

Energy Audit Report



SOMAIYA VIDYAVIHAR UNIVERSITY

Address – Vidyanagar, Vidya Vihar East, Vidyavihar, Mumbai, Maharashtra 400077

Audit Date – 07, 08, 09 July 2025

Audit Conducted by



**M/S Quality Asia Certifications Private Limited
212, Bhera Enclave, Paschim Vihar, New Delhi, Delhi, 110087**

1.0 Acknowledgement

Somaiya Vidyavihar University (SVU) is Mumbai's first self-financed State Private University, established in 2019. Its sponsoring body, Somaiya Vidyavihar, has an 82-year legacy in education. Recognized by the University Grants Commission (UGC) and a member of the Association of Indian Universities (AIU), SVU successfully completed its first cycle of National Assessment and Accreditation (NAAC) with an A grade, valid until 12th February 2030.

Founded by Padmabhushan K. J. Somaiya in 1959 with the motto "Knowledge Alone Liberates," the university spans 28.08 acres within a 49.16-acre green campus. It offers education across multiple disciplines, including Engineering & Technology, Education, Science, Dharma Studies, Humanities & Social Sciences, Commerce & Business Studies, Management Studies, and Music & Performing Arts.

SVU provides a wide range of Undergraduate, Postgraduate, and Doctoral programs, designed to encourage interdisciplinary learning through minor and honors programs, fully aligned with the National Education Policy (NEP). The university also fosters entrepreneurship and innovation through its award-winning incubation centers—Research Innovation Incubation Design Laboratories (riidl) and BioRiiDL—supported by DST, DBT-BIRAC (Government of India), and MSInS (Government of Maharashtra).

Notable Achievements:

- **K. J. Somaiya Institute of Management (KJSIM)**, established in 1981, holds the **coveted AACSB accreditation** and has been recognized among the **top 25 business schools across India**. It also secured **45th rank in NIRF 2023**.
- **K. J. Somaiya College of Engineering (KJSCE)**, established in 1983, attained autonomous status in 2014 and received NAAC accreditation with an **A grade in 2017**.
- **K. J. Somaiya College of Education**, established in 1990, became **Maharashtra's first autonomous College of Education** and has been accredited thrice by NAAC with an A grade.
- **K. J. Somaiya Institute of Dharma Studies**, established in 2020, hosts the **Indian Knowledge System Centre** under the **Ministry of Education, Government of India**.

SVU continues to expand with the **School of Design, School of Music, Sports Academy, and Somaiya Institute of Research and Consultancy**, strengthening its commitment to **education, research, and consultancy**. With a mission to **nurture excellence**, the university provides an environment of **academic freedom**, fostering **creativity, innovation, leadership, responsible citizenship, and holistic growth**. SVU empowers students to follow their passions and realize their full potential.

Institutional Infrastructure

The university campus comprises a diverse array of institutions and facilities, including:

- K J Somaiya School of Engineering (Aryabhat & Bhaskaracharya Buildings)
- K J Somaiya Institute of Management (SIMSR & Chanakya Buildings)
- Dr. Shantilal K. Somaiya School of Commerce and Business Studies (Aurobindo Building)
- Somaiya School of Humanities and Social Sciences (Aurobindo Building)
- Somaiya School of Basic and Applied Sciences (6th Floor, Bhaskaracharya Building)
- K J Somaiya School of Education (6th Floor, Bhaskaracharya Building)
- K J Somaiya Institute of Dharma Studies (4th Floor, SIMSR Building)
- Somaiya Sports Academy (Eklavya Sports Complex)
- Somaiya School of Design (5th Floor, Bhaskaracharya Building)
- Somaiya Institute of Research and Consultancy (Madhuban)
- Maya Somaiya School of Music and Performing Arts (Vinaymandir)
- Department of Library and Information Science (4th Floor, Bhaskaracharya Building)
- Administrative Building (Under Construction)
- Sanskriti Vihar Building (Under Construction)

In addition, shared facilities such as the Project Office, Welcome Centre, Biogas Plant, Solar Operated Vehicles, Solar Street Lights, Vermicomposting Unit, IT Department, Mess, EV Charging Station, Campus Gardens, Canteens, Borewells, and Water Storage Tanks were also considered as part of the audit.

Hostel Details

The following hostels were included in the scope of the environmental audit:

1. **Sandipani Hostel** – Fully managed by SVU, with independent utilities and covered under this audit.
2. **Maitreyi Hostel** – Fully managed by SVU, with electricity and water usage records submitted for this audit.

3. **Polytechnic Hostel (Shared Facility)** – While the Polytechnic College does not fall under the purview of SVU, this hostel is a shared residential facility where some SVU students are accommodated.
- **Note:** Electricity and water bills for the Polytechnic Hostel were not submitted during this audit because they are combined with the Polytechnic College infrastructure. Only occupancy-related environmental observations have been included in this report, and no Polytechnic College-specific infrastructure details are covered.

These hostels were reviewed for their environmental performance with respect to energy usage, water consumption, waste management, and compliance with health, safety, and hygiene standards.

Shared Facilities Within Campus

In addition to the academic buildings, hostels, and administrative blocks, the environmental audit also covered the shared facilities within the **Somaiya Vidyavihar University, Mumbai (SVU)** campus. These facilities support the university's sustainability objectives and campus operations. The following shared facilities were included in the audit scope:

- **Project Office** – Central administrative and project coordination hub.
- **Welcome Centre** – Main entry point for visitors and administrative interactions.
- **Biogas Plant** – Operational plant for organic waste treatment and renewable energy generation.
- **Solar Operated Vehicles** – Campus transport facility running on solar power to reduce carbon footprint.
- **Solar Street Lights** – Energy-efficient lighting installed across major roads and walkways in the campus.
- **Vermicomposting Unit** – Organic waste treatment facility producing compost for landscaping and gardens.
- **IT Department** – Centralized IT infrastructure supporting campus operations.
- **Campus Mess and Canteens** – Facilities reviewed for waste management and energy efficiency.
- **EV Charging Stations** – Installed to support sustainable mobility and electric vehicle adoption.
- **Gardens and Green Zones** – Key landscaped areas including Nakshatra Garden, Founders' Garden, and Butterfly Garden, supporting biodiversity and carbon sequestration.

- **Borewells and Water Storage Tanks** – Infrastructure for water supply and conservation across the campus.

These shared facilities play a crucial role in the university’s environmental performance and were evaluated for their energy usage, waste management, water conservation, and compliance with environmental sustainability practices.

Global Engagement and Innovation

Somaiya Vidyavihar University maintains active collaborations with international universities, enabling:

- Faculty and student exchange programs
- Joint research and publications
- Immersive learning and cultural exchange
- International internships and placement pathways

An advanced **Innovation & Incubation Centre** supports entrepreneurial ventures and start-up ideas, while a dedicated **Placement Cell** ensures robust career support for graduates. Residential facilities, including safe and inclusive hostels, offer students a nurturing environment conducive to academic and personal growth.

Commitment to Sustainability

The university has also demonstrated a strong commitment to environmental stewardship and sustainable campus development, actively promoting green practices across operations, infrastructure, and student engagement.

About Quality Asia Certifications

M/s Quality Asia Certifications Private Limited (QACPL) is a leading Management System Certification Body established in 2021. QACPL has emerged as a trusted name in the field of ISO Certifications, Green audits, Environmental Audits, Energy Audits and other third-party audits across India.

Backed by a multidisciplinary team of BEE-certified energy auditors, environmental experts, and sector-specific professionals, QACPL operates with a vision to promote resource optimization, energy conservation, and climate-resilient development. The firm adopts a systematic and data-driven approach, emphasizing transparency, client engagement, and continual improvement in its audit and consulting processes.

