ENERGY AUDIT REPORT

SANT BABA BHAG SINGH UNIVERSITY, JALANDHAR

CONDUCTED BY:

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

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2023-2024

ENERGY AUDIT CERTIFICATE

(2023-24)

This is to certify that the **"R.K. Electricals and Energy Audit Services**" conducted Energy Audit of **"Sant Baba Bhag Singh University** situated, Punjab from 27/11/2023 to 28/11/2023 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 3.59 Lacs KWH with annual monetary saving: Rs. 32.13 Lacs by investing Rs.114.99 Lacs

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Rakesh Kumar
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For R.K. Electricals & Energy Audit Services

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ACKNOWLEDGEMENT

R.K. ELECTRICALS & ENEGY AUDIT SERVICES expresses sincere thanks to the authorities of **Sant Baba Bhag Singh University** for giving us an opportunity to carry out the study in the campus & for their kind assistance and co-operation during the Detailed Energy Audit Project Report & Preparation for energy efficiency improvements of their Campus.

We would like to place on record our sincere thanks to the

Hon'ble Chancellor:	Sant Manmohan Singh ji
Hon'ble Secretary:	S. Hardaman Singh Minhas
Hon'ble Vice – Chancellor:	Dr. Dharamjit Singh Parmar
Manager Facilities In- Charge:	Capt. Sukhdev Singh
"Dean Academics":	Dr. Vijay Dhir
Registrar:	Dr. Aneet Kumar
Dy. Registrar:	Mr. Roop Singh
Director IQAC:	Dr. Anil Kumar Singh
Dean UIL:	Dr. Pooja Bali
Dean UIS:	Dr. Shweta Singh
Dean UIET:	Dr. Jagdeep Kaur
Dean UIA:	Dr. Vikas
HOD Department of Electrical Engineering:	Dr. Gurmanik Kaur
HOD Department of Agriculture:	Dr. Vikrant Jaryan
Coordinator, Environment Sustainability Management Cell:	Dr. Indu Sharma

We would also like to extend gratitude to all the officers, technicians, staff and operators of **Sant Baba Bhag Singh University** who have rendered their valuable assistance during the course of study.

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 **Sant Baba Bhag Singh University** 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 **Sant Baba Bhag Singh University** 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 **Sant Baba Bhag Singh University** 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 27/11/2023 to 28/11/2023 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.32.13Lacs, Investment-Rs. 114.99 Lacs, Energy (KWh) Saveable- 3.59 Lakh**

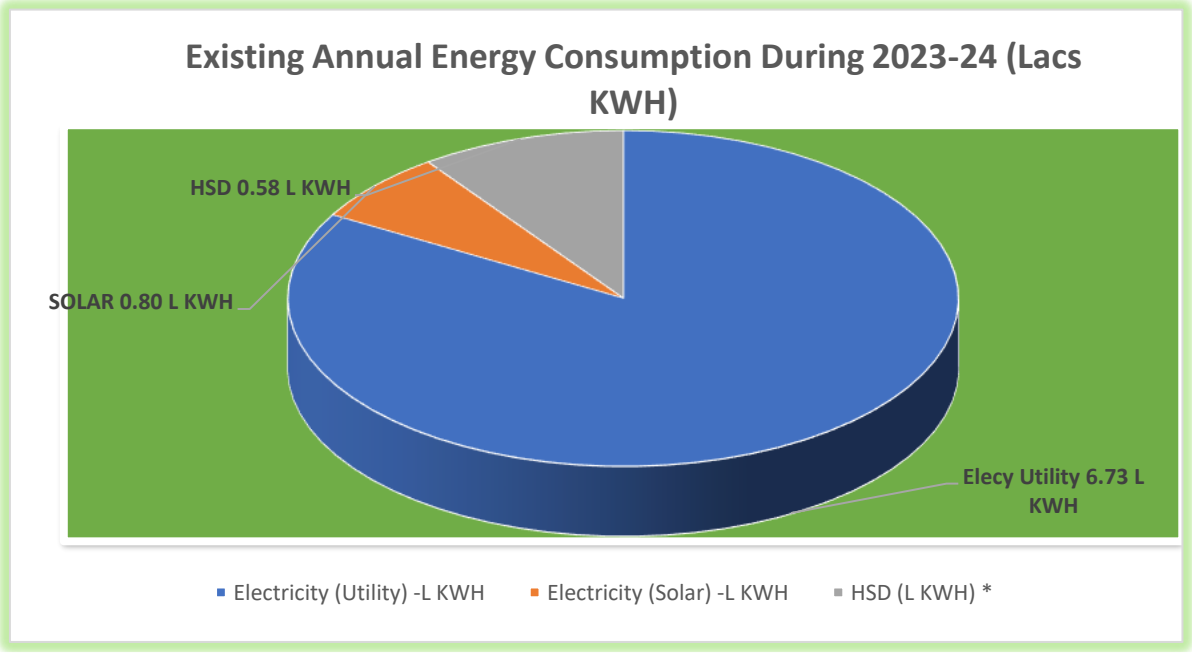
Detail of Energy Consumption

Using the historical data, the total energy consumptionof the University campus during the 2023-24 was **8.08 Lacs KWH** with the annual energy cost amounting to Rs **70.68 Lacs**. Electricity sourced from Utility, Solar and Diesel Generator in the campus

Annual Existing Energy Consumption

Energy Source	Annual consumption	Energy cost (Lacs)
Electricity (Utility) -L KWH	6.73	65.43
Electricity (Solar) -L KWH	0.58	
HSD (L KWH) *	0.80	5.25
Total	**8.08**	**70.68**

*Equivalent Annual cost of electricity through DG Set



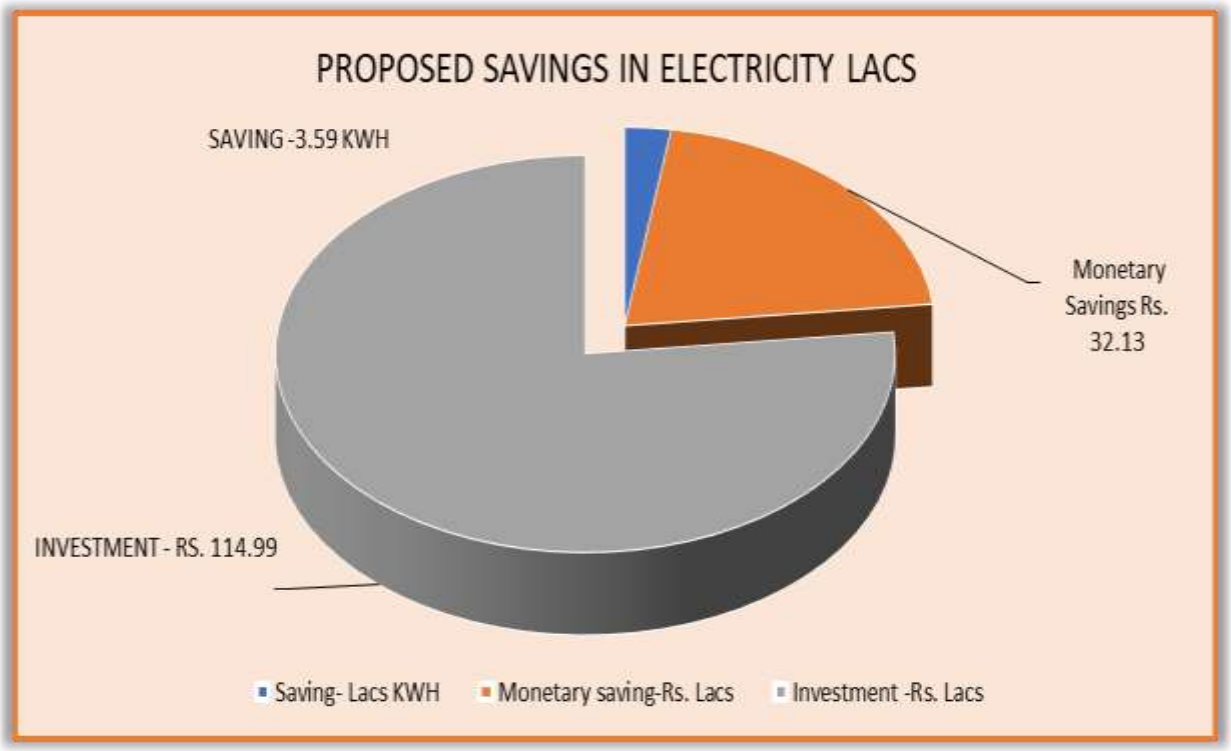
Summary:

Sr.No.	Description	Details
1	Name of the building	Sant Baba Bhag Singh University
2	Location/Address	Sant Baba Bhag Singh University Jalandhar
3	Name and address of the owner	Sant Baba Bhag Singh University Jalandhar
4	Ground covered area of the building	46159.4 Sq mt
5	Connected load/Contract demand of the building	980 KW/324 KVA
6	No. Of Gen sets with capacity	500 KVA +200 KVA (200 KVA not working)
7	Average annual consumption of the Diesel	12389 Litres/yr. App.
8	Nature of the building	Educational Institution
9	Storey	Ground, +5 Floor
10	No. of Rooms	7 No. blocks & 2 Hostels
11	Hours of normal operation of the building	6-7 hrs
12	Percentage of air-conditioned floor area	Less than40%
13	Name & contact Number of the Nodal officer I/C	Dr. Anil Kumar Singh M:819976193
14	Energy Audit Report No.	RKS/EA-38/2024,Dt.23/12/24
15	a) Existing annual electricity Consumption purchased from utility	6.73 LAKH KWH
	b) Existing annual Electricity Consumption through DG sets	1.01 LAKH KWH
	c) Existing annual Electricity Consumption through solar	0.80 LAKH KWH
	d)Total existing annual existing Electricity consumption (Utility+ Solar+ DG)	8.08 LAKH KWH
16	Energy Performance Index (EPI of the Bldg.)	17.50 kWh/Sqm/Annum
17	a) Annual Electricity Cost purchased from utility	Rs.65.43 Lakh
	b) Existing equivalent annual cost of electricity through DG Set	Rs.5.25 Lakh
	c) Total annual electricity cost (utility + DG) - Rs	65.43+5.25=Rs.70.68Lakh
18	Avg overall Electricity rate/KWH	Energy charges Rs.8.74
19	Proposed Annual Electricity Units saving (KWH)	**3.59 Lakh KWH**
20	Proposed Annual Monetary Savings	**Rs.32.13 Lakh**
21	Proposed investment	**Rs.114.99 Lakh**
22	ROI / Payback	**3.5 Years**

23	Recommendations	
Sr No.	**Summary of Recommendations**	**Monetary Savings in Lacs**
i	Optimizing the existing contract demand from 324 KVA to 305 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	25176
ii	Improvement in power factor of the system from 0.904 to 0.999 by adjustment in capacitor bank/addition of capacitors/replacing defective capacitor	311791
iii	Replacement of existing ceiling/wall mounted type fitting 40-watt fluorescent tube lamp with ceiling/wall mounted LED batten tube light 4 feet 18-watt fitting	358567
iv	Replacement of Existing 9-watt direct fit CFL lamp with direct fit 7-watt LED lamp	3522
v	Replacement of existing 75/85-watt old conventional ceiling fan with BLDC BEE 5 star rated 28-watt 1200 mm sweep ceiling fan	1773923
vi	Replacement of existing 45-watt old conventional exhaust fan with BLDC BEE 5 star rated 20-watt exhaust fan	134115
vii	Replacement of existing 1.5 T old conventional window type-air conditioner with BEE 5 star rated 1.5 T window type AC	294503
viii	Replacement of existing 1.5 T old conventional split type-air conditioner with BEE 5 star rated 1.5 T split type AC	188784
ix	Replacement of existing 15 hp conventional submersible pump set with BEE 5 star rated energy efficient 12.5 hp submersible pump set	27025
x	Replacement of existing 5 hp standard motor of blower of STP with energy efficient motor	22077
xi	Replacement of existing 10 hp standard motor of collection tank of STP with energy efficient motor	20050
xii	Extra generation electricity units from Installed (55+45) KWp Solar plant in the campus as Renewal energy source	53193
TOTAL-Rs.		**3212726**
TOTAL in Rs. LACS		**32.13**

SUMMARY OF PROPOSED SAVINGS

Energy Source	Saving- Lacs KWH	Monetary saving- Rs. Lacs	Investment -Rs. Lacs
Electricity	3.59	32.13	114.99



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 60% 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, institute's management has installed (55+45) KWp roof top grid interactive Solar plant and it is generating about 55585 units of electricity annually which is excellent. The expected annual saving in electricity shall be about 8121units Which will be 3 % 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 324 KVA to 305 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			25176		
EEM-2	Improvement in power factor of the system from 0.904 to 0.999 by adjustment in capacitor bank/addition of capacitors/replacing defective capacitor	1	34923	311791	50000	0.16
EEM-3	Replacement of existing ceiling/wall mounted type fitting 40-watt fluorescent tube lamp with ceiling/wall mounted LED batten tube light 4 feet 18-watt fitting	770	41026	358567	154000	0.4
EEM-4	Replacement of Existing 9-watt direct fit CFL lamp with direct fit 7-watt LED lamp	8	403	3522	1200	0.3
EEM-5	Replacement of existing 75/85-watt old conventional ceiling fan with BLDC BEE 5 star rated 28-watt 1200 mm sweep ceiling fan	3297	202966	1773923	9231600	5
EEM-6	Replacement of existing 45-watt old conventional exhaust fan with BLDC BEE 5 star rated 20-watt exhaust fan	155	15345	134115	401450	2.9
EEM-7	Replacement of existing 1.5 T old conventional window type-air conditioner with BEE 5 star rated 1.5 T window type AC	39	33696	294503	936000	3.1
EEM-8	Replacement of existing 1.5 T old conventional split type-air conditioner with BEE 5 star rated 1.5 T split type AC	25	14668	188784	510000	3.9
EEM-9	Replacement of existing 15 hp conventional submersible pump set with BEE 5 star rated energy efficient 12.5 hp submersible pump set	1	3092	27025	100000	3.7

EEM	Proposed Energy Efficiency Measures	Nos	Annual energy saving - kwh	Annual monetary saving- Rs.	Total investment including installations-Rs.	SPB period -yrs
EEM-10	Replacement of existing 5 hp standard motor of blower of STP with energy efficient motor	1	2526	22077	35000	1.5
EEM-11	Replacement of existing 10 hp standard motor of collection tank of STP with energy efficient motor	1	2294	20050	50000	2.5
EEM-12	Extra generation electricity units from Installed (55+45) KWp Solar plant in the campus as Renewal energy source	1	8121	53193	30000	**0.5**
TOTAL		4299	**3,59,060**	**32,12,726**	**114,99,250**	**3.5**

NET SAVINGS

Units Saveable: - 3.59 Lacs KWH
Amount Saveable: - Rs. 32.13 Lacs
Investment: - Rs. 114.99 Lacs
Payback period: -3.5 Yrs.

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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 Sant Baba Bhag Singh University, near Adampur Jalandhar

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 & ENEGY AUDIT SERVICES** was entrusted by the authorities of Sant Baba Bhag Singh University 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.

