable energy conservation plan/s for improvements/ reduction in specific energy consumption.

1.5. INSTRUMENTATION SUPPORT

Instruments used for undertaking the audit include the following:

- Electric Load Manager with appropriate CT's & PT's for Power Measurements with recording facilities.
- Dual Type Digital Temperature (°C/°F) Measuring Device with appropriate probes;
- Ultra-Sonic Flow Meter
- Flue Gas Analyzer
- Pressure Gauges
- Anemometers
- Lux Meter
- Hygrometer

CHAPTER-2 BASE LINE DATA

2.1. General Details

Contact Details		
Brief description of Assignment	:	Detailed Energy Audit of Electrical Systems & Utility Equipment's.
Name & Address of the Building	:	DIT University Village-Makkawala, Mussoorie Diversion Road Dehradun
Operational Days	:	330 Days per annum
Contact Officer	:	Mr. Alok Saxena
Power		
Source	:	Uttarakhand power Corporation Limited (UPCL)
AC No.	:	
Sanctioned Load	:	700 KW
Contracted Demand	:	824 KVA
Annual Purchased Power Consumption	:	
Apr. 2021 to Mar. 2022	:	14,83,360.00 KWH
Apr. 2021 to Mar. 2022	:	14,96,600.00 KVAh
Annual Purchased Power Bill	:	
Apr. 2021 to Mar. 2022	:	Rs. 75,29,504.00
Average Purchased Power Cost	:	
Apr. 2021 to Mar. 2022	:	Rs. 5.1 per KVAh
Apr. 2021 to Mar. 2022	:	Rs. 5.1 per KWh
Energy Charge	:	Rs. 4.4 per KVAh
Fixed Charge	:	Rs. 85 per KVA
Electricity Duty	:	Rs. 0.3 per KWh
Green Energy Charge	:	Rs. 0.1 per KWh

CHAPTER-3 PRESENT ENERGY SCENARIO

3.1. Purchased Power

DIT University, Dehradun draws power from the Uttarakhand power Corporation Limited (UPCL), at 11 kV; subsequently the voltage is stepped down by one transformer 11 KV to 0.433 KV by 1000 KVA transformer. The Contract demand of plant is 824 KVA. Billing is done on 11 KV.

3.2. Reactive Power Compensation

Based on the electricity bills, it was observed that the power factor from Apr. 2021 to Mar. 2022 varies from 0.922-1.00 i.e., average power factor was 0.993 which appears to be on good side. The building is being billed on KVAH basis; therefore, the effect of power factor is inbuilt in the billing structure. The minimum, maximum and average PF (Apr. 2021 to Mar. 2022) are a s follows.

Description	Min. PF	Max. PF	Average PF
Power Factor	0.922	1.000	0.993

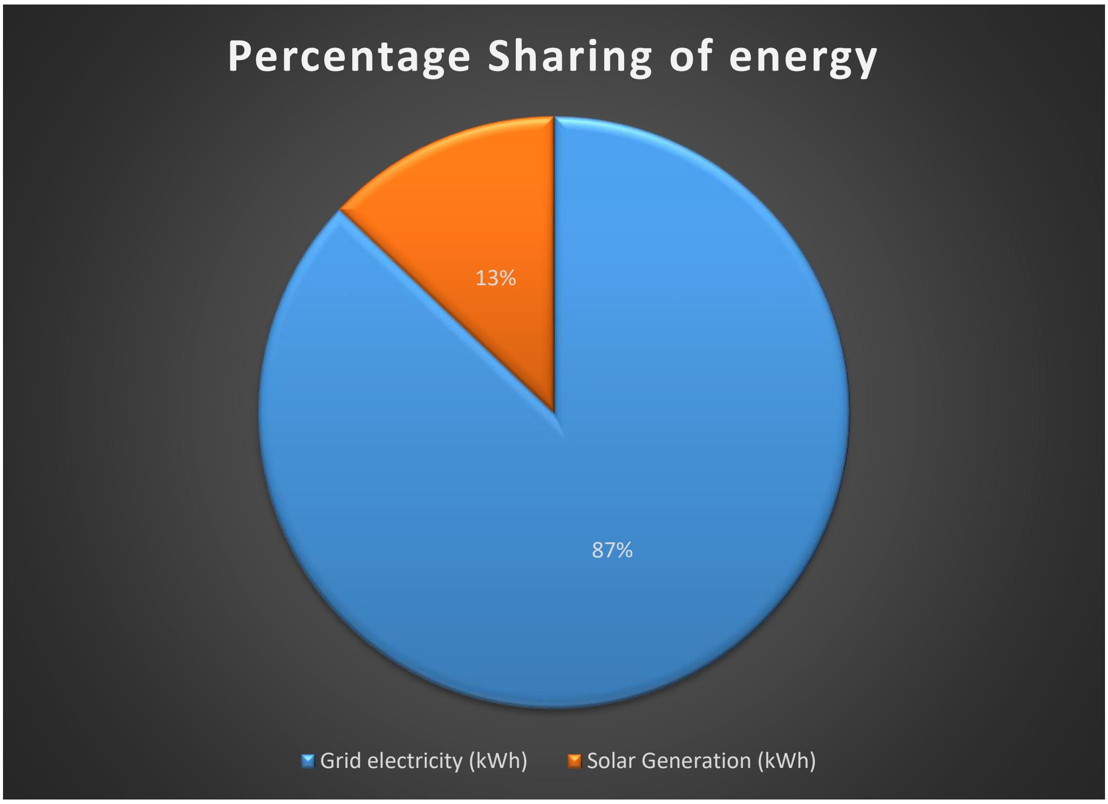
3.3. Self-generated Power

The university has 2 No's DG Sets of 500 KVA & 250 KVA. D.G installed for in-house power generation during power cut. The operation of the DG Sets is during in power cut & testing only.

3.4. Solar PV

250 kWp solar PV installed on roof top of building. Solar Photovoltaic Cell for Power Generation for lighting load & other load in the Building. Solar Pv installed in different location.

Description	Capacity (kWp)
Workshop Building	100
Civil Block	50
Vedanta Block	100

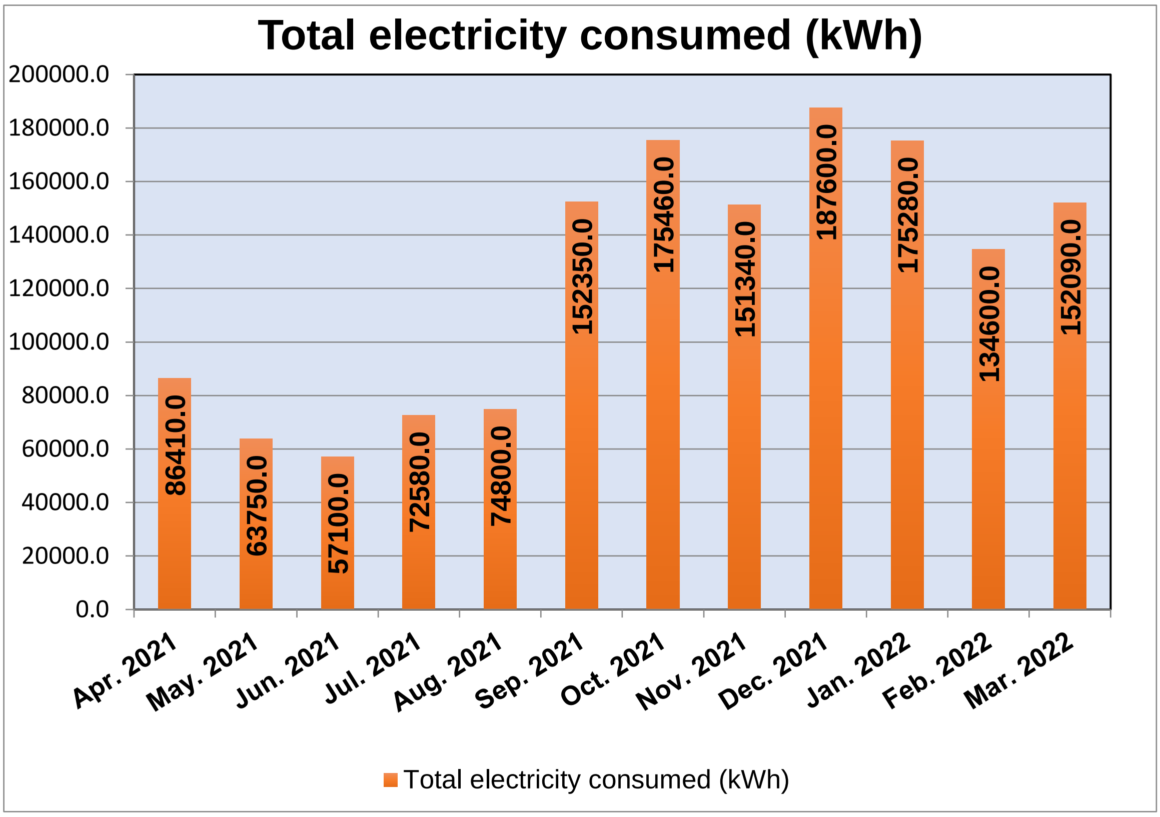

Percentage Sharing of energy
13%
87%
Grid electricity (kWh)
Solar Generation (kWh)

3.5. Purchased Power Consumption Pattern

3.5.1. Apr 2021- Mar 2022

Sr. No.	Billing Month	MDI	Power factor	Electricity consumed (kWh)	Electricity consumption (kVAh)	Solar Adj Unit	Total Unit	Energy Charge	Fixed Charges	Electricity Duty
1	Apr. 2021	307.0	0.996	86410.0	86800.0	150.0	86650.0	381260.0	70040.0	25923.00
2	May. 2021	208.0	1.000	63750.0	63750.0	130.0	63620.0	279928.0	70040.0	19125.00
3	Jun. 2021	187.0	1.000	57100.0	57100.0	650.0	56450.0	248380.0	70040.0	17130.00
4	Jul. 2021	266.0	1.000	72580.0	72580.0	10.0	72570.0	319308.0	70040.0	21774.00
5	Aug. 2021	282.0	1.000	74800.0	74800.0	20.0	74780.0	329032.0	70040.0	22440.00
6	Sep. 2021	615.0	1.000	152350.0	152350.0	0.0	152350.0	670340.0	70040.0	45705.00
7	Oct. 2021	510.0	1.000	175460.0	175480.0	0.0	175480.0	772112.0	70040.0	52638.00
8	Nov. 2021	403.0	1.000	151340.0	151340.0	0.0	151340.0	665896.0	70040.0	45402.00
9	Dec. 2021	475.0	1.000	187600.0	187600.0	0.0	187600.0	825440.0	70040.0	56280.00
10	Jan. 2022	548.0	1.000	175280.0	175280.0	20.0	175260.0	771144.0	70040.0	52584.00
11	Feb. 2022	520.0	1.000	134600.0	134600.0	0.0	134600.0	592240.0	70040.0	40380.00
12	Mar. 2022	488.0	0.922	152090.0	164920.0	0.0	164920.0	725648.0	70040.0	45627.00
	Total			**1483360.0**	**1496600.0**	**980.0**	**1495620.0**	**6580728.0**	**840480.0**	**445008.0**
	Avg.	**400.8**	**0.993**	**123613.3**	**124716.7**	**81.7**	**124635.0**	**548394.0**	**70040.0**	**37084.0**
	Max	**615.0**	**1.000**	**187600.0**	**187600.0**	**650.0**	**187600.0**	**825440.0**	**70040.0**	**56280.0**
	Min	**187.0**	**0.922**	**57100.0**	**57100.0**	**0.0**	**56450.0**	**248380.0**	**70040.0**	**17130.0**

Sr. No.	Billing Month	Green Energy Charge	FCA Charges	Solar Rebate	Current LPS	Amount Due	Adjustment	Other Dues	Total Payable Amount	Inr/Unit kvah	Inr/Unit kwh
1	Apr. 2021	8641.0	0.00	46000.0	0.00	0.00	0.00	0.00	439864.0	5.1	5.1
2	May. 2021	6375.0	0.00	46000.0	0.00	0.00	0.00	-3039.0	326429.0	5.1	5.1
3	Jun. 2021	5710.0	0.00	46000.0	9.22	737.50	0.00	3039.0	299046.0	5.2	5.2
4	Jul. 2021	7258.0	5079.9	46000.0	0.00	0.00	0.00	-2065.0	375395.0	5.2	5.2
5	Aug. 2021	7480.0	5234.6	46000.0	0.00	0.00	0.00	-2597.0	385630.0	5.2	5.2
6	Sep. 2021	15235.0	10664.5	46000.0	0.00	0.00	0.00	-2667.0	763318.0	5.0	5.0
7	Oct. 2021	17546.0	33341.2	46000.0	0.00	0.00	-5267.0	0.00	894410.0	5.1	5.1
8	Nov. 2021	15134.0	28754.6	46000.0	0.00	0.00	0.00	-6181.0	773046.0	5.1	5.1
9	Dec. 2021	18760.0	35644.0	46000.0	0.00	0.00	0.00	-5343.0	954821.0	5.1	5.1
10	Jan. 2022	17528.0	17526.0	46000.0	0.00	0.00	0.00	-6598.0	876224.0	5.0	5.0
11	Feb. 2022	13460.0	13460.0	46000.0	0.00	0.00	0.00	-6045.0	677535.0	5.0	5.0
12	Mar. 2022	15209.0	16492.0	46000.0	0.00	0.00	0.00	-4677.0	763786.0	4.6	5.0
	Total	**148336.0**	**166196.8**	**552000.0**	**9.2**	**737.5**	**-5267.0**	**-36173.0**	**7529504.0**		
	Avg.	**12361.3**	**13849.7**	**46000.0**	**0.8**	**61.5**	**-438.9**	**-3014.4**	**627458.7**	**5.1**	**5.1**
	Max	**18760.0**	**35644.0**	**46000.0**	**9.2**	**737.5**	**0.0**	**3039.0**	**954821.0**	**5.2**	**5.2**
	Min	**5710.0**	**0.0**	**46000.0**	**0.0**	**0.0**	**-5267.0**	**-6598.0**	**299046.0**	**4.6**	**5.0**