Energy Audit Team – Assignment Overview

The following team members were engaged in conducting the Energy Audit at *Somaiya Vidyavihar University, Mumbai*:

- **Mr. Deepak Bajpai** – Lead Auditor, *Bureau of Energy Efficiency Certified Energy Auditor* (EA19771)
- **Mr. Samarth Suri** – Audit Team Member
- **Ms. Palak Ahuja** – Audit Team Member
- **Mr. Deepak** – Energy Engineer
- **Mr. Atul Suri** – Technical Reviewer, *Bureau of Energy Efficiency Certified Energy Auditor* (EA0388)

The audit team brings a diverse blend of expertise in campus energy profiling, thermal and electrical systems analysis, load pattern assessment, and renewable energy feasibility studies. The team followed a collaborative, standards-aligned methodology to ensure the delivery of evidence-backed recommendations and energy-saving measures aligned with university objectives and national energy efficiency benchmarks.

CONTENTS

1.0	Acknowledgement	2
1.1	Executive Summary	11
1.2	Methodology	12
1.3	Energy Sources and Costs.....	13
1.4	Electricity	14
1.5	Solar Institute	19
2.0	ENERGY CONSERVATION MEASURES	20
2.1	Power Factor Improvement	20
2.1	Contract Demand	21
2.1	Replace Ceiling Fans in the institute with BLDC Fan- phase wise	22
3.0	OBSERVATION & ANALYSIS	22
3.1	Electricity supply and Network	22
3.2	Energy bill Analysis	23
3.3	Transformer loading.....	26
3.4	Capacitor health check.....	27
3.5	Motor Loading.....	29
3.6	Overview of Chilled air generation plant	30
3.7	Water Pumps.....	30
3.8	Air Conditioning System	32
4.0	EXECUTIVE SUMMARY OF POWER QUALITY	39
4.1	Standards for Evaluation	41
4.2	Background.....	41
4.3	Problems Caused by Harmonics	41
4.4	Effects due to Harmonics	42
4.5	Power Factor	42
4.6	Three Phase Current Unbalance	42
4.7	Selection of New Devices/Equipment.....	42
4.8	Power Quality Analysis – Guidelines	43
4.9	Standards.....	43
4.10	Current distortion limits (120 V to 69kV) – User's responsibility.....	43

4.11	Summary of Power Quality Analysis	45
4.111	K J Engineering College.....	45
4.112	S K SOMAIYA COLLEGE(AUROBINDO)	50
4.113	K J Somaiya Management College	55
4.114	Chiller	59
5.0	DISCLAIMER	65

LIST OF TABLES

Table 1.	Summary of Power Quality Analysis & recommendations are below:	11
Table 2.	Energy cost component of energy sources	13
Table 3.	Month wise electrical energy consumption 2024-25 at KJS Institute of Management Studies	14
Table 4.	Month wise electrical energy consumption 2024-25 at SK Somaiya College (SUV)	17
Table 5.	Month wise electrical energy consumption 2024-25 at KJS College of Engg.	18
Table 6.	Cost benefit Analysis of by PF improvement	20
Table 7.	Cost benefit Analysis by installing capacitor bank	20
Table 8.	Cost benefit analysis of MDI.....	21
Table 1.	Cost benefit Analysis of replacing ceiling fans with EC BLDC fans.....	22
Table 9.	Electricity bill Analysis 2024-25 at KJS Institute of Management Studies	23
Table 10.	Electricity bill Analysis 2024-25 at S K Somaiya College SUV	24
Table 11.	Electricity bill Analysis 2024-25 at KJ Somaiya College of Engineering	25
Table 12.	Transformer Loss	27
Table 13.	Capacitor Bank (300 kVAr)	28
Table 14.	Capacitor Bank (250 kVAr)	28
Table 15.	Capacitor Bank (100 kVAr)	29
Table 16.	Motor loading	29
Table 17.	Performance Analysis of Chiller.....	30
Table 18.	Chiller Primary Pump.....	31
Table 19.	Chiller Secondary Pump.....	31
Table 20.	List of ACs	32
Table 21.	Standards THD & Unbalancing.....	43
Table 22.	Current Distortion Limits	43
Table 23.	Harmonics Limits.....	44

LIST OF FIGURES

Figure 1.	Graph between Month & KWH	15
Figure 2.	Graph between Month & KVAH	15
Figure 3.	Graph between Month & PF	16
Figure 4.	Graph between Month & Net Amount Payable (INR)	16
Figure 1.	Graph between Month & KVAH	17
Figure 2.	Graph between Month & Net Amount Payable (INR)	18
Figure 3.	Graph between Month & KVAH	19
Figure 4.	Graph between Month & Net Amount Payable (INR)	19
Figure 5.	Voltage Profile of K J ENGINEERING COLLEGE	46
Figure 6.	Current Profile of K J ENGINEERING COLLEGE	46
Figure 7.	Power factor Profile of K J ENGINEERING COLLEGE	47
Figure 8.	Power Profile of K J ENGINEERING COLLEGE	47
Figure 9.	Voltage THD% Profile of K J ENGINEERING COLLEGE	47
Figure 10.	Current THD% Profile of K J ENGINEERING COLLEGE	48
Figure 11.	Unbalanced voltage Profile of K J ENGINEERING COLLEGE	48
Figure 12.	Unbalanced Current Profile of K J ENGINEERING COLLEGE	49
Figure 13.	Voltage Profile of S K SOMAIYA COLLEGE(AUROBINDO)	51
Figure 14.	Current Profile of S K SOMAIYA COLLEGE(AUROBINDO)	51
Figure 15.	Power factor Profile of S K SOMAIYA COLLEGE(AUROBINDO)	52
Figure 16.	Power Profile of S K SOMAIYA COLLEGE(AUROBINDO)	52
Figure 17.	Voltage THD% Profile of S K SOMAIYA COLLEGE(AUROBINDO)	53
Figure 18.	Current THD% Profile of S K SOMAIYA COLLEGE(AUROBINDO)	53
Figure 19.	Unbalanced voltage Profile of S K SOMAIYA COLLEGE(AUROBINDO)	54
Figure 20.	Unbalanced Current Profile of S K SOMAIYA COLLEGE(AUROBINDO)	54
Figure 21.	Voltage Profile of K J Somaiya Management College	56
Figure 22.	Current Profile of K J Somaiya Management College	56
Figure 23.	Power factor Profile of K J Somaiya Management College	56
Figure 24.	Power Profile of K J Somaiya Management College	57
Figure 25.	Voltage THD% Profile of K J Somaiya Management College	57
Figure 26.	Current THD% Profile of K J Somaiya Management College	58
Figure 27.	Unbalanced voltage Profile of K J Somaiya Management College	58
Figure 28.	Unbalanced Current Profile of K J Somaiya Management College	59
Figure 29.	Voltage Profile of Chiller	60
Figure 30.	Current Profile of Chiller	61
Figure 31.	Power factor Profile of Chiller	61
Figure 32.	Power Profile of Chiller	62
Figure 33.	Voltage THD% Profile of Chiller	62
Figure 34.	Current THD% Profile of Chiller	63
Figure 35.	Unbalanced voltage Profile of Chiller	63
Figure 36.	Unbalanced Current Profile of Chiller	64

1.1 Executive Summary

Energy management has become a critical aspect for Institute competitiveness. Rising fuel costs, combined with increasing global competition, are driving industries, Institutes, and other facilities to focus on reducing energy expenses.

The primary objective of audit was to gain a comprehensive understanding of various end-use energy consumption and power quality activities. This included identifying, enumerating, and evaluating potential energy-saving opportunities and power quality improvement measures.

With this goal in mind, the Energy Audit team, in active collaboration with the Institute, has identified the following recommendations.

The following **Energy Conservation Measures (ECMs)** were proposed for the Institute:

Table 1. Summary of Power Energy Conservation Measure are below:

S. No	Energy Conservation Measure	Annual Savings Electricity		Investment	Payback
		kWh	Rs. Lakhs	Rs. Lakhs	Month
1	Power Factor Improvement	0	2.3	2.5	13.1
	It is observed that average power factor is 0.980. It is recommended to maintain the power factor up to 0.995 by installing the additional ASVG (100kVAr) at power distribution.				
2	Reduction in contact demand	0	4.05	0	0
	It is recommended to reduce contract demand from 1111 KVA to 800 KVA.				
3	Conventional ceiling fan replacement with BLDC fan	112000	8.09	25.0	37
	Building is fitted with conventional Ceiling fans. These conventional fans consume more power than BLDC (Brushless DC) fans. Hence, replace conventional fan (capacity 60W) with BLDC fan. Consider, replacing 1000 ceiling fans.				
Total		112000	14.44	27.5	22.8

These recommendations are intended to support Somaiya Vidyavihar University, Mumbai in progressing from energy efficiency implementation to energy performance excellence, promoting long-term sustainability, operational cost savings, and leadership in responsible energy management.

