ENERGY, ENVIRONMENT & GREEN AUDIT REPORT
FOR

Birla Institute of Technology and Science (BITS – PILANI)

From 19th to 22nd December 2022

By

IRCLASS SYSTEMS AND SOLUTIONS PRIVATE LIMITED

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1. Executive Summary

The Birla Institute of Technology & Science, (BITS) Pilani, Pilani Campus has been planned and designed to meet sustainable environmental standards. With growing awareness of environmental pollution and its hazards it has become necessary to take measures to make the campus an Eco campus. The Environment, Energy and Green Assessment of the campus was carried out to assess if measures taken by university are sufficient to make the campus environment friendly. This is the first attempt to conduct such Assessment of the Institute's Pilani campus .

This Assessment is mainly focused on Energy Savings, Water Management, Waste Management, Renewable Energy, Carbon Accounting , Green Belt / Landscaping/ Gardening.

To start with a Data Collection / Survey was done through a Questionnaire. Then On Site Assessment was carried out.

- Site Rounds to assess and understand the Set ups, Operations, Monitoring etc.
- Interactions with the Process Owners
- Obtaining Data related to Water, Energy, Waste, Plantations, Vehicle movements etc.
- Energy Efficiency measurements of High Power Consuming Machineries
- Compilation & Analysis of Data
- Evaluation of findings for Positive Points and identifying improvement areas.

Campus is steadily moving towards sustainability in electricity, water & uses of natural resources. Water conservation and systematic distribution of portable water supply is managed and monitored efficiently. Water used by campus residents is treated scientifically and recycled back to use in the campus, whereas the recycled water is being reused in flushing systems & in horticulture work. Our aim is to make it zero discharge campus.

Campus had also aimed to reduce its dependence on conventional power. In this regard, solar power plants and energy saving fixtures have been introduced and installed in the campus.

Usage of transport in the campus is very limited, whereas Battery operated vehicles are being introduced in campus for transportation. 5000+ students residing in the campus are not permitted to use their private transport inside the campus and are encouraged to use bicycles for their local movement inside the campus & public transportation for outside the campus.

2. Introduction

The Birla Institute of Technology & Science, BITS Pilani is an all-India Institute for higher education. The primary motive of BITS is to "train young men and women able and eager to create and put into action such ideas, methods, techniques and information". The Institute is a dream come true of its founder late Mr G.D. Birla - an eminent industrialist, a participant in Indian freedom struggle and a close associate of the Father of Indian Nation late Mr. Mohandas Karamchand Gandhi (Mahatma Gandhi). What started in early 1900s as a small school, blossomed into a set of colleges for higher education, ranging from the Humanities to Engineering until 1964 when all these colleges amalgamated to culminate into a unique Indian University of International standing. This university was christened as the Birla Institute of Technology and Science, Pilani, known to many as BITS, Pilani.

Over the years, BITS has provided the highest quality technical education to students from all over India admitted on the basis of merit. Its graduates may be found throughout the world in all areas of engineering, science and commerce. BITS symbolizes the maturing of Indian technical ability and "can-do" entrepreneurial spirit, especially as derived from the private sector. BITS is located in the Vidya Vihar campus adjacent to the town of Pilani in Rajasthan

BITS mission is to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century.

The Institute is committed to generating, disseminating, and preserving knowledge, and to working with others to bring this knowledge to bear on the world's great challenges. BITS is dedicated to providing its students with an education that combines rigorous academic study and the excitement of discovery with the support and intellectual stimulation of a diverse campus community. We seek to develop in each member of the BITS community the ability and passion to work wisely, creatively, and effectively for the betterment of humankind.

BITS, Pilani has been accredited by the National Assessment & Accreditation Council (NAAC) with 'A' grade with a CGPA of 3.45 on a four-point scale after visiting its Pilani, K.K Birla Goa & Hyderabad campuses in 2016.

ACADEMICS:

Integrated First Degrees:
BE, Pharm, M.Sc. & M.Sc. (Tech)
Higher Degree:
ME, Pharm & M.B.A
Doctoral Programs
Full Time Ph. D
Part Time Ph. D
Faculty development scheme
Ph. D aspirant scheme

3. General Introduction and Objectives of Environmental, Energy & Green Assessment Process:

The Environmental, Energy & Green Assessment is a process of systematic Identification, Quantification, Recording, Reporting and Analysis of components of environmental diversity of various establishments. It aims to analyze Environmental, Energy Conservation & Green practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambiance.

Objectives in brief:

- To ensure that the performance of the institution with respect to environmental activities they are involved in, is in compliance with existing laws and regulations.
- To check the functionality and their operating success including water supply, energy related matters and other similar matters that are related to green operations in the campus
- To measure the environmental impact of operational process related to green activities in the campus.
- To measure the performance of each green related operations and actions in the campus.
- To generate a database of green activities for continuous monitoring to assess the success of each of them.
- to identify future potential liabilities.
- to align the institution's developmental and day to day activities with the stated vision, mission, strategies, etc.
- to identify possible ways to reduce expenditure and running costs on equipment's, appliances, etc. or try enhance revenue income.

to improve process and materials efficiency, and in response to stakeholder requests for increased disclosure.

4. General Steps and Scope of the Assessment:

1. Data collection based on questionnaire.
2. Visit to the campus by audit team.
3. Data analysis and evaluation.
4. Discussion on the findings.
5. Report preparation.

5 . ENERGY MANAGEMENT ASSESSMENT

In the campus total 996.4 kWp of on grid roof top solar power plant installed and commissioned to use of renewable energy in the campus & and out of which 45 KWp roof top solar power plant was installed in 2019 was latest

- Total 26 Nos. standalone solar powered street lights are installed in the campus, which is estimated to save around 9, 90 kW of electricity annually.
- Around 80 Nos. of the street lights out of 495 in the campus are connected to off-grid solar power plant of 18.5 kW per day. These street lights work on solar power for about eight to ten hours every night, which is estimated to save around 6,753 kW of electricity annually. After exhausting the solar power, these street lights function on conventional power.

- Since 2014, hostels, residential quarters, academic and administrative blocks constructed as part of the infrastructure expansion by Project Parivartan, replace all CFL, Metal Hallide, Fluorescent tube lights are provided with LED fixtures to reduce consumption of energy. Similarly existing CFL, tube lights and other electrical fixtures are being replaced with energy saving LED fixtures in a phased manner.

- In campus 28 nos. (Each carry 2 nos. of four wheelers) of car parking stand having standalone solar powered lights, able to park 56 nos. of four wheelers.
- In campus all the newly renovated hostel's toilet lights & exhaust fans working are controlled with motion sensor to save electricity.
- In campus all street lights (Total No.495) fixtures are LED type.
- In campus all street lights (Total 495 Nos.) on/off with LDR, as per sun light intensity availability. No need to change time as seasons change.

Objective of Energy Audit:

- Identifying the quality and cost of various energy inputs.
- Assessing present pattern of energy consumption in different cost centers of operations.
- Relating energy inputs and production output. Identifying potential areas of thermal and
- electrical energy economy.
- To achieve and maintain optimum energy procurement and utilization, throughout the organization
- To minimize energy costs / waste without affecting production & quality.
- To minimize environmental effects.

Process:

Electrical, Mechanical and Thermal team worked independently and an Assessment is done based on measured energy data and historical data related to energy consumption collected from the university during the audit

Energy usage in the campus:

i. LPG
ii. Diesel
iii. Solar – a) Power
b) Water Heater
iv. Grid Electricity

- **Electricity bill amount for the last three years –**

Power is supplied by Ajmer Vidyut Vitran Nigam Ltd. The major electricity consuming equipment installed in the campus are Windows and Split AC, deep freezer (-80^0 C, 7^0 C etc.) Submersible pump, STP, Air Cooler, RO Plant, UPS, Desktop, Printer, Fans, Tube light, LED Bulb, Mosquito Replete. Fire Alarm System is not installed, however fire hydrant is available in the campus.

- **Rajasthan State Electricity Board (As per bill)**

Year 2018-19 – Rs. - 7,73,13,946

Year 2019-20 – Rs. - 12,56,48,424

Year 2020-21 – Rs. - 5,25,24,431

- **M/S Cleanmax Solar IPP Pvt. Ltd. (As per bill)**

Year 2018-19 – Rs.5404078

Year 2019-20 – Rs. 5994866

Year 2020 – 21 – Rs. 6213746

RSEB				Solar	
Month	**KWH**	**PF**	**RSEB Billing**	**KWH**	**Solar Billing**
April-21	366900	0.994	4216019	145286	636062
May-21	354720	0.996	3798964	131756	576809
June-21	467130	0.997	4812197	129587	523555
July-21	619110	0.996	6163136	120767	528722
August-21	619380	0.996	6263271	132879	581742
September-21	631140	0.997	6368798	101638	444697
October-21	681990	0.998	6729035	116986	512166
November-21	522990	0.998	5314220	92995	407133
December-21	694470	0.998	6832873	79557	348512
January-22	578550	0.998	5809059	74788	327750
February-22	439320	0.998	4569138	108778	476707
March-22	656790	0.998	6502990	138172	610375
Apr-22	960000	0.998	9250777	137749	606095
May-22	1128750	0.999	10796096	138820	610810
Jun-22	848370	0.998	8316567	135726	597197
Jul-22	857160	0.998	8414138	110344	485514
Aug-22	790380	0.998	7960795	126128	555840
Sep-22	1025280	0.997	10009653	111620	491129
Oct.-22	803370	0.999	7861859	110823	487624
Nov.-22	709740	0.998	7213931	94170	414346

4.2 Electricity Consumption

Birla Institute of Technology and Science, Pilani (BITS Pilani) uses electricity as its only energy source for its daily operations. Presently, the electrical supply comes from the grid at 33 kV. Two number of 33/11 kV step down transformer are installed at the main electricity incomer of source capacity 3.5 MVA each. Electricity at 11 kV is transferred to 14 transformers. These 14 transformers are supplying power to each building in university premises.
The electricity consumption for the last 12 months is considered for studying cost of electricity and the different charges associated with them. The detail of the same is given below.

Table 1. Electricity Consumption – 2021-22

RSEB				
Month	**kWh**	**PF**	**RSEB Billing**	**Unit Rate+ Additional Charges**
21-Apr	366900	0.994	4216019	11
21-May	354720	0.996	3798964	11
21-Jun	467130	0.997	4812197	10
21-Jul	619110	0.996	6163136	10
21-Aug	619380	0.996	6263271	10
21-Sep	631140	0.997	6368798	10
21-Oct	681990	0.998	6729035	10
21-Nov	522990	0.998	5314220	10
21-Dec	694470	0.998	6832873	10
22-Jan	578550	0.998	5809059	10
22-Feb	439320	0.998	4569138	10
22-Mar	656790	0.998	6502990	10
22-Apr	960000	0.998	9250777	10