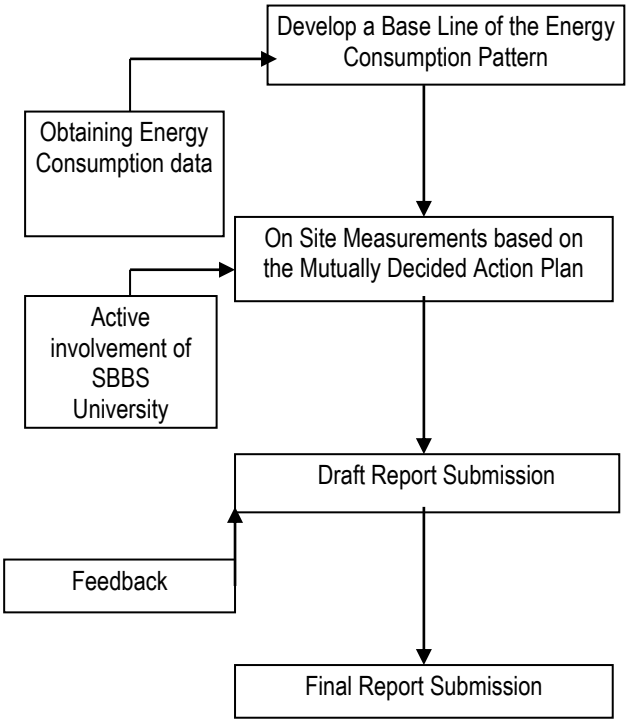
1.2 Back ground of Sant Baba Bhag Singh University, Jalandhar

The Sant Baba Bhag Singh Memorial Charitable Society, under the dynamic leadership of Sant Baba Malkit Singh Ji, has been providing essential infrastructure facilities to the people living in the vicinity of Dera Sant Pura Jabbar, near Adampur Doaba, Dist. Jalandhar. This includes constructing bridges and roads and providing street lights to villages. The Society began offering formal education by establishing the SBBS Institute of Engineering & Technology in 2003. This was followed by the establishment of SBBS International School in 2004, SBBS Institute of Education in 2005, SBBS Institute of Nursing in 2005, SBBS Research & Development Centre in 2010, SBBS Post Graduate College in 2011, and SBBS Public School, Binjon in 2011. Rural healthcare has been provided through Guru Nanak Sadh Sangat Charitable Hospital, Kalra, since 2003.
In pursuance of the vision: "To encourage each and every child to get educated, acquire knowledge and wisdom so as to learn the art of leading a happy, successful, and meaningful life," all these institutions established their presence in the field of education, leading to their flowering into Sant Baba Bhag Singh University, established under the

Sant Baba Bhag Singh University Act, 2014.
The institutions have made significant contributions in the field of education, as evidenced by excellent results and placement records. With state-of-the-art infrastructure catering to the needs of students, a pollution-free and drug-free campus, a focus on excellence in teaching, and the active involvement of students and faculty in co-curricular and extracurricular activities—including NCC, NSS, industrial visits, and a remarkable presence in sports among educational institutions—along with a culture of imbibing ethical values, Sant Baba Bhag Singh University is an ideal choice for 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

1.5. Calibration of measuring instruments

All the above measuring instruments used in the instant energy audit are duly calibrated from Accredited Lab.

CHAPTER – 2 BASE LINE SCENARIO & HISTORIC DATA ANALYSIS

2.1 OVER VIEW OF THE BUILDING

Area wise summary and detail of rooms:

Plot area- 469516.2821 Sq mt

Covered area of the building- 46159.4 Sq mt

The building has Ground + 5 floors

Block 3- comprise of education and society Lobby, wash rooms etc.

Block 5 comprise of Ground floor -room no.101 to120 Reception office, VC office, seminar hall, Faculty rooms and wash rooms etc.

Floor-1 Rooms 201 to 225, chancellor's office, conference room and wash rooms etc.

Floor-2 Rooms 301 to 325 and wash rooms etc.

Floor-3 Rooms 401 to 428, Faculty rooms and wash rooms etc.

Block 7 comprise of Law, computer applications, institute of commerce and management and wash rooms etc.

Block 8 comprise of Administration branch

Boys hostel and girls' hostel with mess, STP plant and wash rooms etc.

Auditorium, dispensary, gymnasium, canteen, transport office, mechanical workshop etc.

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2.2. REVIEW OF PRESENT ENERGY CONSUMPTION & BILLING:

PSPCL Account no	**3005850320**
Connected load	980 KW
Contract demand	324 KVA

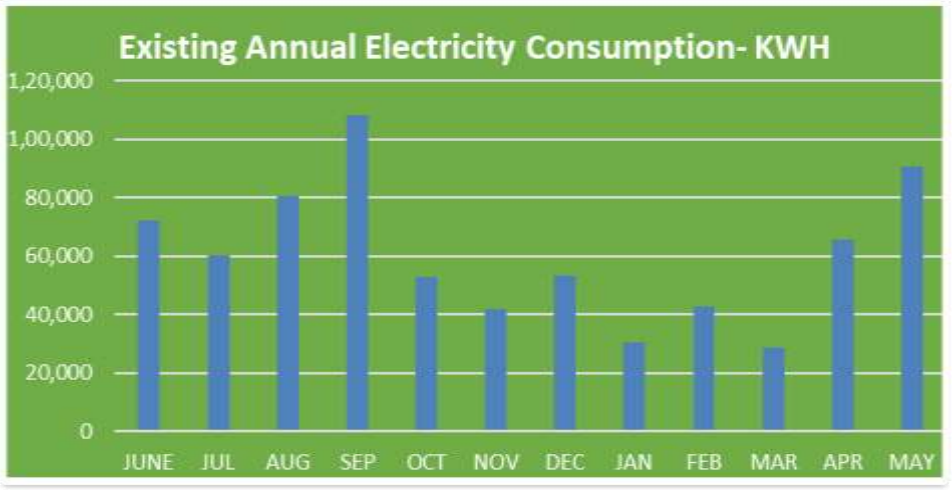
The details of electrical consumption copied from electricity bills for 2023-24

MONTH --> 2023-24	SOLAR GENERATION	SOLAR EXPORT	NET SOLAR CONSUMPTION	UTILITY CONSUMPTION	TOTAL CONSUMPTION	TOTAL CONSUMPTION	BILLING AMOUNT
	KWH	KWH	KWH	KWH	KWH	KVAH	Rs.
JUN	5639	0	5639	66508	72,147	75,268	624440
JUL	5369	12	5357	55068	60,425	66,805	565600
AUG	5071	16	5055	75552	80,607	84,843	723790
SEP	5587	0	5587	102608	1,08,195	1,13,049	1007980
OCT	0	0	0	53040	53,040	56,248	726080
NOV	9059	424	8635	33068	41,703	44,877	325080
DEC	4469	0	4469	48692	53,161	55,677	440630
JAN	1345	4	1341	29260	30,601	31,859	288680
FEB	4270	0	4270	38588	42,858	45,464	362450
MAR	2076	0	2076	26576	28,652	30,235	253320
APR	6893	4	6889	58792	65,681	68,276	486486
MAY	5808	0	5808	84749	90,557	93,586	738520
TOTAL	**55586**	**460**	55126	6,72,501	**7,27,627**	**7,66,187**	6543056

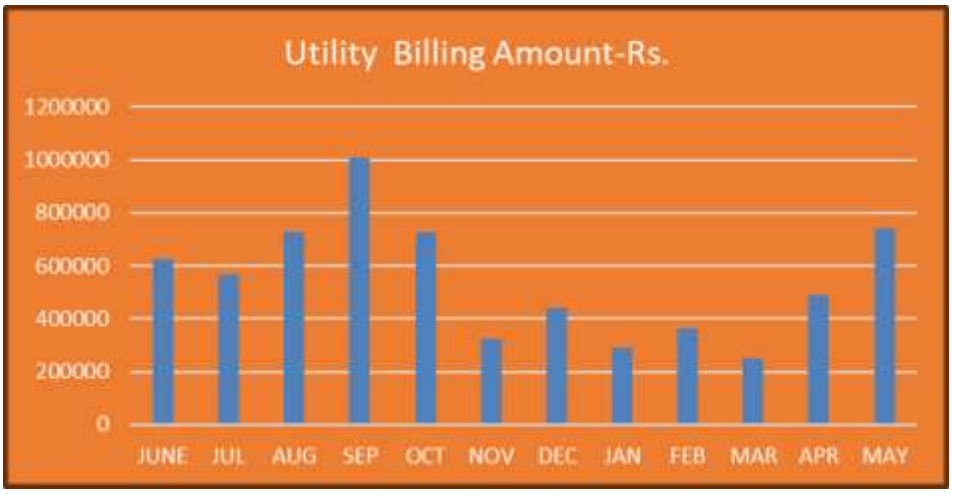
Year-2023-24	Value
Annual electricity consumption purchased from utility - Lacs kWh	6.73
Annual Amount of utility billing – Rs lacs	65.43
Existing Annual electricity consumption through Solar -kWh	0.55
Equivalent Annual electricity consumption through DG set - kWh	0.80
Equivalent Amount of DG consumption) – Rs lacs	5.25
Total Annual electricity consumption (Utility +Solar +DG) - Lacs kWh	8.08
Existing Amount of Total billing (utility + DG fuel) – Rs lacs	70.68
Existing Electricity overall rate, (70.68/8.08)-Rs/KWH	8.74

Thus, annual electricity consumption from utility of about **6.73 kWh** costing Rs.**65.43 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 65.43 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 --> 2023-24	TOTAL CONSUMPTION	TOTAL CONSUMPTION	SANCTIONED CD	MDI	FIXED CHARGES
	KWH	KVAH	KVA	KVA	Rs.
JUN	72,147	75,268	324	255.96	32212
JUL	60,425	66,805	324	217	38177
AUG	80,607	84,843	324	301.28	41601
SEP	1,08,195	1,13,049	324	301.28	43247
OCT	53,040	56,248	324	239.68	27440
NOV	41,703	44,877	324	121.92	38177
DEC	53,161	55,677	324	130.24	32212
JAN	30,601	31,859	324	108.52	41642
FEB	42,858	45,464	324	134.6	34503
MAR	28,652	30,235	324	239.68	10737
APR	65,681	68,276	324	176	40452
MAY	90,557	93,586	324	302	38825
TOTAL	**7,27,627**	**7,66,187**	**324**	**210**	**419225**

From the bill analysis, it is clear that monthly fixed charges levied on the monthly bill to the tune of ranging from Rs. 10737-43247 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 324 KVA TO 305 KVA

Energy Saving Opportunities

Reduce fixed cost of Power by surrender of fixed demand (Contract Demand) .CD to be reduced from current 324 KVA to 305 KVA.

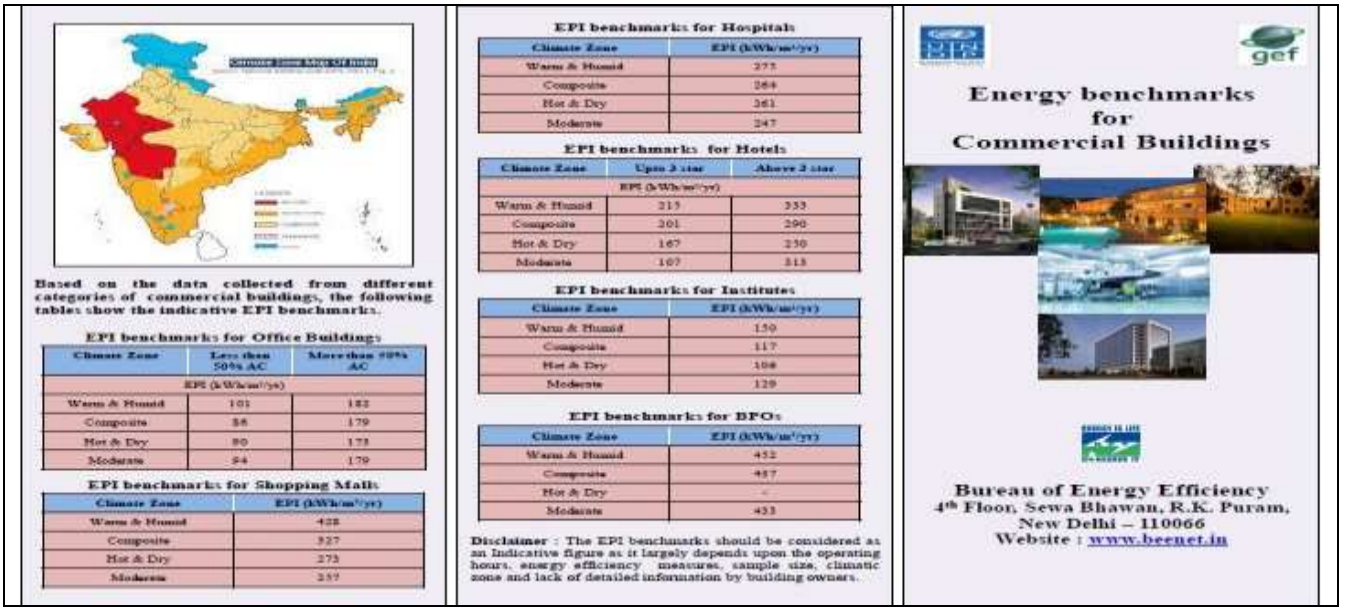
Description	Present KVA	Proposed KVA	Fixed Charges Per Month per KVA	Total Fixed Charges per Month in RS	Total Fixed Charges per Month in Rs after reduction in contract	Saving Per month in Rs	Saving Per Annum in RS
Contract demand	324	305	140	35790	33692	2098	**25176**

Thus, by reducing the existing contract demand from 324 KVA to 305 KVA, Rs. 0.25 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=807853 KWh

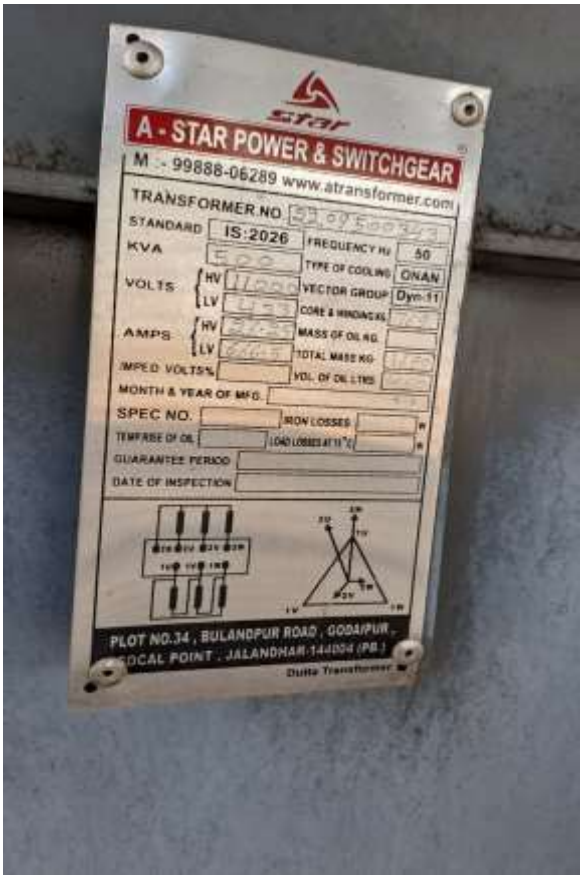
Total built up area of the building-46159.4 sqm

