# Detailed Energy Audit Report

Submitted to


# Nehru Memorial Government College, Mansa

Prepared and Submitted by

**Indona Innovative Solutions**

**8/W-11, Railway Road, Dinanagar,**
**Punjab- 143531**

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## GLOSSERY

| APFC | Automatic Power Factor Correction Capacitor |
|---|---|
| DBT | Dry Bulb Temperature |
| DG | Diesel Generator |
| EL | Electronics |
| HSD | High speed diesel |
| HT | High Tension |
| HV | High Voltage |
| LT | Low Tension |
| LV | Low Voltage |
| MDI | Maximum Demand Index |
| PA | Power Analyzer |
| PBP | Payback Period |
| PSPCL | Punjab State Power Corporation limited |
| RH | Relative Humidity |
| SB | Stand By |
| SDA | State Designated Agency |
| SPV | Solar Photo Voltaic |
| THD | Total Harmonics Distortion |
| VFD | Variable Frequency Drive |
| WBT | Wet Bulb Temperature |

## ASSUMPTIONS FOR CALCULATIONS

| Description | Value |
|---|---|
| Operating days per annum | 300 |
| Average Operating hours per day | 6.0 |
| Unit Cost, Rs./kVAh | 6.63 |

## ACKNOWLEDGEMENT

Indona Innovative Solutions is thankful to Nehru Memorial Government College for providing an opportunity to conduct Detailed Energy Audit Study at college campus located at Barnala Road, District Mansa, Punjab - 151505.

We take the opportunity to express our profound gratitude towards Mrs. Lovleen (Principal) for award of work. We are also very thankful to her for her advice and valuable support extended to this project.

We are also grateful to Mr. Sukhdeep Singh (Professor Punjabi Department) for his valuable time and actively participation in discussion with audit team with tremendous patience and understanding

Our sincere thanks to all respondents from different departments for clearing our doubts with tremendous patience and understanding.

The Following Officers /representative from Indona Innovative Solutions under the guidance of Shri Devinder Singh have carried out the energy on 15/05/2023.

| Name | Role |
|---|---|
| Shri Devinder Singh | Team Leader |
| Shri Yogesh Kumar | Consultant |
| Shri Kamaljeet | Field Engineer |

We do hope that management will find the recommendations given in this report useful in energy conservation as well as improvement in system performance. We have made every attempt to adhere to high quality standards, in both data collection and analysis. We would welcome any suggestions from your side as to how we can improve further.

INDONA INNOVATIVE SOLUTIONS
Regd. off.: Railway Road
Opp. Onkar Feed Store, Dina Nagar,
Punjab -143531

**Devinder Singh**
**Certified Energy Auditor**
**Indona Innovative Solutions**

## EXECUTIVE SUMMARY

Nehru Memorial Government College, Mansa awarded the Detailed Energy Audit study to Indona Innovative Solutions with a target to identify the energy reduction key areas and submission of report. The facility is getting grid supply from Punjab State Power Corporation Limited (PSPCL). The contract demand of the college is 112kVA. The campus has load variation due to occupancy and seasonal variation. The facility has consumed 55,548kVAh during one year (Apr- 22 to Mar- 23).

The intensive energy audit is conducted by the energy audit team of M/S Indona Innovative Solutions on 15/05/2023 to understand the energy consumption pattern and found there is huge energy saving potential. Based upon the site visit and performance assessment of utilities, recommendations are given to capture energy saving potential. The various measures have been given in below table based upon the sample payback period:

| Sr. No. | Description | Energy saving, kWh | Annual Saving, Rs. | Investment, Rs. | Simple Payback Period, months |
|---|---|---|---|---|---|
| 1 | Reduction in Contract Demand From 112kVA To 55kVA to reduce the fixed charges | 0.0 | 59,384 | Nil | Immediate |
| 2 | Installation of capacitor bank for maintaining power factor from average power factor of 0.959 close to 0.99 and reduction in energy consumption | 9,324 | 59,952 | 45,000 | 9.0 |
| 3 | Ensuring switching off the lights when there is no occupancy in the respective class room or office areas | 2,728 | 18,089 | 16,200 | 10.7 |
| 4 | Replacement of the conventional lights FTL- 12 with new (20W LED) energy efficient lights | 4,640 | 29,835 | 45,000 | 18.1 |
| 5 | Replacement of old ceiling fans with new 35W energy efficient BLDC fans | 3,780 | 25,061 | 1,20,000 | 57.5 |
| 6 | Installation of 45.0kWp capacity Grid connected Solar PV System for lighting load and other load | 45,455 | 3,01,364 | 17,32,500 | 69.0 |

**Table 1: List of Energy Conservation Measures**

The energy saving from the installation of SPV is more than the energy saving from all the measurement. The installation of SPV will lead to huge energy saving and will cover the energy savings from all other measures. There are few other measures which can be implemented for energy saving and will improve energy accounting system:

- Installation of Energy Monitoring System for benchmarking and targeted energy reduction can help in further reduction in energy consumption.
- Maximize the use of natural light to reduce the energy consumption in artificial light.
- Keep AC unit set point close to 25°C.
- Always switch off the lights while going out of the classrooms.
- Use of float valve for water overheat tank so that the water energy saving can be achieved by avoiding overflow.

# 1. INTRODUCTION

## 1.1. INTRODUCTION ABOUT GOVT. RIPUDAMAN COLLEGE, NABHA

The foundation stone of the College building was laid by Late Comrade Ram Kishen, the then Chief Minister of Punjab, on 18th August 1965. Later in 1997, college was taken over by the Punjab Government and Late Sardar Beant Singh, the then Chief Minister of Punjab, who was largely instrumental in the Punjab Govt. taking over the College, graced the College with his presence at a function marking the inauguration of the College as Govt. College on 21st March, 1994. This institute has been catering the educational needs of the area is backed by liberal grants by the Punjab Government from time to time. Sardar Parkash Singh Badal, the then Chief Minister of Punjab, laid the foundation stone of the new (present) building on 7th August, 1997 Govt. The main building of the college is surrounded by beautiful shady trees. A vast majority of the students belong to the surrounding rural areas. The college has steadily grown, fulfilling its aims and goals. It offers various undergraduate, post graduate and PGDCA courses in Arts and commerce. The Arial view of the campus is as below:

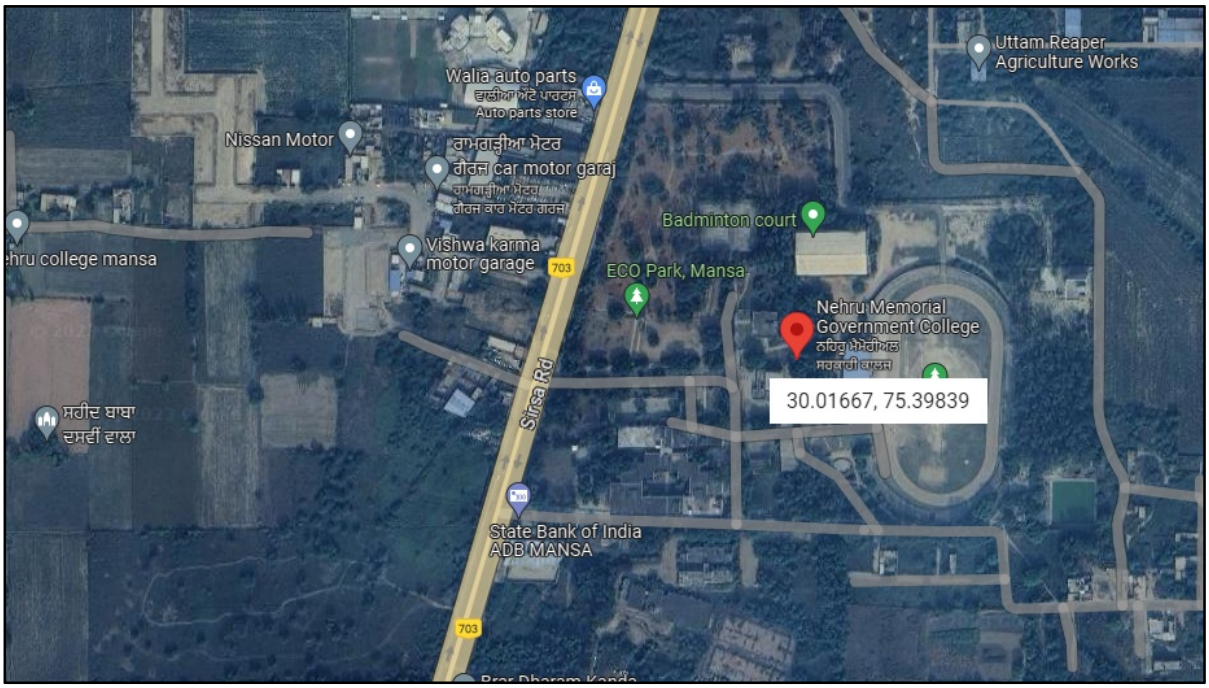



**Figure 1: Arial view of the Campus**

## 1.2. CLIMATE CONDITION OF MANSA

The climate in the area is typical semi-arid type with distinct wet and dry seasons. The climate of Mansa district is classified as subtropical steppe, semi-arid and hot which is mainly dry except in rainy months and characterized by intensely hot summer and cold winter. The normal average annual rainfall of the district is 378.2 mm. The rainfall occurs due to southwest monsoon which sets in the last week of June and withdraws towards end of September. During three months of monsoon season from July to September the district experiences high humidity, cloudiness and good monsoon rainfall. The period from October to November Constitutes post monsoon season. The cold weather season prevails from December to February followed by hot weather season or Pre monsoon season which ends up to the last week of June.

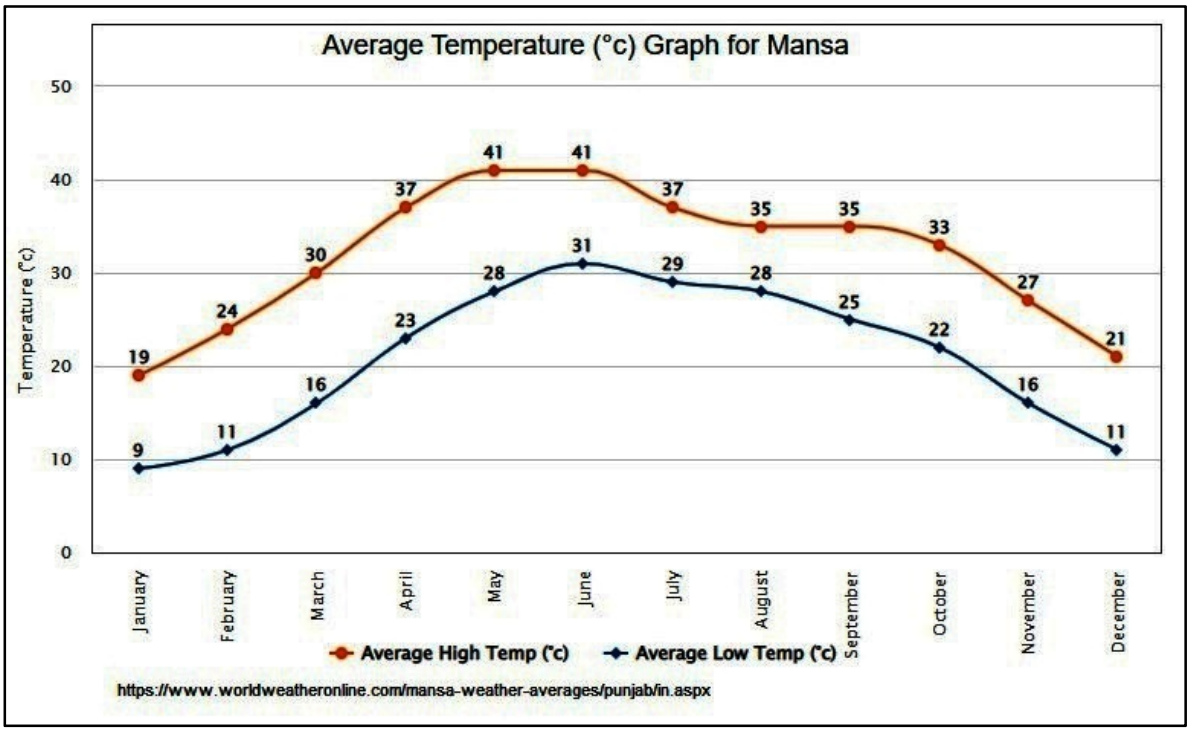



**Figure 2: Annual temperature profile of Mansa**

The temperature profile contributes towards the trend of energy consumption. During extreme summer, the energy consumption increase as the running of AC units, fans etc. adds into the normal running load. While in winter the AC units and fans don't run so the energy consumption during winter will be lesser as compared to the summer.

