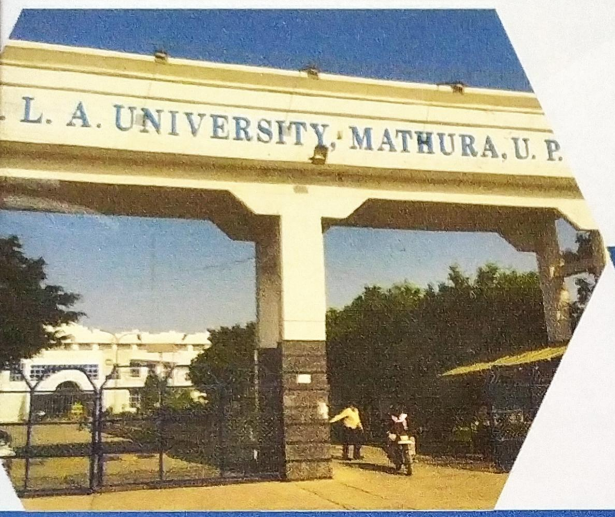
G.L.A UNIVERSITY

17KM STONE, NH-2, MATHURA-DELHI ROAD

P.O. CHAUMUHAN, MATHURA-281406 (U.P)



GLA UNIVERSITY MATHURA

DETAILED ENERGY AUDIT REPORT

2020

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

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List of ABBREVIATIONS AND ACRONYMS

AC	Air Conditioning
APFC	Automatic Power Factor Control
CFL	Compact Fluorescent Lamp
CFM	Cubic Feet per Minute
CoP	Coefficient of Performance
CO_2	Carbon Dioxide
CT	Cooling Tower
CW	Cooling Water
DG	Diesel Generator
EE	Energy Efficient
EER	Energy Efficiency Ratio
ENCON	Energy Conservation Measures
EPI	Energy Performance Index
FRP	Fibre Reinforced Plastic
FTL	Fluorescent Tube Light
HP	Horse Power
HPSV	High Pressure Sodium Vapour
HT	High Tension
HVAC	Heating, Ventilation and Air conditioning
ID	Induced Draft
IEEE	Institute of Electrical and Electronics Engineers
INR	Indian Rupees
IRR	Internal Rate of Return
kVA	Kilovolt Ampere
kVAh	Kilovolt Ampere Hour
kVAR	Kilovolt Ampere Reactive
kWh	Kilowatt Hour
LED	Light Emitting Diode
LT	Low Tension
MH	Metal Halide
Mkcal	Million Kilo Calories
PF	Power Factor
THD	Total Harmonic Distortion
TR	Ton of refrigeration
TRh	Ton of refrigeration in one hour
TOD	Time of Day
VFD	Variable Frequency Drive
WBT	Wet Bulb Temperature

BACKGROUND

Most of present human activities draw its energy from fossil fuel energy sources. The secondary form of energy, the Electricity, which is mainly generated from fossil fuel, is the lifeline of today's modern and highly mechanized lifestyle. Energy is a basic requirement for economic development in almost all major sectors of economy i.e. agriculture. Industry, transport, commercial, and residential (domestic); Consequently, consumption of energy in different forms has been steadily rising all over the country, and more so in Commercial Buildings, which has maintained a steady growth pattern in the past and the trend is likely to continue in future as well. However major concern is that the fossil fuel based sources of Energy are limited and these sources will get exhausted soon. Therefore Every nation whether developed or under-developed is very much concerned about optimal utilization of energy resources. Energy conservations is one of the initiatives which is a proven measure to optimize the uses to retard the depletion of energy resource.

Therefore considering the vast potential of energy saving and benefits of energy efficiency, the Government of India enacted the Energy Conservation Act, 2001 in October 2001. The Energy Conservation Act.2001, become effective from 1st March 2002. The Act provides for institutionalizing and strengthening delivery mechanism for energy efficiency programs in the country and provides a framework for the much needed coordination between various government entities. As per the EC Act, Government of India established "Bureau of Energy Efficiency" (BEE) with the mission to develop policy and strategies with a thrust on self-regulation and market principles, within the overall frame work of the Energy Conservation Act (EC Act) 2001 with the primary objective of reducing the energy intensity of the Indian economy.

ACKNOWLEDGEMENT

We at A-Z Energy Engineers Pvt. ltd express our gratitude to management of GLA University, Mathura for awarding this work of Detailed Energy Audit of GLA University, Mathura in the month of October 2020.

We also express gratitude to following officials for showing keen interest and co-operation, which was extended during the course of our study.

1. Mr. Hari Om Sharma
2. Mr. Vikash Bawa

We also convey thanks to maintenance staff who were directly or indirectly involved for collecting the data and field measurement.

We hope that the recommendations given in the Report, if implemented will result in reduction in Energy consumption and Energy expenses of Owners of Campus, by which there shall be reduction in carbon foot print of building through reduction in cost as a tangible benefit and also take further interest by adopting Vision and Mission of Ministry of Power and Renewable Energy for optimization of energy use.

AUDIT TEAM

Audit team for this assignment consisted of Energy Auditors, Engineers and Experts namely Dr. P.P. Mittal, Accredited Energy Auditor (AEA-011), Sh. Satvinder Singh, Accredited Energy Auditor, Sh. Pankaj Chauhan, Sr. Energy Consultant, Sh. Alok Tiwari, Data Analysis.

Place: **DELHI**

For A-Z Energy Engineers Private Limited

Director

Date: **October 2020**

METHODOLOGY ADOPTED FOR THE AUDIT

A detailed energy audit was conducted at GLA University. The energy audit team comprised of electrical energy experts. During the field visit, a range of portable energy audit instruments were used to take various measurement at different sections of the premises. In addition, design and operational data were collected from logbooks and equipment manuals. Discussions were held with various technical personnel at the Building to understand its operations and energy use. The energy audit focused on the study of all major energy consuming equipment and the evaluation of operational efficiency/performance of such equipment from the energy conservation point of view.

The methodology adopted for the audit involved:

- ✓ Resource planning, establish/organize the Energy audit team
- ✓ Organize instruments & time frame
- ✓ Familiarization of activities
- ✓ First hand observation & assessment of current level operation and practices
- ✓ Historic data analysis, baseline data collection
- ✓ Prepare process flow
- ✓ All service utilities system diagram (example: single line power distribution diagram)
- ✓ Annual energy bill and energy consumption pattern (refer manual, log sheet, name plate, interview)
- ✓ Motor survey, insulation, and lighting survey with portable instruments for collection of more and accurate data, confirm and compare operating data with design data.
- ✓ Trials/Experiments:
  1. Power monitoring (MDI, PF, kWh etc.)
  2. Load variation trends
  3. Equipment Performance
- ✓ Documentation, report presentation to the top manages Eco Safe tech Consultant

1. Scope of the Work

The present audit laid emphasis on the following areas to identify energy saving opportunities:

- ✓ Power Distribution System
- ✓ Lighting system
- ✓ ACs & Ventilation
- ✓ Water Pumping and treatment System
- ✓ Transformers
- ✓ DG Sets
- ✓ Motors/ Pumps

2. Instruments Used for Energy Audit

The following portable instruments were used for data measurement:

- ✓ 3 – phase Power Analyzer
- ✓ Single phase Power Analyzer
- ✓ Anemometer
- ✓ Hygrometer
- ✓ Digital Thermometer
- ✓ Pressure gauge
- ✓ Lux Meter
- ✓ Thermograph Camera
- ✓ Flow Meter
- ✓ Earth Tester

3. Executive Summary

OBJECTIVE OF THE ENERGY AUDIT STUDY

The objective of the energy audit is to review the present energy consumption scenario, monitoring and analysis of the use of energy and explore the energy conservation options including submission of a detailed energy audit report containing recommendations for improving energy efficiency with cost benefit analysis.

The detailed energy audit identifies all possible energy conservation measures including detailed report on energy efficiency improvement techniques. It will provide a dynamic model of energy use characteristics of both the existing facility and all energy conservation measures identified. Extensive attention is given to understanding not only the operating characteristics of all energy consuming systems but also situations which cause load profile variations on both annual and daily basis.

During 23rd October and 2nd November to 4th November, an energy audit study was conducted at GLA university campus, Mathura.

During study, measurements were taken and all the installed energy consuming equipment were visited for finding improvement opportunities for energy use.

Broadly following different energy use areas were considered

1. To understand Energy use in Building
2. To check Operation and Maintenance practices that may impact Energy use.
3. Potential for Renewable Energy-Solar PV use.

4. General Observation and Recommendations

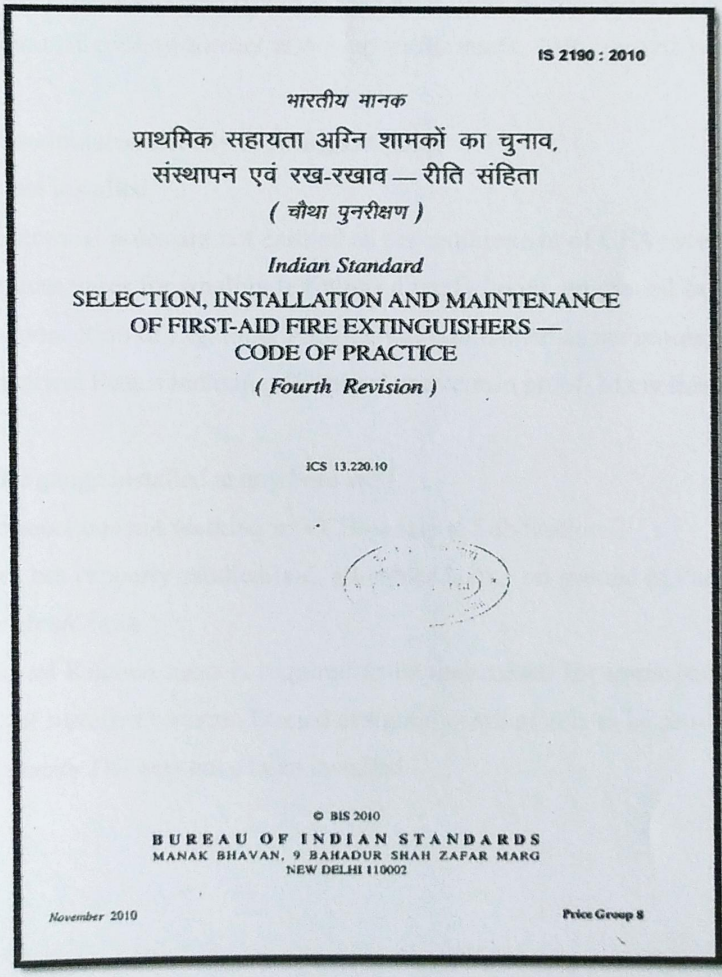
POINTS OF APPRECIATION

1. The Danger Signage Installed

2. Sand Buckets found filled with Sand.

3. Fire extinguishers found installed and re-filled as per requirement.

For Selection, Installation and maintenance of first aid Fire extinguisher –Code of Practice as per IS-2190-2010 be referred for future selection, Installation and maintenance including re-filling of fire extinguishers be followed.



IS 2190 : 2010

भारतीय मानक

प्राथमिक सहायता अग्नि शामकों का चुनाव, संस्थापन एवं रख-रखाव — रीति संहिता

(चौथा पुनरीक्षण)

Indian Standard

SELECTION, INSTALLATION AND MAINTENANCE OF FIRST-AID FIRE EXTINGUISHERS — CODE OF PRACTICE

(Fourth Revision)

ICS 13.220.10

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 2010 Price Group 8

POINTS OF CONCERN

1. The HT Cable termination at Sub Station-3 Transformer is not as per specification.
2. The LT Cable termination at Sub Station-3 Transformer is not as per specification. - Terminated without Glands
3. The Cable End Box Cover is not fixed at LT Cable termination at Sub Station-3 Transformer
4. No Exhaust window and Exhaust Fan Installed in Sub Station-3 Panel Room
5. The Halogen Light Fixed in Sub Station-2 and 3 to dry up the Moisture. It is regular energy wastage. Instead proper designed ventilation should be provided at all places.
6. All The Stacks of DG's not installed as per the CPCB requirement
7. The Stack of Caterpillar DG at substation-2 not Insulated inside.
8. The wires connected in MCBDB without Lugs
9. The access to Electrical Panel Room at Block-10 blocked with cycles.
10. The condition of cooling towers is not up to the mark. Not covered with wire mesh near bottom.
11. The cables terminated directly in fittings at poles
12. Pole Box not installed
13. External Electrical poles are not earthed as per requirement of CEA safety guidelines.
14. At some places wires for small pole fittings directly laying on ground in planters
15. The earth connection of Lightning Arrester not maintained as per requirement.
16. All the Electrical Panels including HT panel not vermin proof. Many lizards found inside the panels
17. No pressure gauge installed at any bore well
18. The PT connections not working in VCB panels at Sub Station-2
19. The Cables not properly saddled/laid, all cables laying on ground at Panel Room of Pumps near Over Head Tank
20. Ventilation of Kitchen mess is required to be maintained for improvement of combustion efficiency of installed burners. Ducted designed ventilation is to be provided.
21. Excess Capacity DG sets have been installed.

RECOMMENDATIONS

Improvement of Power Factor

1. **Avoid Power Factor Penalties**

   DUPVNL, all Non-domestic loads HT connection consumers are charged on the basis of kVAh and not kWh. So in this type tariff if power factor is not maintained at appropriate level, client end up paying indirect penalty due to higher kVah units for the same real power that is kWh. As the power factor goes bad electricity bill increases automatically without penalty word actually appearing in Utility Bill. Ii is recommended to improve power factor of installation to 0.99 for energy savings and other related benefits as noted hereunder.

2. **Below you'll find a list of benefits in descending order of the potential financial impact on your utility bill.**

   a. A lower power factor causes a higher current flow for a given load. As the line current increases, the voltage drop in the conductor increases, which may result in a lower voltage at the equipment. With an improved power factor, the voltage drop in the conductor is reduced, improving the voltage at the equipment.

   b. Power factor correction can be extremely beneficial as the contract demand is in kVA. Benefits include everything from reduced demand charges on your power system to increased load carrying capabilities in your existing circuits and overall reduced power system loses.

   c. **Increased Load Carrying Capabilities in Existing Circuits and Equipment i.e. Transformers, DG Sets, UPS etc.**

      Loads drawing reactive power also demand reactive current. Installing power factor correction capacitors at the end of existing circuits near the inductive loads reduces the current carried by each circuit. The reduction in current flow resulting from improved power factor may allow the circuit to carry new loads, saving the cost of upgrading the distribution network when extra capacity is required for additional machinery or equipment, saving your company thousands of dollars in unnecessary upgrade costs. In addition, the reduced current flow reduces resistive losses in the circuit.

   d. **Reduced Power System Losses**

      Although the financial return from conductor loss reduction alone is not sufficient to justify the installation of capacitors, it is sometimes an attractive additional benefit; especially in older plants with long feeders or in field pumping operations.

Comfort Air-conditioning

1. Use of Ceiling Fans along with Air Conditioners for saving Energy used in Air Conditioning
2. Window type and Split type AC units-Timely Periodical Maintenance and cleaning of filters
3. Inter Active effect-All top roofs be provided with reflective china tiles for better comfort control. The terraces which already have Solar PV installations are not required to be provided with such tiles.
4. Renewable Energy Solar Photovoltaic-Already installed and operating well.
5. Set point temperature of AC's
6. Automatic closing of doors
7. Cleaning of filters-Filters should be periodically cleaned to reduce resistance and for effective cooling.
8. Wet Services-Twice annually due to increased use of AC's due to global warming.
9. Condition of Insulation of Refrigerant piping should be checked and kept under good condition. Monkey menace can also lead to damaged piping and insulation
10. Refrigerant –A/Cs purchased in future should be with Environment friendly refrigerant.

Lighting

1. Occupancy Sensors may be considered to be provided for Common toilet and Corridors with control of exhaust fans also through Exhaust fans. 85% of lights in common area should be controlled with Occupancy sensors.
2. Automatic Switching On/Off of Lighting for external lighting with Astronomical switch be provided.
3. Switching off 50 % of external lighting during late hours be considered.

Pumping system

Automation of Pumping system be considered for savings of Energy.

Renewable Energy system

For enhancement of generation during time of failure of grid, an arrangement can be made by installation of PLC so that in such case if demand exceeds generation, the Solar PV can generate electricity and the same is utilized for internal consumption thereby reducing use of electricity from Generator which is generated @ Rs.22.00 per Unit.

Ventilation of Electrical Equipment Rooms

Ventilation of electrical equipment rooms and UPS room is not up to mark and due to higher temperature inside electrical rooms and UPS room area there are additional losses and higher energy consumption of UPS, there by de-rating it substantially. There is no mechanical ventilation provided.

The batteries and UPS are installed side by side and due to ventilation not provided the fumes from batteries re-circulate in closed space and thereby reduce the life of equipment and reduction of mean time between failure and reducing reliability of operation.

Ventilation of all equipment rooms is required to be revisited, and as per design proper ventilation is required to be provided.

Awareness of Staff

Over-all awareness of working staff is required to be enhanced for improving the practices of Energy conservation.

