ENERGY AUDIT REPORT

GURU NANAK COLLEGE, BUDHLADA

CONDUCTED BY:

R.K. ELECTRICALS & ENERGY AUDIT SERVICES an ISO Co.

Er. R. K. Sharma MIE, FIV
BEE's Energy Auditor (EA-10080) MoP, GoI
Indian Green Building Council of India Accredited Professional
HP Govt. Emp Energy Auditor, DoE, Shimla
Govt. Regd. Valuer & Chartered Engineer
M: 09501332233 E-Mail: **er.rakesh50@ymail.com**

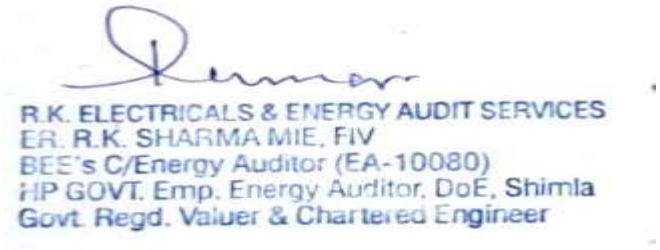
2023-2024

ENERGY AUDIT CERTIFICATE

(2023-24)

This is to certify that the **"R.K. Electricals and Energy Audit Services**" conducted Energy Audit of **"Guru Nanak College Budhlada situated** in Punjab from 19/02/2024 to 20/02/2024 for the academic year 2023-24. This audit involved extensive consultation with all the related campus team, office record, data collection, measurements and cost benefit analysis

The study exhibited the Annual Energy saving potential of 0.77 Lacs KWH with annual monetary saving: Rs. 8.25 Lacs by investing Rs.25.04 Lacs



For R.K. Electricals & Energy Audit Services

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ACKNOWLEDGEMENT

R.K. ELECTRICALS & ENEGY AUDIT SERVICES expresses sincere thanks to the management of "**Guru Nanak College, Budhlada"** for entrusting the project of Energy Audit of their campus & for their kind assistance and co-operation during the Project Report & Preparation for energy efficiency improvements of their Campus particularly:

Dr. Narinder Singh - Principal

We express our thanks to the IQAC Team and all Staff members without whose constant support, we could not have carried this audit.

Engineers who participated in audit & report preparation

1) Er Rakesh Kumar Sharma: EA: 10080
2) Er Harvinder Singh: EA: 12433
3) Er. Paramjeet Singh: EA: 19322
4) Er Varun Sharma: B.Tech, PGD industrial Safety Management
5) Er. Pushap Raj Sharma B.Tech Electrical Engg

ER. R.K, Sharma MIE, FIV

For R.K. Electricals & Energy Audit Services

ABBREVIATIONS

A	Ampere
AC	Alternating Current
APFC	Automatic Power factor Controller
Avg.	Average
BEE	Bureau of Energy Efficiency
CEA	Certified Energy Auditor
CFL	Compact florescent lamp
EER	Energy Efficiency Ratio
FTL	Florescent Tube Light
Kcal	Kilo Calories
Kg.	Kilogram
KL	Kilo Liter
KV	Kilo Volt
kVA	Kilo Volt Ampere
KVAr	Kilo Volt Ampere Reactive
kW	Kilo Watts
kWh	Kilo Watt Hour
M or m	Meter
Mm	Millimetre
Max.	Maximum
Min.	Minimum
MT	Metric Ton
No.	Number
PF	Power Factor
TR	Tons of Refrigeration
V	Voltage
W	Wattage (watt)

EXECUTIVE SUMMARY

R.K. ELECTRICALS & ENEGY AUDIT SERVICES was entrusted the DPR for energy efficiency improvement in the **Guru Nanak College Budhlada** Punjab. The Institution's management is conscious with regard to its Energy Efficiency Levels and they have initiated several measures to reduce the energy consumption. During field studies, it was observed that the management was found to be progressive as it has done very well on energy conservation front by implementing several energy conservation initiatives such as awareness on energy efficiency, and is in process of making Green Building Campus, Good usage of day light in campus, installation of LED light fixtures at few locations and solar plant etc. We acknowledge and appreciate the commitment of the **Guru Nanak College Budhlada** management towards conservation of Energy.

However, energy conservation is a continuous process and there is always scope for further improvements. The objective was to reduce further the energy consumption. This involved a detailed Energy:

i) Establish a baseline of the present energy consumption pattern,

ii) Identify Energy Efficiency Measures (EEM's) which can lead to sustained energy savings in the campus and

iii) Prepare an action plan to implement the same.

This report is an attempt to provide overview of energy consumption, its variation and energy reduction potential of **Guru Nanak College Budhlada** campus. The report also highlights the major energy saving opportunities available in the air conditioners, fans, lighting at the campus A set of recommendations which will assist in improving energy efficiency has also been highlighted in this report. This report has emerged after a detailed energy audit of campus during 19/02/2024 to 20/02/2024 to find out the performance level of, and lighting, fans, air conditioners, pumps other equipment installed in the premises and find out potential for energy conservation and reduction in power consumption.

Total saving potential: **Amount of expected annual saving – Rs. 8.25 Lacs, Investment-Rs. 25.04 Lacs, Energy (KWh) Saveable- 0.77 Lakh**

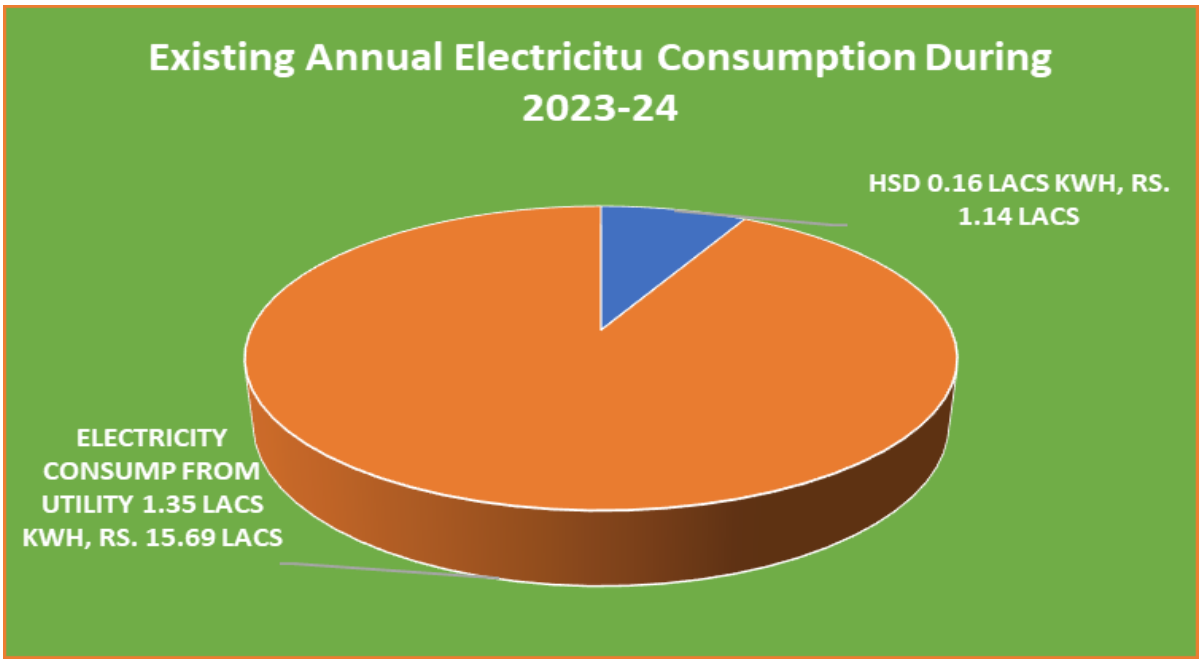
Detail of Energy Consumption

Using the historical data, the total energy consumptionof the College campus during the 2023-24 was **1.51 Lacs KWH** with the annual energy cost amounting to Rs **16.83 Lacs**. Electricity sourced from Utility and Diesel Generator in the campus

Annual Existing Energy Consumption

Energy Source	Annual consumption	Energy cost (Lacs)
Electricity (Utility) -L KWH	1.35	15.69
HSD (L KWH) *	0.16	1.14
Total	**1.51**	**16.83**

*Equivalent Annual cost of electricity through DG Set



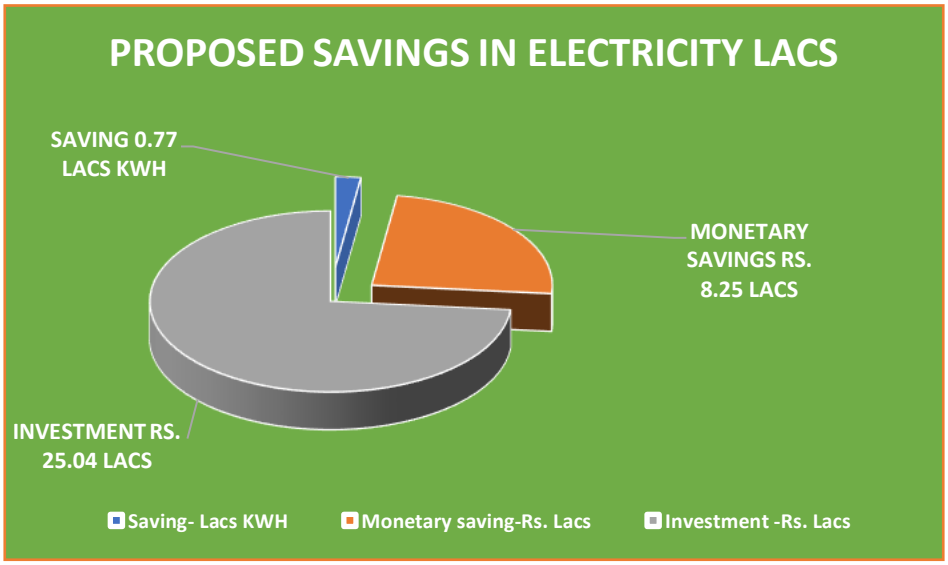
Summary:

Sr.No.	Description	Details
1	Name of the building	Guru Nanak College Budhlada
2	Location/Address	Guru Nanak College Budhlada
3	Name and address of the owner	Guru Nanak College Budhlada
4	Ground covered area of the building	13966.53 Sq mt
5	Connected load/Contract demand of the building	219.42 KW/229 KVA
6	No. Of Gen sets with capacity	125 KVA
7	Average annual consumption of the Diesel	1972 Litres/yr. App.
8	Nature of the building	Educational Institution
9	Storey	Ground, +2 Floor
10	No. of Rooms	4 No. blocks & 1 Hostels
11	Hours of normal operation of the building	6 hrs
12	Percentage of air-conditioned floor area	Less than 40%
13	Name & contact Number of the Nodal officer I/C	Astt. Prof. Simran Singh M:9855800595
14	Energy Audit Report No.	RKS/EA-39/2024,Dt.10/05/24
15	a) Existing annual electricity Consumption purchased from utility	1.35 LAKH KWH
	b) Existing annual Electricity Consumption through DG sets	0.16LAKH KWH
	d)Total existing annual existing Electricity consumption (Utility+DG)	1.51 LAKH KWH
16	Energy Performance Index (EPI of the Bldg.)	10.86 kWh/Sqm/Annum
17	a) Annual Electricity Cost purchased from utility	Rs.15.69 Lakh
	b) Existing equivalent annual cost of electricity through DG Set	Rs.1.14 Lakh
	c) Total annual electricity cost (utility + DG) - Rs	15.69+1.14=Rs.16.83 Lakh
18	Avg overall Electricity rate/KWH	Energy charges Rs.11/-
19	Proposed Annual Electricity Units saving (KWH)	**0.77 Lakh KWH**
20	Proposed Annual Monetary Savings	**Rs.8.25 Lakh**
21	Proposed investment	**Rs.25.04 Lakh**
22	ROI / Payback	**3.0 Years**

23	Recommendations	
Sr No.	**Summary of Recommendations**	**Monetary Savings in-Rs.**
i	Optimizing the existing contract demand from 229 KVA to 164.5 KVA in the billing to reduce the fixed charges in the monthly electricity bill (no investment required for reduction of contract demand). Take up matter with the utility PSPCL) for reduction of CD	78917
ii	Providing and installation of 30Amps 3 phase 4 wire Active Harmonic Filter in the main LT distribution panel for suppression the excess current harmonics	5500
iii	Improvement in power factor of the system from 0.85 to 0.99 by installing7 KVAR with panel capacitor bank/addition of capacitors/replacing defective capacitor	143693
iv	Replacement of existing ceiling/wall mounted type fitting 36-watt fluorescent tube lamp with ceiling/wall mounted LED batten tube light 4 feet 18-watt fitting	36421
v	Replacement of Existing 18-watt CFL lamp with direct fit 9-watt LED lamp	7271
vi	Replacement of Existing CFL PL 2'X2'X3X18 watt with LED PL 36 W	59081
vii	Replacement of existing 85-watt old conventional ceiling fan with BLDC BEE 5 star rated 26-watt 1200 mm sweep ceiling fan	128502
viii	Replacement of existing 75-watt old conventional inefficient exhaust fan with BLDC BEE 5 star rated 20-watt exhaust fan	23377
ix	Providing and fixing of occupancy sensors for existing exhaust fans installed in 21 No. wash rooms and 2 no. connected lobbies	27590
x	Replacement of existing 1.5 T old conventional window type-air conditioner with BEE 5 star rated 1.5 T window type AC	87120
xi	Replacement of existing 7.5 hp conventional submersible pump set with BEE 5 star rated energy efficient 7.5 hp 9 stage submersible pump set	16786
xii	Supply and erection of 25 KWp roof top Solar power plant on the roofs of campus as Renewal energy source of power	211584
TOTAL-Rs.		**825842**
TOTAL in Rs. LACS		**8.25**

SUMMARY OF PROPOSED SAVINGS

Energy Source	Saving- Lacs KWH	Monetary saving- Rs. Lacs	Investment -Rs. Lacs
Electricity	0.77	8.25	25.04



Graph Showing Proposed Annual Energy Savings

SOME OTHER RECOMMENDATIONS

1. Current Energy Audit Report Academic Year (2023-24): Findings/Comments Recommendations contained in the current energy audit

i) Utility system:

a) Main LT panel: Checked Voltage, Current, harmonics and power factor profile of the main LT panel installed in the electric substation and found well within the permissible limits.

b) Diesel Generator Sets: Checked the working of DG Sets installed in the substation for power back up and found their working excellent.

ii) Campus electric wiring: inspected campus electric wiring and found healthy with no defect.

iii) Campus lighting system: Checked Lux level of some rooms and found excellent. With the retrofitting of remaining conventional lighting with the LED lighting and LED fixtures, proposed average energy Savable is 12 % from total savings

iv) Campus Fans & HVAC system: With the retrofitting of remaining conventional ceiling fans and air conditioners proposed average energy Savable is 28% from total savings

v)Renewable Energy Application (Solar power plant): Solar energy is one of the most widely used renewable source of energy one can use renewable energy technologies to convert solar energy in to electricity, it is very reliable source of energy and can significantly reduce the electricity bills, as such, 25 KWp roof top solar power plant has been recommended in the energy audit report, which shall generate about 30400 units of electricity annually which is excellent. The expected annual saving in electricity shall be 39 % of total savings

vi)Switching off lights, when not required: Some postures & stickers installed at all important locations so that staff and students remain conscious about it.

vii) Awareness campaigns: Awareness campaigns made in the campus for energy conservations covering lighting and renewable source of energy in the campus

viii) National Energy conservation day: Energy conservation day celebrated during December 2023 in the campus where various initiatives were taken by the management and students for promoting energy conservation

SUMMARY OF ENERGY EFFICIENCY MEASURES

EEM	Proposed Energy Efficiency Measures	Nos	Annual energy saving - kwh	Annual monetary saving- Rs.	Total investment including installations-Rs.	SPB period -yrs
EEM-1	Optimizing the existing contract demand from 229 KVA to 164.5 KVA in the billing to reduce the fixed charges in the monthly electricity bill (no investment required for reduction of contract demand). Take up matter with the utility PSPCL) for reduction of CD			78917		
EEM-2	Providing and installation of 30Amps 3 phase 4 wire Active Harmonic Filter in the main LT distribution panel for suppression the excess current harmonics	1	500	5500	15000	2.7
EEM-3	Improvement in power factor of the system from 0.85 to 0.99 by installing7 KVAR with panel capacitor bank/addition of capacitors/replacing defective capacitor	1	13063	143693	50000	0.3
EEM-4	Replacement of existing ceiling/wall mounted type fitting 36-watt fluorescent tube lamp with ceiling/wall mounted LED batten tube light 4 feet 18-watt fitting	88	3311	36421	17600	0.4
EEM-5	Replacement of Existing 18-watt CFL lamp with direct fit 9-watt LED lamp	41	661	7271	6150	0.8
EEM-6	Replacement of Existing CFL PL 2'X2'X3X18 watt with LED PL 36 W	148	5371	59081	266400	4.5
EEM-7	Replacement of existing 85-watt old conventional ceiling fan with BLDC BEE 5 star rated 26-watt 1200 mm sweep ceiling fan	200	11682	128502	560000	4.3
EEM-8	Replacement of existing 75-watt old conventional inefficient exhaust fan with BLDC BEE 5 star rated 20-watt exhaust fan	23	2125	23377	59570	2.5

EEM	Proposed Energy Efficiency Measures	Nos	Annual energy saving - kwh	Annual monetary saving- Rs.	Total investment including installations-Rs.	SPB period -yrs
EEM-9	Providing and fixing of occupancy sensors for existing exhaust fans installed in 21 No. wash rooms and 2 no. connected lobbies.	23	483	27590	115000	4.2
EEM-10	Replacement of existing 1.5 T old conventional window type-air conditioner with BEE 5 star rated 1.5 T window type AC	10	7920	87120	240000	2.7
EEM-11	Replacement of existing 7.5 hp conventional submersible pump set with BEE 5 star rated energy efficient 7.5 hp 9 stage submersible pump set	1	1526	16786	50000	2.9
EEM-12	Supply and erection of 25 KWp roof top Solar power plant on the roofs of campus as Renewal energy source of power	1	30400	211584	1125000	**5.32**
TOTAL		4299	**77042**	**825842**	**2504720**	**3.0**

NET SAVINGS

Units Saveable: - 0.77 Lacs KWH
Amount Saveable: - Rs.8.25 Lacs
Investment: - Rs. 25.04 Lacs
Payback period: -3.0 Yrs.

