Add Square

# ADD SQUARE SOLUTIONS

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Ref: Add Square/HPBC/EA/2021/03 Date: 28/09/2021

To,

The Principal
Hemo Prova Borbora Girls' College
Bengenakhowa, Golaghat, Assam (India).785621

Subject: Submission of Energy Audit Report.

Dear Sir,

We are pleased to inform you that M/S Add Square Solutions is an organization working on Renewable energy and energy conservation and management sector in Assam. Our prime objective is to promote and provide solutions to adopt Renewable Energy and to take initiative for energy conservation in various organizations.

We are grateful to be a part of your initiative for taking objective of reducing energy intensity in the college campus and entrusted Add Square Solutions conducting Energy Audit. Our scope of work for the project were-

- To understand the present energy consumption pattern and scope of energy conservation in various components and subcomponents.
- To assess their actual operating load and scope for optimizing the same.
- Illumination study and energy conservation in lighting system.
- Energy conservation in Cooling System/Ceiling Fan
- Submission of detailed Energy Audit report highlighting the energy conservation and energy loss reduction measures/ recommendation.

As a part of audit methodology, we have visited Hemo Prova Borbora Girls' College campus on 7th of September 2021 to collect data and to take some instantaneous measurements. After collecting the required data and analyzing those data, Energy Audit Report has been prepared which includes our finding and necessary recommendation as energy conservation opportunities.

We have attached the Report along with this letter. We, hope that this activity will improve the energy efficiency and reduce the overall energy consumption of the College campus.

Thanking you,
For ADD SQUARE SOLUTIONS,

Mr. Deepjyoti Barman, B.E (Mech), M.Tech (Energy Technology)
(Proprietor)
Cell: +91 7002743184

SEPTEMBER 26, 2021

# A REPORT
# ON
# ENERGY AUDIT AT HEMO PROVA BORBORA GIRLS' COLLEGE, GOLAGHAT

**SUBMITTED TO**
**THE PRINCIPAL**
**HEMO PROVA BORBORA GIRLS' COLLEGE**
**BENGENAKHOWA, GOLAGHAT, ASSAM**
**(INDIA).785621**

**SUBMITTED BY**

ADD SQUARE SOLUTIONS
HOUSE NO: 298 (A), WARD NO:04, M.G ROAD,
ABHAYAPURI, DIST: BONGAIGAON, ASSAM-783384

Contents

**Acknowledgement:**

We are sincerely thankful to the Hemo Prova Borbora Girls College management for giving us the opportunity to conduct energy audit in Hemo Prova Borbora Girls College campus.

We are also grateful to Dr. Bipul Chandra Bhuyan, Principal, Hemo Prova Borbora Girls College Assam, whose valuable comments / feedback, during various reviews have helped us to bring the report in the present format.

We express our sincere gratitude to all other concerned officials for their support and guidance during the conduct of this exercise.

**For Add Square Solutions**


Mr. Deepjyoti Barman, B. E (Mech), M. Tech (Energy Technology)
(Proprietor)

**STUDY TEAM:**

1. Mr. Deepjyoti Barman, B.E (Mechanical), M. Tech (Energy Technology),
   ADD SQUARE SOLUTIONS House No: 298 (A), Ward No:04, M.G Road, Abhayapuri, Dist: Bongaigaon, Assam-783384
2. Mr. Dibakar Gayari, B.E (Electronic Engineering),
   ADD SQUARE SOLUTIONS House No: 298 (A), Ward No:04, M.G Road, Abhayapuri, Dist: Bongaigaon, Assam-783384

**RESOURCE PERSON AND ENERGY AUDITOR**

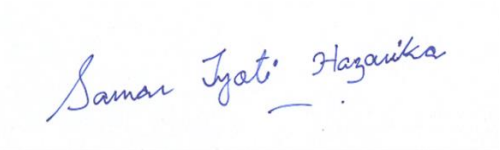
Mr. Samar Jyoti Hazarika, B.E (Mechanical), M. Tech (Energy Technology), Assistant Professor, Department of Energy Engineering, North Eastern Hill University, Shillong, Meghalaya

B.E.E Certified energy auditor (EA15266)

Deepjyoti Barman

Proprietor

Add Square Solution



Mr. Samar Jyoti Hazarika

B.E. E Certified energy auditor (EA15266)

## 1. BACKGROUND:

Energy is a basic requirement for economic development in almost all major sectors of Indian economy i.e. agriculture, industry, transport, commercial, residential (domestic) and educational institutions. Consequently, consumption of energy in different forms has been steadily rising all over the country, which has maintained a steady growth pattern in the past and the trend is likely to continue in future as well. This has increased the dependence of the state on fossil fuels and electricity. The Government of India enacted the Energy Conservation Act, 2001 in October 2001. The Energy Conservation Act, 2001 became 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. Hemo Prova Borbora Girls College, Golaghat an educational institute in Golaghat district of Assam taking voluntary objective of reducing energy intensity in the College Campus entrusted Add Square Solutions conducting Energy Audit. To conduct the energy audit, the audit team visited the campus on 7th of September 2021 to collect data and to take some measurement for assessment of different energy consuming components.

## 2. SCOPE OF WORK

### 2.1 Assessment of actual operating load and scope for optimizing the same

- Review of present electrical load in the campus
- Assessment of Building wise electrical load base on electrical fittings

### 2.2 Illumination study and energy conservation option in lighting system

- Review of present lighting system, lighting inventories etc. Estimation of lighting load at various locations like different building floor, corridor, rooms etc. outside light and other important locations as mentioned by the management.
- Detail lux level study at various locations and comparison with acceptable standards.
- Study of present lighting system and recommendation for improvement.
- Exploring Energy Conservation options in lighting system.

### 2.3 Energy Conservation in Air-Conditioning and water pumping system

- Observation and energy conservation.
- Exploring Energy Conservation Option (ENCON) in system.

### 2.4 Diesel Generator (DG) Sets

- Review of DG set operation
- Performance assessment of DG sets in terms of Specific Fuel Consumption (SFC i.e. Lit/kWh).