Covered Area Chart for GLA University			
Sr. No.	**Building type**	**Area**	**Unit**
1	Academic Buildings	84770.26	Sq.mts
2	Hostel Area	112241	Sq.mts
3	Residential Area	207693	Sq.mts

5. Labelling Program of BEE

LABELING PROGRAM FOR PUMPS

The Standard rating covered under the energy labelling scheme are as follows

Sl. No.	Product detail Electrical Pumps	Range kW	No. of Poles	Applicable IS
1.	3 Phase open well submersible pump sets	1.1kW, 1.5kW, 2.2kW, 3.0 kW, 3.7kW, 4.5kW, 5.5kW, 7.5kW, 9.3kW, 11kW, 13kW & 15kW	2 Pole	IS 14220(with all amendments)
2.	3 Phase submersible pump sets	1.1kW, 1.5kW, 2.2 kW, 3.0kW, 3.7 kW, 4.5KW, 5.5 kW, 7.5kW, 9.3kW, 11kW, 13kW, 15kW & up to 75kW	2 Pole	IS 8034(with all amendments)
3.	3 Phase Mono-set pumps	1.1kW, 1.5kW, 2.2kW, 3.7 kW & 5.5kW, 7.5kW, 9.3kW, 11kW & 15kW & up to 22kW	2 Pole	IS 9079(with all amendments)
4.	Single phase open well submersible	0.37kW to 2.2kW	2 Pole	IS 14220(with all amendments)
5.	Single phase submersible pump set	0.37kW to 2.2kW	2 Pole	IS 8034(with all amendments)
6.	Single phase mono set pumps	0.37kW to 2.2kW	2 Pole	IS 9079(with all amendments)

Energy Labeling Plan: The star rating plan for pump sets is as below:

Star Rating	Performance Factor of the Pump Set
1 Star	≥1.00 & <1.10
2 Star	≥1.10 & <1.20
3 Star	≥1.20 & <1.30
4 Star	≥1.30 & <1.40
5 Star	≥1.40

The above star rating plan for pump sets is valid from 1st February 2020 to 31st January 2023.

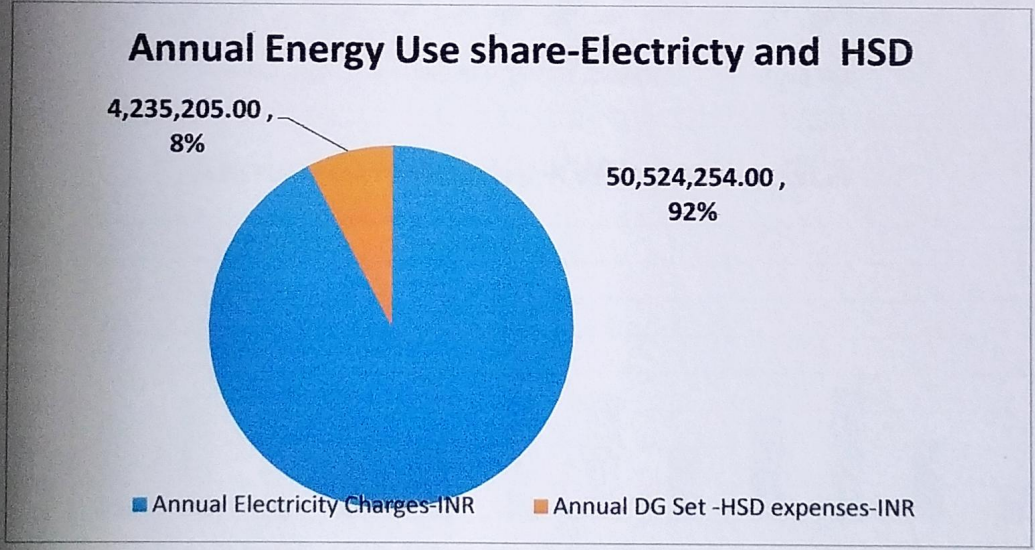
Sampling Plan

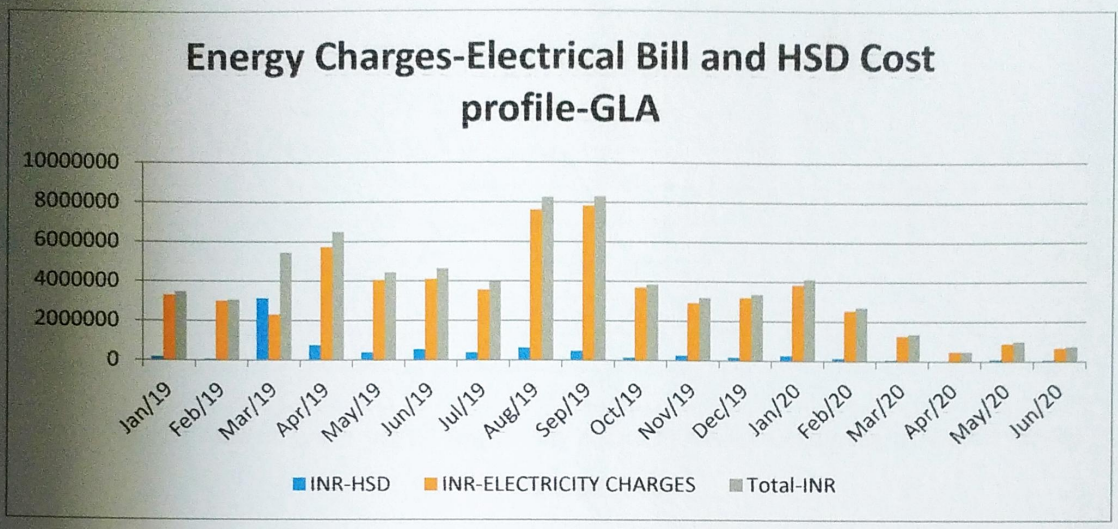
The samples will be picked up by Bureau of Energy Efficiency or its designated agency for testing from either manufacturing facility or warehouse or the dealer. Sample size would be 2 pump sets per rating.

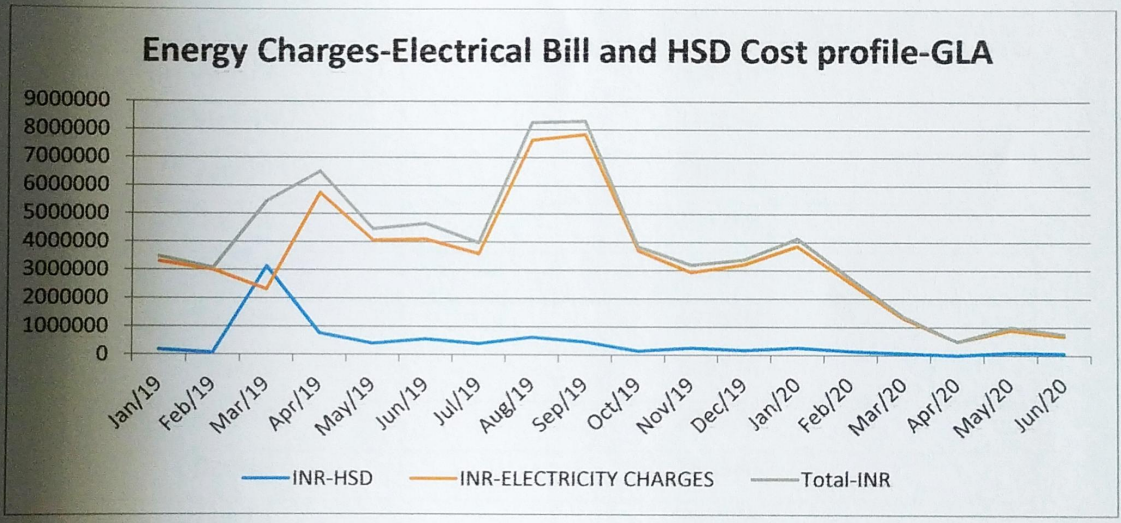
6. Percentage Share of Annual Energy Consumption

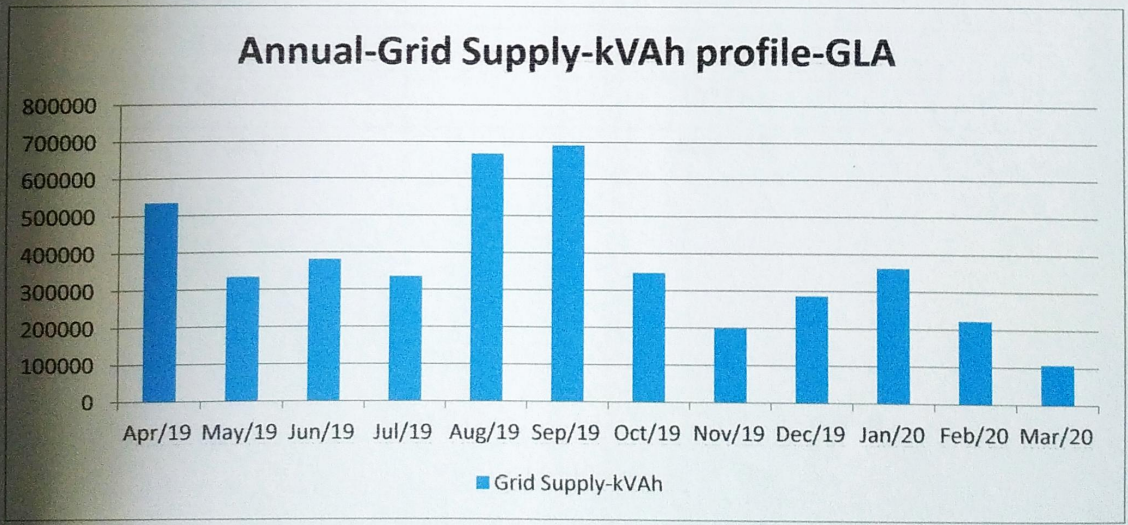
ELECTRICITY AND DG SET USE

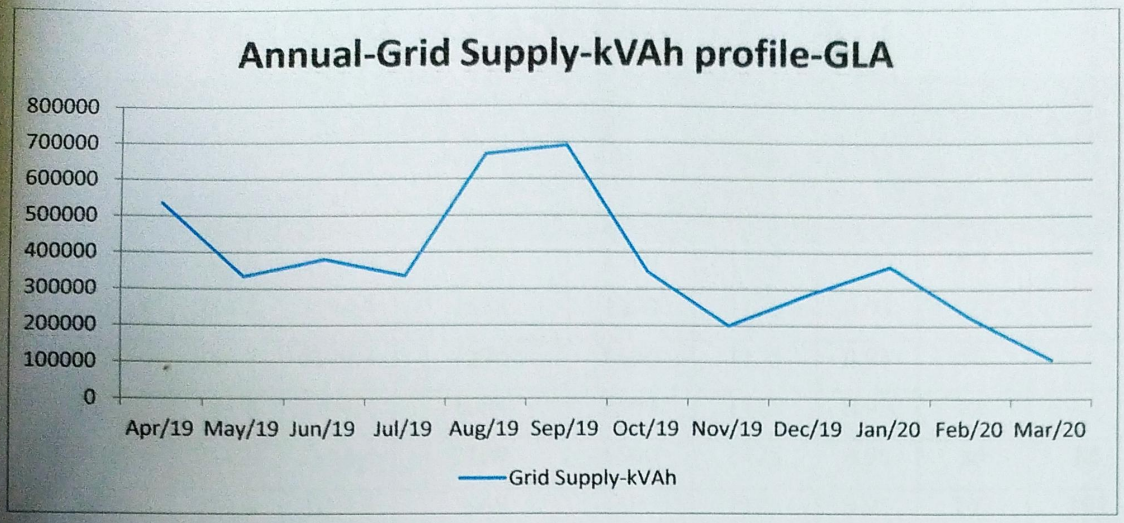
S.No	Month	INR-HSD	INR-Electricity Charges	Total-INR
1	Jan-19	166699	3304876	3471575
2	Feb-19	62037	3007206	3069243
3	Mar-19	3131648	2318373	5450021
4	Apr-19	759257	5743289	6502546
5	May-19	392553	4063951	4456504
6	Jun-19	546147	4100945	4647092
7	Jul-19	389546	3583844	3973390
8	Aug-19	625248	7627358	8252606
9	Sep-19	465432	7834027	8299459
10	Oct-19	143845	3700871	3844716
11	Nov-19	256100	2934459	3190559
12	Dec-19	172352	3209616	3381968
13	Jan-20	266304	3863778	4130082
14	Feb-20	145971	2567187	2713158
15	Mar-20	72450	1294929	1367379
16	Apr-20	0	480092	480092
17	May-20	97324	901925	999249
18	Jun-20	71398	676444	747842




Energy Charges-Electrical Bill and HSD Cost profile-GLA
10000000
8000000
6000000
4000000
2000000
0
Jan/19
Feb/19
Mar/19
Apr/19
May/19
Jun/19
Jul/19
Aug/19
Sep/19
Oct/19
Nov/19
Dec/19
Jan/20
Feb/20
Mar/20
Apr/20
May/20
Jun/20
INR-HSD
INR-ELECTRICITY CHARGES
Total-INR


Energy Charges-Electrical Bill and HSD Cost profile-GLA
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
Jan/19
Feb/19
Mar/19
Apr/19
May/19
Jun/19
Jul/19
Aug/19
Sep/19
Oct/19
Nov/19
Dec/19
Jan/20
Feb/20
Mar/20
Apr/20
May/20
Jun/20
INR-HSD
INR-ELECTRICITY CHARGES
Total-INR

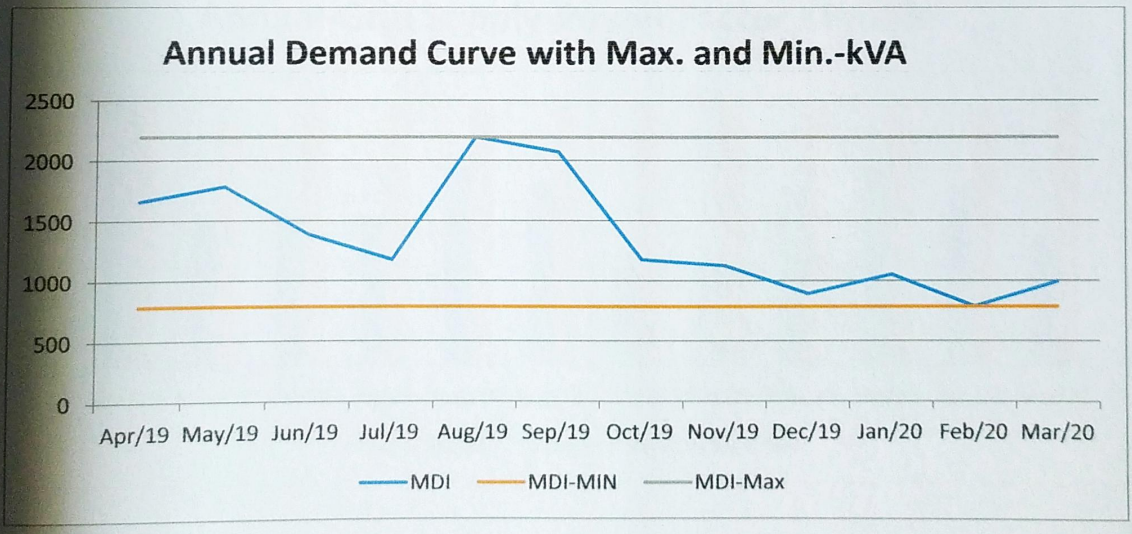

Annual-Grid Supply-kVAh profile-GLA
800000
700000
600000
500000
400000
300000
200000
100000
0
Apr/19
May/19
Jun/19
Jul/19
Aug/19
Sep/19
Oct/19
Nov/19
Dec/19
Jan/20
Feb/20
Mar/20
Grid Supply-kVAh