The closure of the above recommendations is expected to be reviewed within one audit cycle.

The next Energy Audit is recommended to be conducted before 09 July 2026 to ensure timely evaluation of progress and to facilitate continual improvement.

1.2 Methodology

The study was conducted by the Energy Auditors of Quality Asia and encompasses the following components:

- **Preliminary Assessments:** Conducted initial visits to each subsystem to gain an overview, engage in brief discussions with relevant Institute executives, and prepare data collection forms, checklists, and instrumentation requirements.
- **Use of Diagnostic Tools:** Employed portable instruments for power measurement, lux measurement, temperature measurement, and air velocity measurement. Additionally, onsite instrumentation data was utilized for further insights.
- **Field Studies:** Carried out performance assessments of the air conditioning system, UPS, and lighting. Trials were conducted wherever possible without disrupting the normal operation of equipment.
- **Data Analysis:** Conducted a detailed analysis of field data to evaluate the energy performance of the studied equipment, assess operational efficiencies, compare results with performance guarantees or industry norms, and identify potential areas for improvement.
- **Energy Conservation Opportunities (ENCON):** Identified actionable energy conservation opportunities to enhance efficiency and reduce energy consumption.
- **Use of diagnostic portable instruments** for power measurement, lux measurement, conventional temperature measurement, and air velocity measurement. We also utilized onsite instrumentation data for further insights.

- **Field studies** in each area, assessing the performance of the air conditioning system, UPS, and lighting. Wherever possible, trials were conducted without disturbing the normal operation of equipment.
- **Detailed analysis** of field data outputs and evaluation of the energy performance of equipment studied, assessing operational efficiencies, comparing these values with performance guarantee figures or typical industry norms, and identifying potential areas for improvement.
- **Identification of Energy Conservation Opportunities (ENCON).**

1.3 Energy Sources and Costs

Electricity is major energy sources of the Institute. Electricity is supplied at 11 kV. There is three 11/0.433 kV LT distribution transformers to meet electricity demand.

In addition, DG sets are kept as standby energy source, in case of power failure.

Table 2. Energy cost component of energy sources

Source of energy	Location	Unit	Cost
Energy charges	KJS IMS	Rs. /kvah	7.61
Energy charges	SK Somaiya college SUV	Rs. /kvah	7.55
Energy charges	KJS College of Engg.	Rs. /kvah	7.84

*Average Electricity cost of Rs.7.61 / kvah is used in ECM calculations.

Note: Bills for Aryabhat, Bhaskaracharya, SIMSR, Chanakya, Sandipani, Maitreyi, Aurobindo, and Eklavya Complex were reviewed during the audit.

1.4 Electricity

The energy demand of the Institute is met by the electricity from Grid. The annual energy consumption from electricity grid sources is as follows:

Table 3. Month wise electrical energy consumption 2024-25 at KJS Institute of Management Studies

DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2024-25									
MONTH	KWH CONSUMPTION	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	PF	CONTRACT DEMAND (KVA)	BILLING DEMAND (KVA)	MDI (KVA)	NET AMOUNT PAYABLE (INR)
May-24	138492	147348	294600	1140474	0.940	982	737	530	2243640
Jun-24	139706	147696	294600	1143167	0.946	982	737	673	2252170
Jul-24	200566	206940	294600	1601716	0.969	982	737	611	3014930
Aug-24	221321	223308	294600	1728404	0.991	982	737	632	3223100
Sep-24	205156	206748	294600	1600230	0.992	982	737	708	3060230
Oct-24	215987	217488	294600	1683357	0.993	982	737	704	3204590
Nov-24	195160	196536	294600	1521189	0.993	982	737	666	2926160
Dec-24	184391	186612	294600	1444377	0.988	982	737	652	2798030
Jan-25	196738	199188	294600	1541715	0.988	982	737	575	2961450
Feb-25	195535	198876	294600	1539300	0.983	982	737	649	2955340
Mar-25	215707	217644	294600	1684565	0.991	982	737	618	3201050
Apr-25	192090	194148	316800	1194010	0.989	982	792	792	2010660
Avg	191737.4	195211.0	296450.0	1485208.6	0.980	982.0	741.6	650.8	2820945.8
max	221321.0	223308.0	316800.0	1728404.0	0.993	982.0	792.0	792.0	3223100.0
min	138492.0	147348.0	294600.0	1140474.0	0.940	982.0	737.0	530.0	2010660.0

