

Report on Energy Audit and MEP Audit for VES Institute of Management Studies & Research, Chembur



by:

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Acknowledgement

Team Energetic wish to thank trust members and staff members of VES Institute of Management studies and research, Campus II, Chembur and the ever-helping team members of administrative team. Team Energetic wish to express their gratitude for all the help extended to our team members.

Team Energetic

Preamble:

Vivekanand Education Society (**VES**) is one of the premier and well-known education societies of Mumbai and they operate many schools and colleges including professional courses such as Engineering, Architecture, Pharmacy, Law and Management.

Building Details:

VES Institute of Management Studies & Research is a G+5 (excluding current construction work) storey building and is offering Masters' courses. There are classrooms, admin offices, conference hall, computer Labs and staff cabins on various floors.

There is fire hydrant system installed and also there is presence of smoke sensors in enclosed spaces for campus. In the Pump room, 2 nos. water pumps (1W + 1S/B) have been installed.

VES management is currently updating all schools and colleges and have taken up task of upgrading school infrastructure and have decided to carry out Energy and MEP services audit of their facilities and have invited Energetic Consulting Pvt. Ltd. (**ECPL**) to carry out energy audit and audit of all MEP services.

Executive Summary:

Electricity Bill:

Tariff Structure:

Sanctioned load for energy meters is 205 kW but connected load is around 222.5 kW. Current tariff structures, **HTV-B** are recommended for load upto above 150 kW respectively. According to #325 of 2019 MERC amendment (Maharashtra Electricity Regulatory Commission); the recommended category for public services (such as schools, hospitals) is **LTIV-B tariff**. In this category there will be fixed demand charges per month.

By implementing the energy efficiency measures for Lighting, Ceiling fans and pumps, the connected load would come down from 222.5 kW to 216.07 kW.

Improvement of power factor at consumer #152951505 should be considered to avail maximum benefit of incentive from EB. Installation of 50 kVAR APFC panel should be considered for respective energy meters. Initial investment of Rs. 0.90 Lakh will be required for both panels and simple payback period will be within 3 years of installation of panel.

VES management need to approach Adani Electricity (Utility provider) for change in tariff category for consumer, as Contract Demand is applicable for consumers below 150 kW. A benefit of Rs. 2/kVAh can be availed on electricity bill.

MEP System:

Lighting System:

The average illumination level inside the classrooms was observed as 465 Lux. As per NBC-2016, the recommended illumination levels at college should be 300 Lux inside each classroom and 500 Lux inside practical laboratories and 150 Lux at passages and staircases.

There are some T5 and T8 tube lights needs to be replaced to achieve required levels of illumination.

Though the no. of tube-lights would increase, from 703 nos. to 738 nos.; there would be marginal increase in installed capacity of lighting power

by 0.6 kW.

An investment of Rs. 0.17 Lakh will be required for replacement of tube-lights and expected saving potential would be Rs. 0.14 Lakh per annum. The sample payback period would be 1.3 years, including addition of 106 nos. new lighting fixtures

Ceiling fans:

Existing ceiling fans in the classrooms are consuming 40W, 60W and 85W power, which are conventional induction motor type fans. Considering the vintage of these fans, it would be prudent to replace these fans by new energy-efficient BLDC fans, which would consume around 28W to 30W power each.

Currently, there are 106 nos. ceiling fans have been installed in the college and if BLDC fans are installed, the electrical load of ceiling fans would get reduced by 5.83 kW.

Total proposed investment for 106 nos. BLDC fans would be Rs.1.96 Lakh and the expected saving potential would be Rs.0.66 Lakh per annum. The sample payback period would be around 3 years.

Air conditioning system:

Air conditioning system installed at college premises are of BEE 2-Star and 3-Star rating under BEE's star labelling program. While installing of new air conditioning system evaluation of star rating is considered in details. Performance of AC was near to rated EER as per star rating.

Water pumping system:

Management college receives water from MCGM. There is a U/G tank of 12 kL capacity, which stores water received from MCGM and then as needed, water is pumped to OH Tanks (5 kL each capacity, respectively). Usually, the water is topped up once a day (after each recess) for one hour.

For lifting water from U/G Tanks, 2 nos. submersible pumps (1W + 1S/B) have been installed. As confirmed by team, these pumps were installed more than 10 years and the pump motors have undergone rewinding.

The operating efficiency of the Pump + Motor was found to be 21%, and it would be prudent to replace these pumps by new energy -efficient pumps. The current energy consumption of the existing pumps is 4.65 kWh/day, while the new pumps would consume 1.68 kWh/day energy.

An investment of Rs. 0.65 Lakh would be needed for replacing both these pumps along with interconnecting piping. Since only single pump is operated for 1 hour/day and the payback period would be very high, but considering vintage of these pumps, VES management need to replace both the pumps without actually considering payback period.

Electrical Safety Audit:

We noticed several others lacunas such as inadequate ventilation, inadequate lighting system and absence of Earth mats in the main Metering Room. Meter rooms are used as store rooms for dumped material from college was observed. Installation of IP 65 panel box for B wing meter box should be considered due to location of distribution.

Our recommendations in improving the power distribution system have been detailed in the chapter on Electrical Safety Audit.

Absence of earthing system was one of the major findings of this study and 8 nos. Earth pits need to be installed (4 nos. for main electrical room for main distribution panel and 4 for lifts) on priority. We recommend using individual plate type earthing system. A copper plate of 600mm X 600mm X 6 mm thick need to be buried in the earth along with adequate layers of charcoal and salt would be needed for maintaining electrolytic connection, necessary for grounding the fault current.

Considering flooding nature of this site, we recommend to use Plate type earthing only (as per IS:3034) and not to consider any options such as chemical earthing pits.

An Earth grid needs to be formed of all these earth pits and they need to be interconnected using copper strip of 40mm X 6mm.

The cost of 8 nos. Earth pits shall be Rs. 1.2 Lakh, including installation.

Loose wiring and improper cable routing were also observed at distribution boxes. The distribution cabling / wiring upto classroom entry point should

be done using fire retardant electrical conduits.

At several classrooms there were observations like loose wiring, Wires removed outside casing and capping, absence of connectors for tube light and fan connections. ELCB for floor distribution or classroom distribution system have not been installed. Earth insulating mats have also not been provided at the Floor DB level, which need to be considered while augmenting the electrical system. By providing these standard electrical practices, significant improvement in health of electrical system can be achieved.

College has to improve housekeeping practice for electrical system and implement preventive maintenance program along with documentation and standard operating procedures for electrical system.

For building above G+5 structure, Lightning protection system is mandatory. Also, college has installed Lightning arrestor but earthing strip needs to be mounted on busbar supporter. Interconnection for lightning arrestor was provided to individual earth pits with strip of 25mm X 3 mm.

The cost of Lightning arrestor along with dedicated earth pits shall be Rs. 0.75 Lakh including installation

Roof-top Solar PV Plant:

Around 5000 Sq.Ft. of shadow free area is available in fragmented manner at terrace level. We recommend installing roof-top Solar PV system of 50 kWp capacity for reducing overall energy consumption of college.

A 50 kWp roof-top Solar PV system would generate around 70000 kWh per annum. The expected saving potential shall be Rs. 7.98 Lakh/annum. The estimated cost of installing 50 kWp Solar PV system shall be Rs. 30.00 Lakh. The simple payback shall be within 4 years.

Summary of energy saving projects:

Sr. No.	Description	Cost Savings, Rs. Lakh	Expected Expenses, Rs. Lakh	Simple Payback period
1	Installation of APFC panels for B wing energy meter to maintain power factor to unity		0.9	< 3 Years
2	Replace existing tube-lights with 20W LED tube-lights, including addition of fixtures	0.14	0.17	
3	Replace existing ceiling fans with 30W BLDC fans, including addition of new fans	0.66	1.96	< 3 Years
4	Replace existing Water pumps with new energy efficient pumps, including piping	0.08	0.65	< 8 Years
5	Addition of 8 nos. Earth-pits (for electrical panels and for Lifts)	-	1.2	-
6	Addition of LA system for lightening protection along with dedicated earth pits	-	0.75	-
7	Install 50 kWp roof-top Solar PV system	7.98	30.00	< 4 Years
	Total:	8.86	35.63	

Chapter 1

Audit Methodology:

ECPL team carried out the entire energy and MEP audit study with a well-defined methodology and all the energy consuming areas were covered including billing analysis. The detailed methodology followed was as under:

1. Electrical Distribution System:

Scope of Work:

- Study the Load distribution pattern of major energy meters
- To suggest various energy efficient measures with first order cost benefit analysis

Methodology:

Census:

- Find out the electrical normal & emergency loading.
- Type of tariff
- General hygiene as per standard maintenance practices
- Data on operating hours data was collected from the operating staff

Performance audit:

Electric load recording with:

- Voltage, current, kVA, kW, kWh, P.F. and Hz
- Harmonic analysis for V_{THD} and I_{THD} levels
- Thermography of electrical panels for identifying 'hot-spots', if any

2. Indoor Lighting:

Scope of Work:

- To study existing lighting scenario of facility and verify the building data
- To find out the performance of lighting fixtures
- To calculate (Watt/m^2) and compare lux with the benchmark/prevailing standard in the facility
- To suggest various energy efficient measures with first order cost benefit analysis

Methodology:

Census:

All the lighting fixtures were inspected for following:

- No. of lights installed and no. of lights working
- Type of lights

- General hygiene as per standard maintenance practices
- Data on operating hours data was collected from the operating staff

Performance audit:

Total connected lighting load from the Census was studied in detail as per following:

- Measurement of Lux level
- Measurement of room dimensions
- Power drawn by the lighting system

3. Pumps:

Scope of Work:

- To study existing pumping system of facility and verify the building data
- To carry out analysis
- To find out the performance of pumping system
- To compare the operating efficiency with the bench mark/prevailing standard in the facility
- To identify the causes of deviation in the performance and suggest recommendations for corrective actions
- To suggest various energy efficient measures with first order cost benefit analysis

Methodology:

Census:

All pumps (Chilled water, Cooling water and domestic water) were audited for following:

- Total no. of pumps installed
- Total no. of pumps working
- Pressure gauge working
- Ammeter working
- General hygiene conditions
- Data on operating hours data was collected from the operating staff

Performance audit:

All working pumps from the Census were studied in detail as per following:

- Water flowrate, m³/hr
- Head generated, mWC
- Power drawn by pump, kW

4. Electrical Inspection:

Scope of Work:

- Physical inspection of power cables, electrical panels, associated with electrical distribution, electrical installations
- To compare the operating efficiency with the bench mark/prevaling standard in the facility

Methodology:

- Visual inspection of cables, panels, and electrical distribution
- Power measurement to check adequacy of current carrying capacity of system.
- Identification of electrical hazards such as improper arrangements, clearance shortfalls, major unattended electrical faults, redundancies check-up, etc.

5. Power Quality Analysis:

Scope of Work:

- Check of incoming power quality using power analyser device (Data collected will indicate the status of deviations in power, harmonics, voltage sags, frequency)
- Specific corrective actions will lead to decrease in losses and increased life of equipment)

Methodology:

- Inspection of power quality with Three phase power quality analyser at main incomer for understanding of various parameters.

6. Earthing system & Lightning Arrestors:

Scope of Work:

- Checking of earthing system and layout encompassing all the accessible and working earth pits, measurement of earth resistance using digital earth tester
- Checking of conductor size from earth pit to various electrical panels and dedicated electrical equipment's
- Checking of the lightning protection system installed on the building, provisions of adequate size, arrangement of down conductor and earth pits.

Methodology:

- Measurement of earth resistance using digital earth tester at various earth pit locations.
- Review of conductor size from earth pit to equipment's

7. Standard operating procedure:

Scope of Work:

- Verification of standard operating procedures, circulars, records of preventive maintenance of electrical installation and equipment maintenance, documentations and compliance

Methodology:

- Review of standard documentation for preventive maintenance and various records
- Review of house-keeping procedures and restrictions in electrically sensitive and hazardous areas.

8. Documentation, Records & log books:

Scope of Work:

- Checking status of statutory approvals, documentation for the relevant records, verification of test reports of original equipment manufacturers or their authorized representatives for proper functioning of transformers, LT switchgear and their protective relays, safety interlocking of circuit breakers.
- Scrutiny of present energy bills of power supply, checking of records of electrical accidents and near miss records, if any, LOTO and switchgear isolation log books, records of training.
- Checking the log of electrical system parameters, trend.

Methodology:

- Review of documentation along with technical staff of school

9. Fire Fighting System:

Scope of Work:

- Checking VESDA status and provisions of fire-fighting equipment and fire alarm system, detectors near all the electrical installations.

Methodology:

- Review of standard operating procedure for firefighting procedure.
- Witnessing mock drill for firefighting, smoke sensor and sprinkler activation drill

10. HVAC System:

Scope of Work:

- To study existing Split Air-conditioners of facility and verify the building data
- To find out the performance of Split Air-conditioners

- To compare the specific energy consumption with the benchmark / prevailing standard in the facility
- To identify the causes of deviation in the performance and suggest recommendations for corrective actions
- To suggest various energy efficient measures with first order cost benefit analysis

Methodology:

- Assess performance of all ODUs and IDUs installed and no. of regularly operated machines by measuring power consumed by compressor and ODU fan, air parameters for DBT and WBT (for supply and return air), and IDU fan air quantity
- General hygiene as per standard maintenance practices
- Data on operating hours data was collected from the operating staff

Chapter 2

Billing Analysis:

Management college receives electricity supply from Adani Electricity. one HT energy meters and one LT energy meters, both meters were installed for the college premises near staircase.

The electrical load mainly comprises of the classroom lighting, office lighting, fans, Split AC units, domestic water pumping on an average, the building functions for about 10-11 hours a day for five and half days a week.

Sr. No.	Energy Meter Number	Tariff category	Phase	Connected Load (kW)	Operation status
1	102703033	HTV-B	3	115	Operational
2	152951505	LTIV-B	3	90	Operational

Connected Load List:

Sr. No.	Load	Power (W)	Quantity (Nos.)	Total Load (kW)
1	Spot Light LED	8	24	0.192
2	Spot Light LED	12	82	0.984
3	LED Tube Light	18	177	3.186
4	LED Tube Light	20	345	6.900
5	T5 Tube Light	36	71	2.556
6	T5 Tube Light	40	1	0.040
7	High Mast	60	3	0.180
8	Ceiling Fan	85	106	9.010
9	AC Unit	2000	87	174.000
10	Water Pump	5500	1	5.500
11	Computer	100	200	20.00
			Total:	222.500

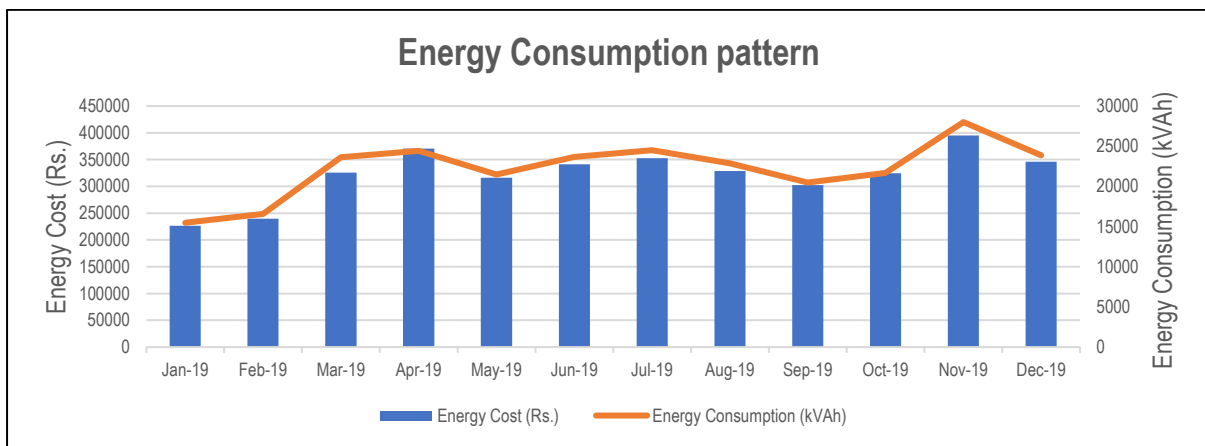
Existing connected load in premises is around 222.5 kW, but sanctioned load is 205 kW from Adani Electricity. Currently, the college is under **HTV-B and LT IV- B tariff** category

The annual energy consumption for each energy meter has been summarized as under:

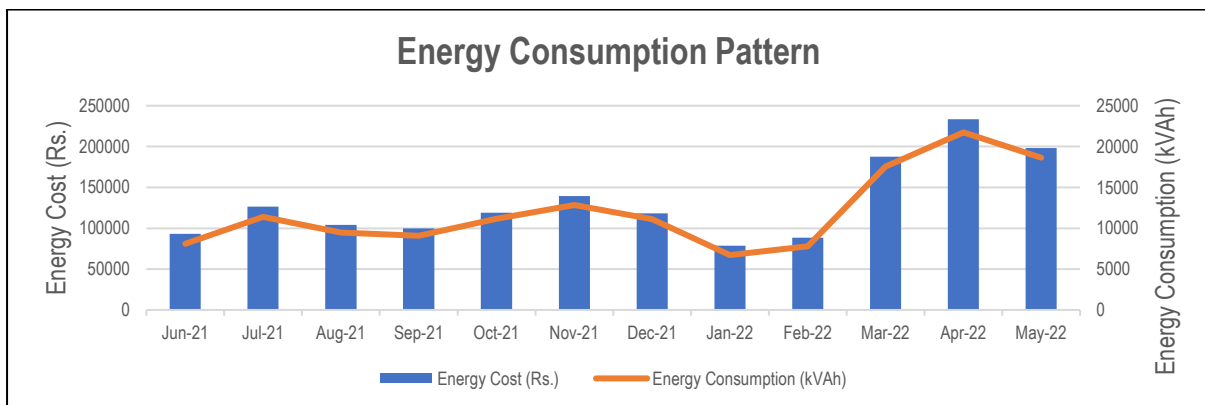
Energy Meter Consumer ID	Annual Energy Consumption 2019, kWh	Annual Energy Consumption 2020, kVAh	Annual Energy Consumption 2021, kVAh	Annual Energy Consumption 2022, kVAh (Till May)
102703033	266626	93084	93764	52825
152951505			24379	19578
Total:	266626	93084	118143	72403

Due to COVID-19, in the year 2020 and 2021, the building was not functional to its fullest capacity, the campus occupancy was negligible during this period. Overall, around 65% reduction in energy consumption was observed during these periods. After June 2021, the campus was reopened in off-campus mode and subsequently, November 2021 the campus operated with full occupancy.

Bar chart of Energy Consumption during 2019



Bar chart of Energy Consumption after June 2021

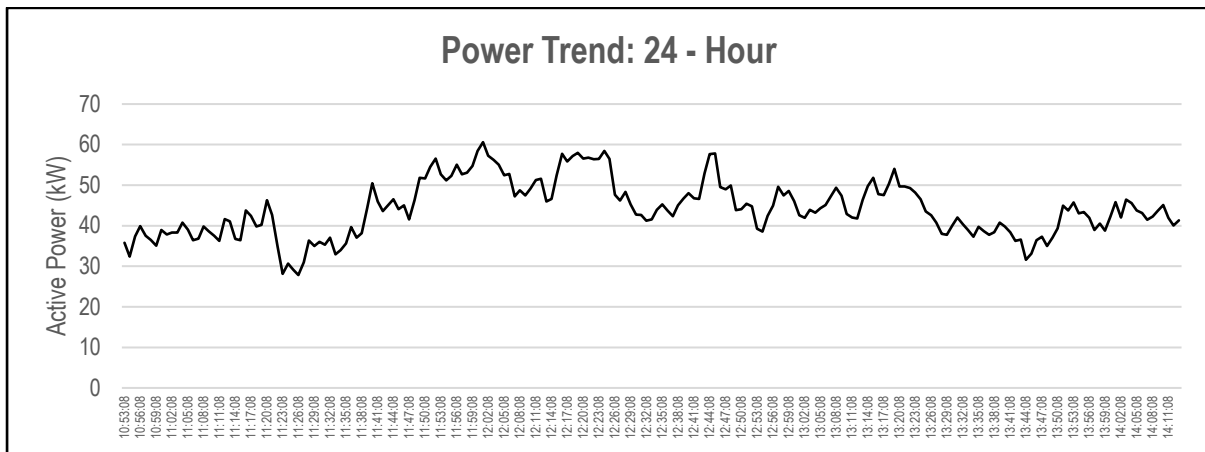


Energy consumption during 24-hour analysis was found around 239 kWh per day. Major contributors to energy consumption are Ceiling fans and AC load, which contribute around 70 % of total load.

During energy audit, energy consumption for all meter was recorded for period of 24 hours and the details are as under:

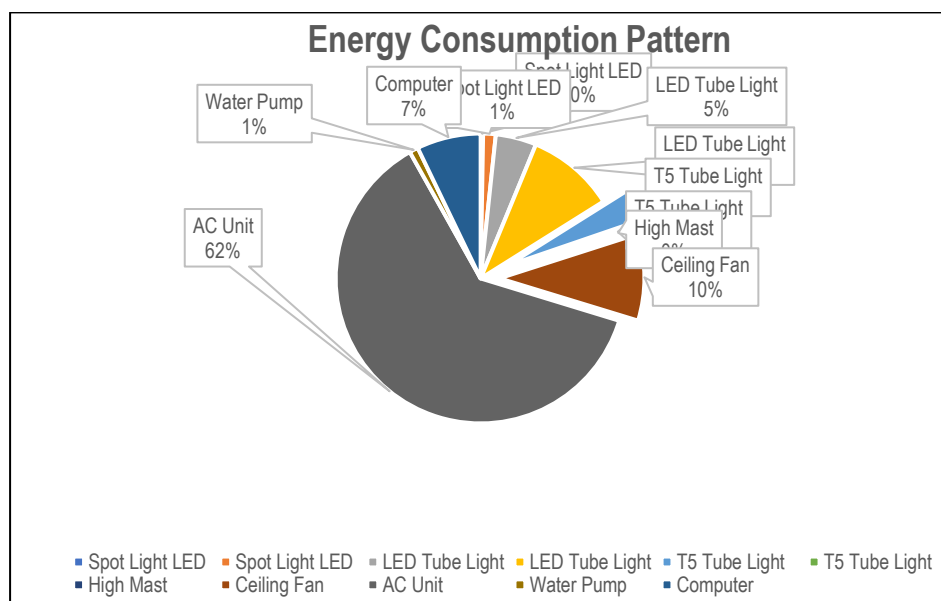
Duration	Energy Consumption (kWh)
09 th June 2022 – 10 th June 2022	239

Line chart of power trend – 24 Hour duration



The average daily consumption was around 658 kVAh and more or less matches with the overall monthly consumption numbers during pre-covid consumption.

Pie chart of Energy consumption



Detailed billing analysis was carried out for year 2019 and 2021; it has been tabulated as **Annexure – 1**.

Detailed analysis of these major energy consuming energy meters revealed the following trends:

- Energy meters are in **HTV-B** category of tariff structure.
- For **LTIV-B** Power meters, the power factor and TOD benefits are accounted for billing, but due to nature of operation, TOD night zone benefit cannot be availed due to negligible load during night hours.
- For **HTV-B** Power meters, the power factor and TOD benefits are accounted for billing, but due to nature of operation, TOD night zone benefit cannot be availed due to negligible load during night hours.
- The energy charges (Rs. Bill value paid / kVAh consumed) are around **Rs. 11.40/kVAh**.
- The energy charges (Rs. Bill value paid / kWh consumed) are around Rs. 9.40/kWh.

Power factor:

For **HTV-B** tariff (**Consumer #102703033**), power factor plays an important role while billing, as HT consumer has kVAh billing instead of kWh billing. In past 5 months, Leading PF was observed, which might get penalized from Utility.

Parameters	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Average power factor	% Lag / Lead	99.56% Lead	99.56% Lead	99.29% Lead	97.08% Lead	94.77% Lead
Apparent energy consumption	kVAh	13789	15448	12282	5969	5337
Active energy consumption	kWh	13728	15380	12195	5795	5058
Difference		61	68	87	174	279

For **LTIV-B** tariff consumers, power factor penalty and incentive are applicable, for **Consumer #152951505** are applicable incentive / penalty. Detailed evaluation of consumers are as follows:

Consumer Number #152951505

Parameters	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Average power factor	% Lag / % Lead	99.20% Lag	99.20% Lag	98.50% Lag	95.90% Lag	80.10% Lag
Power factor incentive/penalty	Rs.	-560	-1214	-1013	-71	219
Incentive percentage	%	-2%	-2%	-2%	-1%	2%
Maximum benefit possible	Rs.	1306.9	1699.6	1417.9	498.5	382.6
Benefit Missed due to Low PF	Rs.	747	486	405	427	601

Recommendation:

- I) Maintaining power factor near to unity throughout year will be important for electricity billing.
- II) According to #325 of 2019 MERC, tariff policy structure power factor incentive upto 3.5% can be achieved on electricity bill by maintaining PF near to unity.

For **Consumer #152951505**, currently no power factor correction unit or no fixed capacitors have been installed at main panel. Power factor panel of 50 kVAR should be added at main metering panel. Stage of automatic power factor correction (APFC) panel of 50 kVAR of 8 steps should be 1, 2, 2, 5, 10, 10, 10, and 10 kVAR for better correction of PF.

Investment: Rs. 90,000 (including installation and Commissioning)

Simple payback period: 3 years

Tariff Policy Recommendation:

According to #325 of 2019 MERC, Multi-year tariff policy structure for education institutes such as schools and colleges, should be in Tariff category **LTIV-B: LT Public services – others**.

Management college is in HT V B category, that should be changed to LT IV B, as Management college sanctioned load is below 150 kVA i.e., 115 kVA College can save upon demand charges at is being levied upon HT consumers. So, average energy charges will be reduced by Rs.2/kWh by tariff policy change.

Comparison of Adani Tariff Structures

Parameter	LTIV-B		HTV-B	
	Value	UoM	Value	UoM
Fixed Charges	425	Rs./Month	355	Rs./kVA
Wheeling Charges	1.47	Rs./kWh	0.66	Rs./kVAh
Energy Charges	6.00	Rs./kWh	5.61	Rs./kVAh

Considering energy consumption for **Consumer #102703033**, for the month of April, the sample cost saving calculations have been done for category change from **HTV-B** from to **LTIV-B**.

Energy consumption for April month was 13789 kVAh and billed demand was 93.99 kVA.

Parameter	LTIV-B		HT V-B	
	Value	UoM	Value	UoM
Fixed Charges	425	Rs./Month	33366	Rs./kVA
Wheeling Charges	20270	Rs./kWh	9101	Rs./kVAh
Energy Charges	82734	Rs./kWh	77356	Rs./kVAh
Total:	103429	Rs./Month	119823	Rs./Month

Cost savings of Rs.16,395 would have been achieved, if consumer was under tariff category of **LTIV-B**.

Other Cost Saving measures:

As per MERC guidelines, a prompt payment discount of one percent of the monthly bill (excluding Taxes and Duties) shall be provided to consumers for payment of electricity bills within 7 days from the date of their issue.

In case the electricity bill is not paid within the due date mentioned on the bill, delayed payment charges on the billed amount, including the taxes, cess, duties, etc..., shall be levied on simple interest basis at the rate of 1.25% on the billed amount for the first month of delay.

A discount of 0.25% of the monthly bill (excluding taxes and duties), subject to a cap of Rs. 500/-, shall be provided to LT category consumers for payment of electricity bills through various modes of digital payment such as credit cards, debit cards, UPI, BHIM, internet banking, mobile banking, mobile wallets, etc....

VES management can avail this benefit and make necessary provisions for making digital payments to Adani Power.

Chapter 3

MEP Systems

Lighting System:

Management college has 703 number of lighting fixtures and out of that 10 % of lighting fixtures are T5 and T8 Type. This lighting is inefficient in terms of lumens/watt and that can be better replaced with LED lighting fixtures.