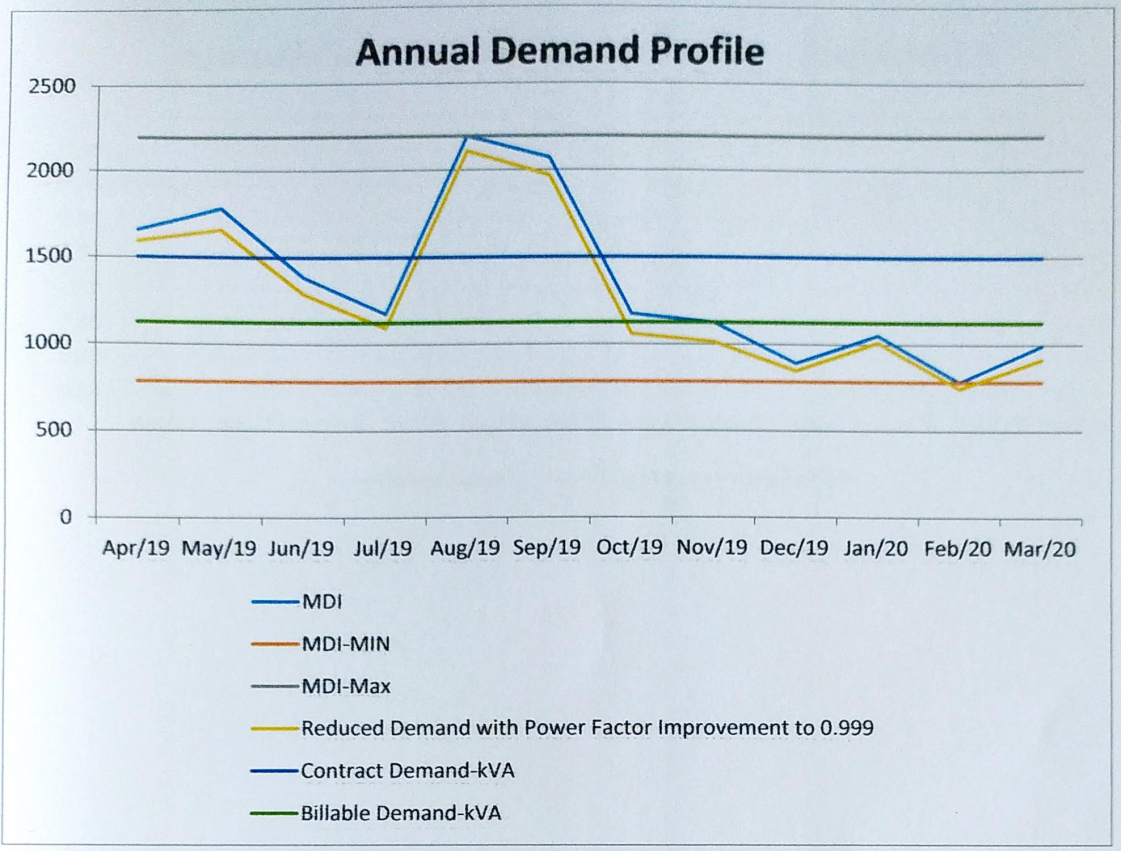


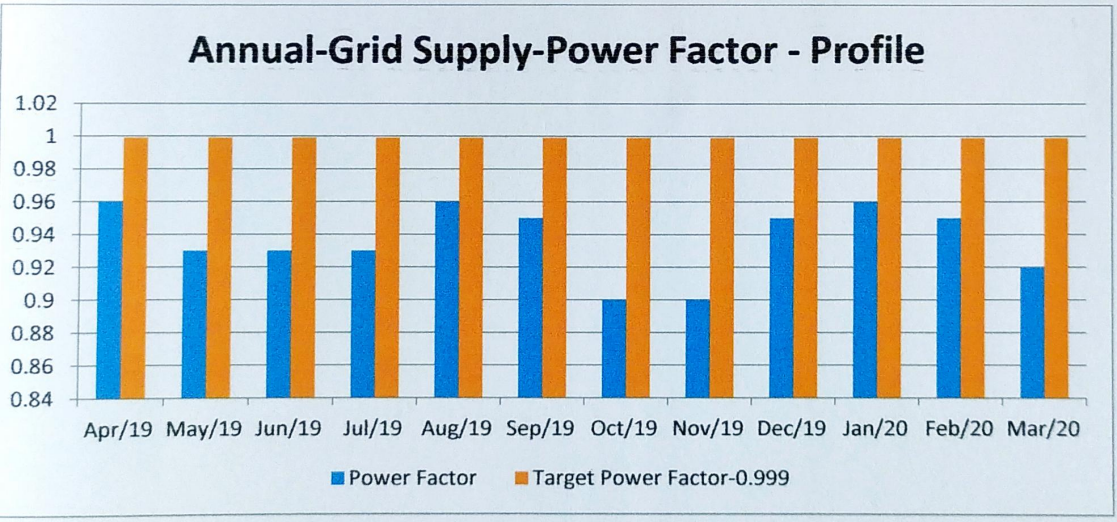
Month	Grid Supply-kVAh
Apr-19	534410
May-19	333850
Jun-19	380598
Jul-19	335260
Aug-19	667490
Sep-19	691810
Oct-19	347270
Nov-19	200080
Dec-19	286860
Jan-20	362340
Feb-20	222080
Mar-20	107710
Total	**4469758**

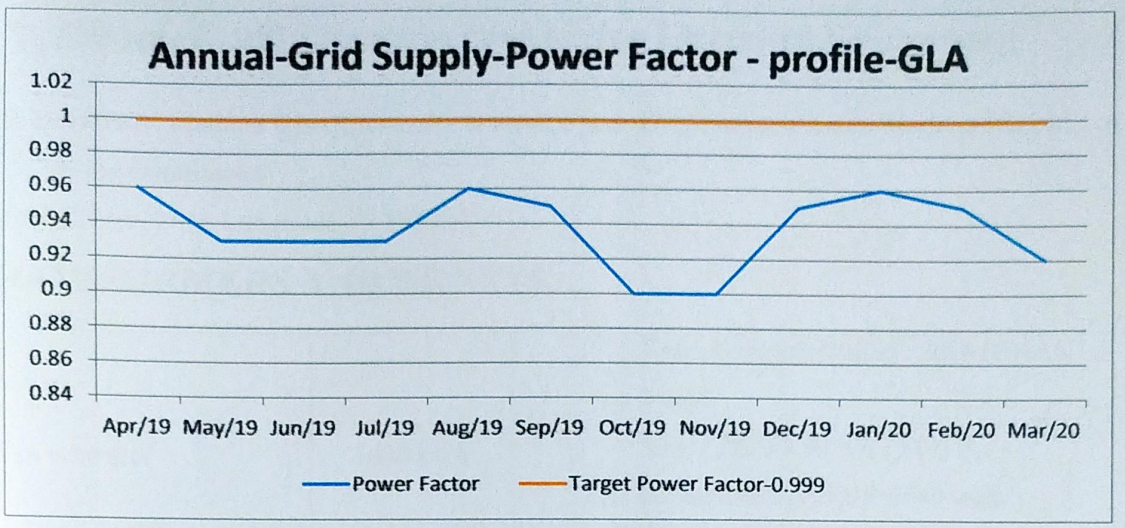
ANNUAL ELECTRICAL DEMAND PROFILE

Month	MDI	MDI-MIN	MDI-Max	Reduced Demand with Power Factor Improvement to 0.999	Contract Demand-kVA	Billable Demand-kVA	Power Factor	Savings in Demand	Savings beyond Contract Demand
Apr-19	1657.2	784.8	2194.4	1593	1500	1125	0.96	65	65
May-19	1780.8	784.8	2194.4	1658	1500	1125	0.93	123	123
Jun-19	1385.6	784.8	2194.4	1290	1500	1125	0.93	96	
Jul-19	1175.2	784.8	2194.4	1094	1500	1125	0.93	81	
Aug-19	2194.4	784.8	2194.4	2109	1500	1125	0.96	86	86
Sep-19	2070.4	784.8	2194.4	1969	1500	1125	0.95	102	102
Oct-19	1174.4	784.8	2194.4	1058	1500	1125	0.9	116	
Nov-19	1125	784.8	2194.4	1014	1500	1125	0.9	111	
Dec-19	892	784.8	2194.4	848	1500	1125	0.95	44	
Jan-20	1052.4	784.8	2194.4	1011	1500	1125	0.96	41	
Feb-20	784.8	784.8	2194.4	746	1500	1125	0.95	38	
Mar-20	992.8	784.8	2194.4	914	1500	1125	0.92	79	
								981	**376**




Annual Demand Profile
2500
2000
1500
1000
500
0
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
MDI
MDI-MIN
MDI-Max
Reduced Demand with Power Factor Improvement to 0.999
Contract Demand-kVA
Billable Demand-kVA


Annual-Grid Supply-Power Factor - Profile
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Power Factor
Target Power Factor-0.999


Annual-Grid Supply-Power Factor - profile-GLA
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Power Factor
Target Power Factor-0.999

7. Energy Audit Location and Major Electrical Equipment

GLA University, Mathura GLA University is located near 17 kM stone at Delhi Mathura Highway at the following Coordinates

Latitude-27.6057° N, Longitude-77.5933° E

TRANSFORMERS AND DG SETS

Transformer	1600 kVA	1	Year of manufacturing : 2016 (ONAN Type) Amp : HV 83.96, LV: 2133.5, No load loss @ 50%: 4500 watt, Full load loss@100%: 13500 watt
Transformer	1600 kVA	1	year of manufacturing : 2016 (ONAN Type) Amp : HV 83.96, LV: 2133.5, No load loss @ 50%: 4500 watt, Full load loss@100%: 13500 watt
Transformer	600 kVA	1	year of manufacturing : 2005 (ONAN Type), Amp : HV 33.06, LV: 840.02, No load loss @ 50%: 1200 watt, Full load loss@100%: 6900 watt
Generator slow speed	2375 kVA	1	
Generator slow speed	2375 kVA	1	
Generator slow speed	1269 kVA	1	
Generator slow speed	890 kVA	1	
Generator Caterpiller	500 kVA	1	
Generator Cummins	500 kVA	1	
Generator Jakson	380 kVA	1	

LOAD DETAILS

	Particulars	Demand
A	Contract demand KVA	1500 KVA
B	Maximum demand	It exceeds during Monsoon
C	Total Energy units consumed / Annum	4469758 KVAh
D	Avg. Power Factor (P.F.)	0.90 to .96
E	Energy bills (Rs/Annual)	505.24 Lacs
F	HSD Consumption -Annual	42.35 Lacs

ANNUAL ELECTRICITY CHARGES AND HSD COST PROFILE

S.No	Month	INR-HSD	INR-Electricity Charges	Total-INR
1	Apr-19	759257	5743289	6502546
2	May-19	392553	4063951	4456504
3	Jun-19	546147	4100945	4647092
4	Jul-19	389546	3583844	3973390
5	Aug-19	625248	7627358	8252606
6	Sep-19	465432	7834027	8299459
7	Oct-19	143845	3700871	3844716
8	Nov-19	256100	2934459	3190559
9	Dec-19	172352	3209616	3381968
10	Jan-20	266304	3863778	4130082
11	Feb-20	145971	2567187	2713158
12	Mar-20	72450	1294929	1367379
	Total	**42,35,205.00**	**5,05,24,254.00**	**5,47,59,459.00**

8. Summary of Proposed Energy Conservation Measured

A summary of the proposed energy conservation measures is provided below:

S. No.	Proposed energy conservation measures	Quantity (nos.)	Total annual energy savings (kWh)	Total annual monetary savings (INR)	Anticipated investment (INR)	Simple payback period (months)	Reduction in Contract Demand-kVA
	Demand Management - Demand Control						
1	Reduction of Contract Demand with Power Factor Improvement	376 kVA	0	323360	0	Instant	
	Total	**Annual**	**0**	**323360**	**0**	**Instant**	**60**
	Improvement of Power Factor						
1	Improvement of Power Factor from present (0.9 to 0.95) to 0.999	1 Lot	255223	2215340	840000	4.55	
	Total		**255223**	**2215340**	**840000**	**4.55**	**125**
	Lighting						**Est.**
1	40 Watts tube rod /CFL to be replaced to be replaced	4246	118888	1031948	891660	10.37	118.888
2	Replacement of 15-20 Watts CFL to be replaced with 9 Watts LED	883	22958	199275	324502.5	19.54	11.479
4	Replacement of 18 Watts Tube with 9 Watts LED Tube	243	6804	59059	76545	15.55	3.402
8	Replacement of 14 Watts T-5 with 7 Watts LED Tube	301	4816	41803	47407.5	13.61	2.408
	Total		**153466**	**1332084.88**	**1340115.00**	**12**	**321.18**
	Ceiling Fans						
1	60 Watts Ceiling Fans to be replaced with 31 Watts Ceiling Fan	6000	195750.00	1699110	11655000	78.84	174
2	80 Watts Ceiling Fans to be replaced with 31 Watts Ceiling Fan	3290	1574215.65	6390825	161.21	46.66	46.66

3	60 Watts Ceiling Fans to be replaced with 31 Watts Ceiling Fan-Residential	852	27796.50	241274	1655010	78.84	24.708
	Total		**17,97,762**	**83,31,209**	**1,33,10,171**	**19**	**245**
	Air Conditioning						
1	Replacement of 1.5 TR AC-(8 years old-5*)with new 5 star rated split AC's-Window type	10	18994.50	164872.26	275625.00	20.06	12.06
2	Replacement of 1.5 TR AC with new 5 star rated split type AC's	1	1663.20	14437	30712.5	25.53	1.06
3	Replacement of 2 TR split AC with new 5 star rated split type AC's	10	22176.00	192487.68	409500	25.53	14.08
4	Replacement of 2 TR split AC with new 5 star rated split type AC's	1	1108.80	9624	20475	25.53	0.704
	Total		**43942.50**	**381420.90**	**736312.50**	**0.00**	**27.900**
	Total Electrical Savings		**22,50,394.12**	**12583414.08**	**16226598.71**	**15.47**	**779.447**
	LPG Savings in Kitchen						
1	Replacement of Kitchen Burners with energy efficient burners	64	53328.60	2218469.90	235200.00	1.27	0.000
		Nos.	**SCM-PNG**				
			62010.00399				
			kWh-T				
	Grand Total		**2312404.12**	**1,48,01,884**	**1,64,61,799**	**13.35**	**779**

9. Energy Scenario and Usage Pattern

Electrical Distribution System

The power is received at 11 kV and supplied at LT Level. Transformer and HT side of distribution is maintained by BSES. The Category of supply billed is HT -Non Residential Category.

The electric current corresponds to total power (kVA) that depends on the power factor, flows from utility-supply point to various load points of the unit through power cables (mostly made of aluminium). During the above power transport, considerable power wasted to oppose the resistance of the cable. The cable resistance increases with length but decreases with cross-section i.e. increase in size. Therefore, the cable capacity has to be selected accordingly to keep the losses within 0.75% and it is only active load, which causes the change in PF from no load to full load. By installing capacitors, we can change the PF of supply system and hence the I2R of the old cable between supply source and motor.

Flowing Current In Feeders

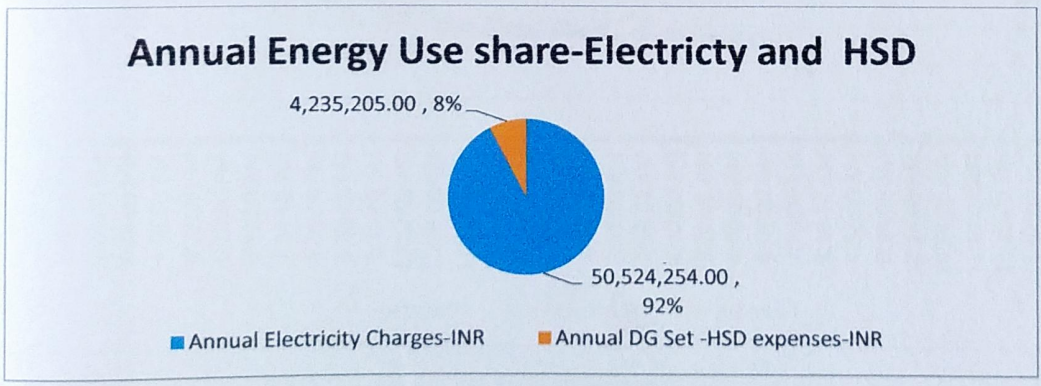
The cable loss is proportional to I2R (square of current flow and resistance of cable). Normally the current rating given by manufacturer is to withstand thermal stress. From the energy conservation point of view, the above needs to be devalued based on length.

Reducing Loss

There are two methods to reduce I2R cable loss in feeders. They are: (i) reducing the current in cables by adding capacitors near to load or bifurcating the overloaded feeders (ii) reducing the resistance of cable by increasing its size or running additional run of cable of equal size.

Capacitor Shifting/ Addition

It is possible to reduce current; thereby I2R losses in cable by providing additional capacitors near to feeder end/ load end.

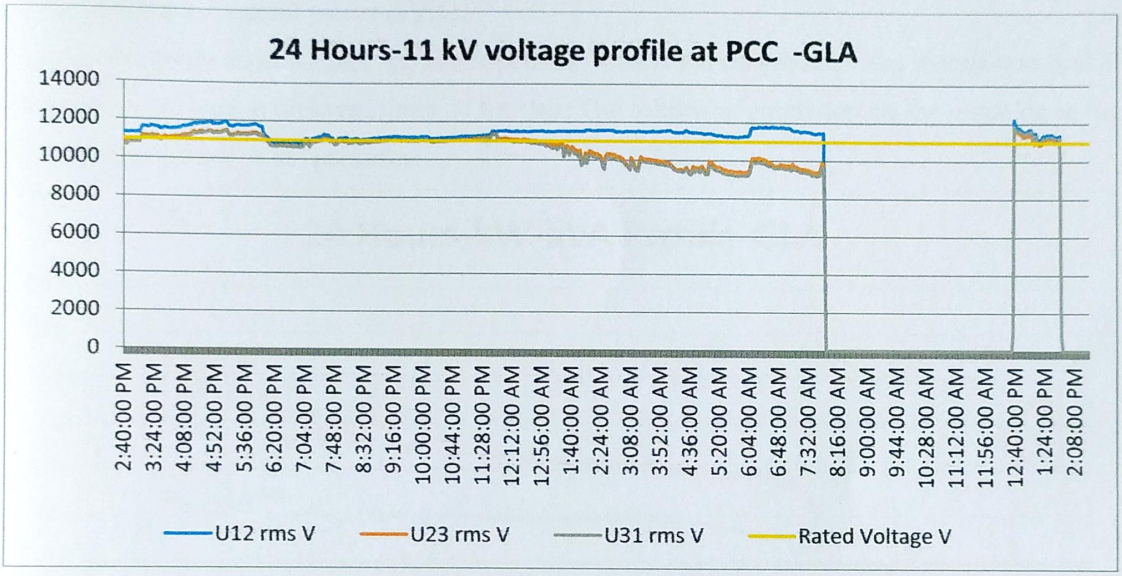


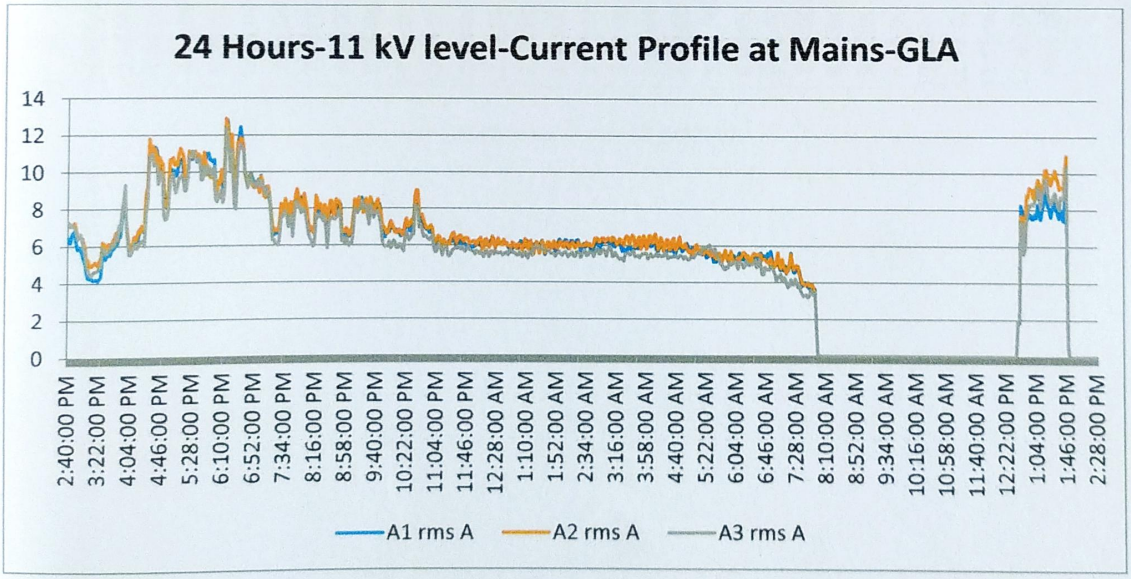
10. Load Profile of Main Incomer

Load profile 24 hours

The load profiles of the electrical parameters were recorded by using a portable 3-phase power analyser. During the recording, the power analyser recorded all the electrical parameters for further detailed analysis. The analyses of the different parameters recorded at the panels are given below.