EPI=807853/46159.4; Hence EPI=17.50S/sqm/year

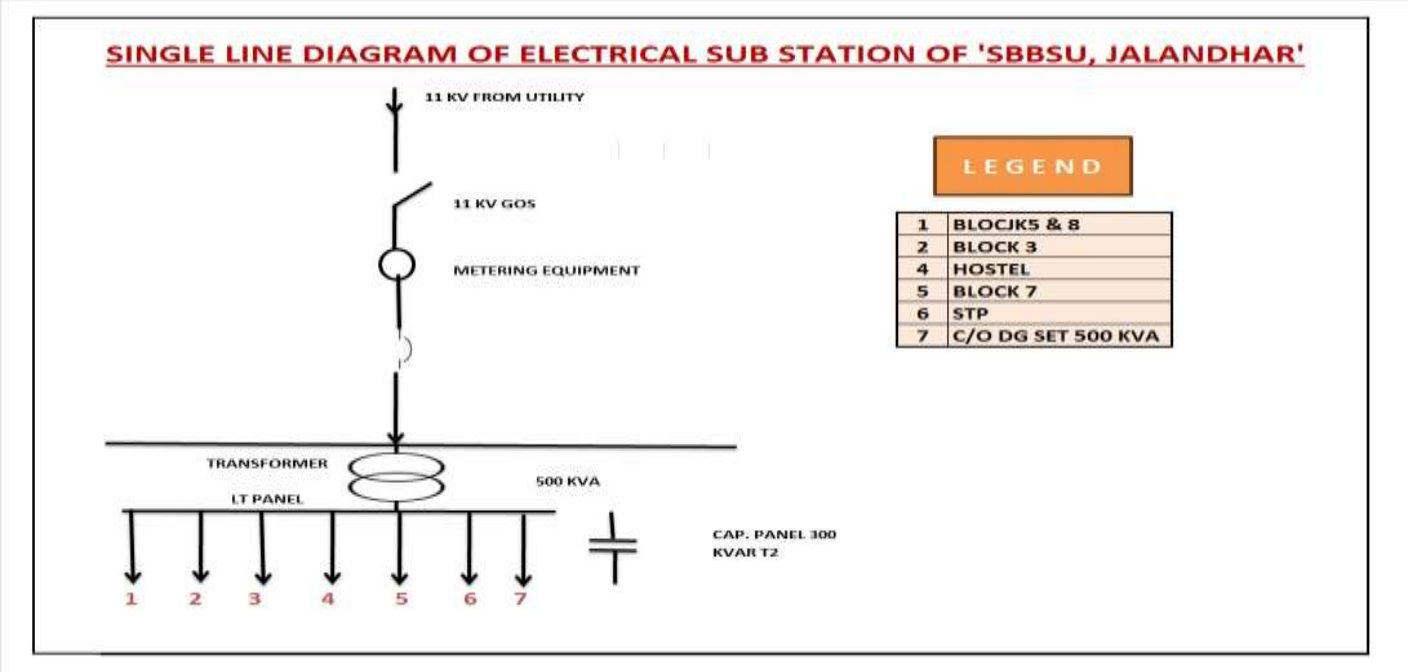
CHAPTER – 3 ELECTRICAL DISTRIBUTION SYSTEM

3.1. PURCHASED/SELF GENERATED POWER

Sant Baba Bhag Singh University, Jalandhar, 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 980 kW. Bi-directional metering equipment has been installed due to installation of roof top 50 & 45 KWp grid interactive solar power plants for the University campus. DG Set of 500 KVA and 200 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 Panel & Transformer



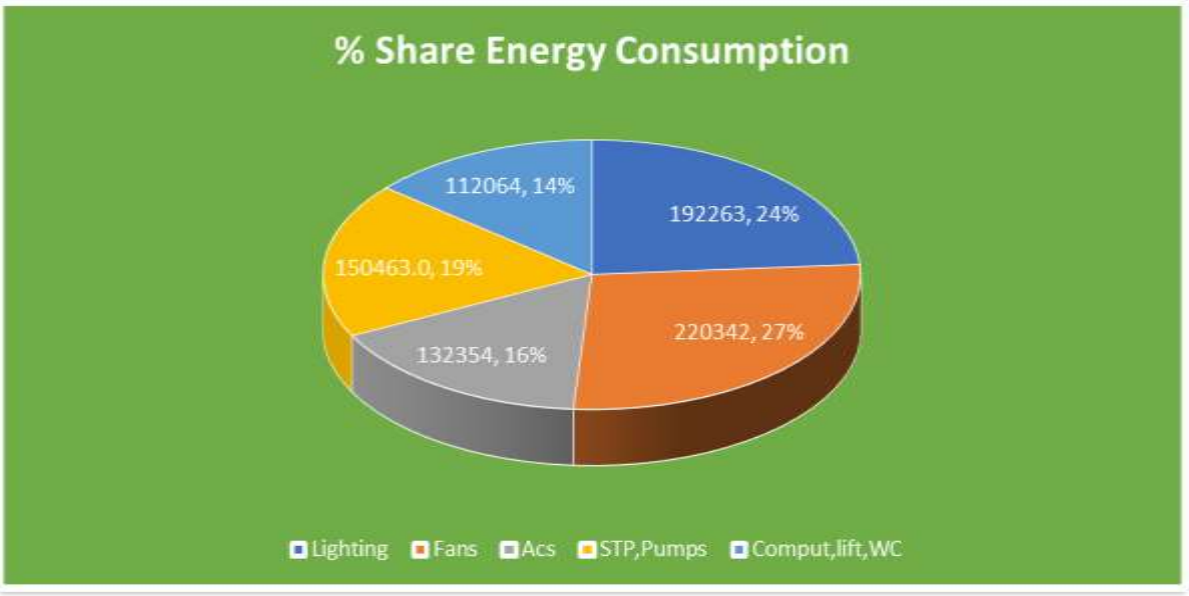
SLD/KEY DIAGRAM OF THE ELECTRIC SUBSTATION

3.2. BUILDING ENERGY CONSUMPTION PROFILE

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

Item	% Share
Lighting	23.8
Fans	27.3
Acs	16.4
STP, Pumps	18.6
Computer, lift, WC	13.9
TOTAL	100

% share of energy consumption in various fields



3.3. BUILDING LOAD PROFILE

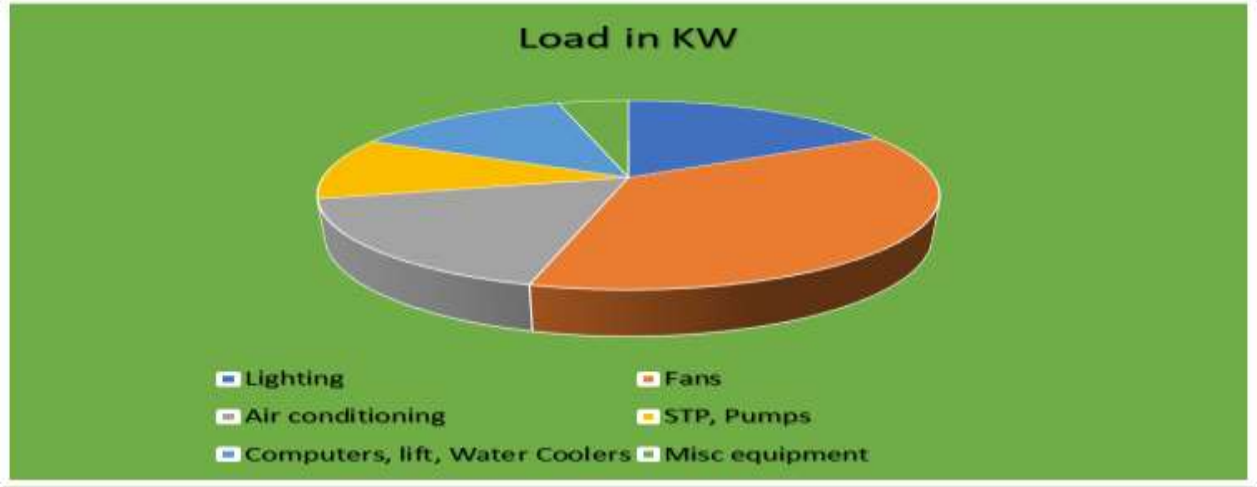
Connected / Sanctioned load of college: **980 KW**

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:

Item	Load in KW	% Share
Lighting	119	17
Fans	255	37
Air conditioning	118	17
STP, Pumps	73	11
Computers, lift, Water Coolers	94	14
Misc equipment	30	4
TOTAL	**689**	**100**

Load details of the building



Graph showing sharing of load

Findings and Recommendations

Sanctioned connected load of university building is 980 KW whereas load found to be 689 KW and found within permissible limits.

3.4. POWER QUALITY

MEASURING ELECTRICAL PARAMETERS OF T/F AT LT SIDE

A

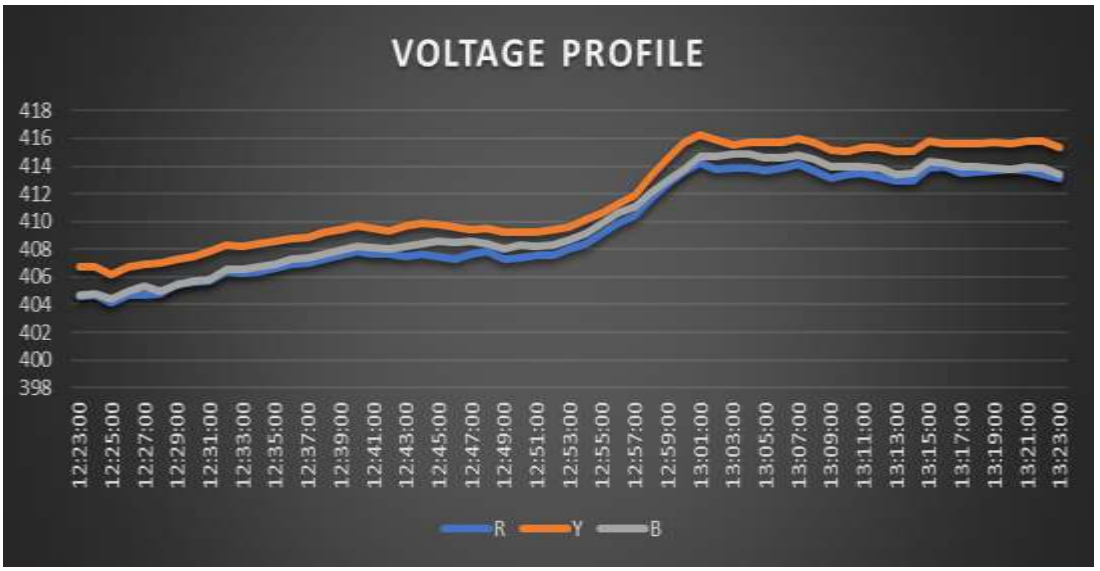
B

TRANSFORMER AND RECORDING OF PARAMETERS OF MAIN LT SIDE OF T/F

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

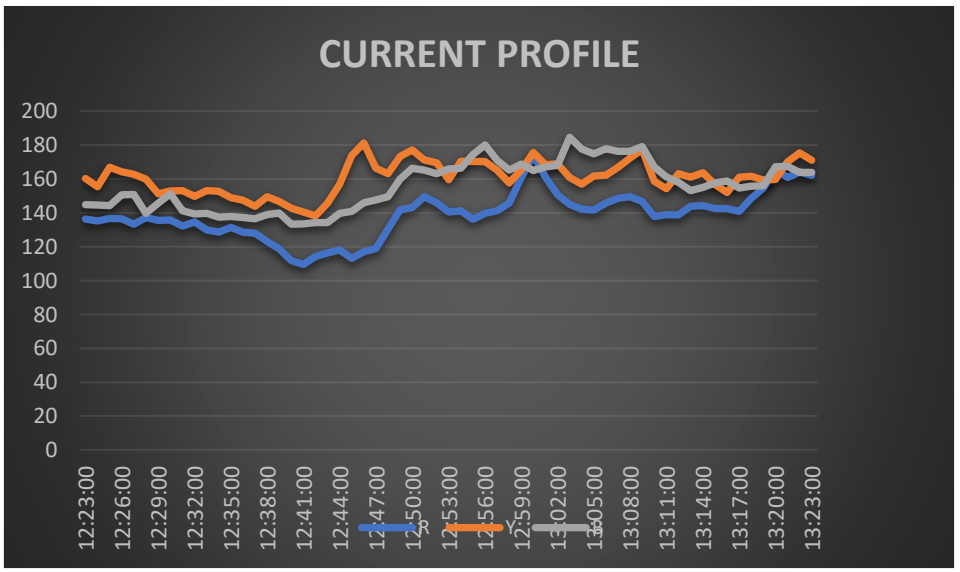
U rms	Urms	Urms	Average	%age
Line 1	Line 2	Line 3		im-balance
409.7	411.7	410.25	410.5	0.47

IMBALANCE VOLTAGE

IMBALANCE VOLTAGE

The unbalanced voltage is 0.47% 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
138.84	160.95	155.98	151.92	14.56

Imbalance current

IMBALANCE CURRENT

The unbalance current was observed to be **14.56 %.** 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%

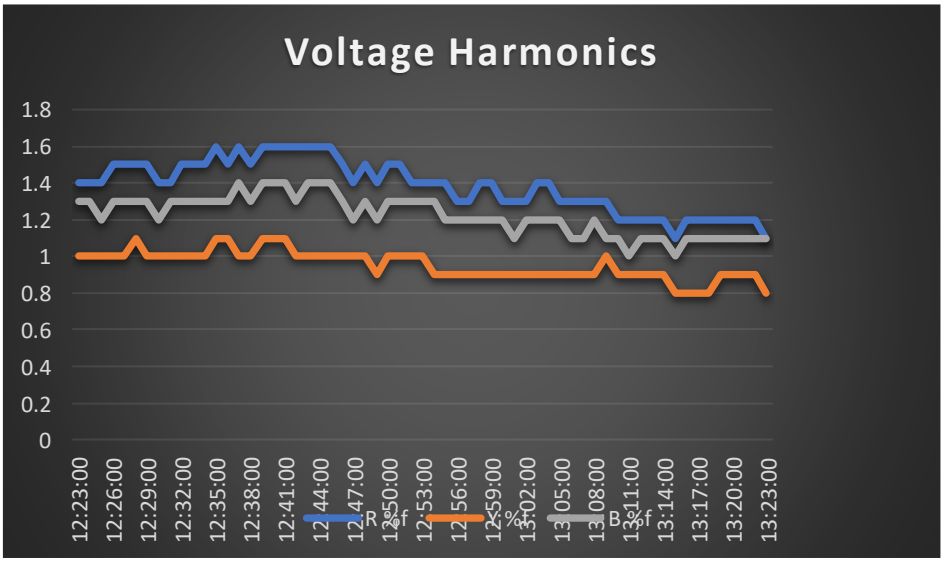
harmonic current limitations

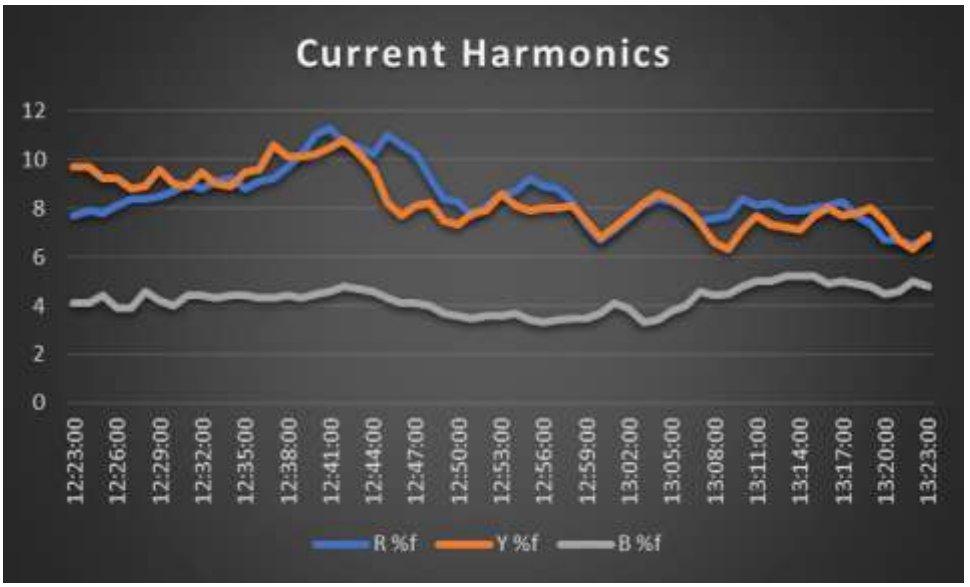
Maximum Harmonic Current Distortion in Percent of IL
120 Volt through 69 KV
Individual Harmonic Order (Odd Harmonics)