R.K. ELECTRICALS & ENERGY AUDIT SERVICES
ER. R.K. SHARMA MIE, FIV
BEE's C/Energy Auditor (EA-10080)
HP GOVT. Emp. Energy Auditor, DoE, Shimla
Govt. Regd. Valuer & Chartered Engineer

For R.K. Electricals and Energy Audit Services

CHAPTER – 1 INTRODUCTION

1.1 The Project the Project was to prepare a DPR for energy efficiency improvements of the entire campus of Guru Nanak College Budhlada, Punjab

With the advent of energy crisis and exponential hikes in the costs of different forms of energy, Energy Audit is manifesting its due importance in Commercial as well as Industrial Establishments. Energy Audit helps to understand more about the ways energy and fuels are used in any Establishments and helps in identifying areas where waste may occur and scope for improvement exists.

Energy Audit is the key to a systematic approach for decision-making in the area of energy management as it attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a facility/ Establishment.

It was with this objective that "**R.K. ELECTRICALS & ENERGY AUDIT SERVICES"** was entrusted by the authorities of Guru Nanak College Budhlada for the study of their Institute. The basic objective of the Audit was to study the load distribution/ consumption pattern in the campus and also to study the operations of major energy intensive equipment/ systems to identify potential areas wherein energy savings are practically feasible.

1.2 Back ground of Guru Nanak College, Budhlada

Guru Nanak College, affiliated to Punjabi University, Patiala (listed in 12(b) & 2(f) sections of UGC Act 1956) is situated on the outskirts of Budhlada city - a small town of district Mansa in Punjab. To tribute the 500th birth anniversary of "Sri Guru Nanak Dev Ji", it was started in 1971 by some eminent personalities of the region to keep in mind the noble cause of making affordable education accessible to all the people of this backward, rural and remote area. In the beginning, it was functioning under the local management but later on handed over to SGPC (Shiromani Gurdwara Parbandhak Committee, Sri Amritsar Sahib), an apex and philanthropic body of the Sikhs committed to serving humanity, on 09 November 1994 due to meagre financial resources and some other executive problems.

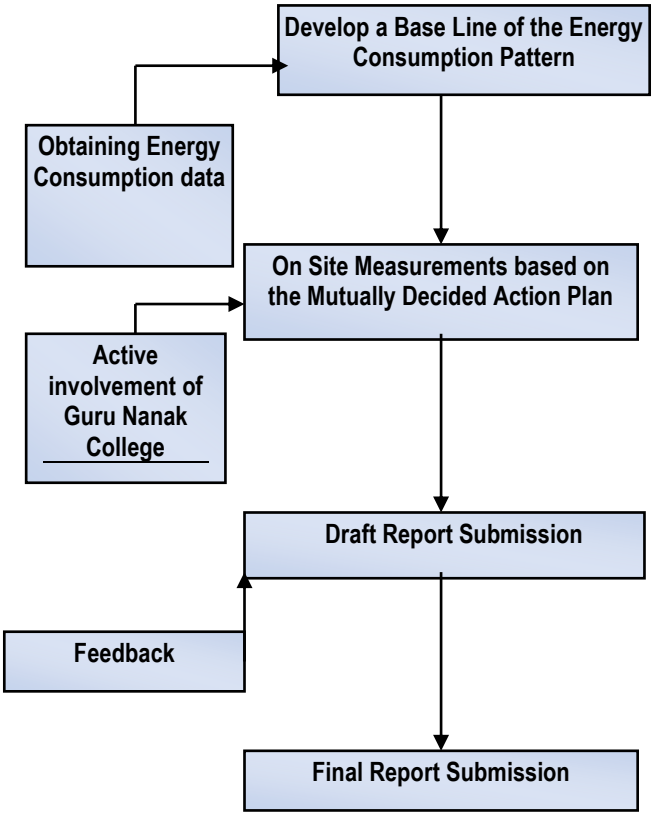
It was followed by some significant reforms in both college functioning and infrastructure. The growth of the college has been at a phenomenal pace since 2008 with a radical adjustment in a number of courses, faculty, infrastructure and other teaching learning resources. At present, it has become the foremost organisation in

the area, having 16 PG and 14 UG courses (including 03 skill-development vocational and industry-oriented courses), 151 faculty members, more than 6000 students (3232 girls and 2768 boys) with state-of-the-art infrastructure and technology to provide quality education.

1.3 Methodology

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

- Discussions with the concerned officials for identification of major **areas of focus** and other related systems;
- A team of engineers visited the campus and had discussions with the concerned officials/ supervisors to collect data/ information on the operations and Load Distribution in the campus. The data was analyzed to arrive at a **base line energy consumption pattern**.
- **Measurements and monitoring** with the help of appropriate instruments including continuous and/ or time lapse recording, as appropriate and visual observations were made to identify the energy usage pattern and losses in the system.



- Computation and **in-depth analysis** of the collected data, including utilization of computerized analysis and other techniques as appropriate were done to draw inferences and to evolve suitable energy conservation measure/s for improvements/ reduction in specific energy consumption.

The entire recommendations have been backed up with techno-economic calculations including the estimated investments required for implementation of the suggested measures and payback period.

1.4 Instrumentation Support

Some of the instruments used for undertaking the audit include the following:

- Digital Pressure Meter
- Anemometer with Vane Type Probe &Hygrometer
- Three Phase Power Analyzer ALM-31 with appropriate CT's & PT's
- Single Phase Power Analyzer with appropriate CT's
- Digital Temperature Meter
- Ultrasonic Flow meter
- Infrared Temperature Meter
- Lux Meter and digital distance meter

CHAPTER – 2 BASE LINE SCENARIO & HISTORIC DATA ANALYSIS

2.1 OVER VIEW OF THE BUILDING Area wise summary and detail of rooms:

Covered area of the building- 13966.53 Sq mt

The building has Ground + 2 floors and basement

Old Building-Admin Block	**Ground floor**	Office Area	Principal Office
			Vice- Principal Office
			Reception
			Superidentant Office
			Accountant office
			Washroom-8
	First floor		S. Jassa Singh Ahluwalia Library
			Spiritual Library
			Washroom- 2
Old Building-Classroom Block	**Ground floor**		Classroom no. 1 to 23
	First floor	Computer Department	Computer Labs
			Classroom no. 24 to 29
		Science Department	Science Labs
	Top Floor	BA Department	Classroom no. 30 to 41
			Washroom- 2
Bhai Nand Lal Block- 1	**Ground Floor**	English PG Department	Office
			Classroom no.52, 53,56, 56 A
		Punjabi PG Department	Office
			Classroom No. 54 to 55
		Seminar Room	1
		Washroom	5
	First floor	Commerce Department	Office
			Classroom no.57 to 64
			Commerce Lab
			Washroom- 5
	Basement	Music Department	Music Labs

		Political Science Department	Office
			Classroom no.- 43 to 51
Bhai Nand Lal Block- 1	**Ground Floor**	Agriculture	Labs-3
		Seminar room	1
		Conference room	1
			Classroom- 73
		Seminar Room	1
		Staff Room	1
		Washroom	4
	First floor	Fashion Department	Fashion Department Office
			Fashion Labs
		Food processing department	Food processing Office
		Home science	Food Processing Lab
			Home Science Lab
			Classroom no.- 74 to 75
			Washroom- 4
	Basement	Mathematics Department	Office
			Office
		History Department	Classroom no.65 to 72
			Museum

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2.2. REVIEW OF PRESENT ENERGY CONSUMPTION & BILLING:

PSPCL Account no	**3007508849**
Connected load	219.42 KW
Contract demand	229 KVA

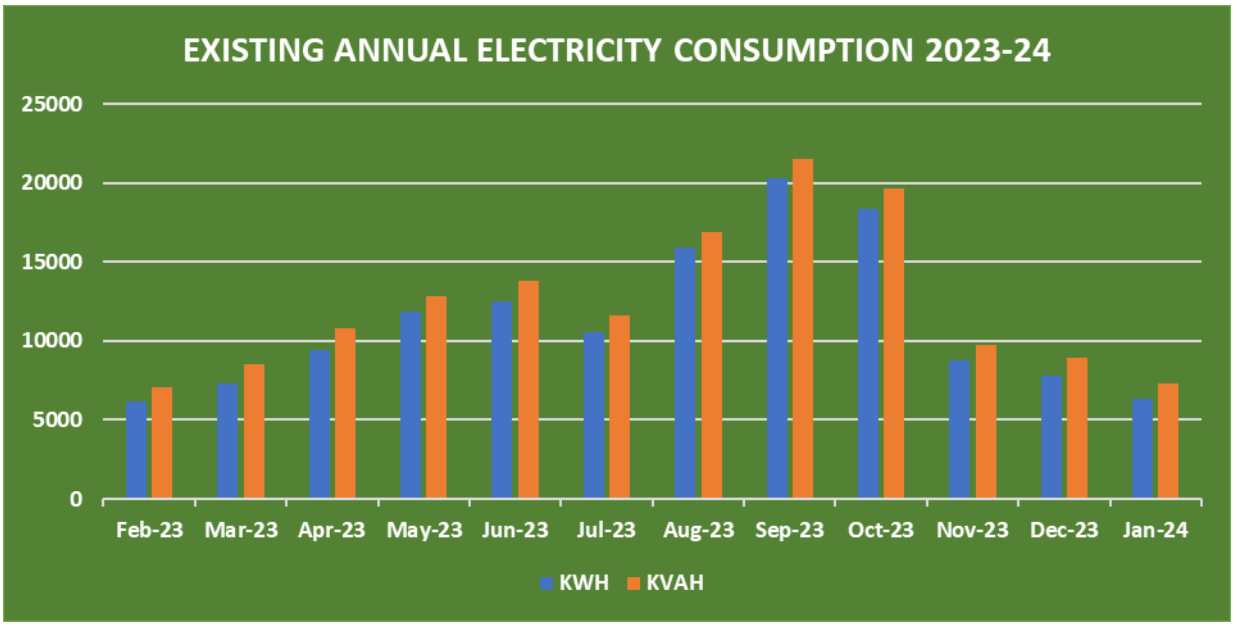
The details of electrical consumption copied from electricity bills for 2023-24

Month	KWH	KVAH	Bill Amt-Rs	MDI-KVA	Fixed chgs. - Rs	Power Factor
Feb-23	6144	7028	82820	26.8	22558	0.874
Mar-23	7286	8536	94540	39.2	22588	0.854
Apr-23	9412	10766	106370	77.36	24094	0.874
May-23	11840	12854	135690	88	26125	0.921
Jun-23	12508	13830	145230	84.14	26142	0.904
Jul-23	10550	11608	126150	64.3	25299	0.909
Aug-23	15946	16884	170160	61.2	26142	0.944
Sep-23	20338	21502	207620	120.28	26142	0.946
Oct-23	18380	19622	193340	112.34	26985	0.937
Nov-23	8744	9756	110070	51.2	24456	0.896
Dec-23	7832	8934	104400	51.2	25299	0.877
Jan-24	6354	7336	92340	28.76	26071	0.866
TOTAL	135334	148656	1568730		301901	

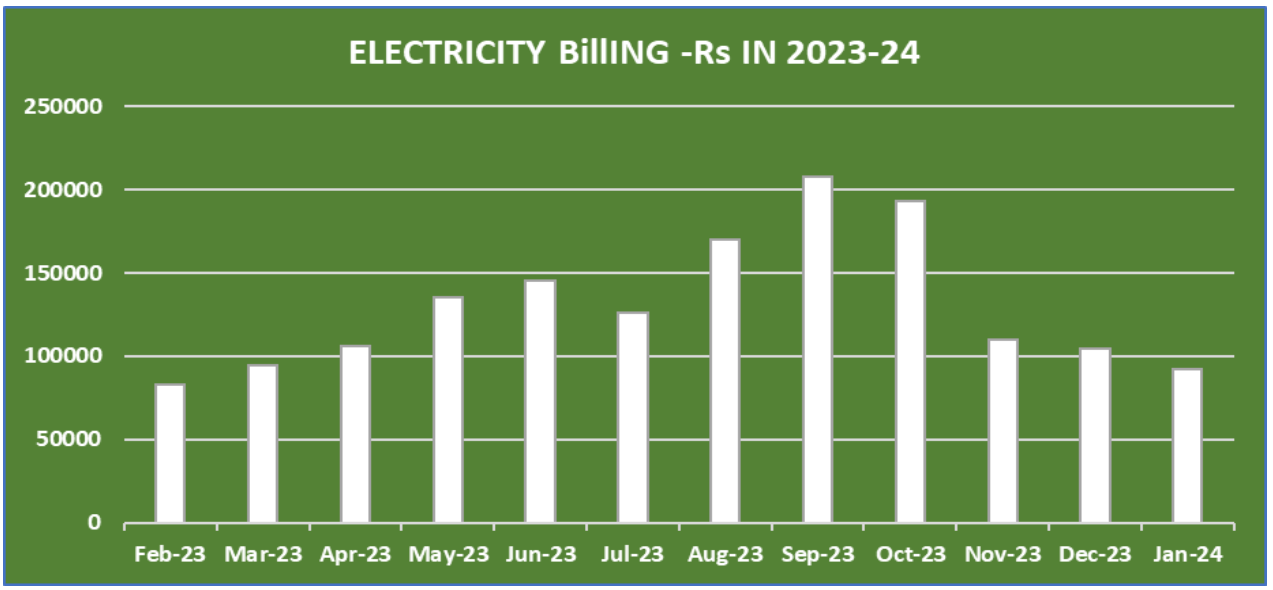
Year-2023-24	Value
Annual electricity consumption purchased from utility - Lacs kWh	1.35
Annual Amount of utility billing – Rs lacs	15.69
Equivalent Annual electricity consumption through DG set - kWh	0.16
Equivalent Amount of DG consumption) – Rs lacs	1.14
Total Annual electricity consumption (Utility+ DG),1.35+0.16 - Lacs kWh	1.51
Existing Amount of Total billing (utility + DG fuel),15.69+1.14 – Rs lacs	16.83
Existing Electricity overall rate-Rs/KWH	11

Thus, annual electricity consumption from utility of about **1.35 kWh** costing Rs.**15.69 Lakh** is consumed annually

Existing Annual Electricity Consumption During 2023-24



Annual billing purchased from utility during 2023-24



Existing Annual Amount of utility billing – Rs 15.69 lacs

2.3. TARIFF STRUCTURE

Fixed Charge (unless otherwise specified in Schedule of Tariff) shall be levied on 80% of the sanctioned load or contract demand (actual demand recorded, if higher) as may be applicable.