Total electricity consumed (kWh)
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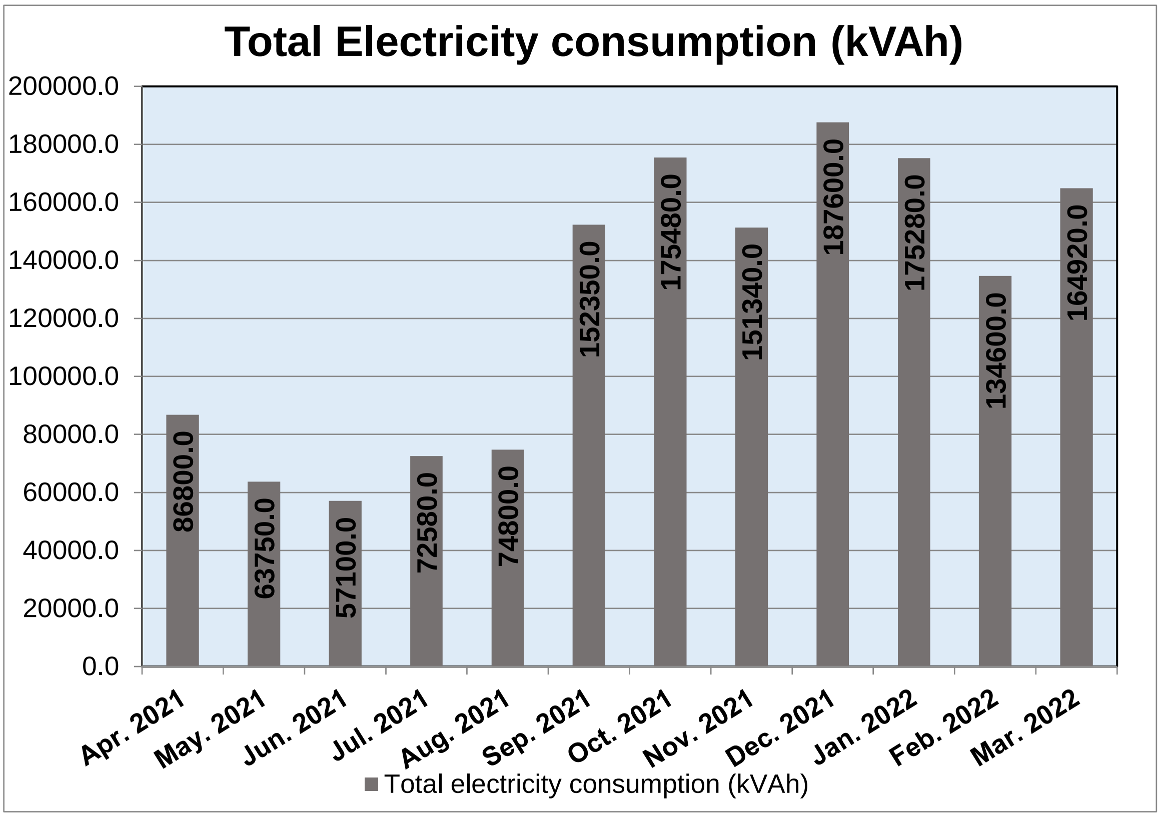
180000.0
160000.0
140000.0
120000.0
100000.0
80000.0
60000.0
40000.0
20000.0
0.0
86410.0
63750.0
57100.0
72580.0
74800.0
152350.0
175460.0
151340.0
187600.0
175280.0
134600.0
152090.0
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022
Total electricity consumed (kWh)


Total Electricity consumption (kVAh)
200000.0
180000.0
160000.0
140000.0
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74800.0
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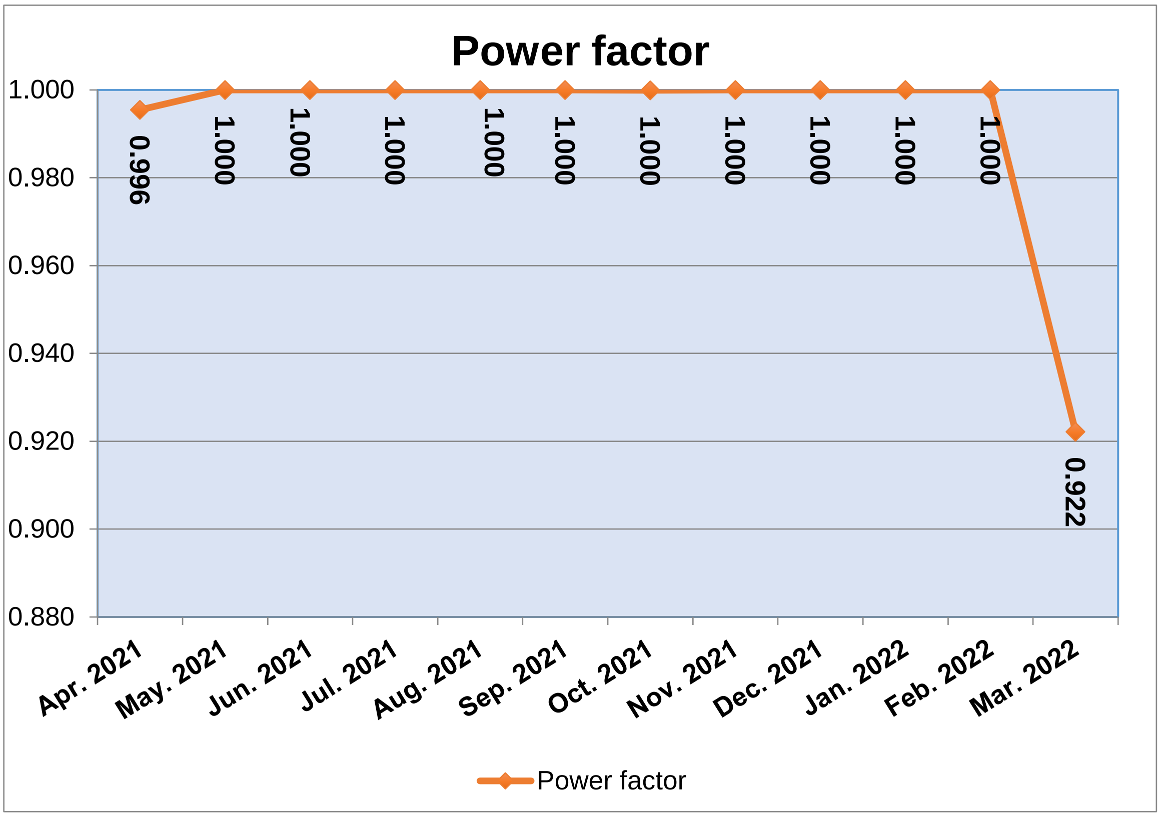
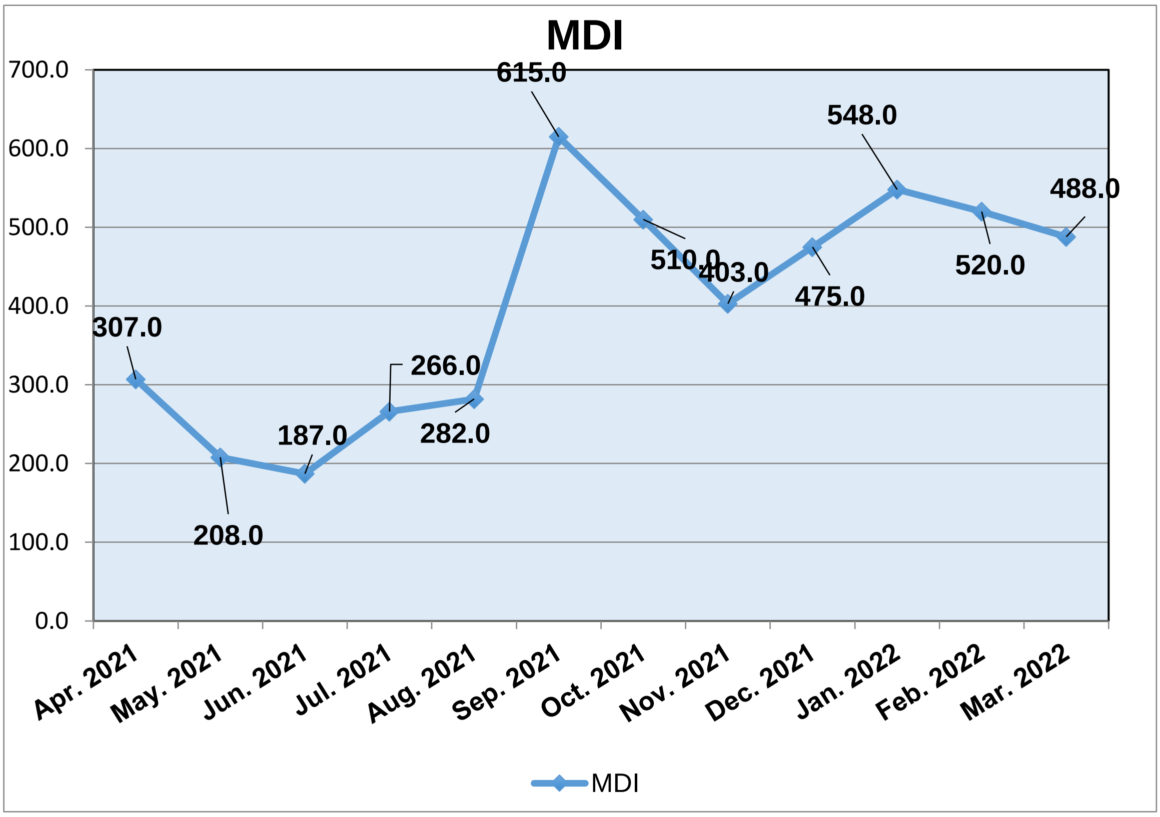
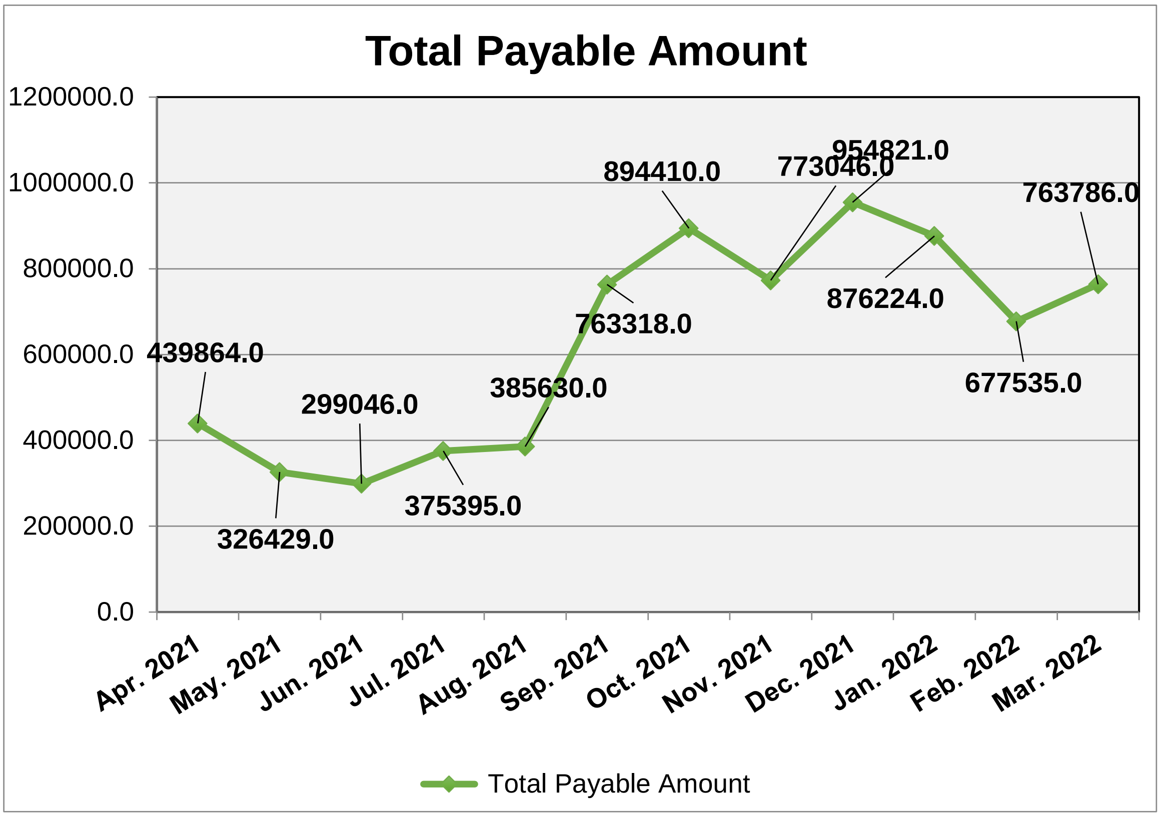
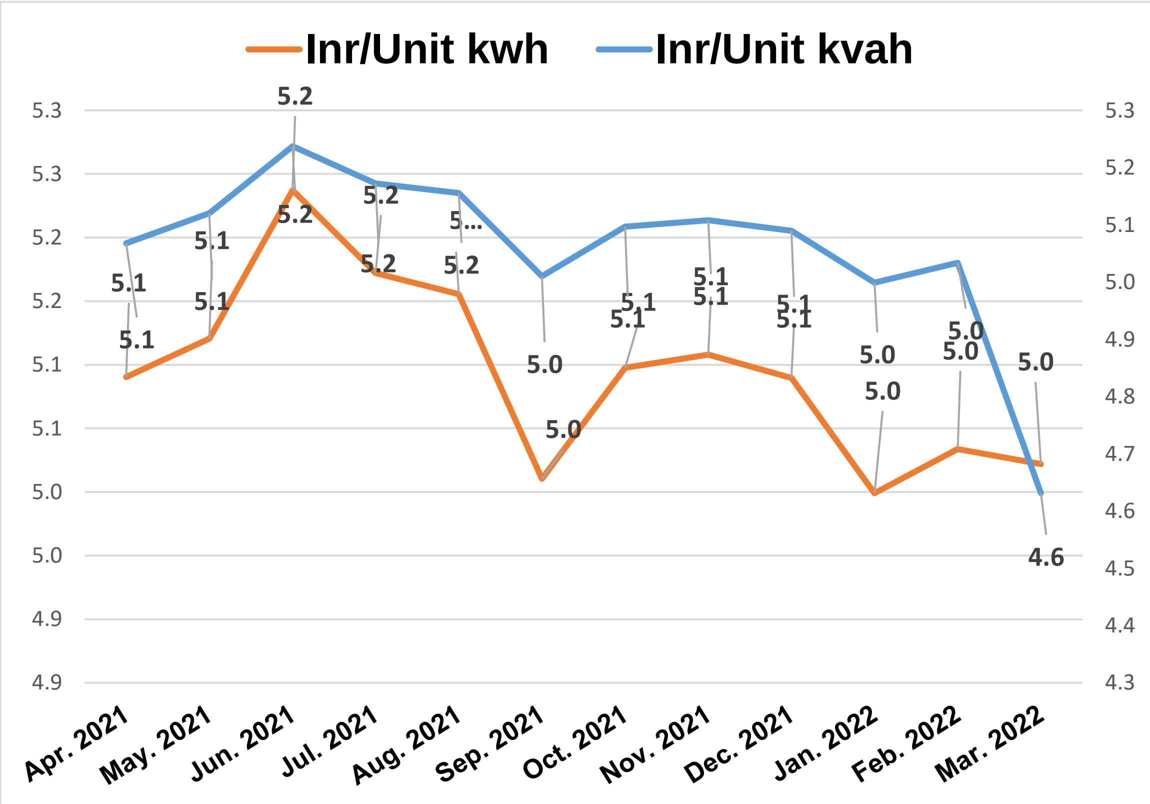
187600.0
175280.0
134600.0
164920.0
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022
Total electricity consumption (kVAh)