Voltage & Current Load Profile

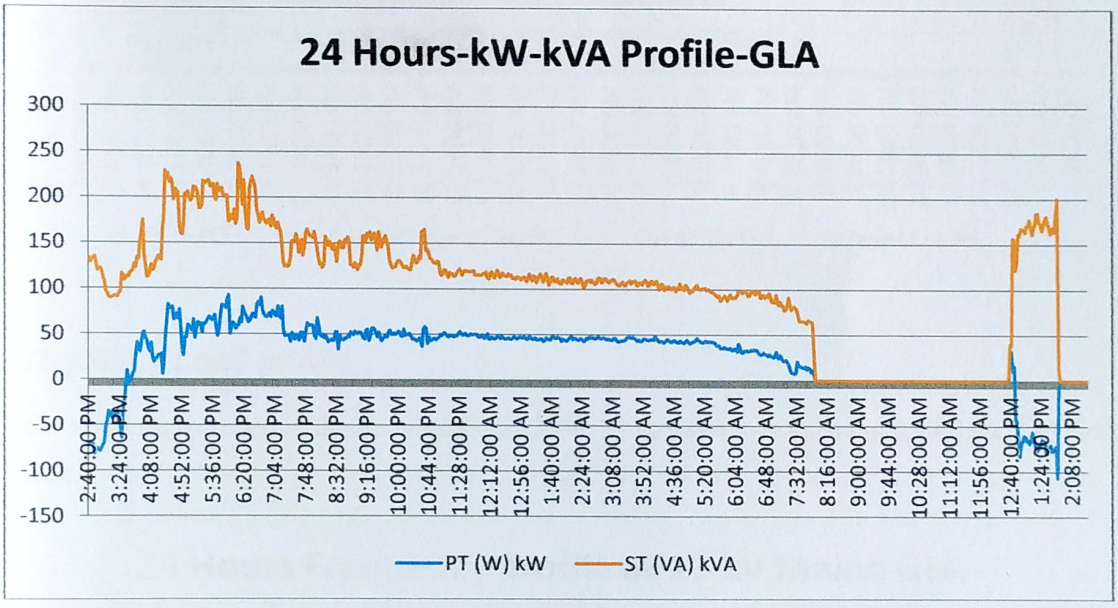




Real power (kW) and apparent power (kVA) profile

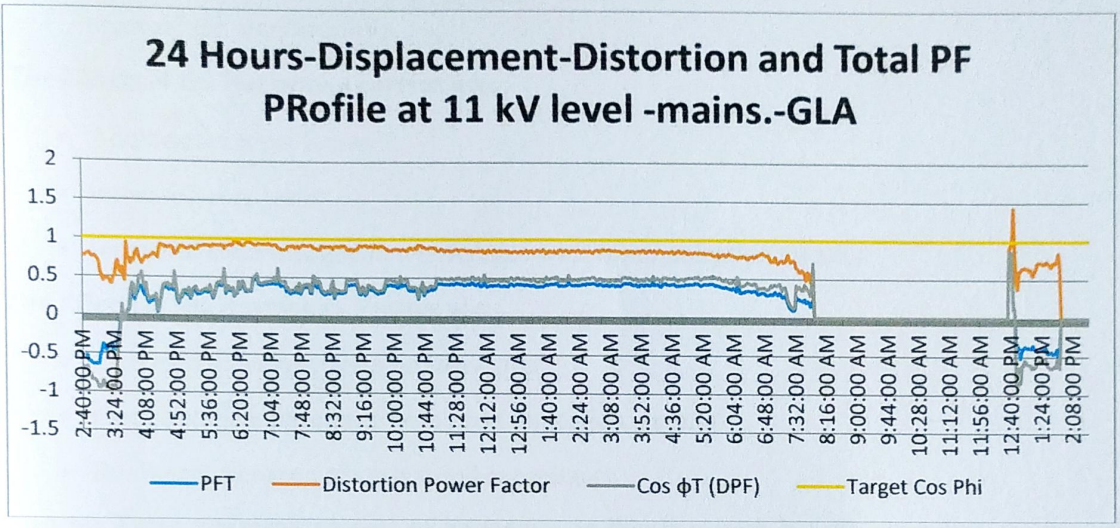
Load (real power) profile and apparent power profile is the variation in the electrical load versus time. In any electrical system, the vector sum of the active power (kW) and reactive power (kVAR) make up the total (or apparent) power (kVA) used. This is the power generated by a generation station for 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:



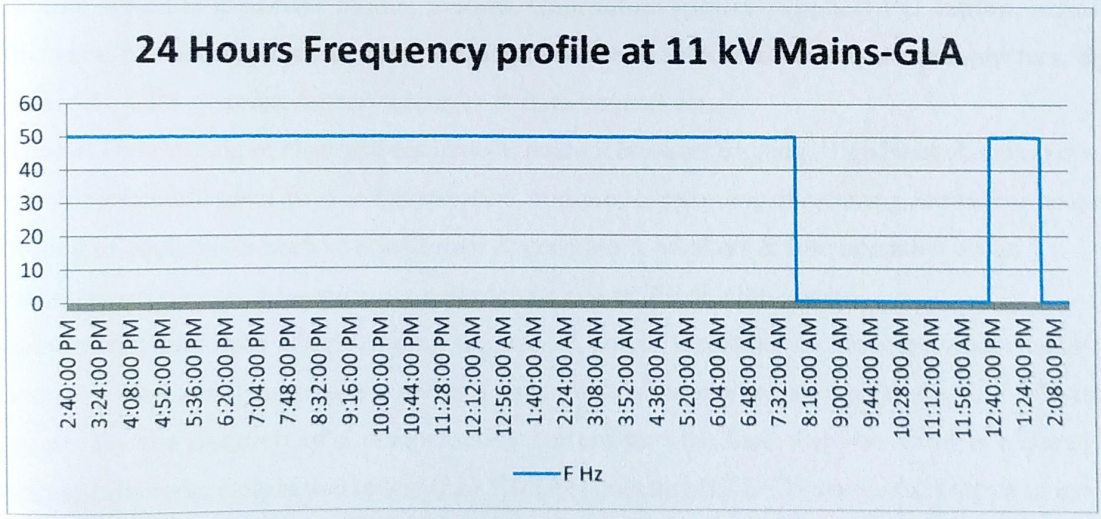
Power Factor Load Profile

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:



Frequency Load profile

The variations recorded in the frequency during the 24 hours of measurement period are provided below:



Total Harmonic Distortion (THD) Analysis

HARMONICS

- Harmonics are the periodic steady-state distortions of the sine wave due to equipment generating a frequency other than the standard 50 cycles per second as now a day's equipment became more sophisticated and with the proliferations of non-linear loads, harmonics have become a pronounced problem on many power systems. Now a-days in many areas non-linear load are approaching significantly.

The Effects of the Harmonics current are:

- Additional copper losses
- Increased core losses
- Increased electromagnetic interference with communication circuits.

The Effects of the Harmonics Voltage are:

- Increased dielectric stress on insulation
- Electro static interference with communication circuits
- Resonance between reactance and capacitance

Causes: There are many sources of harmonics in Power system but all harmonics sources share a common characteristic. This is a non-linear voltage current operating relationship and any device that alters the sinusoidal wave form of voltage or current is harmonics producer. The following are the source of harmonics: **Electronic ballasts; non—linear loads; variable frequency drives, diodes, transistors, thyristors, rectifier output, frequency conversion, Transformers; circuit breakers; phone systems; capacitor banks; motors, Computers (power supplies) PC, laptop, mainframe, Servers, Monitors, Video display, Copiers, scanners, FAX machines, printers, plotters, lighting controls, UPS systems, battery charges & data centres etc.**

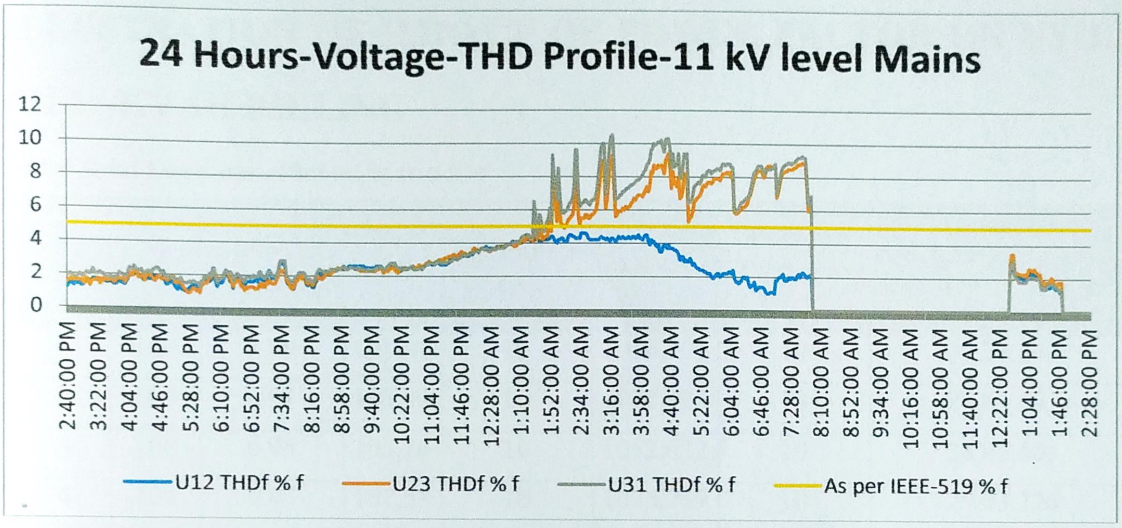
Effects: Overheating of electrical equipment; random breakers tripping, High Neutral current due to 3rd Harmonics, interference with communication, non-proper recording of metering, increase in cooper loss, heating of equipments such as transformer & generators, breakers & fuse operation occur.

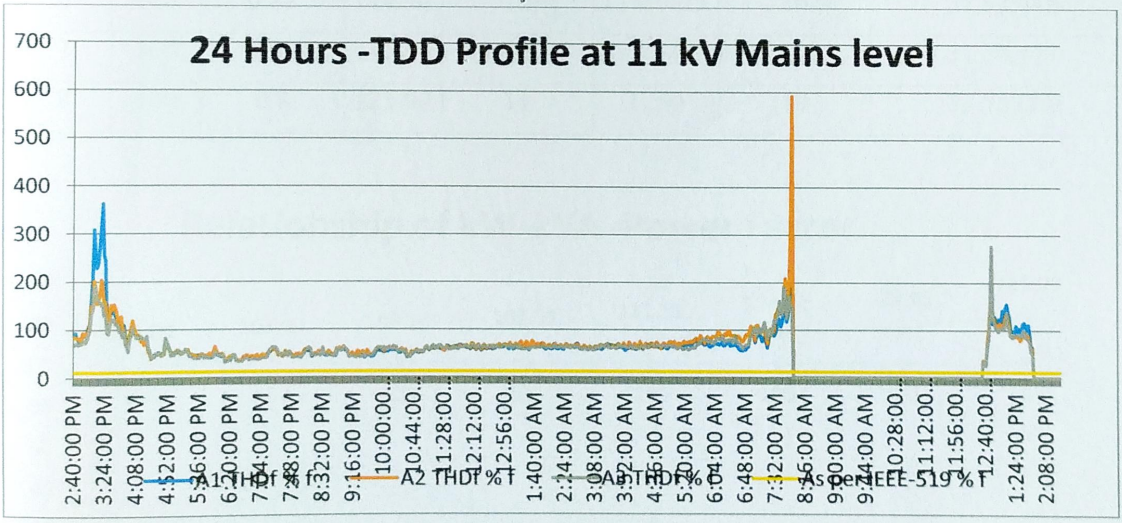
Harmonics contents can place serious Burden on power distribution system.

Solutions: Harmonics filters employ the use of power electronic technology, which monitors the nonlinear load and dynamically corrects a wide range of harmonics, such as the 3rd to 51st harmonics orders. By the injection of a compensating current into the load, the waveform is restored which dramatically reduce distortion to less than 5% THD, meeting IEEE 519 standards. Further to meet other

power quality demand surge protection, metering, relay protection, control, SCADA and communication can be one of the solution. Solution can range from simply tightening connections in a switchboard to help overheating of conductors, to use of a 200% rated neutral in a panel board:

The percentage of total current and voltage harmonic distortion in all the three phases (R, Y and B) were recorded at the main incoming panel. The graphs below depict the percentage of total harmonic distortion in the electrical distribution system:





The voltage and Current THD recorded is within permissible limits as per IEEE-519 standard. Only loads used on supply are crossing threshold values of current harmonics at some point of time.

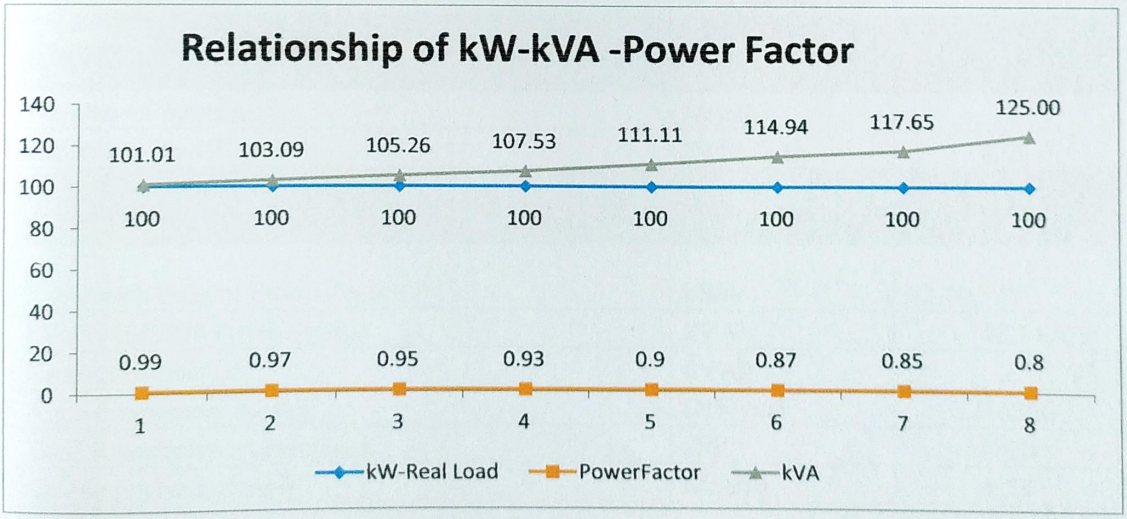
11. Details Study of System and ECON Measures options