The total lighting load for the building is 14.03 kW and with overall BUA of 24095 ft², the actual LPD is 0.58 W/ft². Avergae diversity for illumination is 0.79 and uniformity is 0.53. The diversity and uniformity are good

All illumination level measurements have been tabulated as Annexure-3

Existing Lighting scheme:

Sr. No	Location	Room Area (m ²)	Lighting Fixture Power (W)						
			8	12	18	20	36	40	60
1	A-503	11.5				3			
2	A-502 / Library Hall	205.4			18		4		
3	A-501 Library room	28.0				2	3		
4	A-504	9.8				3			
5	B-503	17.2			15	30			
6	B-501	108.1			15	30			
7	B-502	100.2			15	30			
8	A-401 Business Incubation Center	13.4				2			
9	A-405 / Faculty room	18.6				2	2		
10	A-402 / Class room	45.6			9	22			
11	A-403	17.7				3			
12	Store Room inside 403	32.6				4	1	1	
13	A-404 / Accreditation	38.5			3	12			
14	B-402	56.7			6	9			
15	B-403	50.9				15			
16	B-404	74.6			10	14			
17	B-401	13.3				1	2		
18	B-405	17.5				4	1		
19	A-301	14.0				2			
20	A-305 (Faculty Room)	37.9				6	4		
21	A-302 / Class Room	87.2			8	18			
22	A-304 / SAS Lab-2	39.0			3	12			
23	A-303 / SAS Lab-1	49.5				5	2		
24	A-303 Classroom	71.0				20			
25	B-304 Classroom	74.1			10	15			
26	B-301 Co-ordination and Exam Department	13.4					5		

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Sr. No	Location	Room Area (m ²)	Lighting Fixture Power (W)						
			8	12	18	20	36	40	60
27	B-302 Co-ordination and Exam Department	32.6				6			
28	201	12.9				11	1		
29	203 Boys' Lounge	85.0		12		6			
30	202 Girls' Lounge	82.9	6			13			
31	205 Faculty room	19.1				2	3		
32	B-201 Associate Dean Cabin	27.7				3			
33	B-205	17.4			2	3			
34	B-202 Placement Cell	35.3				4	6		
35	B-203 Class room	66.8				12			
36	B-204 Class room	75.3		10	15				
37	A-102 Computer Lab	88.1					37		
38	A-110	9.2		4					
39	A-109	8.8		4					
40	A-111	9.3		4					
41	A-113	12.7		4					
42	B-101 / Registrar Cabin	10.5				3			
43	B-102 Dean Office	13.3		6					
44	A-108 Director's room	13.4		6					
45	A-102 Director Office	20.0			6				
46	Deputy Registrar Office	5.7				2			
47	105-Admin Office	17.8		0	1	3			0
48	B-103 MBP-2	74.2		18		6			3
49	B-104 Class room	75.1	8	14					
50	105	11.6				3			
51	B-105	16.9				4			
52	A002	9.8			4				
53	Baquet Hall	45.9			12				
54	A-005	10.5			4				
55	A-004 / Conference Hall	71.9	10		15				
56	Guest Lounge	13.6			6				
Total:			24	82	177	345	71	1	3

Energy Saving Calculations:

Sr. No	Location	Average Lux	Existing Lumens	Required Lumens	Actual Fittings required	Total Wattage	Existing Wattage	Saving Wattage
1	A-503	407	4694	3460	3	60	60	0
2	A-502 / Library Hall	168.9	34686	102683	40	764	468	296
3	A-501 Library room	331.7	9272	13977	9	180	148	32
4	A-504	309.7	3024	2930	2	60	60	0
5	B-503	423.6	13031	5163	4	870	870	0
6	B-501	757.2	94622	32434	21	870	870	0
7	B-502	875.2	34238	30051	19	870	870	0

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Sr. No	Location	Average Lux	Existing Lumens	Required Lumens	Actual Fittings required	Total Wattage	Existing Wattage	Saving Wattage
8	A-401 Business Incubation Center	341.8	3855	4028	3	60	40	20
9	A-405 / Faculty room	287.1	16228	5567	4	80	112	-32
10	A-402 / Class room	874.5	12675	13692	9	602	602	0
11	A-403	277.7	4290	5297	4	80	60	20
12	Store Room inside 403	243	29787	9792	7	140	156	-16
13	A-404 / Accreditation	912.6	25845	11550	8	294	294	0
14	B-402	671.3	46027	17005	11	288	288	0
15	B-403	812	41869	15275	10	300	300	0
16	B-404	822.3	21001	22389	14	460	460	0
17	B-401	281.4	3772	3984	3	60	92	-32
18	B-405	284	2667	5246	4	100	116	-16
19	A-301	152.5	5345	4202	3	60	40	20
20	A-305 (Faculty Room)	381.6	38585	11356	8	200	264	-64
21	A-302 / Class Room	1019.3	74494	26169	17	504	504	0
22	A-304 / SAS Lab-2	854	4733	19495	13	294	294	0
23	A-303 / SAS Lab-1	121.4	42703	24761	8	160	172	-12
24	A-303 Classroom	862.3	17752	21285	14	400	400	0
25	B-304 Classroom	250.2	16210	22236	14	480	480	0
26	B-301 Co-ordination and Exam Department	218.7	3682	4019	3	100	180	-80
27	B-302 Co-ordination and Exam Department	274.8	9197	9795	7	140	120	20
28	201	281.7	5683	3877	3	240	256	-16
29	203 Boys' Lounge	439.8	50182	42513	20	304	264	40
30	202 Girls' Lounge	590.2	27604	41448	20	328	308	20
31	205 Faculty room	333	6391	5718	4	100	148	-48
32	B-201 Associate Dean Cabin	335.3	11475	8305	6	120	60	60
33	B-205	414.5	6799	5230	4	96	96	0
34	B-202 Placement Cell	390	37536	10592	7	200	296	-96
35	B-203 Class room	1063.1	49307	20038	13	260	240	20
36	B-204 Class room	738.2	41268	22588	15	390	390	0
37	A-102 Computer Lab	548.1	25961	44061	28	740	1332	-592
38	A-110	294.6	3185	2763	2	48	48	0
39	A-109	345.8	2714	2645	2	48	48	0
40	A-111	307.8	3725	2780	2	48	48	0
41	A-113	402	4366	3809	3	48	48	0
42	B-101 / Registrar Cabin	343.9	6034	3146	2	60	60	0
43	B-102 Dean Office	575.4	8072	4002	3	72	72	0
44	A-108 Director room	605.1	8154	4024	3	72	72	0
45	A-102 Director Office	607.9	9934	5987	4	108	108	0
46	Deputy Registrar Office	497.8	2241	1724	2	40	40	0
47	105-Admin Office	390.1	15567	5347	4	78	78	0
48	B-103 MBP-2	873.4	24201	22250	14	396	516	-120
49	B-104 Class room	326.3	12186	22539	15	232	232	0

Sr. No	Location	Average Lux	Existing Lumens	Required Lumens	Actual Fittings required	Total Wattage	Existing Wattage	Saving Wattage
50	105	162.2	2323	3483	3	60	60	0
51	B-105	200.1	4772	5080	4	80	80	0
52	A002	281.8	5417	2946	2	72	72	0
53	Baquet Hall	551.6	12711	13771	9	216	216	0
54	A-005	276.9	3941	3164	2	72	72	0
55	A-004 / Conference Hall	373.7	21438	21560	14	350	350	0
56	Guest Lounge	298.3	4067	4090	3	108	108	0
					Total:	13462	14038	-576

Recommendation:

Some of fluorescent lighting fixtures are of T5 and T8 type, their lumen output values are lower, when compared with energy efficient LED tubes. An exercise was carried of calculating existing lumen levels in the classroom and how many fixtures would be needed to get required illumination levels, when 20W LED tube-lights would be used.

Total, 738 (considering existing LED fixtures) nos. of LED tube-lights would be needed to meet desired illumination levels as NBC-2016. Quantity of fixtures would increase, though the no. of fixtures would increase, the overall lighting load would be reduced by 0.6 kW.

Additional Light Quantity:

Sr. No	Location	Existing Lighting Fixtures (W)							Additional Tubelight (W)
		8	12	18	20	36	40	60	
1	A-503				3				
2	A-502 / Library Hall			18		4			18
3	A-501 Library room				2	3			4
4	A-401 Business Incubation Centre				2				1
5	A-403				3				1
6	Store Room inside 403				4	1	1		1
7	A-301				2				1
8	A-303 / SAS Lab-1				5	2			1
9	B-302 Co-ordination Exam Department				6				1
10	203 Boys' Lounge		12		6				2
11	202 Girls' Lounge	6			13				1
12	B-201 Associate Dean Cabin				3				3
13	B-203 Class room				12				1
	Total:	24	82	177	345	71	1	3	35

Energy Saving Calculations:

Parameters	Value
Existing Connected load, kW	14.03
Proposed connected load, kW	13.46
Power Savings, kW	0.57
Operating Hours/annum (11 hrs./day X 200 days/annum)	2200
Energy Savings, kWh/annum	1254
Cost Savings, Rs. Lakh/annum	0.14
Investment required for replacement, Rs. Lakh	0.17
Simple payback period, years	1.3

Ceiling Fans:

Management college has 106 number of ceiling fans for air circulation at various classrooms, staff rooms and passages. These existing ceiling fans are with conventional inductive motor and consume 40W, 60W and 85W power each. The total connected fan load for the building is 9.01 kW.

As per NBC-2016, 5 to 7 Air changes per hour have been recommended for classrooms. Typically, most of the classrooms has split air conditioning system for HVAC. So, ventilation fans are used at admin offices and staff rooms

Exiting Scenario:

Sr. No	Location	Existing Wattage 85 (W) Quantity	Total Wattage (W)
1	A-503	1	85
2	A-502 / Library Hall	22	1870
3	A-501 Library room	3	255
4	A-504	2	170
5	B-503	2	170
6	B-501	0	0
7	B-502	0	0
8	A-401 Business Incubation Center	1	85
9	A-405 / Faculty room	2	170
10	A-402 / Class room	0	0

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Sr. No	Location	Existing Wattage 85 (W) Quantity	Total Wattage (W)
11	A-403	2	170
12	Store Room inside 403	4	340
13	A-404 / Accreditation	0	0
14	B-402	0	0
15	B-403	0	0
16	B-404	0	0
17	B-401	2	170
18	B-405	2	170
19	A-301	1	85
20	A-305 (Faculty Room)	4	340
21	A-302 / Class Room	0	0
22	A-304 / SAS Lab-2	0	0
23	A-303 / SAS Lab-1	6	510
24	A-303 Classroom	0	0
25	B-304 Classroom	0	0
26	B-301 Co-ordination and Exam Department	2	170
27	B-302 Co-ordination and Exam Department	3	255
28	201	1	85
29	203 Boys' Lounge	0	0
30	202 Girls' Lounge	0	0
31	205 Faculty room	2	170
32	B-201 Associate Dean Cabin	2	170
33	B-205	2	170
34	B-202 Placement Cell	3	255
35	B-203 Class room	0	0
36	B-204 Class room	0	0
37	A-102 Computer Lab	8	680
38	A-110	1	85
39	A-109	1	85
40	A-111	1	85
41	A-113	0	0
42	B-101 / Registrar Cabin	2	170
43	B-102 Dean Office	1	85
44	A-108 Director room	1	85
45	A-102 Director Office	2	170
46	Deputy Registrar Office	1	85
47	105-Admin Office	1	85
48	B-103 MBP-2	0	0
49	B-104 Class room	6	510
50	105	2	170
51	B-105	2	170
52	A002	1	85
53	Baquet Hall	6	510
54	A-005	1	85
55	A-004 / Conference Hall	0	0
56	Guest Lounge	0	0
Total:		106	9010

According to **NBC-2016, clause 5.7.4**, the number of recommended ceiling fans are calculated according to room dimensions. There are changes in some of classroom and addition of fans are required of further mechanical ventilation.

Sr. No	Location	Length	Width	Number of Fans Recommended	Sweep	Air Flow	Total Airflow
1	A-503	3.95	2.92	1	1200	12900	12900
2	A-502 / Library Hall	18.19	11.29	7	1500	15600	109200
3	A-501 Library room	5.91	4.73	2	1400	15600	31200
4	A-504	3.86	2.53	1	1200	12900	12900
5	B-503	4.39	3.92	1	1200	12900	12900
6	B-501	11.92	9.07	6	1400	15600	93600
7	B-502	11.13	9	6	1400	15600	93600
8	A-401 Business Incubation Centre	4.63	2.9	1	1400	15600	15600
9	A-405 / Faculty room	4.82	3.85	1	1400	15600	15600
10	A-402 / Class room	9.11	5.01	2	1400	15600	31200
11	A-403	5.5	3.21	1	1500	15600	15600
12	Store Room inside 403	5.86	5.57	4	900	10200	40800
13	A-404 / Accreditation	7	5.5	4	1050	10200	40800
14	B-402	9.64	5.88	4	1400	15600	62400
15	B-403	9.68	5.26	4	1400	15600	62400
16	B-404	11.04	6.76	4	1500	15600	62400
17	B-401	4.66	2.85	1	1400	15600	15600
18	B-405	4.59	3.81	1	1400	15600	15600
19	A-301	4.83	2.9	1	1400	15600	15600
20	A-305 (Faculty Room)	9.44	4.01	2	1400	15600	31200
21	A-302 / Class Room	9.66	9.03	4	1400	15600	62400
22	A-304 / SAS Lab-2	7	5.57	4	1050	10200	40800
23	A-303 / SAS Lab-1	9.07	5.46	2	1400	15600	31200
24	A-303 Classroom	9.64	7.36	4	1400	15600	62400
25	B-304 Classroom	11.03	6.72	4	1500	15600	62400
26	B-301 Co-ordination Exam Department	4.62	2.9	1	1400	15600	15600
27	B-302 Co-ordination Exam Department	9.12	3.58	2	1400	15600	31200
28	201	4.55	2.84	1	1400	15600	15600
29	203 Boys' Lounge	9.363	9.081	4	1400	15600	62400
30	202 Girls' Lounge	9.18	9.03	4	1400	15600	62400
31	205 Faculty room	4.85	3.93	1	1400	15600	15600
32	B-201 Associate Dean Cabin	9.71	2.851	2	1400	15600	31200
33	B-205	4.54	3.84	1	1400	15600	15600
34	B-202 Placement Cell	9.1	3.88	2	1400	15600	31200
35	B-203 Class room	9.1	7.34	4	1400	15600	62400
36	B-204 Class room	11.04	6.82	4	1500	15600	62400
37	A-102 Computer Lab	11.24	7.84	4	1500	15600	62400

Sr. No	Location	Length	Width	Number of Fans Recommended	Sweep	Air Flow	Total Airflow
38	A-110	3.87	2.38	1	1200	10200	10200
39	A-109	3.8	2.32	1	1200	10200	10200
40	A-111	3.91	2.37	1	1200	10200	10200
41	A-113	4.32	2.939	1	1200	10200	10200
42	B-101 / Registrar Cabin	4.62	2.27	1	1200	10200	10200
43	B-102 Dean Office	4.6	2.9	1	1200	10200	10200
44	A-108 Director room	4.69	2.86	1	1200	10200	10200
45	A-102 Director Office	4.551	4.385	1	1400	15600	15600
46	Deputy Registrar Office	2.977	1.93	1	1200	10200	10200
47	105-Admin Office	4.57	3.9	1	1400	15600	15600
48	B-103 MBP-2	9.067	8.18	4	1400	15600	62400
49	B-104 Class room	11	6.83	4	1500	15600	62400
50	105	3	3.87	1	1200	10200	10200
51	B-105	4.41	3.84	1	1200	10200	10200
52	A002	3.44	2.855	1	1200	10200	10200
53	Baquet Hall	9.09	5.05	2	1400	15600	31200
54	A-005	3.74	2.82	1	1200	10200	10200
55	A-004 / Conference Hall	12.099	5.94	6	1200	10200	61200
56	Guest Lounge	4.75	2.87	1	1400	15600	15600

Recommendation:

Existing ceiling fans can be replaced with energy-efficient brushless DC (BLDC) fans, which consume lower power and have higher air volume sweep. The other benefits of BLDC fans are lower noise generation, which is an advantage for college environment.

The proposed power consumption, after installation of BLDC fans, would reduce from 9.01 kW to 3.18 kW; resulting in savings of 5.83 kW of power per hour of usage.

Energy Saving calculations:

Parameters	Value
Proposed quantity of ceiling fans, nos.	106
Total Power consumed by existing fans, W	9.01
Recommended power for BLDC fans, W	30
Total proposed power by all BLDC fans, W	3.18

Expected Power Savings, W	5.83
Expected energy Savings per annum, kWh	5830
Annual cost savings, Rs. Lakh	0.66
Investment required, Rs. /Fan	1850
Total Investment, Rs. Lakh	1.961
Simple payback period, years	2.95

Air Conditioning System:

Room air conditioners have been installed at Classrooms, Conference halls, and at multiple offices. The installed Split air conditioning units are BEE 1,2 and 3 Star labeled. The air conditioning requirement is at diverse locations, and hence, there is no possibility of installing a centralised air conditioning system. While replacing air conditioning system with new split air conditioning system, latest BEE Star labelled air conditioning system should be selected for installation. As per BEE's notification dated 10th November 2021, the minimum Energy efficiency ratio (EER) has been published in the gazette for manufacturing companies and consumer. Star labelling

Time period: From 1st January, 2021 to 31st December, 2023

Reference (BEE STAR Labelling)		
Indian Seasonal Energy Efficiency Ratio (kWh/kWh)		
Star Level	Minimum EER	Max EER
1	3.3	3.49
2	3.5	3.79
3	3.8	4.39
4	4.4	4.99
5	5.0	

Comparison of EER and payback period-

For various operating hours we have evaluated Air conditioning selection option on operating hours. Various star rated system of same capacity has higher initial investment and different operating costs. For initial selection of AC system, we have evaluated following data

AC system for 8 Hours/day usage:

AC TR Load	Star rating	Annual energy Consumption (kWh)	Operating Cost (Rs.)	Initial Investment (Rs.)	Operating Cost Difference (Rs.)	Initial Cost Difference (Rs.)	Payback Period (Rs.)	proposition
1.0	3	1108	10,475	31,990	766	3,000	3.9	4 Star v/s 3 Star
	4	1027	9,708	34,990	883	4,000	4.5	5 Star v/s 4 Star
	5	934	8,826	38,990	1,649	7,000	4.2	5 Star v/s 3 Star
1.5	3	1663	15,712	31,499	1,150	2,321	2.0	4 Star v/s 3 Star
	4	1541	14,562	33,820	1,324	6,170	4.7	5 Star v/s 4 Star
	5	1401	13,238	39,990	2,473	8,491	3.4	5 Star v/s 3 Star
2.0	3	2217	20,949	49,499	2,857	4,491	1.6	4 Star v/s 3 Star
	4	1915	18,092	53,990	2,171	3,000	1.4	5 Star v/s 4 Star
	5	1685	15,921	56,990	5,028	7,491	1.5	5 Star v/s 3 Star

Considering 8 hours operation period, the VES management should select BEE 5-Star rated split air conditioning system. As the operating cost of 5-Star system is much lower than any other Star rated air conditioning system, the incremental cost of system can be easily compensated with higher usage.

AC system for 5 Hours/day usage:

AC TR Load	Star rating	Annual energy Consumption (kWh)	Operating Cost (Rs.)	Initial Investment (Rs.)	Operating Cost Difference (Rs.)	Initial Cost Difference (Rs.)	Payback Period (Rs.)	proposition
1	3	693	6,547	31,990	479	3,000	6.3	4 Star v/s 3 Star
	4	642	6,068	34,990	552	4,000	7.3	5 Star v/s 4 Star
	5	584	5,516	38,990	1,031	7,000	6.8	5 Star v/s 3 Star
1.5	3	1039	9,820	31,499	719	2,321	3.2	4 Star v/s 3 Star
	4	963	9,101	33,820	827	6,170	7.5	5 Star v/s 4 Star
	5	876	8,274	39,990	1,546	8,491	5.5	5 Star v/s 3 Star
2	3	1386	13,093	49,499	1,785	4,491	2.5	4 Star v/s 3 Star
	4	1197	11,308	53,990	1,357	3,000	2.2	5 Star v/s 4 Star
	5	1053	9,951	56,990	3,142	7,491	2.4	5 Star v/s 3 Star

Considering 5 hours operation period; the VES management should select BEE 4-Star rated split air conditioning system.

Considering lower operation hours and impact of power consumption, system selection of BEE 4-Star rated system would be more appropriate.

AC system for 3 Hours/day usage:

AC TR Load	Star rating	Annual energy Consumption (kWh)	Operating Cost (Rs.)	Initial Investment (Rs.)	Operating Cost Difference (Rs.)	Initial Cost Difference (Rs.)	Payback Period (Rs.)	proposition
1	3	416	3,928	31,990	287	3,000	10.4	4 Star v/s 3 Star
	4	385	3,641	34,990	331	4,000	12.1	5 Star v/s 4 Star
	5	350	3,310	38,990	618	7,000	11.3	5 Star v/s 3 Star
1.5	3	623	5,892	31,499	431	2,321	5.4	4 Star v/s 3 Star
	4	578	5,461	33,820	496	6,170	12.4	5 Star v/s 4 Star
	5	525	4,964	39,990	928	8,491	9.2	5 Star v/s 3 Star
2	3	831	7,856	49,499	1,071	4,491	4.2	4 Star v/s 3 Star
	4	718	6,785	53,990	814	3,000	3.7	5 Star v/s 4 Star
	5	632	5,971	56,990	1,885	7,491	4.0	5 Star v/s 3 Star

Considering 3 hours operation per day, the VES management should invest into BEE 3-Star split air conditioning system. Considering fewer operating hours per day, and power consumption of system; it would be prudent for VES management to select BEE 4-Star system over a BEE 3-Star rated system.

Existing Air conditioning system:

Location	BEE Star Rating	Rated Capacity, TR	Rated EER (kW/kW)
A-503	3	1	3.01
A-502 / Library Hall	3	2	2.8
	3	2	2.8
	3	2	2.8
	3	2	2.8
	3	2	3.6
	3	2	3.6
	3	2	3.6
	3	2	3.6
A-504	3	1	3.11
B-503	1	2	2.67
B-501 / Class Room	3	2	3.12
	3	2	3.12
	2	2	3.67
	2	1	3.67
502-B	2	2	3.12
	2	2	3.67
	2	2	3.12
	2	2	3.12
	3	2	2.39
401-A	2	1.5	2.68
402-A	3	1.5	3.11
404-A	3	2	3.51

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Location	BEE Star Rating	Rated Capacity, TR	Rated EER (kW/kW)
402-B	2	2	2.67
403-B	2	2	2.8
403-B	2	2	2.8
404-B	2	2	2.67
	2	2	2.67
401-B	3	1.5	2.68
405-B	3	2	2.8
301-A	2	1	2.68
305-A	1	1.5	2.39
	1	1.5	2.39
302-A	1	1.5	2.39
	1	1.5	2.39
304-A	1	2	2.67
	3	1	3.23
303-A	3	2	3.61
	3	2	3.61
303-B	2	2	2.67
	2	2	2.67
	3	2	3.67
304-B	2	2	2.67
	2	2	2.67
	3	2	3.67
201-A	2	1	2.68
203-A / Boys' Lounge	3	2	3.67
	3	2	3.67
202-A / Girls' Lounge	1	2	2.39
	1	2	2.39
205-A / Faculty Room	3	2	3.84
201-B / Associate Dean Cabin	2	1	2.65
205-B	3	2	3.6
203-B / Classroom	3	1.5	3.11
	3	2	3.51
	1	2	2.79
204-B / Class Room	1	2	2.39
	1	2	2.39
	2	2	3.51
102-A / Computer Lab	3	2	3
	1	2	2.67
	2	2	2.81
	2	2	2.81
110-A	3	1	3.23
109-A	3	1	3.23
111-A	3	1	3.23
113-A	2	2	2.81
	3	2	3.16
101-B	2	1	2.65
102-B	2	1	2.65

Location	BEE Star Rating	Rated Capacity, TR	Rated EER (kW/kW)
108-A	3	1.5	3.16
Deputy Registrar Office	2	1	2.68
105 / Admin Office	2	1	2.65
103-B / MBP-2	3	2	3.12
	3	1.5	3.11
	3	1.5	3.11
104-B / Class Room	2	2	2.81
105-B	2	2	2.81
002-A	3	1	3.17
Banquet Hall	3	2	3.16
	3	2	3.16
	3	2	3.16
005-A	3	2	3.15
004-4 / Conference Hall	3	2	3.16
	3	2	3.16
	3	2	3.16
	3	2	3.16

Detailed evaluation of air conditioning system has been tabulated as **Annexure - 7**.

Water Pumping System:

College of Management has 1 underground storage tanks (UGT) of 12 kL for storage of municipal water and 2 no. overhead tank (OHT) of 5 kL each capacity. Water is pumped from UGT to OHT with the help of submersible pump of 3.7 kW capacity. 2 nos. of submersible pumps have been installed (1W + 1S/B) for this purpose.

The water pump is operated once for one hour, after the recess. These pumps have been installed since inception of this college and have been rewound at least 2-3 times.

Operating efficiency of these pumps was evaluated using ultrasonic flowmeter and power analyzer.

Pump Performance Evaluation:

Parameters	Value
Voltage, V	389
Current, Amp	8.2
Power factor	0.819
Power, kW	4.65
Water flowrate, m ³ /hr	10.84
Total Head generated, mWC	23
Rated Motor Power, kW	3.7
Overall Pump + Motor Efficiency, %	21

Recommendation:

Replace these existing pumps with efficient pump, which would have 60% pump efficiency and Motor efficiency would be 80% or more. Also, by installing Automatic level controller system, the pump operations can further be optimised

Parameters	Value
Pump Model (Kirloskar make)	KOS 538+
Water flowrate, m ³ /hr	29.52
Total head generated, mWC	32
Powe consumed, kW	4.20
Current Operating Hours/day	1
Total Water discharged, m ³ /day	10.84
Time required by new pump for discharging water, hours	0.4
Energy consumed by existing Pump	4.65

Energy consumed by proposed pump	1.68
Energy Savings per annum	743
Cost Savings, Rs. /Annum	0.08
Investment for replacement of 2 Pumps (1W + 1S/B and piping)	0.65
Simple payback period, years	8

Since only single pump is operated for 1 hour/day and we need to replace both pumps, along with interconnecting piping, the initial investment is high; but considering vintage of these pumps, it would be prudent to replace these pumps without actually looking at payback period.

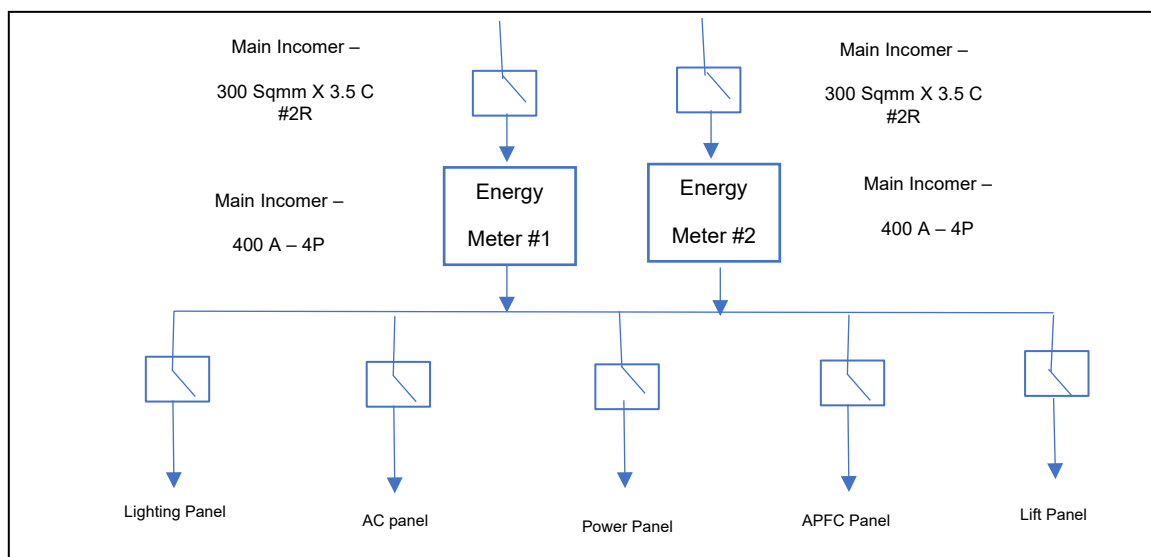
Chapter 4

Electrical Safety

Electrical System:

Low Voltage Distribution

Management college receives 415 V power supply from Adani Electricity at metering panel. There is one HT energy meters and one LT energy meters for college situated in meter room. Distribution of power has been supplied to the various outputs at the meter room. The schematic single line diagram is placed below.



Schematic Electrical System Diagram

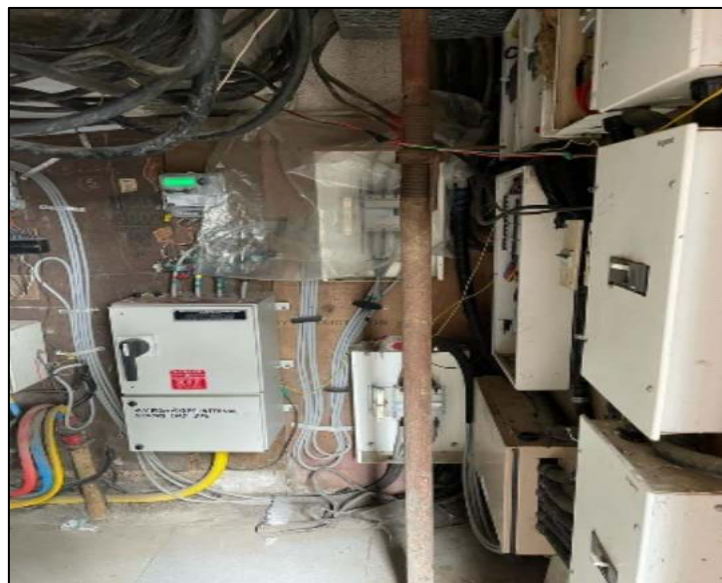
Observations LT Panel:

Sr. No.	Observations	Remarks	Photo	Remarks
1.1	B Wing distribution panel situated outside of meter room	B Wing meter panel are situated outside of meter room, due to monsoon season panel is covered with polythene.		Dust and dirt proof along with water splash proof panel (IP 65) should be provided for switchgear protection

Sr. No.	Observations	Remarks	Photo	Remarks
1.2	Missing provision of Earth mat in meter room	Safety earth mat was not provided for meter room		Earth mat of 1.1kV 2 mm thickness should be provided for meter room
1.3	Missing provision of Earth mat in meter room	Safety earth mat was not provided for meter room		Earth mat of 1.1kV 2 mm thickness should be provided for meter room

Observations:

1. The electrical insulating mats were not provided in front of panels and in the Meter room.



Electrical Meter room – Overview

Recommendations:

1. Immediately place IS marked electrical insulating rubber mat of rating up to 1.1kV, BDV 30kV, thickness 2mm, insulation resistance 1,00,000 Mega Ohm conforming to IS:15652 - 2006 (or IEC: 61111) for Meter room and for floor DBs. (**Note: Nominal voltage at Main LT panel is 415 volts**).
2. Two distinct earthing connections should be provided at each panel, using copper strip of at least 40 x 6 mm, this is in view of panel rating and short-circuit or fault level of the system.