2.3.1. Present billing

Month	KWH	KVAH	Bill Amt-Rs	MDI-KVA	Fixed chgs. - Rs
Feb-23	6144	7028	82820	26.8	22558
Mar-23	7286	8536	94540	39.2	22588
Apr-23	9412	10766	106370	77.36	24094
May-23	11840	12854	135690	88	26125
Jun-23	12508	13830	145230	84.14	26142
Jul-23	10550	11608	126150	64.3	25299
Aug-23	15946	16884	170160	61.2	26142
Sep-23	20338	21502	207620	120.28	26142
Oct-23	18380	19622	193340	112.34	26985
Nov-23	8744	9756	110070	51.2	24456
Dec-23	7832	8934	104400	51.2	25299
Jan-24	6354	7336	92340	28.76	26071
TOTAL	135334	148656	1568730		301901

From the bill analysis, it is clear that monthly fixed charges levied on the monthly bill to the tune of ranging from Rs. 22588-26985 on maximum demand basis. The month wise demand (MDI) has never reached close to the contract demand

In present billing, the fixed charges in the bill are being levied @of Rs 140/-of 80% of contract demand or maximum demand whichever is higher.
The reduction in demand will lead to direct reduction in the energy bill.

EEM-1 OPTIMIZING THE EXISTING CONTRACT DEMAND FROM 229 KVA TO 164.5 KVA

Energy Saving Opportunities

Reduce fixed cost of Power by surrender of fixed demand (Contract Demand) .CD to be reduced from current 229 KVA to 164.5 KVA.

Description	Present KVA	Proposed KVA	Fixed Charges Per Month per KVA-Rs	Total Fixed Charges per/month 229x80%x31 x140x12/365 - RS	Total Fixed Charges per Month in Rs after reduction in CD	Saving Per month in Rs	Saving Per Annum in RS
Contract demand	229	164.5	140	25297	18720	6576	**78917**

Thus, by reducing the existing contract demand from 229 KVA to 164.5 KVA, Rs. 0.79 Lacs annually can be saved without any investment.

2.3.2. ENERGY PERFORMANCE OF THE BUILDING (EPI)

Energy performance index (EPI) is total energy consumed in a building over a year divided by total built up area in kWh/sq. m/year and is considered as the simplest and most relevant indicator for qualifying a building as energy efficient or not

Benchmarking for EPI is tabulated as below

Calculation of EPI

Considering composite climate as Chandigarh/Punjab falls under Composite climate zone

Annual energy consumption during the year 2023-24=151702 KWh

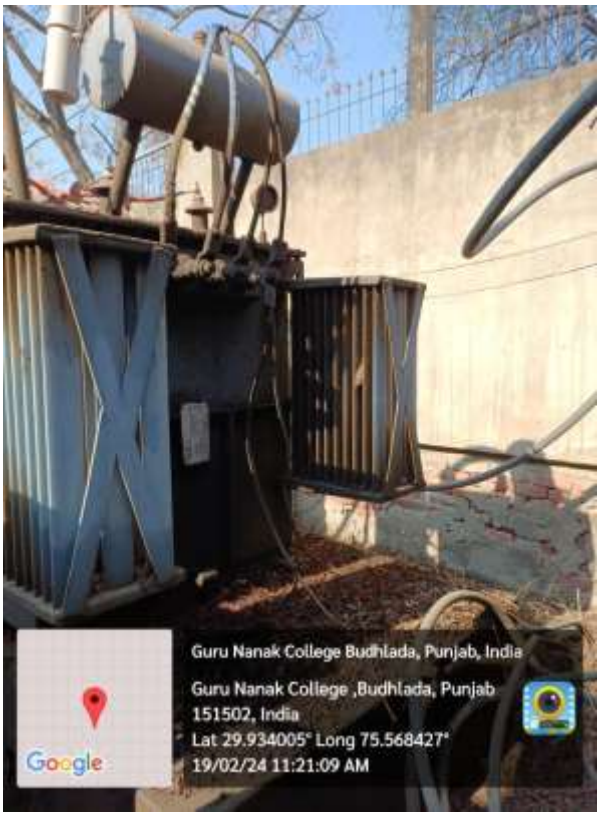
Total built up area of the building-13966.53 sqm

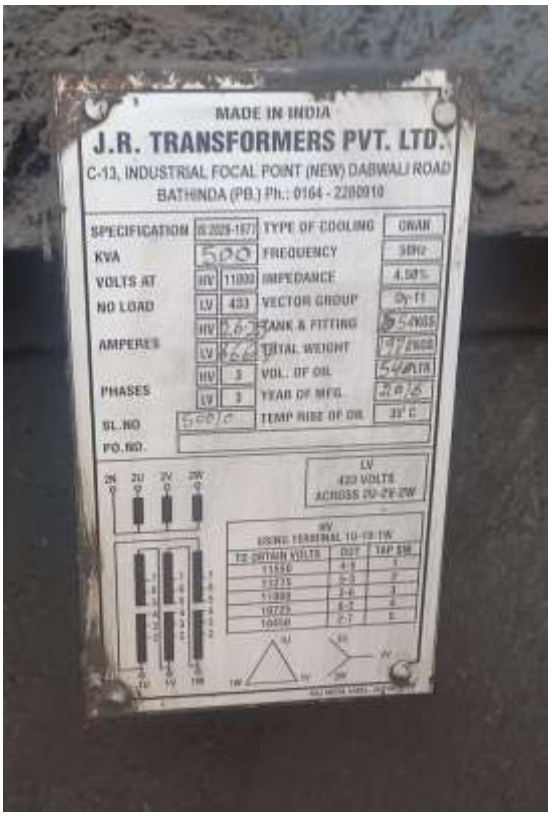
EPI=151702/13966.53; **Hence EPI=10.86/sqm/year**

CHAPTER – 3 ELECTRICAL DISTRIBUTION SYSTEM

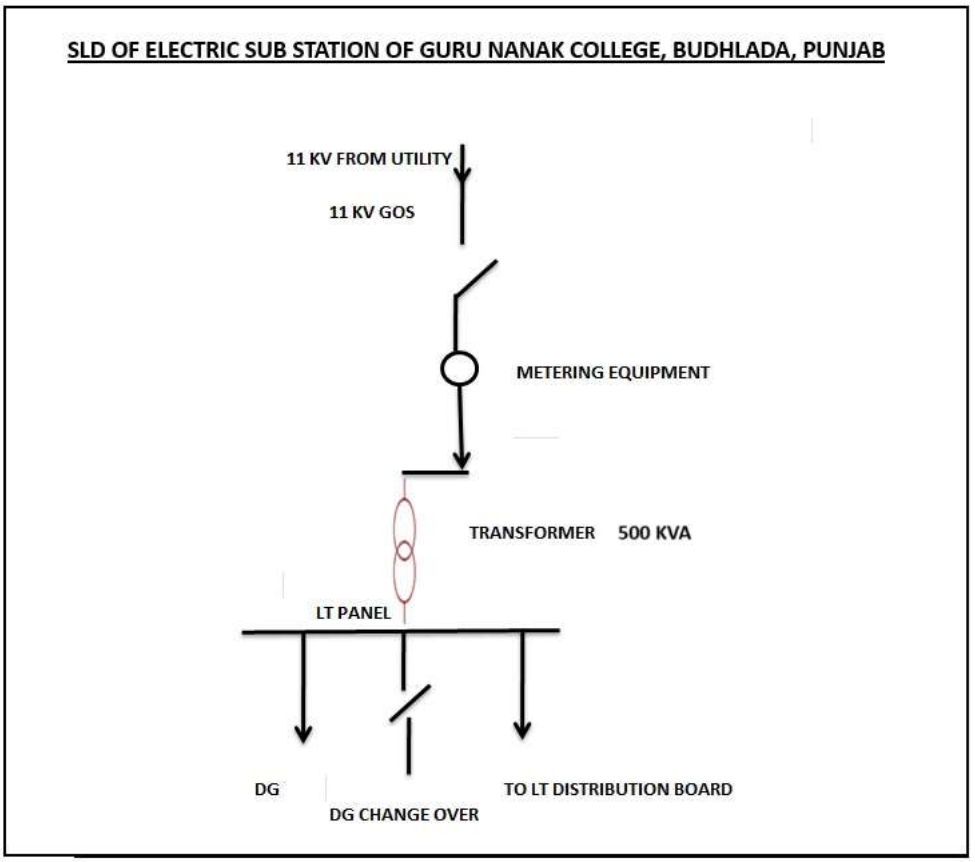
3.1. PURCHASED/SELF GENERATED POWER

Guru Nanak College Budhlada, Punjab draws power from PSPCL through 11 KV system from utility and has installed 500 KVA transformer in the substation. The connected/sanctioned load of the building is 219.42 kW. DG Set of 125 KVA installed in acoustic cover for in-house power generation. The operation of the DG set is limited to power cuts only. SLD/key diagram of the building is shown below:





Main LT Distribution Transformer

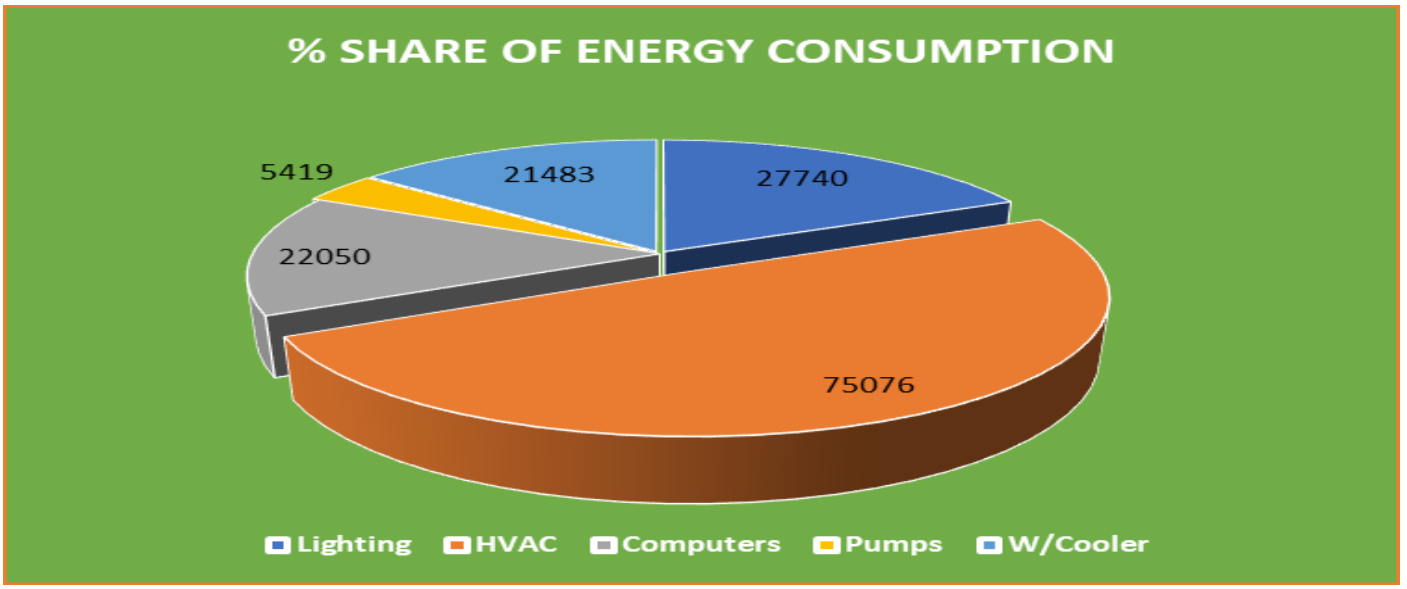


SLD/KEY DIAGRAM OF THE ELECTRIC SUBSTATION

3.2. BUILDING ENERGY CONSUMPTION PROFILE

Annual energy consumption of the building during the year 2023-24 =807853 KWh

Item	Kwh	% share
Lighting	27740	18.3
HVAC	75076	49.5
Computers	22050	14.5
Pumps	5419	3.6
W/Cooler	21483	14.2
TOTAL	**151768**	**100**



% share of energy consumption in various fields

3.3. BUILDING LOAD PROFILE

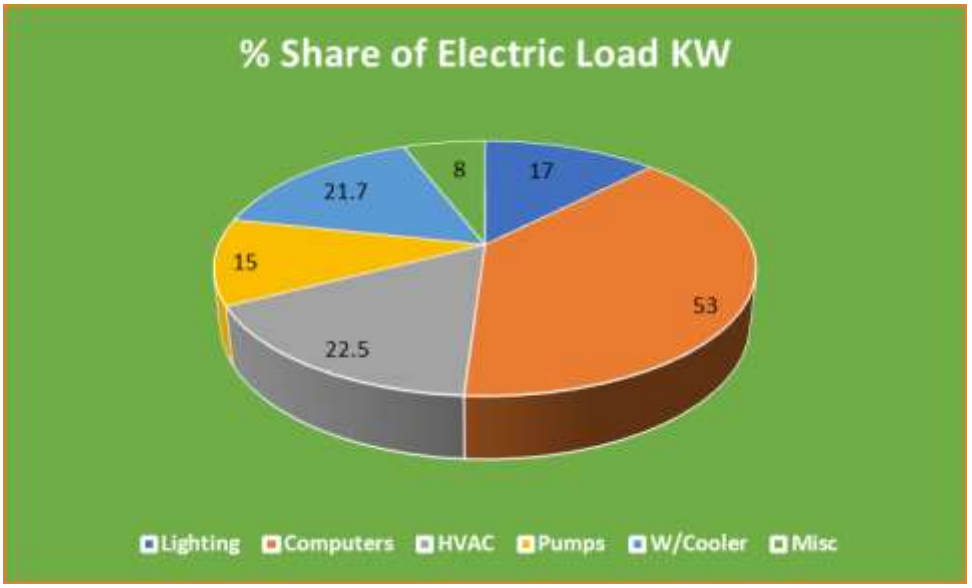
Connected / Sanctioned load of college: 219.42 **KW**

It was noticed during onsite assessment that one Transformer 500 KVA installed for the entire campus at one farthest end. Inventory list of the building is shown below:

The auditors checked and calculated the electric load of the building and the load detail is as under:

% Share of electric Load		
Item	**KW**	**% Share**
Lighting	17	12
Computers	53	39
HVAC	22.5	16
Pumps	15	11
W/Cooler	21.7	16
Misc	8	6
Total	137	100

Load details of the building



Graph showing sharing of load

Findings and Recommendations

Sanctioned connected load of college building is 219.42 KW whereas load found to be well within permissible limits.

3.4. POWER QUALITY

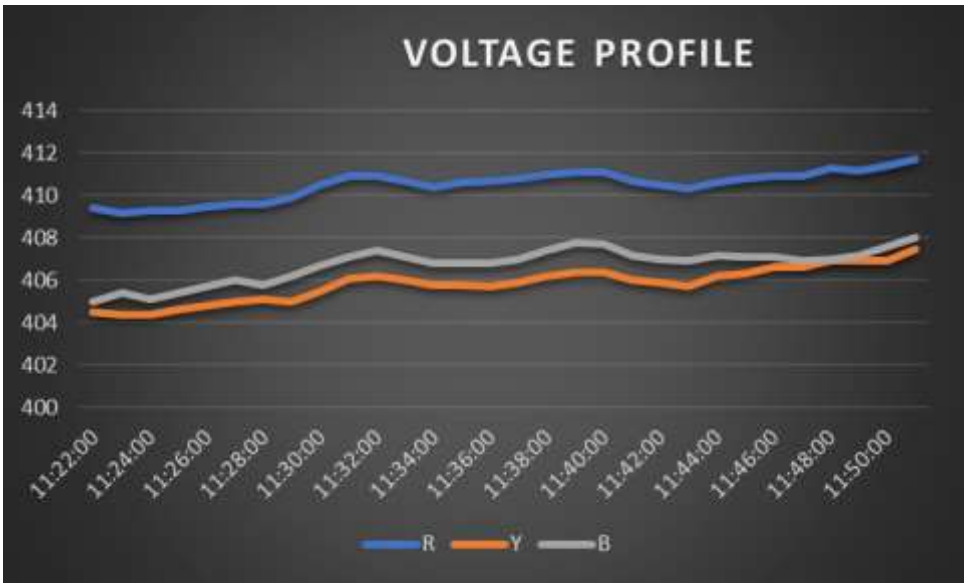
MEASURING ELECTRICAL PARAMETERS OF T/F AT LT SIDE

RECORDING OF PARAMETERS

3.4.1. VOLTAGE PROFILE – LT IN COMMER

During the audit, quality of in-coming power is measured through 3 Phase Power Analyser. The observations on power quality of various loads/connections are provided in below paragraph.