## 1.3. MAJOR ENERGY USE AREAS

In Nehru Memorial Government College, Mansa Electricity is the only source of energy in the entire campus to run day to run operations. In annual energy bill, major contribution is due to Electrical Energy only. The connected load in the entire campus is 104.67kW. The detail of the connected load is as below:

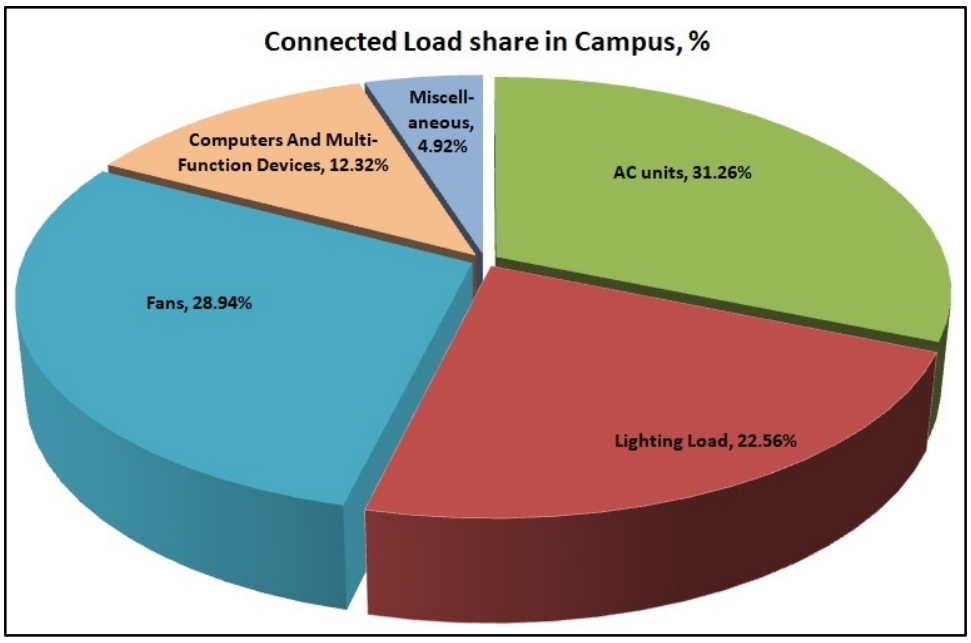



**Figure 3: Percentage share of different loads**

| Description | Percentage share, % | Connected Load, kW |
|---|---|---|
| AC units | 31.26% | 32.72 |
| Lighting Load | 22.56% | 23.615 |
| Fans | 28.94% | 30.29 |
| Computers And Multi-Function Devices | 12.32% | 12.9 |
| Miscellaneous | 4.92% | 5.15 |
| **Total** | | **104.67** |

**Table 2: Connected load in the campus**

The percentage shown in figure above is based upon the connected load. To run the connected load, the college is getting 0.415kV supply from PSPCL. The major contribution is from fan 20.28% (20.72kW) however the running load of fan depends upon the weather condition and occupancy.

## 1.4. KEY INITIATIVE TAKEN BY COLLEGE TOWARDS ENERGY CONSERVATION

The college management knows its responsibility towards energy conservation and many initiatives taken as below:

1. Installation of LED Lights whenever there is replacement.
2. Use of star rated equipments.
3. Capacity building of the students through awareness sessions and various competitions on energy conservation so that the energy conservation habit is developed in the students.


**Figure 4: Glimpse of Energy Conservation activities**

# 2. ENERGY AUDIT APPROACH AND METHODOLOGY

## 2.1 APPROACH

A team of Energy Auditors was involved in carrying out the study, the general scope of which was as follows:

- Conduct energy performance evaluation of the various utilities.
- Conduct efficiency test of equipment and make recommendations for replacement (if required) by more efficient equipment with projected benefits
- Suggest improved operation & maintenance practices
- Provide details of investment for all the proposals for improvement.
- Evaluate benefits that accrue through investment and payback period
- Discuss with the respective personnel, the individual Energy Saving Projects (ESPs) for agreement for implementation.
- Analyze various energy conservation measures and to prioritize based on the maximum energy saving & investment i.e. short, medium and long term.

| Prioritization | Payback Period |
|---|---|
| Short Term Project | Less than 1 year |
| Medium Term Project | Between 1 and 3 years |
| Long Term Project | More than 3 years |

**Table 3: Type of Project Category and PBP**

## 2.2 MEHODOLOGY

The general methodology followed is captured in the following figure:

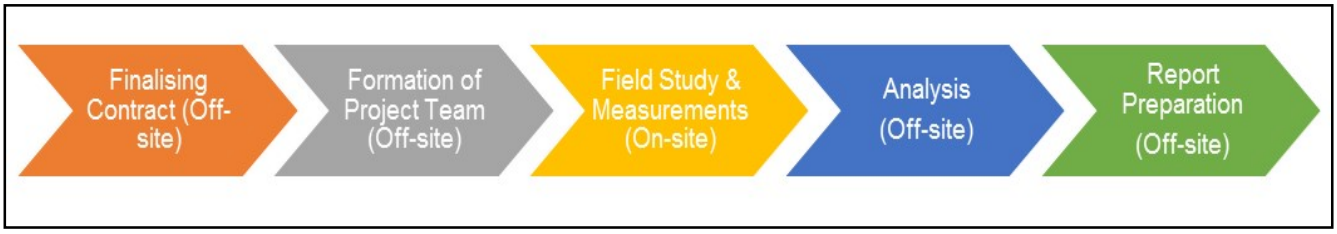



**Figure 5: Methodology for Energy Audit**

## 2.3 INSTRUMENTS USED FOR ENERGY AUDIT

The following portable instruments were used for data measurement:

- 3 – phase Power Analyzer
- Single phase Power Analyzer
- Ultrasonic Water Flow Meter
- Anemometer
- Hygrometer
- Digital Thermometer
- Infrared Thermometer
- Pressure gauge
- Lux Meter

# 3. ELECTRICAL SYSTM AND BILL ANALYSIS

## 3.1. ELECTRICAL SYSTEM

This facility is receiving 0.415kV power supply from Punjab State Power Corporation Limited (PSPCL). The direct power supply is coming at main LT panel installed in the Electrical Room. There is one DG Set also to cater the energy supply during power failure in exam. The change over switch is provided in the LT panel to switch over the power supply based upon the requirement.

**Figure 6: LT Panel Installed in NMC, Mansa**

There are few observations and recommendation based upon the observation which can help in reduction in energy loss and improved reliability.

1. It is recommended to provide the insulation mat to safeguard the manpower during operations/maintenance.
2. There should be no cable joints or unwanted cables on the floor. This leads to energy loss and can also lead to unsafe working condition.
3. Electrical room should be identified with proper marking and danger signage.
4. There should be fire extinguisher in the electrical panel room to stop fire to propagate.
5. The electrical room should be free from any type of unwanted material.

### 3.2. ELECTRICITY BILL ANALYSIS

Nehru Memorial Government College, Mansa is getting electricity supply from PSPCL having account number 3002309341. As per tariff order, facility falls under "DS rate category for DS>100kW DPC type. The sanctioned load for the campus is 101.2kW and contract demand is 112.4kVA. This facility is billed on two-part tariff structure. One part for capacity or demand drawn basis i.e. fixed Charges and the second part for actual energy drawn during the billing cycle. Fixed Charges are calculated based upon the MDI. Actual Energy Consumption is calculated based upon the Meter reading. The following components are the part of tariff structure as per latest tariff order:

| Sr. No. | Components | Description | Charges |
|---|---|---|---|
| 1 | Fixed Demand Charges | Charges for Fixed/Maximum demand registered during the month/billing period | Rs.125/ kVA |
| 2 | Energy Charges | Billed on drawn kWh units. | Rs. 6.63/kVAh |
| 3 | Total Rent with Tax | | Rs. 1491.52/month |
| 4 | Total Surcharge | | Variable |
| 5 | Total Rebates | | Variable |
| 6 | Subsidy | | Not Applicable |
| 7 | Electricity Duty | | 12.7% of Energy and fixed charges |

**Table 4: Energy Bill Components**

The electricity bill analysis is done for one year and various values for billing are as below:

| Month | MDI, kVA | Billable Demand, kVA | kWh | kVAh | Power Factor | Energy Charges, Rs | Fixed Charges, Rs | Bill Amount, Rs, RS |
|---|---|---|---|---|---|---|---|---|
| Apr-22 | 26.74 | 89.96 | 5,581 | 6,845 | 0.82 | 45,382 | 12,199 | 2,52,580 |
| May-22 | 27.86 | 89.96 | 5,397 | 6,094 | 0.89 | 40,403 | 11,090 | 2,18,090 |
| Jun-22 | 21.56 | 89.96 | 3,023 | 3,376 | 0.90 | 22,383 | 8,133 | 2,76,790 |
| Jul-22 | 28.65 | 89.96 | 5,235 | 5,854 | 0.89 | 38,812 | 11,090 | 65,910 |
| Aug-22 | 33.54 | 89.96 | 5,393 | 6,099 | 0.88 | 40,436 | 11,090 | 1,30,800 |
| Sep-22 | 39.28 | 89.96 | 7,089 | 7,978 | 0.89 | 52,894 | 11,830 | 2,12,340 |
| Oct-22 | 21.49 | 89.96 | 2,310 | 2,901 | 0.80 | 19,234 | 7,763 | 2,67,020 |
| Nov-22 | 13.88 | 89.96 | 2,366 | 3,571 | 0.66 | 23,676 | 11,830 | 44,700 |
| Dec-22 | 11.10 | 89.96 | 2,214 | 3,002 | 0.74 | 19,903 | 11,090 | 37,080 |
| Jan-23 | 14.17 | 89.96 | 2,620 | 3,458 | 0.76 | 22,927 | 11,090 | 41,460 |
| Feb-23 | 15.08 | 89.96 | 2,516 | 3,395 | 0.74 | 22,509 | 11,830 | 41,850 |
| Mar-23 | 13.43 | 89.96 | 2,018 | 2,975 | 0.68 | 19,724 | 6,349 | 36,830 |
| **Total** | | | **45,762** | **55,548** | **9.637** | **3,68,283** | **1,25,384** | |
| **Maximum** | **39.28** | **89.96** | **7,089** | **7,978** | **0.895** | **52,894** | **12,199** | |
| **Average** | **22.23** | **89.96** | **3,814** | **4,629** | **0.803** | **30,690** | **10,449** | |
| **Minimum** | **11.10** | **89.96** | **2,018** | **2,901** | **0.663** | **19,234** | **6,349** | |

**Table 5: Major Components of Electricity Bill**

The major outcomes of the bill analysis are as below:

- Total Annual Energy consumption for this facility from grid is 55,548kVAh (45,762) kWh and the energy charges are Rs 3.68Lakh.
- The maximum energy consumption (7,978kVAh) is observed during September- 2022 and minimum during October- 2022 (2,901kWh). Annual average Electricity consumption on monthly basis is 3,814kVAh.
- The reason for the variation in the electricity energy consumption is climate condition in the region and occupancy.
- The bill amount is very high compared to the energy consumption in few months because the bill was not paid in the previous months. Due to non-payment of the bills during payment period, penalty is imposed in the next month bills.

### 3.3.1 MAXIMUM DEMAND PATTERN

The contract demand for facility is 112kVA and minimum billable demand is 80% (89.96kVA) of the contract demand as per tariff order till March 2023.Maximum Demand Indicator (MDI) is another component mentioned in the electricity bill. MDI is maximum demand value in one month during one particular time reached during the billing period (this average time may vary depending on the country/DISCOM). The monthly MDI should not exceed the contract demand; otherwise customer will pay a penalty on the electricity bill as defined in Tariff Order. The month wise MDI is as below:

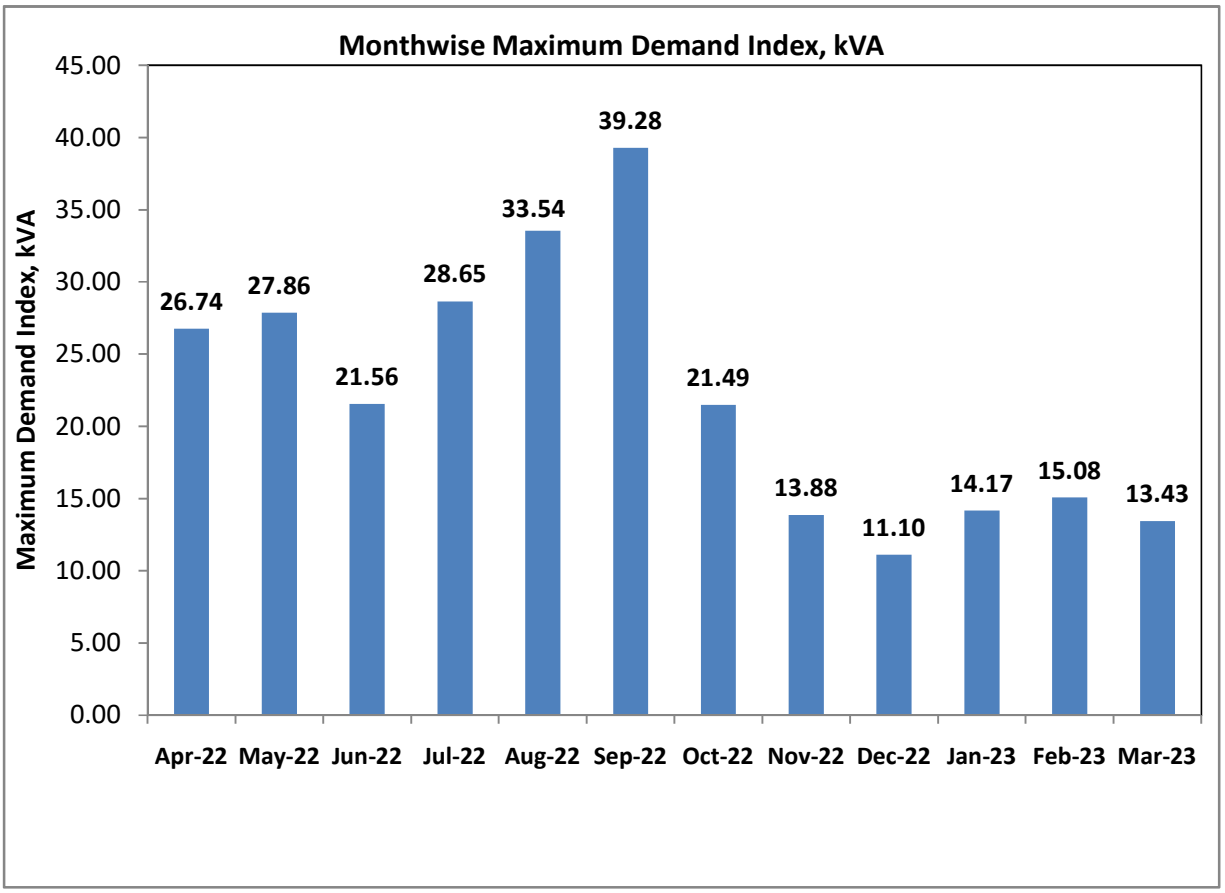



**Figure 7: Month wise Maximum recorded demand**

As per electricity bill, MDI is varying from 11.10kVA to 39.28kVA in one year which means MDI in one year Electricity bill has not even exceeded the minimum billable demand (89.96kVA ) at which campus is charged as fixed charges.