Details of Panel switchgears and electrical observations have been mentioned as Annexures – 5 & 6.

Unbalanced Current Values:

Sr. No.	Location and Rating	R phase, Amp	Y phase, Amp	B phase, Amp	N phase, Amp	Remarks
1	Main Electrical Room A wing	73.73	66.60	48.18	50.16	Not Ok
2	Main Electrical Room B wing	6.05	5.84	7.41	5.03	Not Ok

As per CEA guidelines, current imbalance within 10% of load current is acceptable. Hence, the unbalance current is more than permissible limits. Load balancing is recommended for avoiding circulation of excess neutral current in system.

ELCB Trip Testing:

Earth Leak Circuit Breaker (ELCB) is essential protective switchgear for the human safety. As per applicable IS Code, in case of any earth fault causing leakage current of 30 mA the ELCB should trip and protect the humans operating the same. It is essential that, the ELCBs trip within their rated fixed trip time (in msec).

The results of ELCB testing are as under:

Sr. No.	ELCB Location And rating	Trip Current , mA	Time taken for Tripping, mSec	Remarks
1	Room A 305 63 A 100mA 4P	R = 70	R = 15	OK. Time taken for tripping of ELCB is well within acceptable limits
2	Room B 501 40 A 100mA 2P	R = 80	R = 25	OK. Time taken for tripping of ELCB is well within acceptable limits
3	Room B 501 40 A 100mA 2P	R = 70	R = 13	OK. Time taken for tripping of ELCB is well within acceptable limits
4	Room B 501 40 A 100mA 2P	R = 80	R = 5	OK. Time taken for tripping of ELCB is well within acceptable limits
5	Room 402 40 A 100mA 2P	R = 90	R = 10	OK. Time taken for tripping of ELCB is well within acceptable limits

Recommendations:

In order to protect human life and equipment's, the trip setting current for ELCB / RCCB should be as under:

Level	Rating capacity (mA)	Location
Level I	30	Downstream, in contact with final end users
Level II	100	Midstream, where there are no end users, but only feeders are present
Level III	300	Upstream, Main distribution board in meter room, where again no end

		users are in direct contact with the electrical system
--	--	--

Earthing System:

The provision of scientifically designed sound earthing system is mandatory and vital requirement irrespective of the type of facility (industries, commercial complexes, single/multiple residences, health care, agriculture, etc...) and size of electrical system. With the proliferation in electrical/electronic gadgets and greater dependence on voice and data communication systems, proper and effective earthing or grounding is very important.

Equipment Earthing:

Equipment earthing is connecting non-metallic parts of various equipment's to the earthing by suitable type and size of conductors. Basic objectives of equipment earthing are as follows.

- (a) to save human beings and animals from dangerous electric shock voltages exposure in the area of electrical installation.
- (b) to provide current carrying capability, both in magnitude and duration, adequate to accept the ground fault current permitted by the overcurrent protective system to prevent resultant fire or explosive hazard to building or contents.
- (c) to contribute to better performance of the electrical system.
- (d) to help in limiting the interference between one appliance and the other, particularly importance in case of voice and data communication devices.
- (e) to divert the lightning stroke current safely to the earth.

System Earthing:

Connecting electrically live component to the earth intentionally is known as grounding, it is also called earthing in many countries. Most common example of system grounding is grounding of transformer and generator neutrals. Basic objectives of system earthing are as follows.

- (a) to provide necessary reference of zero potential and to activate the operation of the circuit breaker provided for the safe disconnection of power in the event of an abnormality in the flow of current.
- (b) to derive 230V voltage between phase and neutral, universally utilised voltage on large scale for various applications.

Observations:

There is absence of earth pits installed at LT Panel system' earthing, for saving panels from the electrical hazard.

The earthing system for industrial and commercial installations should conform to **IS:3043-2018, Cl. 27 and Cl. 30**. Following provision is made in Cl. 27.1.3 for maintaining the earth resistance of earthing system network.

“As far as the value of the earth resistance is concerned, the objective from the point of safety consideration is not to attain minimum value of the earth resistance as is sometimes understood. But the consideration should be whether there is adequate coordination between the practically obtainable value of the earth resistance and setting of the protective devices.”

Based on the average value of overall earth resistance obtained, the maximum and minimum earth fault currents are calculated and setting of protective devices for current and time duration is considered accordingly and properly coordinated with the upstream and downstream protective devices.

Observations for earth pits:

- No earthing pit was provided for LT panel and there was dump of civil debris at entrance

Recommendations:

- Installation of 4 nos. each earth pits for Main LT panel (A wing and B wing), should be carried out in accordance with IS:3043, for grounding of electrical short circuit in system.
- This earth pits should be connected with LT panel with copper strip of 40 X 6 mm
- Installation of 4 nos. each earth pits for individual lift, should be carried out in accordance with IS:3043, for grounding of electrical short circuit in system
- Individual earth pit shall be identified according to its application, i.e., for equipment earthing, neutral grounding, solid state grounding, etc. Nameplate shall indicate Pit No., value of earth resistance, date of measurement and next due date of testing (**Reference: NBC-2016, Vol. 2, Cl. 9.3.2.7, page 77**).
- The earth pits for equipment earthing, neutral grounding, data/communication system, solid state medical equipment/ instruments, etc. shall be separate. Earth pits for different applications shall not be interconnected to avoid electromagnetic interference and diversion of short-circuit current/lightning stroke current.
- **The cost of 8 dedicated earth pits shall be Rs. 1.2 Lakh including**

installation.

Recommendation:

Installation of Earth Pits:

Material:

Earth Plate: Copper earth plate of 2 feet X 2 feet X 6 mm thick

Earthing Conductor: Annealed bare copper wire

GI Pipe: As per specification (CW-PLB/GP) for watering, and as enclosure

Hardware: Brass Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' nails and material

Filling Material: Charcoal and salt mixture

Lugs: Copper

Method of Construction:

Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanized cast iron / Copper earth plate or G.I. pipe. The earth connection to equipment / switch gear and earthing electrode shall be connected as per IS 3043 amended up to-date.

The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate or pipe, where ever required in an approved manner. As far as possible continuous strip shall be used, but where ever jointing of strips is unavoidable, the overlap portion must not be less than 2 ½ times the width of the strip either welded / brazed / soldered, from all sides or 6 inches overlap with two Brass nut bolts with required washer and covered by anti-corrosive paint.

Pit shall then be filled with screened soil with alternate layer of Charcoal and salt, and if, necessary brick masonry work shall be done as specified in IS: 3043, with laying wires in PVC / G.I. pipe and watering arrangement as per and covered with C.I. Cover.

Testing:

The value of each earth electrode shall be measured by earth tester on annual basis and the details need to be maintained as under:



Lightening Protection System (LPS):

Lightning arresters are installed suitably on the top of the high-rise buildings to protect the building and occupants from the lightning stroke. The building geometry is criteria for location of the lightning arresters on the building. The hostel building currently does not have any lightning arrestors installed on the building.

Observations:

Currently Management college does not have any lightning arrestor installed at terrace level. Also, there is construction activity going on 6th and 7th floor for management college.

Recommendations:

College needs to install lightening arrestor in accordance of design based on IS/IEC 62305 (Part 1, 2 and 3). It is recommended to carry out the design of lightning protection system in accordance with the provisions made in IS/IEC 62305 (Part 1, 2 and 3), which has been made effective from 2011 in place of old IS:2309. The LP system may be modified as per the estimated risk assessment and design.

LPS requirements for high rise Management buildings provided in NBC 2016 - Volume 2, Part 8, Clause 11.3.4 & Table-5: Lightning Protection Level is **LPL-I**, which provides maximum protection and corresponding **Class-I type** of Lightning Protection System is required for high rise hospitals.

Depending on the building height and design, the vertical air terminations and horizontal air terminations are required to be installed on the building. The

method of design in referred IS/IEC is very elaborative and addresses almost all aspects of LP to make the building safer.

The cost of Lightening arrestor along with dedicated earth pits shall be Rs. 0.75 Lakh including installation.

Personal Protective Apparatus and Safety Appliances:

(1) Fire-fighting:

- At least 2 no. of portable fire extinguishers (suitable for fighting electrical fires, dry chemical powder type, 5 kg capacity) should be installed outside the Electrical Room just besides entry door.
- If fire extinguishers are installed inside the room, they should be shifted outside. In the event of fire within the room, no one will be able to approach this vital equipment.
- All the fire extinguishers, installed in the building, need to be maintained and replacement should be carried out before expiry date.

Observations:

- Fire hydrant system has been installed at the college building, as well as smoke sensors have been installed in the college building
- Regular training and mock drills for the fire fighter and operating team should be carried out, as there is no SOP set for emergency evacuation or situation handling.

(2) Checks for availability of personnel protective equipment and aids and their physical condition:

- (a) Provision of ISI marked safety helmets and use by all the personnel working on electrical installation
- (b) Provision of safety shoes suitable for working on electrical installation and use by all the personnel working on electrical installation
- (c) Provision of at least 2 pairs of ISI marked insulated rubber hand-gloves suitable for 415 V installation in Electrical Panel Room with 415 V switchgear (Check the condition of hand-gloves, if provided)
- (d) Display of Shock Treatment Chart (description in English, Hindi and local language-Marathi) in Electrical Panel Room.
- (e) Provision of First Aid Box near the Electrical Panel Room.
- (f) Provision of insulated earthing rod, extendable type, suitable for 415V, to be available in Electrical Panel Room
- (g) Caution Board outside Electrical Panel Room, Battery Room need to be affixed with description "**ENTRY RESTRICTED, ENTRY TO AUTHORISED PERSONS**" in English, Hindi and local language

Chapter 5

Power Quality Analysis:

In the Power Quality study, the Site team carried out the power quality survey for the load. 3 Phase energy analyser was connected at the main incoming feeder for the period of 24 Hours.

The energy parameters logged were as under:

- Voltage Profile
- Current Trends
- Power trends and consumption
- Power Factor
- Frequency
- Harmonics
- Unbalance, if any

To measure the electrical parameters for the meters, a 3-phase power analyser with the following details has been connected to the main incoming for 24 hours.

Details of 3 Phase Power Analyser:	
Make	Fluke
Model number	434 II
Serial Number	39783011
CT Details	iFlex CTs 6000A

Test Method:

- As per requirement, the instruments stated above were connected at the main incoming of the panel
- Logging of electrical parameters was done for 24 hours' duration
- Measuring interval period, set on the device, was 1 min (60 reading in 1 hour) with minimum maximum and average for each reading.
- Following parameters have been measured and recorded by the instrument:
 - Voltage(V): Phase Voltage, Line Voltage, Peak Voltage, N-G voltage
 - Current(A): Line Current, Peak Current
 - Power (kW, kVA, kVAR): Active, Reactive, Apparent
 - Energy (kWh, kVAh, kVARh): Active, Reactive, Apparent
 - Harmonics (V_{THD} and I_{THD})
 - Voltage & current unbalance

- Power Factor
- Frequency (Hz)
- The readings taken, were compared with the reference standards available for tolerances. For detailed information, Electricity Supply Act or Electricity Act were also referred.

Reference Codes and Standards:

Parameters	Reference Limits	Referenced Standards
Power Frequency	Mean Value of fundamental measured over 10s +/- 2% for 99.5%	EN 50160
Voltage magnitude Variation	+/- 10% for 95% of week, mean 10mins RMS values	EN 50160
Harmonics Voltage	$V_{THD} < 5\%$ individual V-h $< 3\%$	IEEE 519
Harmonics Currents	$I_{THD} \%$: as defined by ratio of 1 (short circuit)/ 1(Full load)	IEEE 519
Supply voltage unbalance	positive, Negative and zero sequence, 2% between line to line	EN 61000-2-12
Load Unbalance	Positive, Negative and zero sequence, leakage currents $< 500\text{ma}$	EN 50161

Harmonic Standards:

Parameters	Benchmark
Total Harmonic Distortion in Voltage and Current (THD)	Less than 5% for 69kv and below (As per IEEE)
Individual harmonic distortion in Voltage and current	Less than 3% for 69kv and below (As per IEEE)
Neutral Current	Less than 10% of load current
Ground Leakage	Ideally Zero
Voltage Variation in transformer's secondary	Less than 3 percentage (As per Electrical Standard)

Voltage Distortion Limits		
Bus Voltage at PCC	Individual Voltage Distortion (%)	Total Voltage Distortion THD (%)
Below 69 kV	3.0	5.0
69 kV to 161 kV	1.5	2.5
161 kV and above	1.0	1.5
Note: High voltage systems can have up to 2.0% THD where the cause is an HVDC terminal that will attenuate by the time it is tapped for a user		

Maximum % Harmonic Current Distortion of an individual Harmonic Order (Odd)						
Individual Harmonic order (Odd Harmonics)						
ISC / IL	< 11	11 < 17	17 – 20	23 < 35	35 <	TDD
< 20	4.0	2.0	1.5	0.6	0.3	6.0
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

Summary of Observations:

A) A Wing

I) Voltage:

- Voltage was observed to be normal and within specified limits however Neutral to Ground voltage was more than 1V for average value.

Parameters	UoM	V _{rms} ph-n RN	V _{rms} ph-n YN	V _{rms} ph-n BN	V _{rms} Ph-n NG	V _{rms} ph-ph RY	V _{rms} ph-ph YB	V _{rms} ph-ph RB
Maximum	V	238.98	242.30	241.36	4.10	415.42	416.64	416.60
Minimum	V	226.72	232.88	232.90	1.38	398.40	400.92	402.10
Average	V	233.32	237.56	236.83	2.79	407.32	409.01	409.39

II) Current:

- Due to the presence of single-phase load in college, current unbalance was observed. This can cause entire system unbalance.
- Neutral Current was slightly higher than permissible limit.

Parameter	UoM	Current R	Current Y	Current B	Current N
Maximum	A	115.20	99.40	75.20	81.00
Minimum	A	51.00	35.70	18.30	19.00
Average	A	73.73	66.60	48.18	50.16

Recommendation:

- 3 Phase balancing of load in college is required to eliminate neutral current or lower neutral current.

III) Frequency:

- Frequency was observed to be normal and within prescribed limits.

IV) Power:

- The power drawn by the load is as per the requirement of the load.

V) Power Factor:

The power factor was maintained near to Unity; the average PF was 0.97 and it is maintaining power factor near to Unity. (i.e., 0.996 Lag to 1.000).

VI) Voltage Harmonics:

Voltage harmonics were within tolerance limits as per standards for individual phase.

VII) Current Harmonics:

Current Harmonics were more than tolerance limits of 8% as per standards for individual phase.

B) B Wing

I) Voltage:

- Voltage was observed to be normal and within specified limits however Neutral to Ground voltage was more than 1V for average value.

Parameters	UoM	V _{rms} ph-n RN	V _{rms} ph-n YN	V _{rms} ph-n BN	V _{rms} Ph-n NG	V _{rms} ph-ph RY	V _{rms} ph-ph YB	V _{rms} ph-ph RB
Maximum	V	245.74	245.76	244.42	3.34	425.66	424.42	424.18
Minimum	V	228.78	229.76	229.60	0.64	398.86	398.34	398.52
Average	V	238.07	237.98	237.16	1.40	412.63	410.92	411.73

II) Current:

- Due to the presence of single-phase load in college, current unbalance was observed. This can cause entire system unbalance.
- Neutral Current was slightly higher than permissible limit.

Parameter	UoM	Current R	Current Y	Current B	Current N
Maximum	A	36.50	24.80	30.90	20.00
Minimum	A	0.50	1.40	0.60	1.00
Average	A	6.05	5.84	7.41	5.03

Recommendation:

- 3 Phase balancing of load in college is required to eliminate neutral current or lower neutral current.

III) Frequency:

- Frequency was observed to be normal and within prescribed limits.

IV) Power:

- The power drawn by the load is as per the requirement of the load.

V) Power Factor:

The power factor was maintained near to Unity; the average PF was 0.72 and installation of 50 kVAR APFC panel should be installed for maintaining power at Unity. (i.e., 0.996 Lag to 1.000).

VI) Voltage Harmonics:

Voltage harmonics were within tolerance limits as per standards for individual phase.

VII) Current Harmonics:

Current Harmonics were more than tolerance limits of 8% as per standards for individual phase.

Details of Power quality observations have been mentioned as Annexure – 2.

Panel Thermography:

All the electrical panels were scanned for 'hot-spots' by using thermal imaging camera. In the thermography, no 'hot-pots' were identified and all switchgears were found to be working without any cause for concern.

Details of thermography have been tabulated as Annexure – 4.

Chapter 6

Roof-top Solar PV System

In line with India's commitment to augment its renewable energy sources and reduce its dependency on fossil fuels, all non-commercial and commercial entities are encouraged to install grid connected Roof-top Solar PV systems and terrace of Management college can also qualify for installing roof-top solar system.

Install 50 kWp roof-top Solar PV system:

Around 5000 ft² of shadow free area (eliminating area used for water tank) is available at various spaces available at terrace level. Install roof-top Solar PV system of 50 kWp and reduce overall energy consumed from Adani Electricity supply.

A 50 kWp roof-top Solar PV system would generate around 70000 kWh per annum. The expected saving potential shall be Rs. 2.63 Lakh/annum. For avoiding addition of structural loading, light-weight and rollable Solar PV modules can be installed. The payback shall be within 4 years.

Energy Saving calculations:

Parameters	Value
Solar PV capacity, kWp	50
Annual Energy generation, kWh	70,000
Energy cost saving potential, Rs. Lakh/annum	7.98
Initial Capital investment, Rs. Lakh	30
Simple Payback Period, years	4

Annexure – 1

Electricity Bill Analysis

Consumer No: 102703033
Electricity Bill analysis – Year 2022

Parameter	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Demand / Fixed charges	Rs.	27497	33367	24120	15027	15027
Wheeling charges	Rs.	9101	10196	7983	3880	3469
Regulatory Asset Charges	Rs.	0	0	0	0	0
Energy Charges	Rs.	83286	93306	76640	37247	33303
TOD 9 Hrs to 12 Hrs Energy Charge	Rs.	1694	2064	1670	698	518
TOD 18 Hrs to 22 Hrs Energy Charge	Rs.	1372	1251	897	672	621
TOD 22 Hrs to 06 Hrs Energy Charge	Rs.	-1184	-1015	-935	-707	-818
Fuel Adjustment Charges	Rs.	0	0	0	0	0
Penalty for exceeding Contract Demand	Rs.	0	0	0	0	0
Power factor incentive / penalty	Rs.	0	0	0	0	0
Government Electricity Duty	Rs.	25571	29226	23179	11931	10945
Tax on sale of electricity	Rs.	4673	5235	4151	1973	1722
Current Month's Bill amount (A)	Rs.	152008	173630	137705	70719	64786
Others / Load Factor Incentive	Rs.	0	0	-12552	0	0
Delayed Payment Charges	Rs.	0	0	0	0	0
Digital Payment discount	Rs.	0	0	0	0	0
Interest on arrears	Rs.	0	0	0	0	0
Adjustments	Rs.	0	0	1326	65	88
Net Other charges in current bill (B)	Rs.	0	0	-11226	65	88
Current Month's Charges (A+B)	Rs.	152008	173630	126478	70784	64874
Previous Month's Bill amount	Rs.	173634	126488	70268	64875	88133
Payment Received	Rs.	172240	125380	69690	64870	87420
Prompt Payment Discount	Rs.	1392	1104	568	521	712
Net previous Balance (C)	Rs.	2	4	10	-516	1
Total Bill Amount (A+B+C)	Rs.	152011	173634	126488	70268	64875
Total Bill amount with DPC	Rs.	153910.62	175804.56	128209.15	71151.79	65685

Energy Audit and MEP Audit Report
For VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Parameter	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Import	kVAh	0	0	0	0	0
Export	kVAh	0	0	0	0	0
Net Billed	kVAh	13789	15448	12282	5969	5337
Banked	kVAh	0	0	0	0	0
Max demand (06:00 hrs to 22:00 hrs)	kVA	77	94	72	35	34
Max demand (00:00 hrs to 24:00 hrs)	kVA	76	93	71	34	33
Reactive energy consumption (Lag)	RkVAh	214	452	388	168	81
Reactive energy consumption (Lead)	RkVAh	1,076	1,001	1,072	1,264	1,623
Contract Demand	kVA	115	115	115	65	65
Penalty for exceeding Demand	kVA	0	0	0	0	0
Load Factor	%	16.05%	18.57%	14.25%	13.27%	10.46%
Average Power Factor	% Lag / Lead	99.56% Lead	99.56% Lead	99.29% Lead	97.08% Lead	94.77% Lead

Consumer No: 102703033
Electricity Bill analysis – Year 2021

Parameter	UoM	Dec-21	Nov-21	Oct-21	Sep-21	Aug-21	Jul-21	Jun-21	May-21	Apr-21	Mar-21	Feb-21
Demand / Fixed charges	Rs.	15027	19552	15027	15027	15027	20036	17135	7527	20100	18933	17600
Wheeling charges	Rs.	5229	5966	5468	4648	4555	5811	4246	3407	4135	6719	4525
Regulatory Asset Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0
Energy Charges	Rs.	50201	57277	52491	44616	43730	55786	40760	32704	39699	59898	40335
TOD 9 Hrs to 12 Hrs Energy Charge	Rs.	908	1140	989	741	731	934	616	380	567	1000	613
TOD 18 Hrs to 22 Hrs Energy Charge	Rs.	777	777	840	802	782	839	739	802	825	887	791
TOD 22 Hrs to 06 Hrs Energy Charge	Rs.	-920	-978	-956	-968	-970	-1062	-1009	-1175	-1100	-1063	-947
Fuel Adjustment Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0
Penalty for exceeding contract demand	Rs.	0	0	0	0	0	0	0	0	0	0	0
Power factor incentive / penalty	Rs.	0	0	0	0	0	0	0	0	0	0	0
Government Electricity Duty	Rs.	14957	17584	15510	1362	13410	17292	13122	9165	13488	18139	13213
Tax on sale of electricity	Rs.	2686	3083	2819	2384	2323	3000	2161	1669	2093	3217	2150
Current Month's Bill amount (A)	Rs.	88865	104401	92189	80870	79588	102636	77770	54479	79807	107730	78280
Others / Load Factor Incentive	Rs.	0	0	0	0	0	0	0	0	0	-13734	0
Delayed Payment Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0
Digital Payment discount	Rs.	0	0	0	0	0	0	0	0	0	0	0
Interest on arrears	Rs.	0	0	0	0	0	0	0	0	0	0	0
Adjustments	Rs.	105	75	0	0	0	0	0	0	0	1090	89
Net Other charges in current bill (B)	Rs.	105	75	0	0	0	0	0	0	0	-12644	89
Current Month's Charges (A+B)	Rs.	88970	104476	92189	80870	79588	102636	77770	54479	79807	95086	78369
Previous Month's Bill amount	Rs.	104481	91545	80235	79594	102646	77770	54487	79810	95087	78370	117631
Payment Received	Rs.	104480	91540	80230	79590	102640	77760	54050	79610	94220	77740	117630
Prompt Payment Discount	Rs.	837	0	649	639	0	0	436	642	864	629	0
Net previous Balance (C)	Rs.	-836	5	-644	-635	6	10	0	8	3	0	1
Total Bill Amount (A+B+C)	Rs.	88133	104481	91545	80235	79594	102646	77770	54487	79810	95087	78370
Total Bill amount with DPC	Rs.	89244.06	105786.11	92697	81246	80588	103929	78742	55168	80808	96433.31	79348.02
Import	kVAh	0	0	0	0	0	0	0	0	0	0	0
Export	kVAh	0	0	0	0	0	0	0	0	0	0	0
Net Billed	kVAh	8085	9179	8412	7150	7008	8940	6532	5241	6362	9599	6464
Banked	kVAh	0	0	0	0	0	0	0	0	0	0	0

Energy Audit and MEP Audit Report
For VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Parameter	UoM	Dec-21	Nov-21	Oct-21	Sep-21	Aug-21	Jul-21	Jun-21	May-21	Apr-21	Mar-21	Feb-21
Max demand (06:00 hrs to 22:00 hrs)	kVA	42	58	41	41	38	60	51	22	53	59	43
Max demand (00:00 hrs to 24:00 hrs)	kVA	41	57	40	40	38	59	50	22	53	58	42
Reactive energy consumption (Lag)	RkVAh	194	236	235	221	154	193	131	46	135	345	166
Reactive energy consumption (Lead)	RkVAh	1,368	1,264	1,240	1,220	1,437	1,301	1,408	1,806	1,502	1,327	1,209
Contract Demand	kVA	65	65	65	65	65	65	65	36	100	100	100
Penalty for exceeding Demand	kVA	0	0	0	0	0	0	0	0	0	0	0
Load Factor	%	16.32%	19.35%	17.12%	14.96%	14.11%	18.23%	13.56%	18.31%	8.54%	12.70%	9.40%
Average power factor	% Lag / Lead	98.09% Lead	98.66% Lead	98.45% Lead	97.95% Lead	97.39% Lead	98.59% lead	97.18% Lead	93.55% Lead	96.63% Lead	98.47% Lead	97.71% Lead

Consumer No: 102703033
Electricity Bill analysis – Year 2019

Parameter	UoM	Dec-19	Nov-19	Oct-19	Sep-19	Aug-19	Jul-19	Jun-19	May-19	Apr-19	Mar-19	Feb-19	Jan-19
Demand / Fixed charges	Rs.	44064	43033	48532	41856	39157	41807	41561	42984	50693	39332	36506	36506
Wheeling charges	Rs.	17194	20164	15592	14736	16460	17642	17045	15475	17584	18430	12917	12073
Regulatory Asset Charges	Rs.	19582	22964	17757	16782	18746	20092	19412	17624	20026	10160	7121	6656
Energy Charges	Rs.	182690	214238	165661	156565	174887	187448	181098	164421	186828	178391	125028	116859
TOD 9 Hrs to 12 Hrs Energy Charge	Rs.	3154	3855	2965	2933	3408	3731	3092	2809	3366	3174	2085	1865
TOD 18 Hrs to 22 Hrs Energy Charge	Rs.	2216	2012	1564	1540	1523	1662	2015	1681	1741	2070	1444	1475
TOD 22 Hrs to 06 Hrs Energy Charge	Rs.	-1445	-1269	-1322	-1157	-1139	-1205	-1459	-1205	-1332	-1208	-1148	-1149
Fuel Adjustment Charges	Rs.	13970	16383	12668	11973	13374	14334	13849	12573	14287	13350	9315	8706
Penalty for exceeding Contract Demand	Rs.	0	0	0	0	0	0	0	0	7415	0	0	0
Power factor incentive / penalty	Rs.	-2814	-3214	-1317	-1226	-1332	-1428	-1383	-1282	-1466	-1318	0	0
Government Electricity Duty	Rs.	59099	67490	55317	51498	55947	59957	58089	53836	63128	55377	40586	38428
Tax on sale of electricity	Rs.	8129	9533	7371	6967	7782	8341	8058	7316	8313	8043	5637	5269
Current Month's Bill amount (A)	Rs.	345840	395189	324788	302465	328812	352382	341376	316234	370582	325800	239490	226688
Others / Load Factor Incentive	Rs.	0	0	0	0	0	0	0	0	0	-27139		0
Delayed Payment Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Digital Payment discount	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Interest on arrears	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Adjustments	Rs.	0	0	0	0	0	-295	295	-659	-659	2714	0	0
Net Other charges in current bill (B)	Rs.	0	0	0	0	0	-295	295	-659	-659	-24425	0	0
Current Month's Charges (A+B)	Rs.	345840	395189	324788	302465	328812	352087	341671	315575	369923	301374	239490	226688
Previous Month's Bill amount	Rs.	392574	324796	302468	328814	352382	339130	315583	369928	301375	239491	226690	258223
Payment Received	Rs.	392570	324790	302460	328810	352380	338835	315580	369920	301370	239490	226690	258222
Prompt Payment Discount	Rs.	0	2621	0	0	0	0	2544	0	0	0	0	0
Net previous Balance (C)	Rs.	4	-2615	8	4	2	295	-2541	8	5	1	0	3
Total Bill Amount (A+B+C)	Rs.	345844	392574	324796	302468	328814	352382	339130	315583	369928	301375	239491	226691
Total Bill amount with DPC	Rs.	350167	397514	328856	306249	332924	356787	343397	319527.5	374552	30544.49	242484	229524
Import	kVAh	0	0	0	0	0	0	0	0	0	0	0	0
Export	kVAh	0	0	0	0	0	0	0	0	0	0	0	0
Net Billed	kVAh	23881	28005	21655	20466	22861	24503	23673	21493	24422	23629	16560	15478
Banked	kVAh	0	0	0	0	0	0	0	0	0	0	0	0
Max demand (06:00 hrs to 22:00 hrs)	kVA	144	141	159	137	128	137	136	141	166	143	116	16