The Load Analyses was done in order to measure the power quality parameters using power analyser at incomer panels of T/F Thus, various parameters were recorded which included Voltage, Current, Power Factor, Total Harmonic Distortion (THD), and Unbalancing of Load etc.



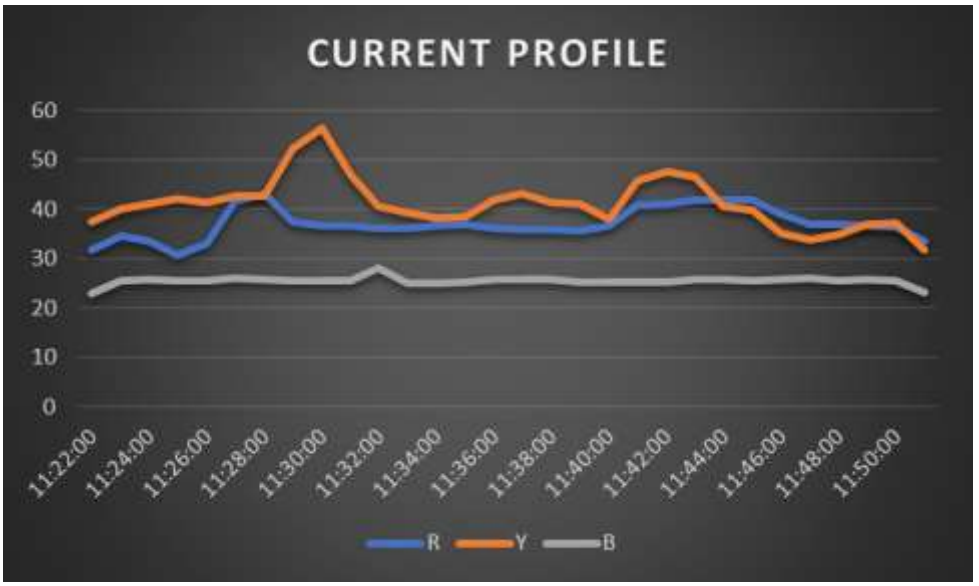
Voltage profile

U rms	Urms	Urms	Average	%age
Line 1	Line 2	Line 3		im-balance
410.5	405.89	406.79	407.7	1

IMBALANCE VOLTAGE

The unbalanced voltage is 1% which is under the prescribed limit as per IEEE standards. An unbalance of 1% is acceptable as it doesn't affect the cable.

3.4.2. CURRENT PROFILE– LT IN COMMER



Current profile

Arms	Arms	Arms	Average	%age
Line 1	Line 2	Line 3		im-balance
37.13	41.20	25.51	34.62	45.3

Imbalance current

IMBALANCE CURRENT

The unbalance current was observed to be **45.3 %.** The long term running with three phase unbalance of the distribution system shall lead to series of problems, such as increase of transformer loss, reduction of output of the transformer, reduction of the output of the transformer, reduction of the active output of the motor, increase of loss of the distribution line and damage of the electric equipment Any large single phase load, or a number of small loads connected to only one phase cause more current to flow from that particular phase causing voltage drop on line.

Recommendations: Recommended to re-check the load again in peak summer and take action accordingly.

3.4.3. HARMONIC GENERATIONS

Equipment based on frequency conversion techniques generates harmonics. With the increased use of such equipment, harmonics related problems have enhanced which are leading to heating of cables, bus bars and transformers, overloading of electrical distribution system, frequent tripping of switchgears, frequent failure of costly mother boards and capacitors of equipment etc.

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

System Problem	Common Causes	Possible Effects	Solutions
Harmonics (non sinusoidal voltages and /or current wave forms)	Office – Electronics, UPSs, variable frequency drives, high intensity discharge lighting and electronic and core coil ballasts.	Over- heating of neutral conductors, motors. transformers, switch gear. Voltage drop, low power factors, reduced capacity.	Take care with equipment selection and isolate sensitive electronics from noisy circuits.

Common causes and solution of harmonics

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

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

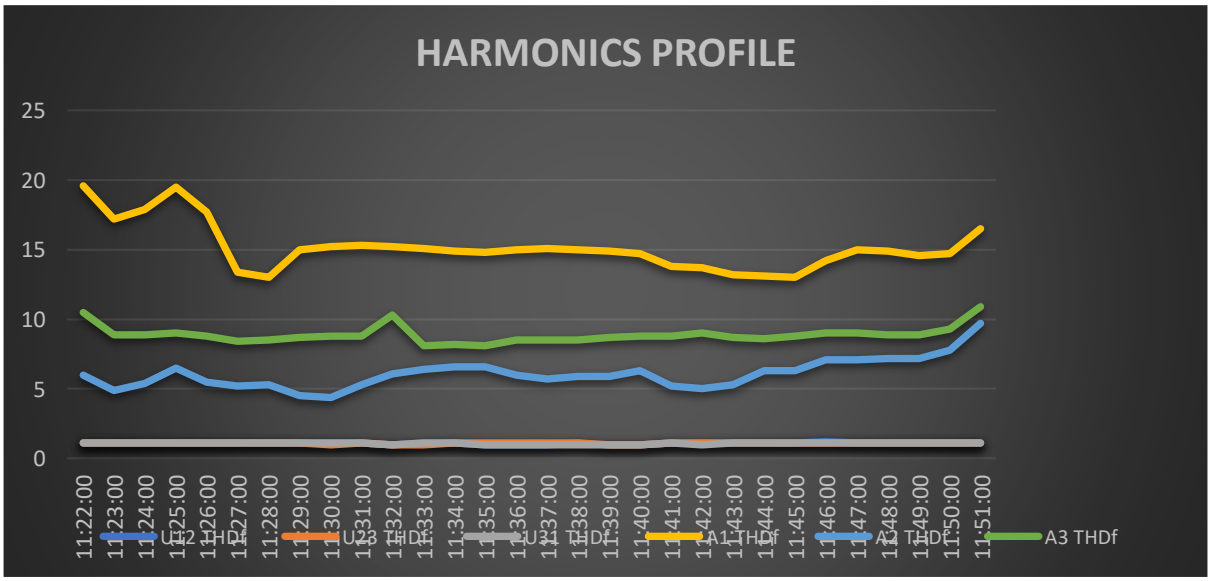
harmonic current limitations

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

ISC/IL	h<11	11<h<17	17<h<23	23<h<35	35<h	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

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

Harmonics (%)



During the assessment, Audit team also measured the harmonics level. Details are mentioned below:

Narration	Date	Average	Minimum	Maximum	% f
A1 THDf	19-02-2024	15.2	13	19.6	% f
A2 THDf	19-02-2024	6.9	4.4	9.7	% f
A3 THDf	19-02-2024	8.9	8.1	10.9	% f
U12 THDf	19-02-2024	1.08	1.0	1.2	% f
U23 THDf	19-02-2024	1.08	1.0	1.2	% f
U31 THDf	19-02-2024	1.07	1.0	1.1	% f

Av. Voltage THD & Current THD (%)

It is evident from the above table that the average voltage THD (%) was observed to be in range of 1.07 % to 1.08 % which is in the prescribed limit as per IEE standard of Voltage harmonics of 5%. It is also evident from the above table that the average current THD (%) was observed to be in range of 6.9 to 15.2 % which is in the prescribed limit as per IEE standard of Voltage harmonics of 12%.

Findings: - From the observations at above table:-
It is concluded that, current harmonics are on high side as average current harmonics are in the range (6.9-15.2 %)

i) Loss due to harmonics: It is not easily possible to calculate losses due to harmonics.

ii) Equipment like motors, transformers, cables: Increase in losses

iii) Loss due to damage to equipment: As stated earlier, high harmonics level causes excessive damage to electronic equipment

Tariff: Central electricity authority under Ministry of Power, Government of India has already approved rules for charging penalty for high harmonics level. Some state regulatory commissions have also approved same but it's implementation not started yet.

Recommendations:

Active harmonics filters-These filters inject negative of the harmonics current resulting in practically no harmonic distortion. Phase balancing and power factor correction also achieved so; it is recommended to install 30 Amperes 3 phase 4 wire active harmonics filter. we assume saving potential of 500 electricity units with the investment of Rs. 15,000***/-***

I2R losses in the transformer due to unbalancing load and current harmonics in the transformer

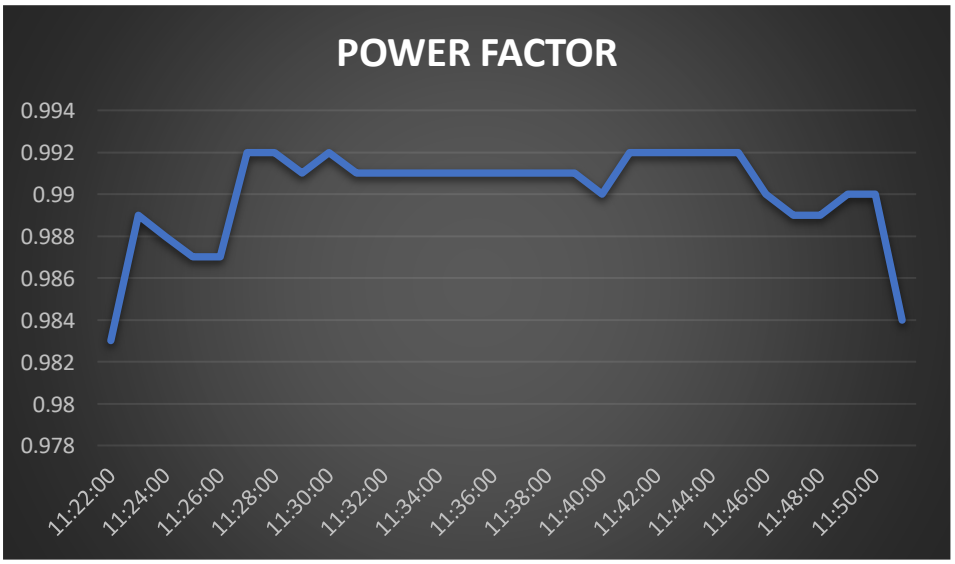
EEM- 2 Install 30 Amperes 3 phase 4 wire active harmonic filter in the main LT distribution panel

Equipment	Ann Saving-kwh	A/Monetary saving-Rs	Investment -Rs	SPB yrs.
Suppression of excess current harmonics & to avoid I2 R transformer losses by installing 30 Amperes 3 phase 4 wire Active harmonic filter in the main LT distribution panel	500	5500	15000	2.7

3.5. REACTIVE LOAD MANAGEMENT

3.5.1. Power factor measurement

Auditors measured the power factor by installing the load master and recorded the parameters as below:



Study and analysis done of Power Factor in Electricity Bill of One Year 2023-24

ENERGY CONSUMPTION 2023-24					PF	0.999	
Month	KWH	KVAH	Bill Amt-Rs	Power Factor	Gap	KWH saving	saving /month in Rs
Feb-23	6144	7028	82820	0.874	0.125	766.66	8433
Mar-23	7286	8536	94540	0.854	0.145	1241.46	13656
Apr-23	9412	10766	106370	0.874	0.125	1343.23	14776
May-23	11840	12854	135690	0.921	0.078	1001.15	11013
Jun-23	12508	13830	145230	0.904	0.095	1308.17	14390
Jul-23	10550	11608	126150	0.909	0.090	1046.39	11510
Aug-23	15946	16884	170160	0.944	0.055	921.12	10132
Sep-23	20338	21502	207620	0.946	0.053	1142.50	12567
Oct-23	18380	19622	193340	0.937	0.062	1222.38	13446
Nov-23	8744	9756	110070	0.896	0.103	1002.24	11025
Dec-23	7832	8934	104400	0.877	0.122	1093.07	12024
Jan-24	6354	7336	92340	0.866	0.133	974.66	10721
TOTAL	135334	148656	1568730	0.900		13063.04	143693
SAVING IN RS-LAC							1.44

Findings & Recommendations:

No capacitor panel has been installed.
It is recommended to install Three phase heavy duty 7KVAR capacitor with capacitor panel in the LT distribution panel

Energy Saving Opportunities

EEM-3 Improvement in Power Factor of the system from 0.904 to 0.999 by installing 7 Kvar capacitor and panel in the LT distribution panel

Description	Existing Power Factor	Gap in Power Factor	KWH Savings Per Annum	Cost per KWH	Investment-Rs	Saving Per Annum Value in Rs
Power Factor Improvement from 0.85 to 0.99	Min 0.98 Max 0.94	Varies as per above record	13063	11	50000	143693

The payback period is calculated to be 0.3 years. Since the product life is much more than that, the move is economically beneficial and energy saving

3.5.2. LOADING POSITION ON TRANSFORMER

The auditors measured the Electrical parameters of the transformers for calculation of % load on the transformers

TRANSFORMER -500 KVA

MEASURED DATA OF T/F				
V	**I**	**PF**	**KW**	**KVA**
407.7	34.62	0.98	24.20	24.44
Load on Transformer-500 KVA	**5 %**			

3.5.3. Load on transformer --***The distribution transformers are designed for taking variation of load with optimum efficiency between 40 & 50% of load. But their maximum utilization is at their rated capacity*. It is observed that average load on this transformer remains approximate 5% *Thus at present, transformer is working in inefficient regime. But at present nothing is techno economically viable***

CHAPTER – 4 STUDY OF LIGHTING SYSTEM

Adequate and proper lighting contributes both directly and indirectly towards productivity, safety and towards providing an improved atmosphere. Primary considerations to ensure energy efficiency in lighting system are**:** selection of most efficient light source as far as possible in order to minimize power cost and energy consumption.

a. Matching proper lamp type to the intended work task or aesthetic application, consistent with colour, brightness control and other requirements.
b. Establish adequate light levels to maintain productivity improve security and improve safety.

4.1. LIGHTING INVENTORY

During the onsite assessment, Audit team has carried out the lighting survey for various locations in Guru Nanak College, Budhlada. The Total lighting details installed in the premises including hostel are given below.