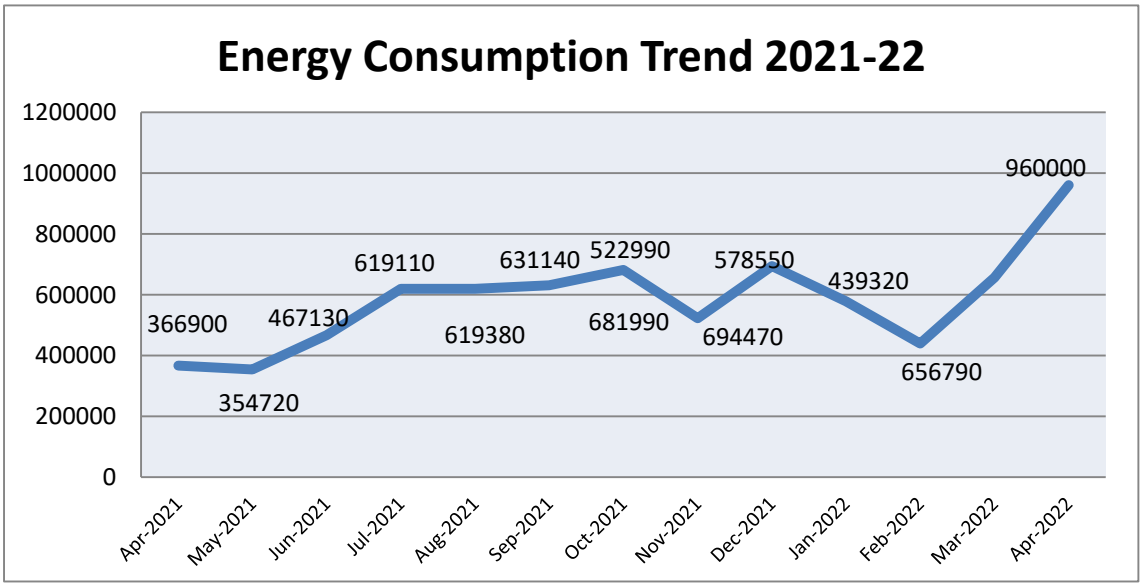


Figure 1. Electricity Consumption – 2021-22

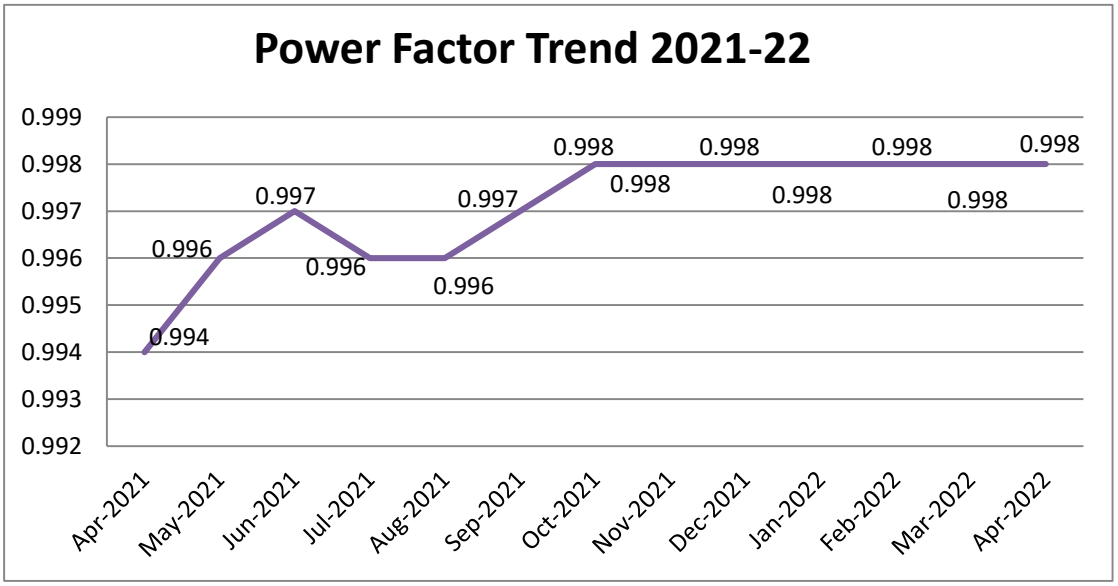
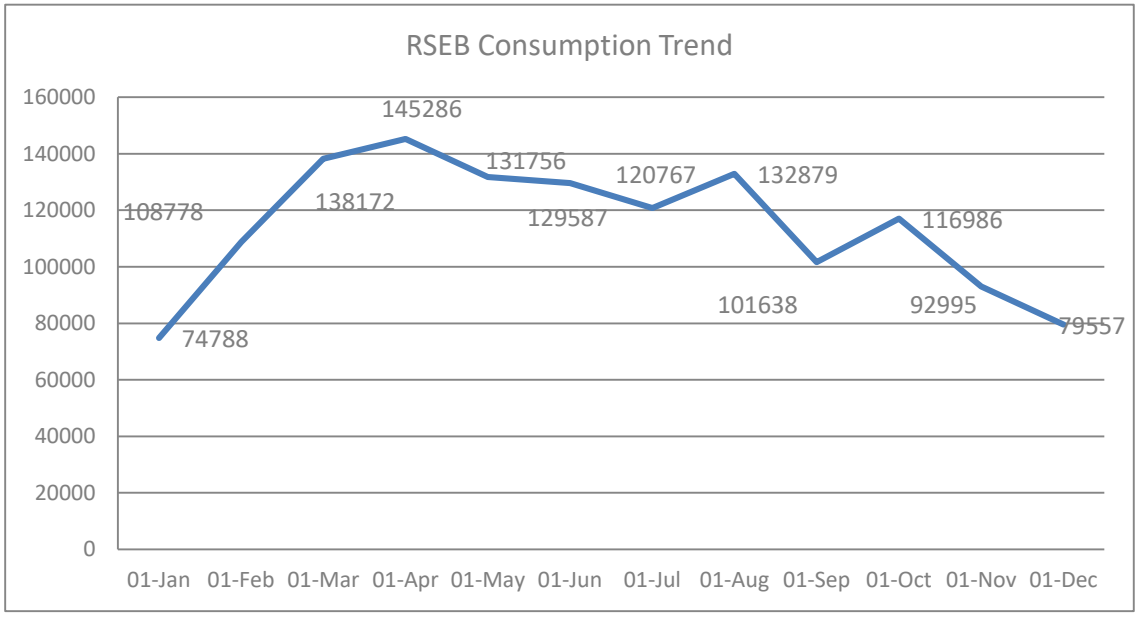


Figure 2. Power Factor Trend 2021-22

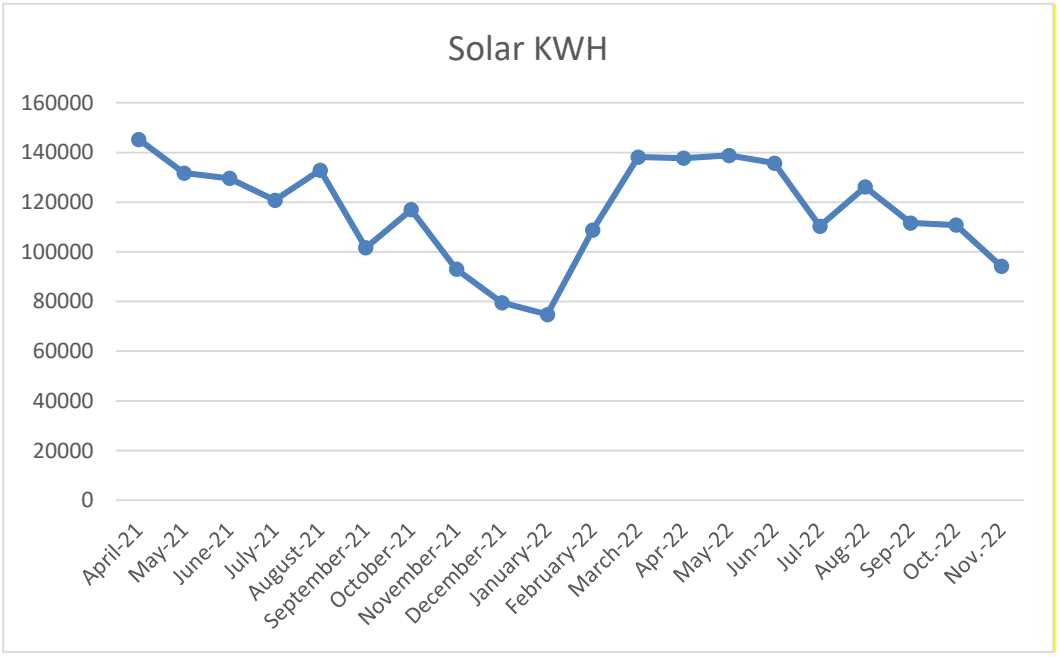
Table 2. Solar Generation Details

Solar Generation			
Month	**kWh**	**Solar Billing**	**Unit Rate**
21-Apr	145286	636062	4.4
21-May	131756	576809	4.4
21-Jun	129587	523555	4.4
21-Jul	120767	528722	4.4
21-Aug	132879	581742	4.4
21-Sep	101638	444697	4.4
21-Oct	116986	512166	4.4
21-Nov	92995	407133	4.4
21-Dec	79557	348512	4.4
22-Jan	74788	327750	4.4
22-Feb	108778	476707	4.4
22-Mar	138172	610375	4.4
22-Apr	137749	606095	4.4

RSEB Power consumption trend



Solar Power generation trend –



2 Electricity Consumption

During the audit, power measurements were carried out for different equipment. The electricity from RSEB and solar generation breakup is provided in below graph.

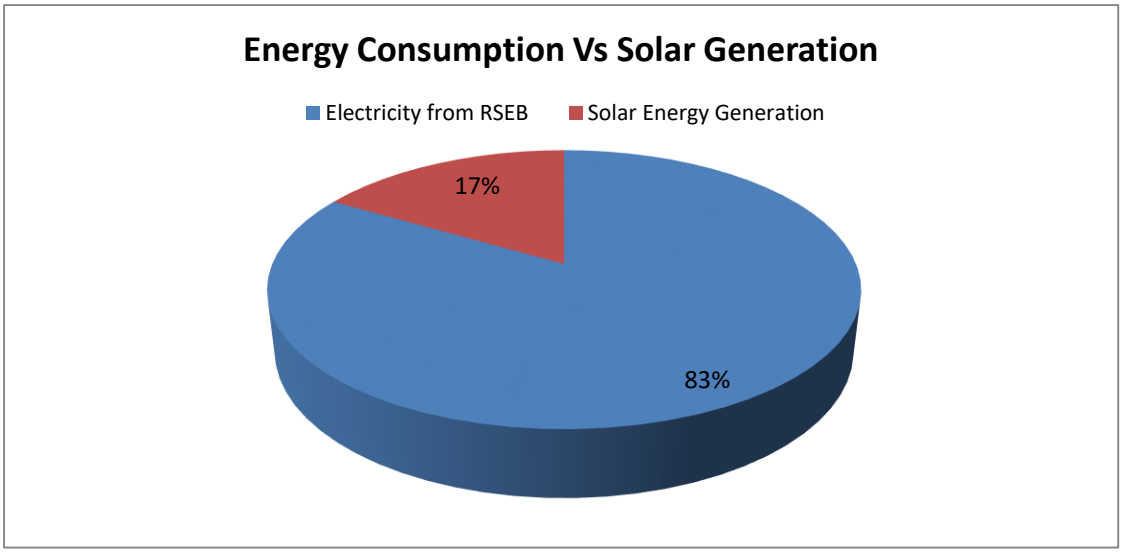


Figure 3. Percentage share of Energy Consumption and Energy Generation

Observations:

- It can be seen from the above figure that the percentage share of electricity from RSEB is 83% and the solar generation is of 17%.

Energy Performance Assessment:

• Auxiliary Transformers

Total 14 numbers of transformers are installed to cater the need of electricity in university premises. Power and other electrical measurements were carried out at the main incomer of each transformer using a Power Quality

Analyzer. The observations for the same are given below.

• Cluster 1 Transformer

Total three number of transformer is installed in cluster 1 and power quality analysis of two transformers is carried using power analyzer, however third transformer analysis is not carried out due to connectivity issue of Instrument.

Transformer 1000 kVA

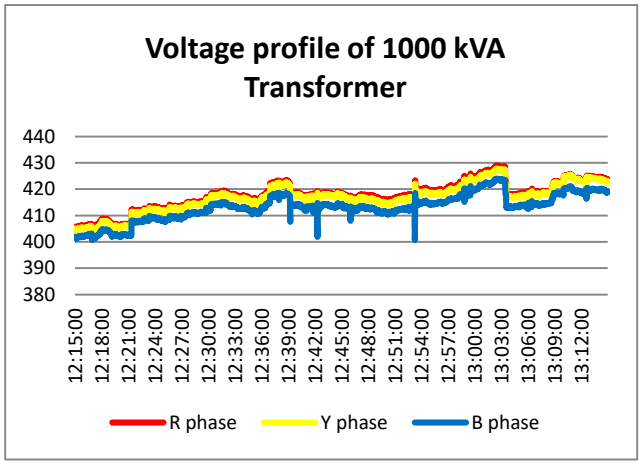
The performance analysis of 1000 kVA transformer is carried out and presented in below table.