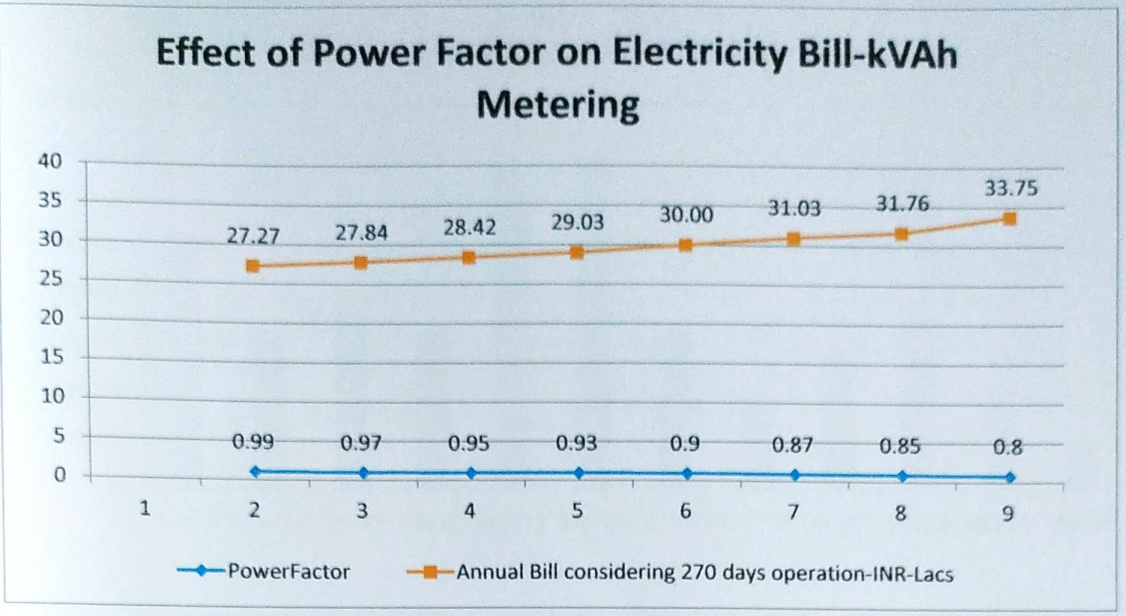
Based on various measurement and analysis carried out of the energy consumption data of the Industry premises, the energy audit team identified various energy conservation options. All these options are given in detail in the following sections:

ILLUSTRATION OF IMPACT OF POWER FACTOR ON UTILITY BILL -KVAH BILLING

Note: Real Load considered is 100 kW

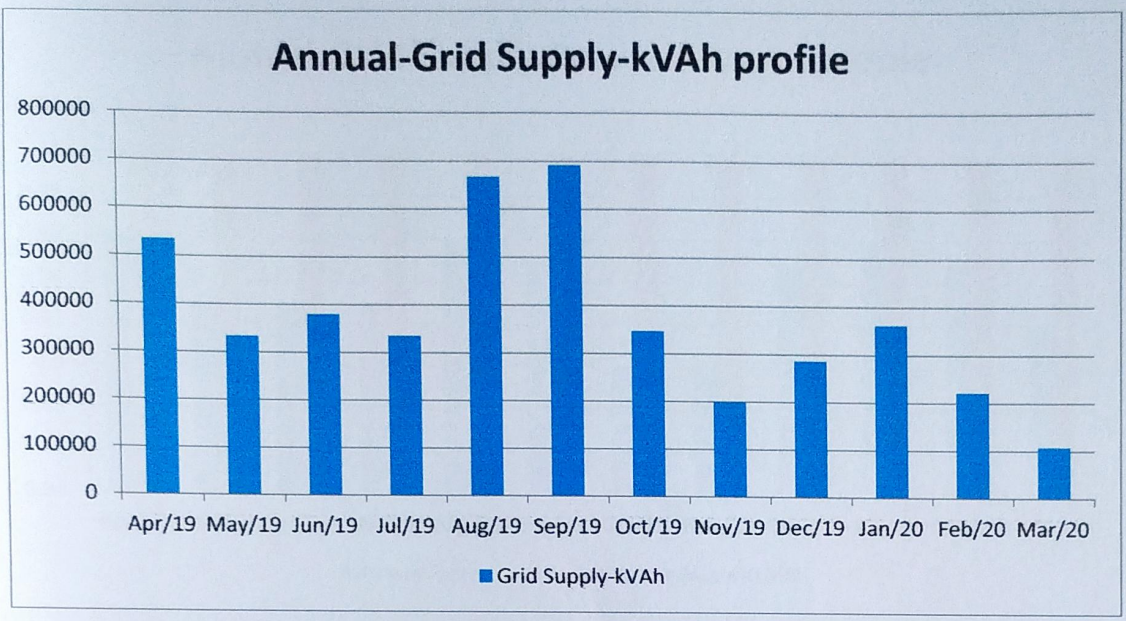
Sr. No.	kW-Real Load	Power Factor	kVA	Operation hours	kVAh	Electricity rates per kVAh	Annual Bill considering 270 days operation-Amount in INR
1	100	0.99	101.01	10	1010.101	10	27,27,273
2	100	0.97	103.09	10	1030.928	10	27,83,505
3	100	0.95	105.26	10	1052.632	10	28,42,105
4	100	0.93	107.53	10	1075.269	10	29,03,226
5	100	0.9	111.11	10	1111.111	10	30,00,000
6	100	0.87	114.94	10	1149.425	10	31,03,448
7	100	0.85	117.65	10	1176.471	10	31,76,471
8	100	0.8	125.00	10	1250	10	33,75,000

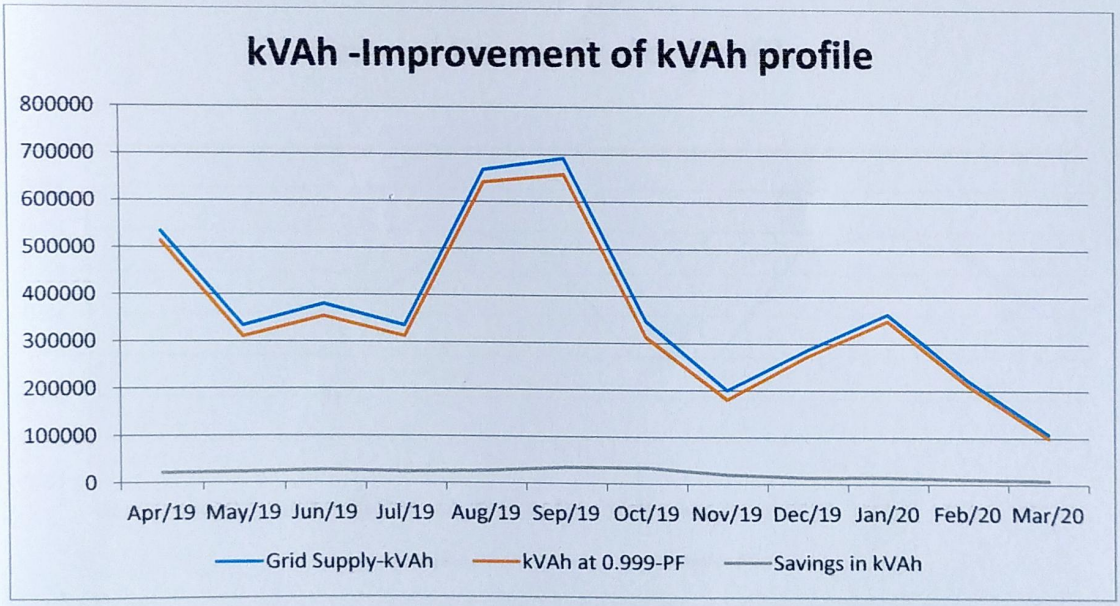


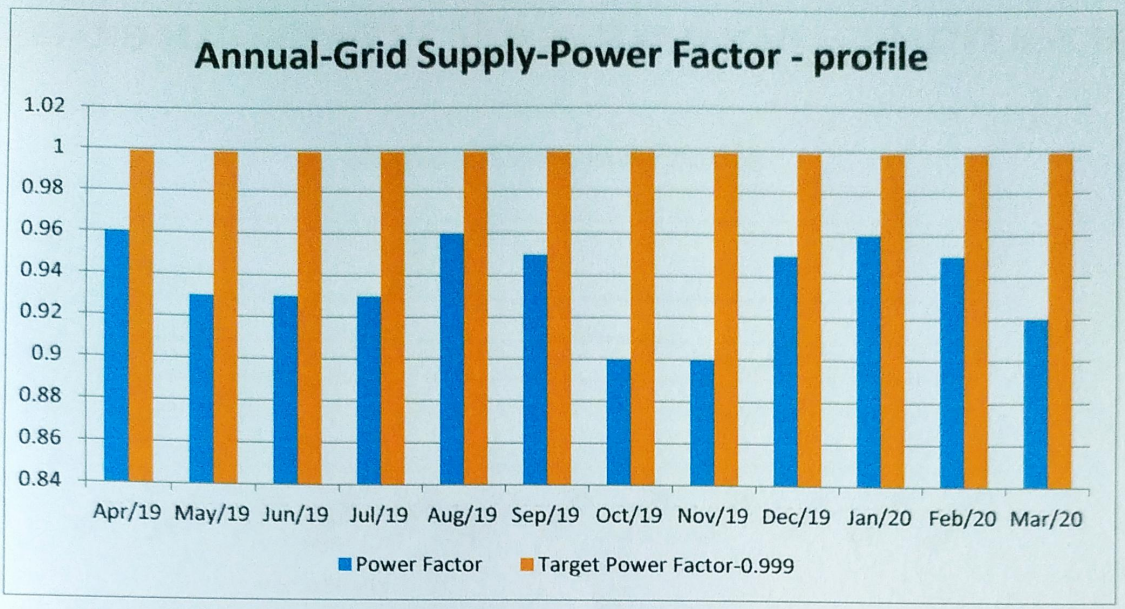


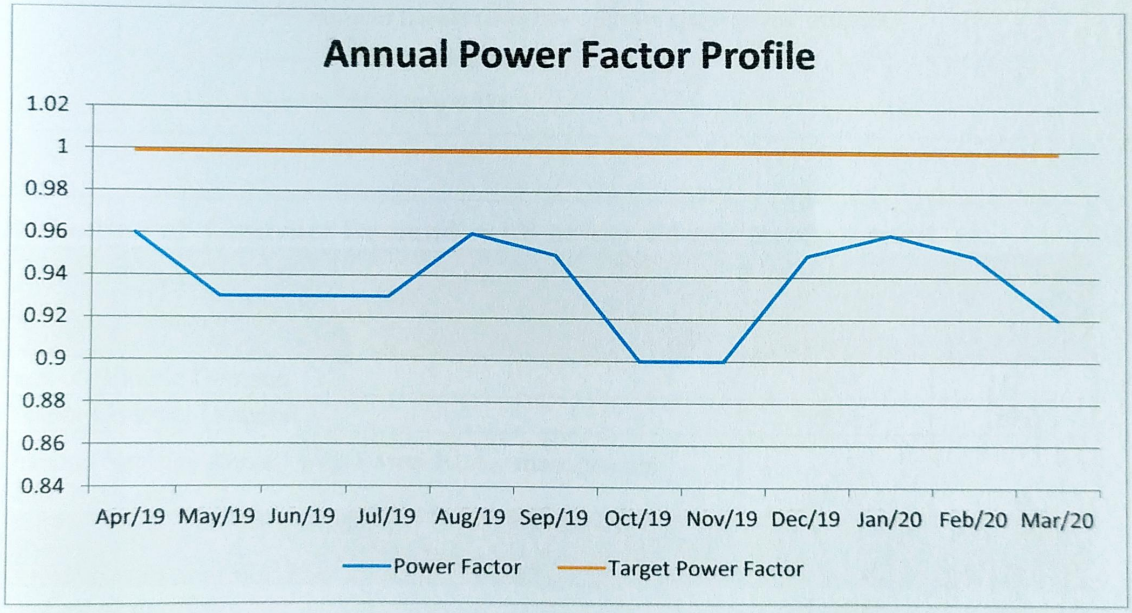
POWER FACTOR ENCON

Improvement of Power Factor from present (0.9 to 0.96) to 0.999		
Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
Total kVAh -Annual-Annual	kVAh	4469758
Present power Factor		09 to .95
Target Power Factor		0.999
Installation cost of APFC Panel-Estimated-400 kVAR		800000
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of months	Months	12
Electricity Tariff	INR/kVAh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
KWh with Present Power Factor	kWh	42,10,320
kVah with .999 Power Factor	kVAh	42,14,535
Savings in Energy	kVAh	2,55,223
Annual monetary saving	INR/year	2215340
Total investment requirement	INR	840000
Simple payback period	Months	4.55

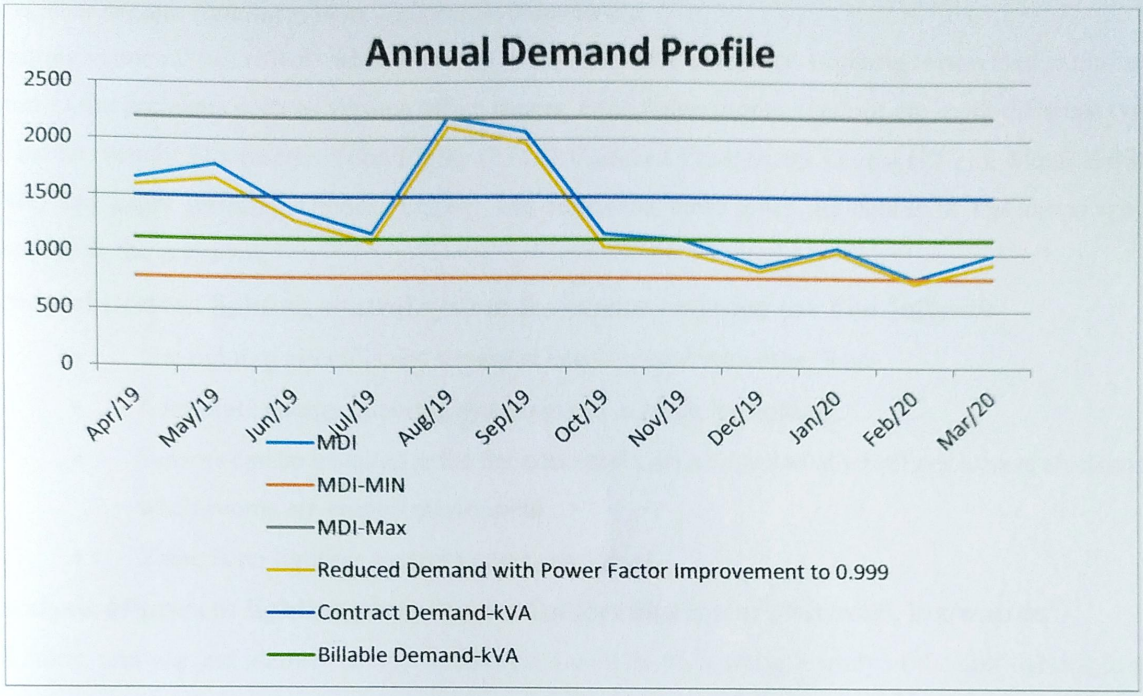

Annual-Grid Supply-kVAh profile
800000
700000
600000
500000
400000
300000
200000
100000
0
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Grid Supply-kVAh


kVAh -Improvement of kVAh profile
800000
700000
600000
500000
400000
300000
200000
100000
0
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Grid Supply-kVAh
kVAh at 0.999-PF
Savings in kVAh


Annual-Grid Supply-Power Factor - profile
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Power Factor
Target Power Factor-0.999


Annual Power Factor Profile
1.02
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
Apr/19 May/19 Jun/19 Jul/19 Aug/19 Sep/19 Oct/19 Nov/19 Dec/19 Jan/20 Feb/20 Mar/20
Power Factor
Target Power Factor

DEMAND MANAGEMENT AND DEMAND MANAGEMENT ENCON



Reduction of Contract Demand with power Factor improvement		
Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
Present Billable Demand	kVA	1125
Present Contract Demand	kVA	1500
Demand Savings Annual with Power Factor management while it exceeds	kVA	376
Operating parameters		
Particulars	Unit	Value
Number of months	Months	12
contract Demand Tariff beyond contract demand	INR/kVA	860
Energy and financial savings		
Parameters	**Unit**	**Value**
Savings in Fixed Charges-Annual	INR	3,23,360
Annual monetary saving	INR/year	323360
Total investment requirement-Investment is taken in Power factor improvement Head	INR	0
Simple payback period	Months	Instant

LIGHTING SYSTEM

Review of present lighting system, lighting inventories etc.

Lighting is one of the critical when it comes to any commercial facility. Lighting is provided at various areas in the premises such as various office rooms, conference rooms, outdoor etc. with different type of lamps namely Fluorescent Tube Lights (FTLs) Compact Fluorescent Lamps (CFLs), Metal Halide (MH) and Light Emitting Diodes (LEDs). The following table gives the details of the lamps types installed in the premises.

Study of present lighting control system & recommendation for Eco Safetech

- The lighting circuit is not separated and is mixed with other loads.
- A separate energy metering system is not in place for lighting.
- Sensors can be installed in the departmental staff rooms and other offices to save electricity when rooms are empty/ unoccupied.
- There is no lighting control system employed.

Analysis of present lighting performance indices like lux/m^2, lux/watt, lux/watt/m^2

To study, analyse 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 building, 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.

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 lux 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 centimetre = 10000 lumens / sq meter = 10000 lux
- 1 foot candle (ftcd, fcd) = 1 lumen / sqft = 10.752 lux

Common Light level outdoor

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

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 it may be as low as 25- 50 lux.

Earlier the light levels used to be in the range of 100 -300 lux for normal activities but today the lux levels are more and are in the range 500 – 1000 lux depending on the activities. For precision and detailed works, the lux levels may even approach 1500 – 2000 lux.