Figure 1. Graph between Month & KWH

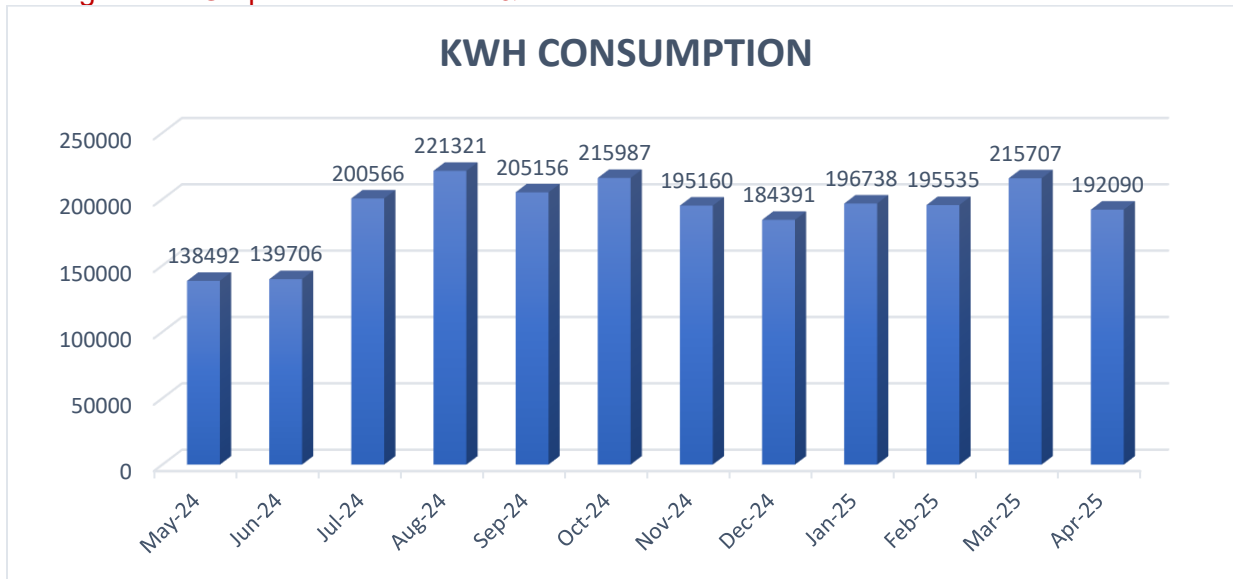


Figure 2. Graph between Month & KVAH

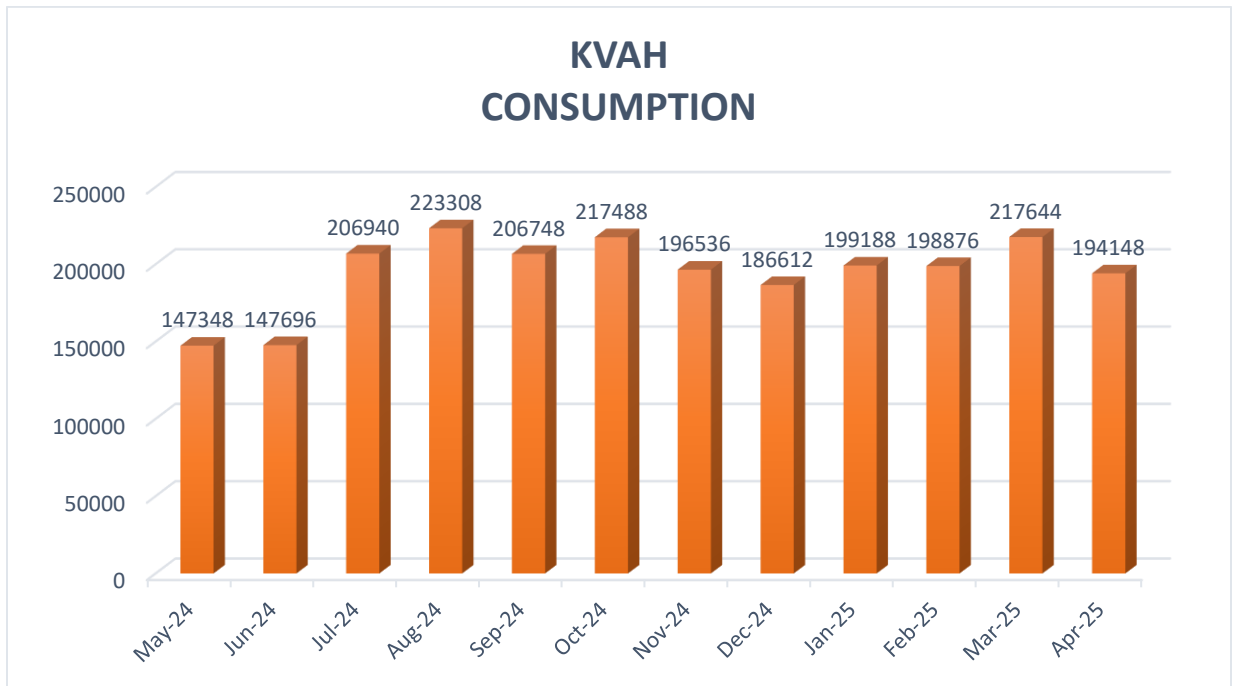


Figure 3. Graph between Month & PF

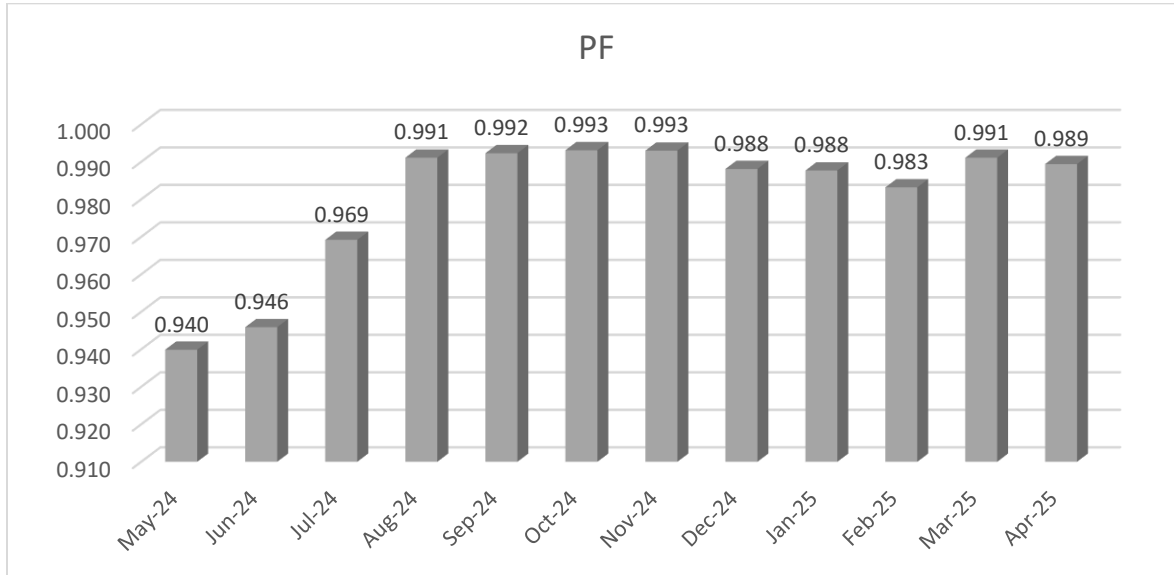


Figure 4. Graph between Month & Net Amount Payable (INR)

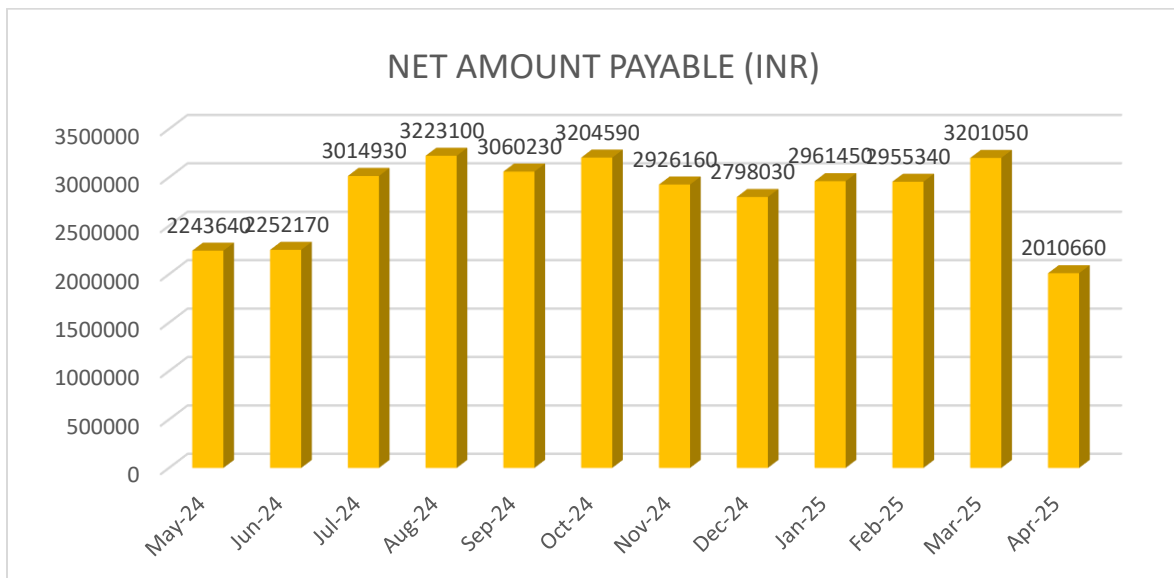


Table 4. Month wise electrical energy consumption 2024-25 at SK Somaiya College (SVU)

DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2024-2025					
MONTH	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	CONTRACT DEMAND (KVA)	NET AMOUNT PAYABLE (INR)
Apr-24	45440.0	126400	357310	406	696030
May-24	35480.0	121800	278705	406	603220
Jun-24	32060.0	122400	251594	406	559640
Jul-24	43540.0	121800	342060	406	706890
Aug-24	75620.0	121800	588223	406	1108190
Oct-24	76000.0	121800	591605	406	1133100
Nov-24	39600.0	121800	310319	406	664430
Dec-24	34160.0	121800	267198	406	592630
Jan-25	43240.0	121800	339032	406	711470
Feb-25	41720.0	121800	327352	406	692440
Apr-25	49400.0	145600	303810	406	580360
May-25	33380.0	121800	205287	406	420200
Avg	45803.3	124216.7	346874.6	406.0	705716.7
max	76000.0	145600.0	591605.0	406.0	1133100.0
min	32060.0	121800.0	205287.0	406.0	420200.0