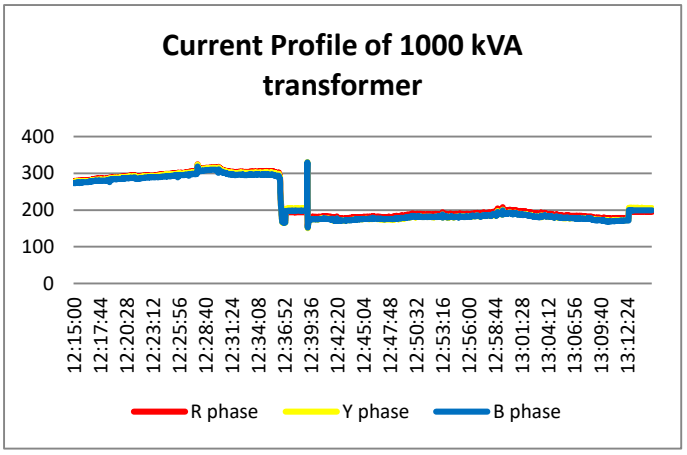
Figure 4. Performance of 1000 kVA transformer

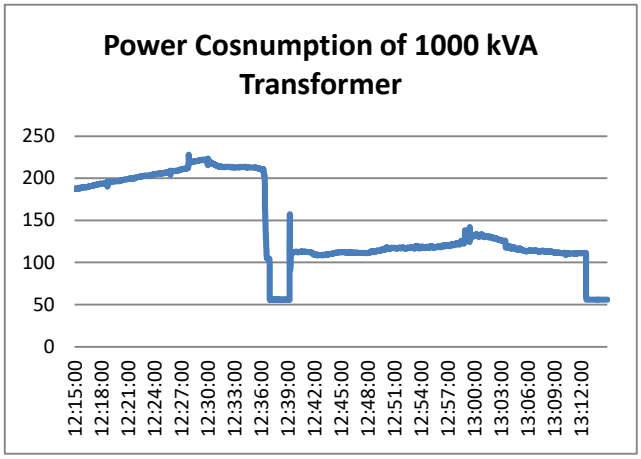
Transformer details			
Parameters	**Maximum**	**Average**	**Minimum**
Voltage (V)			
U12 rms	429	417.6	404.3
U23 rms	427.8	416.7	403.5
U31 rms	424	413.1	400.7
Current			
L1 (A)	325.8	226.7	157.1
L2 (A)	330.5	223.0	150.7
L3 (A)	330.1	220.9	152.3
Active Power			
Total (KW)	228	143	55.45
Apparent Power			
Total (KVA)	233	160	110
Power Factor			
Total	0.998	0.9	0.38
Harmonics			
Voltage THD %	2.4	1.8	1.4
Current THD%	26.75	16.2	9.6

Observations:

- There is no voltage variation in three phases; voltage level is maintained at 424 V which is acceptable range.
- The current harmonics (ITHD %) is 26.75 %, which is higher than the limits as specified in the IEEE 519-2014 standard i.e. 8 %.
- Capacitor bank is installed at each transformer but still the power factor is observed at 0.996 to 0.998 which can be maintain near to 0.99 by fine tuning of APFC.
- Percentage loading of transformer 1000 kVA is 23% which is lower side.
- Oil leakage observed at 1600 kVA transformer, it is recommended that to repair it immediately or shut down the transformer as early as possible







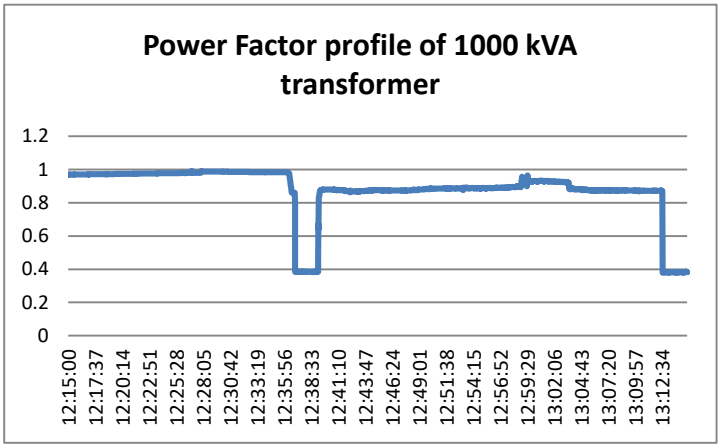


Figure 5. 1000 kVA Transformer Profile

Harmonics at each transformer is measures and presented in below table

Table 3. Voltage harmonics of 1250 kVA transformer

	Max	Average	Min
H3	0.233	0.1	0.033
H5	2.1	1.7	1.067
H7	1.067	0.4	0.067
H9	0.2	0.1	0
H11	0.767	0.5	0.3
H13	0.4	0.2	0
H15	0.0	0.0	0
H17	0.1	0.0	0
H19	0.0	0.0	0.0

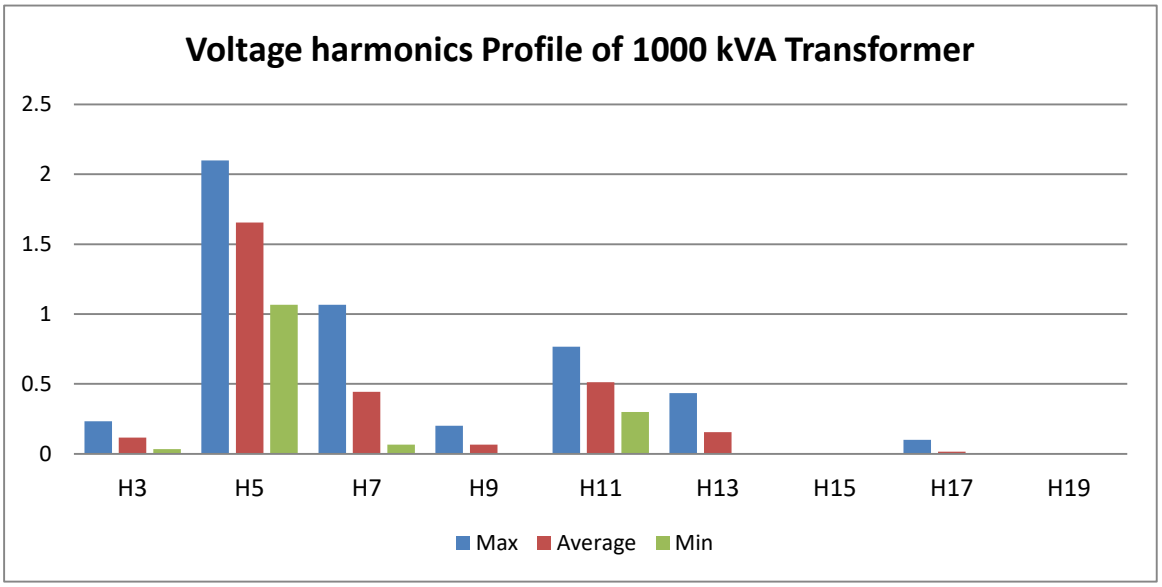


Figure 6. Voltage Harmonics Graph of 1000 kVA Transformer

Current harmonics at 1000 kVA transformer is presented in below table

Table 4. Current Harmonics of 1000 kVA transformer

	Max	Average	Min
H3	4.433	1.0	0.2
H5	18.57	12.8	7.3
H7	11.8	6.3	2.833
H9	1.7	0.7	0.133
H11	9.433	6.0	2.4
H13	3.0	1.8	0.6
H15	0.6	0.1	0
H17	1.2	0.6	0.3
H19	0.6	0.2	0.0

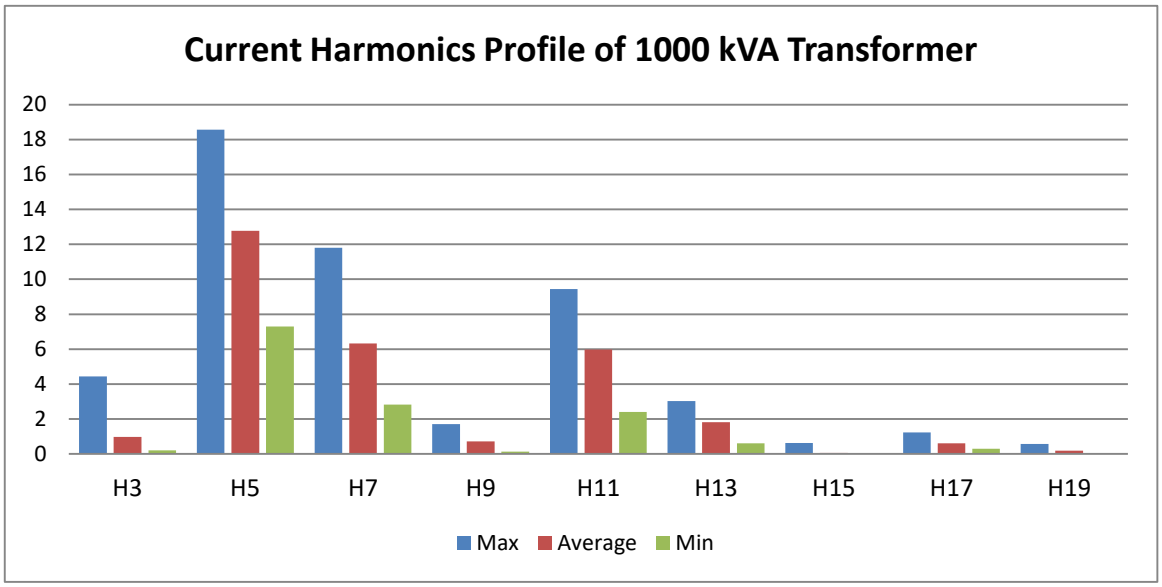


Figure 7. Current Harmonics Graph of 1000 kVA transformer

Observations:

- It is observed from the above figure that the power consumption of the 1000 kVA transformer is varied tremendously between minimum values of 55 kW to a maximum value of 228 kW.
- Due to this high variation and inductive load, there is a generation of high amount of harmonics. The harmonics generated on the LT side of the transformer is approximately 18% in current.
- It is also seen that in Voltage Harmonics, 5^{th}, 7^{th} and 11^{th} Harmonics dominated the total harmonics generation.

Transformer 1250

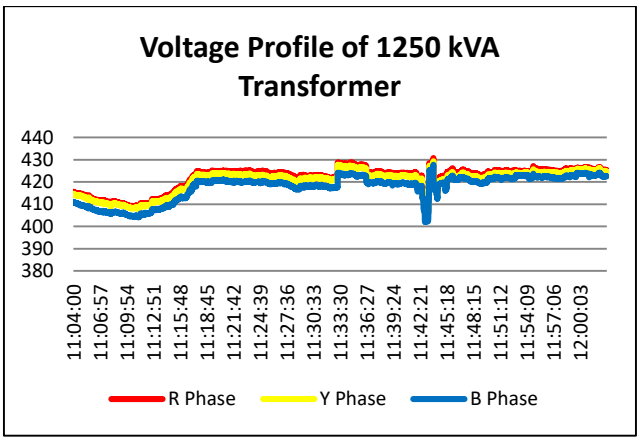
The performance analysis of 1250 kVA transformer is carried out and presented in below table.

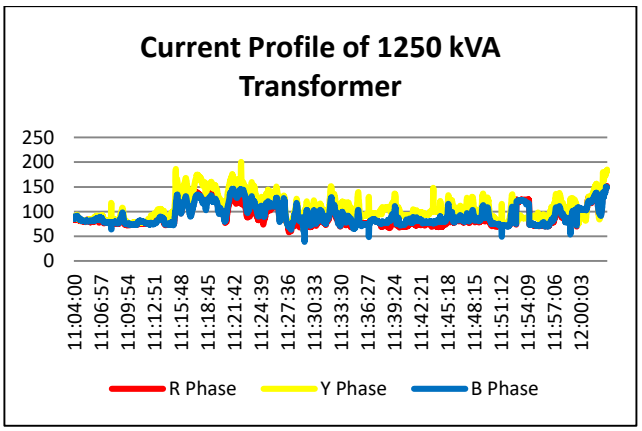
Figure 8. Performance of 1250 kVA transformer

Transformer details			
Parameters	**Minimum**	**Average**	**Maximum**
Voltage (V)			
U12 rms	430.8	421.7	406.1
U23 rms	429.3	420.6	405
U31 rms	427.8	417.7	402
Current			
L1 (A)	152.2	89.0	57.9
L2 (A)	200.8	106.9	60.8
L3 (A)	150.6	92.0	38.6
Active Power			
Total (KW)	107.248	46.1	-4.3026
Apparent Power			
Total (KVA)	118.672	69.9	45.901
Power Factor			
Total	0.94	0.6	-0.063
Harmonics			
Voltage THD %	2	1.3	0.53
Current THD%	60.2	28.1	12.6

Observations:

- There is no voltage variation in three phases; voltage level is maintained at 430 V which is acceptable range.
- The current harmonics (ITHD %) is 60 %, which is higher than the limits as specified in the IEEE 519-2014 standard i.e. 8 %.
- Capacitor bank is installed at each transformer but still the power factor is observed at 0.996 to 0.998 which can be maintain near to 0.99 by fine tuning of APFC.
- Percentage loading of 1250 kVA transformer is 9% which is lower side.