Energy Audit and MEP Audit Report
For VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Parameter	UoM	Dec-19	Nov-19	Oct-19	Sep-19	Aug-19	Jul-19	Jun-19	May-19	Apr-19	Mar-19	Feb-19	Jan-19
Max demand (00:00 hrs to 24:00 hrs)	kVA	143	140	158	136	127	136	135	140	165	142	115	18
Reactive energy consumption (Lag)	RkVAh	5,244	5,958	5,024	4,747	4,998	5,776	5,450	5,348	5,748	5,916	5,285	5,048
Reactive energy consumption (Lead)	RkVAh	1,220	933	1,399	1,420	1,412	1,190	1,268	1,106	1,156	1,275	1,006	1,276
Contract Demand	kVA	190	190	190	190	150	150	150	150	150	150	150	150
Penalty for exceeding Demand	kVA	0	0	0	0	0	0	0	0	0	0	0	0
Load Factor	%	16.89%	20.47%	15.32%	14.96%	16.17%	17.33%	21.92%	19.26%	22.61%	21.17%	16.43%	14.60%
Average power factor	% Lag / Lead	96.50% Lag	97.10% Lag	95.90% Lag	95.80% Lag	96.30% Lag	96.20% Lag	96.20% Lag	95.80% Lag	96.20% Lag	95.70% Lag	93.50% Lag	95.10% Lag

Consumer No: 152951505
Electricity Bill analysis – Year 2022

Parameter	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Demand / Fixed charges	Rs.	425	425	405	405	405
Wheeling charges	Rs.	7109	9246	7671	2648	2021
Regulatory Asset Charges	Rs.	0	0	0	0	0
Energy Charges	Rs.	29016	37740	31524	10884	8304
TOD 9 Hrs to 12 Hrs Energy Charge	Rs.	705	1119	871	259	187
TOD 18 Hrs to 22 Hrs Energy Charge	Rs.	213	107	130	100	93
TOD 22 Hrs to 06 Hrs Energy Charge	Rs.	-128	-78	-90	-55	-80
Fuel Adjustment Charges	Rs.	0	0	0	0	0
Penalty for exceeding Contract Demand	Rs.	0	0	0	0	0
Power factor incentive / penalty	Rs.	-560	-1214	-1013	-71	219
Government Electricity Duty	Rs.	7841	10197	8507	2991	2295
Tax on sale of electricity	Rs.	1646	2141	1788	617	471
Current Month's Bill amount (A)	Rs.	46267	59684	49794	17779	13915
Others / Load Factor Incentive	Rs.	0	0	-383	0	
Delayed Payment Charges	Rs.	0	0	0	0	0
Digital Payment discount	Rs.	-118	-99	-35	0	-59
Interest in arrears	Rs.	0	0	0	0	0
Adjustments	Rs.	0	0	386	0	60
Net Other charges in current bill (B)	Rs.	-118	-99	-32	0	1
Current Month's Charges (A+B)	Rs.	46149	59585	49761	17779	13916
Previous Month's Bill amount	Rs.	59588	49768	2386	-15281	29203
Payment Received	Rs.	59110	49370	2380	0	58400
Prompt Payment Discount	Rs.	473	395	0	111	0
Net previous Balance (C)	Rs.	4	3	6	-15392	-29197
Total Bill Amount (A+B+C)	Rs.	46153	59588	49768	2386	-15281
Total Bill amount with DPC	Rs.	46731.41	60334	50390	2608.5	0
Import	kWh	0	0	0	0	0
Export	kWh	0	0	0	0	0
Net Billed	kWh	4836	6290	5254	0	1384
Banked	kWh	0	0	0	0	
Max demand (06:00 hrs to 22:00 hrs)	kVA	49	50	43	-	25

Energy Audit and MEP Audit Report
For VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Parameter	UoM	May-22	Apr-22	Mar-22	Feb-22	Jan-22
Max demand (00:00 hrs to 24:00 hrs)	kVA	49	50	43	-	25
Reactive energy consumption (Lag)	RkVAh	969	666	783	-	597
Reactive energy consumption (Lead)	RkVAh	102	128	126	-	184
Contract Demand	kVA	90	90	90	90	90
Penalty for exceeding Demand	kVA	0	0	0	0	0
Load Factor	%	0.00%	0.00%	0.00%	0.00%	0.00%
Average power factor	% Lag / %Lead	99.20% Lag	99.20% Lag	98.50% Lag	95.90% Lag	80.10% Lag

Consumer No: 152951505
Electricity Bill analysis – Year 2021

Parameter	UoM	Dec-21	Nov-21	Oct-21	Sep-21	Aug-21	Jul-21	Jun-21	May-21	Apr-21	Mar-21	Feb-21	Jan-21
Demand / Fixed charges	Rs.	405	405	405	405	405	405	405	405	405	385	385	257
Wheeling charges	Rs.	4440	5323	4002	2827	3593	3593	2278	1169	1344	3008	2449	2107
Regulatory Asset Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Energy Charges	Rs.	18246	21876	16446	11616	14766	14766	9360	4806	5484	11496	9360	8052
TOD 9 Hrs to 12 Hrs Energy Charge	Rs.	502	628	422	288	371	364	196	82	115	274	176	182
TOD 18 Hrs to 22 Hrs Energy Charge	Rs.	140	138	157	142	155	146	118	92	79	76	116	80
TOD 22 Hrs to 06 Hrs Energy Charge	Rs.	-99	-121	-113	-104	-106	-124	134	-109	-62	-59	-74	-52
Fuel Adjustment Charges	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Penalty for exceeding Contract Demand	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Power factor incentive/penalty	Rs.	-118	-424	0	0	574	0	0	226	552	0	-124	0
Government Electricity Duty	Rs.	4963	5923	4477	3187	4029	4021	2567	1354	1545	3188	2607	2232
Tax on sale of electricity	Rs.	1035	1241	933	659	838	838	531	273	311	652	531	457
Current Month's Bill amount (A)	Rs.	29514	34990	26729	19020	24624	24009	15588	8298	9774	19020	15426	13314
Others / Load Factor Incentive	Rs.	0	0	0	0	0	0	0	0	0	-134	0	0
Delayed Payment Charges	Rs.	0	0	0	0	0	0	0	-20	0	0	166	0
Digital Payment discount	Rs.	-70	-53	-38	-49	-48	0	-17	0	38	0	0	0
Interest on arrears	Rs.	0	0	0	0	0	0	0	0	0	0	0	0
Adjustments	Rs.	35	27	0	0	0	0	0	0	0	156	0	9000
Net Other charges in current bill (B)	Rs.	-35	-26	-38	-49	-48	0	-17	-20	38	22	166	9000
Current Month's Charges (A+B)	Rs.	43217	34963	26691	18970	24576	24009	15571	8278	9726	19042	15592	22314
Previous Month's Bill amount	Rs.	34982	26539	18970	24390	24013	15314	8280	9732	19048	28907	13315	0
Payment Received	Rs.	34980	26530	18970	24390	24010	15310	8270	9730	18890	28900	0	9000
Prompt Payment Discount	Rs.	278	0	152	0	192	0	0	0	152	0	0	0
Net previous Balance (C)	Rs.	-277	9	-151	0	-188	4	10	2	7	7	13315	-9000
Total Bill Amount (A+B+C)	Rs.	29203	34973	26539	18970	24388	24013	15581	8280	9818	19048	28907	13314
Total Bill amount with DPC	Rs.	29572	35419	26873	19208	24698	21313	15506	8383.7	9854.2	19286	290099	13481
Import	kWh	0	0	0	0	0	0	0	0	0	0	0	0
Export	kWh	0	0	0	0	0	0	0	0	0	0	0	0
Net Billed	kWh	3041	3646	2741	1936	2461	2461	1560	801	914	1916	1560	1342
Banked	kWh	0	0	0	0	0	0	0	0	0	0	0	0
Max demand (06:00 hrs to 22:00 hrs)	kVA	30	43	25	19	25	22	19	16	21	26	38	22

Energy Audit and MEP Audit Report
For VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Parameter	UoM	Dec-21	Nov-21	Oct-21	Sep-21	Aug-21	Jul-21	Jun-21	May-21	Apr-21	Mar-21	Feb-21	Jan-21
Max demand (00:00 hrs to 24:00 hrs)	kVA	30	43	25	19	25	22	19	16	21	26	38	22
Reactive energy consumption (Lag)	RkVAh	729	542	1,002	696	1,391	1,085	531	346	650	772	248	321
Reactive energy consumption (Lead)	RkVAh	202	130	124	149	166	84	106	179	125	123	146	99
Contract Demand	kVA	90	90	90	90	90	90	90	90	90	90	90	90
Penalty for exceeding Demand	kVA	0	0	0	0	0	0	0	0	0	0	0	0
Load Factor	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Average power factor	% Lag /	95.60%	98.30%	92.50%	91.60%	84.50%	90.30%	92.60%	83.60%	76.30%	90.60%	97.00%	95.40%
	Lead	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag

Annexure – 2

Power Quality Study

I) A – Wing Energy meter

1. Voltage:

The voltage values were recorded for 24 hours at an interval of 10 minutes; the voltage variations can be represented as follows:

Parameters	UoM	V _{rms} ph-n RN	V _{rms} ph-n YN	V _{rms} ph-n BN	V _{rms} Ph-n NG	V _{rms} ph-ph RY	V _{rms} ph-ph YB	V _{rms} ph-ph RB
Maximum	V	238.98	242.30	241.36	4.10	415.42	416.64	416.60
Minimum	V	226.72	232.88	232.90	1.38	398.40	400.92	402.10
Average	V	233.32	237.56	236.83	2.79	407.32	409.01	409.39

Observations and Remarks:

- Voltage was found to be normal across all phases. The mean voltage values were 235.90V and 408.57V
- Neutral to Ground voltage was more than 1V, which is more than prescribed limit.
- Voltage variations observed, were within permissible limits.

Standards Referred:

EN50160: Voltage Fluctuation is within 10% and is within permissible limits.

Recommendation:

N-G voltage in system will be earthed in system by implementation of earthing at LT load panel

2. Current:

Current values were recorded across all phases including neutral Current. The current fluctuations observed were as under:

Parameter	UoM	Current R	Current Y	Current B	Current N
Maximum	A	115.20	99.40	75.20	81.00
Minimum	A	51.00	35.70	18.30	19.00
Average	A	73.73	66.60	48.18	50.16

Observations and Comments:

- Current is driven by the load. This parameter has no limit and is based upon the requirement of the load.
- **Neutral Current was far more than the permissible limit**
- The maximum neutral current values were found to be very high. The rule states that permissible neutral current should be 10% of load current.

Recommendations:

Load and Phase balancing should be done to avoid loading on neutral phase.

3. Frequency:

Frequency of the network is being monitored in this logging session. The summary can be shared as follows

Parameter	UoM	Frequency
Maximum	Hz	50.07
Minimum	Hz	49.89
Average	Hz	49.99

Observations and Remarks:

Frequency variations were within acceptable tolerance of $\pm 2\%$

Standards Referred:

EN 50160: Mean Value of fundamental measured over 10s $\pm 2\%$ for 99.5

4. Power:

Active, reactive and apparent power has been recorded and summarised as below:

Power	Parameters	UoM	R Phase	Y Phase	B Phase	Total
Active Power	Maximum	kW	26.26	23.34	17.60	60.60
	Minimum	kW	11.68	8.34	4.24	27.84
	Average	kW	17.10	15.72	11.29	44.12
Apparent Power	Maximum	kVA	26.32	23.38	17.72	63.00
	Minimum	kVA	11.72	8.40	4.30	30.12
	Average	kVA	17.15	15.78	11.39	45.45
Reactive Power	Maximum	kVAR	1.60	2.82	2.46	5.82
	Minimum	kVAR	- 0.48	- 0.90	0.04	- 0.66
	Average	kVAR	0.41	0.34	0.98	1.81

Observations and Remarks:

- As mentioned previously in the current section, the power drawn by the load is as per the requirement of the load.

5. Power Factor:

Parameter	R Phase	Y Phase	B Phase	Total
Maximum	1.00	1.00	1.00	0.99
Minimum	0.99	0.98	0.96	0.91
Average	1.00	1.00	0.99	0.97

Observations and Remarks:

- As seen in the table above, the average power factor was 0.97.

6. Energy:

As seen in the power section, the energy that has been consumed over 24 hours can be stated as follows

Parameter	UoM	Energy Consumed			
Phase		R Phase	Y Phase	B Phase	Total
Energy	kWh	57.11	52.48	37.693	147.283

Observations and Remarks:

- The energy consumed by the load is in line with consumption pattern.

7. Harmonics:

The summary of harmonics recorded is as under:

Parameters	UoM	Voltage R Phase	Voltage Y Phase	Voltage B Phase	Voltage N Phase	Current R Phase	Current Y Phase	Current B Phase	Current N Phase
Maximum	%	1.39	1.46	1.56	44.58	7.83	7.76	17.33	80.03
Minimum	%	1.16	1.16	1.22	10.95	4.85	4.27	3.97	14.05
Average	%	1.24	1.30	1.34	20.54	5.87	5.60	7.12	25.87

Observations and Remarks:

Voltage Harmonics:

- Total Voltage Harmonics were within acceptable limits of 5%, and individual Harmonic distortion was within 3 % limits.
- Neutral voltage harmonics were 20.54%, which were very high. This was observed due to unbalanced loads and missing Earthing system.**

Current Harmonics:

- Current Harmonics were lower than upper tolerance limits of 8%
- The individual harmonic distortions were lower than limit 8%
- Harmonics of order 5th and 7th were observed to be below 8% as per prescribed limits.
- Neutral Harmonics were high with average of 25.87% and maximum is 80.03%

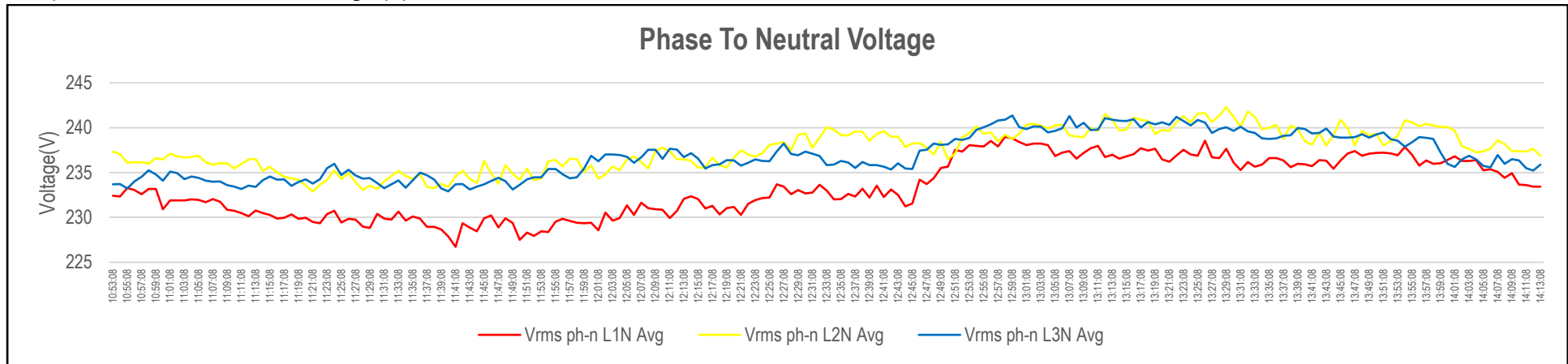
Recommendation:

- To reduce the effects of harmonics on the system by phase balancing at load side.
- Further reduction in harmonics will be done by implementation of earthing for LT load.

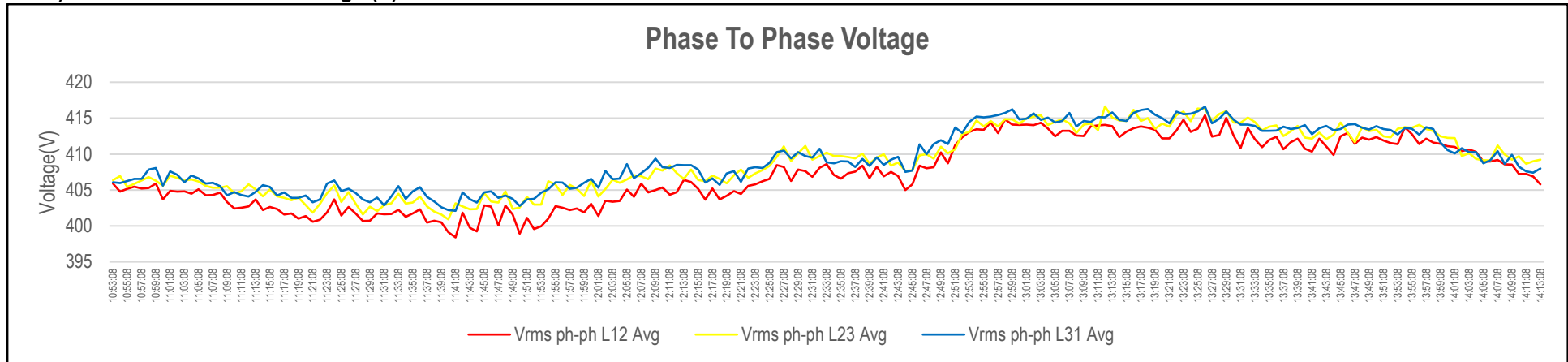
Standard Referred: IEEE 519

Graphs

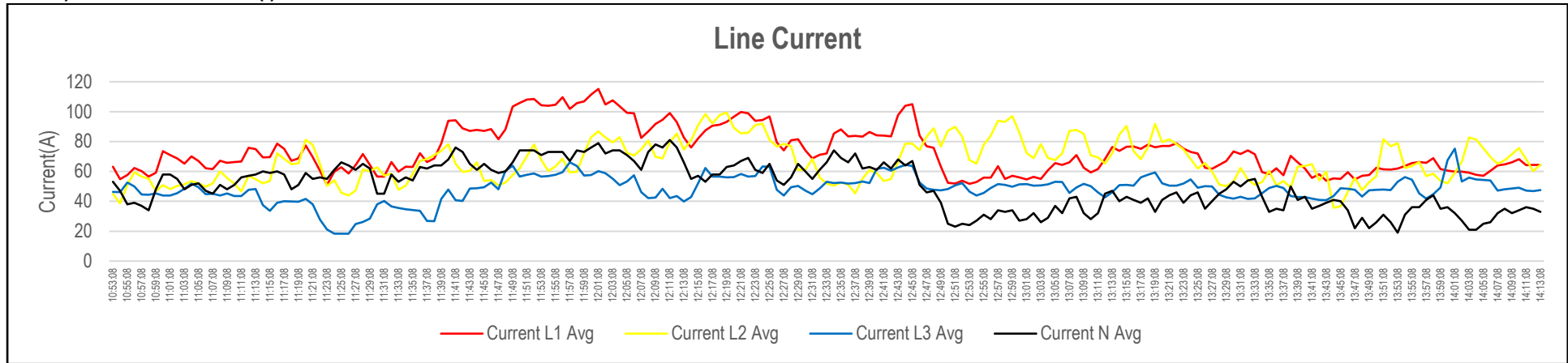
I) Phase to Neutral Voltage (V):



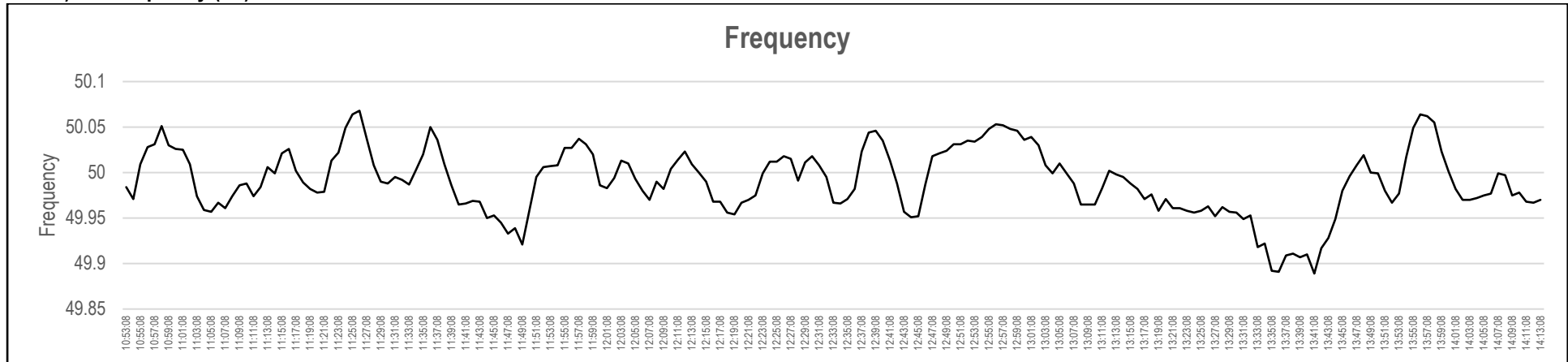
II) Phase to Phase Voltage (V):



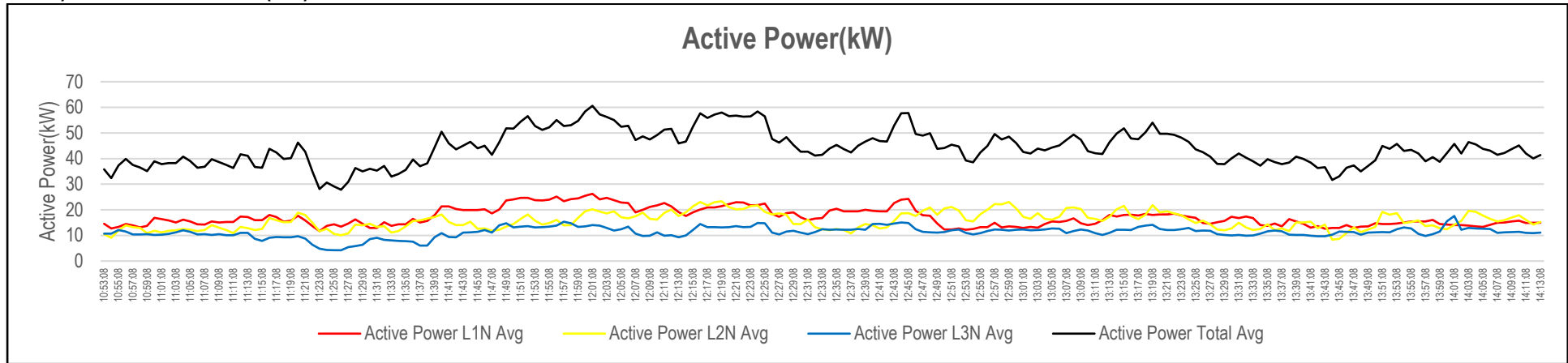
III) Line Current (I):



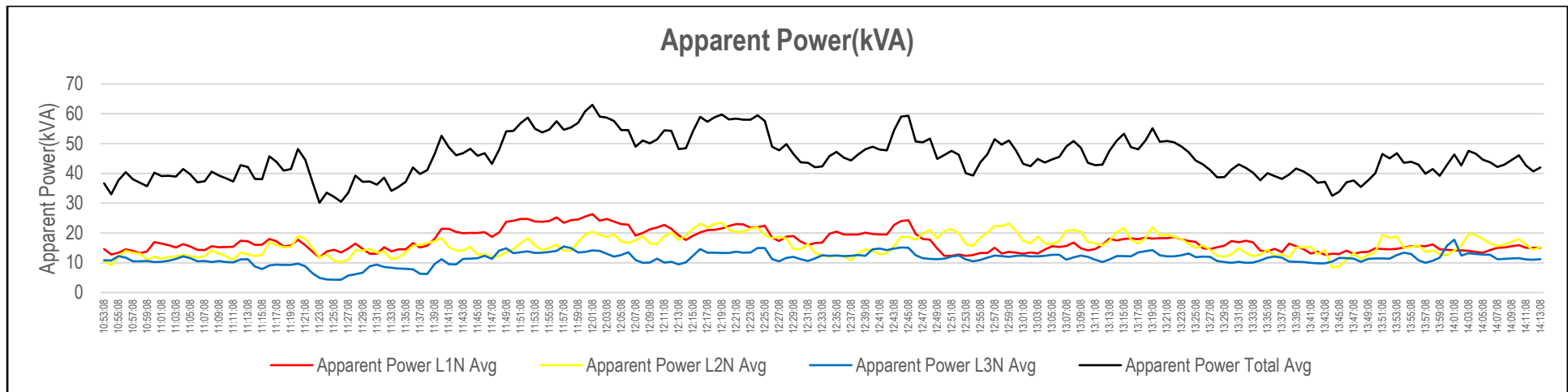
IV) Frequency (Hz):



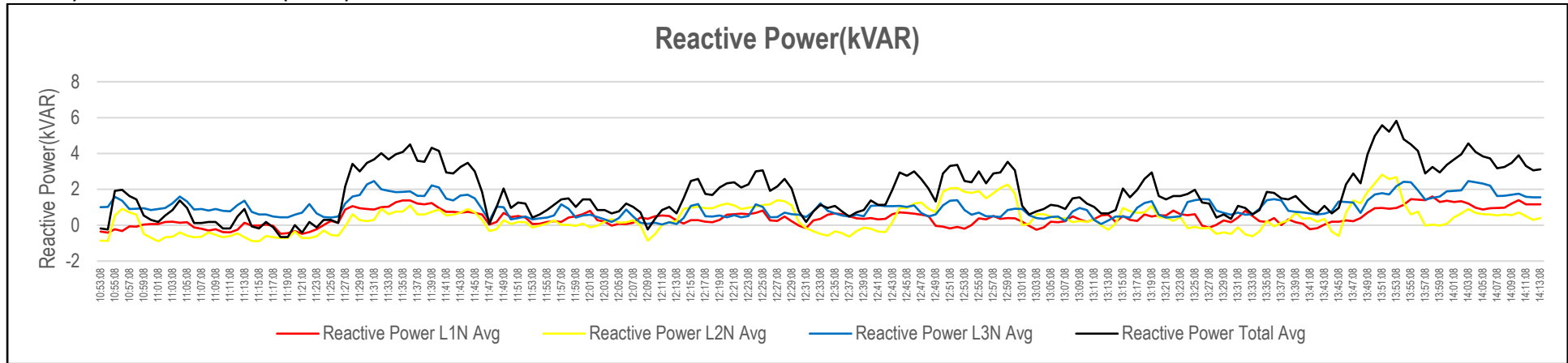
V) Active Power (kW):



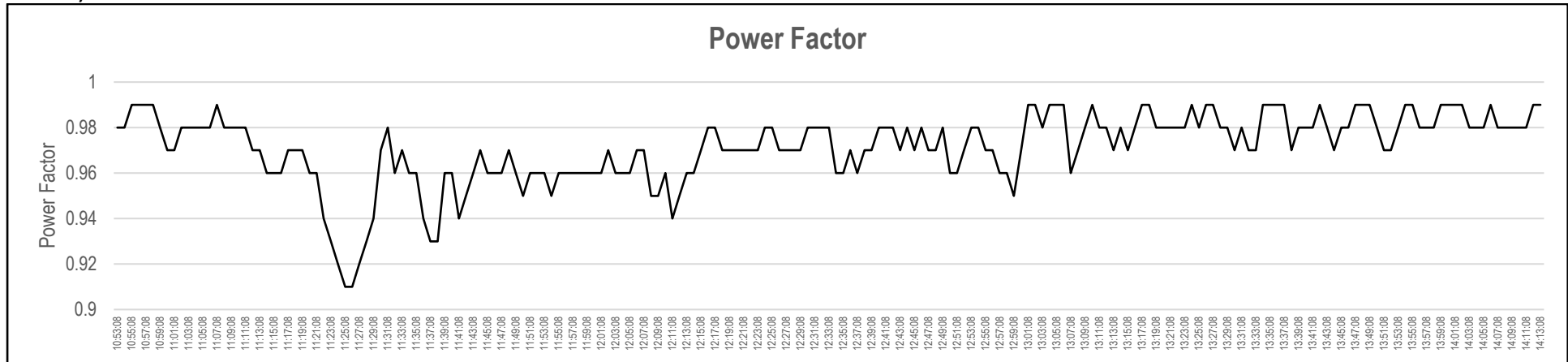
VI) Apparent Power (kVA):