Figure 1. Graph between Month & KVAH

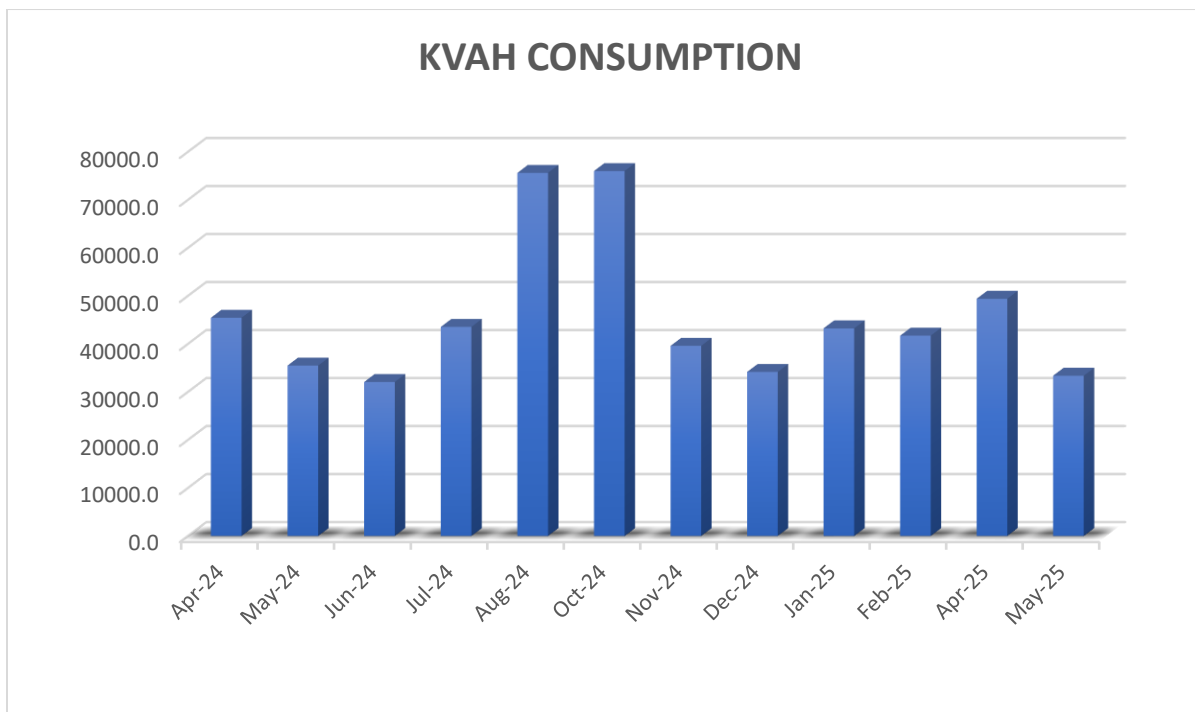


Figure 2. Graph between Month & Net Amount Payable (INR)

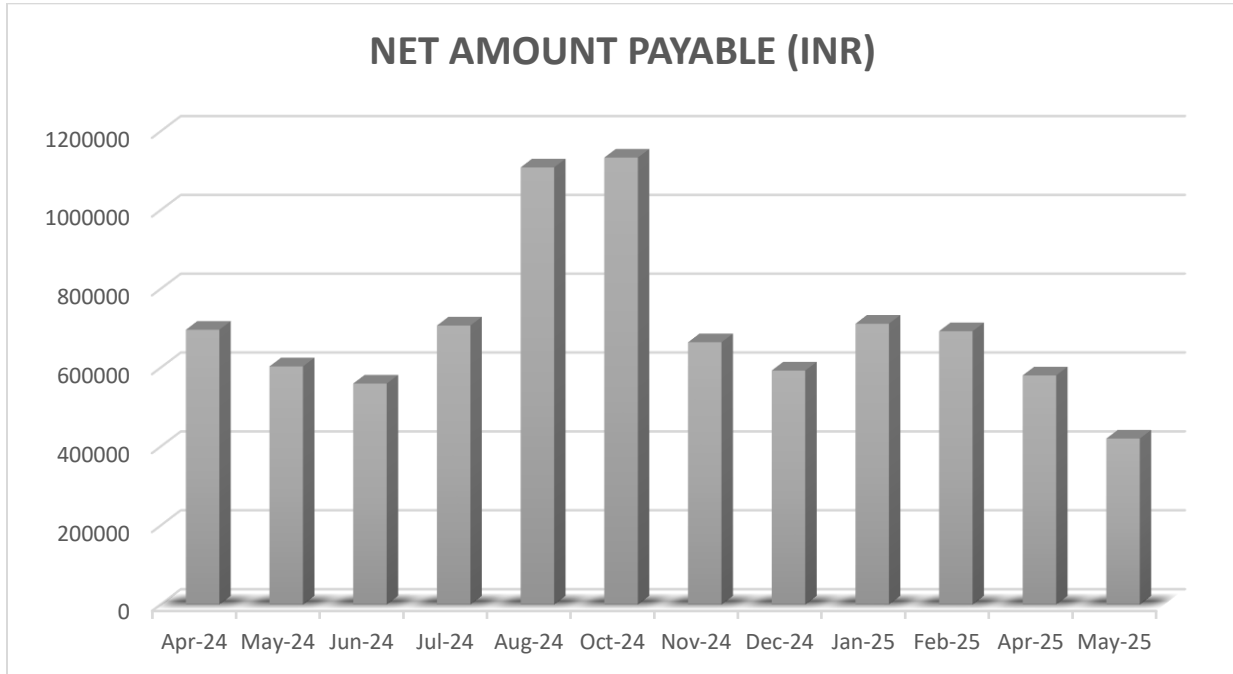


Table 5. Month wise electrical energy consumption 2024-25 at KJS College of Engg.

DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2024-2025					
MONTH	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	CONTRACT DEMAND (KVA)	NET AMOUNT PAYABLE (INR)
Apr-24	145104	287520	1139127	922	2078490
May-24	116268	276600	909403	922	1824160
Jun-24	115836	276600	908180	922	1821720
Jul-24	133056	276600	1044535	922	2044370
Aug-24	152124	321120	1194749	922	2343840
Sep-24	143304	304320	1125450	922	2245270
Oct-24	171792	407040	1354426	922	2748850
Nov-24	123684	360000	969749	1200	2054390
Dec-24	106068	360000	829984	1200	1846200
Jan-25	149016	360000	1169496	1200	2386640
Feb-25	152124	360000	1191173	1200	2421670
Mar-25	170652	367680	1337820	1200	2676870
Avg	139919.0	329790.0	1097841.0	1037.8	2207705.8
max	171792.0	407040.0	1354426.0	1200.0	2748850.0

min	106068.0	276600.0	829984.0	922.0	1821720.0
-----	----------	----------	----------	-------	-----------