Power factor
1.000
0.980
0.960
0.940
0.920
0.900
0.880
0.996
1.000
1.000
1.000
1.000
1.000
1.000
1.000
1.000
1.000
1.000
0.922
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022
Power factor


MDI
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
307.0
208.0
187.0
266.0
282.0
615.0
510.0
403.0
475.0
548.0
520.0
488.0
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022
MDI


Total Payable Amount
1200000.0
1000000.0
800000.0
600000.0
400000.0
200000.0
0.0
439864.0
326429.0
299046.0
375395.0
385630.0
763318.0
894410.0
773046.0
954821.0
876224.0
677535.0
763786.0
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022
Total Payable Amount


Inr/Unit kwh
Inr/Unit kvah
Apr. 2021
May. 2021
Jun. 2021
Jul. 2021
Aug. 2021
Sep. 2021
Oct. 2021
Nov. 2021
Dec. 2021
Jan. 2022
Feb. 2022
Mar. 2022

- Average monthly consumption of the plant is 1.25 Lakhs kVAh /month, while total annual consumption of the plant is 14.97 Lakhs kVAh units. For fulfilling energy needs DIT University, has been paying Rs. 6.27 lakhs/Month while annually DIT University, is paying Rs 75.30 Lakhs.
- Incoming supply voltage is 11 kV which is further stepped down to 433 V with the help of transformer.
- Average demand of the plant is 400.8 KVA, while variation of M.D. is within 187.0 to 615.0 KVA respectively.
- Maintenance department is doing a great job by maintaining the power factor within the range of 0.99, which is good side. The effect of power factor is inbuilt in the billing structure so to be improves power factor is 0.999.

3.6. SUMMARY

Average Purchased Power Cost	:	
Apr. 2021 to Mar. 2022	:	Rs. 5.1 per KVAh
Apr. 2021 to Mar. 2022	:	Rs. 5.1 per KWh
Energy Charge		
Energy Charge	:	Rs. 4.4 per KVAh
Fixed Charge	:	Rs. 85 per KVA
Electricity Duty	:	Rs. 0.3 per KWh
Green Energy Charge	:	Rs. 0.1 per KWh

CHAPTER-4 TRANSFORMER LOAD PROFILE

4.1. RATED SPECIFICATION OF TRANSFORMER

DIT University, Dehradun draws power from the Uttarakhand power Corporation Limited (UPCL), at 11 kV; subsequently the voltage is stepped down by one transformer 11 KV to 0.433 KV by 1000 KVA transformer. The Contract demand of plant is 824 KVA. Billing is done on 11 KV.

Details of transformers, whose load profile has been taken during the audit,

Name Plate Data		TR-1
Rated	kVA	1000
Voltage	H. V	11000
	L.V	433
Amp.	H. V	52.5
	L.V	1333.4
Impedance Volt.	%	4.81
Phase	-	3
HZ	-	50
Cooling Type	-	ONAN
Vector Group	-	Dyn11
Mfg.	Year	2012
Make	-	Schneider
Remarks	-	
Condition of Transformer	-	Good
Silica Gel	-	OK
Temperature	-	OK
Oil Level		OK

4.2. LOADING ON MAIN INCOMER

The total loading was recorded on 1000 KVA transformers and load profile of transformer was measured during the audit and the averaged-out readings are given here in:

4.2.1. Load Profile of Transformer- 1000 KVA

Identification	Max	Min	Avg.
Voltage (Volts)			
"R" Phase	427.5	415.6	421.0
"Y" Phase	429.7	418.2	424.0
"B" Phase	430.2	419.9	424.7

Identification	Max	Min	Avg.
Current (Amps)			
"R" Phase	639.8	103.8	350.8
"Y" Phase	611.9	100.1	328.9
"B" Phase	658.6	100.1	356.8
Power Factor			
"R" Phase	0.998	0.970	0.988
"Y" Phase	0.997	0.969	0.988
"B" Phase	0.998	0.975	0.987
Power Drawn (KW)			
"R" Phase	154.71	24.96	84.62
"Y" Phase	148.30	23.76	79.27
"B" Phase	158.07	24.35	86.46
Total	**461.08**	**73.07**	**250.36**
Power Drawn (KVA)			
"R" Phase	156.88	25.21	85.65
"Y" Phase	149.67	24.28	80.15
"B" Phase	160.91	24.54	87.66
Total	**467.46**	**74.03**	**253.46**
Voltage Harmonics (THD %)			
"R" Phase	2.0	1.0	1.5
"Y" Phase	2.1	1.0	1.6
"Y" Phase	2.0	0.9	1.6
Current Harmonics (THD %)			
"R" Phase	12.1	3.0	7.4
"Y" Phase	12.3	3.3	7.8
"B" Phase	11.8	3.6	7.2
Frequency	50.3	49.7	50.0

4.3. Graphical Load Profile Of Transformer

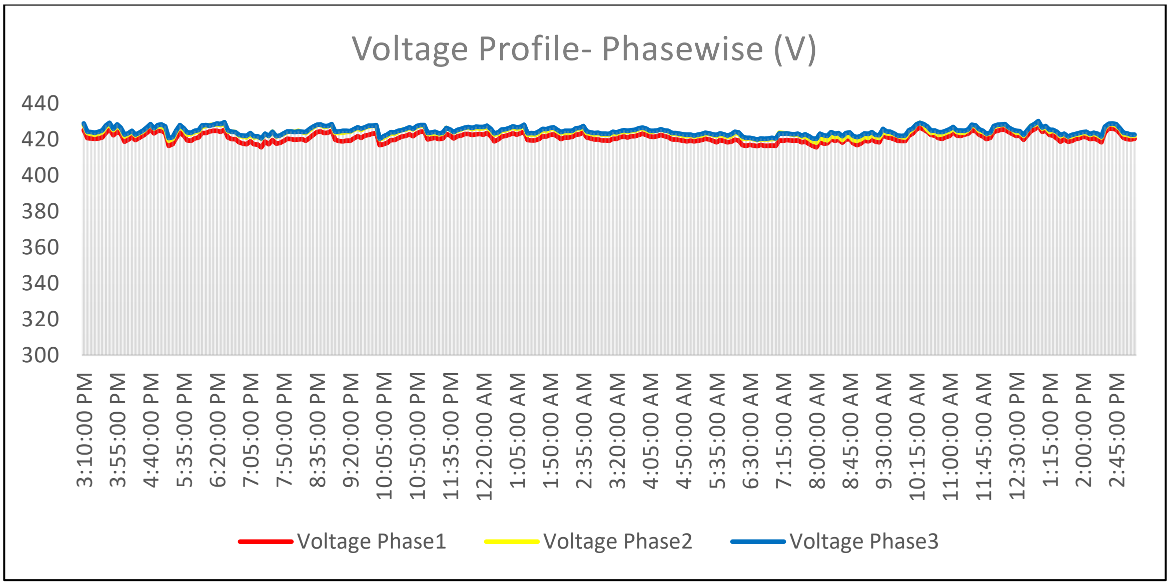
The load profile of the electrical parameters was recorded by using a portable 3-phase power analyzer. During the recording, the power analyzer recorded all the electrical parameters for further detailed analysis. The analysis of the different parameters recorded 24 hours reading at the LT incoming main supply is given below

4.3.1. Graphical Load profile of LT Panel Transformer-1

A) Graphical Voltage Profile (Volt)

All electrical equipment has a designed range of operating voltage. Therefore, it is important to operate all electrical equipment, within the specified voltage range. The voltage variations in all the three phases (R, Y and B) were recorded at the main Supply. The graphs below depict the variations in the voltage

Voltage Profile- Phase wise (V)



The observations taken from the above graphs:

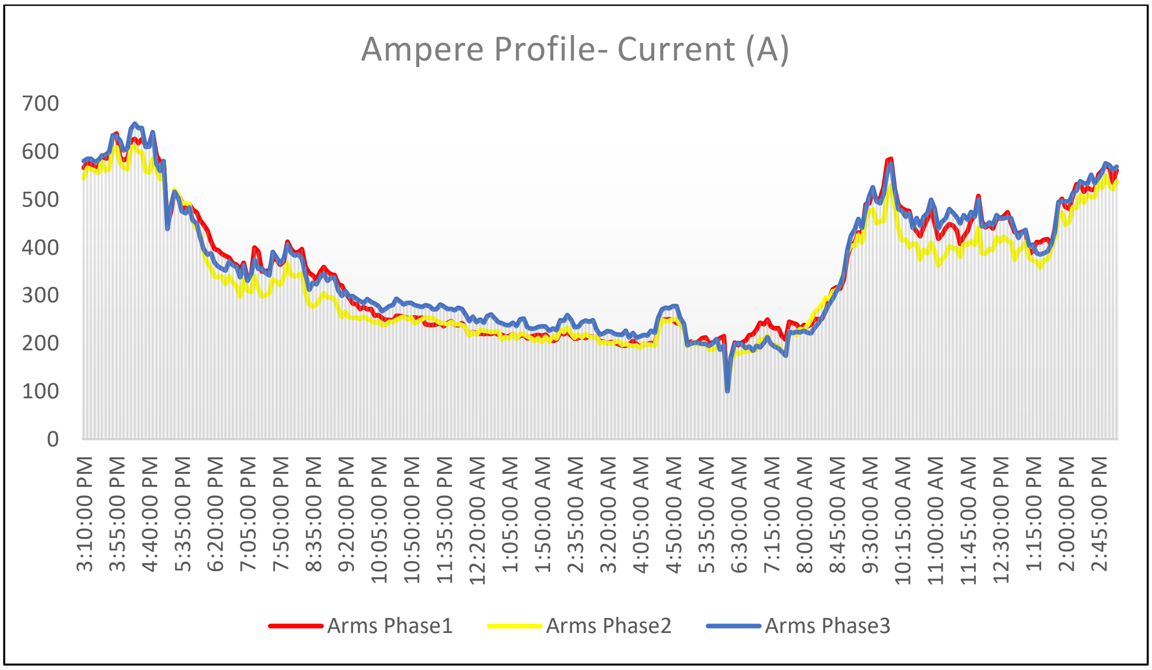
- There was a slight variation in phase-to-phase voltage.
- The average voltage recorded