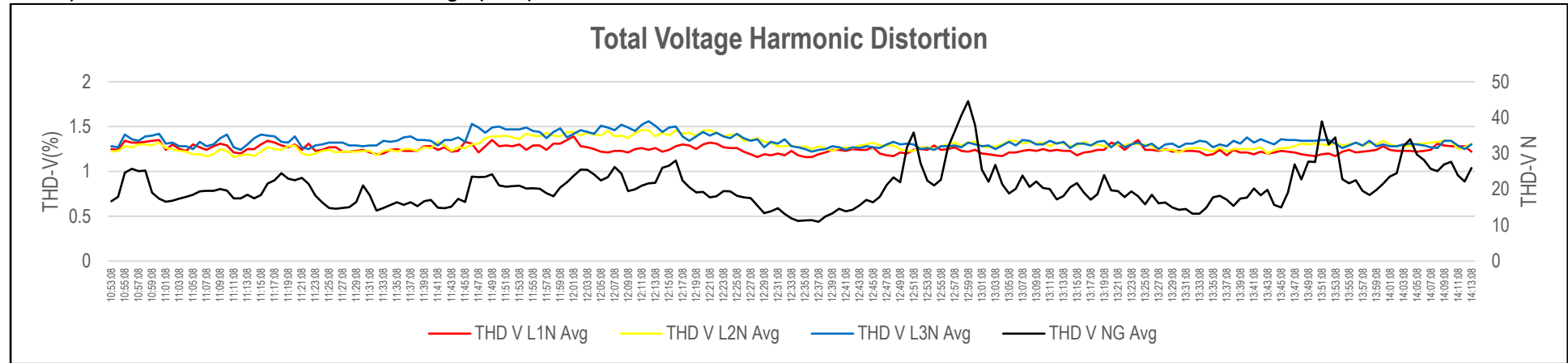
VII) Reactive Power (kVAR):



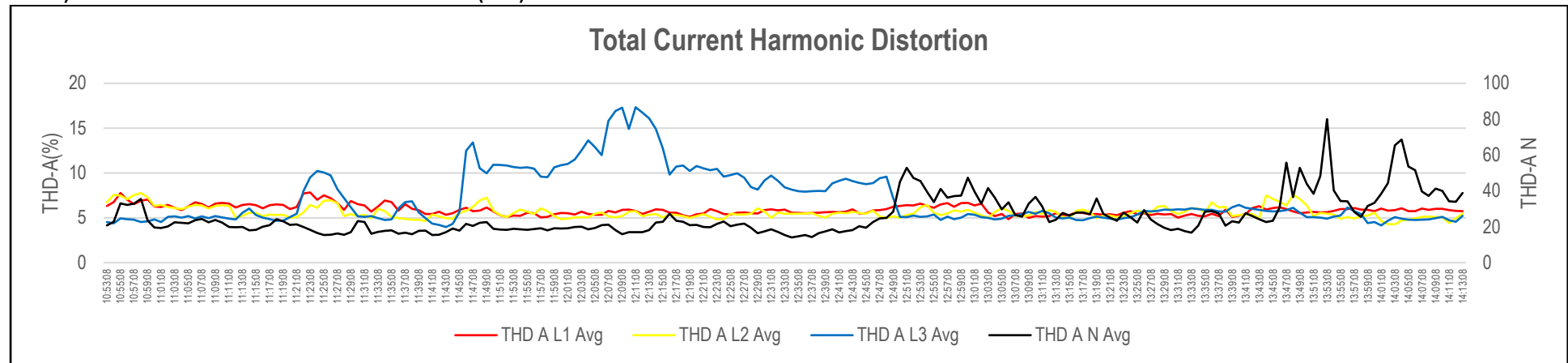
VIII) Power Factor:



IX) Total Harmonic Distortion Voltage (V_{THD}):



X) Total Harmonic Distortion Current (I_{THD}):



II) B Wing Energy meter:

1. Voltage:

The voltage values were recorded for 24 hours at an interval of 10 minutes; the voltage variations can be represented as follows:

Parameters	UoM	V _{rms} ph-n RN	V _{rms} ph-n YN	V _{rms} ph-n BN	V _{rms} Ph-n NG	V _{rms} ph-ph RY	V _{rms} ph-ph YB	V _{rms} ph-ph RB
Maximum	V	245.74	245.76	244.42	3.34	425.66	424.42	424.18
Minimum	V	228.78	229.76	229.60	0.64	398.86	398.34	398.52
Average	V	238.07	237.98	237.16	1.40	412.63	410.92	411.73

Observations and Remarks:

- Voltage was found to be normal across all phases. The mean voltage values were 237.73V and 411.76V
- Neutral to Ground voltage was more than 1V, which is more than prescribed limit.
- Voltage observed was within permissible limits.

Standards Referred:

EN50160: Voltage Fluctuation is within 10% and is within permissible limits.

Recommendation:

N-G voltage in system will be earthed in system by implementation of earthing at LT load panel

2. Current:

Current values were recorded across all phases including neutral Current. The current fluctuations observed were as under:

Parameter	UoM	Current R	Current Y	Current B	Current N
Maximum	A	36.50	24.80	30.90	20.00
Minimum	A	0.50	1.40	0.60	1.00
Average	A	6.05	5.84	7.41	5.03

Observations and Comments:

- Current is driven by the load. This parameter has no limit and is based upon the requirement of the load.
- Neutral Current was far more than the permissible limit**
- The maximum neutral current values were found to be very high. The rule states that permissible neutral current should be 10% of load current.

Recommendations:

Load & Phase balancing should be done to avoid loading on neutral phase.

3. Frequency:

Frequency of the network is being monitored in this logging session. The summary can be shared as follows

Parameter	UoM	Frequency
Maximum	Hz	50.20
Minimum	Hz	49.70
Average	Hz	50.01

Observations and Remarks:

Frequency variations were within acceptable tolerance of $\pm 2\%$

Standards Referred:

EN 50160: Mean Value of fundamental measured over 10s $\pm 2\%$ for 99.5%

4. Power:

Active, reactive and apparent power has been recorded and summarised as below:

Power	Parameters	UoM	R Phase	Y Phase	B Phase	Total
Active Power	Maximum	kW	7.86	4.82	6.68	18.78
	Minimum	kW	0.06	0.24	0.10	0.42
	Average	kW	1.25	1.18	1.62	4.06
Apparent Power	Maximum	kVA	8.42	5.76	7.12	21.18
	Minimum	kVA	0.12	0.34	0.14	0.66
	Average	kVA	1.39	1.36	1.72	4.79
Reactive Power	Maximum	kVAR	3.34	3.18	2.96	9.24
	Minimum	kVAR	-0.20	-0.12	-0.28	-0.54
	Average	kVAR	0.26	0.27	0.25	0.78

Observations and Remarks:

- As mentioned previously in the current section, the power drawn by the load is as per the requirement of the load.

5. Power Factor:

Parameter	R Phase	Y Phase	B Phase	Total
Maximum	0.99	0.99	0.99	0.98
Minimum	0.22	0.29	0.34	0.29
Average	0.69	0.83	0.80	0.72

Observations and Remarks:

- As seen in the table above, the average power factor is 0.72.

6. Energy:

As seen in the power section, the energy that has been consumed over 24 hours can be stated as follows

Parameter	UoM	Energy Consumed			
Phase		R Phase	Y Phase	B Phase	Total
Energy	kWh	28.23	26.64	36.58	91.45

Observations and Remarks:

- The energy consumed by the load is in line with consumption pattern.

7. Harmonics:

The summary of harmonics recorded is as under:

Parameters	UoM	Voltage R Phase	Voltage Y Phase	Voltage B Phase	Voltage N Phase	Current R Phase	Current Y Phase	Current B Phase	Current N Phase
Maximum	%	1.92	1.92	1.96	327.67	41.44	73.67	35.63	138.80
Minimum	%	1.12	1.12	1.19	29.68	3.25	6.35	4.37	16.45
Average	%	1.40	1.41	1.43	72.34	26.14	41.42	21.21	63.86

Observations and Remarks:

Voltage Harmonics:

- Total Voltage Harmonics were within acceptable limits of 5%, and individual Harmonic distortion was within 3 % limits.
- Neutral voltage harmonics were 72.34%, which were very high. This was observed due to unbalanced loads and missing Earthing system.**

Current Harmonics:

- Current Harmonics were higher than upper tolerance limits of 8%
- The individual harmonic distortions were higher limit 8%
- Harmonics of order 5th and 7th were observed to be above 8%.**
- Neutral Harmonics were high with average of 63.86% and maximum is 138.80%**

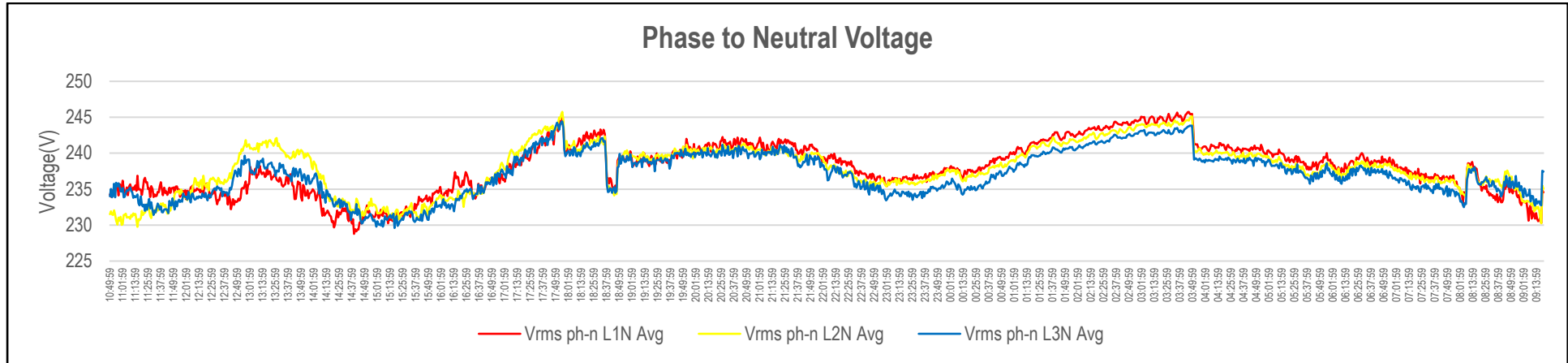
Recommendation:

- To reduce the effects of harmonics on the system by phase balancing at load side.
- Further reduction in harmonics will be done by implementation of earthing for LT load.

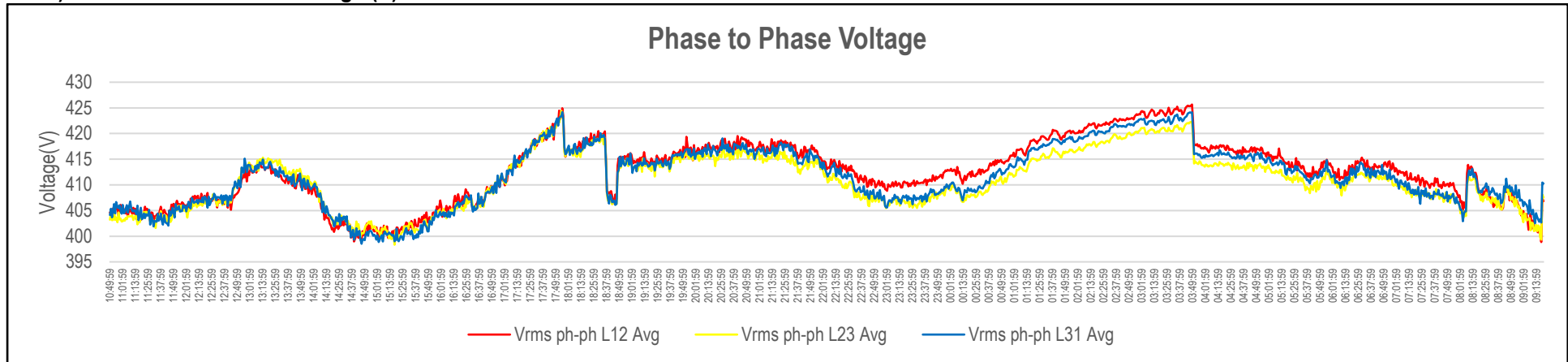
Standard Referred: IEEE 519

Graphs

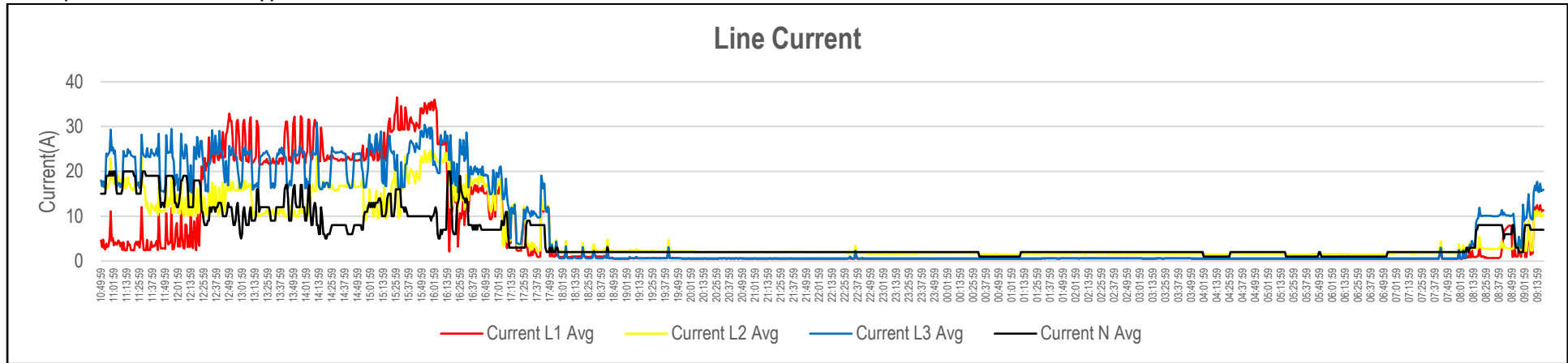
I) Phase to Neutral Voltage (V):



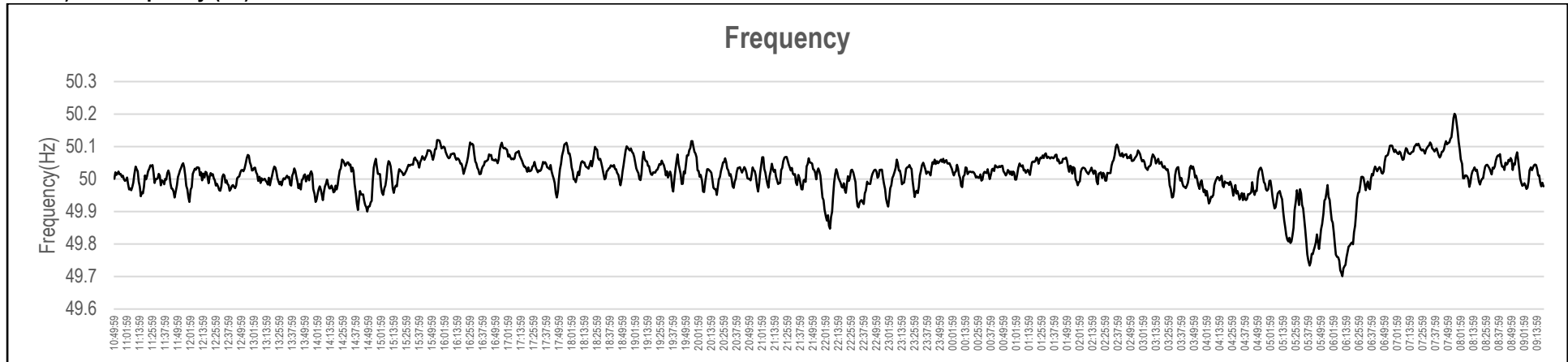
II) Phase to Phase Voltage (V):



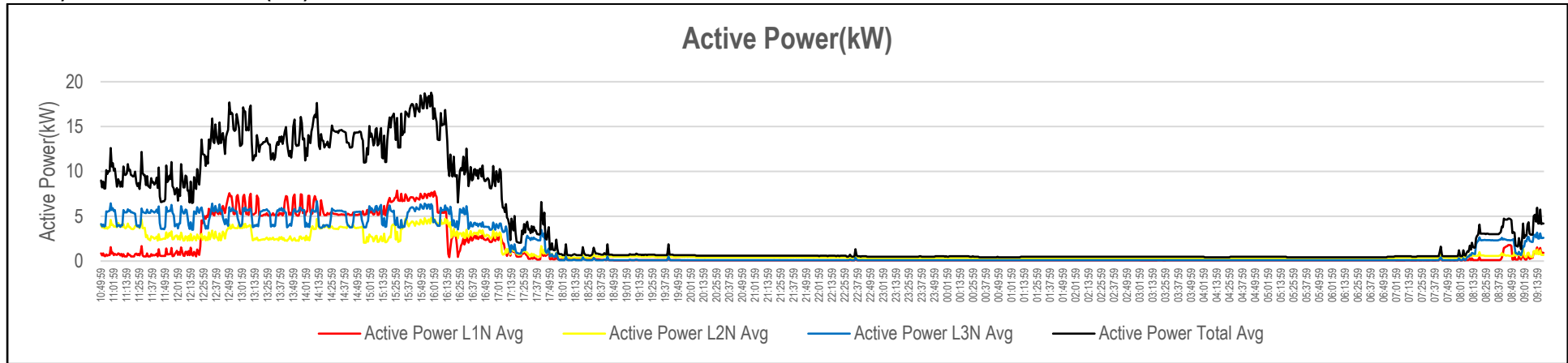
III) Line Current (I):



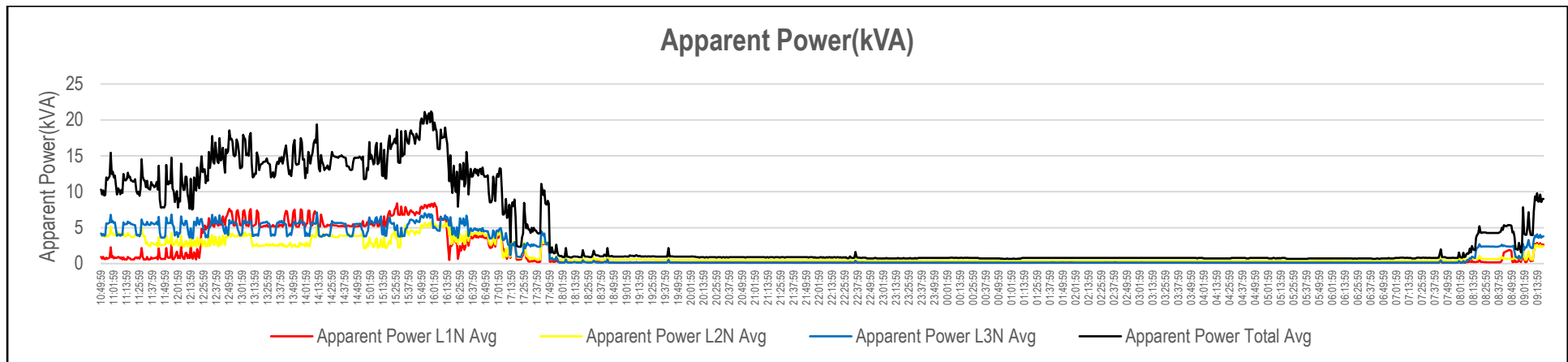
IV) Frequency (Hz):



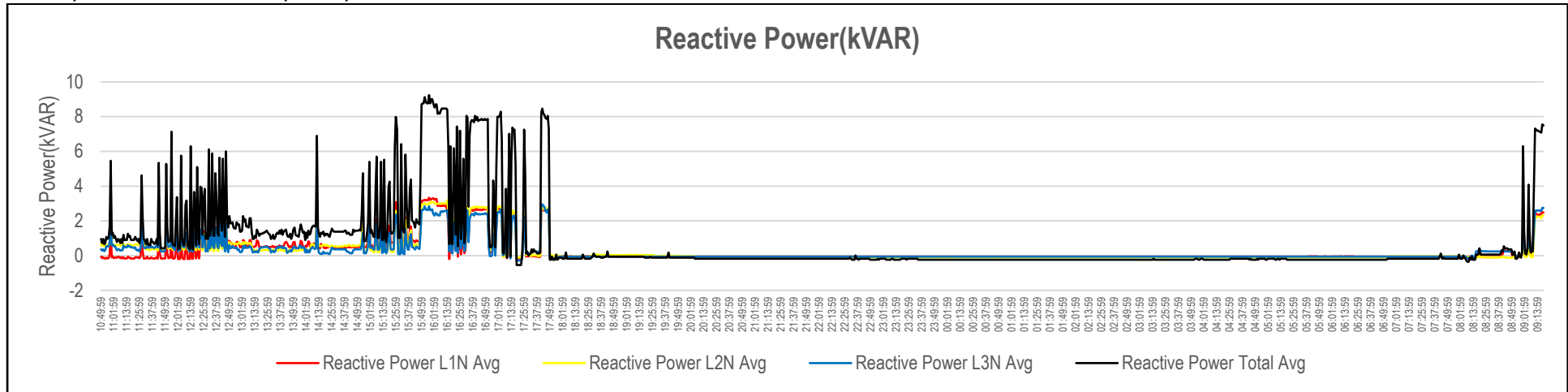
V) Active Power (kW):



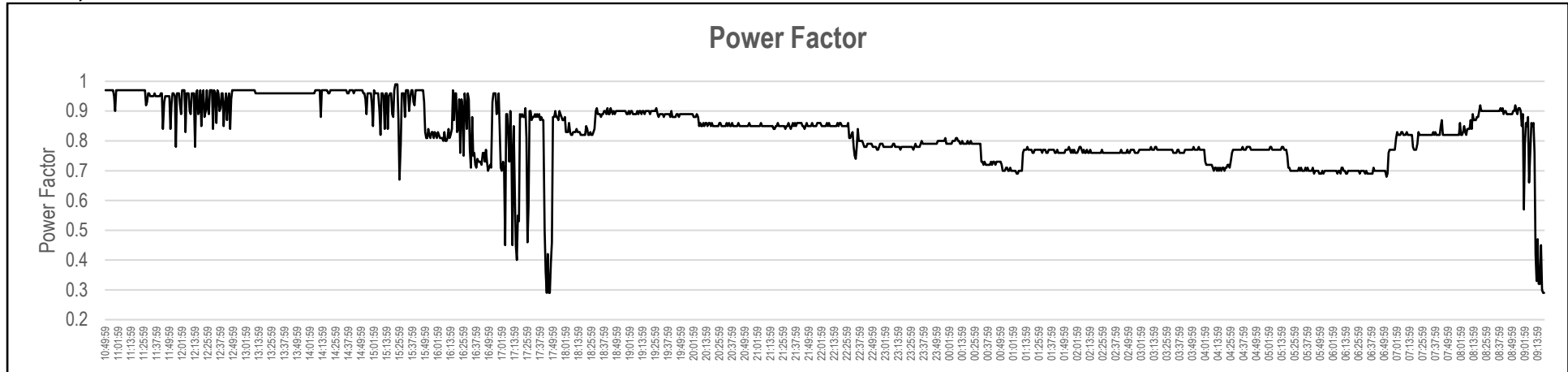
VI) Apparent Power (kVA):



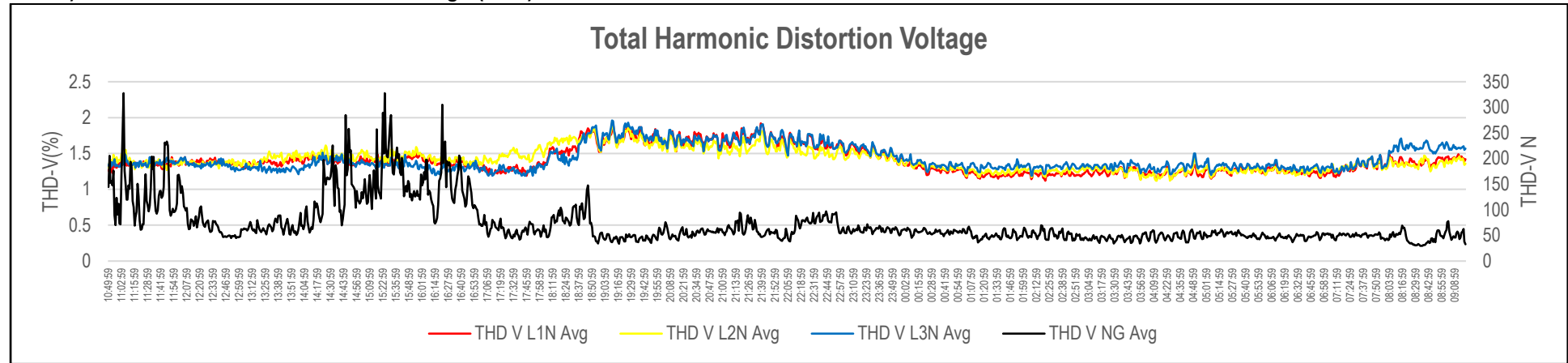
VII) Reactive Power (kVAR):



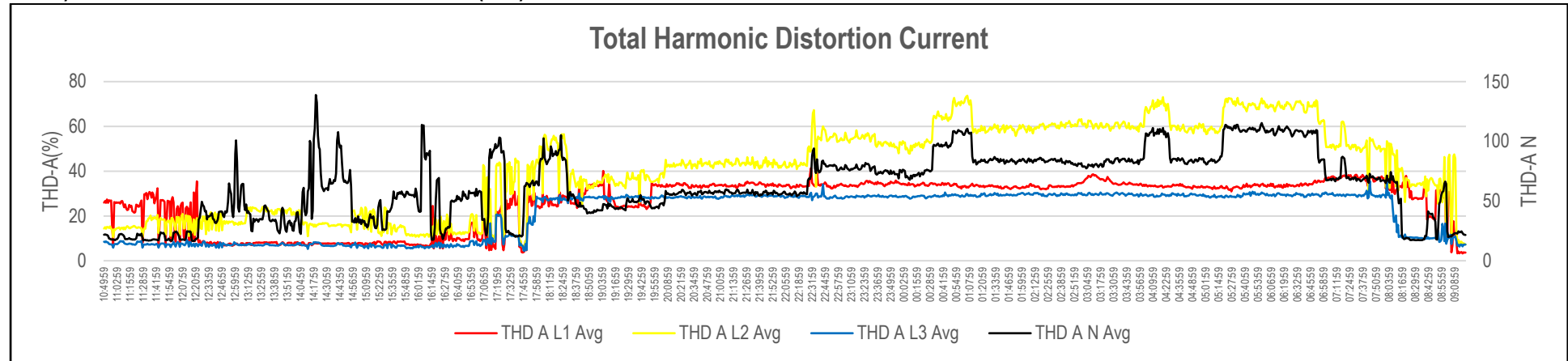
VIII) Power Factor:



IX) Total Harmonic Distortion Voltage (V_{THD}):



X) Total Harmonic Distortion Current (I_{THD}):



Annexure – 3

Illumination Level Study

Floor	Location	Lights Switched ON / OFF	Lux Readings										Average	Maximum	Minimum	Diversity (Min/Max) Lux	Uniformity (Min/Avg) Lux	Remarks
			1	2	3	4	5	6	7	8	9	10						
Fifth Floor	A - 503	ON	496	505	511	276	449	444	395	369	361	264	407	511	264	0.80	0.52	Adequate
		OFF	95	56	189	82	67	63	72	84	86	101	89.5	189	56	0.47	0.30	Inadequate
	A - 502 / Library Hall	ON	214	189	175	144	143	137	151	107	212	217	168.9	217	107	0.78	0.49	Inadequate
		OFF	41	52	48	51	57	69	52	58	59	61	54.8	69	41	0.79	0.59	Inadequate
	A - 501 Library room	ON	351	254	257	353	376	440	432	248	244	362	331.7	440	244	0.75	0.55	Adequate
		OFF	15	20	14	31	28	18	20	68	262	247	72.3	262	14	0.28	0.05	Inadequate
	A - 504	ON	265	262	279	312	324	318	320	341	298	378	309.7	378	262	0.82	0.69	Adequate
		OFF	21	23	24	27	29	34	44	52	82	113	44.9	113	21	0.40	0.19	Inadequate
	B - 501	ON	601	829	721	778	901	799	621	732	698	892	757.2	901	601	0.84	0.67	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	B - 502	ON	792	775	891	922	1058	821	922	799	831	941	875.2	1058	775	0.83	0.73	Adequate
		OFF	0	1	0	2	4	2	3	0	1	0	1.3	4	0	0.33	0.00	Inadequate
	B - 503	ON	376	451	464	371	209	414	354	514	559	524	423.6	559	209	0.76	0.37	Adequate
		OFF	0	1	0	2	0	2	3	0	1	0	0.9	3	0	0.30	0.00	Inadequate
Fourth Floor	A - 401 Business incubation Centre	ON	307	361	301	285	401	420	453	255	388	247	341.8	453	247	0.75	0.55	Adequate
		OFF	38	25	24	30	33	28	22	20	18	17	25.5	38	17	0.67	0.45	Inadequate
	A - 405 / Faculty room	ON	258	251	238	350	421	372	361	280	228	112	287.1	421	112	0.68	0.27	Inadequate
		OFF	0	2	3	6	4	26	21	18	14	9	10.3	26	0	0.40	0.00	Inadequate
	A – 402 / Class room	ON	936	970	839	830	976	993	940	715	714	832	874.5	993	714	0.88	0.72	Adequate
		OFF	3	2	3	4	6	5	4	7	8	9	5.1	9	2	0.57	0.22	Inadequate
	A - 403 / Purchase Dept	ON	244	251	248	269	236	289	305	311	325	299	277.7	325	236	0.85	0.73	Inadequate
		OFF	27	22	26	31	19	41	29	37	42	55	32.9	55	19	0.60	0.35	Inadequate
		ON	248	301	221	302	291	128	152	310	299	178	243	310	128	0.78	0.41	Inadequate