4.2. LIGHTING LOAD DETAILS OF THE BUILDING

Type of Luminary	No.	Watt	Ballast	Total-Watts	Hrs	Days	LF	Total KWH	KW
FTL 4' 36 Watt	88	36	10	46	6	280	0.8	5441	3.168
CFL 18 watt	41	18	3	21	6	280	0.8	1157	0.738
CFL PL 2'X2'X3X18	148	54	9	63	6	280	0.8	12531	7.992
LED Flood light 50W	25	50	0	50	10	365	1	4563	1.25
4" led tube light 20 watt	353	20	0	20	6	280	0.8	9489	7.06
LED PL36 W	1	36	0	36	6	280	0.8	48	0.036
LED PL12W	20	12	0	12	6	280	0.8	323	0.24
								27740	**17.04**

4.3. LUX MEASUREMENT

A high-quality DIGITAL LUX METER was used to measure the illumination levels at various locations of Guru Nanak College, Budhlada and the recommended level of lightning in these areas is given in the table

The recommended light level as per standard is shown below:

Location	Recommended LUX
Normal work station space, open or closed office	200-500
Conference Rooms	300
Training Rooms	500
Internal Corridors	200
Auditorium	150-200
Entrance Lobbies, Atria`	200
Stairwells	200
Toilets	100-200
Dining Areas	150-200

MEASURING THE LUX LEVEL IN SOME ROOMS

4.3.1. STUDY FINDING OF LIGHTING

The building authorities provided the details of luminaries installed within their Building premises. Based upon this survey and data obtained from the authorities, we checked Lux level of all rooms & halls. The details checking & calculations & comparison with others are as follows:

Lux level & ILER of some locations

Location:1 room -Conference Hall				
	99	52	57	**Av Lux**
	328	303	300	310

Location:1 room -Conference Hall				
Length of room	6.3	Area - m2	54.2	Max. Required
Breadth of Room	8.6	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	318	Watt/Square mtr	5.9	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	52.9	
Days per year	280	ILER	1.47	
Measured Av. Lux in the Room	310	Actual -Lux/watt	0.98	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:2 Chemistry lab-2					Av lux
239	221	114	55	189	163.6

Location:2 Chemistry lab-2				
Length of room	9.5	Area - m2	69.4	Max. Required
Breadth of Room	7.3	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	80	Watt/Square mtr	1.2	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	141.8	
Days per year	280	ILER	3.94	
Measured Av. Lux in the Room	163.6	Actual -Lux/watt	2.05	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:3 Botany Lab					Av lux
250	200	160	100	210	184

Location:3 Botany Lab				
Length of room	7.3	Area - m2	69.4	Max. Required
Breadth of Room	9.5	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	160	Watt/Square mtr	2.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	79.8	
Days per year	280	ILER	2.22	
Measured Av. Lux in the Room	184	Actual -Lux/watt	1.15	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:4 room no.21					Av lux
75	30	21	45	36	41.4

Location:4 room no.21				
Length of room	9	Area - m2	108.0	Max. Required
Breadth of Room	12	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	80	Watt/Square mtr	0.7	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	55.9	
Days per year	280	ILER	1.55	
Measured Av. Lux in the Room	41.4	Actual -Lux/watt	0.52	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:5 room-11					Av lux
25	17	36	80	75	46.6

Location:5 room-11				
Length of room	5.8	Area - m2	33.1	Max. Required
Breadth of Room	5.7	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	108	Watt/Square mtr	3.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	14.3	
Days per year	280	ILER	0.40	
Measured Av. Lux in the Room	46.6	Actual -Lux/watt	0.43	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:6 Computer centre lab -2					Av lux
61	72	85	200	197	123

Location:6 Computer centre lab -2				
Length of room	2	Area - m2	18.0	Max. Required
Breadth of Room	9	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	400	Watt/Square mtr	22.2	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	5.5	
Days per year	280	ILER	0.15	
Measured Av. Lux in the Room	123	Actual -Lux/watt	0.31	
Final remarks				
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:7 Computer centre lab -1					Av lux
180	200	150	260	230	204

Location:7 Computer centre lab -1				
Length of room	9	Area - m2	108.0	Max. Required
Breadth of Room	12	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	140	Watt/Square mtr	1.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	157.4	
Days per year	280	ILER	4.37	
Measured Av. Lux in the Room	204	Actual -Lux/watt	1.46	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:8 HOD Chemistry 1st floor					Av lux
160	185	194	195	180	183

Location:8 HOD Chemistry 1st floor				
Length of room	9	Area - m2	117.0	Max. Required
Breadth of Room	13	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	60	Watt/Square mtr	0.5	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	356.5	
Days per year	280	ILER	9.90	
Measured Av. Lux in the Room	183	Actual -Lux/watt	3.05	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:9 Principal room					Av lux
409	482	408	430	113	368

Location:9 Principal room				
Length of room	6.2	Area - m2	37.8	Max. Required
Breadth of Room	6.09	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	276	Watt/Square mtr	7.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	50.4	
Days per year	280	ILER	1.40	
Measured Av. Lux in the Room	368	Actual -Lux/watt	1.33	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m^2		

Location:10 Vice Principal room					Av lux
170	142	134	113	98	131.4

Location:10 Vice Principal room				
Length of room	4.5	Area - m2	27.9	Max. Required
Breadth of Room	6.2	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	45	Watt/Square mtr	1.6	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m2	81.5	
Days per year	280	ILER	2.26	
Measured Av. Lux in the Room	131.4	Actual -Lux/watt	2.92	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		5 to 6 watt / m2		

3.4. Study of present lighting control system and recommend for improvement.

The campus remains continuously working for 6-7 hours & after that, it is shut down. All energy efficient LED luminaries at proper heights are installed. The rooms and halls have lot of windows.

i) Analysis of lighting performance indices like Lux/m2, Lux/watt, Lux/watt/m2 and comparison with norms of high-rise buildings.

Comparison

Narration	For all 8 Locations	Standard	Narration
Measured Av. Lux in the Rooms	163 to 368 at 6 locations	> 150	AS perIS-3646 Part 11
Actual Lux/Watt/m^2	> 36 at 8 locations	36	BEE Code
Watt/Square mtr	< 4 at 7 locations	5 to 7	ECBC+ building offices
Actual -Lux/watt	> 1 at 6 locations	1 to 2	BEE Code

OBSERVATIONS

So lighting is satisfactory. One major reason for very good result is use of energy efficient luminaries, sufficient natural lights. It was observed that some fluorescent tubes are fitted with magnetic blasts on conventional 36W luminaries

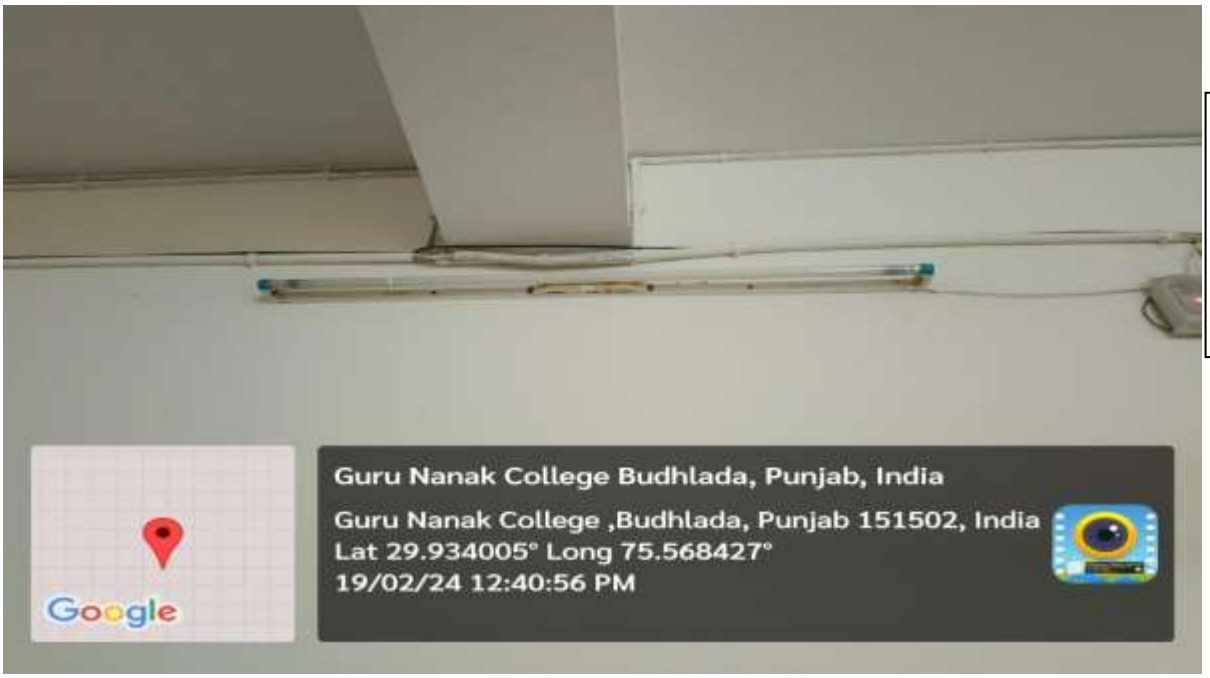
- During Audit, it was observed that the fluorescent tubes are fitted with magnetic blasts on conventional 36W luminaries.
- It was also observed during the audit that reflector/diffuser were not provided for most of the fluorescent tubes to distribute the uniform lighting in the room.

RECOMMENDATION

4.4 Installation of Energy Efficient Lights

EEM-4 Replacement of 36 W T-12 WITH 18 W LEDTUBE LIGHT

In the existing system 88 nos.36 W, T-12 FTLs are being used to provide general illumination to part of this building. The proposed scenario includes replacement of T-12 type with 18 W LED 4' long Tube Light. The energy saving calculations is shown below.



Existing FTL 36 watts installed in the campus ←

Energy Saving Calculation

Energy Saving Calculation		Units	Value
Total Number of fittings	=	Nos.	88
Existing annual Energy Consumption of 36 W T-12 FTL (including ballast) 88No.x46watt x6 hrs.x280daysx0.8/1000=	=	kWh	5440
Proposed annual Energy Consumption of 18 W LED Tube Light;(88X18x6x280x.8/1000= 2129KWH)	=	kWh	2129
Cost Benefit Analysis			
Proposed Annual Energy Savings potential;(5440-2129=3311)	=	kWh	3311
Per Unit cost	=	Rs.	11
Proposed annual monetary savings;(3311x11)		Rs	36421
Investment/ fixture (including replacement cost)	=	Rs.	200
Total Investment	=	Rs.	17600
Simple Payback Period	=	Years	0.48

EEM-5 Replacement of existing 41 No. CFL 18 watts with direct fit 9 W LED bulb

Energy Saving Calculation

Energy Saving Calculation		Units	Value
Total Number of fittings	=	Nos.	41
Existing annual Energy Consumption of 12-watt CFL including ballast 41x21x6x280x.8/1000= 1157 kwh	=	kWh	1157
Proposed annual Energy Consumption of direct fit 7W LED bulb;(41x9x6x280x.8/1000= 123 KWH)	=	kWh	496
Cost Benefit Analysis			
Proposed Annual Energy Savings potential (526-123)	=	kWh	661
Per Unit cost	=	Rs.	11
Proposed Annual Monetary Savings (403x8.74)	=	Rs.	7271
Investment/ fixture (including replacement cost)	=	Rs.	150
Total Investment	=	Rs.	6150
Simple Payback Period	=	Years	0.8

In the existing system 148 nos. CFL panel light 3x18 W are being used to provide general illumination to part of this building. The proposed scenario includes replacement with LED panel light 36 W. The energy saving calculations is shown below.

EEM-6 Replacement of existing 148 No. CFL PL 2'X2'X3X18 with LED PL 36 W

Energy Saving Calculation

Energy Saving Calculation		Units	Value
Total Number of fittings	=	Nos.	148
Existing annual Energy Consumption of 148 No.3x18-watt CFL PL including ballast 148x63x6x280x.8/1000= 12531 kwh	=	kWh	12531
Proposed annual Energy Consumption of direct fit 7W LED bulb;(148x36x6x280x.8/1000= 7956 KWH)	=	kWh	7160
Cost Benefit Analysis			
Proposed Annual Energy Savings potential (12531-7160)	=	kWh	5371
Per Unit cost	=	Rs.	11
Proposed Annual Monetary Savings (4575x11)	=	Rs.	59081
Investment/ fixture (including replacement cost)	=	Rs.	1800
Total Investment	=	Rs.	266400
Simple Payback Period	=	Years	4.5

The payback period is calculated to be 4.5 years. Since the product life is much more than that, the move is economically beneficial and energy saving

CHAPTER – 5 STUDY OF HVAC SYSTEM

STUDY OF FANS

5.1. STUDY FINDING OF FANS

The Fan details installed in the premises are given below

Sr No	Specification Item	Rating Watt	Total nos.
1	Ceiling Fans 1200mm sweep	80	745
2	Wall fans	50	23
3	Exhaust fans	60/1000	63

Inventory list of existing fans

5.2. CEILING FANS

Existing old 75/85W Ceiling fan installed in the campus

The standard fans are installed in the premises. 75W Ceiling fan, consumes up to 85 watts, thus should be replaced with BEE 5 star rated energy efficient BLDC fan comparatively with same air Flow but reduced in their wattage.

Service Value= Minimum Air Delivery (m3/min) / Power Consumption (kWh)
Star: Service Value ≥ 3.2 to <3.4
2 star: Service Value ≥ 3.4 to <3.6
Star: Service Value ≥ 3.6 to <3.8
Star: Service Value ≥ 3.8 to <4.5star: Service Value ≥ 4.0

OBSERVATIONS
During Audit, Air delivery was not observed on their name plate

RECOMMENDATION It was observed and discussed with college authorities during the audit that 745 Nos. ceiling fans are installed in the different Floors, class rooms and hostels building. Out of which 200 fans identified for replacement being very old and some rewound. As such, has been taken for replacement.

EEM-7 Replacement of 200 nos. old conventional inefficient ceiling fans with 26 W Energy efficient/5 star rated BLDC ceiling fans

The energy saving calculation is shown below:

Energy Saving Calculations

Energy Saving Calculation		Units	Value
Total Number of ceiling fans	=	Nos.	200
Existing annual Energy Consumption of old conventional 85-watt Ceiling fan ;(200x85x6x165/1000=16830 KWH)	=	Watt	16830
Energy Consumption after replacement with 26 W energy efficient BLDC ceiling fans;(200x26x6x165/1000=5148 KWH)	=	Watt	5148
Cost Benefit Analysis			
Proposed Annual Savings potential (16830-5148) =11682	=	kWh/year	11682
Per Unit cost	=	Rs.	11
Proposed Annual Monetary Savings;(11X11682=128502)	=	Rs.	128502
Investment-1200 mm sweep ceiling fan	=	Rs.	2800
Total Investment	=	Rs.	560000
Simple Payback Period	=	year	4

5.3. Wall fans

Only 23 nos. wall fans of 50 watt each are being used rarely in the campus, thus not recommended to replace as replacement is not viable.

5.4. EXHAUST FANS

63 nos. Exhaust fans of 60/1000 watt each are being used in the campus.

An exhaust fan's primary function is to remove stale, polluted, or moisture-laden air from a room or building. Exhaust fans work by:

- Removing unwanted air: Drawing in and expelling unwanted air outside
- Improving air quality: Removing pollutants and allowing fresh air to enter naturally through cracks, windows, or other openings
- Reducing odors: Removing unwanted odors from the air
- Maintaining humidity level: Maintaining a comfortable humidity level

Exhaust fans are often used in bathrooms and kitchens and different labs.

Taking average power as may consume up to 75 watts

Recommendation

21 No**.** exhaust fans has been provided each in wash room and 2 nos. 1in lobbies connected with wash rooms which are of 1000 watts and runs for 6 hours a day These

are recommended to replace with 20-watt energy efficient BEE star rated BLDC exhaust fans with air delivery 1150 CHM,250 mm2 and speed 1300 rpm (which are readily available in the market, as annexure- List of Vendors)

EEM-8 Replacement of 23 nos. of average 75 W inefficient exhaust fan with 20 W Energy efficient BEE 5 Star rated BLDC exhaust fan

The energy saving calculation is shown below

Energy Saving Calculation		Units	Value
Total Number of Exhaust fans	=	Nos.	23
Existing Electricity Consumption of old inefficient E/F, (23x75x6x280/1000=2898 KWH)	=	kwh	2898
Proposed annual Electricity Consumption after replacement with 20 W energy efficient BEE 5 star rated BLDC E/fans with air delivery 1150 CHM,250 mm2 and speed 1300 rpm (23x20x6x280/1000=773 KWH)	=	kwh	773
Cost Benefit Analysis			
Proposed Annual Savings potential	=	kWh/year	2125
Per Unit cost	=	Rs.	11
Proposed Annual Monetary Savings	=	Rs.	23377
Investment/ fixture replacement	=	Rs. /Fixture	2590
Total Investment-Rs	=	Rs.	59570
Simple Payback Period	=	year	3

The payback period is calculated to be 3 years. Since the product life is much more than that, the move is economically beneficial and energy saving.

5.5. Occupancy Sensors for existing Exhaust fans

Exhaust fans are the biggest energy consuming devices. The study shows that there are cases, where Exhaust fans are working even when there is no occupancy in the wash rooms, thus un necessary wastage of electrical power as such it becomes necessary to use occupancy sensors to overcome this loss. PIR (passive infrared) motion sensor switches are energy saving devices which detects movement-based

occupancy and keep the connected load like lights, fan, exhaust fans etc ON, it shuts of the appliances, when its detection area is vacant. It is useful for energy saving

EEM-9 Providing and fixing of Occupancy Sensors for existing Exhaust fans installed in 21 no. wash rooms and 2 lobbies connected with wash rooms

Energy Saving Calculations

Considering an average 1-hour time working of an Exhaust fan without occupancy in the wash rooms

Occupancy Sensors for Exhaust fans	No. E/F
Item	**23**
Energy Consumption of existing Exhaust fans (23No.x6 hrx75 wx280 days/1000=2898)- KWH	2898
Annual Saving in electricity Consumption after fixing the occupancy sensors with existing E/F (23no.x1 hrx75 wx280 days/1000=483 KWH) -KWH	483
Proposed annual saving in electricity consumption-kwh	2415
Annual monetary saving @ Rs. 11-Rs	26565
Investment Rs.5000/- per AC Sensor	115000
Payback period--Years	4.3

The payback period would be 4.3 year, which is viable. Since the product life is much more than that. Move is economically beneficial and energy saving

5.6. AIR CONDITIONING SYSTEM & WATER COOLERS

The main purpose of an Air Conditioning (AC) system is to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort. AC systems are among the largest energy consumers in buildings. The choice and design of the AC system can also affect many other high-performance goals, including water consumption (water-cooled air conditioning equipment) and acoustics.