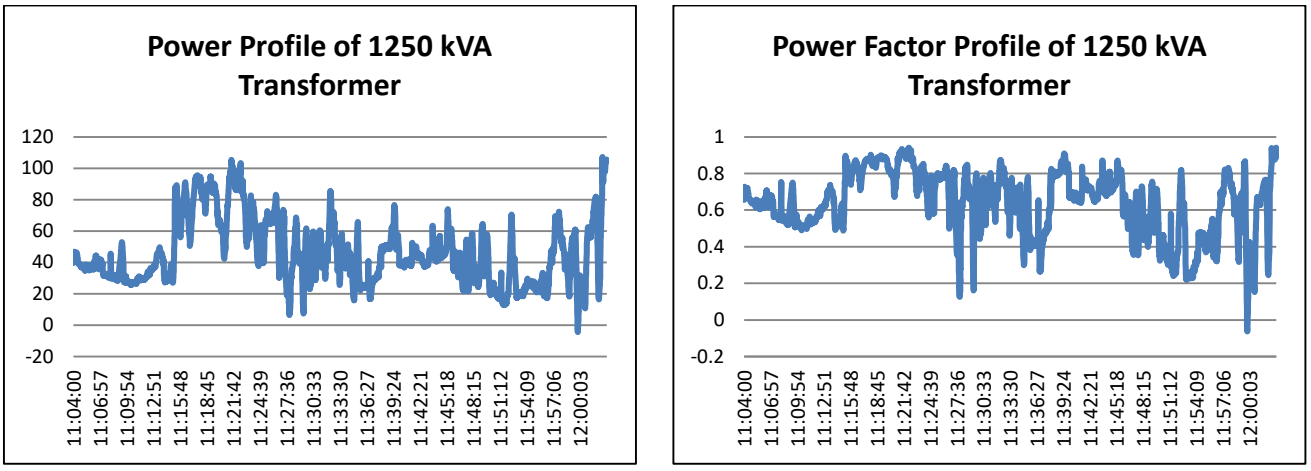


Figure 9. 1250 kVA Transformer Profile

Table 5. Voltage Harmonis of 1250 kVA transformer

	Max	Average	Min
H3	0.4	0.1	0
H5	1.6	0.8	0.03
H7	1.97	0.9	0
H9	0.233	0.1	0
H11	0.4	0.1	0
H13	0.3	0.2	0
H15	0.0	0.0	0
H17	0.1	0.0	0
H19	0.1	0.0	0.0

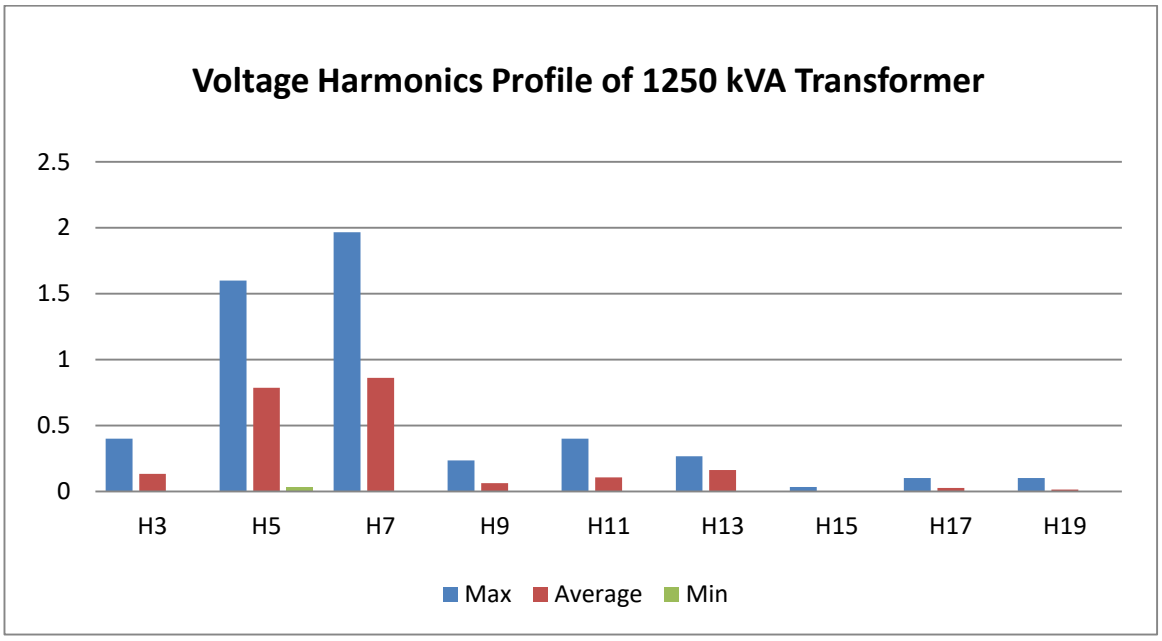
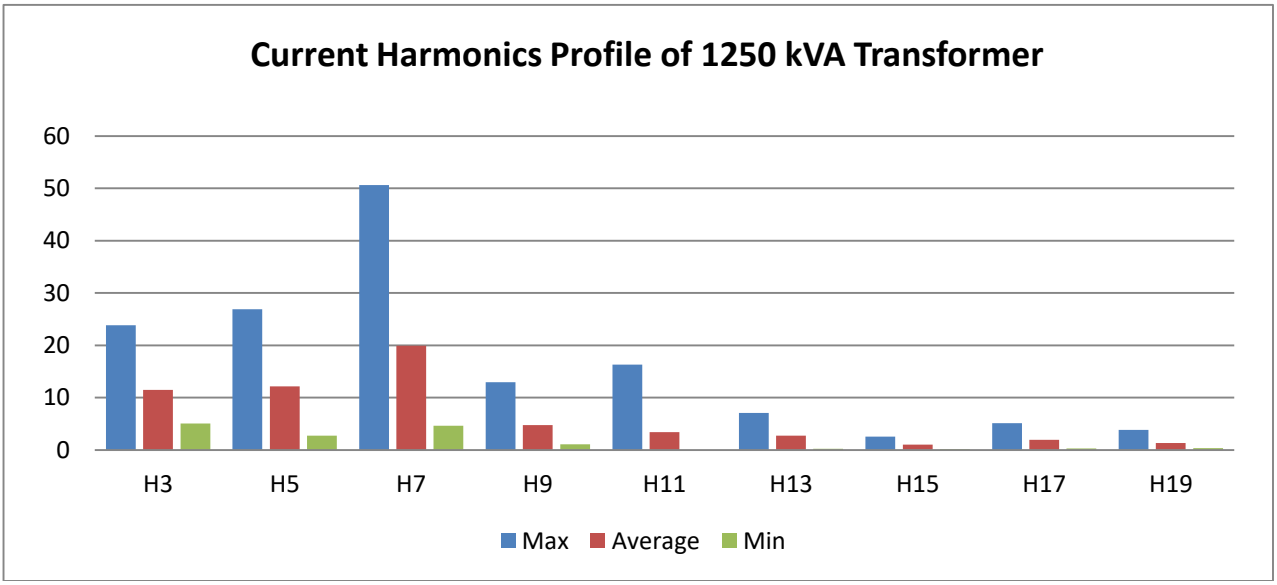


Figure 10. Voltage Harmonics Graph of 1250 kVA Transformer

Table 6. Current Harmonics of 1250 kVA transformer

	Max	Average	Min
H3	23.83	11.5	5.067
H5	26.87	12.1	2.7
H7	50.6	19.9	4.6
H9	12.93	4.7	1.067
H11	16.33	3.4	0
H13	7.1	2.7	0.233
H15	2.6	1.0	0.167
H17	5.1	1.9	0.267
H19	3.8	1.3	0.3



Observations:

- It is observed from the above figure that the power consumption of the 1000 kVA transformer is varied tremendously between minimum values of 45 kW to a maximum value of 118 kW.
- Due to this high variation and inductive load, there is a generation of high amount of harmonics. The harmonics generated on the LT side of the transformer is approximately 50% in current.
- It is also seen that in Voltage Harmonics, 5^{th}, 7^{th} and 11^{th} Harmonics dominated the total harmonics generation.
- From above data it is observed that the loading on both transformer is on lower side that will lead to increase total losses of transformer.

Cluster 1 Transformer loading

The efficiency of the transformers not only depends on the design, but also, on the effective operating load. The variable losses depend on the effective operating load to the transformer. The maximum efficiency of the transformer occurs at a condition when constant loss is equal to variable loss. For distribution transformers, the core loss is 15 to 20% of full load copper loss. Hence, the maximum efficiency of the distribution transformers occurs at a loading between 40 – 60%. For power transformers, the core loss is 25 to 30% of full load copper loss. Hence, the maximum efficiency of the power transformers occurs at a loading between 60 – 80%.

Table 7. transformer loading details

Description		Cluster 1		Cluster 2	Cluster 4	Cluster 5		Cluster 7	
Rating (kVA)		1000	1250	800	1000	750	1000	630	500
Voltage (V)		424	430	430	430	430	430	430	430
Current (A)		330	200	200	200	200	200	200	200
P.F		0.98	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Active power (kW)	Average	143	46	107	201	17	82	46	58
	Maximum	228	107	125	254	24	97	123	80
Apparent power (kVA)	Average	160	70	127	229	21	102	56	73
	Maximum	233	118	147	286	38	112	134	90
Transformer loading	Maximum	23%	9%	18%	29%	5%	11%	21%	18%
	Average	16%	6%	16%	23%	3%	10%	9%	15%

Table 8. Transformer losses details

Rated Specifications	Cluster 1		Cluster 2	Cluster 4	Cluster 5		Cluster 7	
	1000 kVA	1250 kVA	1600 kVA	500 kVA	630 kVA	1000 kVA	1600	750 kVA
Rated kVA	1000	1250	1600	500	630	1000	1600	750
Voltage (HV/LV) V	11000 / 433	11000 / 433	11000 / 433	11000 / 433	11000 / 433	11000 / 433	11000 / 433	11000 / 433
Make	-	-	-	-	-	-	-	-
Cooling	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN	ONAN
Frequency (Hz)	50	50	50	50	50	50	50	50
Location	Cluster 1							
Serial No.	-	-	-	-	-	-	-	-
Manufacturing Year	-	-	-	-	-	-	-	-
Transformer Rating in kVA	1000	1250	1600	500	630	1000	1600	750
Avg.Load in KVA	160.00	69.47	140.00	229.00	21.00	56.00	280.00	73.00
Present % Loading	16.00	5.56	8.75	45.80	3.33	5.60	17.50	9.73
Rated Full Load Losses of Transformer (kW)	13.50	16.40	19.80	5.70	9.50	13.50	19.80	7.50
Total Losses of Transformer(kW)	1.70	2.10	2.50	0.80	1.08	1.70	2.50	1.15
Operating Power Factor	0.98	0.94	0.89	0.85	0.91	0.85	0.89	0.89
No Load Loss (kVA)	1.73	2.23	2.81	0.94	1.19	2.00	2.81	1.29
Total Losses= Load Losses+N.L. Losses	3.27	2.88	4.04	2.79	1.41	2.54	5.27	1.81
Transformer Efficiency, %	97.96	95.85	97.11	98.78	93.28	95.47	98.12	97.52

5.5 Performance Analysis of Pumping System

Three pumping stations (zone) are installed to circulate water to university premises. Each zone is having

domestic water pumps and flush pumps.