Standard lux level in different areas

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, Theatres, 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 extrEco Safetechly low contract and small size	10000 - 20000

The table above is guidance for recommended light level in different area

ILLUMINATION SURVEY

Illumination levels in the office rooms were assessed by measuring the illumination (lux) levels with the help of digital lux meter on a sample basis. The detailed measurement of lux level in some of the office/premises shed as measured is given below:

Lux Level Measurement in GLA campus

Sr no	Location	Lux
1	Mr. Hari Om Sharma's Office	340
2	Civil Conference Room no 121	330
3	Between Two Blocks	0
4	Dr. Rajinder Prasad Hostel	18
5	S P Mukharji Hostel	72
6	Pt. Lok Mani Sharma Hostel	42
7	Under Light	72
8	Sir Vishvasaria Hostel	0
9	Road in front of Residential Block- 9	35
10	Between Two Poles	7
11	C V Raman Boys Hostel	53
12	Dr. B R Ambedkar Hostel	58
13	In front of Catering Office	314
14	Dr. APJ Abdul Kalam Boys Hostel	18
15	Bhagwan Das Agrawal Boys Hostel	72
16	S. Radha Krishnan Boys Hostel	42
17	Hari Das Agrawal Boys Hostel	72
18	Godawari Girls Hostel	31
19	University Polytechnic	35
20	Faculity of Education	53
21	Boys Wing - 1	28
22	Boys Wing - 2	17
23	Boys Wing - 3	34
24	Boys Wing - 4	10
25	Boys Wing - 5	38
26	Residential Block - 6	10
27	Residential Block - 7	19
28	Residential Block - 8	53

29	Residential Block - 9	7
30	Residential Block - 10	13
31	Guest House - 3	17
32	Academic Block	34
33	Deptt. Of Computer Science	10
34	VIP Guest House	38
35	Ganga Girls Hostel	48
36	Yamuna Girls Hostel	72
37	Kalpana Chawla Girls Hostel	27
38	Staff Residence Block - 1	11
39	Staff Residence Block - 2	20
40	Staff Residence Block - 3	48
41	Institute of Applied Science	9
42	Civil Engineering	11
43	Proposed Auditorium	19
44	Mechanical Engineering Block	24
45	Polytechnic Block	8
46	B.Ed and Polytechnic Block	16
47	Biotech and Agriculture Block	26
48	MBA Deptt.	17
49	IDR / Pharmacy Block	16
50	Mess	334

LIGHTING ENCON-1

Replacement of 40 Watts T-12 tube with 18 Watts LED Tube

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
40 Watts tube rod /CFL to be replaced to be replaced	Number	4246
Cost of 18 Watts LED Tube retrofit	INR/ piece	200
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	8
Number of operating days	Per year	275
Average life of LED based tube lights	Hours	50,000
Average life of LED based tube lights	Years	8
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of 40 Watts-T-12 Fl. Light	W/piece	46
Power consumption of LED Fixture	W/piece	18
Power savings	W/piece	28
Annual energy saving	kWh/year	261554
Annual monetary saving	INR/year	2270285
Total investment requirement	INR	891660
Reduction in Demand	kW/kVA	118.888
Simple payback period	Months	4.71

LIGHTING ENCON-2

Replacement of 15/20 Watts CFL to be replaced with 9 Watts LED

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
9 Watts tube rod /CFL to be replaced to be replaced	Number	883
Cost of 9 Watts LED Tube retrofit	INR/ piece	350
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	10
Number of operating days	Per year	275
Average life of LED based tube lights	Hours	50,000
Average life of LED based tube lights	Years	8
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of 15/20 Watts CFL	W/piece	22
Power consumption of LED Fixture -9 Watts	W/piece	9
Power savings	W/piece	13
Annual energy saving	kWh/year	31567
Annual monetary saving	INR/year	274004
Total investment requirement	INR	324502.5
Reduction in Demand	kW/kVA	11.479
Simple payback period	Months	14.21

LIGHTING ENCON-3

Replacement of 20 Watts Tube with 9 Watts LED Tube

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
18 Watts Tube Lights to be replaced	Number	243
Cost of 9 Watts LED Tube	INR/ piece	300
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	10
Number of operating days	Per year	275
Average life of LED based tube lights	Hours	50,000
Average life of LED based tube lights	Years	8
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of 18 Watts Tube	W/piece	23
Power consumption of LED Fixture	W/piece	9
Power savings	W/piece	14
Annual energy saving	kWh/year	9356
Annual monetary saving	INR/year	81206
Total investment requirement	INR	76545
Reduction in Demand	kW/kVA	3.402
Simple payback period	Months	11.31

LIGHTING ENCON-4

Replacement of 14 Watts T-5/CFL with 7 Watts LED Tube

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
14 Watts-T-5 tube rod to be replaced to be replaced	Number	301
Cost of 7 Watts LED Tube retrofit/lamp	INR/ piece	150
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	8
Number of operating days	Per year	225
Average life of LED based tube lights	Hours	50,000
Average life of LED based tube lights	Years	8
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of 9 Watts CFL	W/piece	15
Power consumption of LED Fixture	W/piece	7
Power savings	W/piece	8
Annual energy saving	kWh/year	4334
Annual monetary saving	INR/year	37623
Total investment requirement	INR	47407.5
Reduction in Demand	kW/kVA	2.408
Simple payback period	Months	15.12

CEILING FAN-ENCON-1

80 Watts Ceiling Fans to be replaced with 31 Watts Ceiling Fan

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
60 Watt Ceiling fan need to be replaced	Number	3290
Cost of 31 Watts Ceiling Fans-Considering retrieval cost of existing fans	INR/ piece	1850
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	10
Number of operating days	Per year	250
Average life of Ceiling Fans	Years	15
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of Existing Ceiling fans	W/piece	80
Power consumption of Super-Efficient fans	W/piece	31
Power savings	W/piece	49
Annual energy saving	kWh/year	403025.00
Annual monetary saving	INR/year	3498257
Total investment requirement	INR	6390825
Reduction in Demand	kW/kVA	161.21
Simple payback period-Considering Demand reduction	Months	21.50

CEILING FAN-ENCON-2

60 Watts Ceiling Fans to be replaced with 31 Watts Ceiling Fan

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
60 Watt Ceiling fan need to be replaced	Number	6000
Cost of 31 Watts Ceiling Fans-Considering retrieval cost of existing fans	INR/ piece	1850
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	10
Number of operating days	Per year	250
Average life of Ceiling Fans	Years	15
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of Existing Ceiling fans	W/piece	60
Power consumption of Super-Efficient fans	W/piece	31
Power savings	W/piece	29
Annual energy saving	kWh/year	435000.00
Annual monetary saving	INR/year	3775800
Total investment requirement	INR	11655000
Reduction in Demand	kW/kVA	174
Simple payback period-Considering Demand reduction	Months	36.32

CEILING FAN-ENCON-3

60 Watts Ceiling Fans to be replaced with 31 Wattts Ceiling Fan

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
60 Watt Ceiling fan need to be replaced	Number	852
Cost of 31 Watts Ceiling Fans-Considering retrieval cost of existing fans	INR/ piece	1850
Installation Cost	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	10
Number of operating days	Per year	250
Average life of Ceiling Fans	Years	15
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of Existing Ceiling fans	W/piece	60
Power consumption of Super-Efficient fans	W/piece	31
Power savings	W/piece	29
Annual energy saving	kWh/year	61770.00
Annual monetary saving	INR/year	536164
Total investment requirement	INR	1655010
Reduction in Demand	kW/kVA	24.708
Simple payback period-Considering Demand reduction	Months	36.32

AIR CONDITIONING ENCON-1

Inventory of AC's more than 8 years old		
S. No.	**Type of AC's**	**Qty.**
1	1.5 TR Window type AC	10
2	1.5 TR -Split AC	1
3	2 TR Non Star split AC	10
4	1 TR Split AC	1

Replacement of 1.5 TR AC -more than 8 Years with new 5 star rated Window type AC's

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
1.5 TR AC is proposed to be replaced	Number	10
Total TR of existing system	TR	15
Price of 5 * AC of 1.5 TR -deducting retrieval cost	Per TR	17500
Installation charges	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	7
Number of operating days	Per year	225
Average life of AC's	Years	10
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Power Consumption of per TR of existing system-Estimated	kW/TR	1.75
Power Consumption of Energy Efficient AC-per TR	kW/TR	0.946
Power savings	kW/TR	0.804
Annual energy saving	kWh/year	18994.50
Annual monetary saving	INR/year	164872
Total investment requirement	INR	275625
Reduction in Demand	kW/kVA	12.06
Simple payback period	Months	20.06

Replacement of 1.5 TR AC- more than 8 years old with new 5 star rated split AC's

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
1.5 TR AC is proposed to be replaced	Number	1
Total TR of existing system	TR	1.5
Price of 5 * AC of 1.5 TR -deducting retrieval cost	Per TR	19500
Installation charges	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	7
Number of operating days	Per year	225
Average life of AC's	Years	10
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of per TR of existing system-Estimated	kW/TR	1.65
Power Consumption of Energy Efficient AC-per TR	kW/TR	0.946
Power savings	kW/TR	0.704
Annual energy saving	kWh/year	1663.20
Annual monetary saving	INR/year	14437
Total investment requirement	INR	30712.5
Reduction in Demand	kW/kVA	1.056
Simple payback period	Months	25.53

Replacement of 2 TR split AC- more than 8 years old with new 5 star rated split AC's

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
1.5 TR AC is proposed to be replaced	Number	10
Total TR of existing system	TR	20
Price of 5 * AC of 1.5 TR -deducting retrieval cost	Per TR	19500
Installation charges	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	7
Number of operating days	Per year	225
Average life of AC's	Years	10
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of per TR of existing system-Estimated	kW/TR	1.65
Power Consumption of Energy Efficient AC-per TR	kW/TR	0.946
Power savings	kW/TR	0.704
Annual energy saving	kWh/year	22176.00
Annual monetary saving	INR/year	192488
Total investment requirement	INR	409500
Reduction in Demand	kW/kVA	14.08
Simple payback period	Months	25.53

Replacement of 1 TR split AC- more than 8 years old with new 5 star rated split AC's

Assumptions and Input parameters		
Cost parameters		
Particulars	Unit	Value
1.5 TR AC is proposed to be replaced	Number	1
Total TR of existing system	TR	1
Price of 5 * AC of 1.5 TR -deducting retrieval cost	Per TR	19500
Installation charges	% of capital cost	5
Operating parameters		
Particulars	Unit	Value
Number of running hours	Per day	7
Number of operating days	Per year	225
Average life of AC's	Years	10
Average electricity tariff	INR/kWh	8.68
Energy and financial savings		
Parameters	**Unit**	**Value**
Power Consumption of per TR of existing system-Estimated	kW/TR	1.65
Power Consumption of Energy Efficient AC-per TR	kW/TR	0.946
Power savings	kW/TR	0.704
Annual energy saving	kWh/year	1108.80
Annual monetary saving	INR/year	9624
Total investment requirement	INR	20475
Reduction in Demand	kW/kVA	0.704
Simple payback period	Months	25.53

3

INVENTORY OF INSTALLED AIR CONDITIONERS

S No.	LOCATION	Year of Installation/ year old	1.5 TR Non Str W. AC	1.5 TR Non Str Split	2 TR Non Str SPLIT	2 TR 3 Str SPLIT	1.5 TR 3 Str SPLIT	1.5 TR 2 Str W. AC
1	AB - VI BLOCK	10	1					
2		10		1				
3		10			1			
4		2				1		
5		2					1	
6		4						1
7	AB - IInd	10	1					
8	AB - IIIrd	10			1			
9		10	1					
10		5					1	
11		10	1					
12	7th Block	10			1			
13		8					1	
14	8th Block	7						
15		10			1			
16		7				1		
17		7					1	
18	9th Block	4						1
19		10	1					
20		4					2	
21	10th Block	4						1
22		10	1					
23		4				1		
24		3					1	
25	AB - Ist	4				1		
26		4					1	
27		8				1		
28		10			1			
29		8				1		
30		10	1					
31	AB - IV IPR	10	1					
32		10			1			
33		4				1		
34	AB - V	10	1					
35		4						1
36		2				1		
37		10			1			
38		10	1					
	TOTAL		10	1	7	8	8	4

Sno	LOCATION	Year of Installation/ year old	1 TR 3 Str SPLIT	1.5 TR 5 Str SPLIT	2 TR 5 Str SPLIT	3 TR 4 Str SPLIT	1 TR Non Str SPLIT	1 TR 5 Str SPLIT
1	AB - VI BLOCK	10						
23		4	1					
4	AB - IInd	8		3				
5		8			1			
6	AB - IIIrd	3			1			
7		3				1		
8		4	1					
9		10					1	
10	7th Block	2			1			
11		8						1
12	8th Block	7						
13		5			1			
14	9th Block	4						
15	10th Block	4						
16		4	1					
17		3						
18	AB - Ist	4						
19		10					1	
20	AB - IV IPR	10						
21	AB - V	10						
	TOTAL		3	3	4	1	2	1

Sno	LOCATION	Year of Installation/ year old	.75 TR 5 Str SPLIT	2 TR 4 Str SPLIT	.75 TR Non Str SPLIT	1.5 TR 2 Str W. AC	3.5 TR Non Str W. AC	3.5 TR Non Str Split
1	AB - VI BLOCK	10						
2	AB - IInd	8						
3	AB - IIIrd	3						
4	7th Block	2						
5		8	1					
6	8th Block	7	1					
7	9th Block	4						
8		5		1				
9	10th Block	4						
10		10						
11		5		1				
12	AB - Ist	4						
13		8			1			
14		4				1		

15		8					1	
16		10						1
17	**AB - IV IPR**	10						
18	**AB - V**	10						
		3		1				

Sno	LOCATION	Year of Installation/ year old	1 TR 4 Str SPLIT	1.5 TR 4 Str SPLIT	7.5 TR Non Str Duct. AC
1	**AB - VI BLOCK**	10			
2	**AB - IInd**	8			
3	**AB - IIIrd**	3			
4	**7th Block**	2			
5	**8th Block**	7			
6	**9th Block**	4			
7	**10th Block**	4			
8	**AB - Ist**	4			
9	**AB - IV IPR**	10			
10		4	1		
11	**AB - V**	10			
12		4		1	
13		10			1
	TOTAL		**1**	**1**	**1**

12.Water Pumping System

Detail of Installed Pumps at GLA

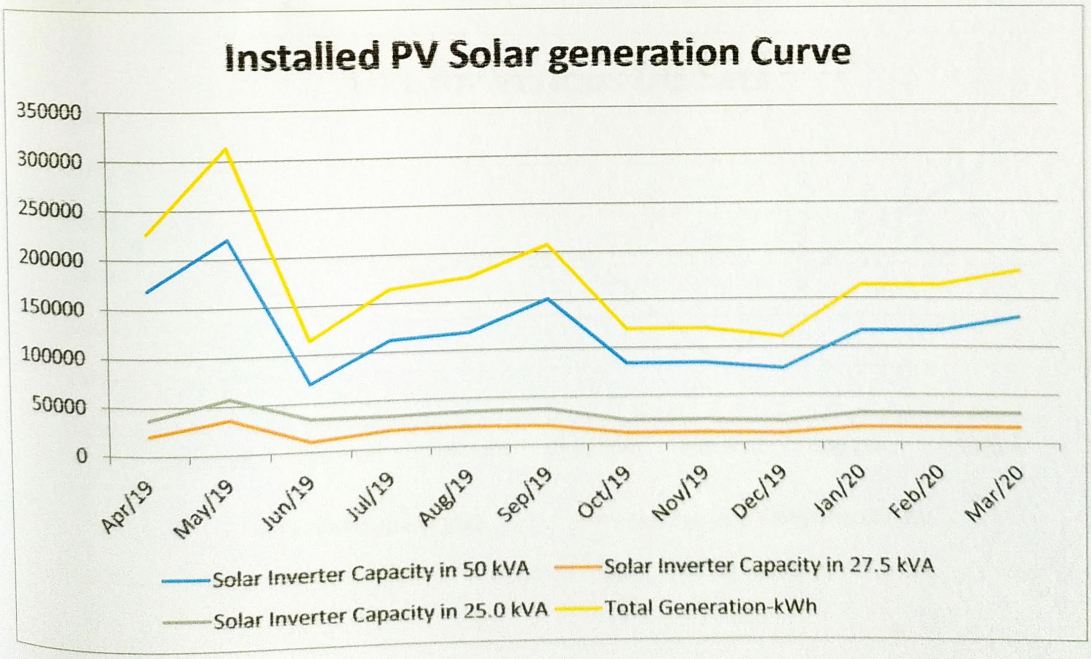
S No.	Detail of Pumps	Qty	Present Status	Running	
1	20 HP Submersible Pumps	6 nos	Running	3 nos	
2	15 HP Submersible Pumps	2 nos	Running	1 no	
3	10 HP Submersible Pumps for STP treated water Supply	1 nos	Under Repair	1 no	Running 5 hrs / day
4	5 HP Mono block Pumps for STP treated water Supply	2 nos	Running	2no	Running 5 hrs / day

Bore- well Details (GLA University Mathura) Dated : 27/10/2020

Sl No.	Pump No.	Boring Depth (Rft.)	Motor Capacity (HP)	Link With	Status	Location
1	1	150	15	OHT	Running	Behind E & F Mess
2	2	200	15	OHT	Running	Near Sport Toilet
3	3	200	15	UGT	Running	Near RO-2
4	4	200	15	Use by Agri.	Running	Behind I & J Mess
5	5	200	15	OHT	Running	Near MM Builder Bore-well
6	6	250	20	OHT	Running	Out Side Boundary
7	7	250	20	OHT/UGT	Running	Out Side Boundary
8	8	150	15	UGT	Running	Out Side Boundary