Figure 3. Graph between Month & KVAH

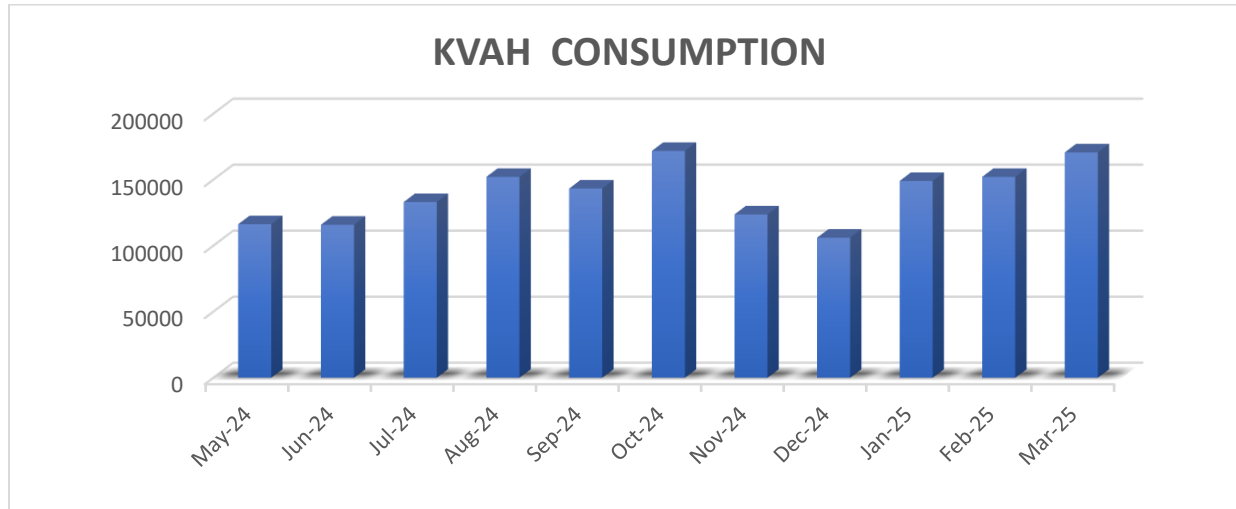
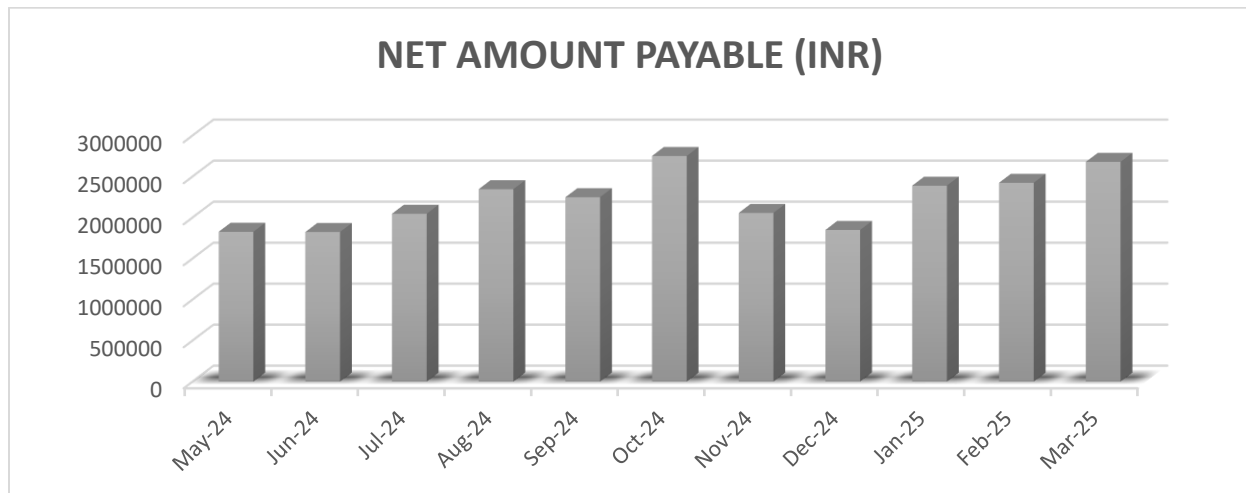


Figure 4. Graph between Month & Net Amount Payable (INR)



1.5 Solar Institute

Institution has installed solar Institute with capacity of 50 KWp.

S.No	Location	Capacity (kW)
1	KJSSC	50

2.0 ENERGY CONSERVATION MEASURES

2.1 Power Factor Improvement

Background

Capacitor panel are installed by K J Somaiya Institute of Management Studies to maintain the power factor.

Findings

During electrical bill analysis average PF found was 0.980

Recommendations

It is recommended to Install additional capacitor bank to maintain the power factor from 0.980 to 0.995.

Benefits

Cost benefit analysis for shown the future saving.

Table 6. Cost benefit Analysis of by PF improvement

Bill Period	KVAh Consumption at Present	Present Power Factor	KVAh Consumption post improvement of existing power factor to 0.995	Net Reduction in KVAh Consumption	Corresponding reduction in Energy Charges (Rs)	Total Monetary Benefit (Rs)
May-24	147348	0.940	139188	8160	62098	62098
Jun-24	147696	0.946	140408	7288	55461	55461
Jul-24	206940	0.969	201574	5366	40836	40836
Aug-24	223308	0.991	222433	875	6657	6657
Sep-24	206748	0.992	206187	561	4270	4270
Oct-24	217488	0.993	217072	416	3163	3163
Nov-24	196536	0.993	196141	395	3008	3008
Dec-24	186612	0.988	185318	1294	9850	9850
Jan-25	199188	0.988	197727	1461	11121	11121
Feb-25	198876	0.983	196518	2358	17948	17948
Mar-25	217644	0.991	216791	853	6492	6492
Apr-25	194148	0.989	193055	1093	8316	8316
Total	2342532		2312411	30121	229220	229220

Table 7. Cost benefit Analysis by installing capacitor bank

Description	UOM	Value
Average PF of the plant		0.980
Improved PF after installing capacitor bank/SVG		0.995
Electricity tariff	Rs./kWh	7.61
Monetary Saving	Lakh INR	2.3
Investment	Lakh INR	2.5

payback	Month	13.1
---------	-------	------

2.1 Contract Demand

Background:

The electrical bill analysis shows that there is some gap between sanction contract demand & billed contract demand.

Findings:

The sanction demand is 982 KVA, minimum billing demand is 75% of sanction demand.

Recommendations:

Consider reducing the contact demand from 982 KVA to 800 KVA and install the MDI controller.

Benefits:

The cost benefit analysis is as follows.

Table 8. Cost benefit analysis of MDI

MONTH	Present Contract Demand				Proposed Contract Demand				
	Contract Demand (KVA)	Billing Demand (75% of Contract Demand)	Actual Demand (KVA)	Demand Charge (INR)	Contract Demand (KVA)	Billing Demand (75% of Contract Demand)	Actual Demand (KVA)	Proposed Demand Charge (INR)	Saving (INR)
May-24	982	737.0	530	294600	800	600.0	530	240000	54600
Jun-24	982	737.0	673	294600	800	600.0	673	269200	25400
Jul-24	982	737.0	611	294600	800	600.0	611	244320	50280
Aug-24	982	737.0	632	294600	800	600.0	632	252800	41800
Sep-24	982	737.0	708	294600	800	600.0	708	283200	11400
Oct-24	982	737.0	704	294600	800	600.0	704	281600	13000
Nov-24	982	737.0	666	294600	800	600.0	666	266400	28200
Dec-24	982	737.0	652	294600	800	600.0	652	260640	33960
Jan-25	982	737.0	575	294600	800	600.0	575	230000	64600
Feb-25	982	737.0	649	294600	800	600.0	649	259600	35000
Mar-25	982	737.0	618	294600	800	600.0	618	247200	47400
Apr-25	982	792.0	792	316800	800	600.0	792	316800	0
Average	982	742	651	296450	800	600.0	651	262647	33803

2.1 Replace Ceiling Fans in the institute with BLDC Fan- phase wise

Background

The K. J. Somaiya Institute of Management Studies has total 3512 conventional ceiling fans

Findings

Conventional fans consume more power than BLDC (Brushless DC) fans.

Recommendations

Replace conventional fan (capacity 60W) with BLDC fan. Consider replacing ceiling fans is 1000 nos.

Benefits

By replacing conventional ceiling fan with BLDC fan, the power consumption will reduce as given below.

Table 1. Cost benefit Analysis of replacing ceiling fans with EC BLDC fans

Parameter	Unit	Value
Average power consumption of the ceiling fan at present	Watt	60
Average power consumption of energy efficient star rated (BLDC) fans	Watt	28
Equivalent Power saving per fan	Watt	32
Numbers of fans to be replaced	Nos	1000
Working Hours Per annum	Hr	3500
Overall electric Power Cost	Rs/KWH	7.23
Annual Energy Saving	KWH	112000
Monetary saving	Rs/Year	809760
Investment	Rs	2500000
Payback	Month	37

3.0 OBSERVATION & ANALYSIS

3.1 Electricity supply and Network

Electricity is major energy sources of the Institute. Electricity is supplied at 11 kV. There is three 11/0.433 kV LT distribution transformers to cater electricity demand.