1. Zone 1 – Three Domestic Pumps and Two Flush pumps are installed to cater the water requirement.
2. Zone 2 – Four Domestic pumps and three flush pumps are installed to cater the water requirement.
3. Zone 3 – Four Domestic pumps are installed

The performance assessment of pumps includes determination of hydraulic efficiency of the pumps. The details of the same are given below.

Table 8. Performance analysis of Zone 1 pumping system

Description	Units	Zone 1					
		Domestic Pump 1	Domestic Pump 2	Domestic Pump 3	Flush 1	Flush 2	
Design parameters							
Make	-	Grundfos	Grundfos	Grundfos	Grundfos	Grundfos	
Model	-	-	-	-	-	-	
Flow rate	m^3/hr	30	30	30	21	21	
Head	m	53.1	53.1	53.1	58	58	
Speed	rpm	2919	2919	2919	2919	2919	
Motor rating	kW	11	11	11	5.5	5.5	
Operating Parameters							
Flow rate	m^3/hr	37	36.0	34.9	3.9	5.0	
Total head developed	m	19	18.7	19	40.0	41	
Motor input power	kW	10.09	9.85	10.34	4.92	6.15	
Motor efficiency	%	92%	92%	92%	92%	92%	
Combined overall efficiency	%	19%	19%	18%	9%	9%	
Pump efficiency	%	21%	20%	19%	9%	10%	

Observations:

- The efficiency of zone 3 domestic pumps lies between 19% to 21% and flush pumps are lies between 9% to 19%.
- VFD is installed to control the system for both domestic and flush pumps.
- Out of these three pumps One pump is continuously running and two are on standby mode.
- However these both set of domestic pumps and flush pumps are having VFD, the discharge line is throttled at about 50% for both set.

Table 9. Performance analysis of zone 2 pumping system

Description	Units	Zone 2

		Domestic Pump 1	Domestic Pump 2	Domestic Pump 3	Domestic Pump 4	Flush 1	Flush 2	Flush 3
Design parameters								
Make	-	Grundfos	Grundfos	Grundfos	Grundfos	Grundfos	Grundfos	Grundfos
Model	-	-	-	-	-	-	-	-
Flow rate	m^3/hr	30	30	30	30	17	17	17
Head	m	97.8	97.8	97.8	97.8	78	78	78
Speed	rpm	2924	2924	2924	2924	2919	2919	2919
Motor rating	kW	11	11	11	11	5.5	5.5	5.5
Operating Parameters								
Flow rate	m^3/hr	41	45.0	34.0	32.0	31.0	30.0	31.0
Total head developed	m	41	45.0	41	51	40.0	40	42
Motor input power	kW	9.72	9.64	9.72	9.85	6.15	6.19	6.15
Motor efficiency	%	92%	92%	92%	92%	92%	92%	92%
Combined overall efficiency	%	47%	57%	39%	45%	55%	53%	57%
Pump efficiency	%	51%	62%	42%	49%	59%	57%	62%

Observations:

- The efficiency of zone 2 Domestic pumps lies between 42% to 62% and for flush pump it lies between 57% to 59%.
- There is no control system if requirement is fulfilled, totally controlled by manually.
- Out of these four pumps two pumps are continuously running and two are on standby mode.
- Only one flush pump is running and other two are on standby mode.
- Domestic pump discharge line was throttled at about 30% and main header discharge line of flush pump is throttled at about 20% as shown in photo below.

Domestic Pumps

Flush Pump

Table 10. Performance Analysis of zone 3 pumping system

Description	Units	Zone 3			
		Domestic Pump 1	Domestic Pump 2	Domestic Pump 3	Domestic Pump 4
Design parameters					
Make	-	Grundfos	Grundfos	Grundfos	Grundfos
Model	-	-	-	-	-
Flow rate	m^3/hr	30	30	30	30
Head	m	97.8	97.8	97.8	97.8
Speed	rpm	2924	2924	2924	2924
Motor rating	kW	11	11	11	11
Operating Parameters					
Flow rate	m^3/hr	35.3	35.5	37.9	32.0
Total head developed	m	22	16.0	18	21
Motor input power	kW	10.46	10.39	10.38	10.49
Motor efficiency	%	92%	92%	92%	92%
Combined overall efficiency	%	20%	15%	18%	17%
Pump efficiency	%	22%	16%	19%	19%

Observations:

- The efficiency of zone 1 pumps lies between 16% to 22% , which is lower side.
- The distance from main pumping station to last user end is almost 2km and the generated head at main header line is 2 kg/cm2.
- There is no control system if requirement is fulfilled, totally controlled by manually.
- Out of these four pumps two pumps are continuously running and two are on stand by mode.

Domestic Pump

Flush Pump

5.6 Performance Analysis of Blowers

Two STP plants are installed in university, each STP plant is having **Three Aeration Blowers** (one is running and Two standby mode). Measurement of these blowers are carried out during audit and presented in below table.

Table 11. Performance analysis of blowers

Description	Unit	1 MLD Blower	1.5 MLD Blower
Design Parameters			
Make	-	-	Everest
Flow	m^3/h	-	800
Static Pressure	mmWC	-	5000
Fan rating	kW	-	-
Motor rating	kW	-	22
Fan speed	rpm	-	1500
Fan static efficiency	%	-	-
Operating Parameters			
Static pressure at fan inlet	mmWC	-200	-300
Static Pressure at fan outlet	mmWC	4000	2000
Fan static pressure	mmWC	4200	2300
Average velocity pressure	mmWC	-	-
Inlet air temperature	^0C	23	24
Gas density	kg/m^3	1.2459	1.2291
Velocity	m/sec	2.40	1.02
Cross sectional area of duct	m^2	0.12	0.4
Quantity	m^3/hr	1037	1469
Input power	kW	17	23.0
Static efficiency of the fan	**%**	76%	44%

5.7 Motor Loading

During the audit, the loading percentage on the motor was also calculated. The details of the same are given below.

Table 12. Motor Loading Percentage

Feeder	Rated kW	Motor effi.	V	I	P.F.	P	% Loading
PCW - 5	7.5	92%	412	11.4	0.87	7.08	87%
CHWP - 5	15.5	92%	415	26.23	0.8	15.08	90%
CT Fan	12	92%	411	17.5	0.8	9.97	76%
SCWP - 2	18.5	92%	410	12.35	0.9	7.89	39%
PCWP-2	7.5	92%	419	11.69	0.89	7.55	93%
SCWP - 2	30	92%	418	32.69	0.9	21.30	65%
STP blower 1 (1.5 MLD)	25	92%	404	38.3	0.95	25.46	94%
STP blower 2 (1.5 MLD)	25	92%	415	40	0.86	24.73	91%
Zone 1 Irrigation pump 1	7.5	92%	412	10.5	0.9	6.74	83%
Zone 2 Irrigation pump 1	7.5	92%	410	10.4	0.89	6.57	81%

5.8 Energy Saving Opportunities

Reduce Transformer Losses by Shifting of Load

Presently three transformers are installed in cluster 1, two in cluster 5 and two in cluster 7. All transformers in these clusters are under loaded which is in the range of 6% to 46%. This will lead to increase the losses of transformer.

So it is recommended that to shift the load of **1000 kVA transformer and 1600 kVA** transformer to **1250 kVA** transformer in cluster 1 which will lead to increase the percentage loading on 1250 kVA transformer in the range of 60% to 80%.

In cluster 5, Shift the load of **750 kVA** transformer to **1000 kVA** transformer to increase the loading on transformer and to reduce the transformer losses.

In cluster 7, Shift load of **500 kVA transformer to 630 kVA** transformer to increase the loading on transformer and to reduce the transformer losses.
The cost benefit analysis by shifting of load and reduction of losses is presented in below table.

Table 13. Energy Savings – Reduce transformer losses by load shifting

Rated Specifications	Cluster 1	Cluster 5	Cluster 7
	1000 kVA	630 kVA	750 kVA
Rated kVA	1000	630	750
Voltage (HV/LV) V	11000/433	11000/433	11000/433
Make	-	-	-
Cooling	ONAN	ONAN	ONAN
Frequency (Hz)	50	50	50
Location	Cluster 1		
Serial No.	-	-	-
Manufacturing Year	-	-	-
Transformer Rating in KVA	1000	630	750
Avg.Load in KVA	160.00	21.00	73.00
Present % Loading	16.00	3.33	9.73
Rated Full Load Losses of Transformer (kW)	13.50	9.50	7.50
Total Losses of Transformer(kW)	1.70	1.08	1.15
Operating Power Factor	0.98	0.91	0.89
No Load Loss (KVA)	1.73	1.19	1.29
Total Losses= Load Losses+N.L. Losses	3.27	1.41	1.81
Transformer Efficiency, %	97.96	93.28	97.52
Running hours	8640	8640	8640
Total annual loss kWh/annum	28238	12197	15642
Energy Cost	11	11	11
Savings in Rs. Lakh	3	1	2

Avoid the Pump Throttling to Increase Pump Efficiency

Zone 2 and zone pumps are observed in throttled position for both set domestic and flush. Throttling on the pump discharge will effect on changing the system resistance curve. This changes the point of intersection with the pump performance curve with resultant change in flow.
In such case pump input remains same but the output of pump will reduce which will reduce the efficiency of pump and degrades pump life.

Zone 3 pumps are having VFD for both domestic and flush pumps but still the discharge side of both set is 50% throttled, this will nullify the purpose of VFD installation and it is running with 50Hz frequency.

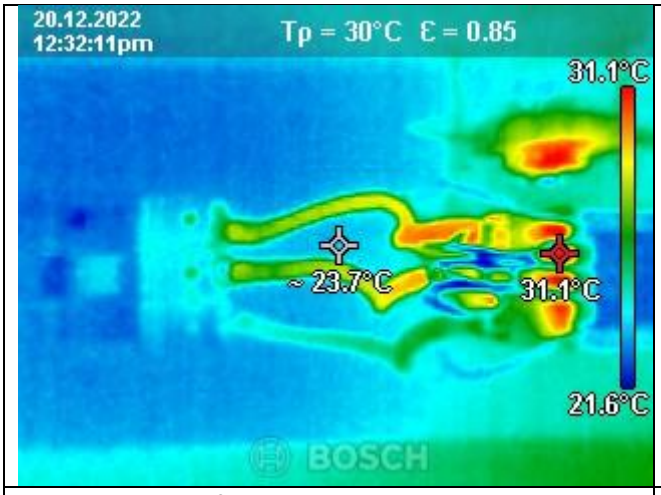
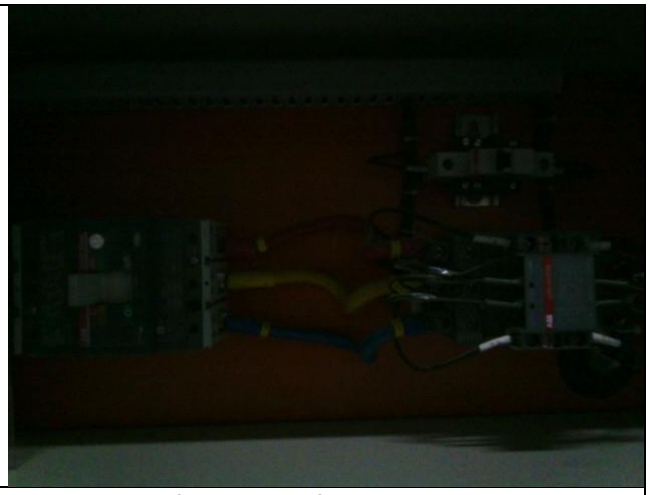
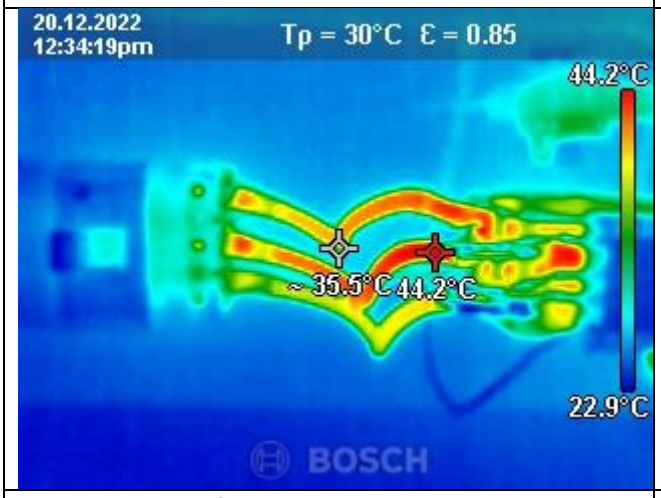
So it is recommended that to install VFD on zone 1 and zone 2 pumps and for zone 3 adjust the frequency and remove throttling on it.