	Voltage (R) Phase	Voltage(Y) Phase	Voltage(B) Phase
Max.	427.5	429.7	430.2
Min.	415.6	418.2	419.9
Ave.	421.0	424.0	424.7

B) Graphical Current Profile (Amp)

Current profile is the variation in the electrical current versus time. The current variations in all the three phases (R, Y and B) were recorded at the main panel of the transformer. The graphs below present the variations in the current:

Current Profile- Phase wise of the main Supply for 24 hours



The observations taken from the above graphs:

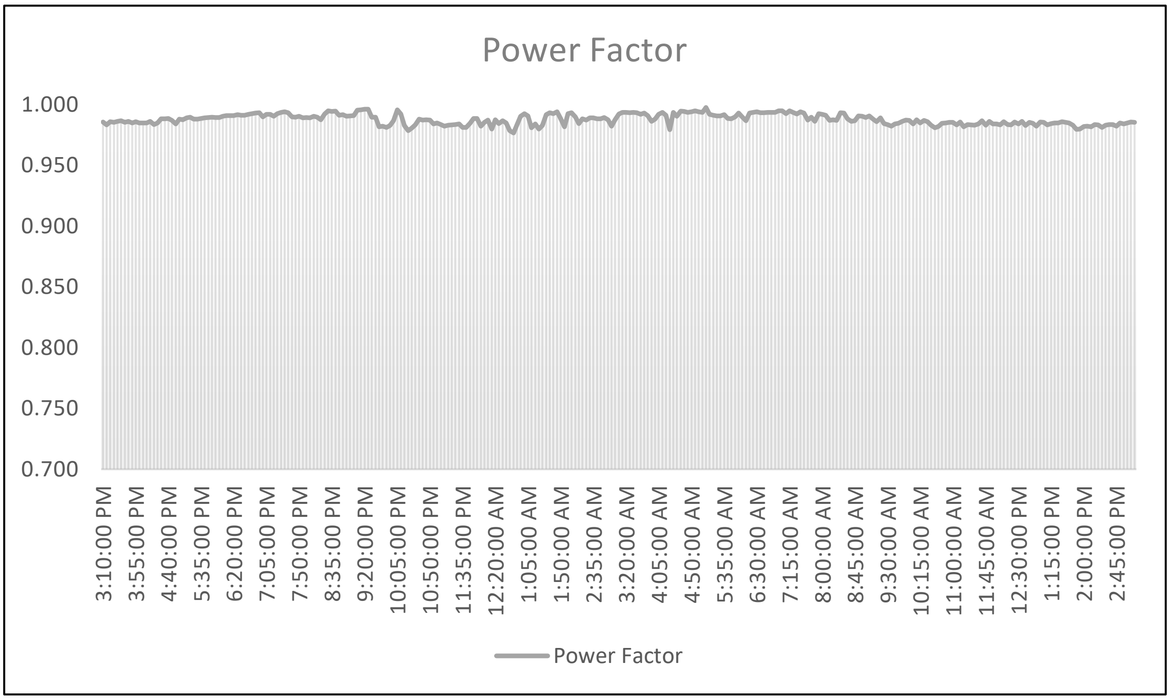
There is a considerable current variation in the different phases and hence the phase-to-phase load is not balanced. The Current variation during the 24 hours of measurement period

	Amp. Phase (R)	Amp. Phase (Y)	Amp. Phase (B)
Max.	639.8	611.9	658.6
Min.	103.8	100.1	100.1
Ave.	350.8	328.9	356.8

C) Graphical Power Factor Profile

Under the current tariff system, the billed units are in kVAh and the demand charges for apparent power (kVA) depend on the power factor. If the facility has a low power factor, then the demand drawn from the grid will increase and consequently the facility will incur more demand charges. The variation in the power factor was recorded to explore opportunities for improvement. The graph below presents the variations in the power factor of the power supply to the building:

Power factor profile for the main Incomer



The observations taken from the above graphs:

- The Power factor varied from 0.971 to 0.998 during the load hours of measurement period and average 0.988.

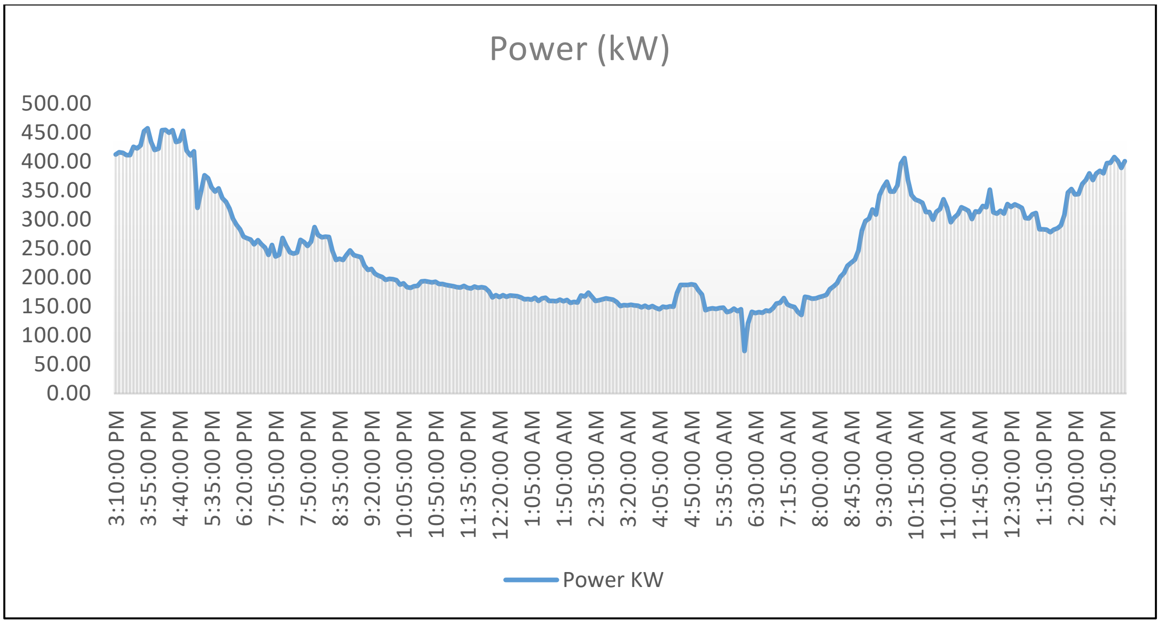
D) Graphical Load Profile (KW & KVA)

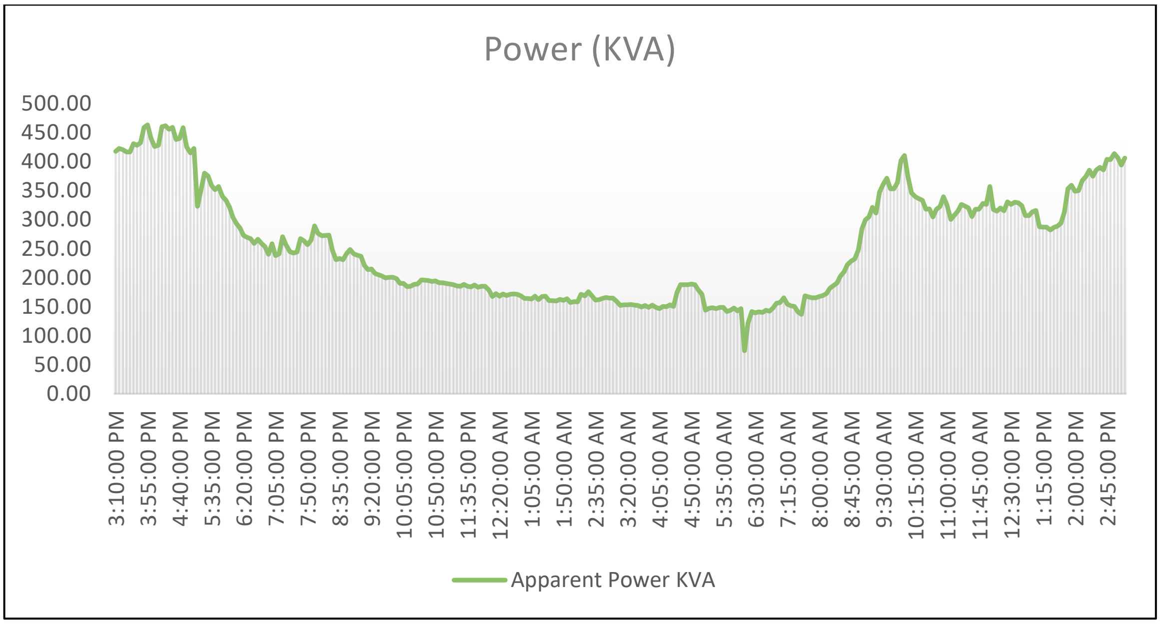
Load (real power) profile and apparent power profile is the variation in the electrical load versus time. In any electrical system, the vector sum of the active power (kW) and reactive power (kVAR) make up the total (or apparent) power (kVA) used. This is the power generated by a generation station for the user to perform a given amount of work. The total power is measured in kVA (Kilo Volts-Amperes) and the load or active power is measured in kW (kilowatts) and they become equal as and when the power factor approaches unity.

Total electricity charges (units and demand) are based on the load or active power (kW) and apparent power (kVA).

During the energy audit studies, the total operating load at the transformer was recorded to find out the variation in the load at different times of the day. The following graph depicts the variation in the load and apparent power of the premises:

Load Profile Real power (kW & kVA) profile of 24 Hr. main incomer





The observations taken from the graph:

- The load (kW) variation ranges from 73.07 kW to 461.08 kW during the load hours of measurement period and Average 250.36 kW.
- The apparent power (kVA) varies from 74.03 kVA to 467.46 kVA during the Load hours of measurement period and Average 253.46 kVA.
- The maximum loading on the transformer during the load hours of measurement period was 46.75% and the average loading on the transformer was 25.35%. To achieve the best efficiency point of any transformer, the loading value should be around 50 percent.

4.4. Efficiency of Transformer

The % loading & efficiency calculation is done on the both transformers which are on load at the time of audit. Transformer normally operate in the best efficiency range when loading percentage is around 50-70%. These transformers are running under loaded. The Running efficiency of Transformers-1 is 97.4%.

Performance Analysis of Transformer		TR-1 Main Incomer
Sr. No.	Rated Specifications	
1	Transformer Rating in KVA	1000
2	Avg. Load in KVA	253.5
3	Present % Loading	25.3
4	Total Losses of Transformer(kW)	6.5
5	Operating Power Factor	0.988
6	Total Loss (KVA)	6.58
7	Transformer Efficiency, %	97.4
8	Avg. Load in KW	250.36
9	Max Load in KW	461.08
10	Min. Load in KW	73.07

Remarks: Transformer normally operate in the best efficiency range when the loading percentage is around 50-70% of the rated capacity.