3.2 Energy bill Analysis

Table 9. Electricity bill Analysis 2024-25 at KJS Institute of Management Studies

DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2024-25									
MONTH	KWH CONSUMPTION	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	PF	CONTRACT DEMAND (KVA)	BILLING DEMAND (KVA)	MDI (KVA)	NET AMOUNT PAYABLE (INR)
May-24	138492	147348	294600	1140474	0.940	982	737	530	2243640
Jun-24	139706	147696	294600	1143167	0.946	982	737	673	2252170
Jul-24	200566	206940	294600	1601716	0.969	982	737	611	3014930
Aug-24	221321	223308	294600	1728404	0.991	982	737	632	3223100
Sep-24	205156	206748	294600	1600230	0.992	982	737	708	3060230
Oct-24	215987	217488	294600	1683357	0.993	982	737	704	3204590
Nov-24	195160	196536	294600	1521189	0.993	982	737	666	2926160
Dec-24	184391	186612	294600	1444377	0.988	982	737	652	2798030
Jan-25	196738	199188	294600	1541715	0.988	982	737	575	2961450
Feb-25	195535	198876	294600	1539300	0.983	982	737	649	2955340
Mar-25	215707	217644	294600	1684565	0.991	982	737	618	3201050
Apr-25	192090	194148	316800	1194010	0.989	982	792	792	2010660
Avg	191737.4	195211.0	296450.0	1485208.6	0.980	982.0	741.6	650.8	2820945.8
max	221321.0	223308.0	316800.0	1728404.0	0.993	982.0	792.0	792.0	3223100.0
min	138492.0	147348.0	294600.0	1140474.0	0.940	982.0	737.0	530.0	2010660.0

Observation:

The maximum Energy consumption in Aug-24 was 221321 kWh and minimum Energy consumption was 138492 kWh in May-24.

Table 10. Electricity bill Analysis 2024-25 at S K Somaiya College SUV

DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2022-2024					
MONTH	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	CONTRACT DEMAND (KVA)	NET AMOUNT PAYABLE (INR)
Apr-24	45440.0	126400	357310	406	696030
May-24	35480.0	121800	278705	406	603220
Jun-24	32060.0	122400	251594	406	559640
Jul-24	43540.0	121800	342060	406	706890
Aug-24	75620.0	121800	588223	406	1108190
Oct-24	76000.0	121800	591605	406	1133100
Nov-24	39600.0	121800	310319	406	664430
Dec-24	34160.0	121800	267198	406	592630
Jan-25	43240.0	121800	339032	406	711470
Feb-25	41720.0	121800	327352	406	692440
Apr-25	49400.0	145600	303810	406	580360
May-25	33380.0	121800	205287	406	420200
Avg	45803.3	124216.7	346874.6	406.0	705716.7
max	76000.0	145600.0	591605.0	406.0	1133100.0
min	32060.0	121800.0	205287.0	406.0	420200.0

Observation:

The maximum Energy consumption in Oct-24 was 76000 kVAh and minimum Energy consumption was 32060 kVAh in Jun-24.

Table 11. Electricity bill Analysis 2024-25 at KJ Somaiya College of Engineering

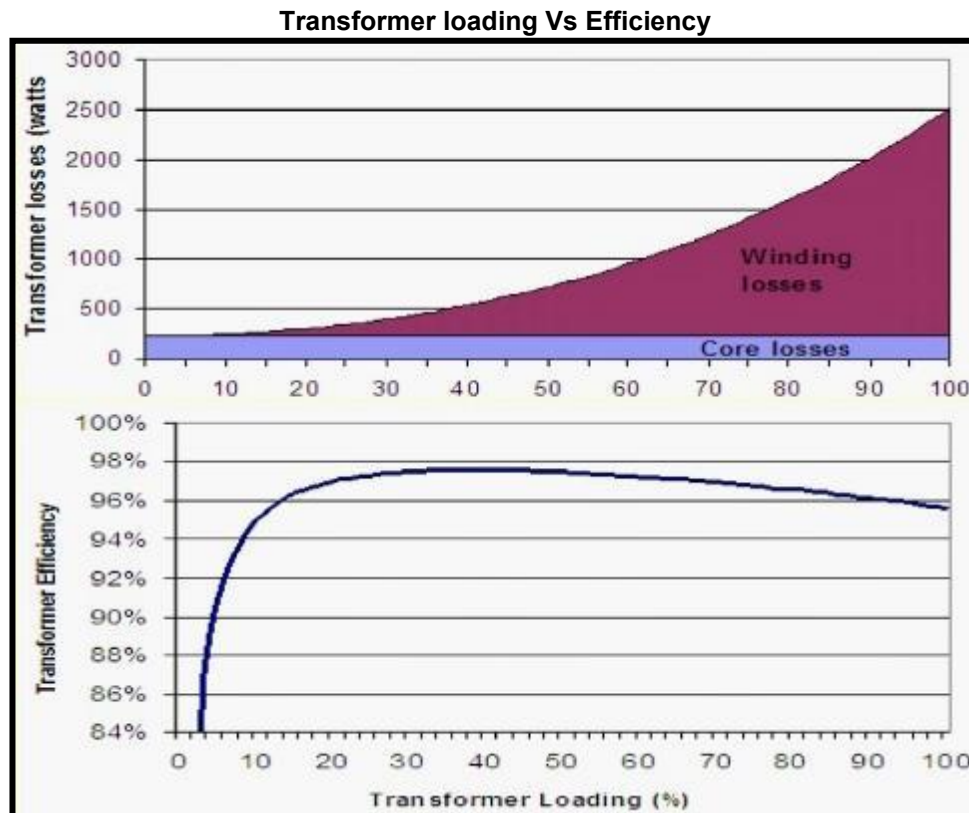
DETAILS OF ELECTRICITY CONSUMPTION FOR THE 2024-2025					
MONTH	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	CONTRACT DEMAND (KVA)	NET AMOUNT PAYABLE (INR)
Apr-24	145104	287520	1139127	922	2078490
May-24	116268	276600	909403	922	1824160
Jun-24	115836	276600	908180	922	1821720
Jul-24	133056	276600	1044535	922	2044370
Aug-24	152124	321120	1194749	922	2343840
Sep-24	143304	304320	1125450	922	2245270
Oct-24	171792	407040	1354426	922	2748850
Nov-24	123684	360000	969749	1200	2054390
Dec-24	106068	360000	829984	1200	1846200
Jan-25	149016	360000	1169496	1200	2386640
Feb-25	152124	360000	1191173	1200	2421670
Mar-25	170652	367680	1337820	1200	2676870
Avg	139919.0	329790.0	1097841.0	1037.8	2207705.8
max	171792.0	407040.0	1354426.0	1200.0	2748850.0
min	106068.0	276600.0	829984.0	922.0	1821720.0

Observation:

The maximum Energy consumption in Oct-24 was 171792 kWh and minimum Energy consumption was 106068 kWh in Dec-24.

3.3 Transformer loading

The efficiency of transformers depends not only on the design but also on the effective operating load. The variable losses are influenced by the effective operating load on the transformer. The maximum efficiency of a transformer occurs when the constant losses equal the variable losses. For distribution transformers, the core loss is 15 to 20% of the full-load copper loss. Therefore, the maximum efficiency of distribution transformers occurs when the load is between 40% and 60%. For power transformers, the core loss is 25 to 30% of the full-load copper loss. Hence, the maximum efficiency of power transformers occurs when the load is between 40% and 60%.



All the electrical parameters required for evaluating the percentage loading and losses of the transformer in the old Institute were recorded. The no-load and full-load losses of the transformer were obtained from standards to calculate the transformer losses, as detailed below.

Table 12. Transformer Loss

Description	Transformer Capacity	No-load loss	Full load loss	Power factor	Maximum Apparent power	Average Apparent Power	Max Loading	Average Loading	Total loss
Unit	kVA	kW	kW	PF	kVA	kVA	%	%	kW
Transformer -1 (1600 kva)	1600	2.6	19.8	0.967	498.3	451.5	31%	28%	4.52
Transformer -2 (1500 kva)	1500	2.2	18.8	0.995	439	409.5	29%	27%	3.81
Transformer -3 (750 kva)	750	1.3	9.8	0.972	102.1	74.77	14%	10%	1.48

Observation:

- The power transformer-1 is average loaded at 28%. The maximum efficiency of the power transformers occurs at a load between 40% and 60%.
- The power transformer-2 is average loaded at 27%. The maximum efficiency of the power transformers occurs at a load between 40% and 60%.
- The power transformer-3 is average loaded at 10%. The maximum efficiency of the power transformers occurs at a load between 40% and 60%.