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			1	2	3	4	5	6	7	8	9	10						
	A – 403 / Store Room	OFF	21	27	31	29	14	16	17	14	14	12	19.5	31	12	0.63	0.39	Inadequate
	A – 404 / Accreditation	ON	760	761	844	890	1007	1016	1126	1190	810	722	912.6	1190	722	0.77	0.61	Adequate
		OFF	21	19	21	22	28	32	41	48	67	50	34.9	67	19	0.52	0.28	Inadequate
	B - 402	ON	728	779	699	773	631	641	557	592	672	641	671.3	779	557	0.86	0.72	Adequate
		OFF	328	221	208	142	134	108	72	76	60	53	140.2	328	53	0.43	0.16	Inadequate
	B - 403	ON	639	701	646	681	888	923	949	971	898	824	812	971	639	0.84	0.66	Adequate
		OFF	23	30	27	28	33	41	49	55	61	76	42.3	76	23	0.56	0.30	Inadequate
	B - 404	ON	603	830	786	952	589	683	711	925	1003	1141	822.3	1141	589	0.72	0.52	Adequate
		OFF	57	59	87	74	62	65	60	58	48	72	64.2	87	48	0.74	0.55	Inadequate
	B - 401	ON	292	297	304	273	256	267	280	328	278	239	281.4	328	239	0.86	0.73	Inadequate
		OFF	3	6	11	13	18	78	102	130	32	53	44.6	130	3	0.34	0.02	Inadequate
Third Floor	A - 301	ON	107	111	95	88	121	140	219	252	210	182	152.5	252	88	0.61	0.35	Inadequate
		OFF	1	2	3	1	3	7	16	25	50	7	11.5	50	1	0.23	0.02	Inadequate
	A – 305 (Faculty Room)	ON	366	344	342	386	450	460	376	345	332	415	381.6	460	332	0.83	0.72	Adequate
		OFF	86	87	73	103	156	133	214	236	44	46	117.8	236	44	0.50	0.19	Inadequate
	A – 302 / Class Room	ON	1027	1060	1191	1199	1217	1142	912	768	759	918	1019.3	1217	759	0.84	0.62	Adequate
		OFF	2	6	8	12	15	27	63	72	49	37	29.1	72	2	0.40	0.03	Inadequate
	A – 304 / SAS Lab #2	ON	784	1098	1021	277	1156	1094	940	914	623	633	854	1156	277	0.74	0.24	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	A – 303 / SAS Lab #1	ON	162	164	137	102	105	117	84	98	103	142	121.4	164	84	0.74	0.51	Inadequate
		OFF	54	77	91	61	69	58	77	98	71	41	69.7	98	41	0.71	0.42	Inadequate
	A - 303 Classroom	ON	864	958	956	722	986	977	952	962	742	504	862.3	986	504	0.87	0.51	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
		ON	291	222	199	178	259	269	236	305	277	266	250.2	305	178	0.82	0.58	Inadequate

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			1	2	3	4	5	6	7	8	9	10						
	B - 304 Classroom	OFF	1	0	4	2	3	4	12	11	1	4	4.2	12	0	0.35	0.00	Inadequate
	B - 301 Coordination & Exam Department	ON	215	178	205	183	192	288	275	189	206	256	218.7	288	178	0.76	0.62	Inadequate
		OFF	19	30	21	15	17	18	22	21	97	111	37.1	111	15	0.33	0.14	Inadequate
	B - 302 Coordination & Exam Department	ON	301	310	350	325	344	275	188	290	185	180	274.8	350	180	0.79	0.51	Inadequate
		OFF	191	97	21	22	16	18	17	21	30	19	45.2	191	16	0.24	0.08	Inadequate
Second Floor	201	ON	257	246	291	319	307	225	230	309	321	312	281.7	321	225	0.88	0.70	Inadequate
		OFF	5	2	12	23	33	27	124	263	212	39	74	263	2	0.28	0.01	Inadequate
	203 Boys' Lounge	ON	523	453	571	758	477	462	399	363	198	194	439.8	758	194	0.58	0.26	Adequate
		OFF	54	34	42	72	147	171	145	73	92	89	91.9	171	34	0.54	0.20	Inadequate
	202 Girls' Lounge	ON	572	737	638	831	671	736	587	463	452	215	590.2	831	215	0.71	0.26	Adequate
		OFF	6	7	8	11	26	17	20	99	78	81	35.3	99	6	0.36	0.06	Inadequate
	205 Faculty room	ON	295	308	284	329	342	315	323	364	375	395	333	395	284	0.84	0.72	Adequate
		OFF	187	81	71	11	13	43	42	32	34	21	53.5	187	11	0.29	0.06	Inadequate
	B - 201 Associate Dean Cabin	ON	211	213	325	318	350	378	369	340	430	419	335.3	430	211	0.78	0.49	Adequate
		OFF	5	4	5	6	7	9	20	25	44	123	24.8	123	4	0.20	0.03	Inadequate
	B - 205	ON	400	410	445	495	351	555	382	356	357	394	414.5	555	351	0.75	0.63	Adequate
		OFF	5	6	7	10	11	92	172	128	57	43	53.1	172	5	0.31	0.03	Inadequate
	B - 202 Placement Cell	ON	118	240	327	390	360	406	495	470	574	520	390	574	118	0.68	0.21	Adequate
		OFF	0	1	2	46	35	14	5	8	21	81	21.3	81	0	0.26	0.00	Inadequate
	B - 203 Class room	ON	1082	1071	1150	953	713	1007	1350	851	1264	1190	1063.1	1350	713	0.79	0.53	Adequate
		OFF	17	71	209	137	471	750	91	83	40	12	188.1	750	12	0.25	0.02	Inadequate
	B - 204 Class room	ON	625	730	690	902	844	875	696	540	630	850	738.2	902	540	0.82	0.60	Adequate
		OFF	11	21	14	19	0	1	3	7	11	9	9.6	21	0	0.46	0.00	Inadequate
	A - 102	ON	366	535	510	46	604	714	682	782	578	664	548.1	782	46	0.70	0.06	Adequate

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			1	2	3	4	5	6	7	8	9	10						
First Floor	Computer Lab	OFF	178	157	164	46	61	18	19	11	10	12	67.6	178	10	0.38	0.06	Inadequate
	A - 110	ON	317	315	308	225	276	267	332	310	299	297	294.6	332	225	0.89	0.68	Inadequate
		OFF	61	70	612	210	155	96	79	57	51	73	146.4	612	51	0.24	0.08	Inadequate
	A - 109	ON	321	356	341	358	333	299	298	351	399	402	345.8	402	298	0.86	0.74	Adequate
		OFF	121	174	19	17	18	27	22	24	26	99	54.7	174	17	0.31	0.10	Inadequate
	A - 111	ON	314	319	320	321	322	299	278	271	333	301	307.8	333	271	0.92	0.81	Adequate
		OFF	63	62	74	81	57	61	121	99	78	84	78	121	57	0.64	0.47	Inadequate
	A - 113	ON	430	438	431	471	375	414	418	433	259	351	402	471	259	0.85	0.55	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	B – 101 / Registrar Cabin	ON	363	357	375	422	270	288	311	413	426	214	343.9	426	214	0.81	0.50	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	B - 102 Dean Office	ON	440	468	586	655	673	706	641	529	571	485	575.4	706	440	0.82	0.62	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	A - 108 Director room	ON	665	667	599	571	584	599	661	678	528	499	605.1	678	499	0.89	0.74	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	A - 102 Director Office	ON	629	709	685	550	424	587	637	711	616	531	607.9	711	424	0.85	0.60	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	Deputy Registrar Office	ON	353	343	485	520	528	390	618	568	577	596	497.8	618	343	0.81	0.56	Adequate
		OFF	22	28	33	37	32	30	25	54	55	49	36.5	55	22	0.66	0.40	Inadequate
	105 - Admin Office	ON	424	428	437	440	339	399	372	421	419	222	390.1	440	222	0.89	0.50	Adequate
		OFF	121	119	55	60	62	80	82	46	72	222	91.9	222	46	0.41	0.21	Inadequate
	B - 103 MBP #2	ON	924	938	982	863	792	779	774	849	961	872	873.4	982	774	0.89	0.79	Adequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate
	B - 104 Class room	ON	338	331	325	389	289	195	252	403	314	427	326.3	427	195	0.76	0.46	Adequate
		OFF	121	139	132	191	251	216	112	117	99	67	144.5	251	67	0.58	0.27	Inadequate
	105	ON	284	194	190	132	141	180	77	153	109	162	162.2	284	77	0.57	0.27	Inadequate
		OFF	0	0	0	0	0	0	0	0	0	0	0	0	0			Inadequate

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			1	2	3	4	5	6	7	8	9	10						
	B - 105	ON	310	119	278	205	219	165	163	135	201	206	200.1	310	119	0.65	0.38	Inadequate
		OFF	121	119	117	114	116	121	229	278	305	504	202.4	504	114	0.40	0.23	Inadequate
Ground Floor	A002	ON	211	239	254	255	301	322	311	278	281	366	281.8	366	211	0.77	0.58	Inadequate
		OFF	0	0	1	1	2	2	1	3	4	1	1.5	4	0	0.38	0.00	Inadequate
	Baquet Hall	ON	240	417	543	514	670	670	720	698	403	641	551.6	720	240	0.77	0.33	Adequate
		OFF	1	2	1	3	4	0	0	1	4	1	1.7	4	0	0.43	0.00	Inadequate
	A - 005	ON	180	188	214	304	318	340	261	235	421	308	276.9	421	180	0.66	0.43	Inadequate
		OFF	1	1	0	2	1	1	2	3	4	1	1.6	4	0	0.40	0.00	Inadequate
	A – 004 / Conference Hall	ON	163	240	237	410	420	482	431	411	461	482	373.7	482	163	0.78	0.34	Adequate
		OFF	1	1	0	0	2	1	12	6	7	5	3.5	12	0	0.29	0.00	Inadequate
	Guest Lounge	ON	301	279	221	321	342	299	259	271	269	421	298.3	421	221	0.71	0.52	Inadequate
		OFF	1	2	1	0	10	2	5	6	4	7	3.8	10	0	0.38	0.00	Inadequate

Annexure - 4

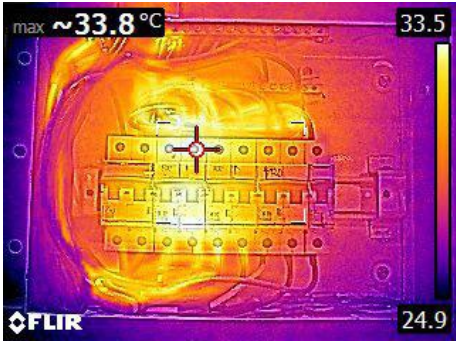
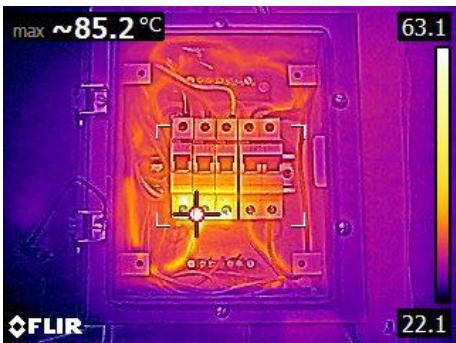
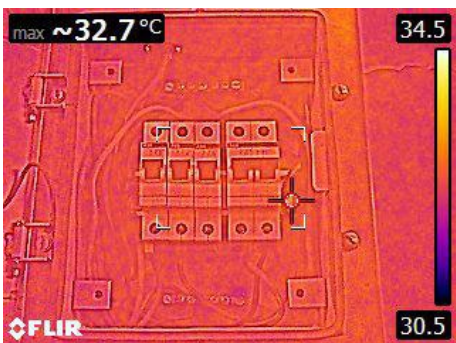
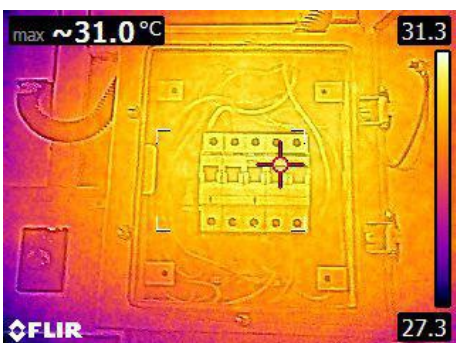
Thermography of Electrical System

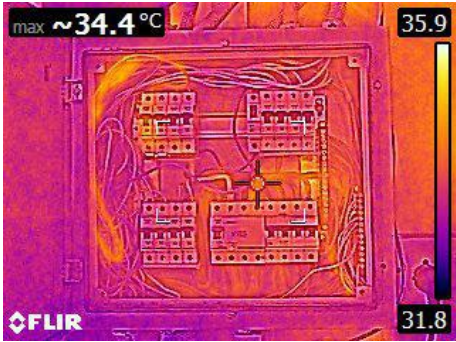
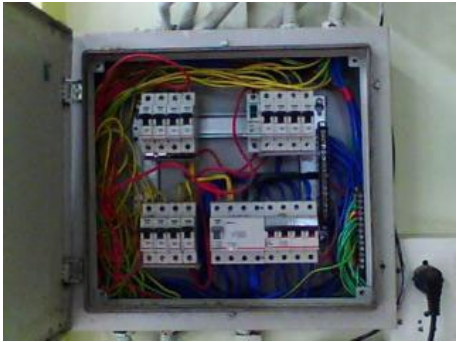
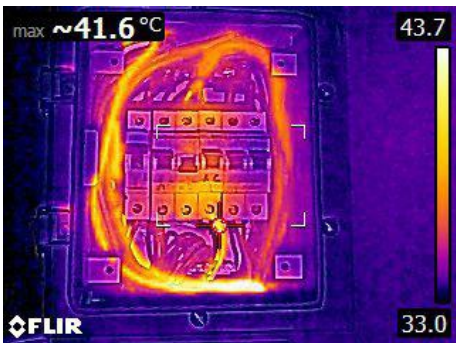
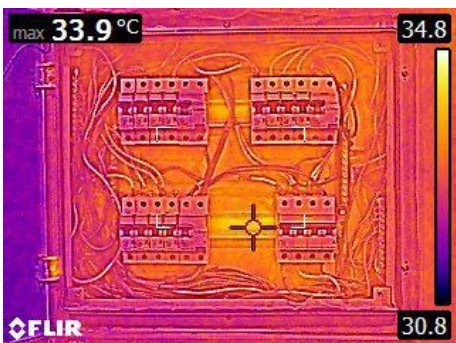
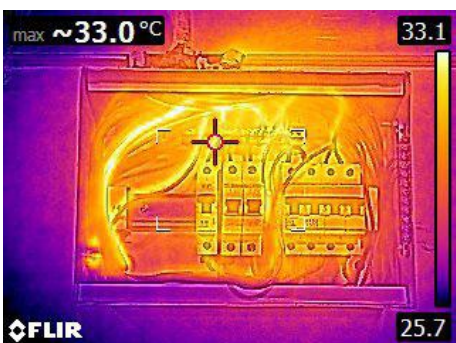
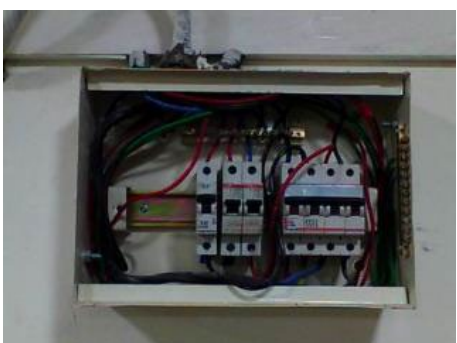
Instrument Details:

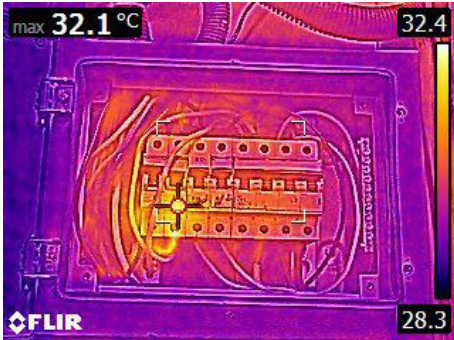
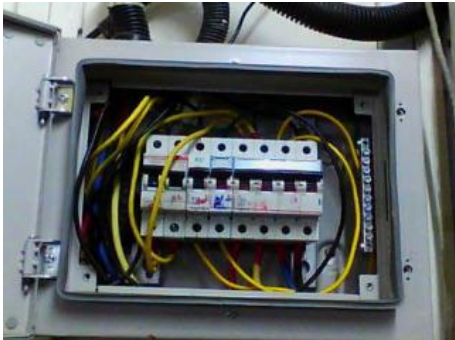
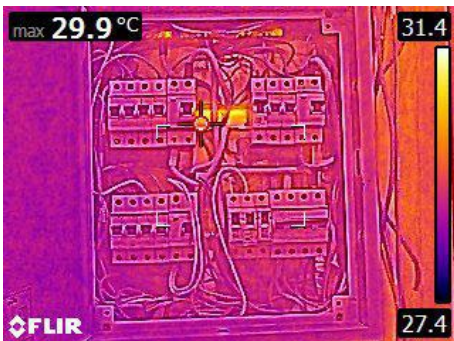
Instrument	Thermal Imager
Make	Flir
Model No	E5
Range	Up to 250°C

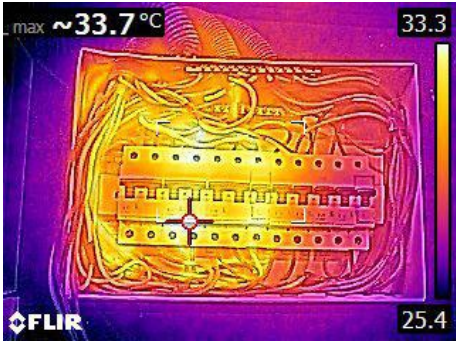
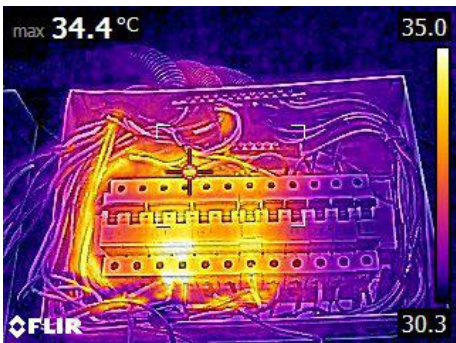
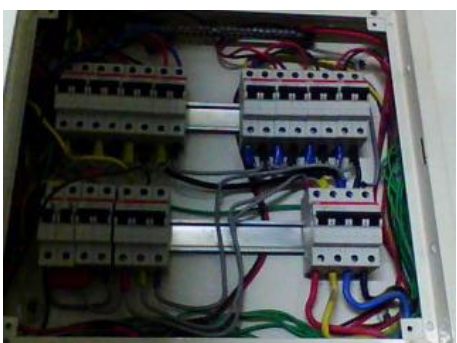
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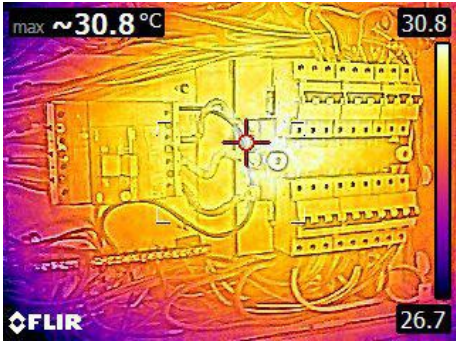
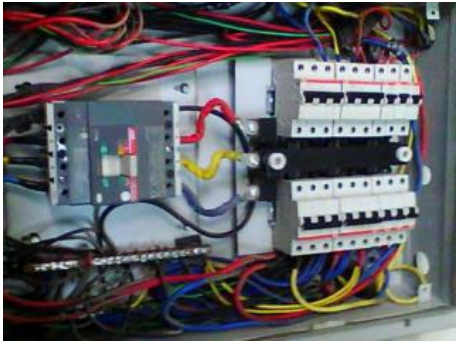
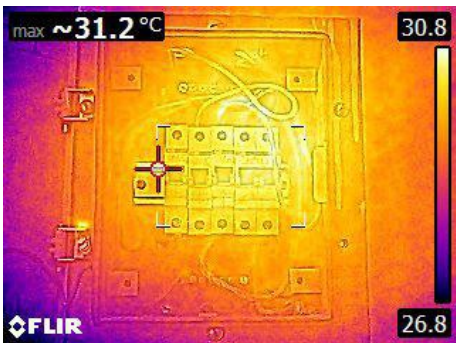
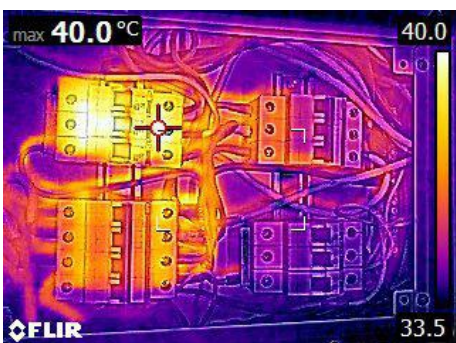
Priority code	Temperature Levels	Abnormalities Recommended Actions
01	Above 100°C	Immediate. Rectification immediate by taking shutdown
02	81°C to 100°C	Critical. Rectification recommended as soon as possible.
03	61°C to 80°C	Severe. Rectification recommended during scheduled shutdown within 30 days.
04	41°C to 60°C	Alert. Monitoring recommended
05	Upto 40°C	Normal. No action

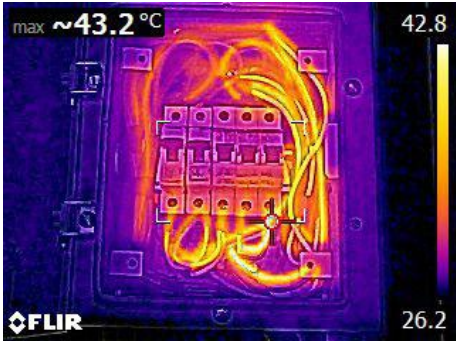
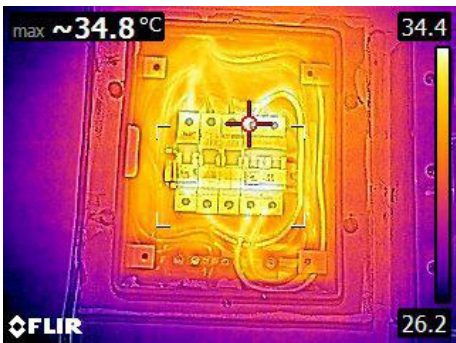
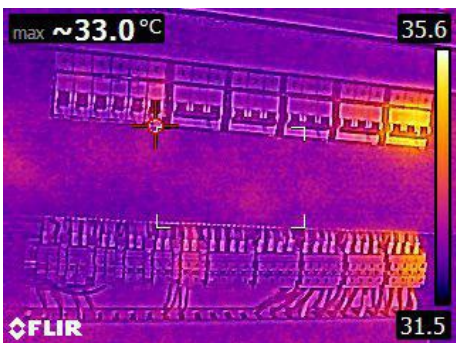
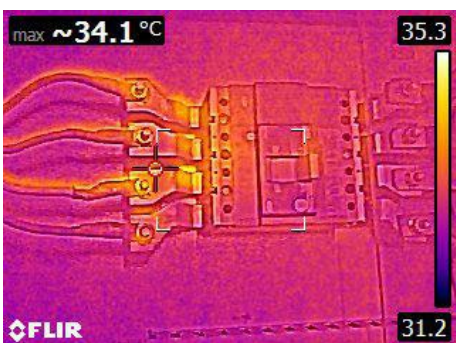
Sr. No.	Thermal Image	Visual Image	Remarks
1			Location: Fourth Floor, B404 - Classroom, Main Incomer Code: 5 Remarks: Normal No action
2			Location: Fourth Floor, B401 - Staffroom, Main Incomer Code: 2 Remarks: Critical. Immediate rectification is recommended at the earliest
3			Location: Fourth Floor, B405, Main Incomer Code: 5 Remarks: Normal No action
4			Location: Third Floor, A-301, Main Incomer Code: 5 Remarks: Normal No action

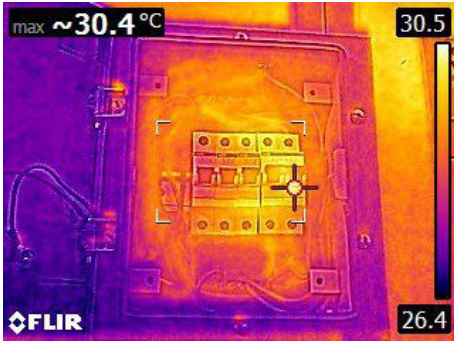
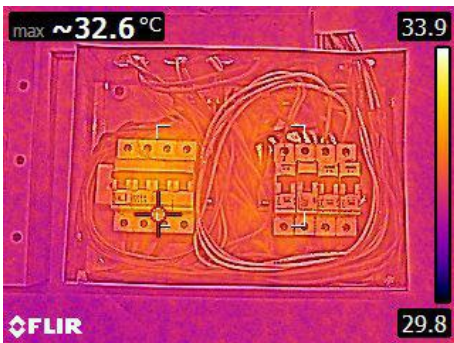
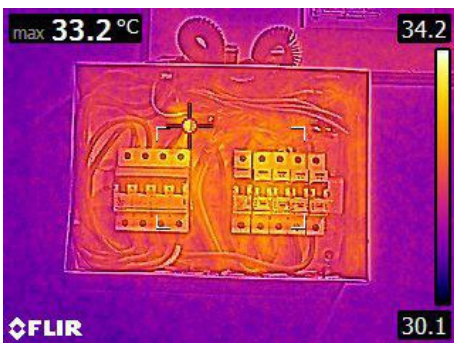
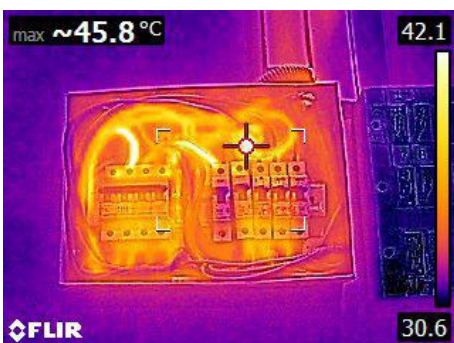
Sr. No.	Thermal Image	Visual Image	Remarks
5			Location: Third Floor, A-305, Main Incomer Code: 5 Remarks: Normal No action
6			Location: Third Floor, A-302, Main Incomer Code: 4 Remarks: Alert Monitoring recommended
7			Location: Third Floor, A-304 Lab-II SAS Lab, Main Incomer Code: 5 Remarks: Normal No action
8			Location: Third Floor, A-304 Lab-II SAS Lab, Main Incomer Code: 5 Remarks: Normal No action

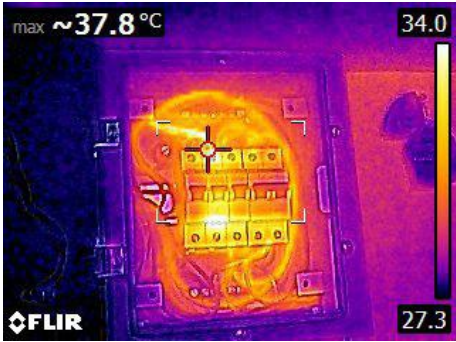
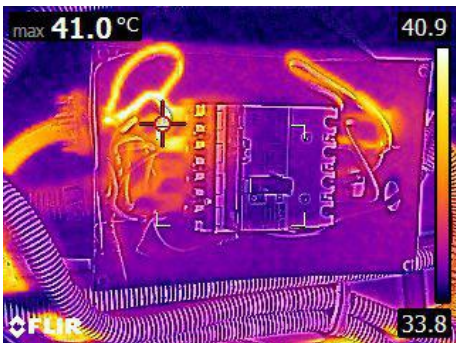
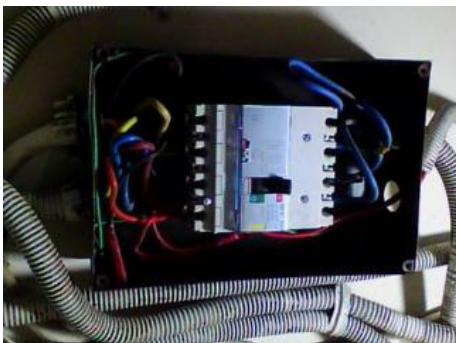
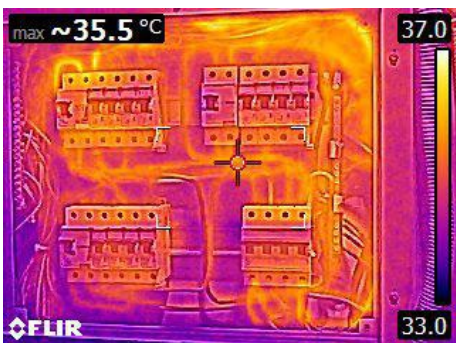
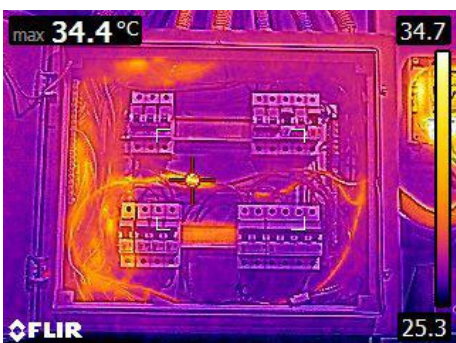
Sr. No.	Thermal Image	Visual Image	Remarks
9			Location: Third Floor, A-303 Computer Lab, Main Incomer Code: 5 Remarks: Normal No action
10			Location: Third Floor, A-303 Computer Lab, Main Incomer Code: 5 Remarks: Normal No action
11			Location: Third Floor, B-303 Classroom-4, Main Incomer Code: 5 Remarks: Normal No action
12			Location: Third Floor, B-304 Classroom-4, Main Incomer Code: 5 Remarks: Normal No action