5.7. DESCRIPTION, OBSERVATIONS & RECOMMENDATIONS OF AC SYSTEM

Guru Nanak College, Budhlada has installed 10 Nos. Window Air Conditioners & 20 Split air conditioners. Split air conditioners are BEE energy efficient 2/3 star rated.

The star rating of the said Acs were valid up to 31st December 2015. The Bureau of Energy Efficiency (BEE) awarded star ratings to air conditioners, which indicate their energy efficiency. The rating scale ranges from 0 to 5, with more stars indicating more power-saving now these are required to replace with BEE 5 star rated ACs

A 5-star air conditioner (AC) is more energy efficient than a 3-star AC, which can lead to lower electricity bills and long-term savings:

- Energy efficiency: 5-star ACs have a higher Energy Efficiency Ratio (EER) than 3-star ACs, which means they waste less energy while operating. 5-star ACs can save up to **28%** more energy than 3-star ACs.
- Cooling capacity: 5-star ACs have a higher cooling capacity and can cool rooms faster than 3-star ACs.
- Noise levels: 5-star ACs operate quieter than 3-star ACs.
- Durability: 5-star ACs have more durable compressors, which require less maintenance.

In view of above it is recommended to replace all ACs with BEE5 star rated ACs

May be in phase manner.

In the instant report it is recommended to replace 10 no. window Acs with energy efficient BEE 5 star rated ACs **which is a mandatory phase** as per star rated plan of BEE

The Performance assessment of units not done due to lien season Regular Maintenance of the A/C is required for proper refrigeration effect by attending the gas leakages present and cleaning of the filters.

EEM-10

10 Nos. existing old inefficient window AC'S are proposed to be replaced with new BEE 5 star rated ACs in the building.

The energy saving calculations shown below:

Energy Saving Calculations		Units	Window 1.5 T
Total Number of Air conditioners	=	Nos.	10
Annual Energy Consumption of existing old and split ACs;(10x2000x6x165x/1000=19800 KWH)	=	kwh	19800
Proposed annual Energy Consumption of BEE 5 star rated energy efficient window and split ACs ;(10x1200x6x165x/1000=11880 KWH)	=	Kwh/year	11880
Cost Benefit Analysis			
Proposed annual electricity savings	=	Kwh	7920
Per Unit cost	=	Rs.	11
Annual Monetary Savings;(7920x11)	=	Rs.	87120
Investment/ fixture replacement	=	Rs. Fixtr	24000
Total Investment	=	Rs.	240000
Simple Payback Period	=	year	2.7

The payback period is calculated to be 2.7 years. Since the product life is much more than that, the move is economically beneficial and energy saving.

5.8. Water Cooler

Existing water cooler in the campus

14 Nos. of water coolers are installed in the building premises to enable the students and staff to get cool water. The water temperature is controlled with a thermostat. Normally it is kept at tap no. 4. Refrigerant R-22 is used in these coolers. No pressure gauges are installed on refrigerant circuit.

OBSERVATIONS & RECOMMENDATIONS

-Performance of water coolers could not be checked due to lien season and all the water coolers were off.

-Install temp. and pressure gauges

-Temperature of cooled water be maintained near about 14 degrees centigrade

The auditors find no any saving in it.

CHAPTER – 6 STUDY OF COMPUTER SYSTEM

This institute has about 300 nos. of computers with LED monitors. The computers are generally for IT/computer classes and for office use

An equivalently sized LED monitor is upwards of 80% smaller in size and weight compared to a CRT/LCD.The larger the screen, the bigger the size difference. The other major drawback of LCD deals with the power consumption. The energy needed for the electron beam means that the monitors consume and generate a lot more heat than the LED monitors. On an average, CRT Monitors consume 500W while LCD monitors consume 300 Watt while LED computer consume only 100 watts. The annual energy consumption is about 22000 KWh units. The auditors find no any saving in it as already existing computers are energy saver.

CHAPTER – 7 STUDY OF WATER PUMPING SYSTEM

7.1. WATER PUMPING SYSTEM

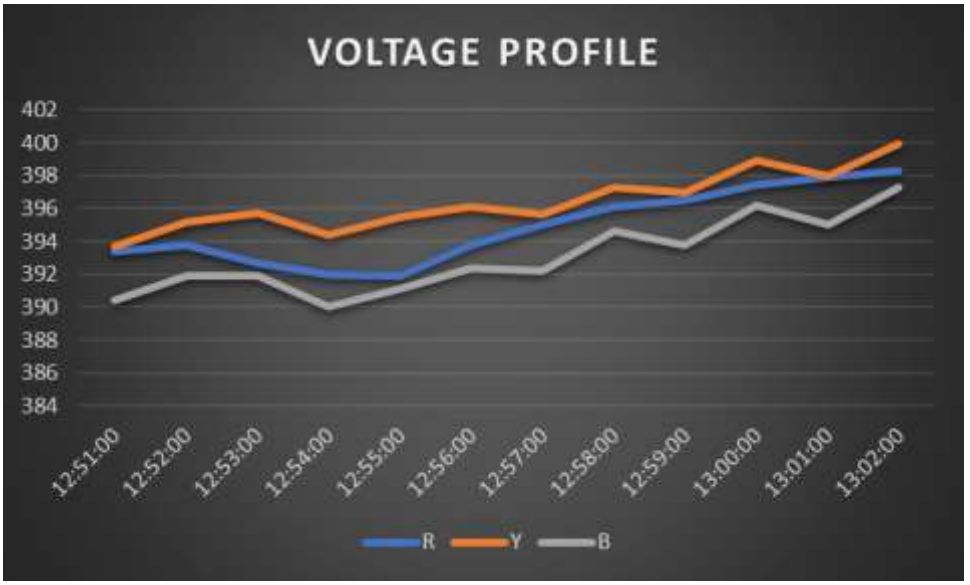
The building has made the provision for storage the water for the facility of the staff and students in the campus and hostels and has installed 24 no. PVC overhead tanks of total capacity 51000 lts on roof tops pumped through 7.5 HP Submersible pump and 2 PVC water tanks each with capacity 1000 lts pumped through 3 HP submersible pump set for school and for storage of fire-hydrants. The pumps run for app. 1-4 hrs. daily. Performance of fire hydrant motors could not be checked as were off,only for testing purpose run.

Auditors measured the parameters of main submersible pump feeding to hostel and college for checking the performance of the pump

7.2. MEASURED PARAMETERS OF SUBMERSIBLE PUMP

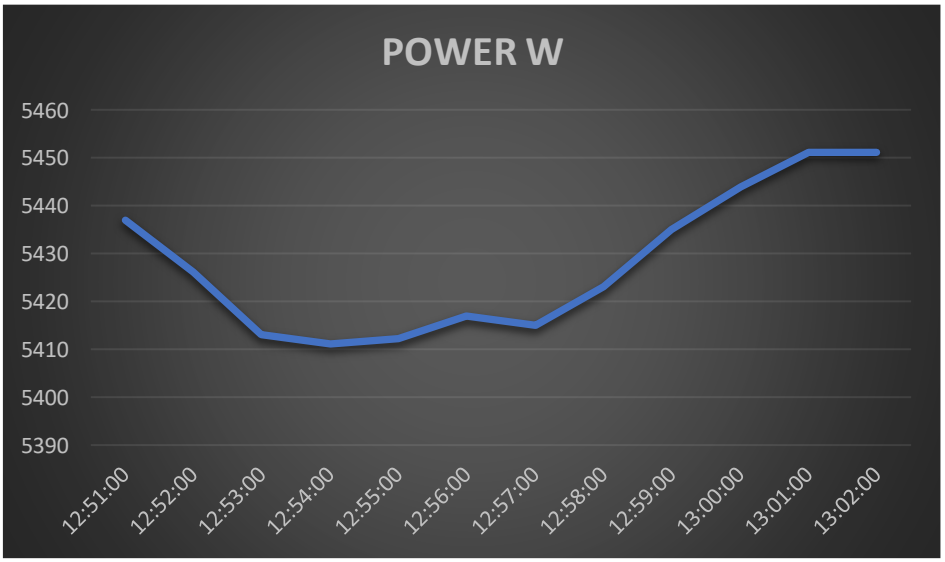
Submersible pump near Hostel

Narration	Date	Av	Mini	Max	
V rms	19-02-2024	396.1	391.87	398.5	V



Narration	Date	Av	Mini	Max	
A rms	19-02-2024	9.0	17.1	9.26	A

Narration	Date	Av	Mini	Max	
P (W)	19-02-2024	5.42	5.41	5.45	k W



The power of pump feeding to hostel was measured during the audit and found to be 5.45 KW which is of full capacity

RECOMMENDATIONS:

Overall efficiency of conventional pump set is low it is recommended to replace the pump with BEE 5 star rated energy efficient pump

At present energy efficient motor-pump sets, whose efficiency is higher than normal standard motor-pump sets are competitively available in market. These have higher efficiency, higher power factor and longer life than normal standard motor-pump sets. Further on each damage & rewinding, efficiency drops from 0.75% to 1.5%. But as inquired, damage rate is not high**. Replace the existing motor pump set with BEE 5 star rated energy efficient pump set of three phase 7.5 hp,9 stage, H-60 M, appx 5lps The other submersible pump may be replaced with BEE 5 star rated energy efficient pump set in phase manner or on damage of same.**

ITEM	Nos	K W	Hrs	Days	kWh
Sub. pump set/15 hp	1	5.45	4	280	6104

EEM-11 Replacement of the existing Submersible motor pump set with BEE 5 star rated energy efficient pump set of three phase 7.5 hp,9 stage

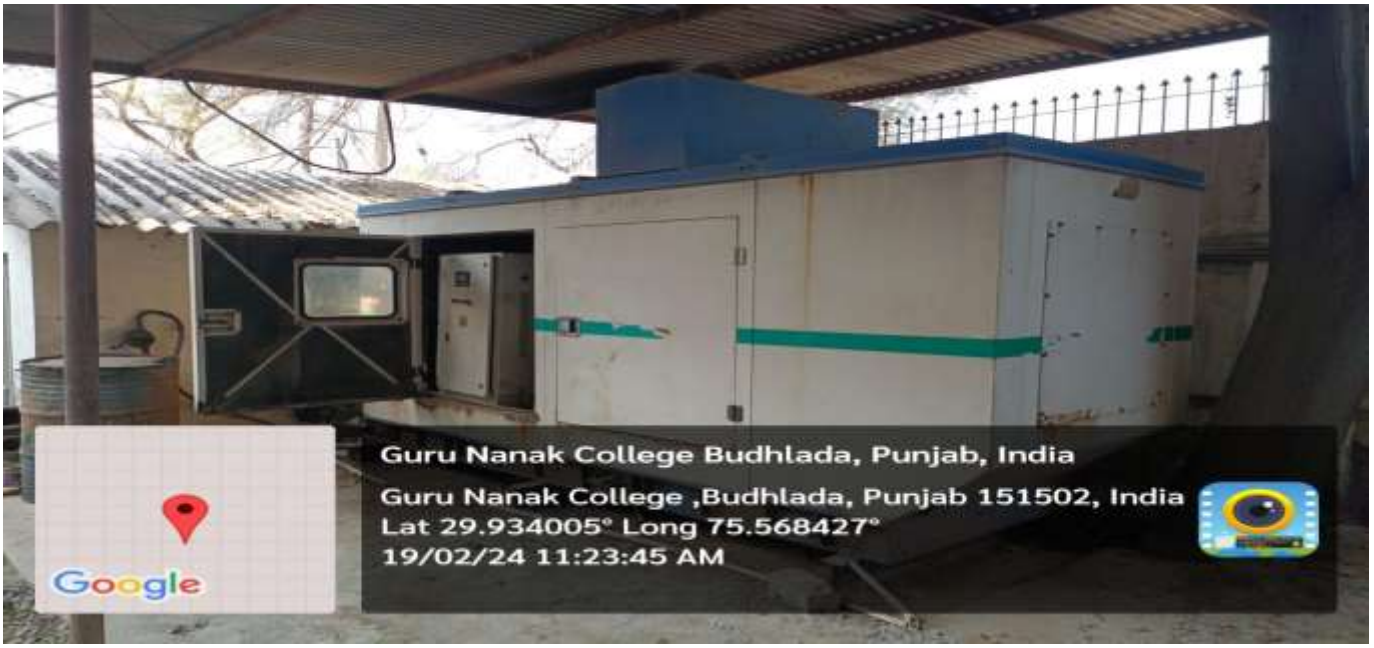
Energy Saving Calculation

Item		Units	Pump 15HP
Submersible pump Motor pump 7.5 HP	=	Nos.	1
Annual Electricity consumption of existing pump	=	kWh	6104
Proposed Saving Potential after replacing with BEE 5 star rated energy efficient pump set @ 25 %, i.e.6104 x0.25=1526 kwh	=	KWh	1526
Cost Benefit Analysis			
Per Unit cost		Rs.	11
Proposed Annual Monetary Savings	=	Rs.	16786
Investment for replacing with energy efficient motor pump sets complete in all respect.	=	Rs.	50000
Simple payback period	=	Years	2.9

The payback period is calculated to be 2.9 year. Since the product life is much more than that, the move is economically beneficial and energy saving.

CHAPTER – 8 STUDY OF DG SET SYSTEM

8.1. Guru Nanak College Budhlada has installed 1 No. of DG Set of 125 KVA capacity with acoustic cover for providing backup to power cut-off from utility supply.



Existing DG Set 125 KVA installed in the College

8.2. Rated parameter

Make-Industrial Equipment Co Chandigarh

DG Sr No.-616**, Model-**125 KVA WS

Rating: KVA-125**, RPM-**1500

Diesel Consumption Details	FY 23-24
Annual- Lts	1972
Rate Rs / lts	84
HSD Billing – Rs	165648
Equivalent HSD charges -Rs	113918
Electricity Generated-KWH	16368

8.3. DG SETs, OBSERVATIONS & RECOMMENDATIONS

Following is supplemented in management's efforts to further bring down energy costs.

1. Specific energy consumption: -The most important thing is to know specific energy consumption. Log book is maintained for DG. At present only hours of operations is being monitored.

2. Effect of temperature & suction pressure - For every 3.5 °C increase in inlet air temperature, fuel consumption increases by 1%. The DG Sets is normally designed for ambient temperature of 25 to 30 degree centigrade. Higher temperature & lower suction pressure decreases efficiency. The position of set is as below: -

3. As verbally informed, normally lubricating oil pressure reaches 79 psi, oil temperature 80 °
4. DG set placed in a big covered in open space. The side from where air is sucked by sets is open.
5. Thus, fresh air at ambient conditions is sucked in. It is good
6. Set is housed in accosted cover. The exhaust pipe inside not insulated.

Typically, a diesel generator will run at about 40 percent efficiency in its designed optimum operating range, usually up to 80 percent of total load capacity. That means for every 100 units of energy input, 40 units are delivered as output.