### 3.3.2 ENERGY CONSUMPTION PATTERN

There is huge variation in energy consumption in one year. Month wise energy consumption is as below:

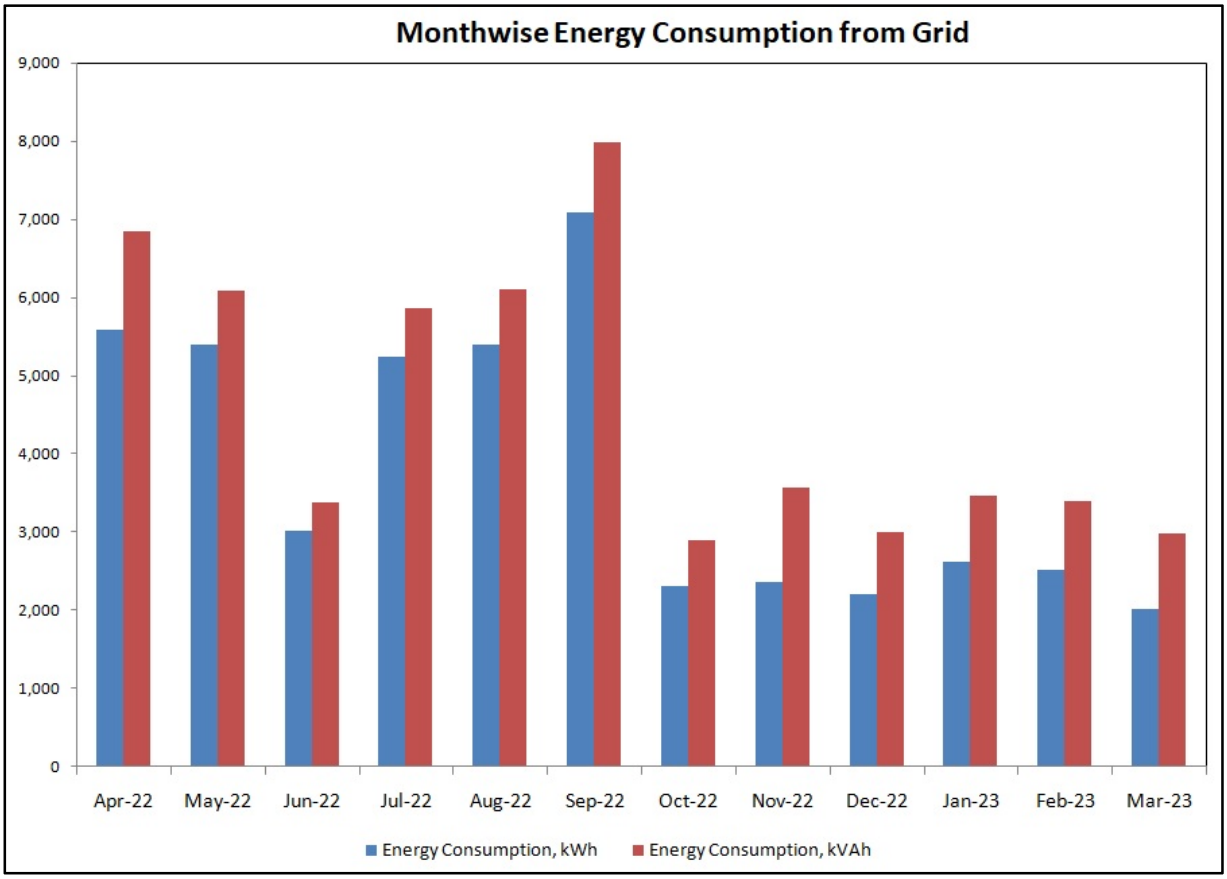



**Figure 8: Month wise Energy Consumption kWh and kVAh**

The billing for this Institute is in Rs/kVAh and the analysis of energy consumption in both kWh and kVAh is important. The difference in energy consumption in kWh and kVAh is due to the power factor variation. For unity power factor, kWh and kVAh will be equal while if power factor is poor, higher difference in kWh and kVAh values are observed. The maximum energy consumption (7,978kVAh) is observed during September- 2022 and minimum during October-2022 (2,901kWh). Annual average Electricity consumption on monthly basis is 3,814kVAh.

### *3.3.3 POWER FACTOR PATTERN*

The month wise power Factor Graph as per energy bill is as below:

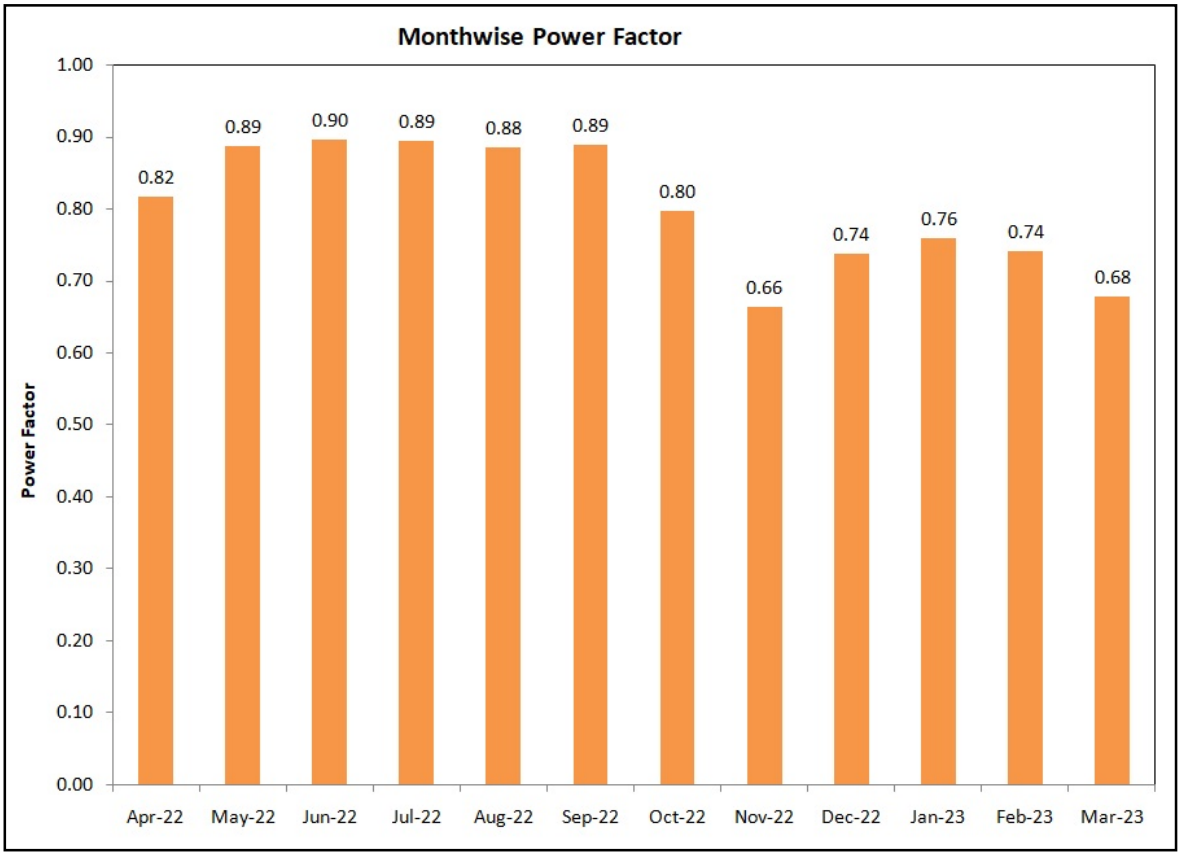



**Figure 9: Month wise Power Factor**

The major observations from the Power factor graph are as below:

1. The power factor in the facility is very low. It is varying from 0.66 to 0.90. On comparing energy consumption with power factor, it is observed that when energy consumption is low, power factor is also low.

2. The lower power factor lead to higher reactive energy demand from the system and thus it leads to the higher apparent power.

# 4. Performance Assessment of Utilities

## 4.1 MAIN INCOMER SUPPLY

There is huge load variation based upon the occupancy in the class room, different office areas, library and running of pumps. Three phase power analyzer has been used for recording of parameters at main incomer. The location of Power Analyzer is as below:

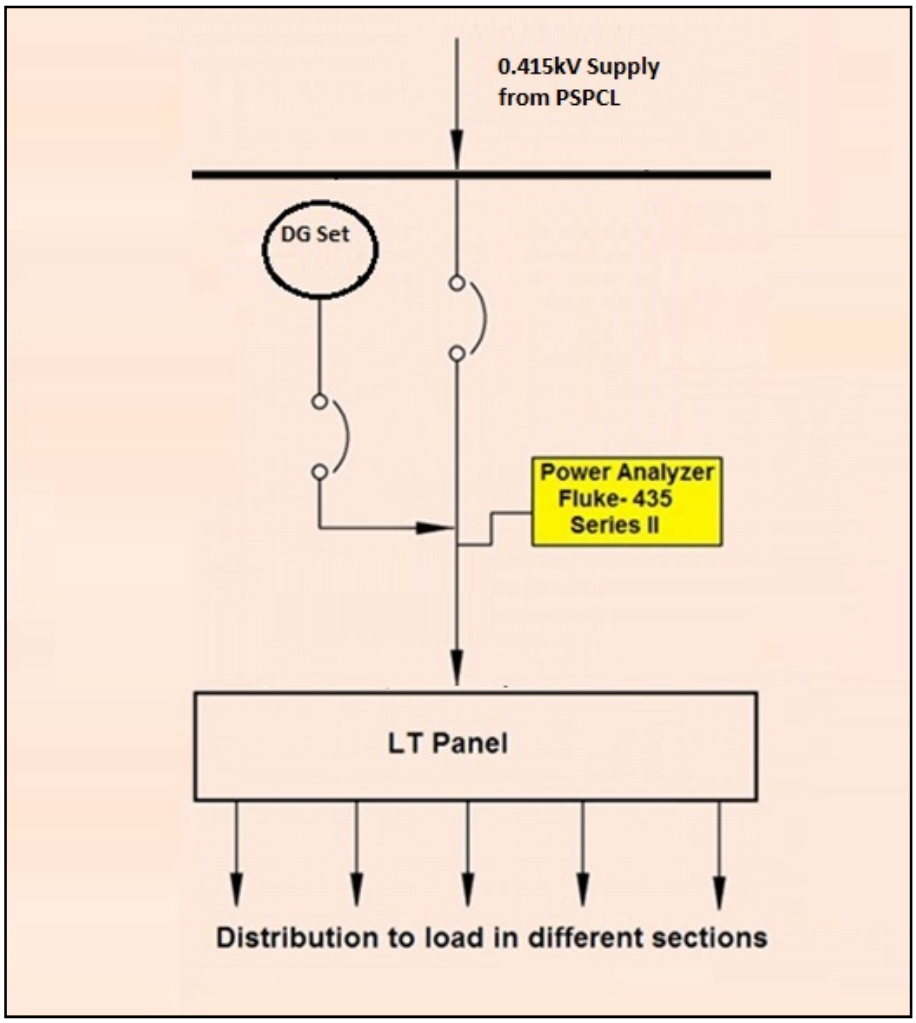


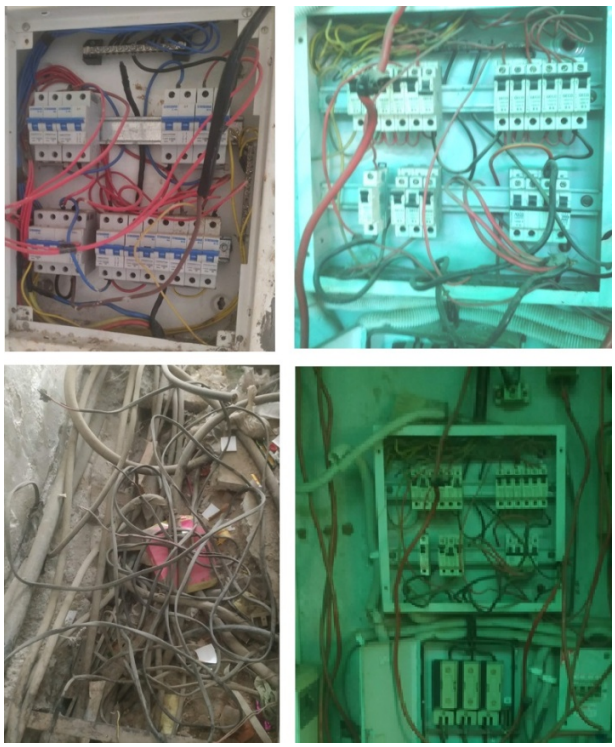

**Figure 10: Position of Power Analyzer**

Based upon the recorded parameters and physical inspection of the entire electrical distribution system