## 3. METHODOLOGY ADOPTED FOR BUILDING AUDIT

Step 1 - Interview with Key Facility Personnel

During the preliminary audit, a meeting is scheduled between the auditor and key operating personnel to start the assignment. The meeting agenda focuses on: audit objectives and scope of work, facility rules and regulations, roles and responsibilities of project team members, and description of scheduled project activities. During this meeting the team enlightened about operating characteristics of the facility, energy system specifications, operating and maintenance procedures.

Step 2 - Facility Tour

After the initial meeting, a tour of the facility is arranged to observe the various operations, focusing on the major energy consuming systems identified during the interview, including the building structure, lighting and power, mechanical energy systems.

Step 3 - Document Review

During the initial visit, available facility documentation are reviewed with facility representatives. This documentation review includes all facility operation and maintenance procedures and logs – sheets/ registers for the previous years.

Step 4 - Facility Inspection

After a thorough review of the construction and operating documentation, the major energy consuming processes in the facility are further investigated. Where appropriate, field measurements are collected to substantiate operating parameters.

Step 5 - Utility Analysis

The utility analysis is a detailed review for the previous months. Data reviewed includes energy usage, energy demand and energy consumption pattern.

Step 6 - Identify/Evaluate Feasible ECMs

Based upon a final review of all information and data gathered about the facility, and based on the measurements final energy conservation measures is developed.

Step 7 - Prepare a Report Summarizing Audit Findings

The results of our findings and recommendations are summarized in this report. The report includes a description of the facilities and their operation, a discussion of all major energy consuming systems, a description of all recommended ECMs with their specific energy impact, implementation costs, benefits and payback. The report incorporates a summary of all the activities and effort performed throughout the project with specific conclusions and recommendations and ECMs – Energy Conservation Measures

## 4. BUILDING DESCRIPTION

The Hemo Prova Borbora Girls College campus consisting of multiple buildings. The following Tables show the basic information about the building and the utilities.

| Sl. No | Basic Building Data | Value |
|---|---|---|
| 1 | Connected Load | 75 kW |
| | Contract Demand | 88.23 kVA |
| 2 | Installed capacity of DG set | 15 kVA (1 Nos, Make: Kohlar Power System)<br>15 kVA (1 Nos, Make: Escorts Limited) |
| 3 | Annual electricity consumption (April'2019 to March'2020) | 24,137 kWh |
| 4 | Annual cost of electricity consumption @7.20/unit | Rs. 3,64,155.00 |
| 5 | Total Numbers of building covered | 8 Nos |
| 5.1 | Working hours (Academic and Administration building) | 8 Hrs (9 AM to 5PM) |
| 5.2 | Working hours (Hostel building) | 24 Hr x7 days |
| 5.3 | Working Days/week | 6 Days |
| 6 | Whether sub-metering of electricity consumption for each building | No |

## 5. PRESENT ENERGY SCENARIO

### 5.1 Review of Present Energy Consumption in various Load

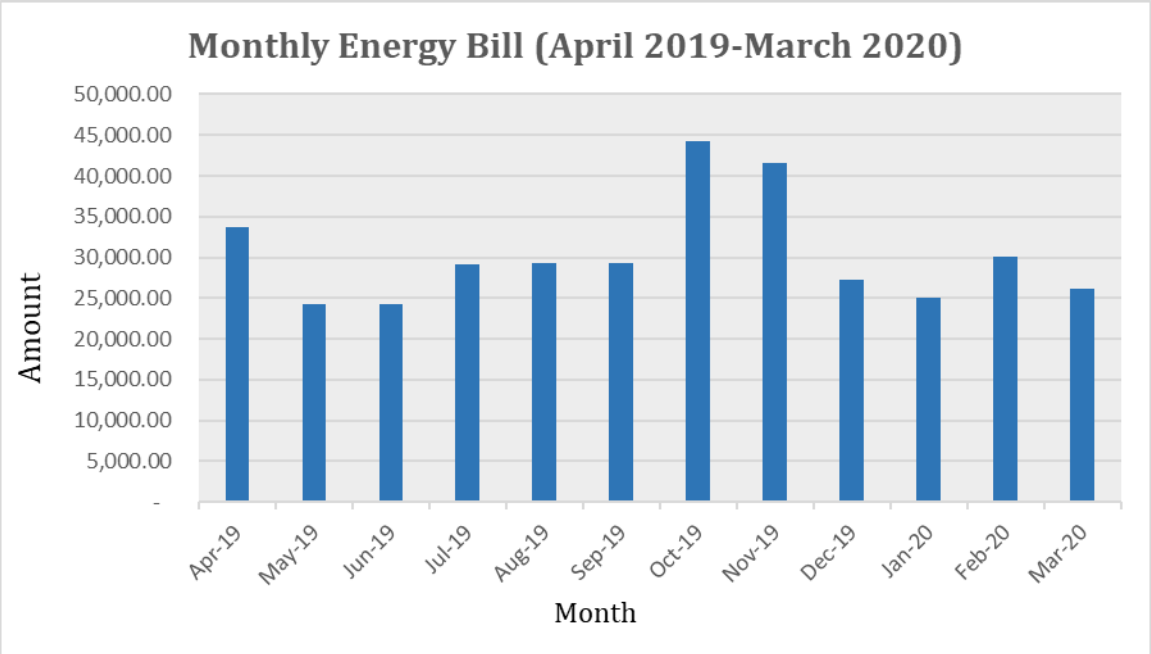
At present the overall energy consumption is catered by the Electricity supply from Assam State Electricity Board (Assam Power Distribution Company Limited) and own DG set. Total Connected load of Hemo Prova Borbora Girls College is 75 kW and Contracted Demand is 88.23 kVA. The campus has a dedicated transformer of 100 kVA.