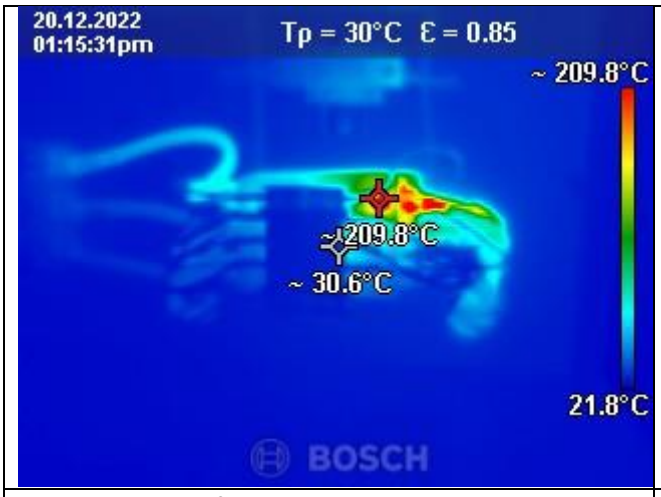
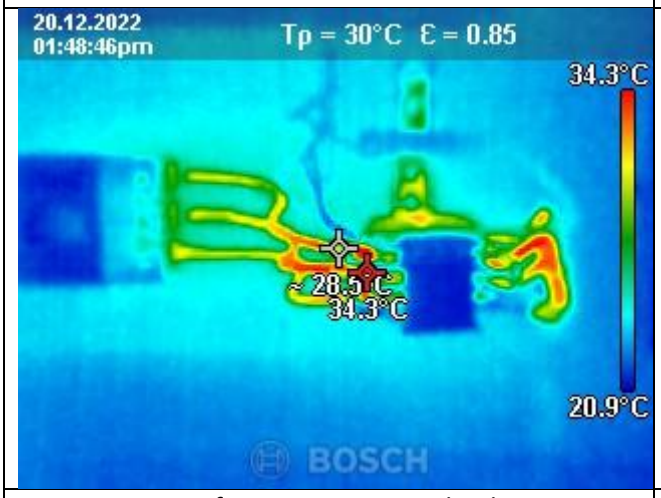
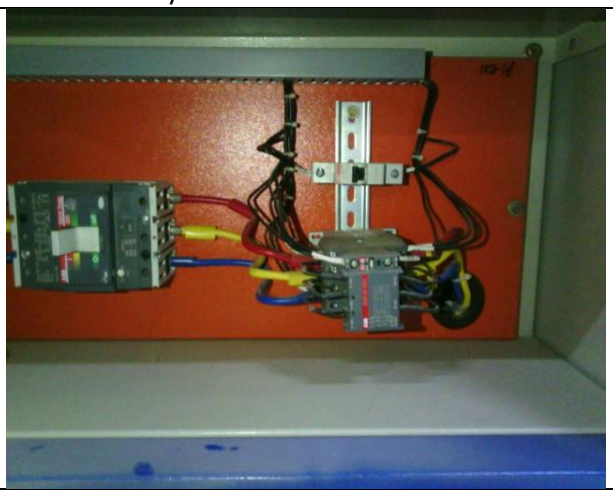
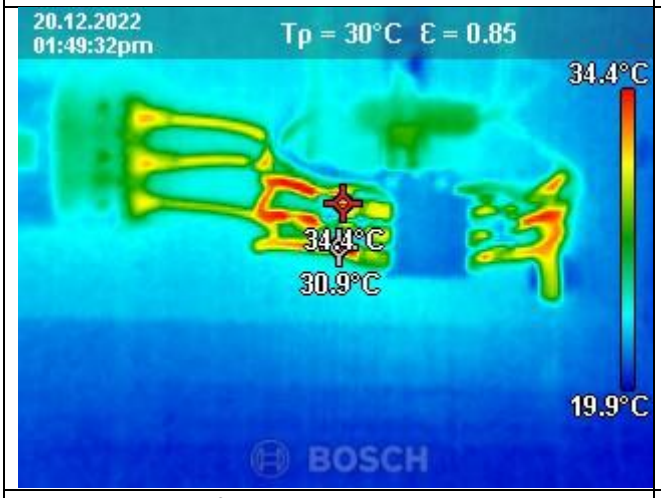
Table 14. Energy Savings – Avoiding throttling on pumps

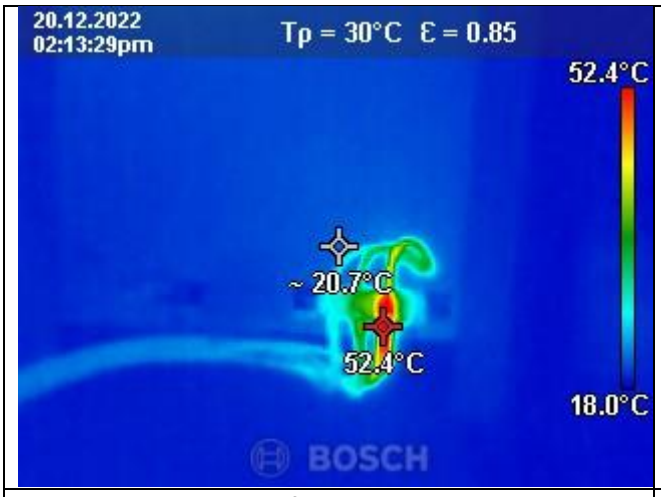
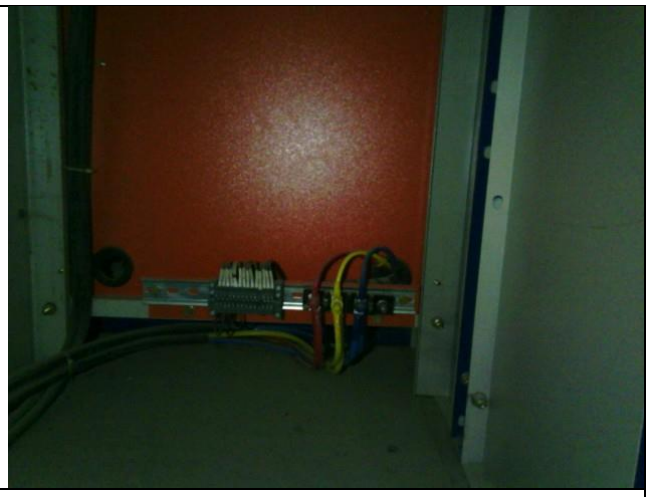
Sr. No.	Parameters	Units	Domestic Pumps	Flush	Domestic Pumps	Flush	Domestic Pumps
1	Present Zone 2 Pump Power Consumption	kW	20.86	8.31	19.47	9.25	15.14
2	Daily Operating Hours	hours	6	6	6	6	6
3	Annual Operating Days	days	365	365	365	365	365
4	Annual Electricity Consumption	kWh/year	45,683	18,199	42,628	20,258	33,157
5	Annual Energy Consumption – VFD	kWh/year	36,547	14,559	34,103	16,206	26,525
6	Annual Electricity Savings	kWh/year	9,137	3,640	8,526	4,052	6,631
7	Electricity Tariff	Rs./kWh	10	10	10	10	10
8	Expected Annual Cost Savings	Rs. Lakhs	0.91	0.36	0.85	0.41	0.66
9	Total Cost Savings	Rs. Lakhs	1.28		1.26		0.66
10			3.20				
11	Invetsment for two VFD	Rs. Lakhs	2				
12	Simple payback period	Months	8				

Thermography

During the audit, IR Thermography of Electrical Panels was also conducted as a preventive maintenance procedure.

	
Location – Transformer 1 Capacitor bank 2F2 50 kVAR	Temperature found on safer side
	
Location – Transformer 1 Capacitor bank 2F3 50 kVAR	Temperature found on safer side
	
Location – Transformer 1 Capacitor bank 1F6 50 kVAR	Temperature found on safer side

	
Location – Transformer 2 Capacitor bank 13F3 50 kVAR	Temperature found on critical side need to correct it immediately
	
Location – Transformer 3 Capacitor bank 7F3 25 kVAR	Temperature found on safer side
	
Location – Transformer 3 Capacitor bank 7F4 25 kVAR	Temperature found on safer side

	
Location – HVAC Transformer SCWP 2 pump	Temperature slightly on higher side.

6. Environment Management Assessment

Water Management:

- Six groundwater recharge points are created across the campus. In this, the surface runoff water during monsoon is directed to a designated area which then percolates in the ground resulting in groundwater recharge. Many such recharge points are being planned across the campus in the coming years.
- All overhead tanks and water coolers are fitted with floats, sensors and other mechanisms to shut the water supply and avoid overflow.
- Overhead tanks which are filled with pressurized supply of water through pumps are fitted with actuator valves for avoiding overflow.
- Insulation on water storage tank at Ram & Budh Bhawan to guard against extreme temperature.
    1. VFD based hydro pneumatic system.
    2. Pumps & equipments selected on ‘’best ‘energy efficiency point.
    3. Use of low flow fixtures.
    4. Use of treated water with BOD less than 10 ppm and COD less than 50 ppm from STP for HVAC cooling tower make up, flushing and irrigation.

Total Area of the campus: 2 38 Acre

Different sources of water in our college,

- In house Bore well –for Domestic Water
- Outside Tanker water supply.
- STP /TSE water
- Rain Water Harvesting
- E RO Plants – for Potable water

Details of Bore Wells 7 Bore wells

S No	Bore well No	Location	Water Level
1	BW-01	SR Ground	844 Feet
2	BW-02	GD Park	1010 Feet
3	BW-03	Near Post Office Gate	905 Feet
4	BW-04	New Faculty Housing	985 Feet
5	BW-05	Near 1.5 MLD STP Plant	700 Feet
6	BW-06	Cricket ground	830 Feet
7	BW-07	Gym Ground	800 Feet

Water Storage Facilities:

Sr No	Tank Location	Storage Capacity in Ltrs
1	Near main cafeteria	70092
2	Clock Tower	90000
3	Near PhD Quarter	39648
4	Near Post Office Gate	64230
5	Near BITS Coop	360090
6	Near Main Gate	61058
7	Pooja Ground	106200
8	Gym ground	50976
9	New Faculty Housing	93456
10	Plumbing Zone-1	350000
11	Plumbing Zone-2	220000
12	Plumbing Zone-3	700000

Capacities:

Capacity of the overhead water tanks in the campus
Capacity of PVC Tanks in hostels 401750
Capacity of cemented Tanks 49500
Capacity of OHT in other Institute Area 52500
Water Pumped in every day - Approx. 1800000 Liter per day.
Water used per day 725 KL for domestic and Flushing purpose.
For the irrigation purpose water used 8-10 Lakhs liter per day

Water Usage Pattern in the Campus:

Description	Total Water(LPD)
Meera Bhawan	135000
Malviya - A	18900
Malviya - B	18900
Malviya - C	24570
SAC	28350
Ram Bhawan	54540
Budh Bhawan	54540
Vayas Bhawan	35370
Shankar Bhawan	54540
Vishavakarma Bhawan	36180
Bhagirath Bhawan	20520
Krishna Bhawan	54540
Gandhi Bhawan	54540
Rana Pratap Bhawan	54540
Ashok Bhawan	54540

RAIN WATER HARVESTING:

- RCC Tanks behind Library Building (Capacity approx. 7,00,000 Liters)
- RCC Tank in Cafeteria Lawn (Capacity approx. 25,000 Liters)
- RCC Tank in Ram Bhawan Hostel Premise (Capacity 50,000 Liters)
- RCC Tank in Krishna Bhawan Hostel Premise (Capacity 50,000 Liters)
- Brick work Tank in Blossom Kids Zone- A school for Infants (Capacity 15,000 Liters)
- Brick work Tank behind residential block 234 (Capacity 15,000 Liters)

Water consumption Per day

Approx. Water Consumption Details Per Pay				
Zone-1				
SrNo	Description	Total Domestic Water LPD	Flushing Water (LPD)	Gross Water (LPD)
1	Faculty Housing	327000	114000	441000
2	Meera Bhawan	90000	45000	135000
	Total	**417000**	**159000**	**576000**
Zone-2				
SrNo	Description	Total Domestic Water LPD	Flushing Water (LPD)	Gross Water (LPD)
1	Faculty Housing	243000	72000	315000
2	Boys Hostels	193000	92000	285000
3	NAB	133000	30000	163000
	Total	**569000**	**194000**	**763000**

Zone-3				
SrNo	Description	Total Domestic Water LPD	Flushing Water (LPD)	Gross Water (LPD)
1	Boys Hostels	243000	97000	340000
2	Institute Area	120000	45000	165000
	Total	**363000**	**142000**	**505000**
SrNo	**Description**	**Total Domestic Water LPD**	**Flushing Water (LPD)**	**Gross Water (LPD)**
1	Zone-1	417000	159000	576000
2	Zone-2	569000	194000	763000
3	Zone-3	363000	142000	505000
	Total	**1349000**	**495000**	**1844000**

Irrigation water Network

Irrigation water for landscape use within the campus is a domestic quality and it sourced from in house STP and has acceptable parameter as per governing requirement, using it to maintain lush green garden.