1. Quality of electrical distribution system
2. Power quality

## 4.2 QUALITY OF ELECTRICAL DISTRIBUTIONS SYSTEM

The visual inspection of electrical installation in the premises including Electrical room, Low tension switch gear panel, Distribution boards, lighting installations, earthing arrangements. During visual inspection all the observations, which are either dangerous or non compatible to the standard engineering practice are noted and potential corrective actions are made toimprove the safety level of the electrical installation.The detailed testing and inspection results are tabulated as below:



**Observations**

- Poor management of wires/cable and no mechanically protection provided.
- Lugs and glands are not found.
- Dressing/ terminations of wires not done properly.
- Conditions of cabling carried out in the Premises are very poor and at many place, cable joints are found.
- The number of cable with joints are lying on floor in Electrical Panel Room

**Recommendations**

- Use lugs and glands at end terminations to protect ingress of water, vermin and dust.
- New Fuse units should be provided.
- All final circuits should be provided with individual overload and short- circuit protection.
- Cables/wires should have mechanical protection (means always to run inside the pipes) and should be adequately supported throughout their run.
- Avoid lose wires and joints in the wiring system.

### 4.3 POWER QUALITY

Power quality determines the fitness of electrical power to consumer devices. There are many ways in which electric power can be of poor quality such as voltage unbalance, harmonics etc. **Fluke make Power Analyzer** is used to check power quality of the system. Under Power Quality, the various parameters measured and calculated are as below:

1. Load Variation
2. Voltage Unbalance
3. Power factor variation
4. Harmonics level

The power analyzer is put at main incomers at LT panel to record data. Based upon the recorded parameters are described as below:

#### 4.2.1 LOAD VARIATION

Since this is not a fully 24x7 operational facility so load behavior is different and depends upon the occupancy and weather condition. The activities which are performed continuously lead to continuously contribution towards energy consumption. The load trend on main incomers is as below:

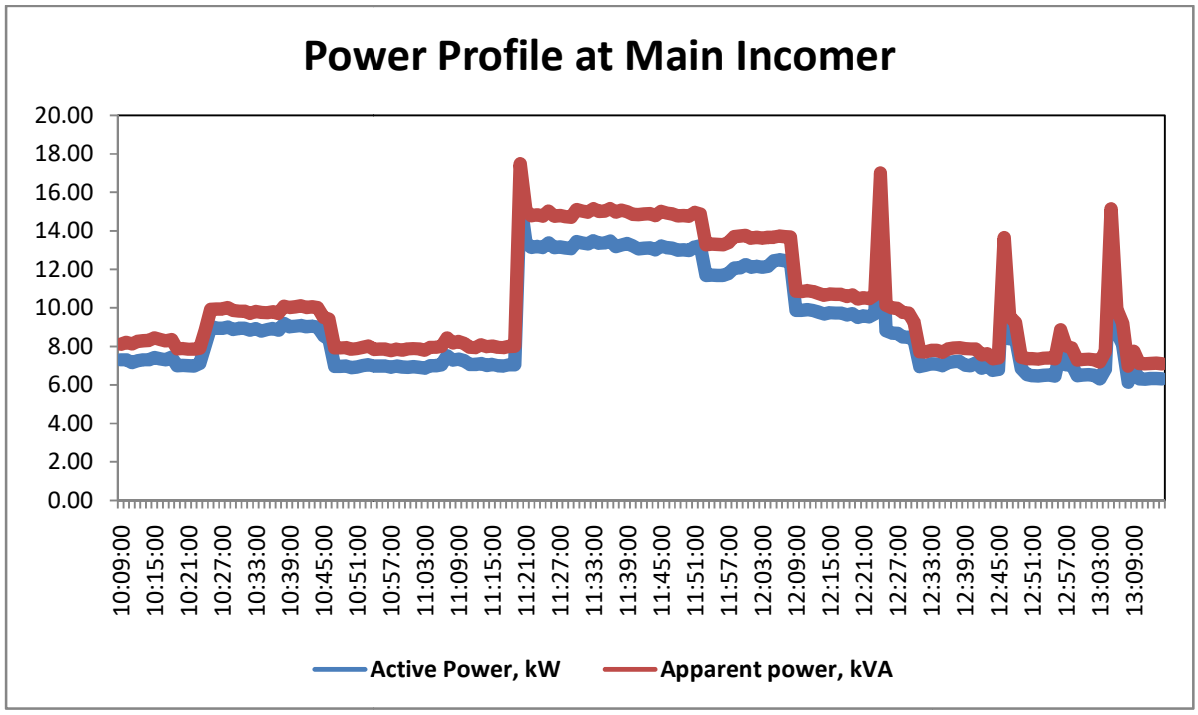



**Figure 11: Trend of Load variation at main incomer**

From trend it is clear the maximum power is 17.5kVA (15.6kW) observed during data logging. It is the running power at normal operating hours. The jerk in the load trends are corresponding to switch on/off of the additional loads. The college was running at partial load due to which measured maximum load is less than the maximum demand.

### 4.2.2 VOLTAGE UNBALANCE

Voltage unbalance occurs when the RMS line voltages on a poly-phase system are unequal. Voltages are seldom perfectly balanced between phases, but when this unbalance becomes excessive, it can create problems for poly-phase motors. Many of the newer induction motors are now more sensitive to unbalance than the older designs, and furthermore, adjustable speed drives can be even more vulnerable than standard motors. According to ANSI (American National standards Institute) codes voltage unbalance should be within 1%.

The main effect of voltage unbalance is motor damage from excessive heat. Voltage unbalance can create a current unbalance 6 to 10 times the magnitude of voltage unbalance. Consequently, this current unbalance creates heat in the motor windings that breaks down motor insulation causing cumulative and permanent damage to the motor. The relationship is exponential, and approximately increases by twice the square of the percent of voltage unbalance. Figure below, shows the percentage of temperature rise as related to the voltage unbalance:

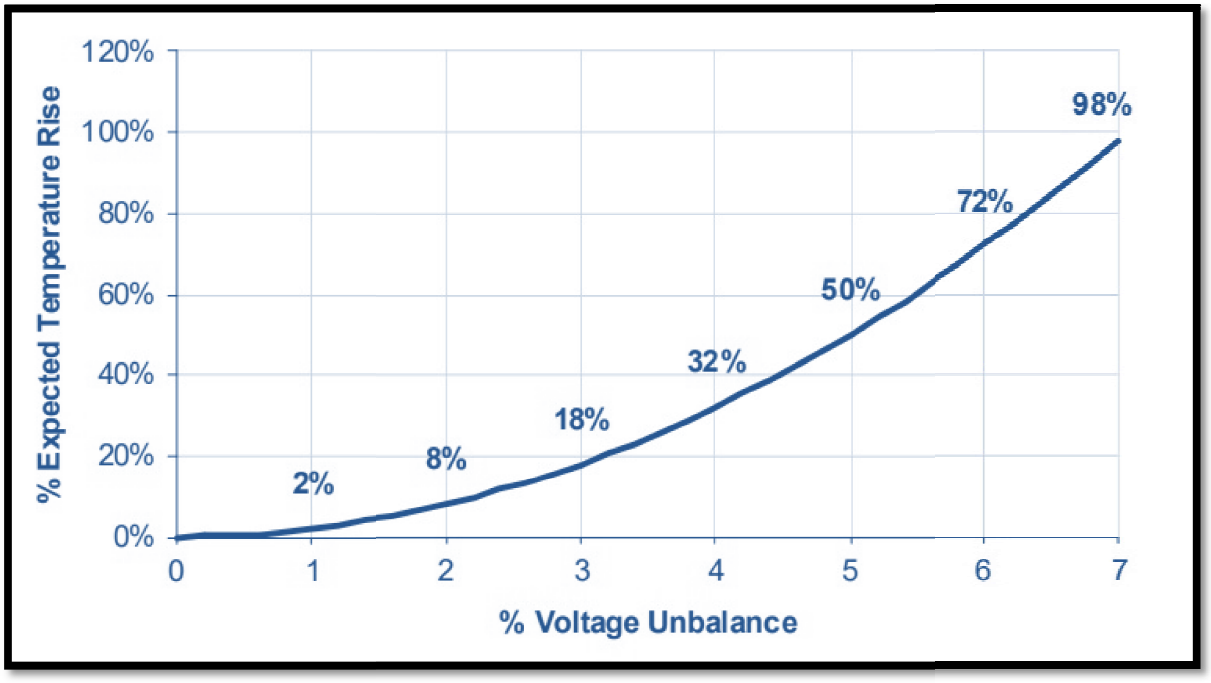



**Figure 12: Relation between Voltage Unbalance and Temperature rise**

There is huge load variation and also there is load shifting based upon requirement and there were chances of voltage unbalance. To verify the trend of voltage unbalance, data for voltage unbalance is recorded and trend is also attached.

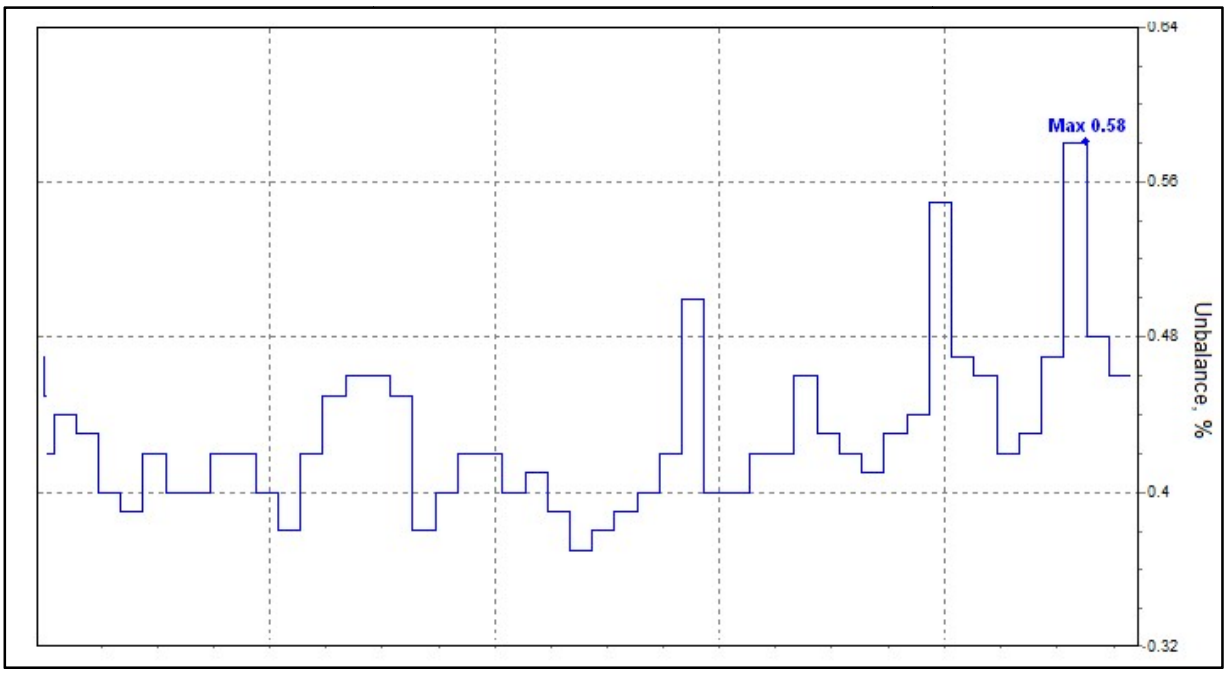



**Figure 13: Trend of Voltage Unbalance at main incomer**

It is clear that maximum recorded voltage unbalance 0.58% is within limit of 1%. This indicates that the electrical load is equally distributed.