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	27-11-2023	8.5	6.5	11.3	% f
A2 THDf	27-11-2023	8.3	6.3	10.8	% f
A3 THDf	27-11-2023	4.3	3.3	5.2	% f
U12 THDf	27-11-2023	1.4	1.1	1.6	% f
U23 THDf	27-11-2023	0.8	1.0	1.1	% f
U31 THDf	27-11-2023	1.0	1.2	1.4	% f

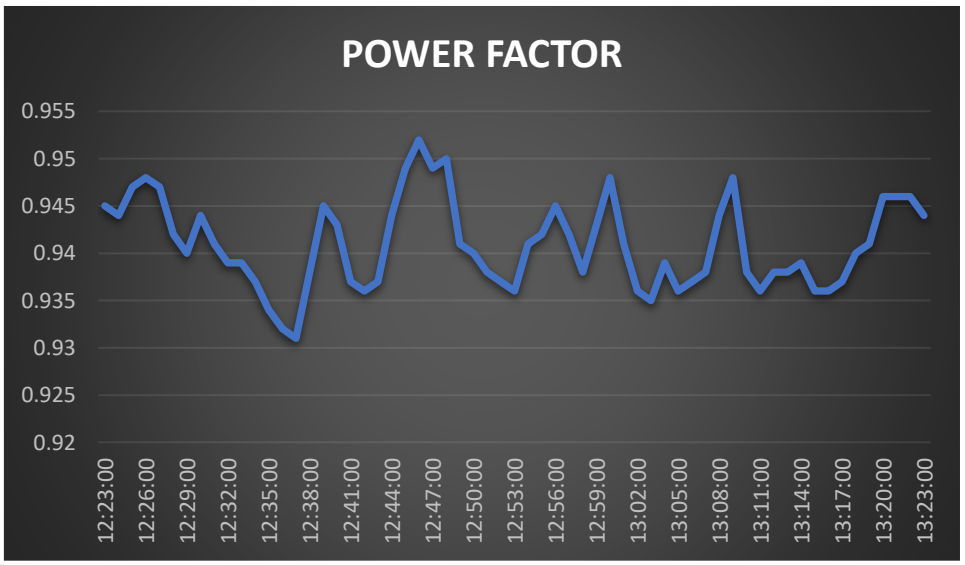
Av. Voltage THD & Current THD (%)

It is evident from the above table that the average voltage THD (%) was observed to be in range of 0.8 % to 1.4 % 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 4.3% to 8.5% which is in the prescribed limit as per IEE standard of Voltage harmonics of 12%.

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:



Findings & Recommendations:

Total 315 kVAR capacity capacitors have been installed.

The capacitors are installed in enclosed panels. The heat dissipated by capacitors is thus entrapped in enclosure and reduces their life. Even the louvers do not provide proper ventilation. The auditors measured room and capacitors enclosure temperature. It was 13.4^0C & 14.9^0C respectively. The difference is not much. It may again be measured in summer season and if substantial difference is observed, then, some louvers be provided. The auditors checked some capacitors most of capacitors are highly de-rated and drawing very less current. The capacitors drawing less current increase losses without appreciably increasing capacitance. These also increase harmonics level. It is suggested that these be opened. Their connections checked and damaged out of these be replaced. It is difficult to exactly calculate adverse effect

Study and analysis done of Power Factor in Electricity Bill of One Year 2023-204

Billing Month 2023-24	Consumption from Grid - KWH	Consumption from Grid - KVAH	PF	0.999	KWH Saving/Annum	SAVINGS - Rs
JUN	72147	75,268	0.959	0.040	2919	25516
JUL	60425	66805	0.904	0.095	5710	49908
AUG	80607	84843	0.950	0.049	3944	34470
SEP	108195	113049	0.957	0.042	4537	39657
OCT	53040	56248	0.943	0.056	2972	25975
NOV	41703	44877	0.929	0.070	2908	25414
DEC	53161	55677	0.955	0.044	2349	20532
JAN	30601	31859	0.961	0.038	1178	10293
FEB	42858	45464	0.943	0.056	2414	21096
MAR	28652	30235	0.948	0.051	1471	12861
APR	65681	68276	0.962	0.037	2431	21244
MAY	90557	93586	0.968	0.031	2840	24825
TOTAL	727627	766187	0.948	0.051	35674	311791

EEM-2 Improvement in Power Factor of the system from 0.904 to 0.999 by adjustment in capacitor bank /Addition of Capacitor/replacement of defective capacitors

Energy Saving Opportunities

Description	Existing Power Factor	Gap in Power Factor	KWH Savings Per Annum	Cost per KWAH	Investment-Rs	Saving Per Annum Value in Rs
Power Factor Improvement from 0.90 to 0.99	Min 0.904 Max 0.96	Varies as per above record	35674	8.74	50000	311791

The payback period is calculated to be 0.16 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**
410.55	151.92	0.940	101.64	108.13
Load on Transformer-500 KVA	**25.79 %**			

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 25.79% *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 Sant Baba Bhag Singh University, Jalandhar. The Total lighting details installed in the premises including hostel are given below.

4.2. LIGHTING LOAD DETAILS OF THE BUILDING **Total load: 119.31 KW**

Type of Luminary	No.	Watt	Ballast-Watts	Total-Watts	Hrs	Days	LF	Total KWH	KW
LED lights 18-watt Panel	4435	18	0	18	6	300	0.8	114955	79.83
LED lights 20-watt T/L	280	20	0	20	6	300	0.8	8064	5.6
CFL 12-Watt main road	8	12	3	15	12	365	1.0	526	0.096
FTL 4',40 watt	770	40	15	55	6	300	0.8	60984	30.8
LED lights 36-watt Panel	12	36	0	36	6	300	1	622	0.432
LED lights 60 watt	23	60	0	60	6	300	0.8	1987	1.38
LED lights 30 watt on main road	29	30	0	30	12	365	1	3811	0.87
LED lights 50-watt FL on main road	6	50	0	50	12	365	1	1314	0.3
								192263	**119.31**

4.3. LUX MEASUREMENT

A high-quality DIGITAL LUX METER was used to measure the illumination levels at various locations of Sant Baba Bhag Singh University, Jalandhar 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 206 FF				
	121	72	23	
	45	99	76	73

Location:1 room 206 FF				
Length of room	5.5	Area - m2	63.3	Max. Required
Breadth of Room	11.5	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	172	Watt/Square mtr	2.7	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	27.0	
Days per year	300	ILER	0.75	
Measured Av. Lux in the Room	73	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:2 room 203					Av lux
69	72	138	90	150	103.8

Location:2 room 203				
Length of room	5.8	Area - m2	16.8	Max. Required
Breadth of Room	2.9	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	80	Watt/Square mtr	4.8	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	21.8	
Days per year	300	ILER	0.61	

Measured Av. Lux in the Room	104	Actual -Lux/watt	1.30	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:3 room No.204					**Av lux**
180	105	70	58	100	102.6

Location:3 room No.204				
Length of room	5.8	Area - m2	16.8	Max. Required
Breadth of Room	2.9	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	72	Watt/Square mtr	4.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	24	
Days per year	300	ILER	0.67	
Measured Av. Lux in the Room	102.6	Actual -Lux/watt	1.43	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:4 room 224					**Av lux**
122	350	192	200	320	236.8

Location:4 room 224				
Length of room	12.2	Area - m2	71.0	Max. Required
Breadth of Room	5.8	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	20	Watt/Square mtr	0.3	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	840.5	
Days per year	300	ILER	23.35	
Measured Av. Lux in the Room	237	Actual -Lux/watt	11.84	

Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:5 room 402 Deptt of training & placement					Av lux
84	127	13o	310	617	284.5

Location:5 room 402 Deptt of training & placement				
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	80	Watt/Square mtr	2.4	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	117.6	
Days per year	300	ILER	3.27	
Measured Av. Lux in the Room	285	Actual -Lux/watt	3.56	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:6 class room 501 Deptt. Of life Science					Av lux
135	170	160	290	510	253

Location:6 class room 501 Deptt. Of life Science				
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	80	Watt/Square mtr	2.4	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	104.6	
Days per year	300	ILER	2.90	

Measured Av. Lux in the Room	253	Actual -Lux/watt	3.16	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:7 room 503 Dr. Shweta Sharma Dean					**Av lux**
120	175	105	200	210	162

Location:7 room 503 Dr. Shweta Sharma Dean				
Length of room	3.08	Area - m2	12.6	Max. Required
Breadth of Room	4.1	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	38	Watt/Square mtr	3.0	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	53.8	
Days per year	300	ILER	1.50	
Measured Av. Lux in the Room	162	Actual -Lux/watt	4.26	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:8 room 510 Plant Physiology, bio lab					**Av lux**
88	50	46	80	73	67

Location:8 room 510 Plant Physiology, bio lab				
Length of room	5.9	Area - m2	70.2	Max. Required
Breadth of Room	11.9	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	40	Watt/Square mtr	0.6	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	118.3	

Days per year	300	ILER	3.29	
Measured Av. Lux in the Room	67	Actual -Lux/watt	1.69	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:9 Conference Hall FF					**Av lux**
238	190	149	278	396	250

Location:9 Conference Hall FF				
Length of room	5.6	Area - m2	68.3	Max. Required
Breadth of Room	12.2	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	180	Watt/Square mtr	2.6	5 to 6
Hrs per Day of Lighting	6	Actual Lux/Watt/m^2	95.0	
Days per year	300	ILER	2.64	
Measured Av. Lux in the Room	250	Actual -Lux/watt	1.39	
Space height (Above working plane) ratio for fluorescent tubes	1.5			
Installed lighting efficacy ratio		- 5 to 6 watt / m^2		

Location:10 Library (reading area)					**Av lux**
238	190	149	278	396	250.2

		Location:10 Library (reading area)		
Length of room	24.32	Area - m2	279.7	Max. Required
Breadth of Room	11.5	RI	1	
Height from Table to Lamp	2	Target lux/w/sq. m as per standards	36	36
Total Lighting Load in the room	620	Watt/Square mtr	2.6	5 to 6

Hrs per Day of Lighting	6	Actual Lux/Watt/m2	95.0	
Days per year	300	ILER	2.6	
Measured Av. Lux in the Room	250.2	Actual -Lux/watt	1.39	
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	162 to 253 at 5 locations	> 150	AS perIS-3646 Part 11
Actual Lux/Watt/m^2	> 36 at 7 locations (21-25) at 3 locations	36	BEE Code
Watt/Square mtr	< 4 at 8 locations	5 to 7	ECBC+ building offices
Actual -Lux/watt	> 1 at 8 locations	1 to 2	BEE Code

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 40W luminaries

OBSERVATIONS

- During Audit, it was observed that the fluorescent tubes are fitted with magnetic blasts on conventional 40/36W 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-3 Replacement of 40W T-12 WITH 18 W LEDTUBE LIGHT

In the existing system 770 nos.40 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 40 watts installed in the campus

←

Energy Saving Calculation

Energy Saving Calculation		Units	Value
Total Number of fittings	=	Nos.	770
Existing annual Energy Consumption of 40 W T-12 FTL (including ballast) as per Sr.No.4.2 of above	=	kWh	60984
Proposed annual Energy Consumption of 18 W LED Tube Light;(770X18x6x300x.8/1000= 810KWH)	=	kWh	19958
Cost Benefit Analysis			
Proposed Annual Energy Savings potential;(60984-810=19958)	=	kWh	41026
Per Unit cost	=	Rs.	8.74
Proposed annual monetary savings;(8.74X141026)		Rs	358567
Investment/ fixture (including replacement cost)	=	Rs.	200
Total Investment	=	Rs.	154000
Simple Payback Period	=	Years	0.4

Energy saving by replacement of Florescent Light with Energy Efficient Tube Light

The payback period is calculated to be 0.4 years. Since the product life is much more than that, the move is economically beneficial and energy saving.

EEM-4 Replacement of existing CFL 12 watts with direct fit 7 W LED bulb

Energy Saving Calculation

Energy Saving Calculation		Units	Value
Total Number of fittings	=	Nos.	8
Existing annual Energy Consumption of 12-watt CFL including ballast as per Sr No.4.2 above	=	kWh	526
Proposed annual Energy Consumption of direct fit 7W LED bulb;(7x8x6x365x1/1000= 123 KWH)	=	kWh	123
Cost Benefit Analysis			
Proposed Annual Energy Savings potential (526-123)	=	kWh	403
Per Unit cost	=	Rs.	8.74
Proposed Annual Monetary Savings (403x8.74)	=	Rs.	3522
Investment/ fixture (including replacement cost)	=	Rs.	150
Total Investment	=	Rs.	1200
Simple Payback Period	=	Years	0.3

Replacement of existing 12 W CFL with direct fit LED 7-Watt direct fit lamp

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

CHAPTER – 5 STUDY OF FANS

5.1. STUDY FINDING OF FANS

The Fan details installed in the premises are given below

Sr No	Specification	Rating	Total nos.	Total load
	Item	Watt		(KW)
1	Ceiling Fans 1200mm sweep	75	3297	247
2	Wall fans	50	12	0.6
3	Exhaust fans	35/50	155	7.15

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

EEM-5 Replacement of 3297 nos. old conventional ceiling fans with 28W Energy efficient/5 star rated BLDC ceiling fans

It was observed and discussed with college authorities during the audit that 3297 Nos. ceiling fans are installed in the different Floors, class rooms and hostels building. Thus 3297 no. ceiling fans are recommended to replace the existing old ceiling fans with 24W BLDC energy efficient fans. The energy saving calculation is shown below:

Energy Saving Calculations

Energy Saving Calculation		Units	Value
Total Number of ceiling fans	=	Nos.	3297
Existing annual Energy Consumption of old conventional 85-watt Ceiling fan ;(3297x85x6x180/1000=302667KWH)	=	Watt	302667
Energy Consumption after replacement with 26 W energy efficient BLDC ceiling fans;(3297x28x6x180/1000=99701 KWH)	=	Watt	99701
Cost Benefit Analysis			
Proposed Annual Savings potential (302667-99701) =200008	=	kWh/year	202966
Per Unit cost	=	Rs.	8.74
Proposed Annual Monetary Savings;(8.74X202966=1773923)	=	Rs.	1773923
Investment-1200 mm sweep ceiling fan	=	Rs.	2800
Total Investment	=	Rs.	9231600
Simple Payback Period	=	year	5

Replacement of 3297 nos. old conventional ceiling fans with 28 W Energy efficient/5 star rated BLDC ceiling fans

5.3. Wall fans

Only 12 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

155 nos. Exhaust fans of 35/50 watt each are being used rarely in the campus, thus not recommended to replace as replacement is not viable.

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.