4.5. Other Feeder Loads

Particulars	Raman Building	Bose Hostel	Boys Mess	Bhabha Hostel	Sarabhai Hostel	Workshop Building	Chanakya Building Old	Civil Block (Visvesvaraya)
Voltage (Volts)								
"R" Phase	428	422	421	423	429	422	426	429
"Y" Phase	427	422	420	421	428	423	425	430
"B" Phase	427	421	421	423	428	424	425	429
Voltage (Volts)								
"R" Phase	247	244	243	244	248	244	246	248
"Y" Phase	247	244	242	243	247	244	245	248
"B" Phase	247	243	243	244	247	245	245	248
Current (Amps)								
"R" Phase	3.3	8	12	12	28.1	68	5	40.0
"Y" Phase	6.2	12	8	11	26.1	65	3	42.0
"B" Phase	4.5	7	9	10	34.6	71	4	41.0
Power Factor								
"R" Phase	0.780	0.980	0.870	0.860	0.890	0.956	0.760	0.840
"Y" Phase	0.800	0.970	0.820	0.840	0.900	0.942	0.740	0.810
"B" Phase	0.810	0.960	0.810	0.845	0.920	0.945	0.740	0.830
Power Drawn (KW)								
"R" Phase	0.6	1.9	2.5	2.5	6.2	15.8	0.9	8.3
"Y" Phase	1.2	2.8	1.6	2.2	5.8	15.0	0.5	8.4
"B" Phase	0.9	1.6	1.8	2.1	7.9	16.4	0.7	8.4
Total	**2.7**	**6.4**	**5.9**	**6.8**	**19.9**	**47.2**	**2.2**	**25.2**
Power Drawn (KVA)								
"R" Phase	0.8	1.9	2.9	2.9	7.0	16.6	1.2	9.9

Particulars	Raman Building	Bose Hostel	Boys Mess	Bhabha Hostel	Sarabhai Hostel	Workshop Building	Chanakya Building Old	Civil Block (Visvesvaraya)
"Y" Phase	1.5	2.9	1.9	2.7	6.4	15.9	0.7	10.4
"B" Phase	1.1	1.7	2.2	2.4	8.6	17.4	1.0	10.2
Total	**3.4**	**6.6**	**7.0**	**8.0**	**22.0**	**49.8**	**2.9**	**30.5**

Particulars	Chanakya Building (New)	Chanakya (AC Panel)	Chanakya Building (New)	Vasto Building	Pharmacy Building	Vedanta Building	Vedanta AC Panel	Sarojni Hostel	Kasturba Hostel
Voltage (Volts)									
"R" Phase	421	423	423	428.2	424	425	426	422	410
"Y" Phase	424	421	424	427.6	425	424	426	423	409
"B" Phase	421	424	421	428	424	425	425	424	407
Voltage (Volts)									
"R" Phase	243	244	244	247	245	245	246	244	237
"Y" Phase	245	243	245	247	245	245	246	244	236
"B" Phase	243	245	243	247	245	245	245	245	235
Current (Amps)									
"R" Phase	36.5	45	75	15	18	70	116	4	62
"Y" Phase	33.2	45	72	14	19	71	122	3	68
"B" Phase	62.2	46	71	16	20	76	116	2.8	84
Power Factor									
"R" Phase	0.964	0.917	0.870	0.927	0.832	0.920	0.850	0.790	0.970
"Y" Phase	0.954	0.913	0.863	0.947	0.845	0.930	0.840	0.800	0.960
"B" Phase	0.945	0.914	0.864	0.928	0.835	0.930	0.830	0.820	0.970
Power Drawn (KW)									

Particulars	Chanakya Building (New)	Chanakya (AC Panel)	Chanakya Building (New)	Vasto Building	Pharmacy Building	Vedanta Building	Vedanta AC Panel	Sarojni Hostel	Kasturba Hostel
"R" Phase	8.6	10.1	15.9	3.4	3.7	15.8	24.3	0.8	14.2
"Y" Phase	7.8	10.0	15.2	3.3	3.9	16.2	25.2	0.6	15.4
"B" Phase	14.3	10.3	14.9	3.7	4.1	17.3	23.6	0.6	19.1
Total	**30.6**	**30.4**	**46.1**	**10.4**	**11.7**	**49.3**	**73.1**	**1.9**	**48.8**
Power Drawn (KVA)									
"R" Phase	8.9	11.0	18.3	3.7	4.4	17.2	28.5	1.0	14.7
"Y" Phase	8.1	10.9	17.6	3.5	4.7	17.4	30.0	0.7	16.1
"B" Phase	15.1	11.3	17.3	4.0	4.9	18.6	28.5	0.7	19.7
Total	**32.1**	**33.2**	**53.2**	**11.1**	**14.0**	**53.2**	**87.0**	**2.4**	**50.5**

CHAPTER-5 REACTIVE POWER COMPENSATION

5.1. Capacitor Bank Installed

The plant is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. In plant different rating LT capacitor banks are installed. The actual KVAr delivery of individual Capacitor banks were measured during the Energy Audit. Results are given in the table.

5.2. Capacitor Bank

The plant is being billed on kVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. In plant one APFC panels (420 kVAr) capacitor bank panels are installed on main incomer. Details of capacitor measurement are given in the below table.

APFC-420 kVAr							
Sr. No.	Capacity (kVAr)	Rated (amp)	Measured			Remark	%Loading
			Measured-R	Measured-Y	Measured-B		
CB-1	10	13.1	13.2	13.2	13.1	**OK**	100.5
CB-2	10	13.1	13.7	13.5	13.1	**OK**	102.4
CB-3	50	65.5	50.2	50.2	51.1	**OK**	77.1
CB-4	50	65.5	42.3	43.5	46.9	**OK**	67.5
CB-5	25	32.8	32.9	32.1	30.4	**OK**	97.1
CB-6	25	32.8	24.6	26.5	27.7	**OK**	80.2
CB-7	25	32.8	30.0	28.7	29.6	**OK**	89.9
CB-8	25	32.8	32.2	31.2	30.6	**OK**	95.7
CB-9	50	65.5	61.2	60.3	59.9	**OK**	92.3
CB-10	50	65.5	60.2	60.6	58.7	**OK**	91.3
CB-11	25	32.8	31.2	30.5	31.0	**OK**	94.4
CB-12	25	32.8	22.2	30.2	30.0	**OK**	83.9
CB-13	25	32.8	29.2	30.1	31.2	**OK**	92.1
CB-14	25	32.8	29.3	31.1	30.7	**OK**	92.7
Total	**420**						

5.3. Recommendations

5.3.1. Improvement in the Operating Power Factor

The plant is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. In plant LT capacitor banks are installed. The minimum, maximum and average PF (Apr 2021 to Mar 2022) as per electricity bill are as follows

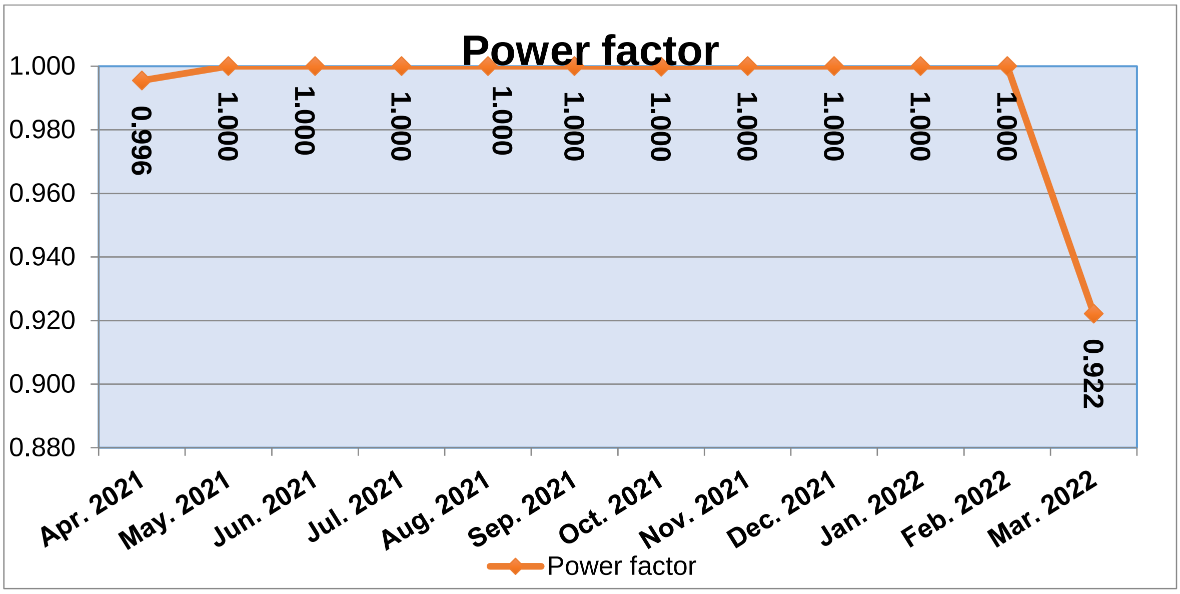
Description	Avg. Power Factor
Min. PF	0.922
Max. PF	1.000
Average PF	0.993

There are three capacitor bank panel is installed in the building at LT Side. The building is being billed on KVAh basis; therefore, the effect of power factor is inbuilt in the billing structure. Based on the electrical bills (11 KV) for Apr 2021 to Mar 2022, the operating power factor on the main incomer varied from 0.922 to 1.000. However, if we look at the overall average power factor is around 0.993, which is satisfactory, which is good side. The effect of power factor is inbuilt in the billing structure so to be improves power factor is 0.999

It is thus recommended to the capacitor banks wherein the delivery is poor (less than 70%) or out of order may be replaced, so that the overall system power factor is maintained at around 0.99 (lag). Improvement in the power factor would subsequently reduce the KVAh consumption, Since the plant management is maintaining Power factor 0.99, so no specific recommendation has been made on PF improvement.

5.3.2. Actual P.F from Electricity bill

Month	Power Factor
Apr. 2021	0.996
May. 2021	1.000
Jun. 2021	1.000
Jul. 2021	1.000
Aug. 2021	1.000
Sep. 2021	1.000
Oct. 2021	1.000
Nov. 2021	1.000
Dec. 2021	1.000
Jan. 2022	1.000
Feb. 2022	1.000
Mar. 2022	0.922
Avg.	**0.993**



5.3.3. Advantages of Power Factor Improvement

- Reactive components of the network are reduced and so also the total current in the system from the source end.
- I2R power losses are reduced in the system because of reduction in current.
- Voltage level at the load end is increased.
- kVA loading on the source generators as also on the transformers and line up to the capacitors reduce giving capacity relief. A high-power factor can help in utilities the full capacity of the electrical system.

5.3.4. Cost benefits of Power Factor Improvement

- Reduced kVA (Maximum Demand) charges in electricity bill
- Reduced distribution losses (kWh) within the plant network
- Better voltage at motor terminals and improved performance of motors
- A high-power factor eliminates penalty charges imposed when operating with low power factor

CHAPTER-6 POWER QUALITY

6.1. Power Quality & Harmonics

Equipment based on frequency conversion techniques generates harmonics. With the increased use of such equipment's, **harmonics related problems** have enhanced.

The harmonic currents generated by different types of loads, travel back to the source. While traveling back to the source, they generate harmonic voltages, following simple Ohm's Law. Harmonic voltages, which appear on the system bus, are harmful to other equipment connected on the same bus. In general, sensitive electronic equipment connected on this bus, will be affected.

The Harmonics Level on the LT side of the Transformers was measured, details of which is as under: -

The Harmonic Voltage and Current Limitations set forth by IEEE 519 1992 are:

- Maximum Individual Frequency Voltage Harmonic: 3%
- Total Harmonic Distortion of the Voltage: 5%

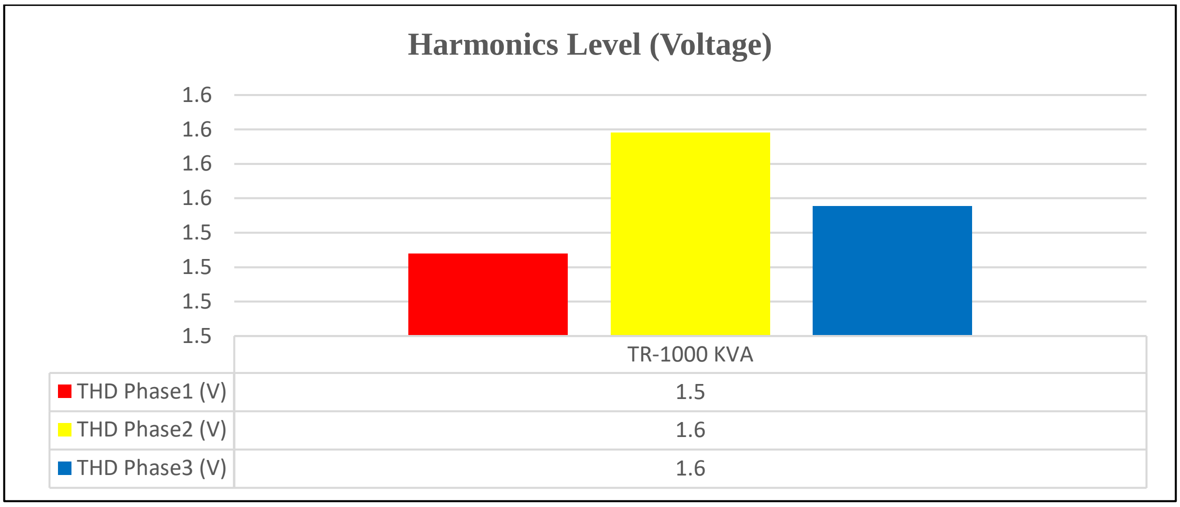
harmonic current limitations

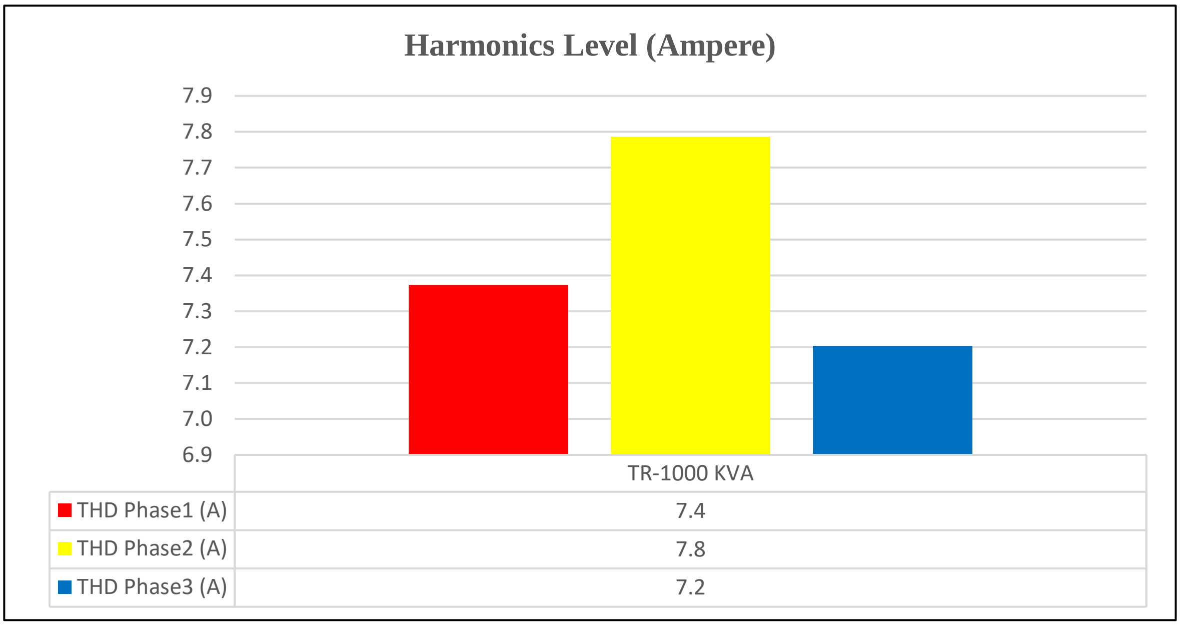
Maximum Harmonic Current Distortion in Percent of IL
120 Volt through 69 KV
Individual Harmonic Order (Odd Harmonics)