RECYCLING

Sewage treatment Plant:

- Domestic waste generated in the campus at residences, hostels, messes, etc. is segregated at source into dry, wet waste.
- To maintain natural balance in the environment and make optimum utilization of waste available, the biodegradable waste is being processed.
- The two Sewage Treatment Plant (STP) with the capacity of 1 MLD & 1.5 MLD each is working round the clock to treat sewage generated by residents of the campus.
- Flushing water sourced from in-house sewage Treatment plant. The Treated Effluent for flushing is obtained after tertiary treatment at STP. Treated effluent is odourless and shall is acceptable chemical /bacteriological parameters as per Rajasthan pollution control boards laws. Recently some hostels, STP treated water is supplied to flush tanks of EWC through dedicated supply network.
- The sludge generated at STP is transferred to drying bed in the vicinity of STP which is used as manure after drying.

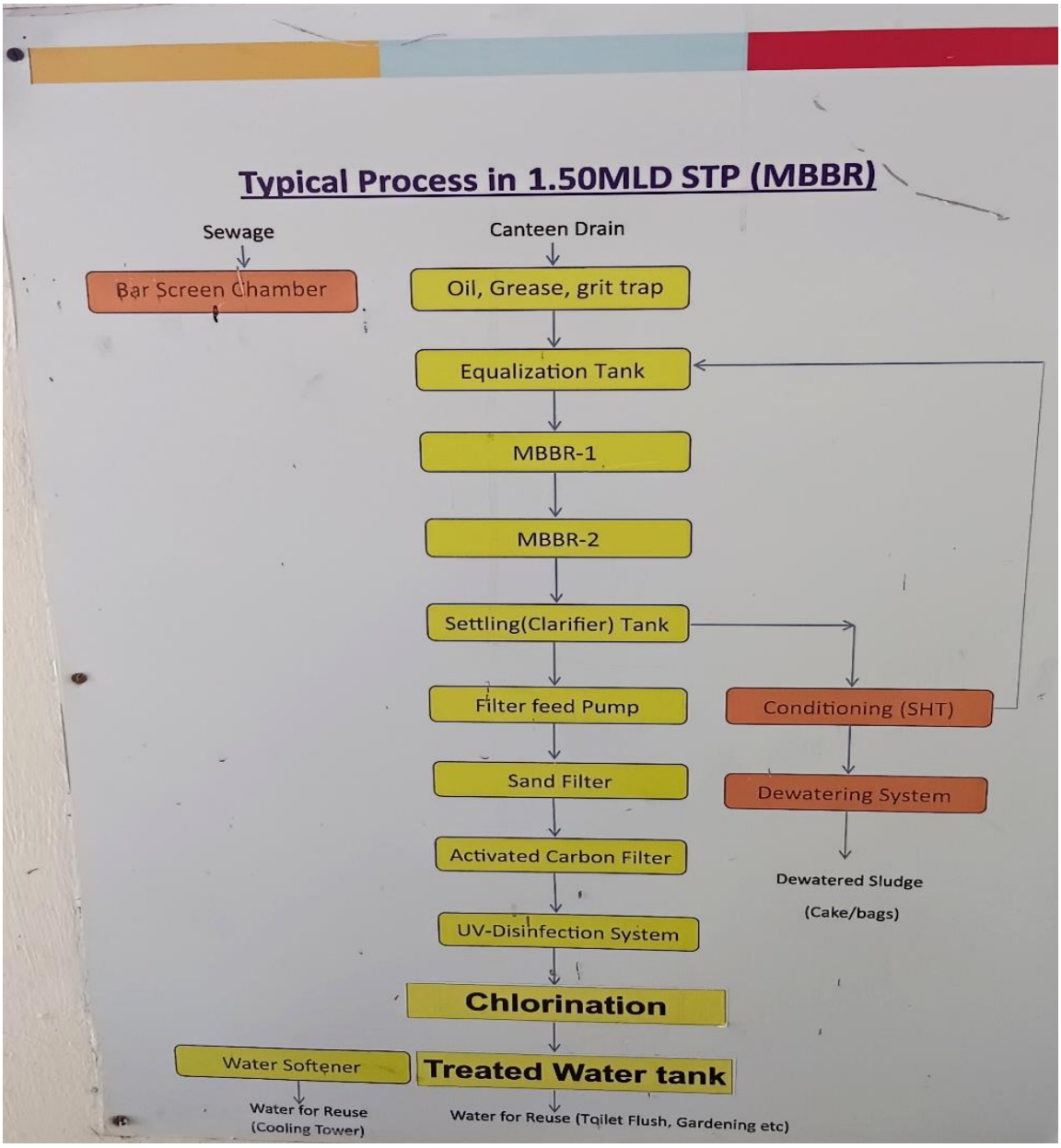
STP Water used for the

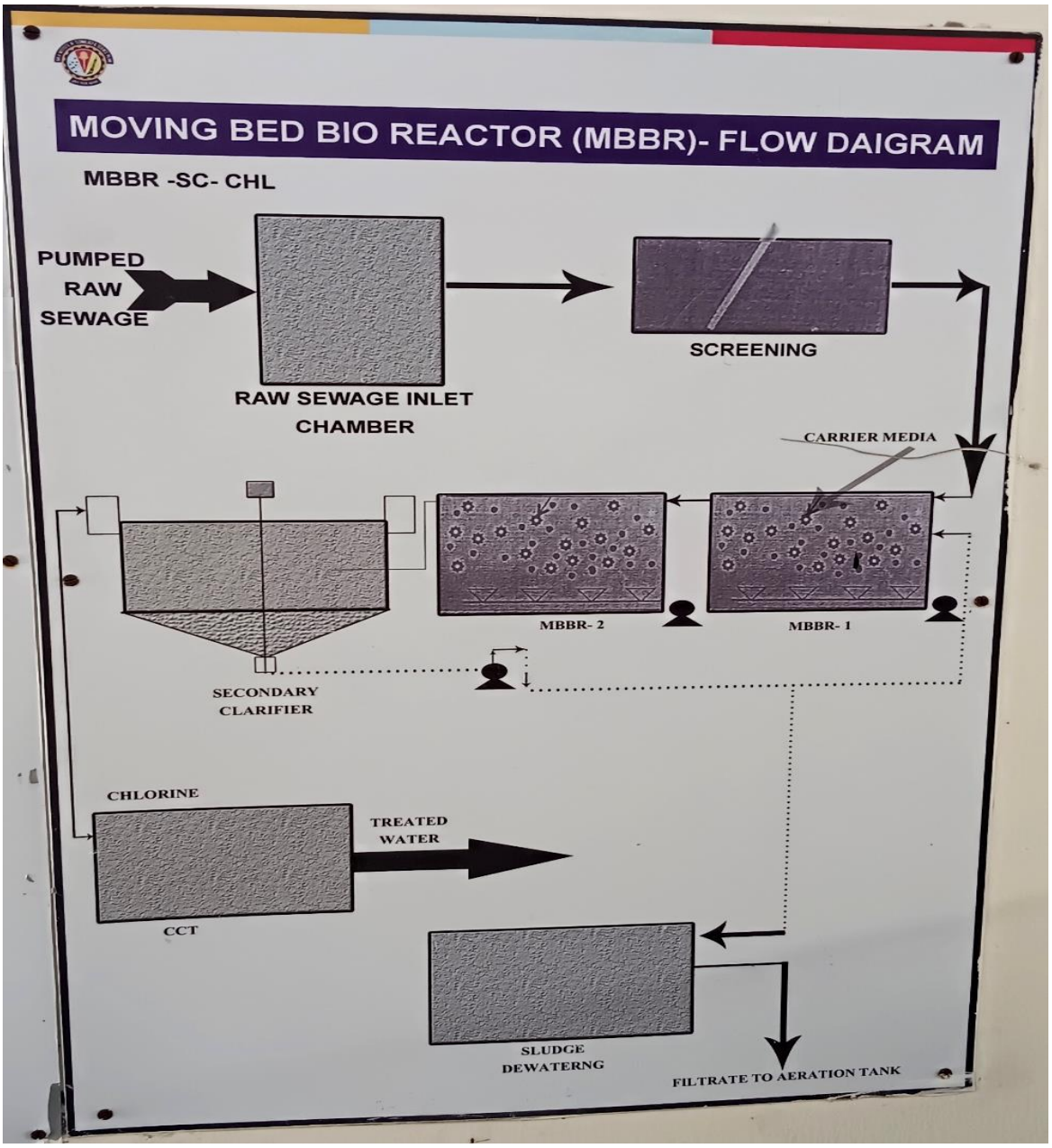
1. Gardening Purpose
2. Flushing Purpose
3. Cooling Tower
4. Chillers
5. Construction
6. Cleaning

Usage

1. Gardening Purpose – 8-10 Lacs liter Per day
2. Flushing Purpose -- 4-5 Lacs liter Per day
3. Cooling Tower – 1 Lacs liter Per Day
4. Chillers – 1 Lacs Liter Per Day
5. Construction – 1.0 Lacs Liter Per Day
6. Cleaning – 50 K Liter Per day

Weekly checked for the BOD, COD, TSS, pH, TDS, Oil and Grease


Typical Process in 1.50MLD STP (MBBR)
Sewage
Canteen Drain
Bar Screen Chamber
Oil, Grease, grit trap
Equalization Tank
MBBR-1
MBBR-2
Settling(Clarifier) Tank
Filter feed Pump
Conditioning (SHT)
Sand Filter
Dewatering System
Activated Carbon Filter
Dewatered Sludge
(Cake/bags)
UV-Disinfection System
Chlorination
Water Softener
Treated Water tank
Water for Reuse
(Cooling Tower)
Water for Reuse (Toilet Flush, Gardening etc)



Positives:

- 100 % utilization of Sewage Treated Water
- Use of TSE water from STP Plant for HVAC Cooling towers, Make up tank, Flushing and Irrigation network.
- Pumps & Equipments selected on best energy efficient point.
- Use of low flow fixtures to reduce water flow & thereby control in water usage
- Insulation of Hot Water Pipes
- Master switches installed in for each class rooms
- CRT Monitors being replaced with LCD/LED Monitor
- Thermostat controlled cooling System
- New academic Block is equipped with rain water management system with channelized Drain & pipe Network, rain water Holding Tank, Pumps and ground water recharge pits
- Appx2 Km of storm water drain line is also provided with four rain water recharge pits
- Rain water harvesting & Recharge pits are provided at numerous locations of the campus

6.2 WASTE MANAGEMENT

Food Waste:

Campus having total 08 Nos Mess and food preparation done in the 2 nos mess and distributed to other mess.
Mess is running by Outsource agency

1. **Blue Chip Hospitalization**
2. **Aditya Food Management**

FSSAI License verified for both.
RO water provided to all mess and Testing of the water done by external agency.