#### 5.1.1 Electrical Energy Consumption

Details of the monthly energy consumption and energy bill of Hemo Prova Borbora Girls College are as follows

| Sl. No | Description | Value | Unit |
|---|---|---|---|
| 1 | Monthly Average consumption | 2,012 | kWh/Month |
| 2 | Monthly average energy consumption cost @ Rs. 7.20 and including fixed charges as applicable | 30,346 | Rs/Month |
| 3 | Annual energy consumption | 24,137.00 | kWh/Annum |
| 4 | Annual energy consumption cost | 3,64,155.00 | Rs/Annum |
| 5 | Connected load | 75 | kW |
| 6 | Average P.F maintained | 98.5 | |

Graphical representation of monthly electricity bill during April 2019-March 2020




5.1.2 Fuel Oil Consumption for Electricity Generation

To meet the electrical requirement during load shading or any interception by the gird power, the campus is also generating their own electricity by using Diesel Generator Set with a rated capacity of 15 kVA and 15 kVA.

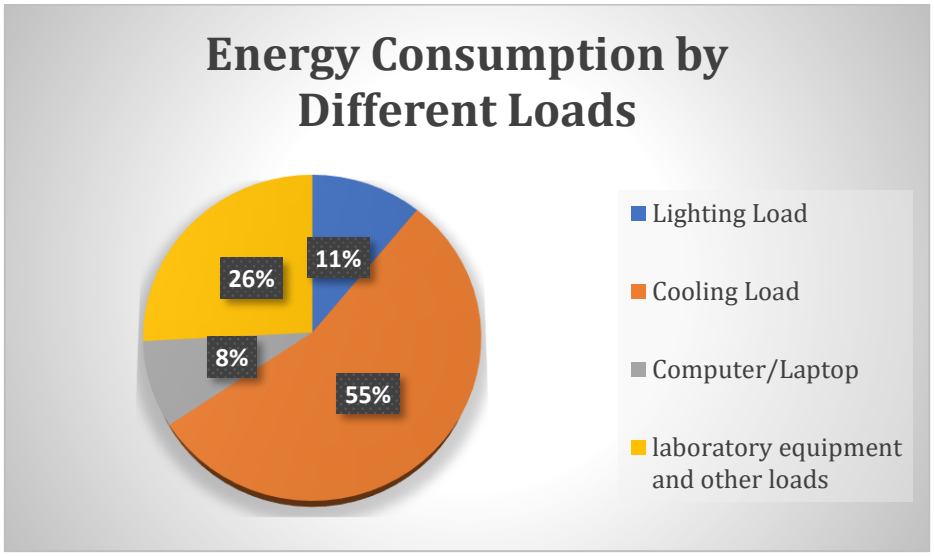
## 6. PERFORMANCE EVALUATION, OBSERVATION AND ANALYSIS

### 6.1 ASSESSMENT OF ACTUAL OPERATING LOAD AND SCOPE FOR OPTIMIZING

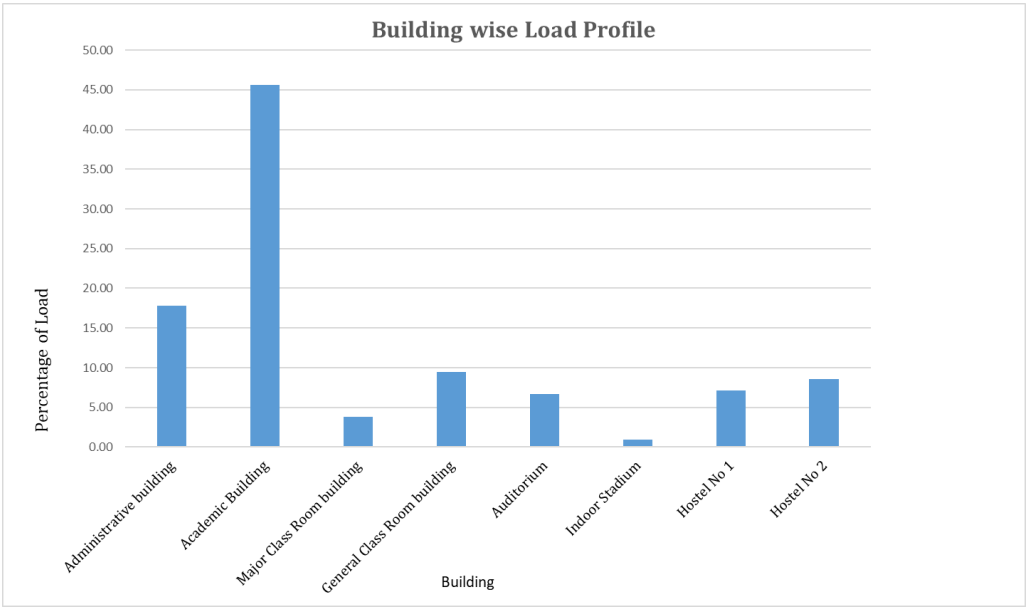
6.1.1 Energy Consumption in various Loads

Presently the College campus is connected with the electrical power for state electricity board and own DG set supplying power to different buildings. The major energy consuming equipments/ utilities available in the building are

- Lighting Load
- Cooling Load/Celling Fan
- Computer/Laptop/projectors and digital classroom equipment
- Laboratory equipment and other loads




6.1.2 Building wise estimation of loads:



## 6.2 OBSERVATION AND RECOMMENDATION

- It has been observed that the campus has one energy meter to measure the electrical energy consumption from the grid. Since the campus consist of multiple numbers of buildings with high energy consuming equipment, therefore it is recommended to install separate submeter for each building to identify and energy consumption of each building. This will help the management to take energy conservation measures as well as it will help to do the performance assessment of electrical uses.
- Presently the total installed load of the campus is 55 KW (Which include lighting load, Fan load, AC load, motor load etc.)
- There is no evidence of recording data of energy generation and consumption by DG set. Therefore, the performance analysis of DG set has been excluded. Management may take initiative to record in the log book for future performance assessment of energy profile of the systems as well as preventive and regular maintenance work. (Please refer annexures for reference)