ISC/IL	h<11	11<h<17	17<h<23	23<h<35	35<h	TDD
<20*	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

Even harmonics are limited to 25% of the odd harmonic limits
TDD refers to Total Demand Distortion based on the average demand current at the fundamental frequency and measured at the PCC (Point of Common Coupling).
*All power generation equipment is limited to these values of current distortion regardless of ISC/ IL value.
ISC = Maximum short-circuit current at PCC.
IL = Maximum demand load current (fundamental) at the PCC.
h = Harmonic number.

Particulars	Transformer-1000 KVA
	Overall (Average)
Voltage Harmonics (V THD)	
"R" Phase	1.5
"Y" Phase	1.6
"B" Phase	1.6
Current Harmonics (A THD)	
"R" Phase	7.4
"Y" Phase	7.8
"B" Phase	7.2





As detailed above, the average voltage harmonics levels were around below 4%, which is under limit. The current harmonics levels were around below 8%, which is under limit. **The Overall Voltage harmonics for Transformer are within limit and current harmonics for Transformer is within limit.**

If Harmonics level is on higher side then appropriate harmonic filters may have to be installed in the system.

Different technologies are available mitigating the harmonics from the system. These include:

Detuned or broadband harmonic filters: these filter banks are tuned to a frequency just below the predominant harmonic frequency. If the predominant harmonic frequency is said, 5th, it is normal practice to tune the filters to 189 Hz, or 3.78th harmonic, in 50 Hz systems.
Active Harmonic Filters: these units are designed in such manner that, they will inject harmonic frequencies in the system, which will be in anti-phase of the load harmonic frequencies. This will effectively free the source being loaded due to harmonics.

6.2. OBSERVATIONS & SUGGESTIONS:

It is clear from the above data that the voltage & Current harmonics are within limit.

6.3. MAJOR CAUSES OF HARMONICS

Devices that draw non-sinusoidal currents when a sinusoidal voltage is applied create harmonics. Frequently these are devices that convert AC to DC. Some of these devices are listed below:

Electronic Switching Power Converters

- Computers, Uninterruptible power supplies (UPS), Solid-state rectifiers
- Electronic process control equipment, PLC's, etc
- Electronic lighting ballasts, including light dimmer
- Reduced voltage motor controllers

Arcing Devices

- Discharge lighting, e.g. Fluorescent, Sodium and Mercury vapor
- Arc furnaces, Welding equipment, Electrical traction system, Ferromagnetic Devices
- Transformers operating near saturation level
- Magnetic ballasts (Saturated Iron core)
- Induction heating equipment, Chokes, Motors

Appliances

- TV sets, air conditioners, washing machines, microwave ovens
- Fax machines, photocopiers, printers

These devices use power electronics like SCRs, diodes, and thyristors, which are a growing

Percentage of the load in industrial power systems.

Many problems can arise from harmonic currents in a power system. Some problems are easy to detect; others exist and persist because harmonics are not suspected. Higher RMS current and voltage in the system are caused by harmonic currents, which can result in any of the problems listed below:

Blinking of Incandescent Lights	Transformer Saturation
Capacitor Failure	Harmonic Resonance
Circuit Breakers Tripping	Inductive Heating and Overload
Conductor Failure	Inductive Heating
Electronic Equipment Shutting down	Voltage Distortion
Flickering of Fluorescent Lights	Transformer Saturation
Fuses Blowing for No Apparent Reason	Inductive Heating and Overload
Motor Failures (overheating)	Voltage Drop
Neutral Conductor and Terminal Failures	Additive Triplen Currents
Electromagnetic Load Failures	Inductive Heating
Overheating of Metal Enclosures	Inductive Heating
Power Interference on Voice Communication	Harmonic Noise
Transformer Failures	Inductive Heating

CHAPTER-7LIGHTING SYSTEMS

7.1. LIGHTING

7.1.1. Systems Installed

Various types of lighting fixtures are installed in different Area as and locations. Premises has already installed energy Efficient LED Lights at most of the places.
Energy Efficient LED Lights offer reduction in the power consumption besides excellent color rendering properties and high luminous efficacy. The detail of lighting fixtures is given below:

LED Light, Street Light, Flood Light, PL, etc. Energy Efficient LED Lights offer reduction in the power consumption besides excellent color rendering properties and high luminous efficacy. The detail of lighting fixtures is given below:

7.1.2. Types of Lighting fitting Fixtures

Sr. No	Fixture	Power Rating (Watt)
1	LED Tube Light	18/20
2	LED Tube Light	10
3	Panel Light 2’x2’	36
4	LED Bulb	9
5	Office Cobe Light	5/610/12/18/22
6	Street/ Outside LED Light	100/20
7	T5 Tube light	28
8	T8 Tube light	36
9	CFL	18WX2
10	CFL	36WX2

Different types of Light various watts are installed in plant. As units has already installed LEDs lights, still further saving in light could be achieved by taking following steps.

7.1.3. Time based control or Daylight linked control

Timed-turnoff switches are the least expensive type of automatic lighting control. In some cases, their low cost and ease of installation makes it desirable to use them where more efficient controls would be too expensive. Newer types of timed-turnoff switches are completely electronic and silent. The best choice is an electronic unit that allows the engineering staff to set a fixed time interval behind the cover plate. This system is recommended for street Lighting application in the building. Photoelectric cells can be used either simply to switch lighting on and off, or for dimming. They may be mounted either externally or internally. It is however important to incorporate time delays into the control system to avoid repeated rapid switching caused, for example, by fast moving clouds. By using an internally mounted photoelectric dimming control system, it is possible to ensure that the sum of daylight and electric lighting always reaches the design level by sensing the total light in the controlled area and adjusting the output of the electric lighting accordingly. If daylight alone is able to meet the design requirements, then the electric lighting can be turned off. The energy saving potential of dimming control is greater than a simple photoelectric switching system

7.1.4. Localized Switching

Localized switching should be used in applications, which contain large spaces. Local switches give individual occupants control over their visual environment and also facilitate energy savings. By using localized switching, it is possible to turn off artificial lighting in specific areas, while still operating it in other areas where it is required, a situation which is impossible if the lighting for an entire space is controlled from a single switch.

7.1.5. llumination & Lux level

To study, analyze and identify energy conservation options in lighting, a study of the unit lighting load was conducted. The purpose of the study was to determine the lighting load and its distribution in various sections of the buildings, determine the quality of illumination provided, and recommend measures to improve illumination and reduce electricity consumption.

A high quality and accurate digital LUX meter was used to measure the illumination level at various sections of the building during working hours. Other performance indicators such as type of lamps used, luminaries, mounting height, physical condition of lamps, use of day lighting, etc. were also noted down

Major reasons for poor illumination levels at selected locations of the building are as follows:

- Poor reflectors/no reflector installed for the tube lights.
- Large height of installed fittings from the working plane.
- Reduction in illumination due to ageing.
- Very old fittings and dust deposition on luminaries

7.1.6. Lux Level Measurements

Srl.	Location	LUX				Average Lux
	Civil Block					
1	Seminar Hall	350	420	450	410	408
2	Room-105	330	390	400	395	379
3	Room-205	250	270	290	320	283
4	Room-214	400	380	335	350	366
5	Room-302	290	310	320	350	318
6	Room-503	250	280	310	280	280
	Workshop					
7	WS-01	320	280	290	350	310
8	WL-107	260	235	240	290	256
9	WL-201	220	190	250	240	225
10	Engineering Physics Lab-II	450	390	440	390	418
11	WL-303	260	240	210	275	246
	Vasto Building					
12	Room-304 Lecture Hall-3	240	260	220	180	225
13	Room-104	305	418	400	390	378
14	Room-105 Studio-2	320	310	290	330	313
15	Room-402 Studio-7	450	410	380	290	383
	Building-Pharmacy					
16	Room-409	380	370	365	290	351
17	Pharmacology Lab-II	275	290	260	250	269
18	Pharmaceutics Lab-V	390	430	445	450	429
19	Lecture Hall-III	320	290	340	300	313
20	Pharmacognosy lab-I	680	590	610	625	626
21	Pharm. Chem Lab-1	340	280	300	265	296
	Vedanta Building					
22	Room-507	280	290	390	400	340
23	Lecture Hall-25	280	350	210	265	276
24	Computer network lab-424	320	300	345	290	314
25	Room-404	220	190	180	175	191
26	Room-328	250	255	210	220	234
27	Romm-305	240	260	270	220	248

7.1.7. Assessment of lighting system

Example: Room

Lux Measured = Average Lux = 286

287	284

Length of the Room = 18ft.

Width of the Room = 14ft

Working Place Height = 10ft

STEP 1	Measure the Floor area of the interior :	Area = 18x14 = 252 sqft
STEP 2	Calculate the Room Index 18 x 14 / 10 (18 + 14) = .78	RI = .78
STEP 3	Determine the total circuit watts of the installation by a power meter if a separate feeder for lighting is available. If the actual value is not known a reasonable approximate can be obtained by totaling up the lamp wattage including the ballasts	Total Circuit watts 54 W x 16 = 864 32 W x 4 = 128 TOTAL = 992W
STEP 4	Calculate Watts per square meter, Value of Step 3 ÷ Value of Step 1	W/m^2 = 3.9
STEP 5	Ascertain the average maintained luminance by using Lux Meter, Eav. Maintained	Eav.maint = 286
STEP 6	Divide 5 by 4 to calculate Lux per Watt per square Meter	$Lux/W/m^2$ = 72.77
STEP 7	Obtain target Lux/W/M2 lux for type of the type of interior/ application and RI (2)	Target $Lux/W/m^2$ = 36
STEP 8	Calculate Installed Load Efficacy Ratio (6 ÷ 7)	ILER = 2.02

ILER 0.75 or over = Satisfactory to Good

Measuring Units Light Level – illuminance

Illuminance is measured in foot candles (ftcd, fc, fcd) or lux in the metric SI system). A foot candle is actually one lumen of light density per square foot, one lsux is one lumen per square meter.

- 1 lux = 1 lumen / sq meter = 0.0001 phot = 0.0929 foot candle (ftcd, fcd)
- 1 phot = 1 lumen / Sq centimeter = 10000 lumens / sq meter = 10000 lux
- 1 foot candle (ftcd, fcd) = 1 lumen / sqft = 10.752 lux

Common Light Level Outdoor

Common light levels outdoor at day and night can be found in the table below :

Lux level of different natural occasions

Condition	Illumination	
	(ftcd)	(lux)
Sunlight	10,000	107,527
Full Daylight	1,000	10,752
Overcast Day	100	1075
Very Dark Day	10	107
Twilight	1	10.8
Deep Twilight	.1	1.08
Full Moon	.01	.108
Quarter Moon	.001	.0108
Starlight	.0001	.0011
Overcast Night	.0001	.0001

7.1.8. Common and Recommended Light Levels Indoor

The outdoor light level is approximately 10,000 lux on a clear day. In the building, in the area closes to windows, the light level may be reduced to approximately 1,000 lux. In the middle area its may be as low as 25- 50 lux. Additional lighting equipment is often necessary to compensate the low levels.

Earlier it was common with light levels in the range 100 -300 lux for normal activities. Today the light level is more common in the range 500 – 1000 lux – depending on activity. For precision and detailed works, the light level may even approach 1500 – 2000 lux.