### 4.2.3 CURRENT UNBALANCE

For a three-phase supply, current unbalance is defined as the maximum deviation of any current phase from the average current, divided by the average current, often expressed as a percentage. A current unbalance will generate excess heat which can melt insulation, leading to stator winding faults. Unbalance will also result in an uneven torque being produced by the electric motor, reducing its efficiency and increasing vibration. The trend of current unbalance at running load is as below:

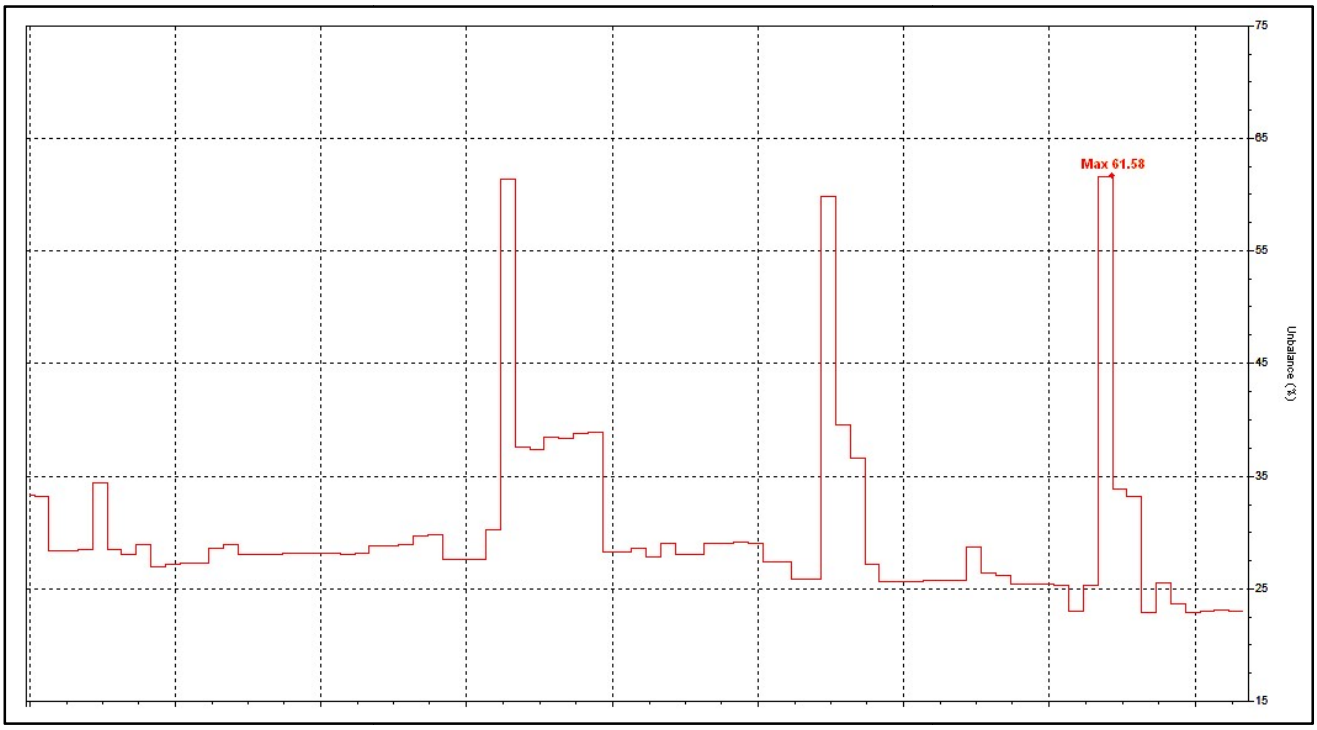



**Figure 14: Trend of the current unbalance**

In entire campus, single phase load is installed. The running load depends upon the occupancy and weather condition. The unequal distribution of loads between the three phases and thus the unbalance is observed. The current unbalance of the system can lead to unbalanced voltage drops on the electric lines. This increases neutral current which cause line and thus energy losses. To mitigate this problem, proper load distribution is recommended at full load condition.

### 4.2.4 POWER FACTOR VARIATION

The power factor is also recorded at running load and trend of power factor variation at main incomer is as below:

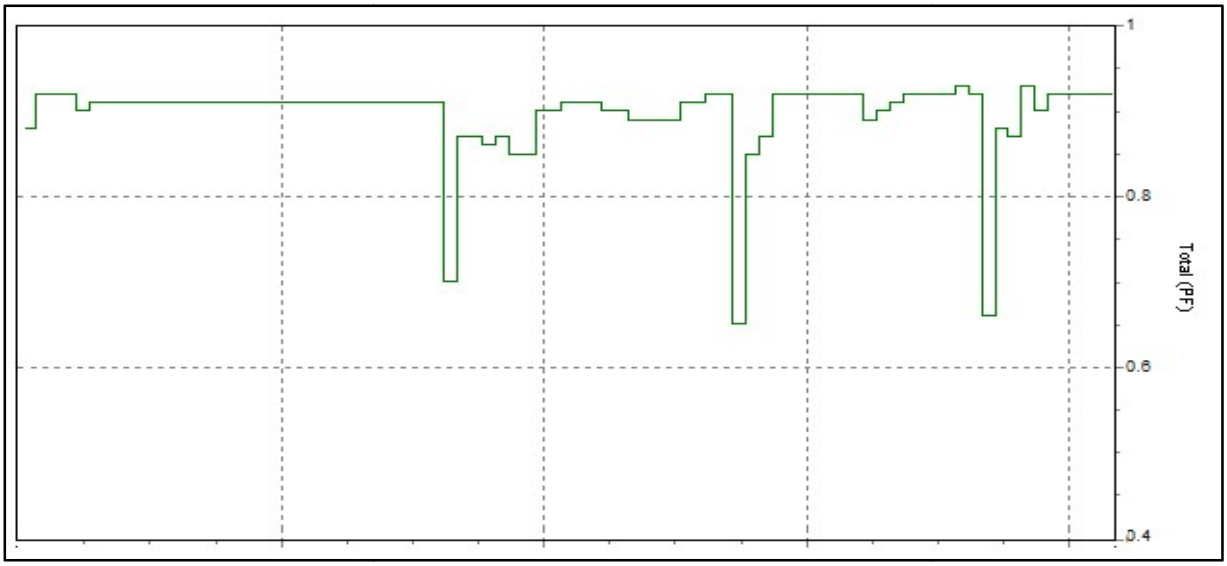



**Figure 15: Power factor measurement at main incomer**

The maximum power factor 0.92 is observed at running load while during jerk load, power factor comes down up to 0.63.

### 4.2.5 HARMONICS LEVEL

Harmonics are currents or voltages with frequencies that are integer multiples of the fundamental power frequency. Ideally, voltage and current waveforms are perfect sinusoids. However, due to the increased popularity of electronic and other non-linear loads, these waveforms get distorted. This deviation from a perfect sine wave can be represented by harmonics—sinusoidal components having a frequency that is an integral multiple of the fundamental frequency. Thus, a pure voltage or current sine wave has no distortion and no harmonics, and a non-sinusoidal wave has distortion and harmonics. To quantify the distortion, the term total harmonic distortion (THD) is used. The term expresses the distortion as a percentage of the fundamental (pure sine) of voltage and current waveforms.

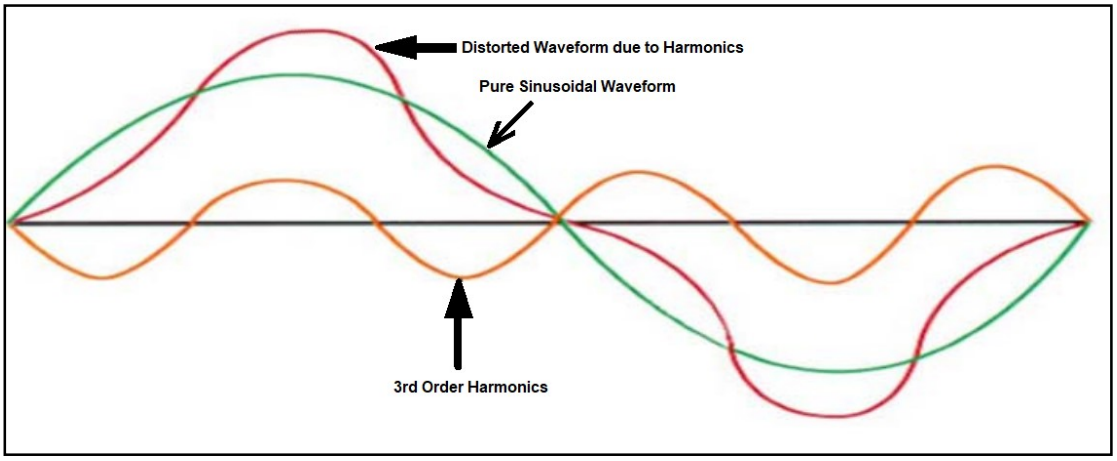



**Figure 16: Harmonic distortion of the Waveform**

When harmonic frequencies are prevalent, electrical power panels and transformers become mechanically resonant to the magnetic fields generated by higher frequency harmonics. When this happens, the power panel or transformer vibrates and emits a buzzing sound for the different harmonic frequencies. Harmonic frequencies from the 3rd to the 25th are the most common range of frequencies measured in electrical distribution systems.

Harmonics provides a mathematical analysis of distortions to a current or voltage waveform. Based on Fourier series, harmonics can describe any periodic wave as a summation of simple sinusoidal waves which are integer multiples of the fundamental frequency. These are steady-state distortions to current and voltage waves and repeat every cycle. They are different from transient distortions to power systems such as spikes, dips and impulses.THD is a common measurement of the level of harmonic distortion present in power systems.

THD can be related to either current harmonics or voltage harmonics, and it is defined as the ratio of total harmonics to the value at fundamental frequency times 100%. Harmonics are created from equipment's containing electronics that control other apparatus, e.g. variable speed drives, soft starters, static compensators, rectifiers and heating furnaces, etc. The harmonic analysis is carried out based upon the data recorded in power analyzer and it is observed that and Current THD% is not within the permissible limits as per IEEE-519, 1992 of main incomer is highlighted in below table.

| Description | | | Main incomer |
|---|---|---|---|
| Measured % of THD at maximum demand load (Fundamental) current ($I_L$) | Voltage | R | 1.65 |
| | | Y | 1.47 |
| | | B | 1.44 |
| | Current | R | 3.93 |
| | | Y | 3.91 |
| | | B | 3.89 |

**Table 6: THD parameters measured at main incomer**

Both the current and the voltage harmonics distortion is within the limit of 3%, indicates that there is no problems of the harmonics.

### 4.3 DIESEL GENEARTING SETS

There are few general recommendations for DG Set as below:

1. The maximum permissible percentage unbalance in phase loads on DG sets is 10%.
2. Lower power factor of a DG set demands higher excitation currents.
3. Calibrate fuel injection pumps frequently and Improve air filtration.
4. Consider fuel oil additives in case they benefit fuel oil properties for DG set usage.
5. Ensure fuel oil storage, handling and preparation as per manufacturers.
6. Ensure compliance with maintenance checklist.
7. In case of a base load operation, consider waste heat recovery system adoption for steam.

The loading of DG Sets can be improved with automation in which all DG Sets can be connected with PLC system and the DG Sets will start based upon the loading of Master DG set. The monitoring if generation and fuel consumption of DG Set on regular basis also helps in taking corrective measure on time for improvement in DG Set Performance. The sample data sheet which can be used for DG Set Performance on monthly basis is as below:

| Description | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Generation, kWh | | | | | | | | | | | | |
| Fuel Consumption in Generation, lit | | | | | | | | | | | | |
| SFC, lit/kWh | | | | | | | | | | | | |
| Generation, kWh/lit | | | | | | | | | | | | |

**Figure 17: Sample Performance Assessment Sheet for DG Set**

## 4.4 AC UNITS

There are 22 number of AC units installed in the campus and the connected load is around 32.72kW however the running load is only 9.22kW. The running load was also instantaneous only because these areas were not occupied. The computer lab new is not in operation so the AC load is not contributing towards the running load. The connected load of AC units is as below:

| Area | Type | Number | Connected Load, kW | Running Load, kW |
|---|---|---|---|---|
| Principal Room | AC Split | 2 | 2.90 | 2.175 |
| Finishing School Lab- 1 | AC Split | 2 | 3.00 | 2.25 |
| Finish Lab- 2 | AC Split | 2 | 3.00 | |
| Punjabi Language | AC Split | 2 | 3.10 | 2.32 |
| Computer Lab New | AC Split | 7 | 10.15 | |
| Computer Science Lab- 1 | AC Window | 3 | 4.65 | 1.12 |
| Computer Science Lab- 2 & 3 | AC Window | 4 | 5.92 | 1.35 |
| **Total** | | 22 | 32.72 | 9.22 |

**Table 7: Connected load of AC units**

The measured maximum power of the AC unit is less than rated power. The AC units are switching on/off based upon the temperature setting. There are few tips to Use Air Conditioner Effectively all around the season:

- Check and Change the Air Filter.
- Use Smart Thermostat or AC Controllers.
- Don’t Let Your Thermostat Take the Heat.
- Try to fix the AC unit in air sealed room to the extent possible.
- Avoid Steep Temperature Changes and try to run AC unit at 25°C

## 4.5 LIGHTING

The total connected lighting load in the entire campus is around 23.615kW. Total lighting load is sum of connected rated power of each luminary. The Mix different types of LED fittings, CFL, T- 8, FTL- 12, T- 5 etc. are installed in the campus. The details of the connected load are as below:

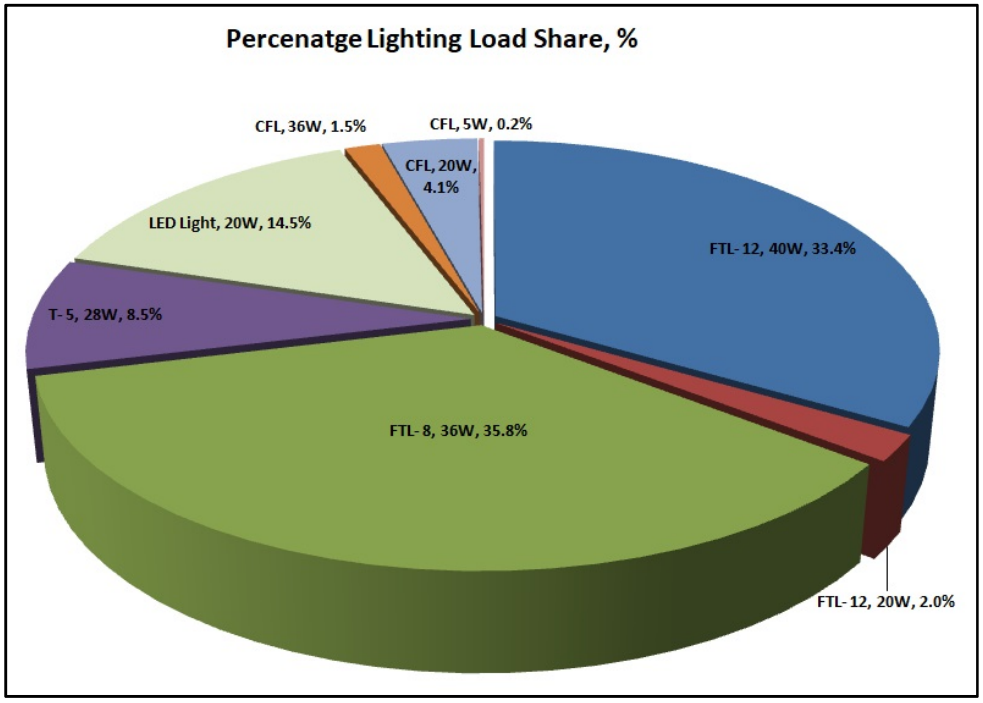



**Figure 18: Percentage share of different lighting**

| Type of Lights | Number of lights | Connected Load, kW |
|---|---|---|
| FTL- 12, 40W | 146 | 7.884 |
| FTL- 12, 20W | 16 | 0.48 |
| FTL- 8, 36W | 192 | 8.448 |
| T- 5, 28W | 61 | 2.013 |
| LED Light, 20W | 171 | 3.42 |
| CFL, 36W | 10 | 0.36 |
| CFL, 20W | 48 | 0.96 |
| CFL, 5W | 10 | 0.05 |
| **Total** | **654** | **23.615** |

**Table 8: Connected Lighting Load**

Most interior lighting requirements are for meeting average luminance on a horizontal plane, either throughout the interior, or in specific areas within the interior combined with general lighting of lower value. For assessing energy efficiency of lighting system, Inventory of the Lighting System is noted and the lux levels measurement at working level has been done with help of lux meter. The various values of lux levels based upon measurements are as below:

| Area | Maximum Lux | Average Lux | Minimum Lux | Remarks |
|---|---|---|---|---|
| Admin Block | 278 | 200 | 145 | |
| Principal Room | 479 | 299 | 158 | Natural light Available |
| Finishing School Lab- 1 | 175 | 151 | 124 | |
| Photocopy Room | 112 | 103 | 86 | |
| Physical Room | 117 | 91 | 63 | |
| Bursar Room | 128 | 114 | 105 | |
| Gym | 87 | 79 | 69 | Additional Light is required |
| English Department | 164 | 148 | 132 | |
| Punjabi | 175 | 154 | 133 | |
| Commerce | 94 | 86 | 73 | Additional Light is required |
| Political Science | 132 | 124 | 114 | |
| Storage Room | 85 | 75 | 62 | Additional Light is required |
| Corridor | 111 | 99 | 87 | |
| Economics | 221 | 208 | 197 | |
| Library | 278 | 238 | 212 | |
| Store Library | 112 | 105 | 96 | |
| Corridor | 123 | 116 | 110 | |
| Computer Science Lab- 1 | 130 | 98 | 68 | Additional Light is required |
| Computer Science Lab- 2&3 | 125 | 113 | 98 | Additional Light is required |
| 1st Floor Room- 1 | 150 | 117 | 83 | |
| EDUSAT | 129 | 108 | 74 | Additional Light is required |
| 1st Floor Room- 4 | 268 | 234 | 210 | |
| 1st Floor Room- 5 | 210 | 171 | 143 | |
| Room - 09 | 165 | 135 | 111 | |
| Finish Lab- 2 | 198 | 169 | 140 | |
| Chemistry Lab- 1 | 179 | 152 | 121 | |
| Chemistry Lab- 2 | 210 | 185 | 154 | |
| Punjabi Language | 240 | 187 | 141 | |
| Auditorium | 201 | 168 | 144 | |
| Girls Common Room | 170 | 152 | 136 | |
| Canteen | 232 | 203 | 167 | |

| Area | Maximum Lux | Average Lux | Minimum Lux | Remarks |
|---|---|---|---|---|
| Theatre- 1 | 219 | 187 | 160 | |
| Theatre- 2 | 176 | 141 | 102 | |
| Theatre - 3 | 181 | 143 | 120 | |
| Theatre - 4 | 193 | 156 | 126 | |
| Room - 01 | 154 | 140 | 130 | |
| Room- 02 | 180 | 145 | 114 | |
| Room - 03 | 191 | 168 | 145 | |
| Room - 04 | 201 | 160 | 114 | |
| Room- 05 | 162 | 145 | 119 | |
| Room - 07 | 128 | 117 | 108 | |
| Room - 08 | 160 | 147 | 130 | |
| Room - 09 | 214 | 163 | 126 | |
| Room - 10 | 210 | 168 | 125 | |
| Room - 11 | 194 | 159 | 124 | |
| Room- 12 | 143 | 135 | 127 | |
| Room - 13 | 154 | 138 | 129 | |
| Room - 14 | 133 | 126 | 120 | |
| Room- 15 | 162 | 152 | 145 | |
| Room - 16 | 164 | 157 | 145 | |
| PTU Block | 265 | 233 | 210 | |
| Computer Lab New | 208 | 182 | 159 | |

**Table 9: Measured Lux level**

The major observations based upon the lux level measurement are as below:

- The number of lights in most of the areas is sufficient but the output from the luminaries is low due to which lux level is low.
- The Lux level in computer labs is very low due to non-functional fittings.
- At many rooms, additional lights need to be installed to improve the lux level.
- Many lights were not working due to which the lux level is low.

## 4.6 FANS

The ceiling fans are more affordable than air conditioners and the right size can make a difference. The summers are very hot in the region so the energy consumption by the fans adds into the energy consumption in summer. Apart from ceiling fans, exhaust fans and wall fans are installed to

maintain the required ambient temperature. The connected load of the fans is 30.29 and is tabulated as below:

| Description | Number | Average Rated Power, W | Connected Load, kW |
|---|---|---|---|
| Ceiling Fans | 372 | 70 | 26.04 |
| Wall Fans, 50W | 6 | 50 | 0.3 |
| Wall Fans, 250W | 11 | 250 | 2.75 |
| Exhaust | 8 | 150 | 1.2 |
| **Total** | **397** | | **30.29** |

**Table 10: Connected Fan Load**

## 4.7 COMPUTERS AND MULTI-FUNCTION DEVICES

These devices are installed in the staff room, labs and the office areas for the supporting and main stream activities. The connected load of these devices is around 12.9kW.

| Description | Number | Connected load, kW |
|---|---|---|
| Computers | 42 | 6.3 |
| Printer | 8 | 5.2 |
| Projector | 2 | 0.8 |
| Scanner | 3 | 0.6 |
| **Total** | **67** | **12.9** |

**Table 11: Details of water cooler**

## 4.8 MISCALANEOUS LOAD

These devices are installed in the staff room, labs and the office areas for the supporting and main stream activities. The connected load of miscellaneous load is 5.4kW.

| Description | Number | Connected Load, kW |
|---|---|---|
| Refrigerator | 2 | 0.7 |
| Air Cooler | 1 | 0.35 |
| Induction Plate | 2 | 1.0 |
| Hot Kettle | 1 | 0.35 |
| Heater | 2 | 2.0 |
| Pump | 1 | 0.75 |
| **Total** | **8** | **5.15** |

**Table 12: Details of miscellaneous load**

# 5. ENERGY EFFICIENCY MEASURES

## 5.1 REDCUCTION IN CONTRACT DEMAND FROM 112KVA TO 55KVA TO REDUCE THE FIXED CHARGES

**Observations**

From annual electricity bill, it is clear that maximum demand recorded in one year is 39.2kVA which is only 35% of the contract demand while the least is only 10% of the contract demand. The unit is being charged for 80% of the contract demand.

**Recommendation**

It is recommended to reduce the contract demand from 112.0kVA to 55kVA. The recommended demand is almost 40% higher than the maximum recorded demand.

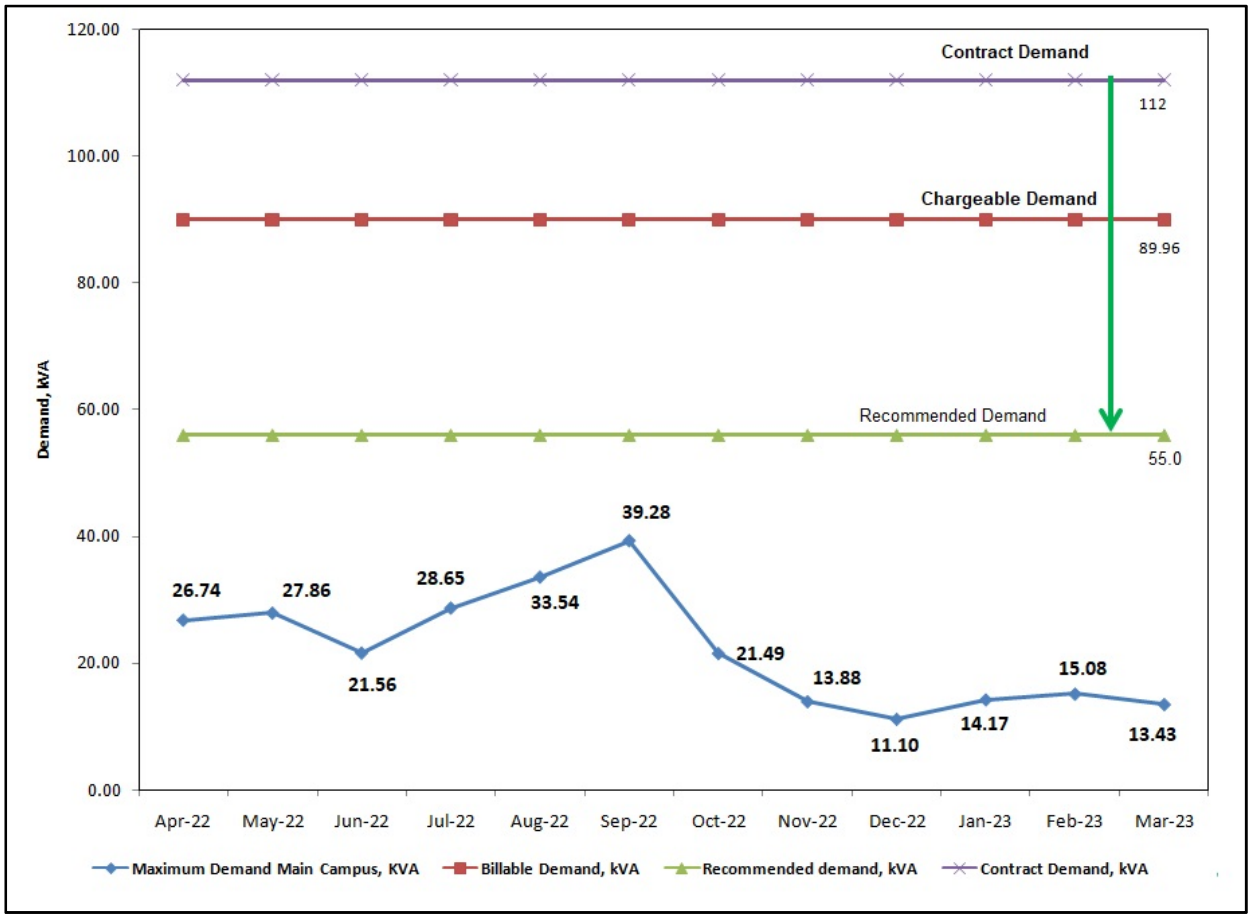



**Figure 19: Reduction in contract demand**

The installation of the APFC and the installation of the energy efficient appliance will give additional margin to the demand. The reduction in demand will lead to direct reduction in the energy bill. The calculated saving in energy bill is as below:

| Description | UoM | Values |
|---|---|---|
| Contract Demand as per latest Bill | kVA | 112 |
| Minimum Billable demand at present scenario | kVA | 89.96 |
| Recommended Contract Demand | kVA | 55 |
| Annual billed fixed charges at present contract demand | Rs. | 1,25,384 |
| Annual billed fixed charges at recommended contract demand | Rs. | 66,000 |
| Annual monetary saving | Rs. | 59,384 |
| Investment | Rs. | Nil |
| Payback period | months | Immediate |

## 5.2 IMPROVEMENT IN ANNUAL AVERAGE POWER FACTOR FROM 0.80 TO 0.99 BY INSTALLING 40KVAR APFC AT MAIN INCOMER

### Observation

The annual average power factor as per electricity bill is 0.80 while the power factor varies from 0.66 to 0.89. There is indirect penalty if power factor is less than unity as billing is in Rs/kVAh. At present there is no provision for improvement in power factor for the facility.