-It is recommended to use additive in lubrication oil in HSD for DG it will increase the average and efficiency and will reduce the carbon deposit on the burner nozzles in the DG Set. **No saving is found, for smooth running of the DG sets and for considerable savings the implementation of above recommendations are essential**

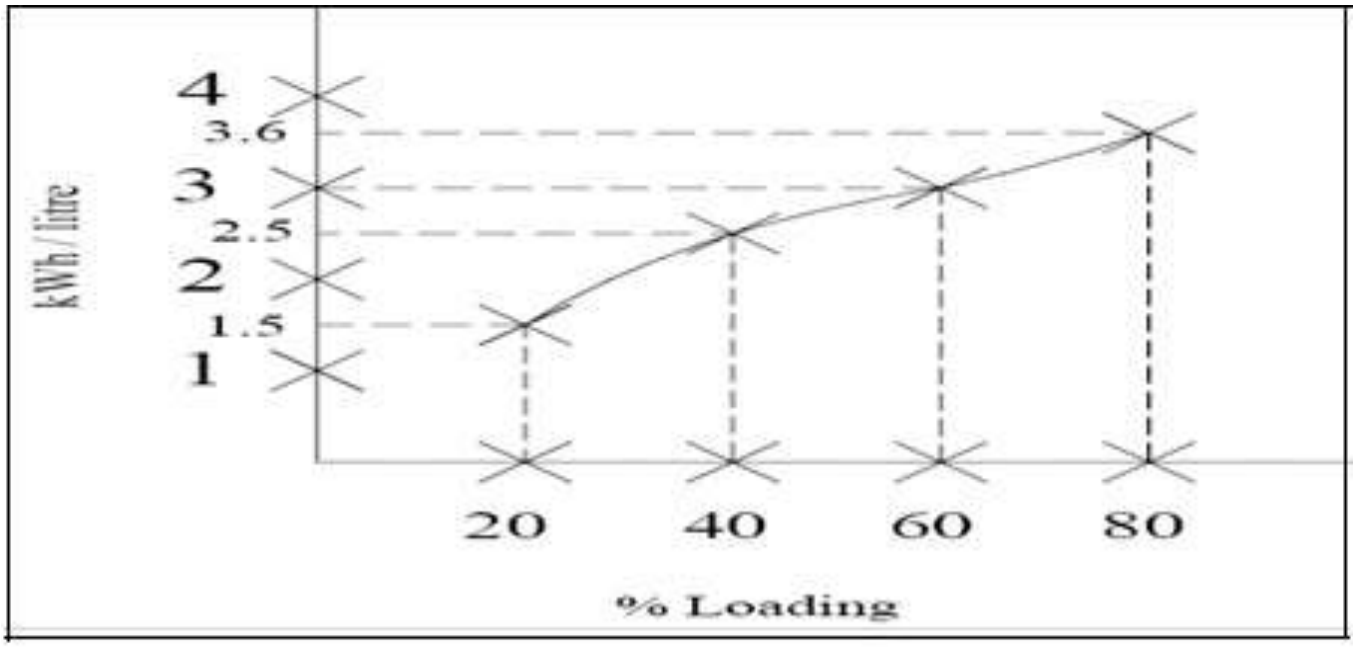
8.4. Energy saving in DG Set

i) **Operate the DG set so as to get at 400 – 405 volts** instead of 415 -420 volts at heavy load end motor terminals. **This gives instant savings in Diesel and without compromising the loading levels**.

Also, majority of loads like pumps, fans and compressors etc are centrifugal type and that too not loaded fully.

ii) Reduce the DG set frequency from 50 Hz + to 48.5 Hz + after studying all the loads into consideration.

Iii) **The DG set is rated by KVA only and hence how much KVA we can take from the DG set is the focus point.** The power factor of the electrical system depends upon the nature of characteristics of the load. If the load ends are compensated so that **an average of 0.8 to 0.9 max at the load end, then we can efficiently make use of the DG set.** See that the PF is around 0.8. **If the PF of load is less than 0.8 PF, alternator gets overloaded** and the energy losses through the alternator increases.
If PF of load is more than 0.8 PF the engine gets overloaded. Hence operating the DG set at low PF increases the alternator losses.



The above figure - Courtesy article by Meher capacitors – Captive gensets need Capacitors.
The above figure indicates that the loading at 60 % is 3.00 UPL and at 80 % loading is 3.6 UPL. In fact, the UPL curve is flat from 60 % onwards and hence we have to load the genset above 60 % always. Hence considering the generator health as priority, **we can plan for higher loading up to 85 % for old set and 90 % for new genset**.

CHAPTER – 9 SOLAR PHOTOVOLTAIC POWER PLANT ASSESSMENTS FOR RENEWABLE POWER

9.1. Solar energy is one of the most widely used renewable sources of energy, one can use renewable energy technologies to convert solar energy in to electricity, it is very reliable source of energy and can significantly reduce the electricity bills

9.2. Installation of 25 KWp roof top Solar Power Plant on Roof top of computer block

At present, power is sourced from the PSPCL at HV system. Power is also generated using 1 DG set of 125 kVA. The average power generation from a 1 KWp SPV System is around 3.8-5 kWh per day. Since the installed SPV system does not have a battery backup grid connection is there to meet the power requirements during night. Also, the SPV power generation varies with time of day, the balance power requirements are automatically met by the grid supply during this period.

Detailed report on Solar Roof Top Grid Interactive Power Plant.

The require space for the installation of the Solar Photovoltaic Power plant has been identified.

Space available at Roof top of computer block for installation of roof top solar power plant measuring 2500 sq. ft appx

S.No.	Net space considering shading and passage (square feet)	Solar Photovoltaic capacity (KWp)
1	2500	25

9.3. Project Overview

The following are the salient features of the photovoltaic project

Item	Description	Details
1	Project Type	CAPTIVE USE
3	Plant Capacity	25 kW
4	Project Location	Budhlada
5	Project Applicant Name	Guru Nanak College, Budhlada
6	Technology – Modules	Polycrystalline Silicon Technology
7	Inverter type	String inverters
8	Mounting Structure	Fixed Tilt- Rooftop
9	Evacuation Voltage	440 V
10	Area Required	Approx. 2500 Sq. Ft
11	Annual Energy generation estimated end of 1st year	30400 kWh in the first year with Crystalline Silicon Module with fixed mounting structure.

The cost of installing a solar PV system has reduced considerable over the years as a result Grid Interactive Solar PV plant are gaining popularity.
The plant could consider installing a grid interactive Solar PV system of 25 kWp. Technical details & payback analysis is given under the subsequent headings.
The SPV power generation varies with time of day, the balance power requirement are automatically met by the grid supply. For instance, if the total load requirement is 100 KWp and the SPV at a particular point of time generates 10 kWp, the balance 90 KWp will be fed from the grid.
The SPV system would be integrated with the existing LT supply. The SPV system would work under auto synchronism with the grid supply. In such systems, the SPV draws a reference of frequency / voltage from the grid and accordingly auto regulates / synchronizes with the grid

Batteries would not be required as it is suggested that the utilization may be focused during daytime only. Installation of batteries would involve higher investment and regular maintenance/replacement after few years.

Some of the salient features are listed below:

- Provides uninterrupted & Stable DC / AC Power Supply to dedicated load
- No noise and Easy to install
- Simple to operate and Pollution free working
- Low maintenance cost with the generating panels having a long life
- Soft loan available / installation under ESCO mode is also available

9.4. Major Components

- PV Module
- MS Galvanized Mounting Structure
- Array / Sub-Main / Main Junction Box
- Power Conditioning Unit
- Cable and Hardware
- Earthing Kit

9.5. Mounting Structure

The mounting structure is designed to fix PV modules of different sizes. This shall be fixed type structure with optimal tilt conforming to geographic location of the PV plant. The module arrays of the mounting structure are designed in a way that the surrounding ground has access to sufficient light, moisture and accessibility for future maintenance activities.

Mounting systems	Specifications
Material	Galvanized steel for frame SS304 for accessories (for module fixing) GI hardware for structure fixing
Modules tilt angle	Approx. 23°(Indicative – can change during detailed engineering)
Number of modules per Structural element	10 x2 [H x V] (Indicative – can change during detailed Engineering)

As the distance from the lower edge of the module to the ground is generally around 0.5-1 m, the ground might be easily maintained. The structure will be designed according to IS 800, IS 801 & load calculations corresponding to IS 875 Part 1 to 5 taking in to consideration of all the applicable load conditions for the given location.

9.5. String Inverter

The selection of the inverter supplier shall be based on best performance in class and proven reliability. The chosen inverter will offer the highest efficiency among string transformer-less inverters.

9.6. Cables and Conduits

PV module wiring and cables are typically exposed to harsh conditions in outdoor climate. It is essential that the cables are designed to withstand such conditions and also reduce the energy losses that occur due to high temperature, ageing, etc.

Type	Material	Insulation & Outer Sheath	Salient Features
Solar Cables	Tinned fine copper strands	PVC	-40°C up to +90°C > 25 years
Other Cables	Single or multi- wire conductors of plain copper/Al	PVC	-40°C up to +70°C

Solar cables manufactured by reputed cable manufacturers, which are especially designed for PV applications. These solar cables must be extremely robust and resist high mechanical load and abrasion. High temperature resistance and excellent weather proofing characteristics provide a long service life.

The characteristics of these solar cables are:

1,000 V DC Voltage rating
Application temperature range from -40ºC to +90ºC
High resistance against UV, ozone and hydrolysis
High mechanical robustness & resistance against water, oil and chemicals

These cables shall be typically fixed to the mounting structures using UV proof cable ties and / or fixing clamps up to the Generator Junction boxes. Maximal admissible temperature is 90 degrees Celsius.

After coupling, cables of bigger sections may be used down to the Inverters Station. They may either mounted on galvanized cable trays in the shade of the modules or buried underground.

9.7. Lightning Arrester

The Solar Plant shall include lightning arresters for protection of the plant against lightning strikes. Streamer type lightning arresters may be used, which will have more coverage area.

9.8. Monitoring System

The Monitoring System provides complete plant monitoring, remote diagnosis, data storage and display. It also allows end user to access plant information via a PC, regardless of operating system or browser type. The system shall be the link between the inverter and its owner. The Monitoring System supports RS232 or RS485 interfaces for data transfer to and from all inverters.

EEM-12 Saving Calculation for Solar Power Plant

Parameters	Unit	Value
Net space considering shading and passage	ft^2	2500
Solar photovoltaic capacity	KWp	25
Unit generation per day	kWh/kWp	3.8
Number of effective operating days in a year	Number	320
Annual unit generation	kWh/year	30400
Electricity charges	INR/kWh	6.96
Annual monetary saving	INR/Year	211584
Price of 90 KWp solar plant	INR	1125000
Simple payback period	Year	5.32

CHAPTER-10 Energy Monitoring & Accounting System

10.1. Detail review of present energy monitoring & accounting system terms of metering record keeping, data logging, periodic performance analysis etc.

10.2. Energy management monitoring system

Energy is costly & its consumption causes environmental degradation. So, without sacrificing production & growth, it is worthwhile saving it to the extent possible

Monitoring and targeting is an important management tool to control energy consumption. Monitoring gives existing energy consumption pattern and targeting is desirable/achievable energy consumption pattern. By proper monitoring & targeting, it is possible to save 2 to 5% energy. For its effectiveness, proper record of energy consumption and production needs to be maintained.

Somehow, the auditors feel that proper record is either confined to 1-2 persons or not maintained. It is necessary to maintain &monitor& record following things:

i Electricity consumption, power factor & maximum demand

ii Maximum, minimum voltage from grid. This will enable them to install Servo stabilizer at important locations.

10.3. For maintenance:

Transformer - Some maintenance schedule should be prepared for transformer. It can be as follows

Checking of silica Jal breather, HV/LV connections, testing of dielectric strength of transformer oil periodically, insulation resistance test periodically etc.

Generator set- Some maintenance schedule should be prepared for DG Set. It can be as follows

L D System

10.3.1. Initially tightening of all connections. Later on, once a month &after 1-2 months, once a year

Thermo graphic images: Be taken after tightening all connections.

There after once in 2 years.

10.3.2. Bench marking

Benchmarking of energy consumption is a powerful tool for performance assessment and logical evolution of avenues for improvement. Historical data, well documented, helps to bring out energy consumption and cost trends month-wise / daily. Trend analysis of energy consumption, cost, relevant production features, specific energy

consumption, help to understand effects of capacity utilization on energy use efficiency and costs on a broader scale

10.3.3. Suggestions to carry out this monitoring & bench marking: Presently, the campus building is being looking after by the competent technical staff provided by the campus authorities. & accounts staff of the college. But, monitoring, targeting etc. is itself a professional work. The energy consumption in this campus is about 1.51 Lakh KWH. It can hire a professional energy manager to visit & guide their staff –initially once afterwards1 visit once in 6 months.

CHAPTER – 11 ENERGY SAVING TIPS

Below are some of the energy efficiency tips in electrical utilities

11.1. ELECTRICITY

- Optimize the tariff structure with utility supplier
- Schedule your operations to maintain a high load factor
- Shift loads to off-peak times if possible.
- Minimize maximum demand by tripping loads through a demand controller
- Stagger start-up times for equipment with large starting currents to minimize load peaking.
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.90 under rated load conditions.
- Relocate transformers close to main loads.
- Set transformer taps to optimum settings.
- Disconnect primary power to transformers that do not serve any active loads
- Consider on-site electric generation or cogeneration.
- Export power to grid if you have any surplus in your captive generation
- Check utility electric meter with your own meter.
- Shut off unnecessary computers, printers, and copiers at night.

11.2. MOTORS

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Use energy-efficient motors were economical.
- Use synchronous motors to improve power factor.
- Check alignment.

- Provide proper ventilation
- (For every 10 oC increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- (An imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.
- (If rewinding is not done properly, the efficiency can be reduced by 5 - 8%)

11.3. PUMPS

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Source: Bureau of Energy Efficiency, New Delhi 4
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

R.K. ELECTRICALS & ENERGY AUDIT SERVICES
ER. R.K. SHARMA MIE, FIV
BEE's C/Energy Auditor (EA-10080)
HP GOVT. Emp. Energy Auditor, DoE, Shimla
Govt. Regd. Valuer & Chartered Engineer

For R.K. Electricals and Energy Audit Services

(END OF THE REPORT)

Credentials in r/o "R.K. Electricals and Energy Audit Services"

a) Certificate ISO 50001:2018(Energy Management Services)

CERTIFICATE

This is to Certify that the Management System of

R.K. ELECTRICALS & ENERGY AUDIT SERVICES

PROGRESSIVE SOCIETY, 1131, SECTOR 50 B, CHANDIGARH - 160047, INDIA.

has been audited and found to comply with the requirements of:

ISO 50001:2018
(Energy Management System)

For the Scope of activities described bellow:

DEALS IN ENERGY MANAGEMENT, ENERGY, ENVIRONMENT & GREEN AUDITS,

THERMOGRAPHY OF ELECTRIC EQUIPMENT AND ELECTRIC INSTALLATIONS OF BUILDINGS & INSTITUTIONS AND INDUSTRIES.

Certificate No.: 279101

Date of initial registration	*Date of this Certificate*	*Surv. audit on or before/ Certificate expiry*	*Recertification Due*
16-07-2022	*16-07-2022*	*15-06-2023*	*15-06-2025*

Validity of this certificate is subject to successful completion of surveillance audit on or before due date, in case surveillance audit not conducted this certificate shall suspended/cancelled.

Director

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

KAB-EN-06

LMS Certification Limited
Labrynth Business Centre, 43 Middle Hill Gate, Stockport,
Great Manchester, England-SK1 3DG
Phone :+44 208 935 5094
Company No.: 11029176

b) Certificate ISO 9001:2015(Quality Management System

Certificate of Registration

This is to Certify that
Quality Management System of

R.K. ELECTRICALS & ENERGY AUDIT SERVICES

PROGRESSIVE SOCIETY, 1131, SECTOR 50 B, CHANDIGARH - 160047, INDIA.

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

DEALS IN ENERGY MANAGEMENT, ENERGY, ENVIRONMENT & GREEN AUDITS, THERMOGRAPHY OF ELECTRIC EQUIPMENT AND ELECTRIC INSTALLATIONS OF BUILDINGS & INSTITUTIONS AND INDUSTRIES.