Presently 155 no. old inefficient conventional exhaust fans with power ranging from 35-50W as per table Sr. No.5 are being used to provide general ventilation to the washrooms, labs in the building. Taking average power as 45 watt and these may consume up to 75 watts

Recommendation

These are recommended to replace with 20watt 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)

5.5. Energy consumption of existing E/fans in the colleges

EEM-6 Replacement of 155 nos. of average 45 W inefficient exhaust fan with 20W 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.	155
Existing Electricity Consumption of old inefficient E/F, (155x75x6x300/1000=6026 KWH)	=	kwh	20925
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 (155x20x6x300/1000=268 KWH)	=	kwh	5580
Cost Benefit Analysis			
Proposed Annual Savings potential	=	kWh/year	15345
Per Unit cost	=	Rs.	8.74
Proposed Annual Monetary Savings	=	Rs.	134115
Investment/ fixture replacement	=	Rs. /Fixture	2590
Total Investment-Rs	=	Rs.	401450
Simple Payback Period	=	year	2.9

Replacement of 155 nos. existing conventional exhaust fans with energy efficient BLDC exhaust fans

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

CHAPTER – 6 STUDY OF HVAC SYSTEM

6.1. 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.

6.2. DESCRIPTION OF AC SYSTEM

Sant Baba Bhag Singh University, Jalandhar has installed 39 Nos. Window Air Conditioners & 25 Split air conditioners The detail is given below:

Air conditioner	Capacity	Type	Total
Boys Hostel	1.5T	window	12
Block-5	1.5T	window	14
Block-3	1.5T	window	1
School	1.5T	window	1
Nursing School	1.5T	window	1
Girls Hostel	1.5T	window	10
Block-8	1.5T	Split	14
Block-7	1.5T	Split	10
Transport office	1.5/2.25T	Split	1
	TOTAL	**window**	**39**
	TOTAL	**Split**	**25**

OBSERVATIONS & RECOMMENDATIONS

The Performance assessment of units not done due to lien season. BEE star rated AC's. **It is recommended to replace the old 25 no. Split Acs and 39 nos. window Acs with energy efficient BEE 5 star rated Acs which is a mandatory phase** as per star rated plan of BEE

- Regular Maintenance of the A/C is required for proper refrigeration effect by attending the gas leakages present and cleaning of the filters.

EEM-7 & 8

39 Nos. existing old inefficient window AC'S and 25 no. split Acs 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	Split 1.5 T
Total Number of Air conditioners	=	Nos.	39	25
Annual Energy Consumption of existing old and split ACs;(39x2000x6x180x/1000=84240KWH) ;(25X2000X6X180/1000=54000 KWH)	=	kwh	84240	54000
Proposed annual Energy Consumption of BEE 5 star rated energy efficient window and split ACs ;(39x1200x6x180x/1000=50544KWH) ;(25X1200X6X180/1000= 32400 KWH)	=	Kwh/year	50544	32400
Cost Benefit Analysis				
Proposed annual electricity savings	=	Kwh	33696	21600
Per Unit cost	=	Rs.	8.74	8.74
Annual Monetary Savings;(8.74x33696);8.74x21600)	=	Rs.	294503	188784
Investment/ fixture replacement	=	Rs. Fixtr	24000	30000
Total Investment	=	Rs.	936000	750000
Simple Payback Period	=	year	3.1	3.9

The payback period is calculated to be 3.1 and 3.9 years. Since the product life is much more than that, the move is economically beneficial and energy saving.

6.3. Water Cooler

Existing water cooler in the campus

39 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 – 7 STUDY OF COMPUTER SYSTEM

This institute has about 573 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 38678 KWh units. The auditors find no any saving in it as already existing computers are energy saver.

CHAPTER – 8 STUDY OF WATER PUMPING & STP SYSTEM

8.1. 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 25 no. PVC overhead tanks of 2000 lts capacity each on roof tops and 1 main overhead water tank with capacity of 5 Lakh KL. There is 1 no. submersible pump set of 1.5 hp for hostel and 2 hp installed for college to feed and store the water direct in the PVC tanks located at roof top. The pump installed for filling the tanks runs for app. 4-5 hrs. daily

Details of Pumps installed in the Campus

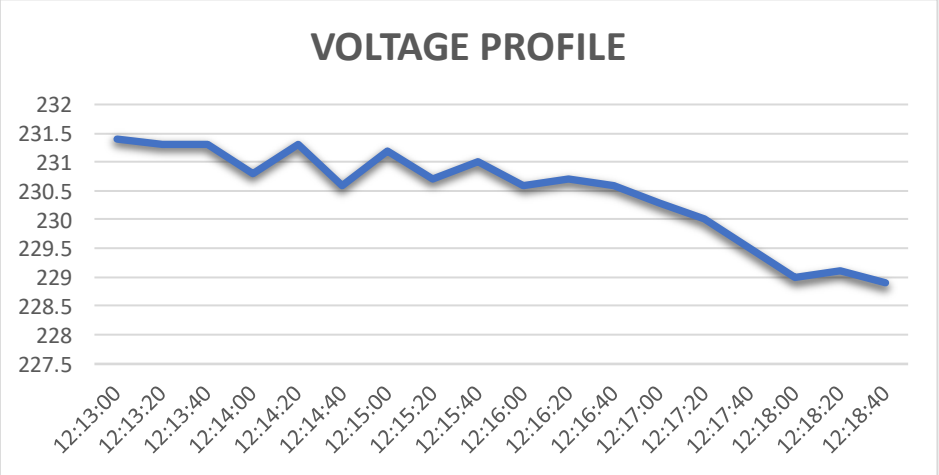
Sr.No.	Name	Quantity (Nos)	Capacity HP	Location	Working (per day)
1	Submersible Pump	1	20 HP	Near workshop	205 minutes
2	Submersible Pump	1	15 HP	Near Block 7	40 minutes
3	Submersible Pump	1	15 HP	Near Block 5	70 minutes
4	Submersible Pump	1	15 HP	Near Block 8	45 minutes
5	Submersible Pump	1	15 HP	Boys Hostel	225 minutes
6	Submersible Pump	1	1.5 HP	Ground	20 minutes
7	Submersible Pump	1	1.5 HP	Football Stadium	25 minutes

Auditors measured the parameters of submersible pump feeding to boy's hostel located near boys' hostel for checking the performance of the pump

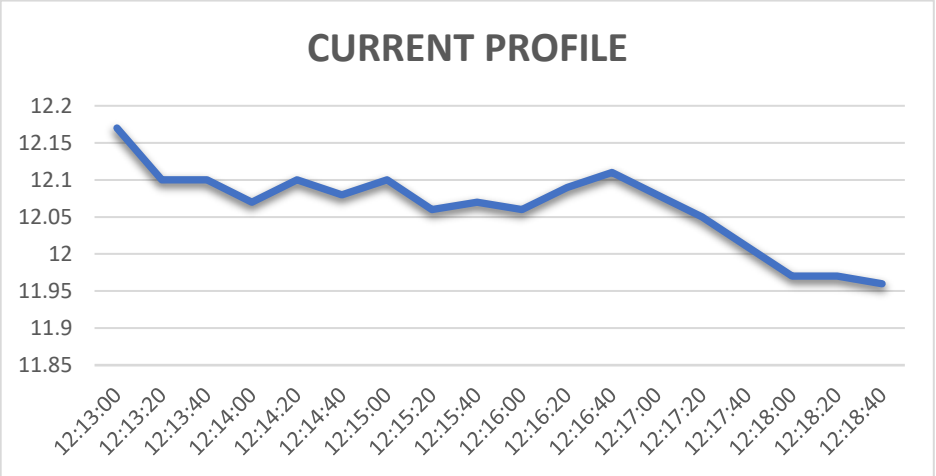
8.2. MEASURED PARAMETERS OF SUBMERSIBLE PUMP

Submersible pump near boys host

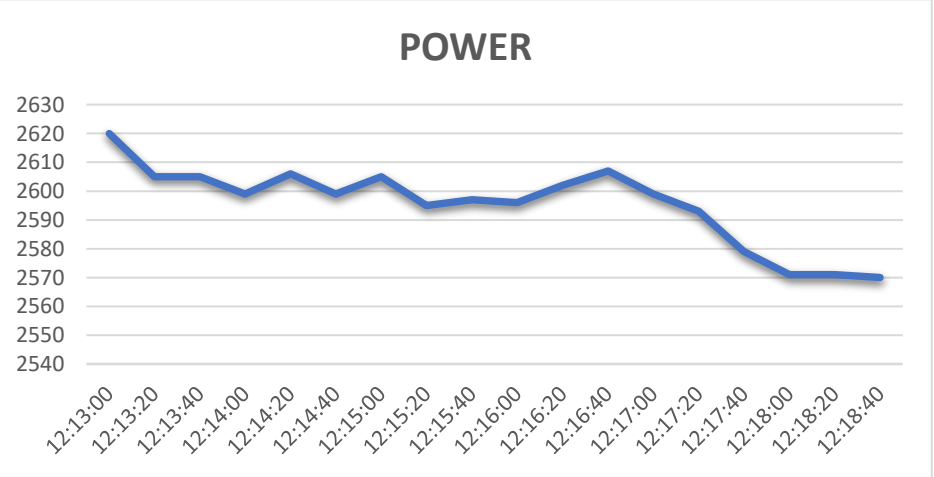
Narration	Date	Av	Mini	Max	
V rms	28-11-2023	393.66	392.97	394.4	V



Narration	Date	Av	Mini	Max	
A rms	28-11-2023	16.88	17.1	17.57	A



Narration	Date	Av	Mini	Max	
P (W)	28-11-2023	9.37	9.35	9.42	k W



The power of pump feeding to hostel was measured during the audit and found to be 9.37 KW.

Performance of main 15 hp pump near boys' hostel

Head assumed- -M	60
flow--M3/hr	11.7
Measured power -kw	9.37
Hydraulic power-kw	1.91
overall efficiency-%	20.42
Efficiency of pump=overall eff/motor Efficiency (.80)-%	25.52

RECOMMENDATIONS:

Overall efficiency of 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 located near boys' hostel with BEE 5 star rated energy efficient pump set of three phase12.5 hp,10 stage, H-70 M, appx 28m3/hr. The balance submersible pumps may be replaced with BEE 5 star rated energy efficient pump sets in phase manner or on damage of same.**

ITEM	Nos	Watts	Hrs	Days	kWh
Water pump set/15 hp	1	9370	4	330	12368

EEM-9 Replacement of the existing Submersible motor pump set near Boys hostel with BEE 5 star rated energy efficient pump set of three phase 12.5 hp,10 stage, H-70 M, appx 28m3/hr

Energy Saving Calculation

Item		Units	Pump 15HP
Submersible pump Motor pump 15 HP	=	Nos.	1
Annual Electricity consumption of existing pump	=	kWh	12368
Proposed Saving Potential after replacing with BEE 5 star rated energy efficient pump set @ 25 %, i.e.12368 x0.25=3092kwh	=	KWh	3092
Cost Benefit Analysis			
Per Unit cost		Rs.	8.74
Proposed Annual Monetary Savings	=	Rs.	27025
Investment for replacing with energy efficient motor pump sets complete in all respect.	=	Rs.	100000
Simple payback period	=	Years	3.7

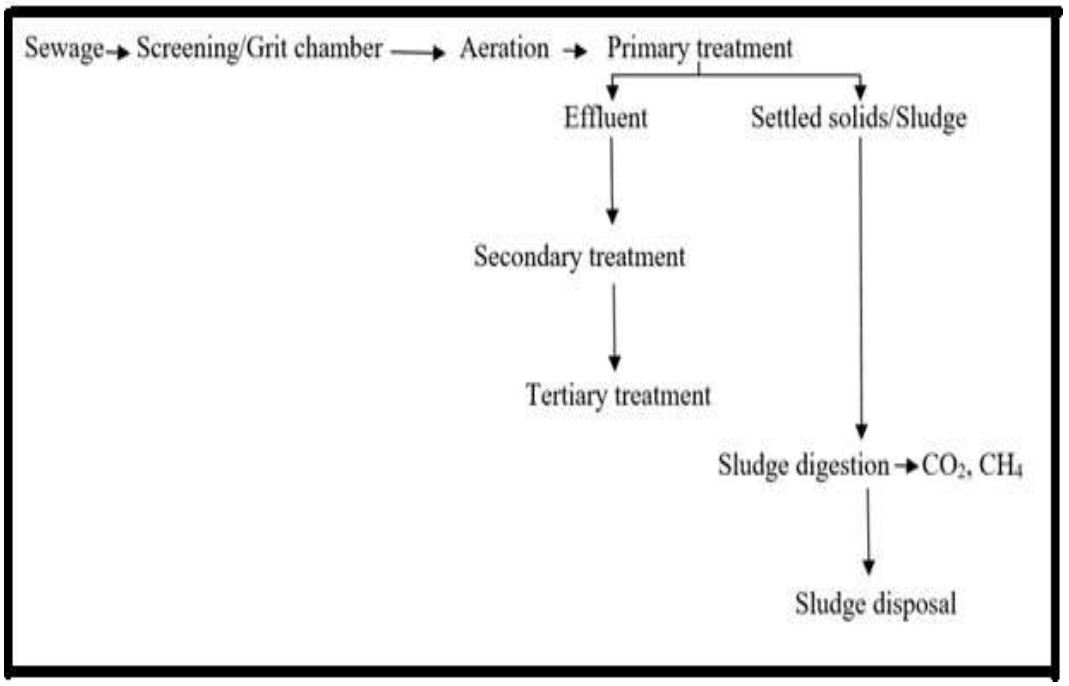
The payback period is calculated to be 3.7 year. Since the product life is much more than that, the move is economically beneficial and energy saving.