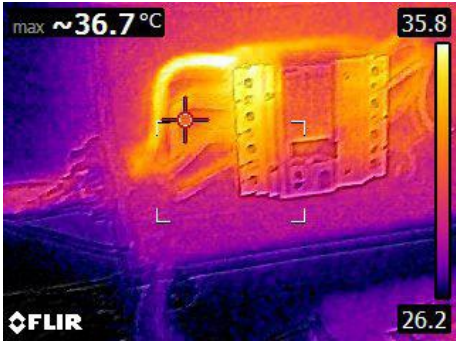
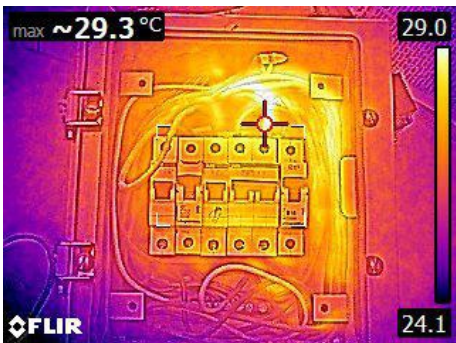
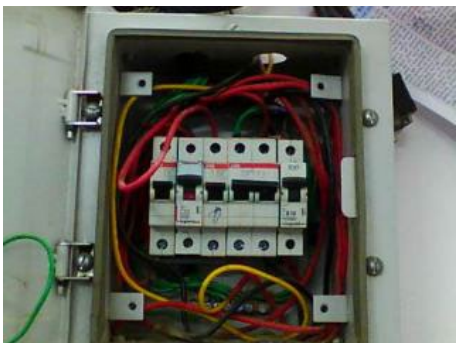
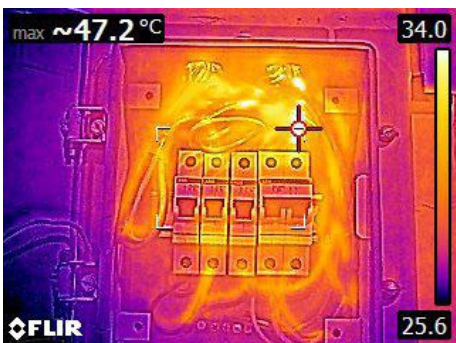
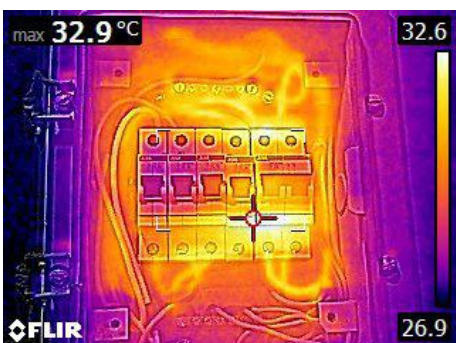
Sr. No.	Thermal Image	Visual Image	Remarks
13			Location: Third Floor, B-302 Coordination and Exam Department, Main Incomer Code: 5 Remarks: Normal No action
14			Location: Third Floor, B-302 Coordination and Exam Department, Main Incomer Code: 5 Remarks: Normal No action
15			Location: Third Floor, B-301, Main Incomer Code: 5 Remarks: Normal No action
16			Location: Third Floor, B-Wing, Main DB. Code: 5 Remarks: Normal No action

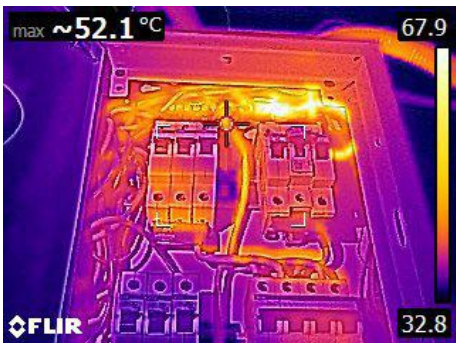
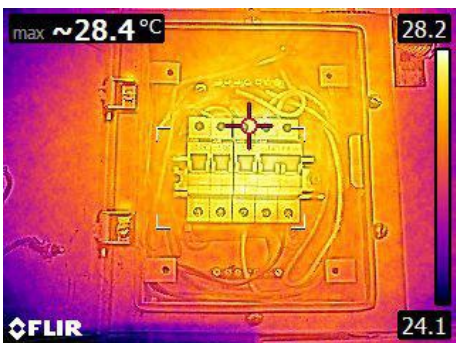
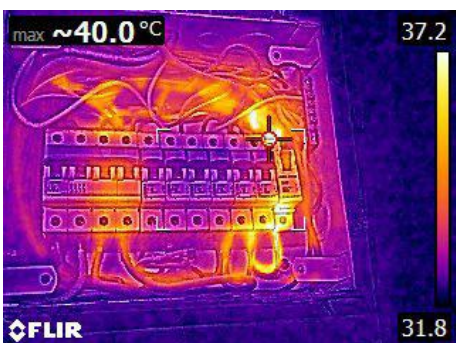
Sr. No.	Thermal Image	Visual Image	Remarks
17			Location: Third Floor, A-Wing, Main DB. Code: 5 Remarks: Normal. No action
18			Location: Second Floor, 201-Faculty room Code: 5 Remarks: Normal No action
19			Location: Second Floor, 205-Faculty room Code: 5 Remarks: Normal No action
20			Location: Second Floor, A-Wing near Lift Code: 5 Remarks: Normal No action

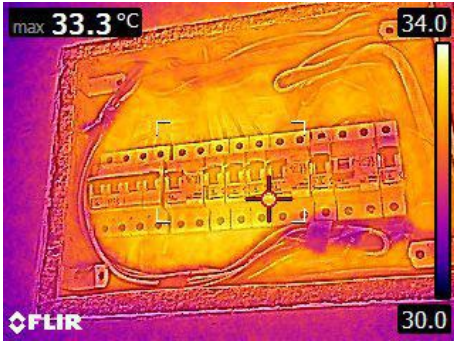
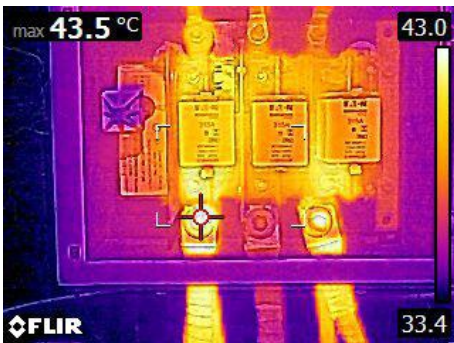
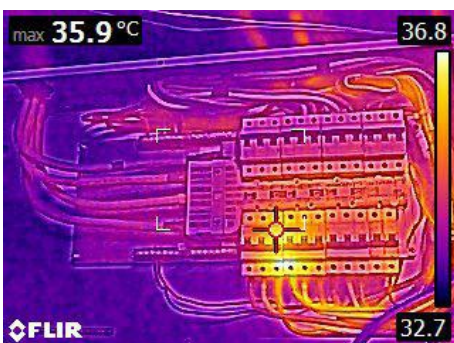
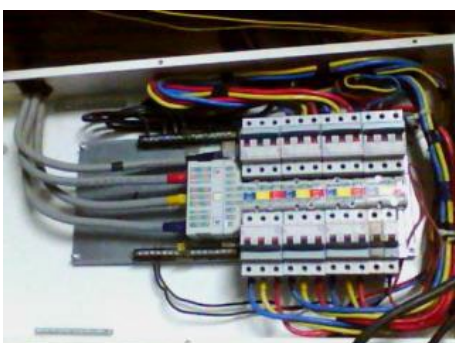
Sr. No.	Thermal Image	Visual Image	Remarks
21			Location: Second Floor, A-202 Girls' Lounge Code: 4 Remarks: Alert Monitoring recommended
22			Location: Second Floor, A-203 Boys' Lounge Code: 5 Remarks: Normal No action
23			Location: Second Floor, B-Wing, Main DB Code: 5 Remarks: Normal No action
24			Location: Second Floor, B-Wing, Main DB Code: 5 Remarks: Normal No action

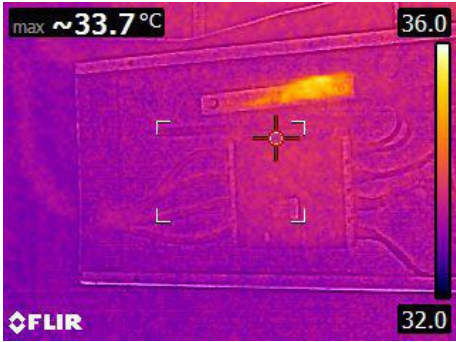
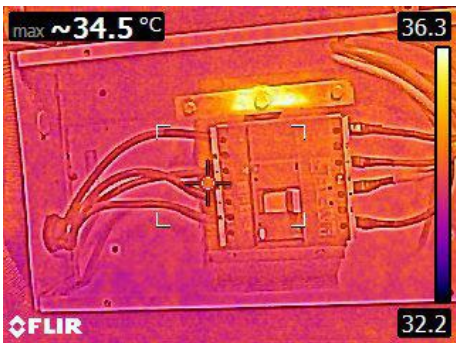
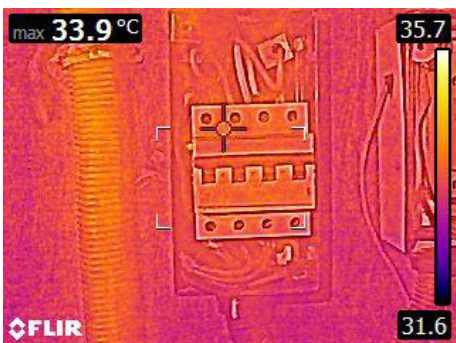
Sr. No.	Thermal Image	Visual Image	Remarks
25			Location: Second Floor, B-205 Faculty room. Code: 5 Remarks: Normal No action
26			Location: Second Floor, B-202 Code: 5 Remarks: Normal No action
27			Location: Second Floor, B-203 Code: 5 Remarks: Normal No action
28			Location: Second Floor, B-204 Classroom Code: 4 Remarks: Alert Monitoring recommended

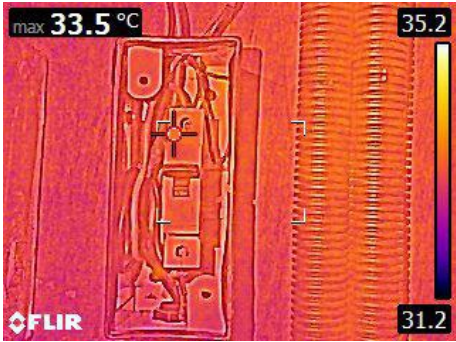
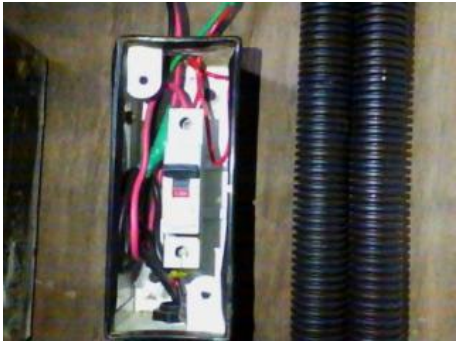
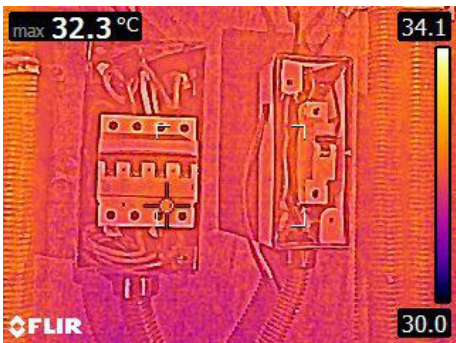
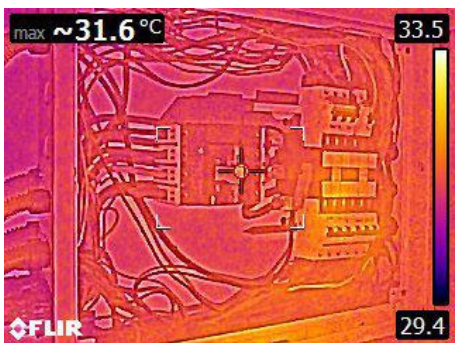
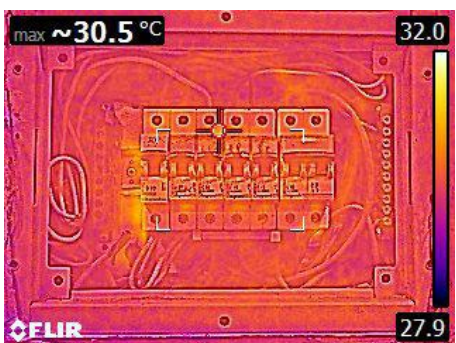
Sr. No.	Thermal Image	Visual Image	Remarks
29			Location: Second Floor, B-201 Faculty room (HOD room). Code: 5 Remarks: Normal No action
30			Location: First Floor, Computer Lab, Main Incomer. Code: 4 Remarks: Alert Monitoring recommended
31			Location: First Floor, A-Wing Code: 5 Remarks: Normal No action
32			Location: First Floor, Server room, A 113 Code: 5 Remarks: Normal No action

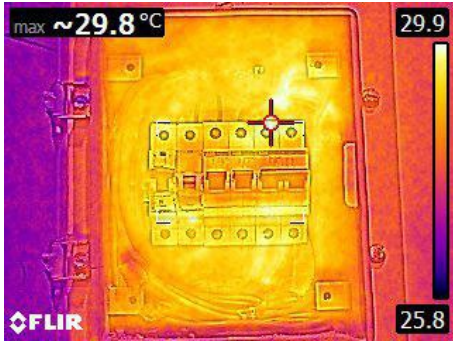
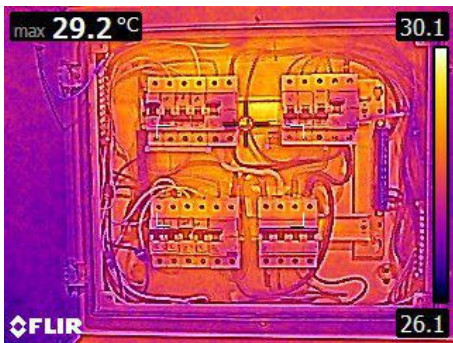
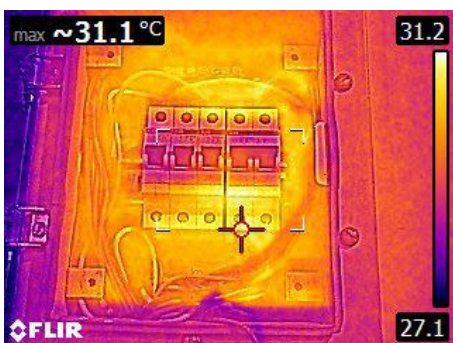
Sr. No.	Thermal Image	Visual Image	Remarks
33			Location: First Floor, A-Wing Main DB Code: 5 Remarks: Normal No action
34			Location: First Floor, B-101, Registrar Office Code: 5 Remarks: Normal No action
35			Location: First Floor, B-102, Dean Office Code: 4 Remarks: Alert Monitoring recommended
36		No Image	Location: First Floor, 101, Director's Office. Code: 5 Remarks: Normal No action

Sr. No.	Thermal Image	Visual Image	Remarks
37			Location: First Floor, Main DB, Girls' Washroom. Code: 5 Remarks: Normal No action
38			Location: First Floor, Main DB, Boys' Washroom. Code: 4 Remarks: Alert Monitoring recommended
39			Location: First Floor, B-106 Code: 5 Remarks: Normal No action
40			Location: First Floor, A-105 Admin Office (Reception). Code: 5 Remarks: Normal No action

Sr. No.	Thermal Image	Visual Image	Remarks
41			Location: First Floor, B-103 MBP Code: 5 Remarks: Normal No action
42			Location: Meter room, A-Wing Main incomer Code: 4 Remarks: Alert Monitoring recommended
43			Location: Meter room, A-Wing, Main MCCB Code: 5 Remarks: Normal No action
44			Location: Meter room, A-Wing, Power DB Code: 5 Remarks: Normal No action

Sr. No.	Thermal Image	Visual Image	Remarks
45			Location: Meter room, 100 A FP MCCB Code: 5 Remarks: Normal No action
46			Location: Meter room, 100 A FP MCCB Code: 5 Remarks: Normal No action
47			Location: Meter room, 25 A FP MCB Code: 5 Remarks: Normal No action
48			Location: Meter room, 100 A FP MCCB Code: 5 Remarks: Normal No action

Sr. No.	Thermal Image	Visual Image	Remarks
49			Location: Meter room, 20 A SP MCB Code: 5 Remarks: Normal No action
50			Location: Meter room, 125 A FP MCCB Code: 5 Remarks: Normal No action
51			Location: Ground Floor, A-Wing DB 80 A FP MCB Code: 5 Remarks: Normal No action
52			Location: Ground Floor, A-002 DB Code: 5 Remarks: Normal No action

Sr. No.	Thermal Image	Visual Image	Remarks
53			Location: Ground Floor, A-005 DB Code: 5 Remarks: Normal No action
54			Location: Ground Floor, A-004 Light and Power DB Code: 5 Remarks: Normal No action
55			Location: Ground Floor, A-003 Banquet Hall Code: 5 Remarks: Normal No action
56			Location: Ground Floor, B-01 Guest room Code: 5 Remarks: Normal No action

Annexure – 5

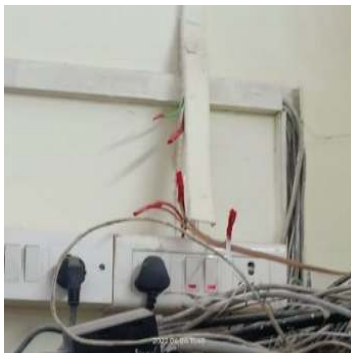
Electrical Panel Observations

Sr. No.	Photograph	Observations	Risk Category
1		Location: 002 Non- Compliance: ELCB was not provided for the DB Dust was found accumulated in the DB Recommendations: ELCB must be provided for protection against earth leakage current All apparatus shall be maintained reasonably free from dust, dirt and moisture, and shall be kept clear of obstructions	Medium
2		Location: 003 Non- Compliance: Loose wiring was observed inside the DB There was no double door cover plate provided for DB Recommendations: Wiring should be properly routed with cable ties Double cover plate should be provided for DB to avoid exposure to cables and terminations.	High
3		Location: 1st Floor Meter Room Non- Compliance: Cables were hanging near the DB Recommendations: Cables should be properly terminated with help of cable saddle or cable tray	Medium
4		Location: 1st Floor Meter Room Non- Compliance: Wire termination was not done properly Recommendations: All fire rated power cables should be routed properly through fire rated plastic conduits Cable termination should be done using cable connector kit.	Medium

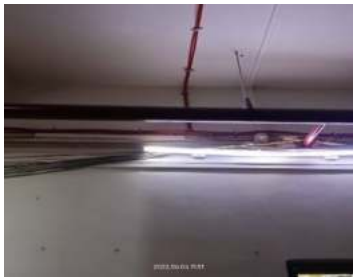
Sr. No.	Photograph	Observations	Risk Category
5		Location: 1st Floor Meter Room Non- Compliance: Loose wiring and hanging cables were observed near switch board Recommendations: Cables must be routed properly with support through saddle support arrangement.	Medium
6		Location: 102 Computer Lab Non- Compliance: Switchboard was observed to be in open condition Recommendations: Dummy plate should be provided for the switchboard or surface box should be replaced	High
7		Location: B 104 Non- Compliance: Improper termination was observed in the DB Recommendations: Termination should be done properly, using cable termination lugs	Low
8		Location: B Side 1st Floor DB Non- Compliance: Wires are not properly routed with cable saddle support Recommendations: All wires must be routed properly using saddle support	Low
9		Location: B Side 1st Floor DB Non- Compliance: Wires were not properly routed. Recommendations: All wires must be routed properly using casing and capping arrangements	Medium

Sr. No.	Photograph	Observations	Risk Category
10		Location: B 201 Non- Compliance: Casing and Caping arrangement were observed to be in open condition Recommendations: All wires must be routed properly using casing & capping arrangements.	Low
11		Location: B 201 Non- Compliance: Switchboard was observed to be in open condition Recommendations: Dummy plate should be provided for the switchboard or surface box should be replaced	High
12		Location: 301 A Non- Compliance: Loose wiring was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Low
13		Location: 303 A Non- Compliance: Improper wire routing inside was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium
14		Location: 303 A Non- Compliance: Loose wiring was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium
15		Location: 303 A Non- Compliance: Tube light was observed to be hanging from the wall Recommendations: Tube light must be properly mounted on the wall, using clamping screws	High

Sr. No.	Photograph	Observations	Risk Category
16		Location: 303 A Non- Compliance: Improper wire routing inside the DB was observed. Recommendations: Wiring should be properly routed using cable ties	Medium
17		Location: 303 A Non- Compliance: Improper wire routing inside was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium
18		Location: 302 B Non- Compliance: Improper wire routing was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium
19		Location: 403 A Non- Compliance: Wire was observed hanging from the ceiling Recommendations: Wire must be routed properly with casing and capping arrangement.	Low
20		Location: B 404 Non- Compliance: Improper wire routing inside was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium

Sr. No.	Photograph	Observations	Risk Category
21		Location: A 501 Non- Compliance: Wire was not routed properly inside casing and capping arrangement Recommendations: All wires must be routed properly with support casing and capping arrangement	Low
22		Location: A 501 Non- Compliance: Wires were not connected properly and they were directly joined without using any connector or junction terminal Recommendations: The wires must be joined by using connectors	Low
23		Location: A 504 Non- Compliance: Cables were not terminated using PVC connector Wiring was not properly routed. Recommendations: Termination should be done properly with help of PVC connectors Wiring should be properly routed using casing and capping arrangement.	Medium
24		Location: A 504 Non- Compliance: Cable was not terminated using PVC connector Recommendations: Termination should be done properly with help of PVC connector	Low
25		Location: B 501 Non- Compliance: No ELCB was provided for the DB. Loose wiring was observed inside the DB. Recommendations: ELCB should be provided for protection against earth leakage current Wiring should be properly routed using cable ties	High

Sr. No.	Photograph	Observations	Risk Category
26		Location: B 501 Non- Compliance: Loose wiring was observed inside the DB Recommendations: Wiring should be properly routed using cable ties	Medium
27		Location: B 502 Non- Compliance: No ELCB was provided for the DB Loose wiring was observed inside the DB Recommendations: ELCB should be provided for protection against earth leakage current Wiring should be properly routed using cable ties	High
28		Location: 5TH Floor A wing DB Non- Compliance: No ELCB was provided for the DB Loose wiring was observed inside the DB Recommendations: ELCB should be provided for protection against earth leakage current Wiring should be properly routed using cable ties	High
29		Location: 5th Floor Passage Non- Compliance: Wires were not routed properly using casing and capping arrangement Recommendations: All wires must be routed properly within casing and capping arrangement	Low
30		Location: 5th Floor Passage Non- Compliance: Wire was not routed properly in casing and capping arrangement Recommendations: All wires must be routed properly using support casing and capping arrangement	Low

Sr. No.	Photograph	Observations	Risk Category
31		Location: 5th Floor Passage Non- Compliance: Cable termination was not proper Recommendations: Cables / wire must be routed properly with support through casing and capping arrangement	Medium
32		Location: 5th Floor Passage Non- Compliance: The fan blade was in direct contact with the fire hydrant line. Recommendations: Length of ceiling rod should be increased for preventing fan and fire hydrant line getting damaged	High

Non-Compliance:

Dummy Plate was not observed in the DB

Recommendations:

Dummy Plate must be provide for the DB to avoid entry of lizard or dust inside panel

		
Classroom #002	004 DB- 1	DB- 2
		
Floor Meter Room DB-1	Floor Meter Room DB-2	Wing -113
		
Classroom #B101	Classroom #B201	Classroom #203
		
Classroom #301	Classroom #A 304	Classroom #A 304

**Energy Audit and MEP Audit Report
for VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai**

		
Classroom #A 303	Classroom #A 305	Classroom #B 303
		
Classroom #A 402	Classroom #A 403	Classroom #B 405
		
Classroom #B 402	Classroom #B 403	Classroom #B 404
		
Classroom #B 405	Classroom #A 501	Classroom #503
		
5 th Floor A Wing DB		

Non-Compliance:

Termination box was observed open and in damaged condition

Termination Box was observed hanging from ceiling

Wire was observed hanging from ceiling

Recommendations:

Termination box should be covered with suitable cover

Termination box should be properly mounted on the ceiling

All fire rated power cables / wire must be routed properly with support through casing and capping arrangement



**Energy Audit and MEP Audit Report
for VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai**



Annexure - 6

Details of Electrical Panels

Summary of Observations:

Main Meter Room 1:

- Illumination levels were low inside the Meter room
- No Earth mat was provided in the Meter room
- Inadequate ventilation was observed in the Meter room
- Dust was found accumulated in the Meter room
- No identification tags were placed on any cables
- The cables were hanging in the Meter room
- The all DBs were open
- Half of the distribution was outside the Meter room.