## ILLUMINATION STUDY AND ENERGY CONSERVATION IN LIGHTING SYSTEM:

6.2.1Review of Present Lighting Loads

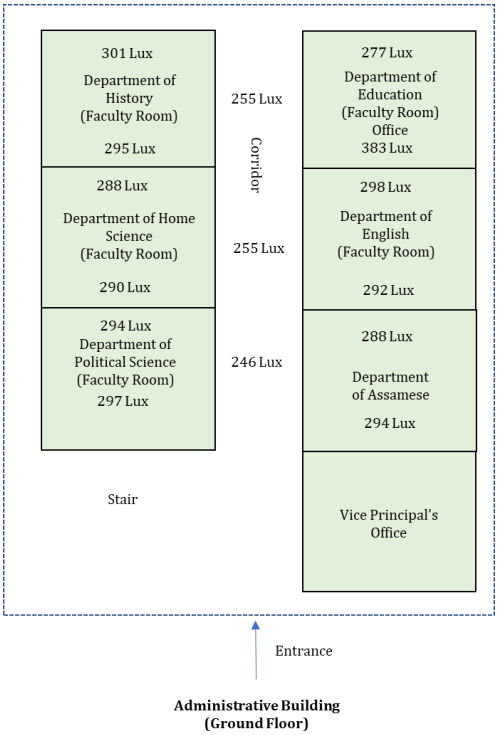
Lighting contributes about 11% of energy consumption of the campus with respect to the connected load of 75 kW. The lighting load of the campus is consisting of 18 W LED tube light and 8 W LED bulb to illuminate the workplace.

6.2.2 Lux Level Survey

The building wise and floor wise lux level is measured by the portable lux meter (Make: Fluke, Model: Fluke 941). For building energy audit the parking area is normally excluded. Location/Floor/ Room/ area wise Lux level was measured and the details are as follows:

**Administrative Building (Ground Floor):**

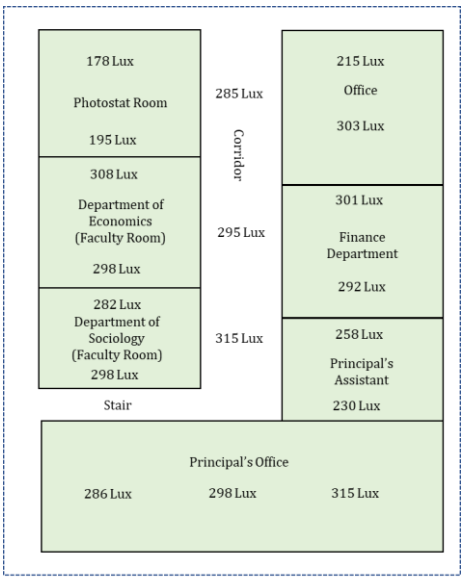
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Administrative Building | LED tube light<br>LED Bulb | 18W<br>8W | 7 Nos<br>2 Nos | 126 W<br>16 W | 290.2 |




**Administrative Building (Ground Floor)**

## Administrative Building (First Floor)

| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Administrative Building | LED tube light<br>LED Bulb | 18W<br>8 W | 7 Nos<br>9 No | 108 W<br>72 W | 275.1 |



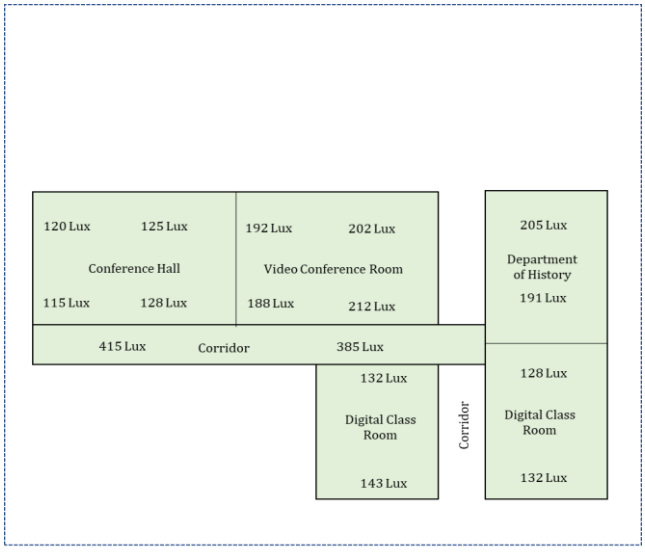

**Administrative Building (First Floor)**

**Administrative Building (Third Floor)**

| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Library | LED bulb<br>CFL | 8 W<br>20 W | 16 Nos<br>4 Nos | 128 W<br>80 W | |

**Academic Building (Ground Floor):**

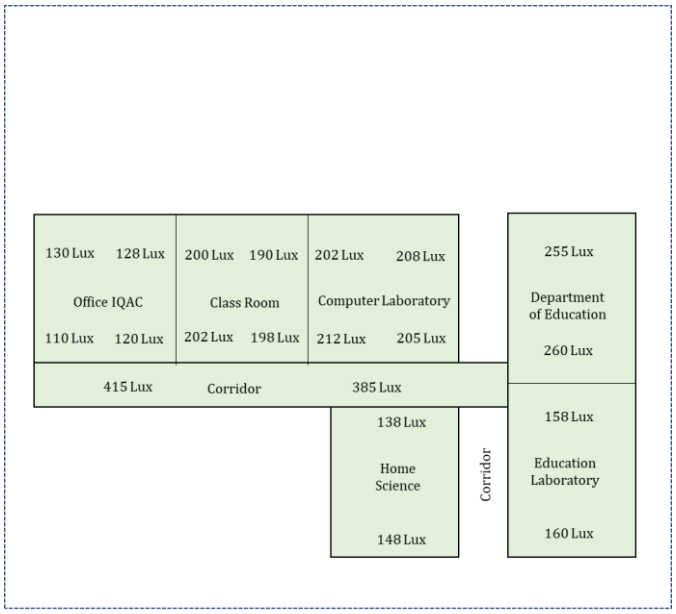
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Academic Building (Ground Floor) | LED tube light<br>LED Bulb | 18W<br>8 W | 3 Nos<br>44 Nos | 54 W<br>352 W | 188.32 |




Academic Building (Ground Floor)