13. Renewable Energy

Month	Solar Inverter Capacity in 50 kVA	Solar Inverter Capacity in 27.5 kVA	Solar Inverter Capacity in 25.0 kVA	Total Generation-kWh
Apr-19	168737	20539	37180	226456
May-19	220110	35875	57375	313360
Jun-19	70210	10605	33511	114326
Jul-19	112199	19065	33511	164775
Aug-19	118186	20728	36256	175170
Sep-19	151186	19355	36945	207486
Oct-19	83716.5	11324.5	24630	119671
Nov-19	83716.5	11324.5	24630	119671
Dec-19	77472	10049	22801	110322
Jan-20	116393	16372	31132	163897
Feb-20	116393	16372	31132	163897
Mar-20	130318.75	16594.75	31352.75	178266.25
Total	**1448637.8**	**208203.75**	**400455.75**	**2057297.25**

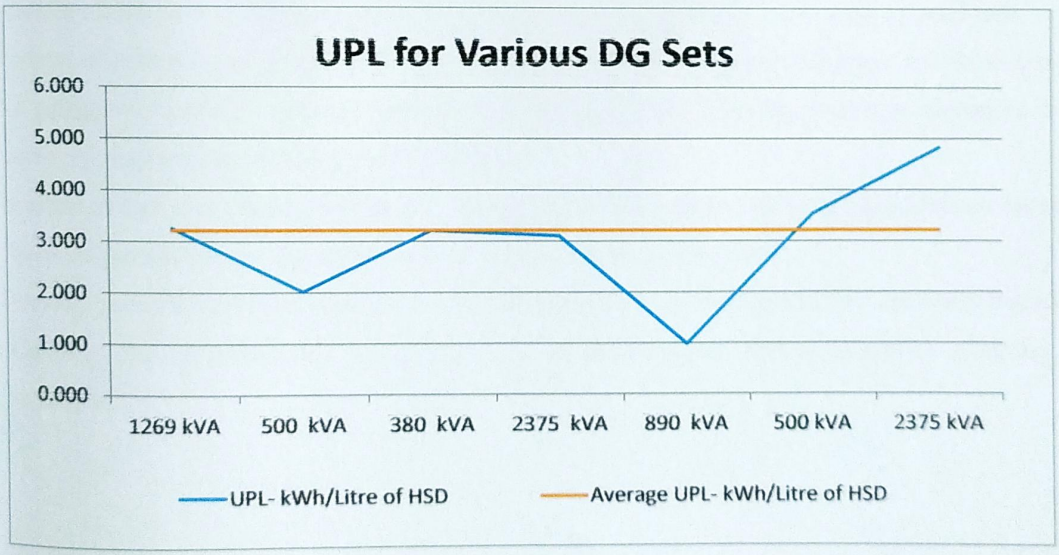


14. Diesel Generator Set

As the condition of Electricity supply is quite reliable, there is limited use of DG set. The consumption of High speed diesel is as per table given.

The capacity of installed DG sets is quite higher than actual requirement. Management of DG set utilization is required to be improved further.

	03-01-2019		30-06-2020			
S.No.	DG Set		kWh	HSD Consumption	UPL- kWh/ Litre of HSD	Location
1	1269	kVA	16880	5191.3	3.252	GLA University
2	500	kVA	17503	8674.05	2.018	GLA University
3	380	kVA	25672	7996.6	3.210	GLA University
4	2375	kVA	92341	29753	3.104	GLA Polytechnic
5	890	kVA	2144	2189	0.979	GLA Polytechnic
6	500	kVA	59137	16723	3.536	GLA Polytechnic
7	2375	kVA	38758	8034	4.824	GLA Polytechnic
Combined	**8289**		**252435**	**78560.95**	**3.213**	



Load Characteristics

Some of the load characteristics influence efficient use of D. G. set. These characteristics are entirely load dependent and cannot be controlled by the D. G. set. The extent of detrimental influence of these characteristics can be reduced in several cases.

Unbalanced Load:

Unbalanced loads on A.C. generator leads to unbalanced set of voltages and additional heating in A.C. generator. When other connected loads like motor loads are fed with unbalanced set of voltages additional losses occur in the motors as well. Hence, the load on the A.C. generators should be balanced as far as possible. Where single phase loads are predominant, consideration should be given for procuring single phase A.C. generator.

Energy Saving Measures for DG Sets

a) Ensure steady load conditions on the DG set, and provide cold, dust free air at intake (use of air washers for large sets, in case of dry, hot weather, can be considered).

b) Improve air filtration.

c) Ensure fuel oil storage, handling and preparation as per manufacturers' guidelines/oil company data.

d) Consider fuel oil additives in case they benefit fuel oil properties for DG set usage.

e) Calibrate fuel injection pumps frequently.

f) Ensure compliance with maintenance checklist.

g) Ensure steady load conditions, avoiding fluctuations, imbalance in phases, harmonic loads.

h) In case of a base load operation, consider waste heat recovery system adoption for steam generation or refrigeration chiller unit incorporation. Even the Jacket Cooling Water is amenable for heat recovery, vapour absorption system adoption.

i) In terms of fuel cost economy, consider partial use of biomass gas for generation. Ensure tar removal from the gas for improving availability of the engine in the long run.

j) Consider parallel operation among the DG sets for improved loading and fuel economy thereof.

k) Carryout regular field trials to monitor DG set performance, and maintenance planning as per requirements.

1. TYPICAL DIESEL EXHAUST GAS COMPOSITION

Component		Typical Component Concentration Range in Diesel Exhaust Gas	Component Concentration in Natural Dry Ambient Air
Nitrogen	N_2	75 – 77 %-vol	78.08 %-vol
Oxygen	O_2	11.5 – 15.5 %-vol	20.95 %-vol
Carbon dioxide	CO_2	4 – 6.5 %-vol	0.038 %-vol
Water	H_2O	4 – 6 %-vol	
Argon	Ar	0.8 %-vol	0.934 %-vol
Totally		> 99.7 %-vol	

%-vol: Concentration, percentage, volume basis

ppm-vol: Concentration, parts per million, volume basis

Additional components found in diesel exhaust – typical concentration range (steady state, high load, residual and distillate fuel oil):

Nitrogen oxides	NO_x:	1000 - 1500 ppm-vol
Sulphur oxides	SO_x	30 - 900 ppm-vol: Fuel composition related
Carbon monoxide	CO	20 - 150 ppm-vol
Total Hydrocarbons	THC (as CH_4)	20 - 100 ppm-vol
Volatile org.comp.	VOC (as CH_4)	20 - 100 ppm-vol
Particulates *)	PM	20 - 100 mg/Nm^3, dry, 15% O_2: Fuel composition related
Smoke:	Related to low load (<50% load), start-up and fast load increase	

Recorded Parameters of Flue gas Analysis of 500 kVA DG Set

Parameters	DG-500 KVA
NET	37
O_2	18
CO	254
EFFICIENCY	78.3
CO_2	2.4
FLUE	101
AMBIENT	28.9
X AIR	596.6
LOSSES O_2	17.6
Ref O_2	2

15. Kitchen-Energy Conservation Option

ANNUAL PNG CONSUMPTION PROFILE

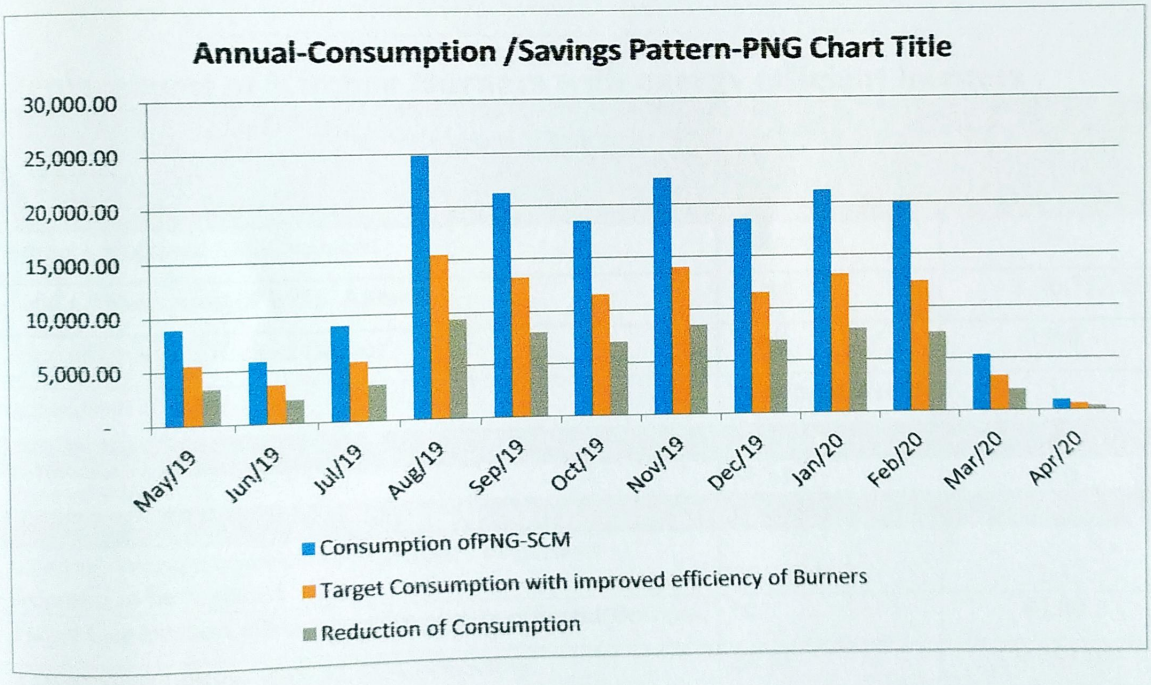
Sr.No.	Mess	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19
1	A	515	0	0	1640	912	1001
2	B	221	0	0	4044	1649	1250
3	C	432	0	0	1145	1256	1120
4	D	455	0	0	1375	1424	1151
5	E	1513	910	25	1433	1744	1236
6	F	577	1318	1509	1606	1594	1335
7	G	615	1141	711	1157	1221	918
8	H	523	0	388	1126	1170	883
9	I	632	0	970	1470.3	1150.5	1722
10	J	119	0	1489	1470	1064	1448
11	Godawari	462	0	606	1409	1367	1039
12	Ganga	548	0	0	1758	1351	1162
13	Yamuna	839	1291	1354	1728	1671	1341
14	Kalpana	283	0	191	713	735	602
15	Wing-3	703	1174	1279	1514	1582	1279
16	Wing-5	480	0	499	1278	1319	1019
	Total	**8917**	**5834**	**9021**	**24866**	**21209**	**18506**

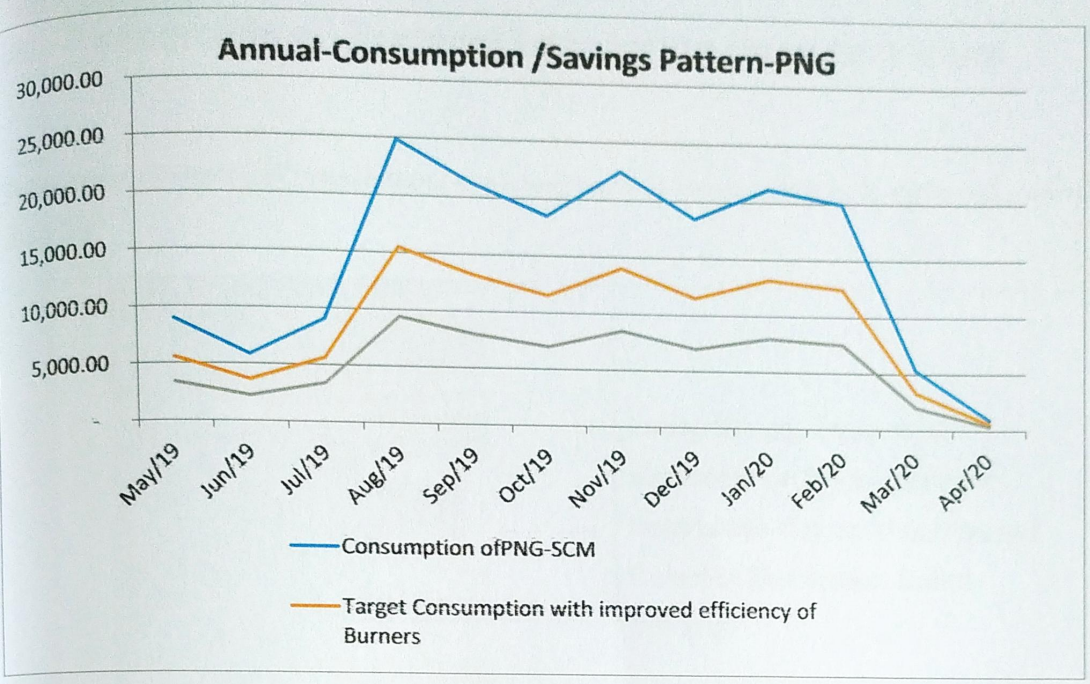
Contd.

S.No.	Mess	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	Annual Total Consumption-SCM
1	A	1250	957	1324	1156	355	0	9110
2	B	1474	1627	1577	1374	1494	965	15675
3	C	1180	1160	1175	1125	272	0	8865
4	D	1451	1136	1314	1254	290	0	9850
5	E	1481	1181	1603	1543	363	0	13032
6	F	1596	1225	1582	1547	320	0	14209
7	G	1180	940	1067	1070	226	0	10246
8	H	1101	833	1084	1031	221	0	8360
9	I	1616	1553	438	357	0	0	9908.8
10	J	2034	1362	1797	1495	0	0	12278
11	Godawari	1386	1119	1444	1330	320	0	10482
12	Ganga	1539	1250	1739	1617	418	0	11382
13	Yamuna	1665	1335	1592	1563	361	0	14740
14	Kalpana	812	738	846	790	162	0	5872
15	Wing-3	1442	1088	1461	1465	293	0	13280
16	Wing-5	1286	981	1127	1239	235	0	9463
	Total	**22493**	**18485**	**21170**	**19956**	**5330**	**965**	**176752**

FLUE GAS ANALYSER

Parameters	MESS BURNER-1	MESS BURNER-2	MESS BURNER-3	MESS BURNER-4	MESS CHAPATI BURNER	Average of inefficient Burners
NET	272	781	795	887	754	
O_2	1.3	3.2	1.9	0.1	8.3	
CO	O/R	O/R	O/R	O/R	O/R	
EFFICIENCY	84.3	55.5	56.6	52.3	44.9	**52.325**
CO_2	92	11.9	11.6	11.8	7.5	
FLUE	580	985	815	1010	886	
AMBIENT	27.3	27.6	27.9	28.3	28.7	
X AIR	20.1	0	37.5	0.9	34.5	
LOSSES O_2	6.1	0	2	0.2	10.6	
Ref O_2	2	2	2	2	2	



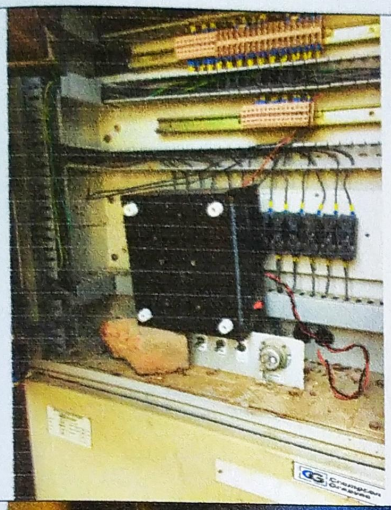
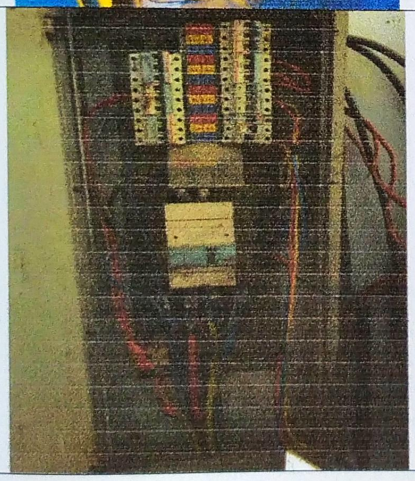


Replacement of Kitchen Burners with energy efficient burners

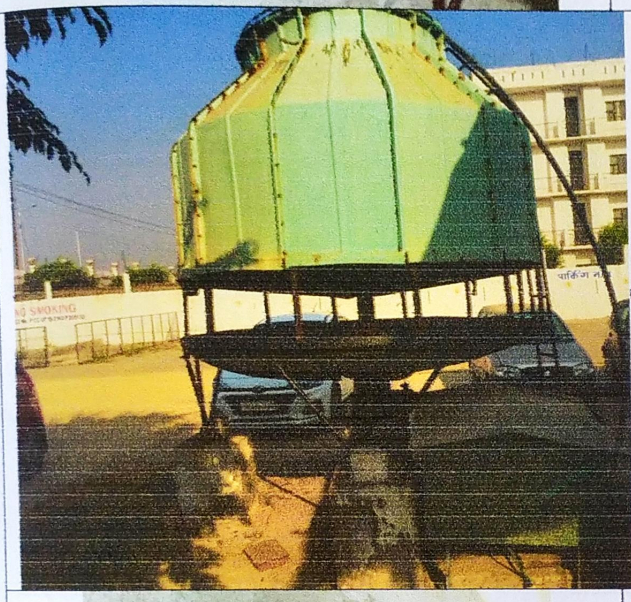
Assumptions and Input parameters		
Cost parameters		
Particulars	**Unit**	**Value**
Burners proposed to be replaced	Number	64
Total Consumption of LPG- Annual	SCM	1,76,752.00
Price of Energy Efficient Burner	Each	3500
Installation charges	% of capital cost	5
Operating parameters		
Price of PNG	SCM	41.6
Energy and financial savings		
Existing Average combustion efficiency of burners proposed to be replaced	%	52.32
Target Combustion efficiency with energy efficient Burners	%	84.00
Annual consumption with 52.32% efficiency	SCM	176752.00
Annual consumption with 84 % Efficiency	SCM	110091.25
Annual PNG Savings with Efficient new PNG Burners	SCM	53328.60
INR-Annual Savings	INR	2218469.90
Total investment requirement	INR	235200.00
Simple payback period	Months	1.27