The table below is a guidance for recommended light level in different work spaces:

Activity	Illumination (lux, lumen/m^2)
Public areas with dark surroundings	20 -50
Simple orientation for short visits	50 -100
Working areas where visual tasks are only occasionally performed	100 -150
Warehouse, Homes, Theaters, Archives	150
Easy Office work, classes	250
Normal Office work, PC work, Study library, Groceries, show room, laboratories	500
Supermarkets, Mechanical workshops, Office landscapes	750
Normal Drawing work, very detailed mechanical works	1000
Detailed drawing work, very detailed mechanical works	1500 -2000

Performance of visual tasks of low contract and very small size for prolonged periods of time	2000 -5000
Performance of visual tasks of low contract and very small size for prolonged period of time	2000 -5000
Performance of very prolonged and exacting visuals tasks	5000 – 10000
Performance of very special visual tasks of extremely low contract and small size	10000 - 20000

7.2. RECOMMENDATIONS

7.2.1. Optimization of the Main Incomer Voltage on Main Panel

The average voltage on LT side of Transformers was around 244 V. This may be an adequate voltage for motive loads like motors etc, but for the lighting systems normally, the voltage should be around 220 volts (phase to neutral). A reduction of around 15% in the lighting voltage can reduce the power consumption by around 20%.

As the conventional light was replaced with LED lamps in phase manner the effect of voltage reduction in terms of power saving will be almost negligible. However, reduction and stabilization of voltage will improve the life of lamps.

CHAPTER-8 D.G SETS

8.1. D.G. Rated Specifications

The plant has installed 02 No's DG Set of 500 KVA & 250 KVA. for in-house power generation. The DG is run during power cut and testing only. All DG set synchronize together. The rated specification of DG is as follows

Name Plate Data	Unit	DG-1	DG-2
Rated	kVA	500	250
	kW	400	200
Voltage	V	415	415
Amp.	I	695.6	348.0
Phase		3	3
PF		0.8	0.8
RPM		1500	1500
Frequency	Hz	50	50
Excitation	Volts	48	48
Excitation	Amps	2.3	2.3

8.2. Performance Assessment of D. G

During the audit we measured the specific fuel consumption (kWh/Ltr) of DG sets. Analyses of last one-year DG log book details for Apr. 2021 to Mar. 2022. Specific energy consumption shows in below table as per standard

The analysis of the different parameters recorded reading at the L.T incoming main supply and during this period the diesel consumption was also recorded empty tank method

The standard specific fuel consumption (SFC) of DG sets is in the range of 3.0 to 4.0 kWh/ltr. Present Average SFC of DG is 3.0 to 3.3 kWh/Ltr, which is good as per design value.

8.3. Observation and Recommendations

The plant has installed 02 No's DG Set of 500 KVA & 250 KVA for in-house power generation. The DG is run during power cut and testing only. Specific power generation is dependent on the DG loading and its overall condition.

1. D.G sets are neat & clean
2. DG set area should have Proper Ventilation
3. DG Log book proper maintain

4. To be suggest Energy kWh in log book

8.4. GENERAL RECOMMENDATIONS FOR ENERGY MEASURED IN DG SETS

1. Ensure Steady load condition on the DG set and avoid idle running.
2. Improve air filtration.
3. Ensure fuel oil storage, handling and preparation as per manufacturers' guidelines/oil company data.
4. Calibrate and overhaul fuel injectors and injection pumps regularly as recommended by manufacturer.
5. Ensure compliance with maintenance checklist
6. Ensure steady load conditions, avoiding fluctuations, imbalance in phases, harmonic loads.
7. Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements.
8. Efficiency of DG Set can be increase by loading 70-80% load
9. The starting current of squirrel cage induction motor is as much as six times the rated current for a few seconds with direct-on-line starters. In practice, it has been found that the starting current value should not exceed 200% of the full load capacity of the alternator. The voltage and frequency throughout the motor starting interval recovers and reaches rated values usually much before the motor has picked up full speed
10. It is always recommended to have the load as much balanced as possible, since the unbalanced loads can cause heating of the alternator, which may result in unbalanced output voltage. The maximum unbalanced load between phases should not exceed 10% of the capacity of the generating sets.
11. The electricity rules clearly specify that two independent earths to the body and neutral should be provided to give adequate protection to the equipment in case of an earth fault and to drain away any leakage of potential from the equipment to the earth.

CHAPTER-9 SOLAR PHOTOVOLTAIC CELL

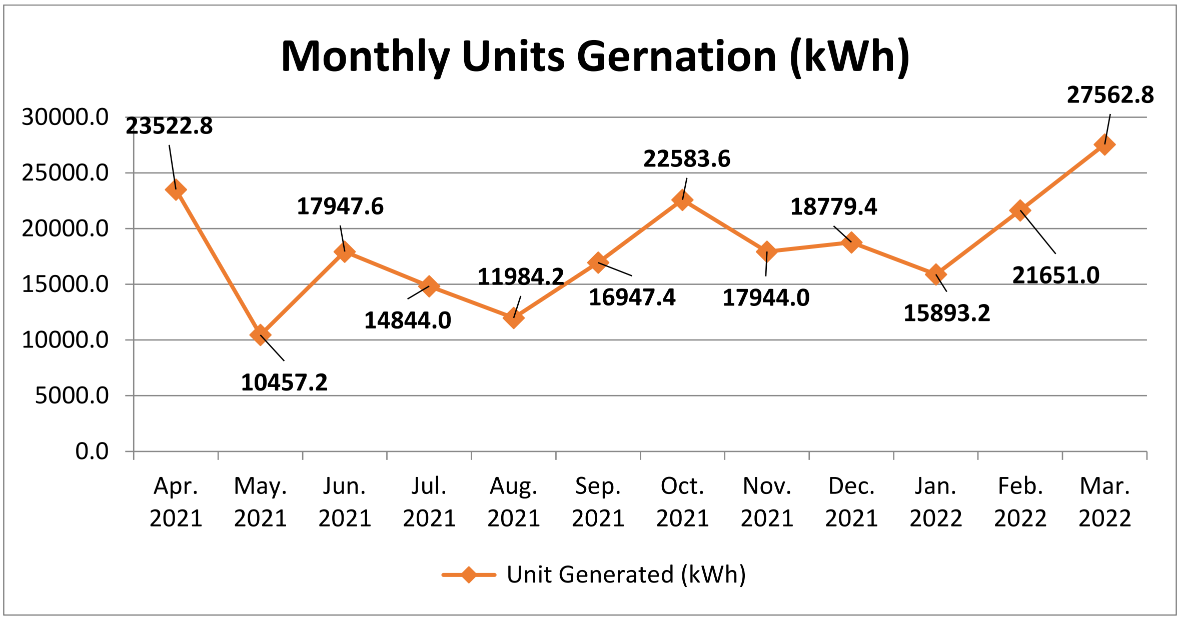
9.1. Installation of Solar Photovoltaic Cell (SPV)

The 250 kWp solar PV installed on roof top of building. Solar Photovoltaic Cell for Power Generation for lighting load & other load in the Building, **Solar photovoltaic technologies** convert solar energy into useful energy forms by directly absorbing solar photons—particles of light that act as individual units of energy—and either converting part of the energy to electricity. **A-Z Energy Engineers Pvt. Ltd. acknowledges and appreciates the commitment of the management towards conservation of Energy.**

Sr. No	Description	Capacity (kWp)
1	Workshop Building	100
2	Civil Block	50
3	Vedanta Block	100

9.2. Unit Generation By Solar PV

Sr No.	Month	days of Month	Unit Generated (kWh)	CUF (%)	Average per day generation (KWp)
1	**Apr. 2021**	30	**23522.8**	13.1	3.1
2	**May. 2021**	31	10457.2	5.6	1.3
3	**Jun. 2021**	30	17947.6	10.0	2.4
4	**Jul. 2021**	31	14844.0	8.0	1.9
5	**Aug. 2021**	31	11984.2	6.4	1.5
6	**Sep. 2021**	30	16947.4	9.4	2.3
7	**Oct. 2021**	31	22583.6	12.1	2.9
8	**Nov. 2021**	30	17944.0	10.0	2.4
9	**Dec. 2021**	31	18779.4	10.1	2.4
10	**Jan. 2022**	31	15893.2	8.5	2.1
11	**Feb. 2022**	28	21651.0	12.9	3.1
12	**Mar. 2022**	31	27562.8	14.8	3.6
		365	**220117.20**	**10.1**	**2.4**



$$\text{Capacity Utilization Factor (C.U.F)} = \frac{\text{(Actual energy from the plant (kWh))}}{\text{(Plant Capacity (kwp) x 24 x 365)}}$$

The performance of Solar PV plant is less than national average of 19%. It is therefore, suggested to regularly clean these panels for better performance

The units or kWh output of a solar panel will depend on the panel efficiency and availability of sunlight in a location. The factor that defines this output is called CUF (or Capacity Utility Factor). For India, it is typically taken as 19% and the calculation of units goes as:

Units Generated Annually (in kWh) = System Size in Kw * CUF * 365 * 24.

So typically, a 1 kW capacity solar system will generate 1600-1700 kWh of electricity per year. This can provide electricity for 25 years.

9.3. Observation and Recommendations

However, the less generation of units is due to poor maintenance of Solar panel, as dust, deposited on the surface of solar plates, which act as shield from sun rays thus effecting the power generation badly. it is recommended that the solar panel inspect the structure at regular intervals for dirt or some other things that might have piled on top. It is important that the panels should be kept clean.

CHAPTER-10 THERMOGRAPHY

10.1. Thermal Imagine

Thermography is a term used to describe a type of photography that uses infrared radiated wavelengths to make pictures as opposed to visible light as in normal photographs. It can be also referred to as 'thermal imaging' or 'infrared'. Objects that have a temperature above absolute zero (-273.15°C or 0 Kelvin) emit infrared wavelengths. Thermography is the production of thermal (heat) pictures from these wavelengths, whereby temperature measurements or comparative analysis can be made.

This survey and report combine images to provide a general thermo graphic overview of the Cables, panels & motors, together with a selection of close-up observations of areas with particular interest. Whilst care has been taken to record temperatures as accurately as possible, the absolute values obtained should be treated with a degree of caution. Variable environmental conditions together with changes in camera angle, distance, material change and emissivity can all adversely affect the result. However, by combining images with equal parameters the 'relative' change of temperature across a selected material will be accurate and therefore useful analysis can be made.

From discussions prior to the survey, the following points have been incorporated into the methodology of data collection and presentation of findings.

- The survey to be a combination of general scanning and capturing of selected images that may fairly represent the situation. (Qualitative Survey).
- Anomalies noted to be identified either within the narrative or on the image.
- In order to classify the severity of the thermal anomalies recorded, atmospheric site temperature was used as a rated temperature.
- Emissivity is set as per the contact probe meter. For setting a emissivity following method was used.

10.2. Summary of Scanned Equipment

In appendix A section of this report contains the actual thermo graphic images of the anomalies. For all anomalies, we have included a control photograph identifying the equipment (regular photograph) and a thermo graphic image (thermal image) of the area where the anomaly was found.

10.3. General Recommendations and Comments

In general, after taking a number of thermal images, we have seen various spots are over the safe temperature limit. You should take appropriate action to capture the heat loss. It creates harmful area for human beings and we can avoid the injuries.

Note: Where temperature is on higher side reason

1) Lose connection
2) Under size cable

CHAPTER-18 OTHER POSSIBLE AREAS FOR ENERGY SAVINGS

18.1.DAY LIGHT HARVESTING

Although there is no simpler way to reduce the amount of energy consumed by lighting system than to manually turn OFF whenever not needed, this is not done as often as it could be. In response, automatic lighting control strategies can be adopted:

- Scheduling Control: Use a time scheduling device to control lighting systems according to predetermined schedules

A central processor with relays is usually capable of controlling several output channels, each of which may be assigned to one or more lighting circuits. Overrides can be provided to accommodate individuals who use the space during scheduled off hours.

- Day lighting: Control lights in response to the presence of daylight illumination in the space
- Lumen Maintenance: gradually adjust the electric light levels over time to correspond with the depreciation of light output from ageing lamps.
- Occupancy Sensing: Control light in response to the presence or absence of people in the space

These are automatic scheduling devices that detect motion and turn ON / OFF the lights accordingly. Most of these devices can be calibrated for sensitivity and for the length of time delay between the last detected occupancy and extinguishing of light. Occupancy sensors typically consist of a motion detector, a control unit and a relay.

Occupancy-linked control can be achieved using infrared, acoustic, ultrasonic or microwave sensors, which detect either movement or noise in room spaces. These sensors switch lighting on when occupancy is detected, and off again after a set time period, when no occupancy movement detected. They are designed to override manual switches and to prevent a situation where lighting is left on in unoccupied spaces. With this type of system it is important to incorporate a built-in time delay, since occupants often remain still or quiet for short periods and do not appreciate being plunged into darkness if not constantly moving around.

Daylight Harvesting is the term used in sustainable architecture and the building controls for a control system that reduces the use of artificial lighting with electric lamps in building interiors when natural daylight is available, in order to reduce energy consumption. The concept of daylight harvesting is simple. Digital photo sensors detect daylight levels and automatically adjust the output level of electric lighting to create a balance. The goal is energy savings.