**Academic Building (First Floor):**

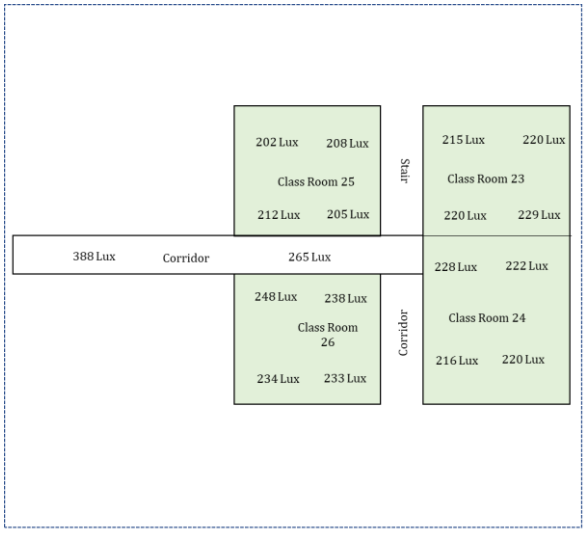
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Academic Building (First Floor) | LED tube light<br>LED Bulb<br>CFL | 18W<br>8 W<br>20 W | 18 Nos<br>10 Nos<br>12 Nos | 144 W<br>80 W<br>240 W | 201.2 |




Academic Building (First Floor)

**Academic Building (Second Floor)**

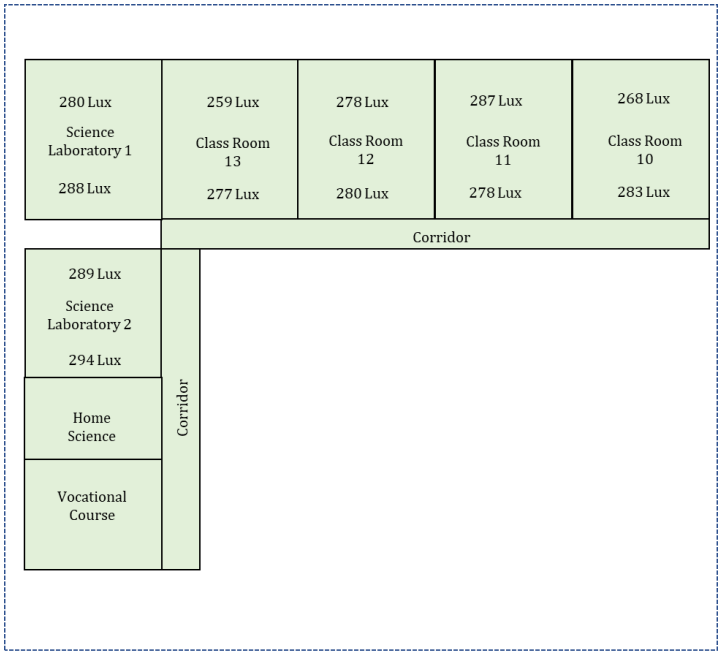
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Academic Building (Second Floor) | LED bulb | 8W | 61 Nos | 488 W | 221.8 |




Academic Building (Second Floor)

**General Class Room Building:**

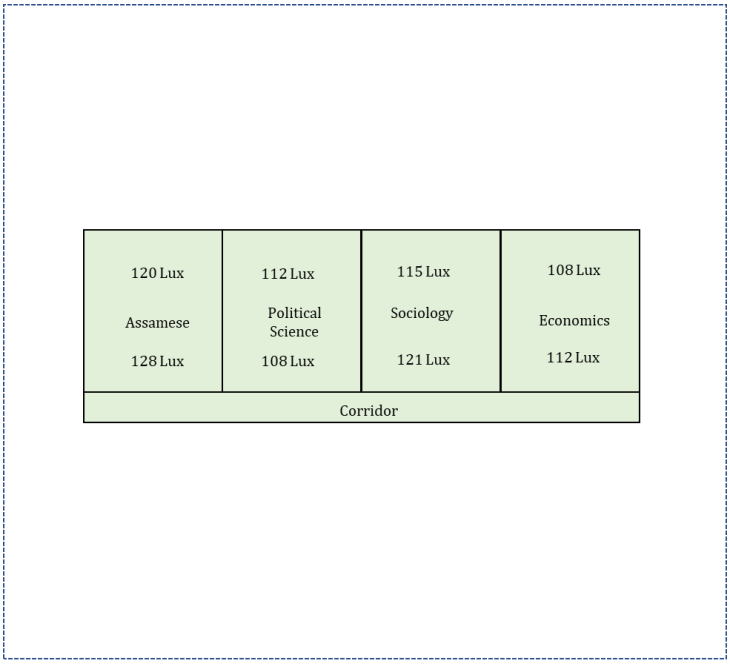
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| General Class Room Building | LED tube light<br>LED Bulb<br>CFL | 18W<br>8 W<br>20 W | 38 Nos<br>10 Nos<br>9 Nos | 684 W<br>80 W<br>180 W | 280.08 |




General Class Room Building

**Major Class Room Building:**

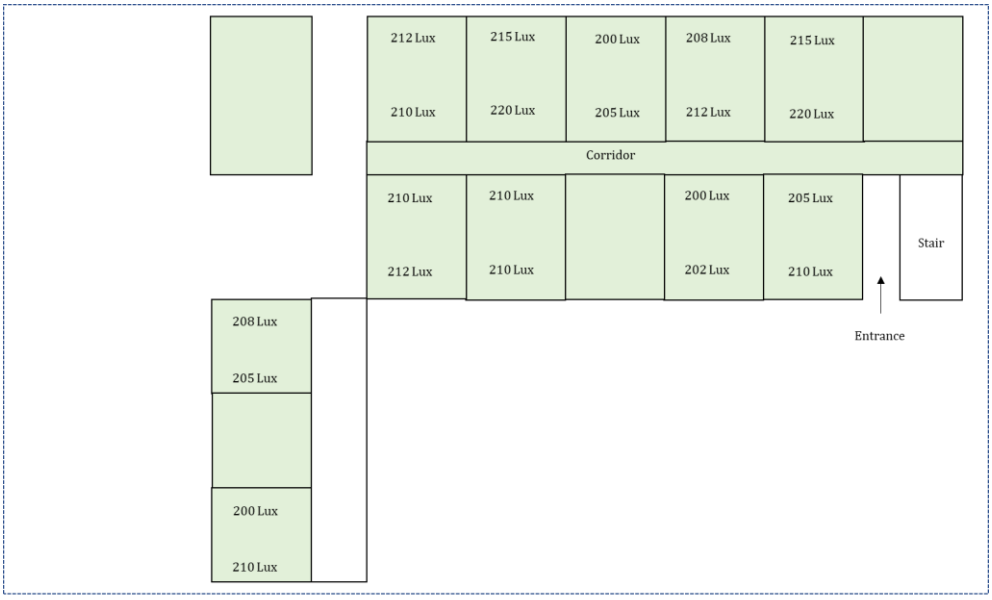
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Class Room | LED tube light | 18W | 12 Nos | 216 W | 298 |