Total student appx 5000 Nos are having the meal per day (Breakfast, Lunch, Dinner)
Total food prepared appx – 3900 - 4000 Kgs/day Excluding the cutting waste
Total waste appx – 1000 – 1200 Kgs / day
Bio Gas plant not working condition, installation done in Year 2019.
Currently Food Waste is handed over to the local Municipality.

BIO WASTE:

Following Colour coding for biomedical waste management: yellow, red, white, and blue bins

1. YELLOW

- Pathological waste
- Soiled (infectious) waste
- Medical chemical waste
- Clinical lab waste
- Pharmaceutical waste (discarded/expired medicines and drugs)

2. RED

Contaminated waste (recyclable)

WHITE (or translucent)

Sharps waste
Considering the nature of this hazardous medical waste, you will need containers that are puncture, leak, AND tamper proof. As for disposal, the case is the same as with the waste falling under the red category: you'll need a medical waste shredder.

4. BLUE

Medical glassware waste
Depending on the sources you look up, you may not even find this type of container, as some literature lists these in the same category of sharps waste, as they are also capable of inflicting puncture and cut wounds.

Data of Bio Waste Generation (All color Bins Total)

July 2022: 23 kgs
Aug 2022: 19 kgs
Sept 2022: 22 Kgs
October 2022: 47 Kgs
November 2022: 54 Kgs
December 2022: 17 Kgs

The Bio Waste are disposed to Pollution Control Board Authorized Agency.

E- Waste:

E – Waste such as Computers and telecommunications equipment, Consumer electronic devices and solar panels. TVs, monitors and screens. LED bulbs etc are under buy- back system

Oil, Grease related Waste:

These are Collected separately and disposed to Pollution Control Board Authorized Agencies.

Plastic & Paper Waste:

Currently no practice of segregation of Plastic & Paper Waste. All such wastes are collected by Municipality.

7. GREEN MANAGEMENT

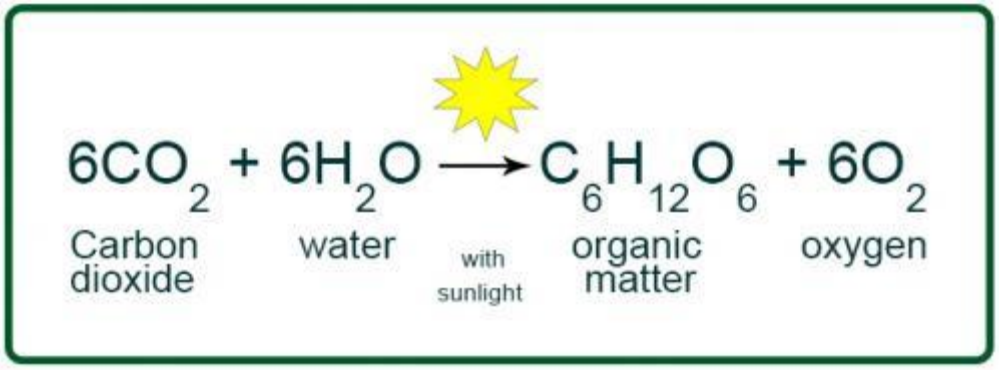
Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to campuses. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen released by the trees of the campus is good for the students and staff in the campus. We need to realize the importance of trees in and around the campus as they significantly contribute towards making the air cleaner for us. The BITS – PILANI campus sustains a luxuriant plant diversity ranging from trees, grasses, herbs, shrubs, creepers ornamental plants, palm and seasonal flowers.

Benefits of plants

- Lowers levels of anxiety. Constantly seeing and being around plants helps people feel more calm and relaxed, thus decreasing levels of anxiety.
- Increases attentiveness and memory. ...
- Increases productivity. ...
- Reduces stress levels and boosts mood. ...
- Sparks creativity.

The ultimate benefit of plants is the air we breathe. Our ancient Earth likely contained very little free oxygen, but scientists estimate that about 2.5 billion years ago the evolution of photosynthesis, whose by-product was oxygen, was the ultimate cause of the rise of oxygen levels in our atmosphere (Photo 1). Modern levels of oxygen in the atmosphere allow us to breathe easy, thanks to photosynthesis.

Today, the levels of oxygen in our atmosphere are not much of a concern, but the rapid rise of carbon dioxide is. However, another benefit of photosynthesis is the absorption of carbon dioxide from the air which ultimately transforms into carbon (organic matter) stored in plant tissues (Photo 1). If the carbon is stored long-term, such as in trunks of long-lived trees, this process is called "carbon sequestration." Many scientists are looking at ways to use plants to sequester carbon in order to mitigate or defer global warming.



The chemical formula of photosynthesis showing how six carbon dioxide molecules and six water molecules in the presence of sunlight are converted into one molecule of organic matter and six molecules of oxygen.

Green Belt/ Landscaping:

Total Area of Green Coverage inside the Campus:

Total Nos.of Out Door Plants: 13134 nos

(Covering the Family of Anacardiaceous, Acanthaceae, Apocynaceae, Fabaceae, Myrtaceae Lythraceae, Phyllanthaceae, Araucariaceae, Simaroubaceae, Combretaceae, Annonaceae Meliaceae, Poaceae, Musaceae, Moraceae, Rutaceae, Rhamnaceae etc.
Myrtales)

Total Nos of Ornamental Indoor Plants: appr. 2000 Nos

(Covering the Family of Arecaceae, Araucariaceae, Araceae, Asparagaceae, Euphorbiaceae & Cycadaceae)

Some specific Benefits of Plants:

Indoor plants are commonly used for their aesthetics benefits but they also have vital role reducing airborne pollution. The right choice of plants can be an excellent way of improving indoor air quality and general health. Local landscape contractor can be contacted for supply and rotation of these plants

Plants	VOC it removes	Indoor source of VOC's	Plant care
 **Aloe Vera**	Formaldehyde, Trichloroethylene and Benzene	Chemical based cleaners and paints	Easy to grow with enough sunlight
 **Bamboo Plant**	Formaldehyde, Trichloroethylene and Benzene	Paints, Plastics, Wood products etc.	Thrives under low light conditions as well as easy to maintain
 **Chinese Evergreen**	Benzene	Paints	Low maintenance plant that prefers low light conditions.
 **English Ivy**	Formaldehyde, Benzene, Air borne fecal matter particles	Wood, Paper products, Air borne fecal – matter particles from pests	Easy to maintain
 **Parlor Palm**	Purifies indoor air		Easy to maintain

Carbon Foot Print

Fossil fuels (such as petrol, diesel) contribute significantly to environmental pollution through emission of greenhouse gases into the atmosphere mainly as carbon dioxide. Vehicular emission is the main source of carbon emission in the campus, hence to document the various means of transportation that is practiced by the university members is important.

Carbon foot print analysis

Nov 2022 Data of Vehicular movements inside the Campus.

Four Wheeler Movements: 5900 nos

Two Wheeler movements: 8200 nos

AutoRiksha: 1427 nos

Cycle: 13488 nos

Total movement: 29,000 nos

% age Cycle Movement: 46%

Initiatives:

Cycle movement encouraged. All students are allowed only to use the Cycles.

To minimize the traveling time and distance the hostels are within the premises only.

Car Pooling is encouraged

Routine Green Practices:

Every year university celebrates World Environment Day and World Water Day in the campus. Many plants are planted on this day every year; in this way the plant count increases every year. The main focus of these programs is to provide awareness to the students about the importance of the environment, its conservation and sustainable use of environmental resources.

8.RECOMMENDATIONS:

Energy Management

1] Avoid the Pump Throttling to Increase Pump Efficiency

Zone 2 and 3 pumps are observed in throttled position for both set domestic and flush. Throttling on the pump discharge will effect on changing the system resistance curve. This changes the point of intersection with the pump performance curve with resultant change in flow. In such case pump input remains same but the output of pump will reduce which will reduce the efficiency of pump and degrades pump life.

Zone 1 pumps are having VFD for both domestic and flush pumps but still the discharge side of both set is 50% throttled, this will nullify the purpose of VFD installation and it is running with 50Hz frequency.

So it is recommended that to install VFD on zone 3 and zone 2 pumps and for zone 1 adjust the frequency and remove throttling on it.

At present the line pressure requirement is 2 kg/ cm2 and if the line pressure goes beyond the VFD will sense the pressure and cut off the power supply.

Replacement of existing lighting with LED:

- **LED lights are up to 80% more efficient than traditional lighting such as fluorescent and incandescent lights. LED lights also consume much less power than traditional lighting. A typical 84-watt fluorescent can be replaced by a 36-watt LED to give the same level of light. Less energy use reduces the demand from grid and decreases greenhouse gas emissions.**
- **LED lights contain no toxic elements. Most offices currently use fluorescent strip lights which contain noxious chemicals such as mercury. This will contaminate the environment when disposed of in landfill waste. Disposal has to be arranged through a registered waste carrier so switching to LED avoids the cost and time implications required for compliant disposal and helps to protect the environment from further toxic waste.**
- **A longer life span means lower carbon emissions. LED Lights last up to six times longer than other types of lights, reducing the requirement for frequent replacements. This results in using fewer lights and hence fewer resources are needed for manufacturing processes, packaging materials and transportation.**
- **It is reported that no Sodium/mercury Vapour Lamps are in used in the campus as on today. It is recommended to replace Sodium/mercury Vapour Lamp light fixture with LED Light if any.**

- **All toilet blocks and passages may be planned to put on motion sensor control in a phased manner.**

General Energy Savings Proposal

Energy Savings for Computers, Printers Scanner, Light, AC, Ceiling Fan etc.

- **Photocopier and printers may be "turned off"" WHEN NOT IN USE", as even in the "sleep mode" these consume power. Power Management features should be activated on all copiers and printers.**
- **Monitor and other office equipment may be plugged into power with a motion sensor. These devices automatically turn off equipment whenever user leaves the room for more than a few minutes that can be set by user. All Computers may be "Switched OFF" at the end of the day.**
- **Air conditioners temperatures can be set at optimum like for rooms may be set at 26^0 C.**

Environment Management

33 KV Sub- Station:

a. 32 earth pits, renovated recently, to be painted for its number, ohmic value measured, date of measurement, next due date etc.
b. Sand bucket is filled with soil, to be replaced with good sand
c. Material stored in battery room, may be shifted to store room
d. Electrical shock chart to be provided

Sewage Treatment Plant:

i. Aisle marking may be provided
ii. High noise area posters and use of necessary PPE to be provided
iii. Chemical cans are stored on floor, proper containments and MSDS to be provided at this storage location
iv. Electrical panel door is kept open for cable termination, to be closed on priority
v. Roof exhaust fans may be provided to for better ventilation to avoid bad smell

DG and chiller units:

vi. Monthly running hours, power generated, diesel consumption to be recorded and analyzed for any possibility of saving
vii. Monthly running hours, power consumption to be recorded and analyzed for any possibility of saving

Waste Segregation at Source I.e. Plastic & Paper waste

GREEN CAMPUS

1. **Replacement of all remaining lights with LED**
2. **It is reported that no Sodium/mercury Vapor Lamps are in used in the campus as on today. It is recommended to replace Sodium/mercury Vapor Lamp light fixture with LED Light if any.**
3. **All toilet blocks and passages may be planned to put on motion sensor control in a phased manner.**
4. **Photocopier and printers may be "turned off"" WHEN NOT IN USE", as even in the "sleep mode" these consume power. Power Management features should be activated on all copiers and printers.**
5. **Monitor and other office equipment may be plugged into power with a motion sensor. These devices automatically turn off equipment whenever user leaves the room for more than a few minutes that can be set by user. All Computers may be "switched OFF" at the end of the day.**
6. **Air conditioners temperatures can be set at optimum like for rooms may be set at 26^0 C.**
7. **Re – start the Bio Gas Plant**

Name of the Client	Date of Audit	Audit Team		Date and Signature
		Name	Role	
Birla Institute of Technology and Science (BITS – PILANI)	From 19th to 22nd December 2022	V. Balakrishnan	Team Leader	V. Balakrishnan  20. 01.2023
		Keshavraj Athavale	Lead Auditor – Energy Management	
		Mahendra Patil	Environment & Green Audit	
		Sunny Subhash Pangire	Energy Auditor	
		Ajay Annasaheb Toraskar	Energy Auditor	
		Swapnil Sanjay Bade	Energy Auditor	