8.3. SEWAGE TREATMENT PLANT (STP SYSTEM)

Sewage treatment plant of capacity 600 KL/Day (MBBR BASED) comprises of Raw effluent pump, Air blowers and Filtration pumps

In a sewage treatment plant, sewage water is first allowed to pass through screens or grit chamber where large solids are removed. Effluent from primary treatment consists of 45-50 % unstable organic matter. The effluent then undergoes secondary treatment where fine solids settle out by means of bacterial activities resulting in secondary sedimentation The effluent then undergoes tertiary treatment/disinfection. Sand filters and reverse osmosis used in this stage of treatment,

Sludge is digested in a tank which results in the release of combustible gases: methane (CH_4) and carbon dioxide (CO_2); that can be used as fuel. The digested sludge can either be disposed by incineration or used as a fertilizer



Sewage treatment plant process flow

MBBR TYPE 600 KLD STP AT SBBS UNIVERSITY CAMPUS

Auditors measured the parameters of Root blower motor-pump set for checking the performance of the pump

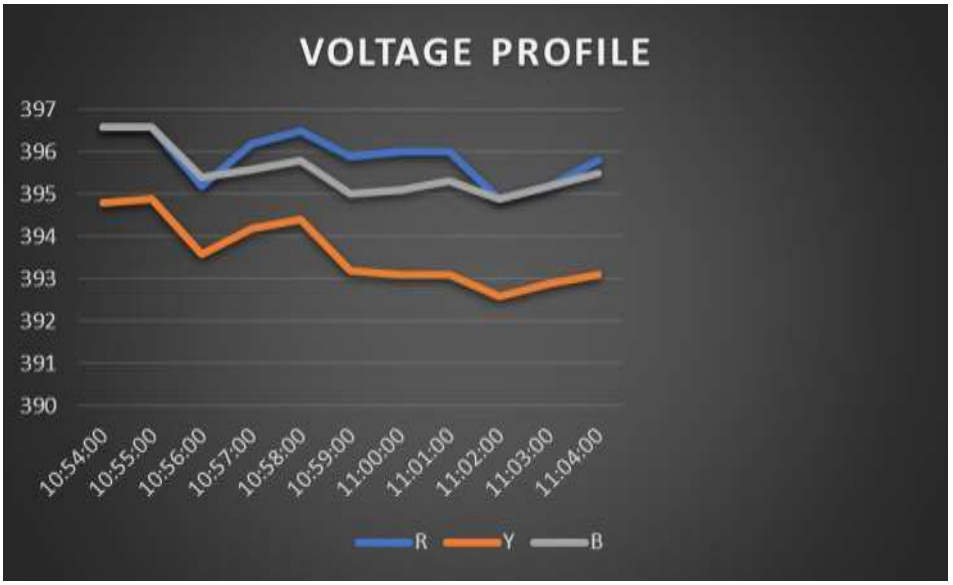
Root blower of 5 hp-Rated parameters

Capacity	5 HP
Pressure	0.40
RPM	1200
H	15M

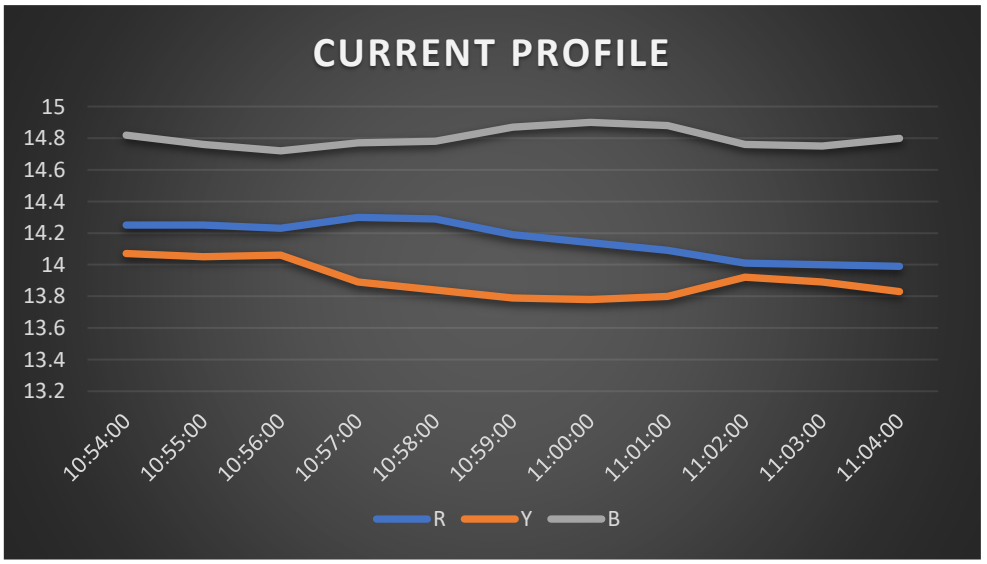
Measured parameters

V1	V2	V3	V Avg
395.9	393.6	395.5	395.02

A1	A2	A3	AAV	P(KW)
14.2	13.9	14.8	14.29	9.25



Voltage Profile



Current Profile

Power Profile

DEPARTMENT	KW	Head -M		Flow- LPS		Actual	Possible
STP	KW	Actual or Reqd	Rated	Actual or reqd.	Rated	motor load -KW	motor load -KW
Blower	3.7	4	4	41	41	9.25	3.8
Collection storage tank	7.5	7.8	7.8	41	41	8.4	7.4

EEM-10 & 11 Replacement of standard motor with energy efficient motors of STP

Energy Saving Calculation

Existing Motor	Rated HP	1no.5hp	1no.10 hp
	Input at FL KW	3.7	7.35
	Avg..Load kw	9.25	8.4
	% Age Load	250%	114%
	App. eff. of standard motor	81.00%	81.00%
Proposed motor	**App. eff. of E E motor**	87.00%	87.00%
	Energy saveable - kw	0.638	0.579
	Hrs / annum	3960	3960
	Energy saveable- kwh	2526.21	2294.07
	Amount saveable @ Rs 8.74/ kwh	22077	20050
	Investment	35000	50000
	Payback period--yrs	1.5	2.5

The payback period is calculated to be 1.5 & 2.5 years. Since the product life is much more than that, the move is economically beneficial and energy saving

CHAPTER – 9 STUDY OF DG SET SYSTEM

9.1. Sant Baba Bhag Singh University Jalandhar has installed 2 No. of DG Sets of 500 KVA & 200 kVA capacity with acoustic cover for providing backup to power cut-off from utility supply. 200 kVA capacity DG Set not being used due to defective

Existing DG Set 500 KVA installed in the university

9.2. Rated parameter

Make-Power Waves Industries, Mohali

DG Sr No.-1037**, Model-**GW-620

Rating: KVA-500**, KW-**400**, RPM-**1500

Diesel Consumption Details	FY 23-24
Annual- Lts	12389
Rate Rs / lts	83
HSD Billing – Rs	1028287
Equivalent HSD charges -Rs	667847
Electricity Generated-KWH	101961

9.3. 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. All are 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. All are housed in accosted cover. The exhaust pipe inside is well insulated. It is also good so that
   temperature inside does not unnecessarily increase.

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**

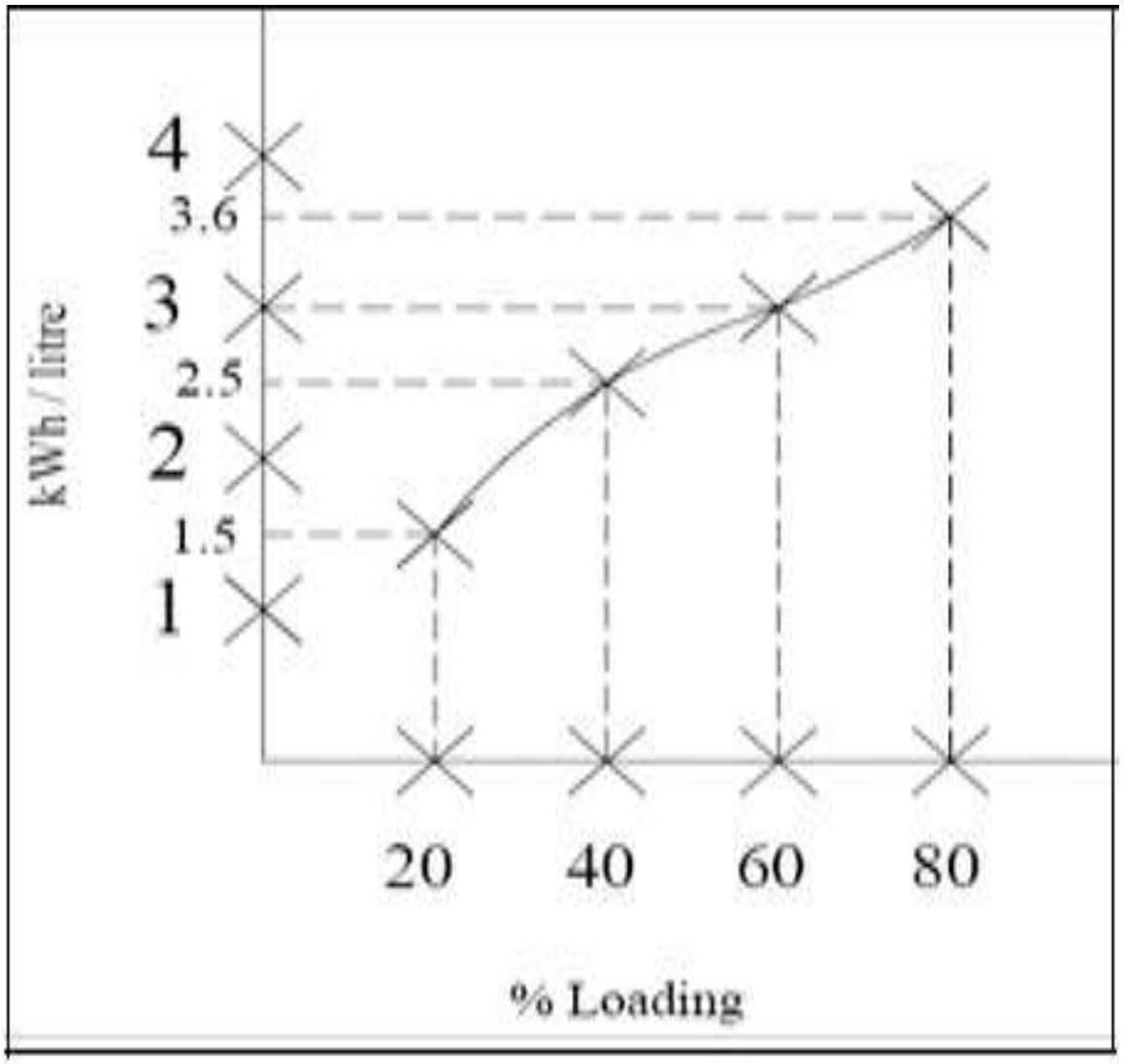
9.4. Energy saving in DG Set

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. **At present average power factor is 0.927 it is recommended to keep it around 0.8**



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**.

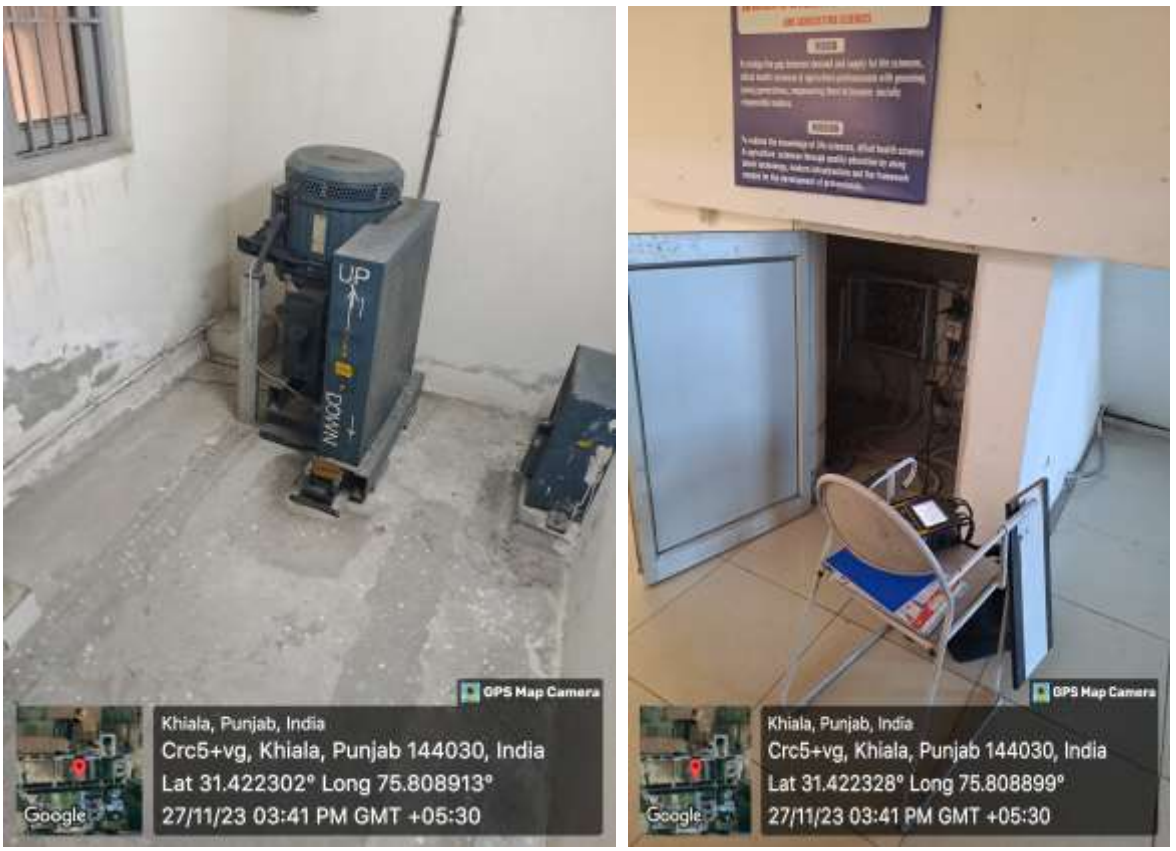
10. STUDY OF LIFT SYSTEM

One lift- has been provided for the comfort of students, staff and visitors in block-5

10.1. RATED PARAMETERS

Make	Ottis
Motor	3 phase squirrel cage induction
Motor voltage	415 V
RPM	1500
Power	4.5 KW

LIFT



AUDITORS CHECKED THE LIFT IN BLOCK-5

10.2. Summary of all the measurement data is tabulated as below:

Measured Parameters

v	A	KW	PF	REMARKS
414	5.67	3.3	0.827	**lift on load moving down ward**
415.5	2.4	1.5	0.912	**lift on load moving upward**
413.4	0.68	0.419	0.862	**lift on no load**

Main observations:

Main observations are as follows:

1. Occupancy level: Since presently occupancy level is normal in this building, actual operation is also being controlled very effectively on account of in built technology

2. Latest technologies: The lift is as per latest technology.

POWER MEASUREMENT DATA

We measured power in three conditions:

a) Lift moving upward

b) Lift moving downward

c) Lift at no load

10.3. DATA ANALYSIS FOR LIFT:

Power consumption is at the low level.

No load power consumption is less i.e. 0.41 KW

CONCLUSION:

The lift is operating very efficiently. The auditors do not find any saving in it. Therefore, energy saving potential–Nil.

CHAPTER – 11 STUDY OF SOLAR POWER SYSTEM

11.1. 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

11.2. Installation of 55 KWp & 45 KWp roof top Solar Power Plant in block-8 & block-3 respectively:

At present, power is sourced from the PSPCL at HV system
Metering is done at the HV level. Power is also generated using 1 DG set of 500 kVA. The average power generation from a 1 KWp SPV System is around 4-5 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.

11.3. Solar power plant Overview

The following are the salient features of the photovoltaic plant

Item	Description	Details
1	Project Type	CAPTIVE USE
3	Plant Capacity	**55 KWp & 45 KWp=100 KWp**
4	Project Location	Jalandhar
5	Project Applicant Name	Sant Baba Bhag Singh University Jalandhar
6	Technology – Modules	Mono perc Technology
7	Inverter type	50 KW
8,	Mounting Structure	Fixed Tilt- Rooftop
9	Evacuation Voltage	440 V
10	Annual Energy generation estimated end of 1st year with clear 330 sunny days	150480 kWh in the first year with fixed mounting structure.