### Recommendation

The recommended to install 40kVA APFC to maintain power factor for the facility close to unity. The trend of running and recommended power factor is as below:

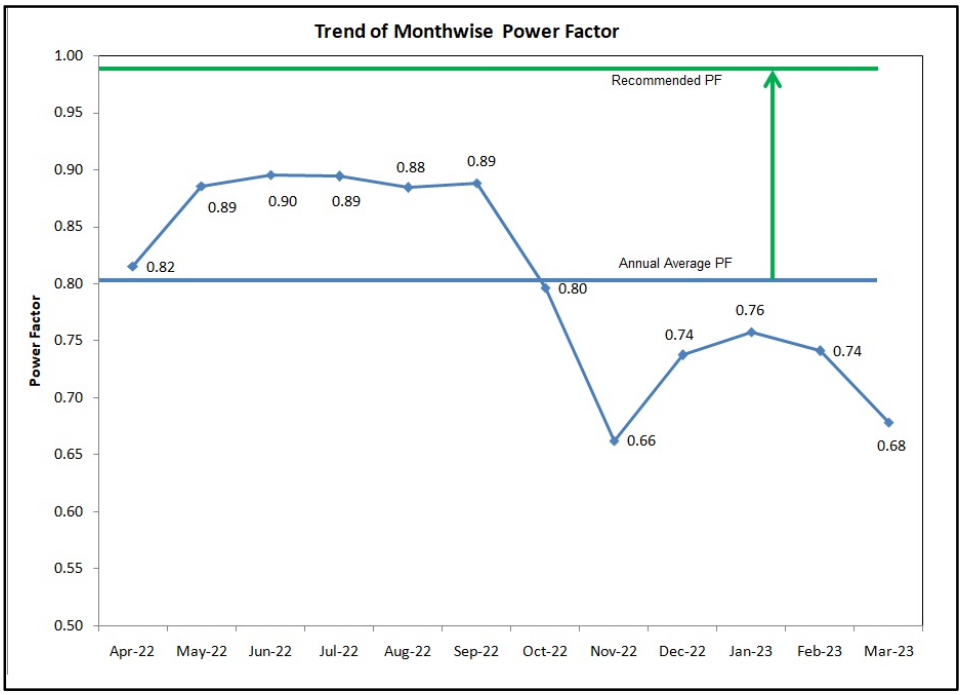



**Figure 20: Improvement in Power Factor**

APFC is an automatic power factor control panel which is used to improve the power factor, whenever required, by switching ON and OFF the required capacitor bank units automatically. It becomes very much important to reduce on electrical consumption for reducing expenditure and economizing the utility expenses by harnessing electrical utility by operation at desired power factor to curtail unwanted electricity penalty rising because of power factor drop. It also helps us to keep reactive power consumption low from the system and thus keeping MDI low. The calculated saving from implementation of measures is as below:

| Description | UoM | Values |
|---|---|---|
| Annual Average Power Factor | | 0.803 |
| Recommended Power Factor | | 0.99 |
| Annual billed energy consumption at present Power Factor | kVAh | 55,548 |
| Annual energy consumption | kWh | 45,762 |
| Annual billed energy consumption at improved Power Factor | kVAh | 46,224 |
| Annual Energy saving at improved power factor | kVAh | 9,324 |
| Annual monetary saving | Rs. | 59,952 |
| Investment (inspection and installation of 40kVAr APFC) | Rs. | 45,000 |
| Payback period | months | 9.0 |

## 5.3 ENSURING SWITCHING OFF THE LIGHTS WHEN THERE IS NO OCCUPANCY IN THE RESPECTIVE CLASS ROOM OR OFFICE AREAS

**Observations**

During lux level measurement, it was observed that many rooms were locked but the ceiling fans and lights were running in the area. During college closing time, the running load was around 11.0kW which indicates that load was running considering minimum 50% (5.5kW) necessary running load, 50% load was which can be switched off.

**Recommendation**

The lighting controls such as motion detectors or timers and dimmers can help reduce your energy consumption by automatically controlling your lights efficiently. The turning off the lights when leaving the classrooms/office is a cost-effective way to reduce wasted energy. It can be achieved by capacity building of the students through training, awareness on energy conservation through different competitions and lectures and giving them the role of energy warriors to ensure that no lights/fans etc. is running when room are empty. This can lead to energy saving of 50- 60 units on daily basis. The saving calculations are as below:

| Description | Units | Value |
|---|---|---|
| Running load considered for the measures | kW | 3.6 |
| Load which is non-essential and can be switched off automatically | kW | 1.4 |
| Annual operating days | | 300 |
| Operating hours | hours | 6 |
| Annual energy saving after capturing non-essential load | kVAh | 2,728 |
| Annual monetary saving | Rs. | 18,089 |
| Investment | Rs. | 16,200 |
| Payback period | months | 10.7 |

## 5.4 REPLACEMENT OF THE CONVENTIONAL LIGHTS (FTL- 12 AND T- 8) WITH NEW (20W LED) ENERGY EFFICIENT LIGHTS

**Observations**

The FTL and T- 8 fittings are considered for the replacement. The connected load of these lights is around connected load of the conventional lights is around 16.8kW (354nos).

**Recommendation**

It is recommended to replace the conventional lights with LED lights. Both types of fittings can be replaced with 20W LED lights. LED lighting is far more energy efficient; it will reduce electricity consumption and lower utility bill. Since all the lights are not working condition, only 100no of lights which are installed in commonly used areas are considered for replacement. The saving calculations are as below:

| Description | Units | Value |
|---|---|---|
| Approximate Connected of lights considered for replacement | kW | 5.4 |
| Number of lights considered for replacement | | 100 |
| Rated power of the LED lights considered for replacement | W | 20 |
| Annual energy consumption at present scenario | kWh | 7,776 |
| Annual energy consumption after implementation of measure | kWh | 3,600 |
| Annual energy saving | kVAh | 4,640 |
| Annual monetary saving | Rs. | 29,835 |
| Investment@ Rs 450/fitting | Rs. | 45,000 |
| Payback period | months | 18.1 |

Based upon the results, the rest of FTL- 12, 8 and T-5 can also be replaced with energy efficient LED lights.

## 5.5 REPLACEMENT OF 50 NUMBER OF OLD CEILING FANS WITH NEW 35W ENERGY EFFICIENT BLDC FANS

**Observations**

The connected load of the 50 old ceiling fans is around 3.5kW. These fans are very old, heavy and consume huge energy.

**Recommendation**

BLDC motor is used in the BLDC ceiling fan as compared to induction motor in normal ceiling fan. The lifespan of these fans is more than a normal ceiling fan because there is no heat generated in BLDC Motor hence its increases lifespan of ceiling fan bearings. There are fewer chances for the winding failure due to the use of high thickness copper wire in the winding. BLDC fan can save 60% electricity in the ceiling fan. The saving calculations are as below:

| Description | Units | Value |
|---|---|---|
| Approximate Connected considered for replacement | kW | 3.5 |
| Number of fans to be replaced | | 50 |
| Rated power of the new fans | W | 35 |
| Annual energy consumption at present scenario | kWh | 6,930 |
| Annual energy consumption after implementation of measure | kWh | 3,150 |
| Annual energy saving | kWh | 3,780 |
| Annual monetary saving | Rs Lakh | 25,061 |
| Investment@ Rs 2400/fan | Rs Lakh | 1,20,000 |
| Payback period | months | 57 |

## 5.6 INSTALLATION OF 45.0KWP CAPACITY GRID CONNECTED SOLAR PV SYSTEM FOR LIGHTING LOAD AND OTHER LOAD

**Observation**

The contract demand for the college campus as per electricity bill is 112kVA. This region of Punjab has immense potential for quality solar irradiation, harnessing of this resource can be best suited to meet the energy requirements. Punjab is endowed with vast potential of solar energy with over 300 days of sunshine in a year. The data source derived from website of Punjab Energy Development Agency and from a PVGIS satellite station indicates that insolation level varying between 4- 7 kWh/$m^2$. There is enough space on roof top in facility where SPV can be installed. The SDA in this region has notification for promoting Renewable energy sources.

**Recommendation**

It is recommended to put Grid connected Solar PV System. The recommended rated power for the SPV system is 45.0kWp. In Grid connected Solar Rooftop PV system the DC power generated from SPV panel is converted to AC power using power conditioning unit. Generated Power by this system during the day time is utilized fully for powering captive loads and excess power is fed to the Grid. Grid connected Solar Rooftop system is operational so long as grid is available. In case, where solar power is not sufficient due to cloud cover etc., the captive loads are served by drawing power from the grid. The Advantages of Grid-Connected Rooftop Solar System is as below:

1. Electricity generation at the consumption point therefore Savings in transmission and distribution losses.
2. Low gestation time.
3. No requirement of additional land.
4. Improvement of tail-end grid voltages and reduction in system congestion with higher self-consumption of solar electricity.
5. Local employment generation.

The facility can also plan for system with battery back-up to shift lighting load from main power supply to solar power during day time. It will be a Hybrid system in which the battery bank could be charged both from Main, DG Set and SPV. The diagram for Hybrid System is as below:

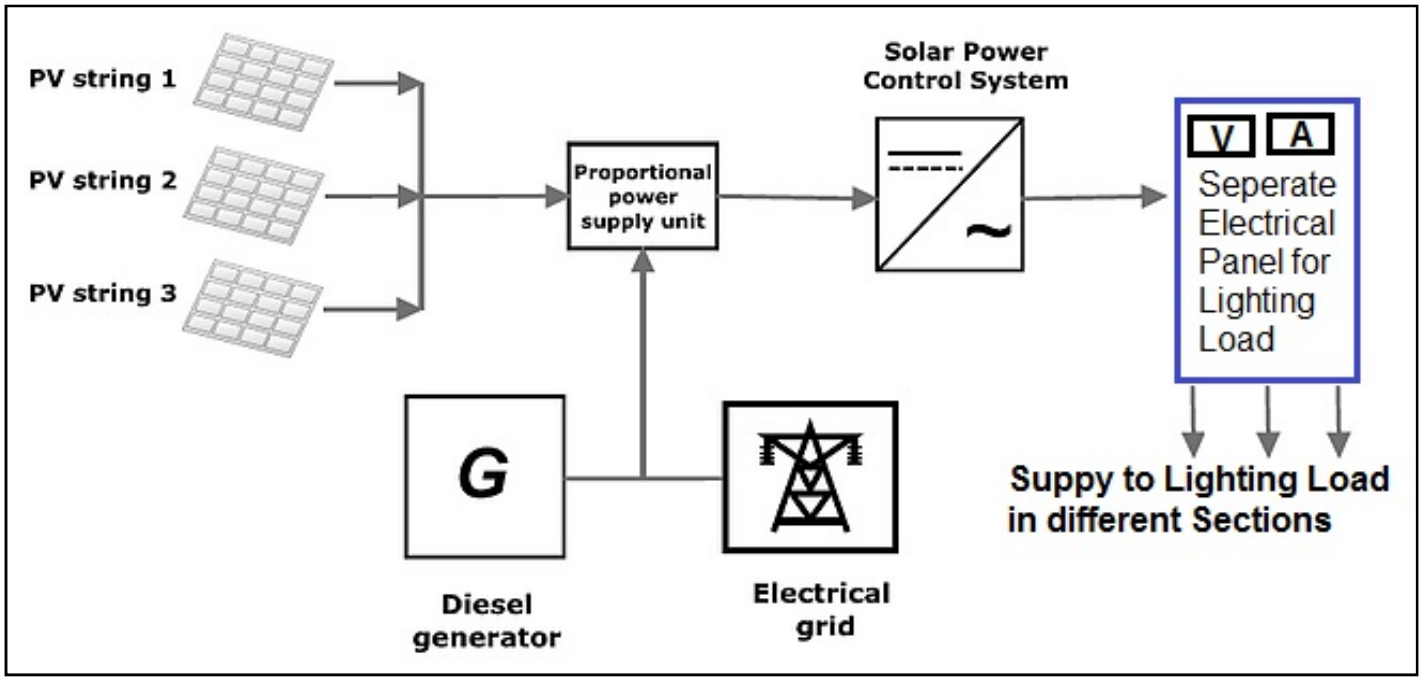



**Figure 21: Grid Connected Hybrid SPV System**

The saving calculation is done based upon grid connected system and cost is taken as per MNRE website. The detailed calculations are as below:

| Description | Units | Value |
|---|---|---|
| Sanctioned load of Unit | kVA | 112 |
| Recommended capacity of SPV considering load reduction | kWp | 45 |
| Expected annual generation from SPV | kWh | 45,000 |
| Annual energy consumption at present scenario | kWh | 45,762 |
| Annual energy consumption after installation of SPV based upon energy bill | kWh | 762 |
| Annual energy saving based upon the present energy consumption scenario | kVAh | 45,455 |
| Annual monetary saving | Rs. | 3,01,364 |
| Investment @Rs. 38,500/kWp | Rs. | 17,32,500 |
| Payback period | months | 69 |

## 5.7 INSTALLATION OF ENERGY MONITORING SYSTEM

**Observation**

In present scenario month wise energy bill is monitored however the season wise, section wise, power outage, in-house power generation is not monitored. The facility has one PSPCL energy meter to monitors the month wise energy consumption.