**Major Class Room**

**Hostel No 1 (Ground Floor):**

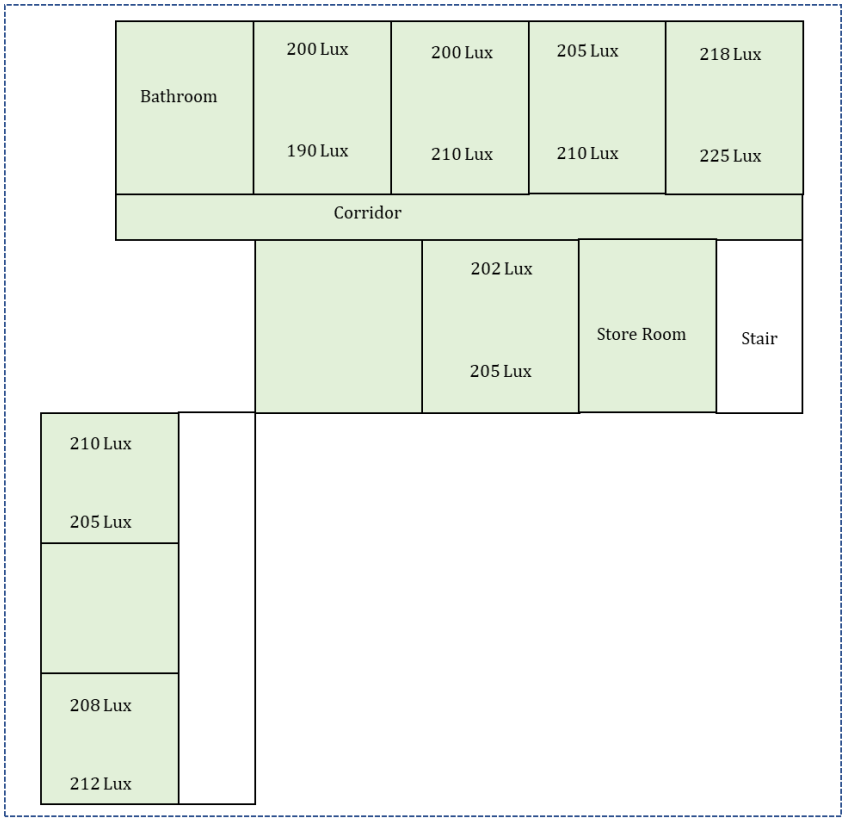
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Hostel Room | LED bulb<br>LED Tube light | 8W<br>18 W | 29 Nos<br>4 Nos | 232 W<br>72 W | 209.05 |




**Hostel No 1 (Ground Floor)**

**Hostel No 1 (First Floor):**

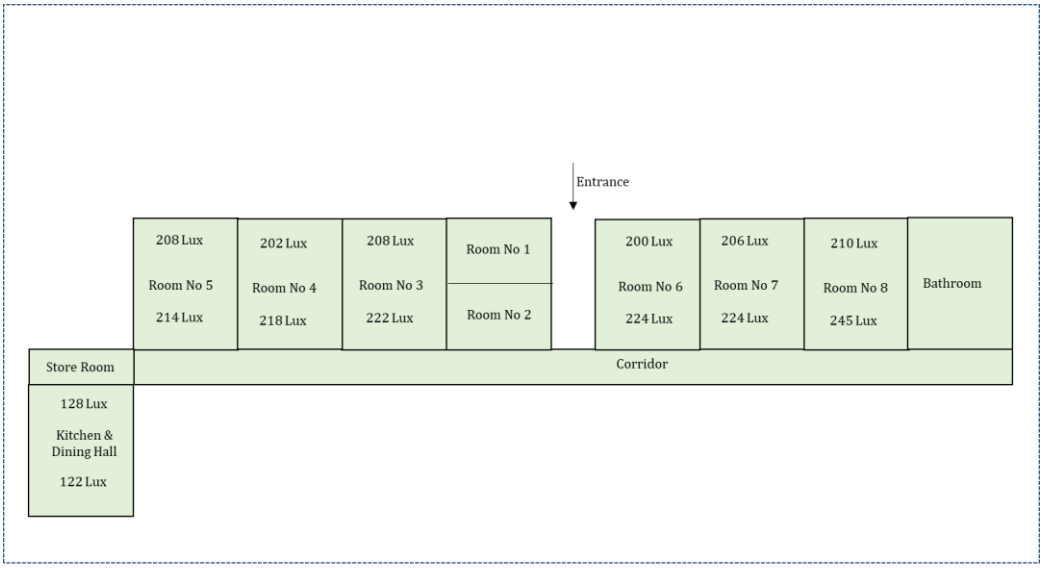
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Hostel Room | LED bulb<br>LED Tube light | 8W<br>18 W | 12 Nos<br>3 Nos | 96 W<br>54 W | 207.15 |