Until now there have been barriers to widespread acceptance of daylight harvesting. This is due in part to complications associated with commissioning. With the availability of integrated micro panel lighting controls, with 2 or 4 switching outputs daylight harvesting is feasible. The features normally include unique set points, delays and adjustment curves for every relay.

18.2. Timed Based Control or Daylight Linked Control

Timed-turnoff switches are the least expensive type of automatic lighting control. In some cases, their low cost and ease of installation makes it desirable to use them where more efficient controls would be too expensive. Newer types of timed-turnoff switches are completely electronic and silent. The best choice is an electronic unit that allows the engineering staff to set a fixed time interval behind the cover plate. This system is recommended for street Lighting application in the building. Photoelectric cells can be used either simply to switch lighting on and off, or for dimming. They may be mounted either externally or internally. It is however important to incorporate time delays into the control system to avoid repeated rapid switching caused, for example, by fast moving clouds. By using an internally mounted photoelectric dimming control system, it is possible to ensure that the sum of daylight and electric lighting always reaches the design level by sensing the total light in the controlled area and adjusting the output of the electric lighting accordingly. If daylight alone is able to meet the design requirements, then the electric lighting can be turned off. The energy saving potential of dimming control is greater than a simple photoelectric switching system.

18.3. Localized Switching

Localized switching should be used in applications, which contain large spaces. Local switches give individual occupants control over their visual environment and also facilitate energy savings. By using localized switching it is possible to turn off artificial lighting in specific areas, while still operating it in other areas where it is required, a situation which is impossible if the lighting for an entire space is controlled from a single switch.

CHAPTER-19 GENERAL TIPS FOR ENERGY CONSERVATION IN DIFFERENT UTILITIES SYSTEMS

19.1. ELECTRICITY

- Schedule your operations to maintain a high load factor
- Minimize maximum demand by tripping loads through a demand controller
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

19.2. MOTORS

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation
- (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- Demand efficiency restoration after motor rewinding.

19.3. DRIVES

- Use variable-speed drives for large variable loads.
- Use high-efficiency gear sets.
- Use precision alignment.
- Check belt tension regularly.
- Eliminate variable-pitch pulleys.
- Use flat belts as alternatives to v-belts.
- Use synthetic lubricants for large gearboxes.
- Eliminate eddy current couplings.
- Shut them off when not needed.

19.4. FANS

- Use smooth, well-rounded air inlet cones for fan air intakes.
- Avoid poor flow distribution at the fan inlet.
- Minimize fan inlet and outlet obstructions.
- Clean screens, filters, and fan blades regularly.
- Use aerofoil-shaped fan blades.
- Minimize fan speed.
- Use low-slip or flat belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable fan loads.
- Use energy-efficient motors for continuous or near-continuous operation
- Eliminate leaks in ductwork.
- Minimize bends in ductwork
- Turn fans off when not needed.

19.5. BLOWERS

- Use smooth, well-rounded air inlet ducts or cones for air intakes.
- Minimize blower inlet and outlet obstructions.
- Clean screens and filters regularly.
- Minimize blower speed.
- Use low-slip or no-slip belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable blower loads.
- Use energy-efficient motors for continuous or near-continuous operation.
- Eliminate ductwork leaks.
- Turn blowers off when they are not needed.

19.6. PUMPS

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

19.7. LIGHTING

- Reduce excessive illumination levels to standard levels using switching, delamping, etc. (Know the electrical effects before doing delamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- Consider lowering the fixtures to enable using less of them.
- Consider daylighting, skylights, etc.
- Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.

19.8. DG SETS

- Optimize loading

- Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.
- Use jacket and head cooling water for process needs
- Clean air filters regularly
- Insulate exhaust pipes to reduce DG set room temperatures
- Use cheaper heavy fuel oil for capacities more than 1MW

19.9. BUILDINGS

- Seal exterior cracks/openings/gaps with caulk, gasketing, weatherstripping, etc.
- Consider new thermal doors, thermal windows, roofing insulation, etc.
- Install windbreaks near exterior doors.
- Replace single-pane glass with insulating glass.
- Consider covering some window and skylight areas with insulated wall panels inside the building.
- If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
- Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.
- Use landscaping to advantage.
- Add vestibules or revolving doors to primary exterior personnel doors.
- Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.
- Use intermediate doors in stairways and vertical passages to minimize building stack effect.
- Use dock seals at shipping and receiving doors.
- Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

19.10. WATER & WASTEWATER

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.
- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.
- Automate blowdown to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Install efficient irrigation.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.
- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.
- Use the lowest possible hot water temperature.

- Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.
- If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.
- Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.
- Use freeze protection valves rather than manual bleeding of lines.
- Consider leased and mobile water treatment systems, especially for deionized water.
- Seal sumps to prevent seepage inward from necessitating extra sump pump operation.
- Install pretreatment to reduce TOC and BOD surcharges.
- Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)
- Verify the sewer flows if the sewer bills are based on them

19.11. MISCELLANEOUS

- Meter any unmetered utilities. Know what normal efficient use is. Track down causes of deviations.
- Shut down spare, idling, or unneeded equipment.
- Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.
- Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.
- Renegotiate utilities contracts to reflect current loads and variations.
- Consider buying utilities from neighbors, particularly to handle peaks.
- Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.
- Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.
- Minimize use of flow bypasses and minimize bypass flow rates.
- Provide restriction orifices in purges (nitrogen, steam, etc.).
- Eliminate unnecessary flow measurement orifices.
- Consider alternatives to high-pressure drops across valves.
- Turn off winter heat tracing that is on in summer.

Annexure-1

Certification

This part shall indicate certification by Accredited Energy Auditor stating that:

(i) The data collection has been carried out diligently and truthfully;

(ii) All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorized and no tempering of such devices has occurred

(iii) All reasonable professional skill, case and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts;

(iv) Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

(v) The energy audit has been carried out in accordance with the Bureau of Energy Efficiency (Manner and Intervals of Time for the Conduct of Energy Audit) Regulations, 2010.

(Dr. P.P. Mittal)

Accredited Energy Auditor AEA-011

Annexure-2

Certificate of Accreditation

BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EA-6851

Accreditation Registration No.: AEA-0011

Certificate of Accreditation

This is to certify that Mr./Ms. Prem Prakash Mittal having its trade/registered office at Delhi has been given accreditation as accredited energy auditor. The certificate shall be effective from 26th day of February 2013

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. 0011 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 26th day of May 2014

Secretary,
Bureau of Energy Efficiency
New Delhi

Annexure-3

Recommended Lux Levels for different locations

➢ **Entrance**	
Entrance halls, lobbies, waiting rooms	= 200
Enquiry Desks	= 500
Gate Houses	= 200
➢ **Circulation Areas**	
Lifts	= 100
Corridors, passageways, stairs	= 100
Escalators, revelators	= 150
➢ **Medicine & First Aid Centers**	
Consulting Rooms, Treatment Rooms	= 500
Rest Rooms	= 150
Medical Stores	= 150
➢ **Staff Rooms**	
Offices	= 300
Changing, locker and cleaners room, Cloak rooms, lavatories	= 100
Rest Rooms	= 150
➢ **Staff Restaurants**	
Canteens, Cafeterias, dining rooms, mess rooms	= 200
Survey, vegetable preparation, washing up area	= 300
Food preparation & cooking	= 500
Food stores, cellars	= 150
➢ **Communication**	
Switch board rooms	= 300
Telephone, apparatus rooms	= 150
Telex room, post rooms	= 500
Reprographic room	= 300

Annexure-4

Transformers Standard Losses in watts

ENERGY IS LIFE
B E E
CONSERVE IT

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)

BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

19th December, 2016

Important Instructions to all Distribution Transformer manufacturers and permittee:

This is with reference to the amendment notification, S.O. No. 4062 (E) for Distribution Transformer dated 16th December, 2016. Amendments in the star rating programs as follows:

Table 2 (Effective from 1st January, 2017 onwards)

Standard Losses in watts up to 11 KV Class (For ratings below 200 kVA & for 200 kVA)										
Rating (kVA)	Star 1		Star 2		Star 3		Star 4		Star 5	
	50 Per cent. Load	100 Per cent. Load	50 Per cent. Load	100 Per cent. Load	50 Per cent. Load	100 Per cent. Load	50 Per cent. Load	100 Per cent. Load	50 Per cent. Load	100 Per cent. Load
16	135	440	120	400	108	364	97	331	87	301
25	190	635	175	595	158	541	142	493	128	448
63	340	1140	300	1050	270	956	243	870	219	791
100	475	1650	435	1500	392	1365	352	1242	317	1130
160	670	1950	570	1700	513	1547	462	1408	416	1281
200	780	2300	670	2100	603	1911	543	1739	488	1582

Table 3 (Effective from 1st January, 2017 onwards)

Standard losses in watts up to 11 KV Class (For ratings above 200 kVA)											
Rating (kVA)	Per Cent. Impedance	Star 1		Star 2		Star 3		Star 4		Star 5	
		50 Per Cent. Load	100 Per Cent. Load	50 Per Cent. Load	100 Per Cent. Load	50 Per Cent. Load	100 Per Cent. Load	50 Per Cent. Load	100 Per Cent. Load	50 Per Cent. Load	100 Per Cent. Load
250	4.5	980	2930	920	2700	864	2488	811	2293	761	2113
315	4.5	1025	3100	955	2750	890	2440	829	2164	772	1920
400	4.5	1225	3450	1150	3330	1080	3214	1013	3102	951	2994
500	4.5	1510	4300	1430	4100	1354	3909	1282	3727	1215	3554

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation

चौथा तल, सेवा भवन, आर० के० पुरम, नई दिल्ली-110 066 वेबसाईट/Website : www.beeindia.in
4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066 टेली/Tel.: 26179699 (5 Lines) फैक्स/Fax : 91 (11) 26178352

630	4.5	1860	5300	1745	4850	1637	4438	1536	4061	1441	3717
1000	5	2790	7700	2620	7000	2460	6364	2310	5785	2170	5259
1250	5	3300	9200	3220	8400	3142	7670	3066	7003	2991	6394
1600	6.25	4200	11800	3970	11300	3753	10821	3547	10363	3353	9924
2000	6.25	5050	15000	4790	14100	4543	13254	4309	12459	4088	11711
2500	6.25	6150	18500	5900	17500	5660	16554	5430	15659	5209	14813”

Manufacturers/permittee should consider the following for getting star rating approvals:

1. Manufacturers/Permittee are allowed to renew their existing models as per table 2 w.e.f 22nd December, 2016.
2. All the existing models will be valid till 31st December 2016 and after this, these models will be made expired automatically by BEE.
3. Manufacturers/Permittee are allowed to register their fresh models as per table 2 & table 3 w.e.f 22nd December, 2016.

Read the following instructions carefully for those manufacturers who wish to continue the existing model.

A. Renewal of Existing Model:

If the existing model is continued to comply with revised star level, then the following shall apply:

1. A renewal option (i.e., from table 1 to table 2) will be available on manufacturers/permittee's web portal from 22nd December, 2016. If any of the permittee willing to continue their existing model, a declaration on company letter head (with stamp & sign of authorised signatory) needs to be submitted to the Bureau Along with Renewal fee of **five hundred rupees**. (Renewal fee may be paid through Online Banking or Demand Draft).
2. **After verification, approval letter will be send to permittee for the renewed model with revised star level and it will directly appear in Search & Compare page of BEE star label website (http://www.beestarlabel.com/Home/Searchcompare).**

Cases in which continuation is applicable:

Case 1: A 100 KVA distribution transformer with Brand name.....DEF.......and model no. ...ABC/x/y/z...... is registered with BEE as per existing table 1 (valid up to 31st December,2016) and its Total Losses (at 50% loading- 435 W & at 100% loading- 1500 W) i.e. **5 star as per existing table.**

So after revision, for the same brand & model with the Total Losses (at 50% loading- 435 W & at 100% loading- 1500 W) i.e. **2 star as per revised table** (Table 2).

Case 2: A 100 KVA distribution transformer with Brand name.....DEF.......and model no. ...ABC/x/y/z...... is registered with BEE as per existing table 1 (valid up to 31st December,2016) and its Total Losses (at 50% loading- 317 W & at 100% loading- 1130 W) i.e. **5 star as per existing table.**

So after revision, for the same brand & model with the Total Losses (at 50% loading- 317 W & at 100% loading- 1130 W) i.e. **5 star as per revised table** (Table 2).

In both the cases, old test reports would be applicable and BEE would consider the old test report for granting renewal approvals. Declaration is applicable even for *Case 2,* if there is no technical modification in order to comply with revised energy performance standards (i.e. table 2).

B. How to apply:

Renewal: All these expired models will appear in manufacturer's portal and in order to renew the model, the following link (marked in red colour) needs to be clicked. Where renewal form will be generated. The link (marked in red colour) would directly appear in manufacturer's portal w.e.f 22nd December, 2016.

Renewal

Saurabh Diddi
(Energy Economist)
19th December, 2016

For further queries write to: helpdesk@beenet.in , mkhiriya@beenet.in