**Recommendation**

Considering all above facts we recommend the installation of Energy Monitoring System. Energy Monitoring System come with different software and parameters (regular and tailor made both) to best capture the process behavior. It has all the standard reports that one would expect from an EMS with following parameters:

- Real-time views & trends
- Historical views & trends
- Energy Reports
- Alarm Reports

The detail presentations of the parameters at standard screens and features make system understanding very easy. Once data is recorded, next time directly parameter will be captured for same quantity and material. This will lead to minimum variation of energy consumption with better control of parameter without human intervention. The one snapshot of report prepared is as below:

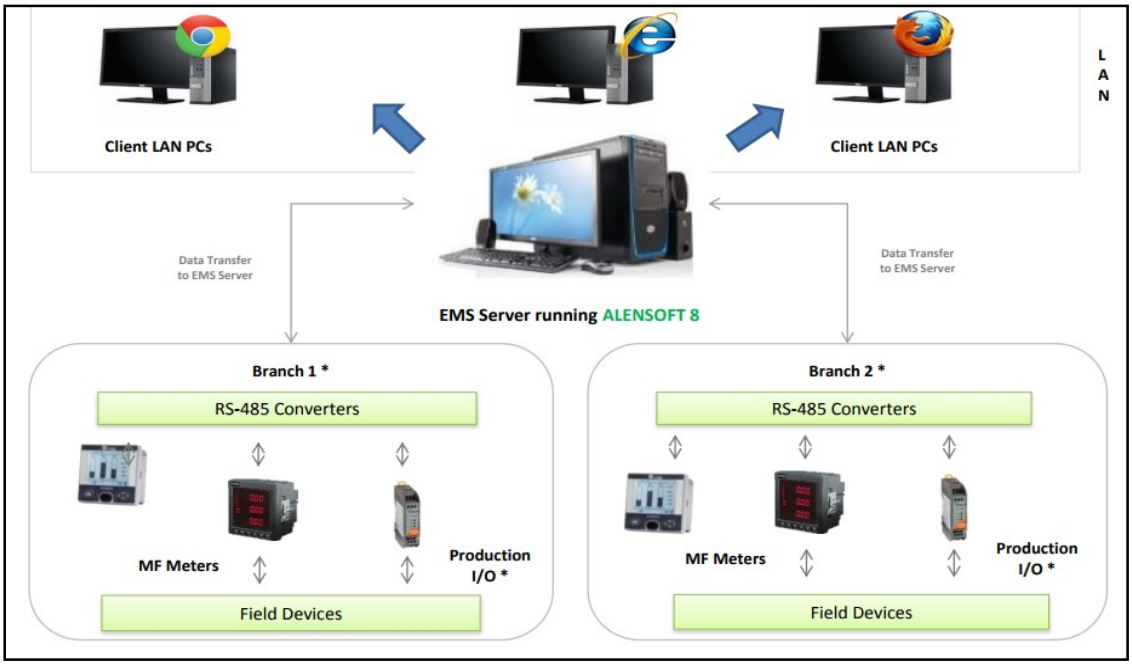



**Figure 22: EnMS Report Snapshot**

# 6. ANNEXURE

## 6.1 COPY OF ELECTRICITY BILL

PSEB Head Office, The Mall, Patiala | Tel. No. : 1912 | GSTIN - 03AAFCP5120Q1ZC
E-Mail : 1912@pspcl.in | CIN : U40109PB2010SGC033813 | Website: www.pspcl.in

Page No: 1

3002309341030420230304202300036830000739001846O

Invoice Cum Bill Of Supply
DS Category:Rate Category for DS>100KWA DPC
Original for Recipient Duplicate for Supplier

| Circle | Division | Sub-Division | Bill Cycle | Bill Date | Bill No. |
|---|---|---|---|---|---|
| BHATINDA | MANSA DIVISION | SUBURBAN SUB DIVISION | 03/2023 | 22.03.2023 | 50020747752 |

Due Date of Payment (By Cash/Online):03.04.2023
Payment by Local Cheque/DD can be made Upto:03.04.2023

To,
M/s NEHRU MEMORIAL COLLE
GE
COLLEGE ROAD
MANSA-151505-INDIA
Date of Connection :01.01.2000
Consumer GSTIN : State : Punjab Code : 03
Nature of Industry: MISCELLANEOUS (OTHERS)

| Admissible Voltage (KV) | Supply Voltage (KV) | Metering Voltage (KV) | Contract Account No.: 3002309341 OLD: B45GC4500004 |
|---|---|---|---|
| 11.000 | 11.000 | 11.000 | |

| | LOAD(KW) | Date | CD(KVA) | Date |
|---|---|---|---|---|
| SANCTIONED | | | 112.444 | |
| Intensive(Arc Furnace) | | | | |
| Intensive(IND.FUR. & OTHERS) | | | | |
| Ice Factory/Candy/Cold Store | | | | |
| General/Mush. Prd. | 101.200 | 03.04.2015 | | |
| Seasonal | | | | |
| Total | 101.200 | | | |

Place of Supply : PB Reverse Charge : N | Meter Make: L&T | Capacity: 5-10

| Reading Dates (New) | Reading Dates (Old) | Period of Bill(Days) | Feeder Code | Name Of Feeder | Meter Equip Security | ACD | Interest on ACD & Security |
|---|---|---|---|---|---|---|---|
| 22.03.2023 | 22.02.2023 | 28 | FDC0000000826 | College Road-F05L Conn To S/S DB10 | 20 | 81445 | |

| MeterNo.Owner | Meter Status | | Meter Reading New Status | Meter Reading Old Status | Meter Multiplier | Line CTR | MTR Ratio | Mtr.Volt. Ratio | Overall Multiplier | MMTS Correction | Addl.Supply Units | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19363713-PSPCL | O | | | | | | | | | | | |
| Last MCO Date | New Meter | MDI | 6.714 | 7.538 | 1.00000 | 10/5 | 5/5 | 11000/110 | 2.00000 | | | 13.429 |
| | | KVAH | 110041.900 | 108554.300 | | | | | 2.00000 | | | 2975 |
| CTPT 10288-PSPCL 10288-PSPCL | | KWH | 91687.100 | 90678.200 | | | | | 2.00000 | | | 2018 |
| | Old Meter | MDI | | | | | | | | | | |
| Last SJO Date 21.02.2023 ZMSC | | KVAH | | | | | | | | | | |
| | | KWH | | | | | | | | | | |

Total KWH: 2018 | Total KVAH: 2975 | MDI: 13.429 | PF : 0.68 | TOD on peak: 0 | TOD Off Peak : 0

### (A) Fixed Charges

| Contract Demand (L)KVA | Actual Demand KVA(A) | 80% of (L)KVA(B) | A or B whichever greater (C) KVA | Rate per KVA/month (R) | Billing Days(D) | Fixed Charge= C*R*D*12/365 or 366 | Amount Fixed Charge Amount(Rs.) |
|---|---|---|---|---|---|---|---|
| General | General | General | General | General | | General | |
| 112.444 | 13.429 | 89.96 | 89.96 | 125.00 | 28 | 10351 | **10351** |

### (B) Energy Charges

| Total KVAH | Tariff Rate | Amount | Energy Charges (Rs.) |
|---|---|---|---|
| | General | General | |
| 2975 | 6.63 | 19724 | **19724** |

### (C) Fuel Cost Adj Charges

| KVAH Consumption | Rate of FCA/KVAH | Amount | FCA (Rs.) |
|---|---|---|---|
| | | 0 | **0** |

### (D) Additional Surcharge***

| KVAH Consumption | Rate | Amount | Add. Surcharge Amount |
|---|---|---|---|
| | | 0 | **0** |

### (E) Rentals

| Meter + CT/PT Rent for PSPCL Meter | MCB unit rental | Rent for any other Equipment | Total rent | SGST | CGST | Total Rent with Tax | Total Rent (Rs.) |
|---|---|---|---|---|---|---|---|
| 1264 | 000 | | 1,264.00 | 113.76 | 113.76 | 1,491.52 | **1,491.52** |

### (F) Surcharges

| Voltage Surcharge: Admissible Voltage | Voltage Surcharge: Actual Supply Voltage | Voltage Surcharge: Surcharge Rate | Voltage Surcharge: Voltage Surch. Amount | Demand Surcharge: Demand in Excess | Demand Surcharge: Rate of Demand surch | Demand Surcharge: Amount of Demand surch | TOD Surcharge: Peak Hours (6 PM to 10PM) | TOD Surcharge: Rate | TOD Surcharge: Amount | Total Surcharge (Rs. |
|---|---|---|---|---|---|---|---|---|---|---|
| 11.000 | 11.000 | | | | 0.00 | | | | 0 | **0** |

### (G) Rebates

| Voltage Rebate: Units | Voltage Rebate: Rate | Voltage Rebate: HT/EHT Rebate | 1P supply Rebate | Threshold Rebate: KVAH eligible for Rebate | Threshold Rebate: Rate | Threshold Rebate: Amount | TOD Rebate: Non Peak Hours (10PM to 6AM) | TOD Rebate: Rate | TOD Rebate: Amount | Total Rebate (Rs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2975 | 0.20- | 595 | 0.00 | | | | | | 0 | **595.00** |

## 6.2 REGISTRATION OF FIRM WITH BEE

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

15 YEARS OF CELEBRATING THE MAHATMA

17/05/ESCO/22-23/ ५३५१ -५२०

15th September,2022

**Shri Hardeep Kaur**
**Partner**
**Indona Innovative Solutions**
**8/W-11, Railway Road,**
**Opposite Onkar Feed Store Dinanagar,**
**District Gurdaspur, Punjab- 143531**

**Sub: Empanelment of Energy Service Company (ESCO)**

Dear Sir,

This has reference to your application for empanelment/ re-empanelment as an Energy Service Company with BEE in response to our advertisement for re-empanelment and fresh empanelment of ESCOs in the month of May, 2022.

Consequent to scrutiny and evaluation of your documents by SEBI accredited Grading Agencies CRISIL/CARE Advisory/ICRA Analytics/SMERA/ IRR Advisory in terms of the approved parameters for evaluation, BEE is pleased to inform that your company **Indona Innovative Solutions** has qualified for empanelment with BEE as a **Grade 3** Energy Service Company (ESCO). This empanelment would be effective from 16th August, 2022 and will be valid till 15th August, 2024.

Further, the list of all the empanelled ESCOs along with grade assigned is uploaded on its website (www.beeindia.gov.in) for use by State/Central government/Public Sector agencies as well as by any other agency interested in implementing energy efficiency projects on ESCO mode. Please acknowledge your acceptance to this letter.

Yours faithfully,

(Arijit Sengupta)
Director

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.gov.in
4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066 टेली./Tel.: 91 (11) 26766700, फैक्स/Fax: 91 (11) 26178352

## 6.3 ISO CERTIFICATE OF THE FIRM

CERTIFICATE

This is to Certify that the Management System of

INDONA INNOVATIVE SOLUTIONS

8/W-11, RAILWAY ROAD, OPPOSITE ONKAR FEED STORE,
DINANAGAR, GURDASPUR-143531, PUNJAB, INDIA

has been found to conform to the Quality Management System standard:

ISO 9001:2015

This certificate is valid for the following scope of operations:

PROVIDING ENERGY AUDIT, SAFETY AUDIT, INFRARED THERMOGRAPHY, POWER QUALITY AND HARMONICS STUDY, AIR AND WATER AUDIT, DESIGNING, PROJECT EXECUTION, TRAINING AND SKILL DEVELOPMENT.

IAF Code: 34, 37 NACE Code: 74.90, 85.59

:: Certificate No :: IN121298A

| Date of initial registration | Date of this Certificate | Surv. audit on or before / Certificate expiry | Recertification Due |
|---|---|---|---|
| 08 December 2022 | 08 December 2022 | 07 December 2023 | 07 December 2025 |

This Certificate remains valid subject to satisfactory surveillance audits.

Director

QMS

For verification and updated information concerning the present certificate visit to www.lmsassessments.com

This Certificate is the property of LMS Certifications Private Limited and shall be returned immediately when demanded.

IAF

CB-QMS-006

LMS Certifications Private Limited
1, Anandham, Rainbow City, Fareedi Nagar,
Lucknow - 226015, U.P. (INDIA).
Phone : +91-9554645484
Visit :- www.lmsassessments.com
E-mail :- info@lmsassessments.com

LMS/FM/001/QMS/REV06

## 6.4 LIST OF VENDORS

**For Interlocking and Automation**

- Monaco Energy
- Indona Innovative Solutions
- ENCON India Pvt. Limited

**For Energy Efficient Lighting**

- EESL
- RL Consumer Products
- Philips India Limited
- Avni Energy Solutions Pvt Ltd

**For Energy Efficient Lighting**

- EESL
- Sawhney Electrical Works
- M.G Engineers

**For SPV**

- Azure Power India Private Limited
- Acme Roof Top Systems Private Limited
- Ujaas Energy Limited
- M/S Mittal Machines Pvt Ltd

## 6.5 ONSITE MEASUREMENTS


----------End of Report----------