**Hostel No 1 (First Floor)**

**Hostel No 2 (Ground Floor):**

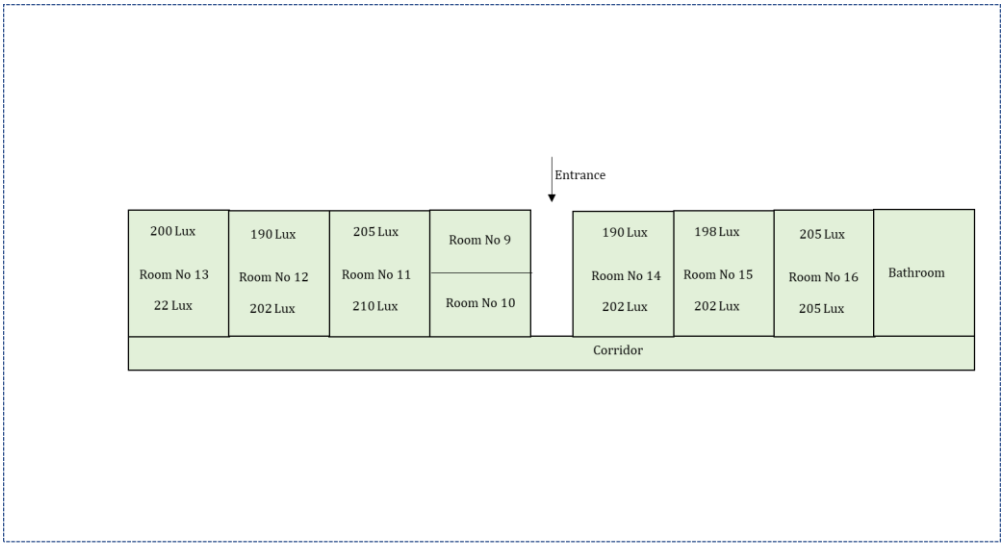
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Hostel Room | LED bulb | 8W | 16 Nos | 128 W | 202.2 |




**Hostel No 2 (Ground Floor)**

## Hostel No 2 (First Floor):

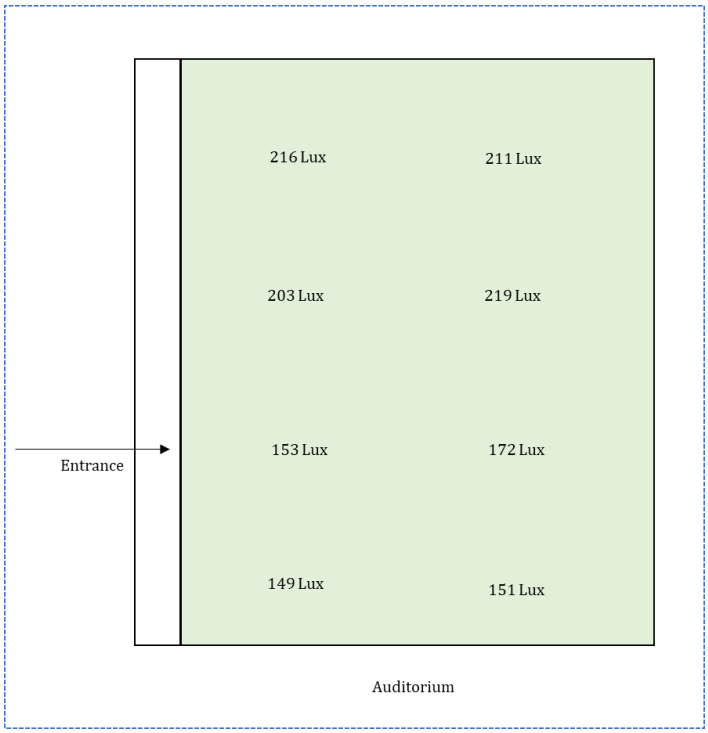
| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Hostel Room | LED bulb | 8W | 16 Nos | 128 W | 202.58 |




**Hostel No 2 (First Floor)**

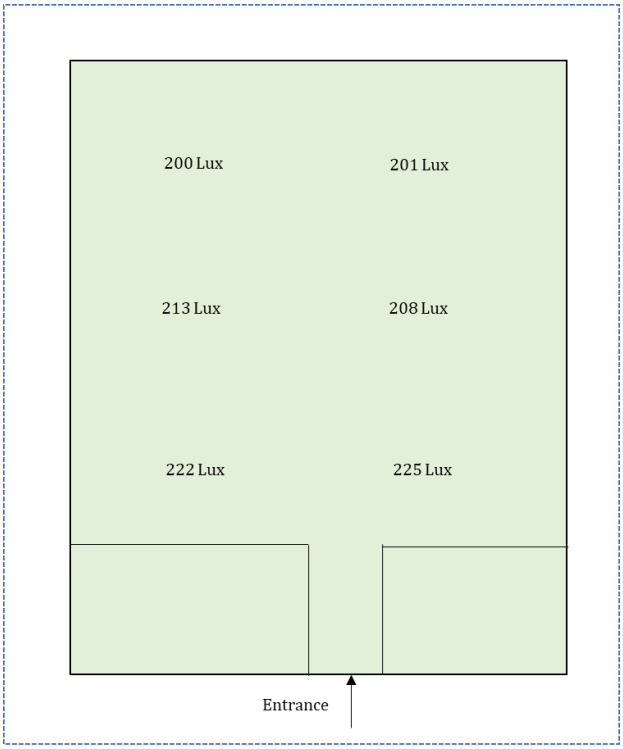
**Auditorium:**

| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Auditorium Hall | LED tube light<br>LED Flood Light<br>Ceiling panel Light | 18W<br>300 W<br>8 W | 14 Nos<br>2 Nos<br>9 Nos | 252 W<br>600 W<br>72 W | 184.25 |




**Indoor Stadium:**

| Area | Type of Luminaries used | Wattage | Total no of fitting/luminaires | Total installed load | Average lux level (Lux) |
|---|---|---|---|---|---|
| Indoor Stadium | LED flood light<br>Ceiling Panel Light | 200 W<br>10 W | 2 Nos<br>10 Nos | 200 W<br>100 W | 374.3 |




Indoor Stadium

**OBSERVATIONS**

Since educational institutes are working mainly on day time, therefore illumination study was carried out during day time only and it is observed that, if all windows are open and use maximum day light the working area or the study area covers adequate illumination level. It is also observed that, some part of the study area there is not adequate day lighting which leads to depend on artificial lighting. This will increase the use of energy and operating cost to meet up the standard illumination level. Although most of the lights are converted to LED to save energy and to achieve the standard illumination level it is observed that there is still some higher energy consuming luminaire in the campus.