16. Photographs of Electrical Installation Depicting Issues

Photographs of electrical installations depicting various issues relating to electrical, safety and reliability

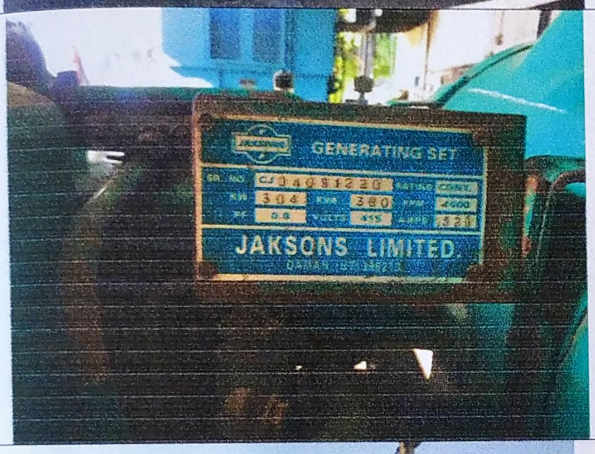
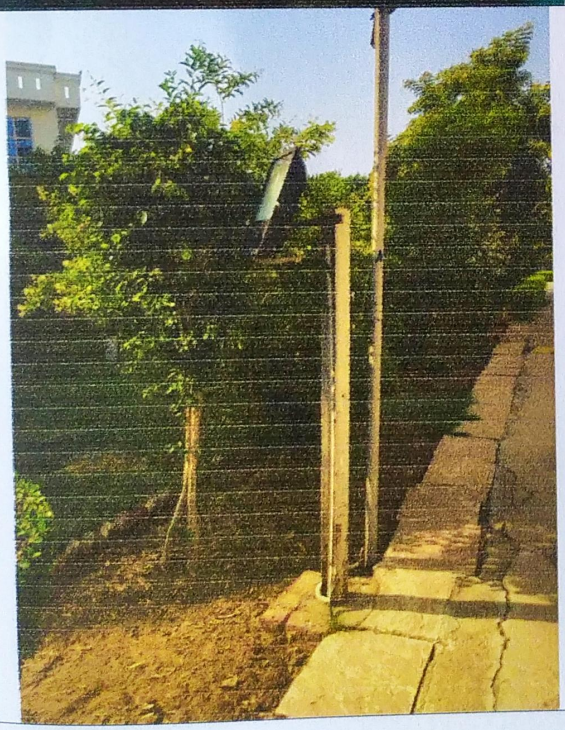
	Loose Wiring, Equipment supported on Brick-Improper Installation-Discontinuity Hazard. Cover of Distribution Board missing.
	Improper Ventilation. Light fitting used for moisture removal. Proper designed ventilation should be provided in all electrical rooms. Hazardous wiring laid haphazardly on floor. No earth connection for earth connection of Fixture.
	Haphazard Wiring-Open Cover-Arc Flash hazard.

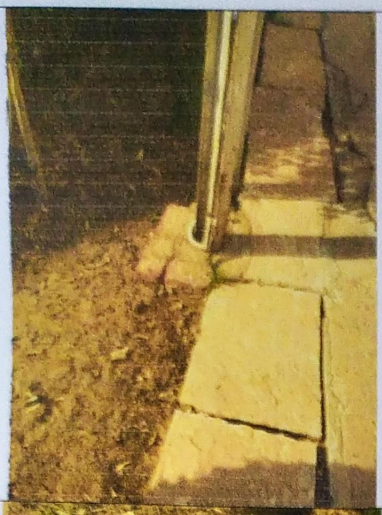
Good Practice-Sand Buckets filled with sand.



Cooling Tower not maintained

Improper Earth Pit

	Ply wood cover-Inflammable material cover provided. Fire hazrd. Metallic sheet cover should be provided. Termination not possible to be done with brass compression Gland. Gland should be provided after sheet metal cover is provided.
	Painting of DG set not done. It causes rapid rusting with atmospheric exposure. Life of Equipment is shortened and reliability also gets affected.
	Pole Box not provided for better control and isolation of fault. Earth connection of metal bracket not done. Electrocution hazard.

	Pole Box not provided for better control and isolation of fault. Earth connection of metal bracket not done. Electrocution hazard.
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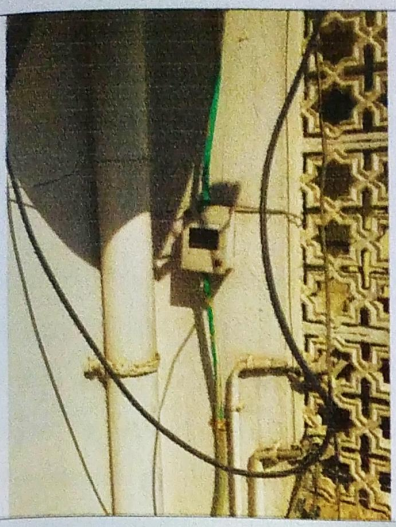
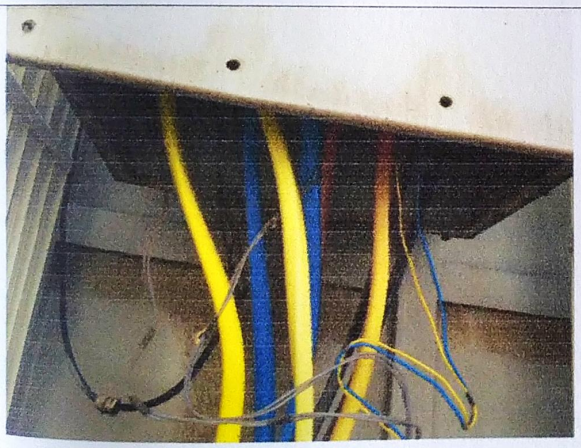
	Haphazard Wiring
	HT termination of Transformer is not done properly. Terminals are under stress. Proper contact area is not established. Bent Insulator metallic rods.
	LT side of Transformer. Main termination is lying open without cover. Electrocution and short circuit hazard. In absence of End cover, Proper termination with Brass compression glands not possible. Terminals get under stress and there is likeliness of damage of terminals and it affects reliability of electrical system.

ANNEXURES

Annex I –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.

For A-Z Energy Engineers Private Limited

Director

(Dr. P.P. Mittal)

Accredited Energy Auditor AEA-011

Annex II –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

ANNEX III

1. Technical Specifications for Retrofit Options

1. All applicable IS standards and various international standards as per applicability.
2. IS: 513 Cold-rolled low carbon steel sheets and strips
3. IEC 60529 Classification of degree of protections provided by enclosures.
4. EN 55015, CISPR15: Limits and methods of radio disturbance characteristic of electrical lighting and similar equipment.
5. IEC 62031 : LED modules for general lighting-Safety requirement
6. EN 61547: Equipment for general lighting purposes – EMC immunity EN 60929: Performance, AC supplied electronics ballast for tubular fluorescent lamps performance requirement.
7. IEC 60598-2-1 :Fixed general purpose luminaries
8. IEC 60598-1 -Luminaries - General Requirement
9. IEC 61000-3-2: Electro Magnetic compatibility (EMC) -Limits for Harmonic current emission (equipment input current ≤ 16 Amps. per phase.
10. IEC 60068-2-38:Environmental Testing:Test Z- AD: composite temperature/ humidity cyclic test
11. IEC 61347-2-13 : Lamp control gear : particular requirement for DC or AC supplied electronic control gear for LED modules.
12. IS 10322 :Specification for the luminaries
13. IS 4905: Method for random sampling LM 79 LED luminaries photometry measurement.
14. LM 80 : Lumen Maintenance
15. IEC 62384 :DC or AC supplied electronic control gear for LED modules performance requirements
16. IEC/PAS 62612 :Self-ballasted LED lamps for general lighting services- Performance requirements

2. Prioritization of Identified Energy Conservation Measures

As in any investment decision, the payback period plays a significant role in prioritization of investment options in energy conservation measures. Generally, recommendations/ projects with a less payback period receive priority over high investment projects or measures (related to equipment and process changes) that involve high cost and require careful scrutiny before implement Eco Safe tech Consultant.

The energy conservation measures (ECMs) suggested under this report is separated into three categories based on the simple payback period. The three categories are as follows:

Categorization of suggested ECMs

Type of category	Simple payback period
Short-term	0-6 months
Medium-term	6-36 months
Long-term	Above 36 months

ANNEX VI-Venders List

The details of suppliers/manufacturers of energy efficient technologies are provided below.

Srl.	Product / Equipment	Agency Name / Address
1	DG Synchronization, Automation and capacitors	SGS Industrial Controls & Solutions Pvt. Ltd. Floor-II, MadanpurKhadar, SaritaVihar, New Delhi Tel. 011-29942516, 41402992
2	Eco-Ventilators	Nu Plast Pipes &profilies SCF – 124, Sector – 17 Market, Faridabad - 121002 Tel. 0129-6456217, 4070023
3	Electrical measurement Instrument	Riken Instrument Ltd. 369, Industrial Area, Phase –II, Panchkula Haryana Tel. : 0172-2591651, 2592028 www.rikeninstrumentation.com
4	Energy Management & Control System	Manaco Energy Solutions (P) Ltd. A-6, Shanti Apts. 21 & 22,1st Cross St.TTK Road, Alwarpet Chennai-18, Tel. 044-42316164 www.mesco.co.in
5	Energy Saving Products	Gautam Enterprises 205, VinayIndl. Est. ChicholiBunder Link Road, Malad(W) Mumbai – 6, India
4	Energy Saving Products	Techmark Engineers & Consultants K-1/28, Ground Floor, Chittaranjan Park, New Delhi – 110019 Tel. 011-26238349
5	Flue Gas Analyzer/ Oxygen Analyzer	Nevco Engineers Pvt. Ltd. 90A, (2nd Floor) Amritpuri B, main Road, East of kailash, Opp. Iskcon Temple, New Delhi – 110 065 Tel. 26226328, 26213009 www.nevco.co.in
6	Flue Gas Analyzer/ Oxygen Analyzer	ACE Instruments & Controls 1 Birandari, Above Kashi Dairy MG Road, Ghatkopar (W) Mumbai – 400 086 Tel. 5125153, 5122762
7	FRP Blades & Cooling Tower accessories	Eneertech Engineers SCO 144 – 145, Sector – 34A, Chandigarh Tel. 0172-5018077, 9876022225
8	HVAC related instruments Thermocouples pipe fittings pressure gauges	Waaree, 36 Damjishamji Industrial Complex, Off Mahakali caves Road, Andheri (E) Mumbai tel. 02266963030, 26874778
9	Infrared Temperature Meters (600 °C to 1800 °C	Toshniwal Industries Pvt. Ltd. Industrial Area Mahukupura, Ajmer – 305 002 Tel. 91145 2695171, 91145 2695205
10	Infrared Temperature Meters (upto 1500 °C)	KusamMeco, G-17, Bharat Industrial Area, T.J. Road, Sewree Mumbai – 400015 Tel. 02224156638, 24124540
11	AC Drives	Rockers Control System SCO 819 2nd Floor, NAC Manimajra, Chandigarh – 160101 Tel. 0172-2730900, 5071627

12	AC Drives	Allen Bradley India Ltd. C – 11, Industrial Area, Site – IV, Sahibabad, Ghaziabad
13	AC Drives	Asea Brown Boveri Ltd. Guru Nanak Foundation Building, 15 – 16, Qutab Institutional Area, SaheedJeet Singh Sansnwal Marg, New Delhi 110 067
14	AC Drives	Crompton Greaves Ltd. Machine 3 Division, A – 6 / 2, MIDC Area, Ahmednagar 414111
15	Automation, Panel Meters	Conzerv System 44P, Electronic City Phase –II, East Hosur Road, Banglore – 560100
16	Automation, Panel Meters	Selec controls Pvt. Ltd. E-121 Ansa Industrial Estate, Saki Vihar Road, Mumbai 400072 Tel.: 022-28471882, 28476443 www.selecindia.com
17	Building Automation, sensors, twilight Switches	Electro Art Plot No. K-11, MIDC Area, Ambad, Nasik – 422010 Tel. 0253-5603954, 2380918, www.electronicswitchesindia.com
18	Burners	Wesman Engineering (P) Ltd. 503-504 Eros Apartments, 56, Nehru Place, New Delhi – 110019 Tel. : 26431723, 26434577
19	Burners, Furnace RecuperatorsHor air Generation, Heating & Pumping unit Laddle pre-heating	ENCON 12/3, Mathura Road, Faridabad – 121003 Tel. : 0129-25275454 www.encon.co.in
20	Capacitors	Asian Electronics Ltd. Plot No. 68, MIDC, Satpur, Nasik – 422 007
21	Capacitors	Shreem Capacitors Pvt. Ltd. /39, VikramVihar, Lajpat Nagar-IV, New Delhi – 110024
22	Capacitors & APFC Panels	Matrix Controls & Engineers Pvt. Ltd. E-725, DSIDC Industrial Complex, Narela, GT Road, Delhi – 011-27786945 / 46 / 47 Rajeev Batra 9811624440, Rajeev@matrixcapacitor.com
23	Capacitors & APFC Panels	Standard Capacitors B-70/43, DSIDC Complex, Lawrence Road, Industrial Area,, Delhi – 110035 Tel: 011-27181490, 27151027 www.standardcapacitors.com
24	Capacitors & APFC Panels	Saif Electronics 174, Hira Building, 1st Floor, Carnac Road, Opposite Police Commissioner Officer Mumbai Tel. 022-22064626, 22086613 www.saifel.com
25	Insulations	Llyod Insulations (India) Ltd. PB NO. 4321, Kalkaji Industrial Area, Punj Sons Premises, New Delhi Tel. : 26430746-7

26	Insulations	Hirnal Supply (India) Ltd. 168, Rajagarden, New Delhi – 110015 Tel: 011-25438602, 25448602
27	Insulations	Technical & Management Consultancy Center SCO – 324, 2nd Floor, Cabin – 203, Sector – 9, Panchkula Ry_tmcc@yahoo.com
28	LED Lighting	Synergy Solar (P) Ltd. SCO 133, Sector 28D, Chandigarh Tel. : 0172-6451133, www.synergysolars.com
29	Lighting system	Philips India Ltd. Regional Office-North, 9th Floor Ashoka Estate, 24, Barakhamba Road, New Delhi – 110 001 Tel. : 3353280, 3317442
30	Lighting system	Crompton Greaves Ltd. Lighting Business Group, 405, Concorde, RC Dutt Road, Baroda – 390 007
31	Lighting system	Osram India Ltd. Signature Towers 11th Floor, Tower B, South City-I, Gurgaon -122001 Tel.: 0124-6526175, 6526178, 6526285
32	Lighting system	Asian Electronics Surya Place, First Floor, K-185, Sarai Julena New Friends Colony, New Delhi – 110 025
33	Lighting system	Philips India Limited, Technopolis Knowledge Park, Nelco Complex, Mahakali Caves Road, Chakala, Andheri (E) Mumbai – 400 093 Tel : 022 56912000
34	Lighting system	Surya Roshni Ltd. Padma Tower_I, Rajendra Palace, New Delhi – 110 006
35	Lighting system	Wipro Limited SCO – 196-197, Sector – 34-A, Chandigarh – 160 022
36	Lighting Voltage Control Systems	Jindal Electric & machinery Corporation C – 57, Focal Point, Ludhiana – 141010 Tel. : 2670250, 2676890
37	Lighting Voltage Control System	ES Electronics (India) Pvt. Ltd. Plot No. 82, KIADB Industrial Area, Bommasandra – Jigani Link Road, JiganiHobli Banglore – 562 106

ANNEX V-Equipment – Indicative Life

With an effective maintenance strategy in place from the start up operation of the respective plant and equipment, the latter have an indicative life noted as per CIBSE Guide:

- Electric hot water heaters –12years
- Water booster pumps – 15 years
- Electrical Switchgear–25years
- Mains cabling – 30 to 35 years
- Mains circuit breaker – 20 years
- Split type air conditioning units – 10 years
- Window type air conditioning units-10 years
- Fans – 15 to 20 years
- Valves – 15 years
- steel – 25 years
- PVC –below ground drainage– 40 years
- Copper – 45 years
- Galvanised steel – 35 years
- Ductwork galvanised – 40 years
- Kitchen cooking & support systems – 15 years
- Water treatment Plant – 15 years
- Air compressor- 20 years
- Incinerators- 15 years
- Lightning Protection- 25 years
- Distribution boards- 20 years
- Lighting installation-external- 15 years
- Fire alarm system – 15-20 years
- Air Cooled Chilled Water system-10 years
- Water Cooled Chilled water system-20-25 years