INSPECTION AT SITE

11.4. Load distribution for solar system: Whole campus Load -980 KW

11.5 Performance evaluation

For performance evaluation some data has been collected and verified to the extent possible

The performance of a PV power plant is often denominated by a metric called the capacity utilization factor. It is the ratio of the actual output from a solar plant over the year to the maximum possible output from it for a year under ideal conditions. Capacity utilization factor is usually expressed in percentage. Capacity Utilization Factor (C.U.F) = (Actual energy from the plant (kwh)) / (Plant Capacity (KWp) x 24 x 365)

The energy generation of a plant primarily depends on two key parameters; solar radiation received and the number of clear sunny days experienced by the plant's location. These two factors affect the capacity utilization factor as well. According to the reports from MNRE in 2013, the average capacity utilization factor of solar PV plants in India is in the range of 15-19%. In particular, solar plants in Rajasthan has recorded the highest capacity utilization factor; it being in the range of 20%. The

geophysical location of these states has helped this cause. Moreover, it is interesting to note that the highest capacity utilization factor was for a Concentrated PV (CPV) plant and it came up to almost 35%. The C.U.F for several solar friendly states in India and the approximate output per day for a 1kWp plant is given below

11.6. The C.U.F for several solar friendly states in India:

State	CUF-%	Output for 1 KWp panel (kWh/day
Gujarat	18	4.32
Karnataka	19	4.56
Madhya Pradesh	19	4.56
Maharashtra	19	4.56
Punjab	19	4.56
Rajasthan	20	4.80
Uttarakhand	19	4.56
Tamil Nadu	19	4.56

11.7. Details of the unit generated:

MONTH/2023-24	SOLAR GENERATION-KWH
JUN	5639
JUL	5369
AUG	5071
SEP	5587
OCT	0
NOV	9059
DEC	4469
JAN	1345
FEB	4270
MAR	2076
APR	6893
MAY	5808
TOTAL	**55586**

11.8. Calculations of the Capacity utilization factor

Actual energy from the plant (Kwh) for the year 2023-24=55586

Plant capacity=55+45=100 KWp

Average Radiations=5.08 Kwh/m2

Capacity Utilization Factor (C.U.F) = (Actual energy from the plant (Kwh)) / (Plant Capacity (KWp) x 24 x365

CUF= 55586/100*8760

=0.063X100 = 6.3%

Findings: Thus, Utilization factor found less than as against prescribed value of 19, may be due to either some cloudy or maintenance issue

11.9. Losses in PV Solar systems

The estimated system losses are all the losses in the system, which cause the power actually delivered to the electricity grid to be lower than the power produced by the PV modules. There are several causes for this loss, such as losses in cables, power inverters, dirt on the modules, ambient temperature, varying insolation levels and so on.

11.10. Inverter efficiency

A solar PV inverter is a type of electrical inverter that is made to change the direct current (DC) electricity from a photovoltaic array into alternating current (AC) for use with home appliances or to be fed into the utility grid. These inverters may be standalone inverters, which are used in isolated systems, or grid tie inverters which are used to connect the power plant to the grid.

The efficiency of an inverter has to do with how well it converts the DC voltage into AC. The currently available grid connected inverters have efficiencies of 96 to 98.5%, and hence choosing the correct inverter is crucial to the design process.

There are less efficient inverters below 95% also available.

Inverters are also much less efficient when used at the low end of their maximum power. Most inverters are most efficient in the 30% to 90% power range

.

Checked up the inverter

Findings: The auditors tried to check the performance of the inverters but the same were not working, thus could not checked their performance

11.11. Module Degradation

The degradation of solar modules with temperature and time contributes significantly to the final output from the panel. As the output reduces each year. The effect of degradation of photovoltaic solar modules and arrays and their subsequent loss of performance has a serious impact on the total energy generation

11.12. Causes of degradation

Tests on module degradation are performed using real-time and accelerated exposures. These tests are conducted by institutions of international repute such as the Fraunhofer Institute, the National Renewable Energy Laboratory, Solar Energy Research Institute of Singapore and so on. These tests have successfully demonstrated that there is module degradation (usually less than 1% per year), and the possible reasons for this are the slow breakdown of a module's encapsulate

(usually ethylene vinyl acetate; EVA) and back sheet (polyvinyl fluoride films), the gradual obscuration of the EVA layer between the module's front glass and the cells themselves, and the deterioration of solar cells due to temperature increase. The silicon cells themselves have infinite life, except for the slight degradation due to thermal effects. The degradation of the module itself is due to a collection of factors as mentioned above.

Module encapsulate protects the cells and internal electrical connections against moisture ingress. Some amount of moisture does enter, and is forced back out on a daily basis, as module temperature increases. Sunlight slowly breaks down the encapsulation materials through ultraviolet (UV) degradation, making them less elastic and more plastic. Over time, this limits a module's ability to force out moisture. The trapped moisture eventually leads to corrosion at the cell's electrical connections, resulting in higher resistance at the affected connections and, ultimately, decreased module operating voltage.

The other cause for degradation is inherent to the silicon cells, resulting from exposure to sunlight, resulting in defects called metastable dangling bonds. These can be removed by heating the cell to a high temperature, something that is not possible in practice. The dangling bonds capture electrons, therefore reducing the electrical output and hence the efficiency. Research has shown that this form of degradation leads to a 15-20% reduction in efficiency.

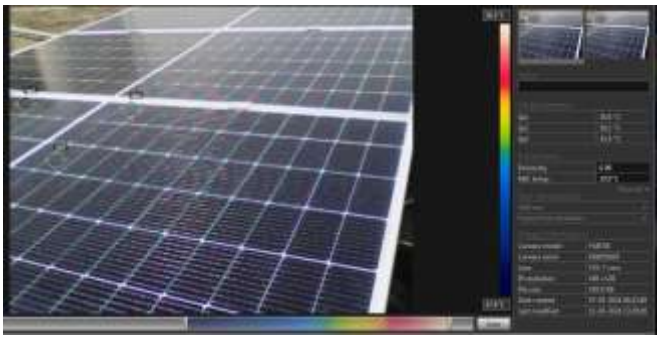
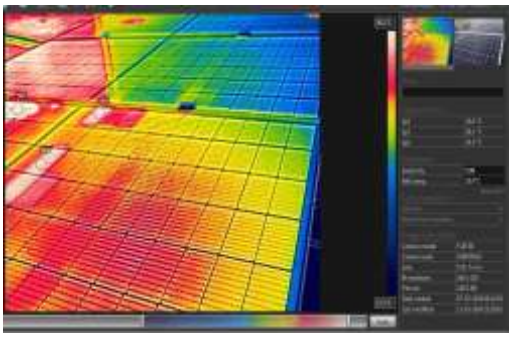
11.13. Temperature

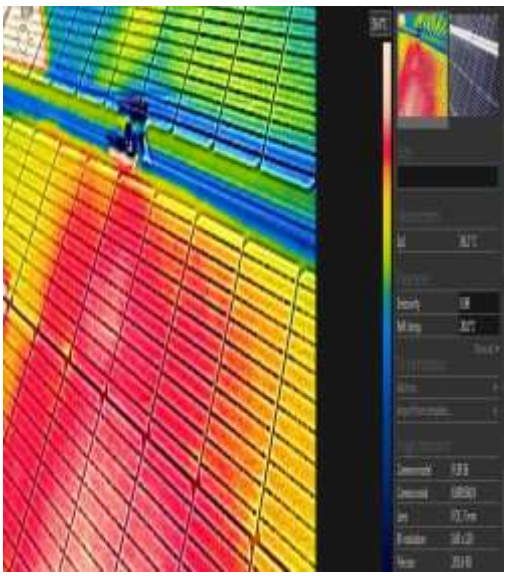
Module performance is generally rated under Standard Test Conditions

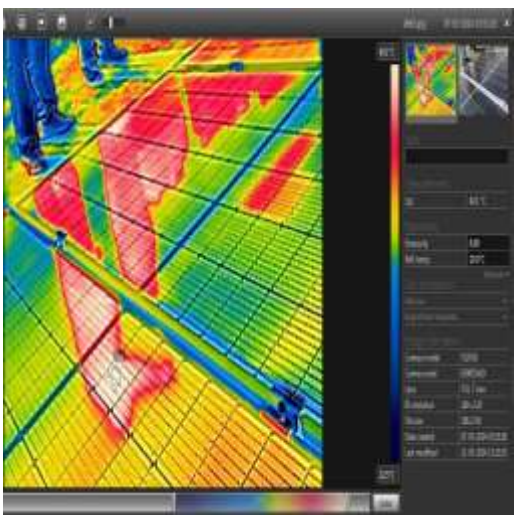
(STC): irradiance of 1,000 W/m², solar spectrum of AM 1.5 and module temperature at 26°C. All electrical parameters of solar module depend on temperature. The module output decreases with increase in temperature.

Some of the modules were tested within two hours of solar noon with module temperatures ranging from 26.1°C to 26.5°C. The measurements were conducted under clear sky conditions. The results found satisfactory

Thermal Scanning of some of Solar Modules





DIGITAL IMAGES THERMAL IMAGES

Observations & Recommendations:

The audit team inspected and measured some data at site and observations are as under:

PV modules found physically installed per plans (number and layout)

All are found shadow free

Array installation found neat and permanent

Roof penetrations are secure and weather tight

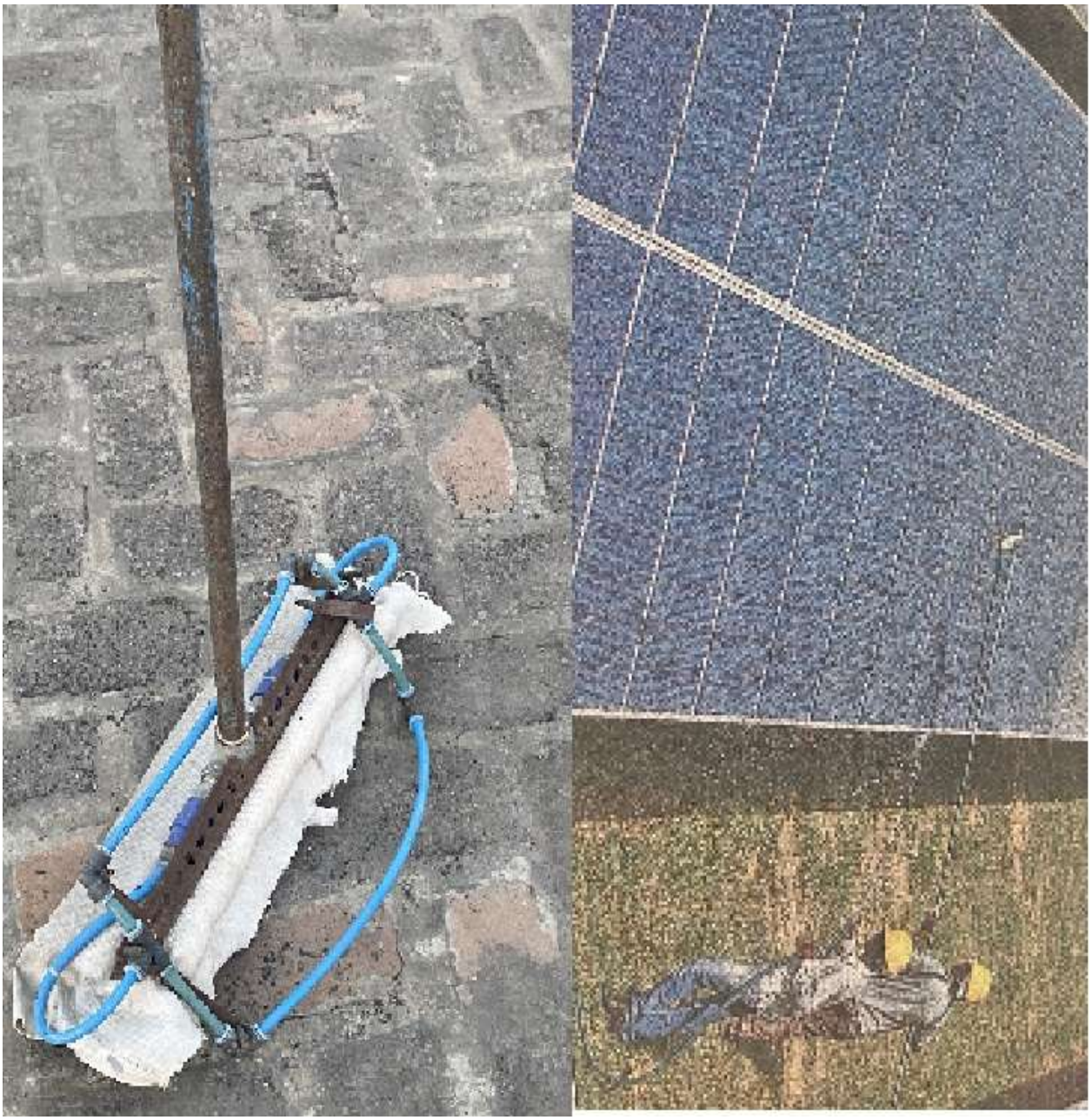
String fuses or circuit breakers are DC-rated and no larger than module fuse rating

PV modules are in good condition (no broken glass or cells, no discoloration, frames not damaged but needs cleaning

11.14. The generation of electricity from above table is as follows:

Narration	Value
Total for 2023-24	55586
Average /day; 55586/365=152.29) KWH	152.29
Energy /kw installed capacity ;(152.29/100 KWp=1.52)	1.52

The Solar panel is expected to generation an average over the year 4.6 kWh of electricity per day (considering 5.5 sunshine hours). If we consider 300 sunshine days, it comes to 4.56*100*300 =136800 kWH/annum for one 100 kW panel. We do not expect 4.56kwh/kw/day in this campus due to some deficiencies. Cleaning at roof top is difficult. The campus authorities may install a water pipe connection at certain locations. But it is not sufficient. Water pipe with proper tee off & valves be laid all around & each panel washed with water & cleaned with cloth at least once a week instead of fortnightly as done now. Practices at some buildings are shown below:



In the first image, a locally made scrubber with water pipe connected is used. The water pipe is connected at handle top & one person can do all cleaning. Here, both manpower & water is saved but cleaning is not very perfect. In second method, one person spays water & 2nd cleans it. It involves lot of water. Secondly a good approach & safety be provided for person going up for cleaning so that he feels secure.

11.15. We expect extra generation

EEM-12 Extra generation from solar power plant by improving cleaning process

Energy Savings Calculations

Item	Value
Solar Generation capacity-taking 300 sunny days,4.56*100*300 = 27600 - KWh	136800
Total generation in 2023-24-KWh	55586
Extra expected generation from solar power plant-KWh	81214
Total Energy saveable, assuming @10% from expected generation - kwh	8121
Amount saveable @ Rs 6.55/ kWh - Rs	53193
Appr investment for improving stairs, water piping, safety, extra lab chgs@2days/fortnightly -Rs.	30000
Payback period -yrs	0.5

The payback period is calculated to be 0.5 years. Since the product life is much more than that, the move is economically beneficial and energy saving

CHAPTER-12 Energy Monitoring & Accounting System

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

12.2. 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.

12.3. 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

12.3.1. 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.

12.3.2. 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

12.3.3. 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 8.08 Lakh KWH. It can hire a professional energy manager to visit & guide their staff –initially once afterwards1 visit once in 6 months.

CHAPTER – 13 ENERGY SAVING TIPS

Below are some of the energy efficiency tips in electrical utilities

13.1. 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.

13.2. 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%)

13.3. 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.

DocuSigned by:
Rakesh Kumar
78B66E70DBBE45A...