**RECOMMENDATION**

- Inculcate discipline and sense of participation in the energy conservation movement, any unnecessary lighting during day period should be avoided through awareness programmes.
- It is recommended that all luminaries should be converted to energy efficient LED as an energy conservation measures.
- Area specific use of task lighting and reduction of back ground illumination.
- Installation of occupancy sensors in the faculty cabin so that the lighting systems are controlled by this smart occupancy sensor.

It is recommended to use standard practice of illumination level as follows (As per IES standard)

| Type of interior/activity | Standard illumination Level (Lux) |
|---|---|
| Libraries | |
| Shelves, book stacks | 150 |
| Reading table | 300 |
| Staff rooms, student rooms\students hostels etc | |
| Gymnasium | 300 |
| Assembly halls general | 300 |
| Teaching spaces general | 300 |
| INDOOR SPORTS AND RECREATIONAL BUILDING | |
| MULTIPURPOSE SPORTS HALLS | |
| Athletics, basketball, bowls, judo | 300 |
| Hockey | 700 |
| BADMINTON COURTS | 300 |
| PUBLIC AND EDUCATIONAL BUILDING ASSEMBLY AND CONCERT HALLS | |
| Theatre and concert halls | 100 |
| Multipurpose | 500 |
| FURTHER EDUCATION ESTABLISHMENT | |
| Lecture theatres general | 500 |
| Chalkboard | 500 |
| Demonstration benches | 500 |
| Examination halls, seminar rooms, teaching spaces | 500 |
| Laboratories | 500 |

### 6.3 DIESEL GENERATOR (DG) SET

6.3.1 Review of present Diesel Generator (DG) Set:

There are two (2) nos of DG sets with capacity of 15 kVA each, which are used to provide backup power during load shading hours.

DG set of 15 kVA:

| | |
|---|---|
| Make: | KOHLER POWER SYSTEM |
| Model | KES 15II |
| Rated kVA | 15 kVA |
| Rated kW | 12 kW |
| Voltage | 230 V |
| Current | 65 Amps |
| Frequency | 50 Hz |
| Phase | 1 Phase |
| RPM | 1500 |

DG set of 15 kVA

| | |
|---|---|
| Make: | Escort Limited |
| Model No | G15-II |
| Rated kVA | 15 kVA |
| RPM | 1500 |

6.4.2 Performance assessment of the Diesel Generator sets:
For the performance assessment of the DG sets its need to study specific fuel consumption [SFC= Total fuel consumed (litres)/ total power generated (kW)]. For which at least Twelve (12) months data of monthly fuel consumption and monthly energy generated by the DG set is required to analyze the specific fuel consumption. As monthly fuel consumption and energy generation data are not available, therefore the performance assessment of DG sets was not able to conduct.

**Recommendation:**

It is strongly recommended the data recording or data logging of monthly fuel consumption and monthly energy generation practices for both the DG set.

**6.4 WATER PUMPING SYSTEM:**
The campus has total six (3) numbers of water pumps. Out of these two (2) are submersible and one (1) is surface water pump.

**OBSERVATION**

The percentage of loading for the 1 HP motor is 85% and for the 0.5 HP motor is 90% is acceptable as per the energy conservation measure.

If any changes and new installation is required to be done management may take initiative to purchase energy efficient motor (EEM) only.

**7. GOOD ENGINEERING PRACTICES**

7.1 GUIDELINES FOR ENERGY MANAGEMENT IN BUILDINGS

7.1.1 Illumination:

Natural light should be used as far as possible to meet the required illumination level. Especially requirement of artificial light is less during daytime. While using the artificial lights care should be taken so as the lights in each area can be switched off partially when not in use. (e.g. The illumination level required for working on computers is 150 - 300 lux, but when the area is not used for work illumination level of 110 lux is sufficient. (This can be achieved by switching off some of the lights.) Also proper naming or numbering of the switches will facilitate the use of them by occupants or staff.

7.1.2 Use of Efficient Lighting Technology

In some of the area FTL and CFL has been observed, replacing them with more efficient LED tube-lights should be used.

7.1.3 Air-Conditioning System

The Hemo Prova Borbora Girls Collegecampus has very less number of air conditioning units as cooling load. It has been observed that the installed air conditioning units are 2 star and 3 star rating, therefore it is recommended to use 5 star rating air conditioning unit.

7.1.4 Preventive Maintenance

Inspect & monitor equipment operations. Maintain regular operation & maintenance log for major equipment. Fix minor problems before they result in major repairs. For this regular inspection of all equipment by trained staff is necessary. If necessary maintenance shutdown should be taken at least once in 6 months. During this wiring, contacts & other components should be thoroughly inspected for voltage imbalance, loose connections or self heating. If major repairs are required, evaluate the economic benefit of replacing the old equipment with more efficient and compact equipment before doing the repairs. Such study should be done well in advance, so that in case of breakdown a decision can be taken quickly. Adjust schedules to keep all equipment on only when necessary. Adjust temperature & humidity set points for AC within comfort zones seasonally.

7.1.5 Training & Awareness

Maintenance & operating staff should be trained / informed about the energy management issues & procedures. To implement an effective preventive maintenance program, the operational staff must be given comprehensive training on each type of equipment, regarding system fundamentals, use of reference material & manuals, maintenance procedures, service guidelines & warranty information. Proper maintenance schedules could be supplied to them for different equipment.

7.1.6 Other Savings

New computers available in the market offer built in power saving modes. These monitors are called as Energy Star compliant monitors. However, it was found that most of the users are not aware of this facility. Therefore, steps should be taken to inform every one of this & any such future options. Switches for computers should be made more accessible, so that employee can turn off their terminals when not in use.

Annex 1

Data logging format for DG Set:

| Month/Year:……../…….. | | | | | Generator Operator Name:…… | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Generator Name | Capacity Location | Time | | Meter Reading | | Fuel Added | Total Runing Hrs | Total Meter Reading | Signature of Operator |
| | | | Start | End | Start | End | | | | |
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Annex 2

Data logging format for periodic maintenance of DG Set:

| Month/Year:……../…….. | | | Generator Operator Name:…… | | | |
|---|---|---|---|---|---|---|
| Date | Lub oil Level | Coolant Level | Fuel Filter | Lub Oil Filter | Battery Water Level | Coolant Filter |
| | | | | | | |
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