Certificate No	: 22EQHU11		
Initial Registration Date	: 01/07/2022	Issuance Date	: 01/07/2022
Date of Expiry	: 30/06/2025		
1st Surve. Due	: 01/06/2023	2nd Surve. Due	: 01/06/2024

mms
EGAC Accredited
QMS Certification
CAB # 118005
IAF
MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT

Director

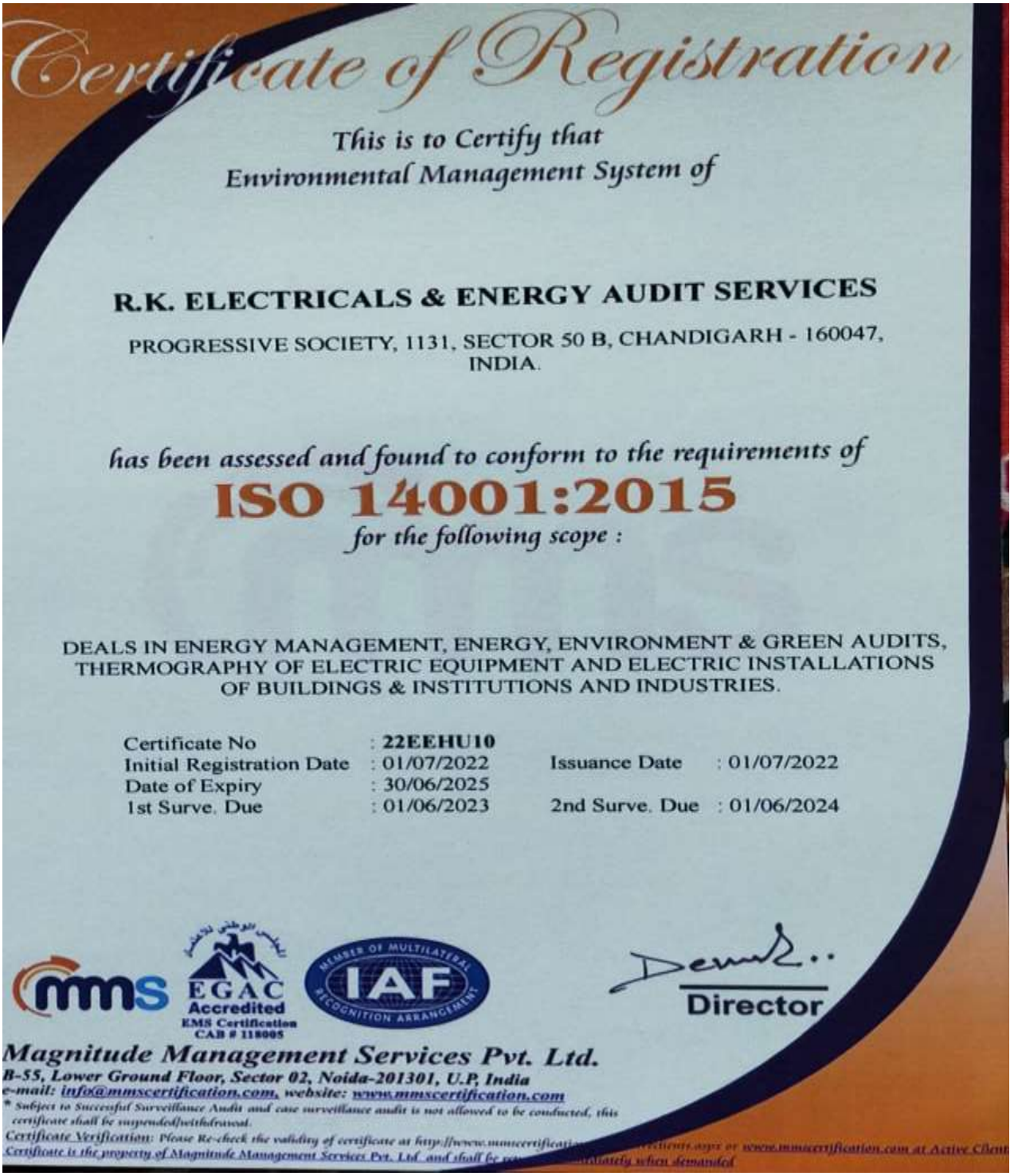
Magnitude Management Services Pvt. Ltd.
B-55, Lower Ground Floor, Sector 02, Noida-201301, U.P, India
e-mail: info@mmscertification.com, website: www.mmscertification.com

* Subject to Succesful Surveillance Audit and case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawn.

Certificate Verification: Please Re-check the validity of certificate at http://www.mmscertification.com

Certificate is the property of Magnitude Management Services Pvt. Ltd. and shall be returned immediately when demanded

c) Certificate ISO 14001:2015 (Environmental Management System)



Certificate of Registration

This is to Certify that
Environmental Management System of

R.K. ELECTRICALS & ENERGY AUDIT SERVICES

PROGRESSIVE SOCIETY, 1131, SECTOR 50 B, CHANDIGARH - 160047, INDIA.

has been assessed and found to conform to the requirements of

ISO 14001:2015

for the following scope :

DEALS IN ENERGY MANAGEMENT, ENERGY, ENVIRONMENT & GREEN AUDITS, THERMOGRAPHY OF ELECTRIC EQUIPMENT AND ELECTRIC INSTALLATIONS OF BUILDINGS & INSTITUTIONS AND INDUSTRIES.

Certificate No	: 22EEHU10		
Initial Registration Date	: 01/07/2022	Issuance Date	: 01/07/2022
Date of Expiry	: 30/06/2025		
1st Surve. Due	: 01/06/2023	2nd Surve. Due	: 01/06/2024

EGAC Accredited EMS Certification CAB # 118005

Director

Magnitude Management Services Pvt. Ltd.
B-55, Lower Ground Floor, Sector 02, Noida-201301, U.P, India
e-mail: info@mmscertification.com, website: www.mmscertification.com
* Subject to Successful Surveillance Audit and case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawal.
Certificate Verification: Please Re-check the validity of certificate at http://www.mmscertification... or www.mmscertification.com at Active Client
Certificate is the property of Magnitude Management Services Pvt. Ltd. and shall be ... immediately when demanded

d) Certificate of Energy Auditor MoP GoI

Regn. No. EA-10080 Certificate No. 5591

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. Rakesh Kumar Sharma

son / daughter of Mr. Krishan Datt

has passed the National Certification Examination for Energy Auditors held in July - 2010, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 7th October, 2010

Controller of Examination

e) Certificate of IGBC Accredited Professional (IGBC India)

IGBC

CII Confederation of Indian Industry

The Indian Green Building Council

hereby certifies that

Rakesh Kumar Sharma

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

IGBC Accredited Professional

K S Venkatagiri
Executive Director
CII-Godrej GBC

Gurmit Singh Arora
Chairman
Indian Green Building Council

B Thiagarajan
Vice-Chairman
Indian Green Building Council

d) Certificate of Energy Auditors MoP GoI

Regn. No. EA-19322 Certificate No. 7889

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Mrs./ Ms. Paramjeet Singh

son / daughter of Mr. Barkha Ram

has passed the National Certification Examination for Energy Auditors held in August - 2013, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 6th January, 2014

Controller of Examination

Regn. No. EA-12433 Certificate No. 6356

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. Harvinder Singh

son / daughter of Mr. Ujjagar Singh

has passed the National Certification Examination for Energy Auditors held in October - 2011, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 1st February, 2012

Controller of Examination

f) Certificate of Electrical Engg.

Regn. cum Roll No. L-40405009

ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ

Punjab Technical University

Jalandhar

BACHELOR OF TECHNOLOGY

Mr./Ms. Varun Sharma son/daughter of Sh. Rakesh Sharma student of Chandigarh Engineering College, Landran, having completed the course of studies approved by the University and having passed the prescribed examination held in Dec.-2007, has been conferred the degree of Bachelor of Technology of this University in the discipline of Electrical Engineering in First Division

Given under the seal of the University

ਰਜਿਸਟਰਾਰ
Registrar
Jalandhar, 25/10/10

ਵਾਈਸ-ਚਾਂਸਲਰ
Vice-Chancellor

ਚਾਂਸਲਰ
Chancellor

g) Award certificate

Government of Punjab
Department of New & Renewable Energy Sources

Award for Outstanding Contribution

Presented to
M/s. R.K Electricals & Energy Audit Services, Chandigarh
(Sector: Energy Auditing Agencies)
participated in the State Level Energy Conservation Award Competition
organized by Punjab Energy Development Agency, Chandigarh
(State Designated Agency-Punjab) and secured the
Second Position
under the category of
BEE Certified Energy Auditors & Energy Auditing Agencies
for their efforts made in the field of
Energy Conservation during the last two years 2021-22 & 2022-23

December 2023
Chandigarh

Dr. Amit Kumar Singh, IAS
Chief Executive Officer
Punjab Energy Development Agency

Annexure – 1 Copy of Energy and Environment Policy

Guru Nanak College, Budhlada

Affiliated to Punjabi University, Patiala

Environment and Energy Usage Policy Document

Principal
Guru Nanak College
Budhlada (Mansa)

POLICY DOCUMENT
ON
ENVIRONMENT AND ENERGY USAGE

The Environment and Energy usage policy of Guru Nanak College, Budhlada is to manage energy in such a systematic way so as to minimize its impact on the environment and to invest in sustainable growth through clean energy as it is the only dependable option to sustain life in future. At the institution we understand the immense potential of renewable energy. The policy implies to explore the renewable energy resources to reduce the burden of the government and to find ways to switch to the sources that are energy efficient and renewable. This transition to the renewable energy and to inexhaustible sources of energy will maintain the interest of our planet and its inhabitants. This environment and energy policy is applicable for all the components of the institution and to all its stakeholders and to the various activities undertaken by the institution. It will enable us to become energy independent and efficient in a cost effective way. This policy will help us to realize our responsibilities and commitment to conservation of natural resources about reducing air & water pollution and greenhouse gas emissions and to limit their usage. Waste Management Cell, Environment and Green Audit Committee are devoted to the cause of environmental awareness, to undertake green initiatives and to conduct green literacy programs to save energy and protect the environment.

POLICIES:

- To assess our energy usage and measure its impact on the environment.
- To count CO_2 emissions generated by our means of transportation vehicles.
- To reduce the air pollution emission using environment friendly vehicles like bicycles, public transportation and sharing of vehicles.
- To install LED and Solar lights in the campus and the hostel to save the energy.
- To organize tree plantation drives and make students adopt the trees.

IQAC

Principal
Guru Nanak College
Budhlada (Mansa)

- To develop rain water harvesting and underground water management system.
- To implement the zero-tolerance policy on single use plastic in the institution.
- To host awareness programs about the importance and benefits of energy conservation measures.
- To encourage faculty and students to switch off lights, fans, air conditioner and electrical appliances in labs and classrooms when not in use.
- To generate awareness about segregation of the waste.
- To adopt paperless measures to minimize impact on nature.
- To get Green Audit, Environment Audit and Energy Audit done by internal committee having external members.
- To organize seminars/lectures on the initiatives that should be undertaken to conserve energy and natural resources.
- To use sprinklers to water lawns and playgrounds to meet emission reduction target.
- To engage in dialogue with the government agencies, municipal corporation and the affiliating university and local institutions to collaboratively work for the promotion of sustainable environment.

The policy is communicated to the students and employees through internal communication channels. The environment and energy usage policy, objectives and targets are monitored periodically by the Waste Management Cell, Environment and Green Audit Committee under the guidance of the principal of the college.

Principal
Guru Nanak College
Budhlada (Mansa)

Annexure – 2 Copy of an Electricity bill of the Campus

PUNJAB STATE POWER CORPORATION LIMITED
(Regd. Office P.S.E.B. Head Office, The Mall Patiala-147001,Ph. 1912), CIN: U40109PB2010SGC033813
E-mail: 1912@pspcl.in, Website: www.pspcl.in, GSTIN NO: 03AAFCP5120Q1ZC
Original for Recipient Duplicate for Supplier, Taxable Invoice, Invoice-cum-Bill of Supply

Billing Category: GSC/SAP-NONSBM-/DS RATE CATEGORY FOR DS>100KWA DPC

Sub Division	Division	Circle	Bill Cycle	Bill Date	Bill No.
BUDHLADA SUB DIVISION	BUDHLADA DIVISION	BHATINDA	05-2024	22-MAY-2024	50221754399

A/C No.: 3007508849
Consumer Name: M/S PRINCIPAL GURUNANAK COLLEGE
Address: BUDHLADA 9876875351 BUDHLADA-151502-INDIA
GST No.:
Connection Date: 07-08-2016
Mobile No.: 9800000351

Load	Contract Demand	Tariff Type	Bill Status	Due Date Cash/Online	Due Date DD/Cheque	Bill Amount
219.42		DS RATE CATEGORY FOR DS>100KWA DPC	O	03-Jun-2024	03-Jun-2024	Rs.171120/-

Voltage Supply	Details of Meter: Meter Number	Make	Capacity	Digit	Meter Status	CT Make	CT No.
11.00	19363715	L&T	5-6	8	O	23	

Feeder Code	Date of New Reading	Date of Old Reading	Bill Period	Meter Security	Securit Cons	Security cons/Meter Security Interest
FDC0000005017	20-MAY-2024	20-APR-2024	30	30010	158584	

Meter Reading

Details	Old Reading	New Reading	Current Units	Meter Multiplier	Line CT Ratio	Meter CT Ratio	Overall Multiplier	MMTS Correction	Old Meter Cons.	Unit Consumed
KWH	275450.00	283574.00		1.00	10/5	5/5	2.00			16248
KVAH	313244.00	321818.00		1.00	10/5	5/5	2.00			17148
MDI	37.15	37.15		1.00	10/5	5/5	2.00			74.3

(A) Fixed Charges

Contract Demand (L) KVA	Actual Demand KVA (A)	80% of (L) KVA (B)	A or B whichever greater KVA (C)	Rate per KVA per month (R)	Billing Days (D)	A: Fixed Charges Amount =CxRxDx12/365
	74.3	183.22	183.22	140.00	30	25230.00

(B) Energy Charges

	Units	Rate/kWh	Amount	B: Total Energy Charges
0-100	17148	6.96	119350.08	119350
100-300	0		0.00	
300-500	0		0.00	
500 & ABOVE	0		0.00	

(C) Fuel Cost Adjustment Charges

Total Energy Charges	KVAH Consumption	Rate of FCS/KVAH	C: Amount
119350			0.00

***Additional Surcharges**

Unit	Rate	Amount	C: FCA + Addl Surcharges
		0.00	119350

(D) Rental Charges

Meter Rent for PSPCL Meter	MCB, CT/PT Unit Rental	Rent for any other equipment	Total Rent
1264	0		1264

GST

HSN Code	SGST	CGST	Total GST	D: Total Rent with Tax
	113.76	113.76	227.52	1491.52

(E) Surcharges

Voltage Surcharge: Supply Voltage	Catered Voltage	Surcharge Rate	Voltage Surcharge Amount	Demand Surcharge: Demand in excess	Rate of Demand Surcharge	Amount of Demand Surcharge	ToD Surcharge: Peak Hours KVAH	Rate	Amount	E: Total Surcharge (Rs.)
11.00	11.00			0.00	0.00	0.00	0.00		0.00	0.00

(F) Rebates

Voltage Rebates: Units	HT/EHT Rebate	Amount	ToD Rebates: Non-Peak Hours KVAH	Rate	Amount	F: Total Rebates (Rs.)
17148.00	3430.00	0.00	0.00		0.00	3430.00

(G) Previous Adjustment Amount Notice No.: and Date:

Units	Fixed Charges	Energy Charges	FCA	Rentals	Surcharges(+)	Rebates(-)	Taxes	Subsidy	Total	G: Net Previous Adjustment (Rs.)
		/		/			/0		0/-100	0/-100

(H) Sundry Charges/Allowances Notice No.: - and Date: -

Late Payment Interest	Units	Fixed Charges	Energy Charges	FCA	Rentals	Surcharges(+)	Rebates(-)	Taxes	Subsidy	Total	H: Net Sundry Charges/Allowances (Rs.)
	/	/	/ 0	/ 0	/ 0	/	/ 0	/ 0	/	/ 0	/ 0

(I) Subsidy

Subsidised KVAH	Rate for Subsidy	Amount	I: Net Subsidy (Rs.)
17148	0.00	0.00	0.00

Annexure – 3 List of Some Vendors

For Lighting: 1. SYSKA LED DELHI, D-, 108, Patpar Ganj Rd, South Ganesh Nagar, Block D, Ganesh Nagar 1, Ganesh Nagar, New Delhi, Delhi 110092 Phone: 099101 11242

2. Philips Lighting India Limited,9th Floor, DLF 9-B, DLF Cyber City DLF Phase-3, Gurgaon – 122002, India

For Pumps: 1. Grundfos Pumps India Pvt. Ltd. 301C, 3rd Floor, D21, Corporate Park, Dwarka Depot, Near Sector 8 Metro Station, Sector 21, Dwarka, New Delhi – 110075, India

2. Kirloskar Brothers Limited, M-11, 3rd Floor, Middle Circle, Connaught Place, New Delhi - 110 001 Tel: 011 - 41501055

For Fans (Celling / Exhaust): 1. Havells Galaxy, SCO 19, Madhya Marg, Sector 7 C Chandigarh

2. Orient Fans, Gupta Electronics, SCO 1117, Sector 22, Chandigarh M – 7947243304

Apart from above, Online Shopping Portals like Jio Mart, Amazon IndiaMart etc. may also be referred such as:

(Source – Jio Mart)

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