For R.K. Electricals and Energy Audit Services

(END OF THE REPORT)

ANNEXURES

i) Copy of Electricity Bill

4/25

ਪੰਜਾਬ ਰਾਜ ਪਾਵਰ ਕਾਰਪੋਰੇਸ਼ਨ ਲਿਮਿਟੇਡ
(ਪਹਿਲਾ ਦਫ਼ਤਰ P.S.E.B., ਮੁੱਖ ਦਫ਼ਤਰ, ਮਾਲ ਪਟਿਆਲਾ-147001, Ph 1912), CIN: U40109PB2010SGC033813
ਈ-ਮੇਲ: 1912@pspcl.in, ਵੈਬਸਾਈਟ: www.pspcl.in, GSTIN ਨੰਬਰ: 03AAFCP5120Q1ZC

ਬਿਲਿੰਗ ਸੂਚੀ
NRS RATE CATEGORY FOR NRS>100KWA DPC

ਉਪ ਮੰਡਲ	ਮੰਡਲ	ਹਲਕਾ	ਬਿਲ ਚੱਕਰ	ਬਿਲ ਦੀ ਮਿਤੀ	ਬਿਲ ਨੰ
ADAMPUR JALANDHAR	CANTT DIVISION JALAN	JALANDHAR	04-2023	26-APR-2023	10055200?5

ਖਾਤਾ ਨੰ: 3006880320 Old A/C No.: ਖਪਤਕਾਰ ਦਾ ਨਾਮ: M/S S.B.B.S UNIVERSITY ਪਤਾ: KHIALA GHURIAL ADAMPUR-144102-INDIA ਜਾਇਦਾਦ ਨੰਬਰ ਕੁਨੈਕਸ਼ਨ ਦੀ ਮਿਤੀ: 20-09-2011 ਮੋਬਾਈਲ ਨੰਬਰ: 98XXXXXX81	ਲੋਡ	ਠੇਕੇ ਦੀ ਮੰਗ	ਟੈਰਿਫ ਦੀ ਕਿਸਮ	ਬਿਲ ਸਥਿਤੀ	ਅਦਾਇਗੀ ਤਾਰੀਖ	ਬਿਲ ਦੀ ਰਕਮ
					ਨਕਦ/ਔਨਲਾਈਨ / ਚਿਕ/ਡਰਾਫਟ/ਚੈਕ	
	980.00	2??	NRS RATE CATEGORY FOR NRS>100KWA DPC	O	11-May-2023 / 09-May-2023	Rs.469930/-

ਵੋਲਟੇਜ Supply	ਮੀਟਰ ਨੰ	ਘਟਾਵਟ	ਸਮਰੱਥਾ	ਅੰਕ	ਮੀਟਰ ਸਥਿਤੀ	ਸੀਟੀ ਘਟਾਵਟ	ਸੀਟੀ ਨੰ
11.00	21006067	L&T	1-1.2	8	O		

ਕੀਮਤ ਕੋਡ	ਨਵੀਂ ਰੀਡਿੰਗ ਦੀ ਮਿਤੀ	ਪੁਰਾਣੀ ਰੀਡਿੰਗ ਦੀ ਮਿਤੀ	ਬਿਲ ਦੀ ਮਿਆਦ	ਮੀਟਰ ਸੁਰੱਖਿਆ	ਸੁਰੱਖਿਆ ਰਕਮ	ਸੁਰੱਖਿਆ ਟਰਾਂਸਫਾਰਮਰ ਸੁਰੱਖਿਆ ਚਿੰਨ੍ਹ
	26-APR-2023	23-MAR-2023	34	43800	668258	

ਮੀਟਰ ਪੜਤ

Type	ਪੁਰਾਣੀ ਪੜਤ	ਨਵੀਂ ਪੜਤ	ਵਰਤਮਾਨ ਯੂਨਿਟ	ਮੀਟਰ ਗੁਣਕ	ਲਾਈਨ ਸੀਟੀ ਅਨੁਪਾਤ	ਮੀਟਰ ਸੀਟੀ ਅਨੁਪਾਤ	ਸਮੁੱਚਾ ਗੁਣਕ	ਐਮਐਮਟੀਐਸ ਸੋਧ	ਪੁਰਾਣੀ ਮੀਟਰ ਖਪਤ	ਯੂਨਿਟ ਖਪਤ
KWH				1.00	200/5	200/5	1.00			
KVAH				1.00	200/5	200/5	1.00			
MDI				1.00	200/5	200/5	1.00		199.00	

(A) ਸਥਿਰ ਖਰਚੇ

ਠੇਕੇ ਦਾ ਲੋਡ / ਠੇਕੇ ਦੀ ਮੰਗ (L) KWH/KVA	ਅਸਲ ਲੋਡ/ ਅਸਲ ਮੰਗ KWH/KVA (A)	80% (L) ਜੇ ਕੋਈ (B)	A ਜਾਂ B ਜੋ ਵੀ ਵੱਡਾ ਹੋਵੇ KWH/KVA (C)	ਦਰ ਪ੍ਰਤੀ KWH/ KVA ਪ੍ਰਤੀ ਮਹੀਨਾ (R)	ਬਿਲਿੰਗ ਦਿਨ (D)	A: ਸਥਿਰ ਖਰਚੇ ਦੀ ਰਕਮ=CxRxDx12/365
		259.2	259.2	110.00	34	31871.00

(B) ਊਰਜਾ ਖਰਚੇ			(C) ਬਾਲਣ ਲਾਗਤ ਸਮਾਯੋਜਨ ਖਰਚੇ			ਲਾਗੂ ਅਧਾਰੇ			
KWH/KVAH	Tariff Rate	B: ਰਕਮ	KWH/ KVAH ਖਪਤ	FCS/KWH-KVAH ਦੀ ਦਰ	C: ਰਕਮ	ਯੂਨਿਟਾਂ	ਟੈਰਿਫ ਦਰ	ਰਕਮ	ਕੁੱਲ ਊਰਜਾ ਖਰਚੇ(Rs.) + ਸਥਿਰ ਖਪਤ ਭੱਤੇ/ਲਾਗੂ ਅਧਿਕਾਰਾਂ
	6.55	413908			0.00			0.00	413908

(D) ਕਿਰਾਏ ਦੇ ਖਰਚੇ				ਜੀਐਸਟੀ				
PSPCL ਮੀਟਰ ਲਈ ਮੀਟਰ ਕਿਰਾਇਆ	ਐਮਸੀਬੀ, ਸੀਟੀ/ਪੀਟੀ ਯੂਨਿਟ ਕਿਰਾਇਆ	ਕਿਸੇ ਹੋਰ ਉਪਕਰਣ ਲਈ ਕਿਰਾਇਆ	ਕੁੱਲ ਕਿਰਾਇਆ	ਐਚਐਸਐਨ ਨੰਬਰ	ਐਸਜੀਐਸਟੀ	ਸੀਜੀਐਸਟੀ	ਕੁੱਲ ਜੀਐਸਟੀ	D: ਟੈਕਸ ਦੇ ਨਾਲ ਕੁੱਲ ਕਿਰਾਇਆ
1527	0		1527		137.43	137.43	274.86	1801.86

(E) ਅਧਾਰੇ

ਵੋਲਟੇਜ ਅਧਾਰੇ				ਮੰਗ ਅਧਾਰੇ			ਟੀਓਡੀ ਅਧਾਰੇ			
ਸਪਲਾਈ ਵੋਲਟੇਜ	ਕੇਟਰਡ ਵੋਲਟੇਜ	ਅਧਾਰਿਆ ਦਰ	ਵੋਲਟੇਜ ਅਧਾਰਿਆ ਰਕਮ	ਵਾਧੂ ਮੰਗ	ਮੰਗ ਅਧਾਰੇ ਦੀ ਦਰ	ਮੰਗ ਅਧਾਰੇ ਦੀ ਰਕਮ	ਪੀਕ ਘੰਟੇ KWH/ KVAH	ਦਰ	ਰਕਮ	E: ਕੁੱਲ ਅਧਾਰੇ(Rs.)
11.00	11.00			0.00	0.00	0.00	0.00		0.00	0.00

(F) ਛੋਟ

ਵੋਲਟੇਜ ਛੋਟ			ਟੀਓਡੀ ਛੋਟ			
ਯੂਨਿਟਾਂ	ਐਚਟੀ/ਈਐਚਟੀ ਛੋਟ	ਰਕਮ	ਗੈਰ-ਪੀਕ ਘੰਟੇ KWH/KVAH	ਦਰ	ਰਕਮ	(F) ਕੁੱਲ ਛੋਟ(ਰੁ.)
	12638.00	0.00	16200.00	1.25	20250.00	32888.00

(G) ਪਿਛਲਾ ਸਮਾਯੋਜਨ/ਬਕਾਇਆ ਰਕਮ ਨੋਟਿਸ ਨੰਬਰ: ਅਤੇ ਮਿਤੀ:

Units	ਸਥਿਰ ਖਰਚੇ	ਊਰਜਾ ਖਰਚੇ	ਐਫਸੀਏ	ਕਿਰਾਇਆ	ਅਧਾਰੇ(+)	ਛੋਟ(-)	ਕਰ	ਸਬਸਿਡੀ	ਸਬਸਿਡੀ	G: ਕੁੱਲ ਪਿਛਲਾ ਸਮਾਯੋਜਨ (ਰੁ.)
		/		/			/0		/0	/0

(H) ਫੁਟਕਲ ਖਰਚੇ/ਭੱਤੇ ਨੋਟਿਸ ਨੰਬਰ: - ਅਤੇ ਮਿਤੀ: -

ਦੇਰੀ ਨਾਲ ਭੁਗਤਾਨ ਦਾ ਵਿਆਜ	ਯੂਨਿਟਾਂ	ਸਥਿਰ ਖਰਚੇ	ਊਰਜਾ ਖਰਚੇ	ਐਫਸੀਏ	ਕਿਰਾਇਆ	ਅਧਾਰੇ(+)	ਛੋਟ(-)	ਕਰ	ਸਬਸਿਡੀ	ਕੁੱਲ	H: ਕੁੱਲ ਫੁਟਕਲ ਖਰਚੇ/ਭੱਤੇ (ਰੁਪਏ)
	/	/	/ 0	/ 0	/ 0	/	/ 0	/ 0	/	27337	27337

(I) ਸਬਸਿਡੀ

ਸਬਸਿਡਾਈਜ਼ਡ KWH/KVAH	ਸਬਸਿਡੀ ਦਰ	ਰਕਮ/ਪੈਸੇ	I: ਕੁੱਲ ਸਬਸਿਡੀ (ਰੁ.)
	0.00	0.00	0.00

(J) ਕਰ

ਬਿਜਲੀ ਡਿਊਟੀ	ਨਗਰਿਕ ਕਰ	ਆਈਡੀਐਫ	ਗਊ ਕਰ	ਕੁੱਲ ਕਰ (J)	ਕੁੱਲ ਊਰਜਾ ਖਰਚੇ	TCS/TDS	ਵਰਤਮਾਨ/ਪਿਛਲੀ ਸਮਾਯੋਗ ਰਕਮ	ਕੁੱਲ ਬਿਲ ਦੀ ਰਕਮ
								Rs.469930/-
61934.00	0.00	20645.00	0.00	82579		0.00/		ਚਾਰ ਲੱਖ ਸੱਠ ਨੌਂ ਹਜ਼ਾਰ ਨੌਂ ਸੌ ਤੀਹ ਰੁਪਏ ਸਿਰਫ

(K) ਕੁੱਲ ਬਿਲ ਦੀ ਰਕਮ

FD

ii)LIST OF SOME VENDORS

FOR FANS	Havells Galaxy, SCO 19, Madhya Marg, Sector 7 C Chandigarh
	Orient Fans, Gupta Electronics, SCO 1117, Sector 22 , Chandigarh M - 7947243304

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

iii) 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.

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

KAB-EN-06

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.

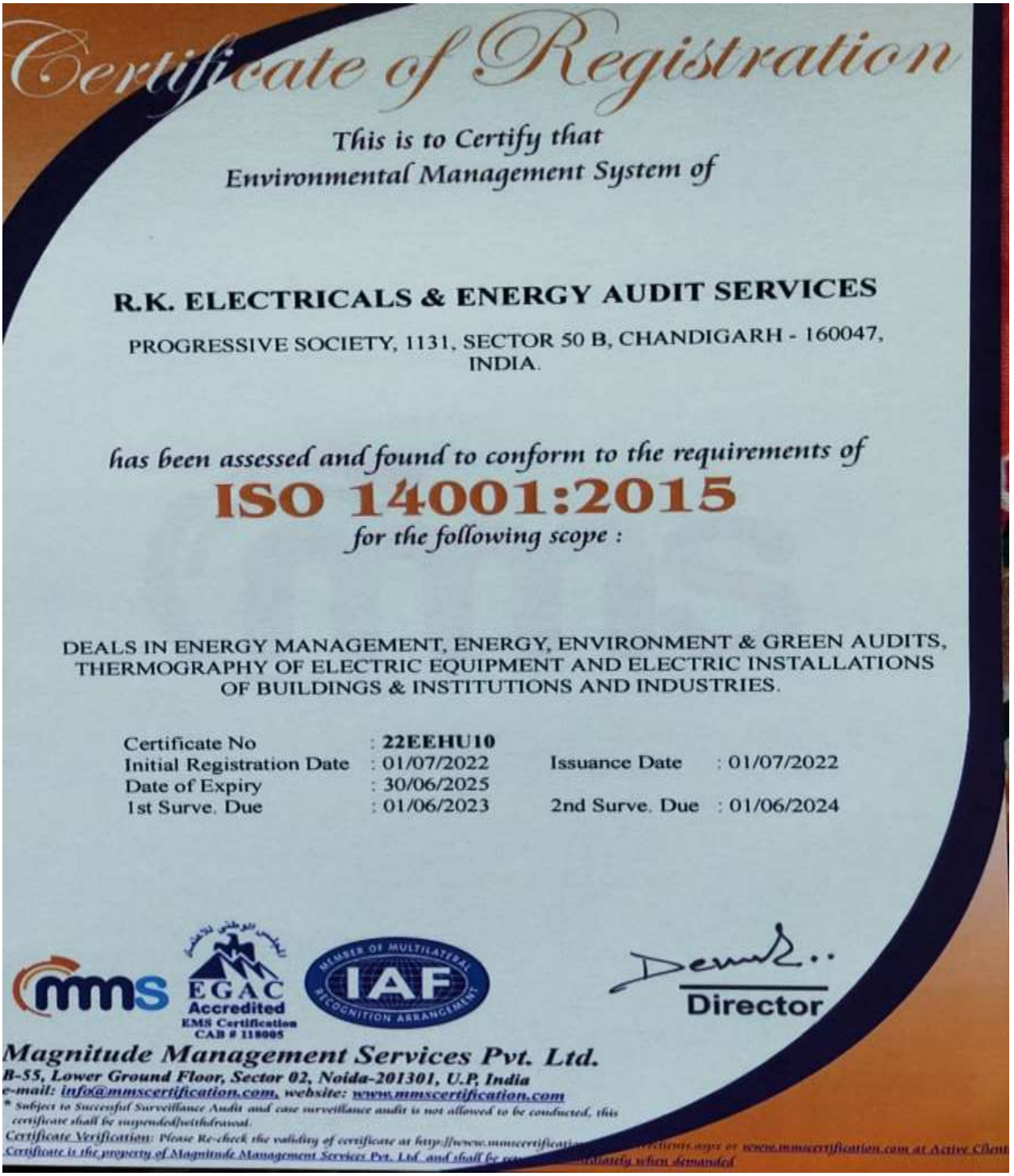
Certificate No	: 22EQHU11		
Initial Registration Date	: 01/07/2022	Issuance Date	: 01/07/2022
Date of Expiry	: 30/06/2025		
1st Surve. Due	: 01/06/2023	2nd Surve. Due	: 01/06/2024

Director

EGAC Accredited QMS Certification CAB # 118005

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...
Certificate is the property of Magnitude Management Services Pvt. Ltd. and shall be ... promptly 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

mms EGAC Accredited EMS 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
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Certificate Verification: Please Re-check the validity of certificate at http://www.mmscertificati... 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

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. Arun K. Singh, IAS
Chief Executive Officer
Punjab Energy Development Agency

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