Panel Room:

- No Earth mats were provided in the Meter room
- Inadequate ventilation was observed in the Meter room
- Dust was found accumulated in the Meter room
- No identification tags were placed on any cables

1. First Floor:

- **First Floor DB Right Side:**
 - The connector plate was observed to be open
 - Improper routing of wires was observed inside the DB
 - No Earth mat was provided for the DB
- **First Floor DB Left Side:**
 - Dummy plates were not observed inside the DB
 - No Earth mat was provided for the DB

2. Second Floor:

- **Second Floor DB Right Side:**
 - The connector plate was observed to be open.
 - Improper routing of wires was observed inside the DB
 - Improper laying of Main Incoming cable was observed
 - MCB was observed hanging inside the DB
 - No Earth mat was provided for the DB
- **Second Floor DB Left Side:**
 - The connector plate was observed to be open

3. Third Floor:

- **Third Floor DB Right Side:**
 - The connector plate was observed to be open
 - No Earth mat was provided for the DB
- **Third Floor DB Left Side:**
 - The connector plate was observed to be open
 - No Earth mat was provided for the DB

4. Fourth Floor:

- **Fourth Floor – A Wing DB:**
 - Improper Termination in the DB was observed
 - The connector plate was observed open
 - Damaged MCB was observed
 - No Earth mat was provided for the DB
- **Fourth Floor – B Wing DB:**
 - Leakage Current was flowing through the DB, mild shock could be was sensed
 - No Earth mat was provided for the DB

5. Fifth Floor:

- **Fifth Floor – A Wing DB:**
 - Dummy Plate was not provided for the DB
 - No Earth mat was provided for the DB

Wing A - Main Meter room:

Sr. No.	Parameters	Details	
1	Panel Name	Main Meter Panel	
2	Panel Location	Meter Room	
3	Breaker Details	400 A Fuse	
4	Cable Size	Incoming: 1R X 3.5C X 185mm ² Outgoing: 4R X 1C X 120mm ²	
5	Gland Type	Available	
6	Visual Observations	Lug	OK
		Termination	OK
		Panel Lock	Available
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	No proper ventilation provided for the Meter room Cables were hanging inside the panel Dust was found accumulated in the panel All DB covers were open No Identification tags were placed on the cable and panel at Meter room	
8	Load Details - Feeder/Motor	A Wing	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Main Incomer:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	B	236.83	48.18	0.990	17.72
	R	233.32	73.73	1.000	26.32
	Y	237.56	66.60	1.000	23.38

Wing B - Main Meter Room:

Sr.No.	Parameters	Details	
1	Panel Name	Main Meter Panel	
2	Panel Location	Meter Room	
3	Breaker Details	200 A Fuse	
4	Cable Size	Incoming: 1R X3.5C X 150mm ² Outgoing: 4R X 1C X 70mm ²	
5	Gland Type	Available	
6	Visual Observations	Lug	OK
		Termination	OK
		Panel Lock	Available
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	No proper ventilation was provided in the Meter room Cables were hanging in the panel. Dust was found accumulated in the panel. No Identification tags were placed on the cables.	
8	Load Details - Feeder/Motor	B Wing	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Main Incomer – B Wing:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	B	237.16	7.41	0.800	1.62
	R	237.98	5.84	0.830	1.18
	Y	238.07	6.05	0.690	1.25

First Floor / B Wing - DB-1 (LHS):

Sr. No.	Parameters	Details	
1	Panel Name	DB-1 (Left Side)	
2	Panel Location	First Floor	
3	Breaker Details	63 A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Available	
6	Visual Observations	Lug	OK
		Termination	OK
		Panel Lock	OK
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	Ok	
8	Load Details - Feeder/Motor	First Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor – B Wing - DB-1:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	Not accessible				

First Floor / B Wing - DB-2 (RHS):

Sr. No.	Parameters	Details	
1	Panel Name	DB-2 (Right Side)	
2	Panel Location	First Floor	
3	Breaker Details	63 A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Available	
6	Visual Observations	Lug	OK
		Termination	OK
		Panel Lock	OK
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	OK	
8	Load Details - Feeder/Motor	First Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor – B Wing - DB-2:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	Not Accessible				

First Floor / A Wing - DB-1:

Sr. No.	Parameters	Details	
1	Panel Name	DB-1	
2	Panel Location	First Floor	
3	Breaker Details	63 A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Available	
6	Visual Observations	Lug	OK
		Termination	OK
		Panel Lock	OK
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	The Connector plate was open.	
8	Load Details - Feeder/Motor	First Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor / A Wing - DB-1:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	240.4	2.1	0.683	0.36
	Y	237.1	1.8	0.552	0.24

First Floor / A Wing - DB-2:

Sr. No.	Parameters	Details	
1	Panel Name	DB-2	
2	Panel Location	First Floor	
3	Breaker Details	63 A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Available	
6	Visual Observation	Lug	OK
		Termination	OK
		Panel Lock	OK
		Earthing mat	Not Available
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observation	OK	
8	Load Details - Feeder/Motor	First Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor / A Wing - DB-2:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	239.7	15.4	0.997	3.74
	Y	234.9	28.1	0.995	6.61
	B	239.8	12.5	0.776	2.34

First Floor / DB next to Computer Lab:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box	
2	Panel Location	First Floor	
3	Breaker Details	40 A MCB FP	
4	Cable Size	Incoming: 1R X4C X 10mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Aluminium Gland	
6	Visual Observations	Lug	Provided
		Termination	Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	OK	
8	Load Details - Feeder/Motor	First Floor Rooms near Computer Lab	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor / DB next to Computer Lab DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	235.2	7.40	0.964	1.66
	Y	229.4	10.30	0.982	2.33
	B	239.2	5.50	0.959	1.26

First Floor / DB Near Computer Lab:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box	
2	Panel Location	First Floor	
3	Breaker Details	125A MCCB FP	
4	Cable Size	Incoming: 1R X4C X 25mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Aluminium Gland	
6	Visual Observations	Lug	Provided
		Termination	Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	Cables were found hanging near the DB	
8	Load Details - Feeder/Motor	First Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at First Floor / DB Near Computer Lab:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	231	7.70	0.983	1.77
	Y	227.2	22.70	0.995	5.17
	B	236.8	1.10	0.949	0.25

Second Floor / B Wing DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box	
2	Panel Location	Second Floor	
3	Breaker Details	100A MCCB FP	
4	Cable Size	Incoming: 1R X4C X 25mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Aluminium Gland	
6	Visual Observations	Lug	Provided
		Termination	Not Provided
		Panel Lock	Not Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	OK	
8	Load Details - Feeder/Motor	Second Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Second Floor / B Wing DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	236.3	21.10	0.975	4.88
	Y	240.9	6.20	0.990	1.50
	B	244.0	1.30	0.865	0.28

Second Floor / A Wing DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box-	
2	Panel Location	Second Floor Left Side	
3	Breaker Details	63A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Aluminium Gland	
6	Visual Observations	Lug	Provided
		Termination	Not Provided
		Panel Lock	Not Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	The connector plate was observed to be open Dummy plate was not provided for the DB	
8	Load Details - Feeder/Motor	Second Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Second Floor / A Wing - DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	No Accessible				

Third Floor / B Wing - DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box	
2	Panel Location	Third Floor	
3	Breaker Details	63A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Provided	
6	Visual Observations	Lug	Not Provided
		Termination	Not Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	Improper wire routing was observed inside the DB Dummy plate was not provided for the DB	
8	Load Details - Feeder/Motor	Third Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Third Floor / B Wing - DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main incomer	R	235.9	11.60	0.985	2.72
	Y	240.1	3.30	0.950	0.77
	B	239.7	2.10	0.916	0.47

Third Floor / A Wing - DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box-1	
2	Panel Location	Third Floor - A Wing	
3	Breaker Details	100A MCCB FP	
4	Cable Size	Incoming: 1R X4C X 25mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Provided	
6	Visual Observations	Lug	Not Provided
		Termination	Not Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	Dust was found accumulated in the DB Improper wire routing was observed in the DB	
8	Load Details - Feeder/Motor	Third Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Third Floor / A Wing - DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	R	235.3	14.50	0.995	3.42
	Y	239.5	5.10	0.944	1.17
	B	238.6	15.20	0.902	3.29

Fourth Floor / A Wing DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box-1	
2	Panel Location	Fourth Floor Wing A	
3	Breaker Details	100A MCCB FP	
4	Cable Size	Incoming: 1R X4C X 25mm ² Outgoing: 2R X 1C X 4mm ²	
5	Gland Type	Provided	
6	Visual Observations	Lug	Not Provided
		Termination	Not Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	The Connector plate was open.	
8	Load Details - Feeder/Motor	Fourth Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Fourth Floor / A Wing - DB:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	Not Accessible				

Fifth Floor DB:

Sr. No.	Parameters	Details	
1	Panel Name	Distribution Box-1	
2	Panel Location	Fifth Floor	
3	Breaker Details	63A MCB FP	
4	Cable Size	Incoming: 1R X4C X 16mm ² Outgoing: 2R X 1C X 4 mm ²	
5	Gland Type	Provided	
6	Visual Observations	Lug	Provided
		Termination	Provided
		Panel Lock	Provided
		Earthing mat	Not Provided
		Cable Turning Radius	Not Provided
		Identification Tag	Not Provided
7	General Observations	Dummy Plate was not provided for the DB	
8	Load Details - Feeder/Motor	Fifth Floor	
9	Earth Protection	Provided	
10	Single Phasing Prevention	Not Provided	

Power Measurements at Fifth Floor / DB-1:

Feeder Name	Phase	Voltage, V	Current, A	Power Factor	Power, kW
Main Incomer	B	234	2.4	0.960	0.55

Annexure – 7

Recommended BOQ

Energy Saving Projects:

Sr. No.	Description	Cost Savings, Rs. Lakh	Expected Investment, Rs. Lakh	Simple Payback period
1	Installation of APFC panels for B wing Energy meter for maintaining Unity power factor		0.9	< 3 Years
2	Replace existing tube-lights with 20W LED tube-lights, including addition of fixtures	0.14	0.17	
3	Replace existing ceiling fans with 30W BLDC fans, including addition of new ceiling fans	0.66	1.96	< 3 Years
4	Replace existing Water pumps with new energy efficient pumps, including piping	0.08	0.65	< 8 Years
5	Addition of 8 nos. Earth-pits (for electrical panels and for Lifts)	-	1.2	-
6	Addition of LA system for lightening protection along with dedicated earth pits	-	0.75	-
7	Install 50 kWp roof-top Solar PV system	7.98	30.00	< 4 Years
	Total:	8.86	35.63	

Annexure – 8

Study of Air Conditioning System

Location	Rated Cooling Load, TR	Rated EER, kW/kW	Area, m ²	Air Flow, m ³ /s	Supply Air Parameters				Return Air Parameters					Evaluated Parameters			
					DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	Density, kg/m ³	Cooling Load, TR	Power, kW	SEC, kW/TR	EER, kW/kW
A-503	1	3.01	0.055	2.48	16	85	14.5	40.63	24	70	20	57.32	1.18	0.79	1.49	1.89	1.85
A-502 / Library Hall	2	2.8	0.09	2.88	14	80	12	34.09	23	69	19	54	1.18	1.80	2.21	1.23	2.85
	2	2.8	0.09	3.81	17	90	16	44.87	23	69	19	54	1.18	1.08	1.88	1.73	2.02
	2	2.8	0.09	3.77	16	90	15	42.02	23	69	19	54	1.18	1.41	2.04	1.45	2.41
	2	2.8	0.09	3.56	15	90	14	39.28	23	69	19	54	1.18	1.65	2.11	1.28	2.73
	2	3.6	0.09	4.02	14.5	95	14	39.3	24	63	19	53.96	1.18	1.85	2.33	1.26	2.78
	2	3.6	0.09	3.99	15.5	95	15	42.04	23	63	19	54	1.18	1.49	2	1.34	2.60
	2	3.6	0.09	3.59	15	100	15	42.05	24	70	20	57.32	1.8	1.72	2.41	1.40	2.50
	2	3.6	0.09	2.81	14	95	13.5	37.97	23	76	20	57.36	1.18	1.71	2.06	1.20	2.91
A-504	1	3.11	0.055	2.13	13	89	12	34.11	23	69	19	54	1.18	0.82	1.99	2.43	1.44
B-503	2	2.67	0.09	2.98	14	90	13	36.65	23	69	19	54	1.18	1.62	1.91	1.18	2.98
B-501 / Class Room	2	3.12	0.09	2.94	15	90	14	39.28	23	76	20	57.36	1.18	1.67	2.01	1.20	2.91
	2	3.12	0.09	2.55	14	95	13.5	37.97	23	84	21	60.86	1.18	1.83	2.44	1.33	2.63
	2	3.67	0.08	2.44	13	89	12	34.11	24	77	21	60.83	1.18	1.84	2.43	1.32	2.64
	1	3.67	0.08	1.99	16	85	14.5	40.63	25	63	20	57.29	1.17	0.92	2.48	2.70	1.30
502-B	2	3.12	0.09	3.12	15	90	14	39.28	24	70	20	57.32	1.18	1.77	2.24	1.27	2.76
	2	3.67	0.08	3.67	15	85	13.5	37.94	23	69	19	54	1.18	1.65	2.31	1.40	2.49
	2	3.12	0.09	3.12	15	80	13	36.63	23	62	18	50.77	1.18	1.39	2.05	1.48	2.37
	2	3.12	0.09	3.12	16	81	14	39.26	22	68	18	50.8	1.19	1.12	1.78	1.59	2.21
	2	2.39	0.085	2.39	16	85	14.5	40.63	23	76	20	57.36	1.18	1.18	1.79	1.52	2.30
401-A	1.5	2.68	0.085	2.05	15	95	14.5	40.65	24	66	19.5	55.63	1.18	0.91	2.1	2.30	1.52
402-A	1.5	3.11	0.08	2.36	15	90	14	39.28	22	68	18	50.8	1.19	0.76	2.093	2.76	1.27
404-A	2	3.51	0.095	2.88	16	81	14	39.26	24	70	20	57.32	1.18	1.71	2.14	1.25	2.80

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Location	Rated Cooling Load, TR	Rated EER, kW/kW	Area, m ²	Air Flow, m ³ /s	Supply Air Parameters				Return Air Parameters					Evaluated Parameters			
					DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	Density, kg/m ³	Cooling Load, TR	Power, kW	SEC, kW/TR	EER, kW/kW
402-B	2	2.67	0.09	2.89	16	90	15	42.02	24	70	20	57.32	1.18	1.38	2.55	1.85	1.89
403-B	2	2.8	0.09	3.41	17	81	15	42	23	76	20	57.36	1.18	1.63	1.99	1.22	2.87
403-B	2	2.8	0.09	2.87	16	85	14.5	40.63	25	70	21	60.79	1.17	1.80	2.49	1.38	2.53
404-B	2	2.67	0.09	4.22	16	90	15	42.02	24	63	19	53.96	1.18	1.57	2.31	1.47	2.38
	2	2.67	0.09	3.11	15	80	13	36.63	23	69	19	54	1.18	1.70	2.11	1.24	2.82
401-B	1.5	2.68	0.085	2.11	15.5	90	14.5	40.64	22	76	19	54.03	1.19	0.83	1.47	1.77	1.98
405-B	2	2.8	0.09	2.64	15	90	14	39.28	25	63	20	57.29	1.17	1.49	1.79	1.20	2.92
301-A	1	2.68	0.08	2.14	14.5	95	14	39.3	23	69	19	54	1.17	0.88	1.29	1.47	2.38
305-A	1.5	2.39	0.09	2.11	15	90	14	39.28	21	75	18	50.84	1.19	0.77	1.31	1.71	2.05
	1.5	2.39	0.09	2.16	13	95	12.5	35.38	21	75	18	50.84	1.19	1.06	1.66	1.57	2.23
302-A	1.5	2.39	0.09	2.23	14	85	12.5	35.35	23	69	19	54	1.18	1.31	1.87	1.43	2.45
	1.5	2.39	0.09	2.19	15	80	13	36.63	23	76	20	57.36	1.18	1.43	1.65	1.16	3.03
304-A	2	2.67	0.09	2.24	15	85	13.5	37.94	24	77	21	60.83	1.18	1.61	1.89	1.17	2.98
	1	3.23	0.08	1.99	15	95	14.5	40.65	22	83	20	57.39	1.18	0.93	1.41	1.52	2.31
303-A	2	3.61	0.09	2.46	17	86	15.5	43.42	26	71	22	64.4	1.17	1.61	1.84	1.14	3.06
	2	3.61	0.09	2.11	16.5	76	14	39.25	24	77	21	60.83	1.18	1.42	1.81	1.28	2.74
303-B	2	2.67	0.09	2.66	15	75	12.5	35.33	23	76	20	57.36	1.18	1.84	2.47	1.34	2.61
	2	2.67	0.09	2.59	16	85	14.5	40.63	25	74	21.5	62.59	1.17	1.77	2.13	1.20	2.91
	2	3.67	0.09	3.57	17	86	15.5	43.42	24	73	20.5	59.06	1.18	1.74	2.11	1.21	2.89
304-B	2	2.67	0.09	2.77	16.5	81	14.5	40.62	24	77	21	60.83	1.18	1.74	2.48	1.42	2.46
	2	2.67	0.09	2.22	13.5	84	12	34.1	25	70	21	60.79	1.17	1.86	2.65	1.42	2.46
	2	3.67	0.09	2.26	14	85	12.5	35.35	25	67	20.5	59.02	1.17	1.68	2.41	1.43	2.44
201-A	1	2.68	0.08	2.06	15	90	14	39.28	23	69	19	54	1.18	0.85	1.44	1.70	2.06
203-A / Boys' Lounge	2	3.67	0.09	3.21	16.5	90	13.5	43.43	24	77	21	60.83	1.18	1.74	2.18	1.25	2.79
	2	3.67	0.09	2.66	16.5	86	15	42.01	25	77	22	64.44	1.17	1.86	2.51	1.35	2.59
202-A / Girls' Lounge	2	2.39	0.09	3.21	17	86	15.5	43.42	26	64	21	60.75	1.17	1.73	2.46	1.42	2.47
	2	2.39	0.09	4.22	17	90	16	44.87	24	70	20	57.32	1.18	1.64	2.55	1.56	2.25

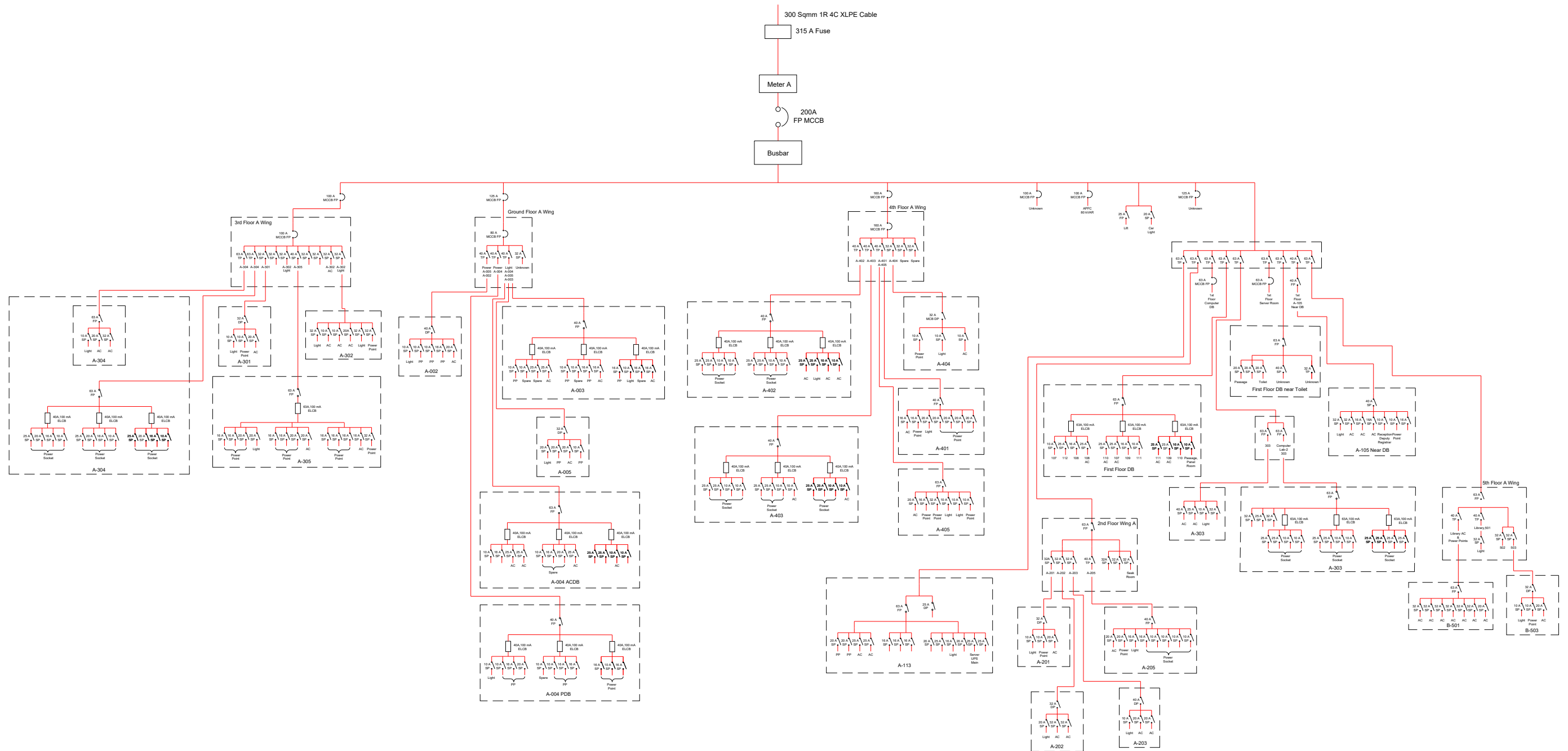
Energy Audit & MEP Audit Report
for VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Location	Rated Cooling Load, TR	Rated EER, kW/kW	Area, m ²	Air Flow, m ³ /s	Supply Air Parameters				Return Air Parameters					Evaluated Parameters			
					DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	Density, kg/m ³	Cooling Load, TR	Power, kW	SEC, kW/TR	EER, kW/kW
205-A / Faculty Room	2	3.84	0.09	2.39	15.5	80	13.5	37.93	25.5	61	20	57.27	1.17	1.45	2.08	1.43	2.44
201-B / Associate Dean Cabin	1	2.65	0.08	1.78	12	100	12	34.13	22	68	18	50.8	1.19	0.84	1.14	1.36	2.57
205-B/	2	3.6	0.08	2.4	13	89	12	34.11	24	77	21	60.83	1.18	1.81	2.52	1.40	2.51
203-B / Class Room	1.5	3.11	0.085	1.97	14	95	13.5	37.97	25	57	19	53.93	1.17	0.93	1.48	1.59	2.21
	2	3.51	0.09	2.14	11.5	94	11	31.67	25	67	20.5	59.02	1.17	1.85	2.44	1.32	2.66
	2	2.79	0.09	2.05	12	89	11	31.66	26	64	21	60.75	1.17	1.89	2.54	1.34	2.60
204-B / Class Room	2	2.39	0.09	2.44	13	95	12.5	35.58	25	70	21	60.79	1.17	1.95	2.69	1.38	2.54
	2	2.39	0.09	2.44	12	89	11	31.66	24	73	20.5	59.06	1.18	2.12	2.57	1.21	2.88
	2	3.51	0.09	2.41	15	85	13.5	37.94	25.5	71	21.5	62.57	1.17	1.87	2.21	1.18	2.95
102-A / Computer Lab	2	3	0.09	2.23	15	90	14	39.28	26	71	22	64.4	1.17	1.76	2.23	1.27	2.76
	2	2.67	0.09	2.64	16	81	14	39.26	25	70	21	60.79	1.17	1.77	2.33	1.32	2.66
	2	2.81	0.09	4.44	15.5	90	14	40.64	24	63	19	53.96	1.18	1.84	2.36	1.28	2.73
	2	2.81	0.09	3.48	15	90	14	39.28	23	73	19.5	55.66	1.18	1.79	2.41	1.35	2.60
110-A	1	3.23	0.08	2.11	15	85	13.5	37.94	23	69	19	54	1.18	0.95	1.33	1.41	2.49
109-A	1	3.23	0.08	2.05	14	90	13	36.65	22	68	18	50.8	1.19	0.81	1.29	1.59	2.20
111-A	1	3.23	0.08	1.98	14	85	12.5	35.35	22	72	18.5	52.4	1.19	0.94	1.28	1.36	2.58
113-A	2	2.81	0.09	2.17	14	80	12	34.09	22	76	19	54.03	1.19	1.36	1.88	1.38	2.53
	2	3.16	0.09	2.55	13	89	12	34.11	23	76	20	57.36	1.18	1.88	2.54	1.35	2.59
101-B	1	2.65	0.08	2.11	12.5	84	11	31.65	24	80	21.5	62.63	1.18	1.84	2.59	1.41	2.49
102-B	1	2.65	0.08	2.08	13.5	84	12	34.1	20	83	18	50.87	1.19	0.97	1.38	1.42	2.47
108-A	1.5	3.16	0.09	2.17	15	90	14	39.28	25	67	20.5	59.02	1.17	1.35	1.71	1.27	2.75
Deputy Registrar Office	1	2.68	0.08	2.11	15	95	14.5	40.65	25	57	19	53.93	1.17	0.78	1.32	1.69	2.08
105 Admin Office	1	2.65	0.08	2.87	15	95	14.5	40.65	24	56	18	50.74	1.18	0.81	1.28	1.58	2.21
103-B / MBP-2	2	3.12	0.09	3.78	17	86	15.5	43.42	24	63	19	53.96	1.18	1.24	2.11	1.70	2.06
	1.5	3.11	0.09	2.89	16	90	15	42.02	22	83	20	57.39	1.18	1.38	1.81	1.31	2.68
	1.5	3.11	0.09	2.57	14.5	80	12.5	35.34	22	68	18	50.8	1.19	1.25	1.79	1.43	2.44
104-B / Class Room	2	2.81	0.09	3.26	15	85	13.5	37.94	23	65	18.5	52.37	1.18	1.48	2.11	1.43	2.45

Energy Audit & MEP Audit Report
for VES Institute of Management Studies & Research, Campus-2, Chembur, Mumbai

Location	Rated Cooling Load, TR	Rated EER, kW/kW	Area, m ²	Air Flow, m ³ /s	Supply Air Parameters				Return Air Parameters					Evaluated Parameters			
					DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	DBT, °C	RH, %	WBT, °C	Enthalpy, kJ/kg	Density, kg/m ³	Cooling Load, TR	Power, kW	SEC, kW/TR	EER, kW/kW
105-B	2	2.81	0.09	2.35	14	80	12	34.09	22	68	18	50.8	1.19	1.23	2.01	1.63	2.15
002-A	1	3.17	0.09	2.19	14	95	13.5	37.97	21	71	17.5	49.27	1.19	0.78	1.19	1.53	2.29
Banquet Hall	2	3.16	0.09	2.11	12	94	11.5	32.88	24	77	21	60.83	1.18	1.87	2.49	1.33	2.63
	2	3.16	0.09	2.29	13	95	12.5	35.38	25	63	20	57.29	1.17	1.59	2.39	1.50	2.33
	2	3.16	0.09	3.29	16	95	15.5	43.44	24	66	19.5	55.63	1.18	1.25	2.28	1.82	1.92
005-A	2	3.15	0.09	3.21	16	81	14	39.26	23	62	18	50.77	1.18	1.15	1.81	1.57	2.23
004-4 / Conference Hall	2	3.16	0.09	2.78	15	80	13	36.63	22	72	18.5	52.4	1.19	1.38	2.06	1.50	2.34
	2	3.16	0.09	3.01	12	89	11	31.66	21	71	17.5	49.27	1.19	1.68	2.19	1.30	2.68
	2	3.16	0.09	2.99	12	94	11.5	32.88	22	68	18	50.8	1.19	1.70	1.98	1.17	3.00
	2	3.16	0.09	3.11	14	85	12.5	35.35	23	65	18.5	52.37	1.18	1.66	2.05	1.23	2.84

WING A

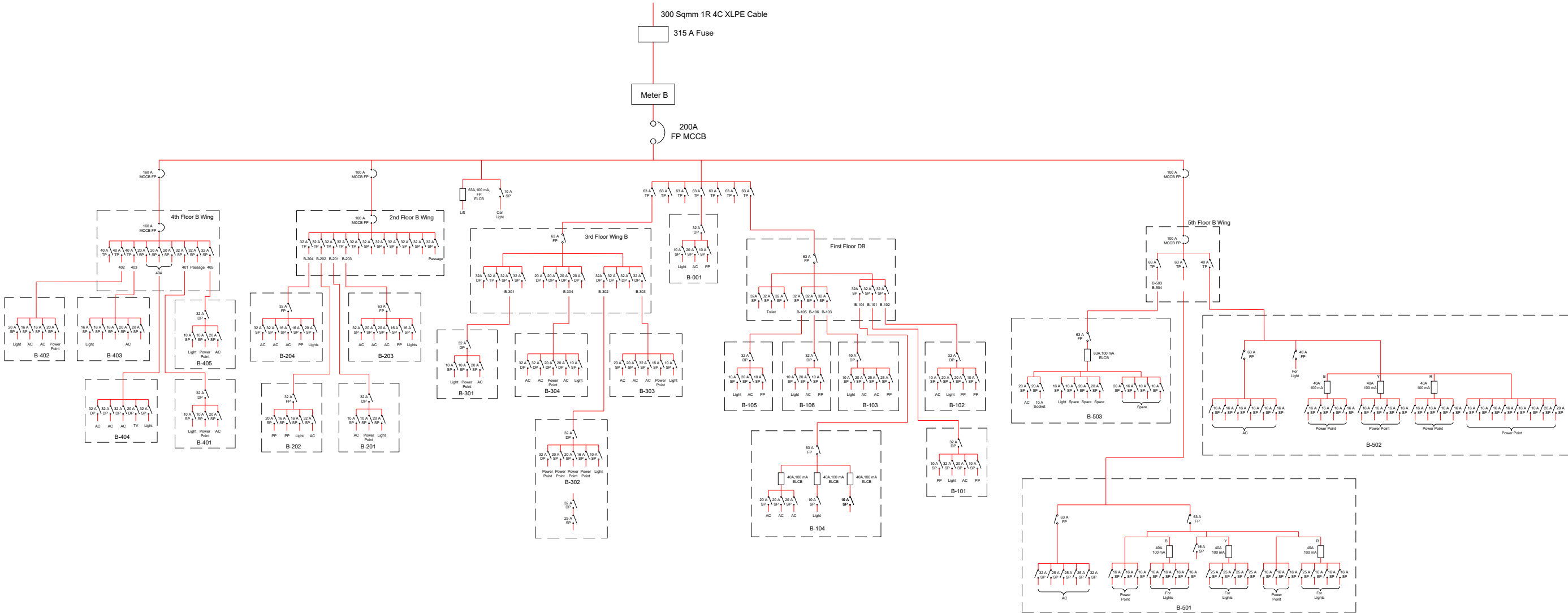


NOTES :-

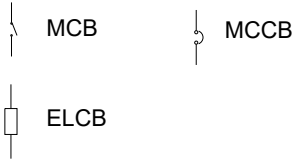
 MCB
  MCCB
 ELCB

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PROJECT: DETAILED ENERGY & MEP AUDIT								
TITLE: EXISTING SINGLE LINE DIAGRAM								
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WING B



NOTES :-



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PROJECT: DETAILED ENERGY & MEP AUDIT									
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DRN.	CHD.	APPD.	DATE	SCALE	JOB NO.				REV.
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