3.4 Capacitor health check

A good capacitor should deliver about 1.3 to 1.2 times current as compared to its rating in kVAr. Hence, a 25 kVAr capacitor should deliver about 32 amps to 30 amps in all the three phases at about 440 volts. If the output falls less than 80% of the rated capacity or there is considerable unbalance of current between the phases, such capacitors may be replaced with new capacitors.

The damaged capacitors can act as a burden on the management rather than delivering the desired good output. It would be beneficial to examine all the installed capacitors for its output current in all the three phases at least once in 15 days and all the derated and damaged capacitors should be replaced with new ones.

Towards monitoring the health of the capacitors operating voltage and current of each phase of the capacitors have been monitored. The capacitor current is slightly higher than the rated current.

The capacitors without reactors are not recommended in systems polluted with harmonics as plain capacitors offer low impedance path for harmonic currents thereby overloading it with harmonic currents

causing excessive heating and leading to premature failure of capacitors and switchgears. Capacitors also cause resonance in the circuit causing amplification of harmonic.

Ideally capacitor voltage rating is to match the supply voltage. If the supply voltage is lower, the reactive power kVAR produced will be the ratio V_1^2/V_2^2 where V_1 is the actual voltage and V_2 is the Rated Voltage.

On the other hand, if the supply voltage exceeds rated voltage, the life of the capacitor is adversely affected.

Measurement for capacitor banks were made for all the locations in the Institute during energy audit.

The results are tabulated below:

Table 13. Capacitor Bank (300 kVAR)

Capacitor Bank -1 (300 kvar)							
Sr. No.	Rating in kVAR @ 440 V	Rated Current (A)	Voltage during measurement (V)	Current (A)			Status
				R	Y	B	
1	25	32.8	415	32.56	32.59	32.57	OK
2	25	32.8	415	32.23	32.38	32.45	OK
3	25	32.8	415	32.45	32.48	32.42	OK
4	25	32.8	415	32.12	32.11	32.23	OK
5	25	32.8	415	32.34	32.37	32.51	OK
6	25	32.8	415	32.24	32.52	32.42	OK
7	25	32.8	415	32.37	32.46	32.42	OK
8	25	32.8	415	32.14	32.28	32.36	OK
9	20	26.2	415	25.33	25.28	25.34	OK
10	20	26.2	415	25.01	25.45	25.82	OK
11	20	26.2	415	24.89	24.45	24.76	OK
12	20	26.2	415	24.83	24.32	24.32	OK
13	10	13.1	415	12.7	12.65	12.45	OK
14	10	13.1	415	12.11	12.34	12.67	OK

- **Observation:** Capacitor performance found satisfactory

Table 14. Capacitor Bank (250 kVAR)

Capacitor Bank -2 (250 kvar)							
Sr. No.	Rating in kVAR @ 440 V	Rated Current (A)	Voltage during measurement (V)	Current (A)			Status
				R	Y	B	
1	50	65.6	415	62.30	64.20	64.20	OK
2	50	65.6	415	62.10	62.70	63.70	OK
3	25	32.8	415	32.21	32.30	32.34	OK
4	25	32.8	415	32.37	32.26	32.18	OK
5	25	32.8	415	32.24	32.36	32.42	OK
6	25	32.8	415	32.14	32.45	32.32	OK

Capacitor Bank -2 (250 kvar)							
Sr. No.	Rating in kVAr @ 440 V	Rated Current (A)	Voltage during measurement (V)	Current (A)			Status
				R	Y	B	
7	20	26.2	415	24.30	24.70	24.20	OK
8	20	26.2	415	24.20	24.60	25.20	OK
9	10	13.1	415	12.6	12.2	12.5	OK

▪ **Observation:** Capacitor performance found satisfactory

Table 15. Capacitor Bank (100 kvar)

Capacitor Bank -3 (100 kvar)							
Sr. No.	Rating in kVAr @ 440 V	Rated Current (A)	Voltage during measurement (V)	Current (A)			Status
				R	Y	B	
1	25	32.8	415	32.45	32.34	0.36	OK
2	25	32.8	415	32.41	32.11	32.48	OK
3	20	26.2	415	24.71	24.21	24.33	OK
4	20	26.2	415	24.34	24.36	24.33	OK
5	10	13.1	415	12.67	12.65	12.68	OK

▪ **Observation:** Capacitor performance found satisfactory

3.5 Motor Loading

As the audit team has inspected the motors and checked the loading of different motors at the Institute and here is the measured motor loading data list attached below.

Table 16. Motor loading

Motor Loading										
S.NO.	Location	Rated Power		Current	Voltage	Power Factor	Measured Power	Motor Loading	VFD	Loading Category
		HP	KW							
1	Secondary Pump 1	20	15	15.89	411	0.82	9.6	52.6	No	Acceptable
2	Secondary Pump 2	20	15	14.69	413	0.83	8.7	51.7	No	Acceptable
3	Primary Pump 1	7	5.5	9.3	411	0.79	5.2	84.6	No	Acceptable
4	Primary Pump 2	7	5.5	9.1	412	0.8	5.2	84.1	No	Acceptable
5	Raw Water Pump-1	3	2.2	3.1	411	0.81	1.8	72.3	No	Optimum
6	Raw Water Pump-2	3	2.2	2.8	411	0.82	1.6	66.1	No	Optimum
7	Filter Feed Pump-1	5	3.7	4.6	409	0.80	2.6	62.7	No	Acceptable
8	Filter Feed Pump-2	5	3.7	4.5	411	0.83	2.7	64.0	No	Acceptable
9	Blower Pump-1	10	7.5	11.3	412	0.79	6.4	75.6	No	Optimum
10	Blower Pump-2	10	7.5	11.7	412	0.76	6.3	75.3	No	Optimum
11	Recycle Pump-1	3	2.2	3.2	410	0.82	1.9	75.4	No	Optimum
12	Recycle Pump-2	3	2.2	2.9	411	0.81	1.7	67.6	No	Optimum

Observation: All motors loading found satisfactory.

3.6 Overview of Chilled air generation plant

Air-cooled chillers are refrigeration systems that lower the temperature of fluids by using ambient air to dissipate heat. It serves the various area in Institute.

In a typical summer day-to-day operation one chiller will operate and one kept standby.

Table 17. Performance Analysis of Chiller

Performance Evaluation Of Chiller		
Description	Unit	Chiller
Make		Climaveneta
Rated Capacity	TR	250
EVAPORATOR		
Chilled water inlet temperature	°C	15.0
Chilled water outlet temperature	°C	11.0
Condenser		
Condenser sensor water inlet temperature	°C	28.00
Condenser water outlet temperature	°C	26.20
EVALUATION		
Temperature difference across chiller	°C	4
Chilled water flow rate	m ³ /hr	165
NET REFRIGATION CAPACITY	TR	218.3
Percentage loading %	%	87.3
Power input to compressor motor	KW	219.3
SPECIFIC POWER CONSUMPTION	KW/TR	1.00
	COP	3.50
	EER	11.94

- performance found below as per design. It is found that chiller performance is satisfactory as per standard.

3.7 Water Pumps

Chiller Primary, Secondary and Cooling Tower Pumps

At the plant, there are pumps installed for the Primary Water Pump and Secondary Water Pump & Cooling Tower. Under normal operating conditions, one pump from each type was running, and other kept on standby mode.

The following parameters have been measured/ recorded to assess the operating performance of the feed water pumps.

- Suction and Discharge Pressure
- Discharge flow rate
- Motor power consumption

The design details of the pumps is captured to compared with operating efficiency of the pump. The detailed calculations of all the water pump is as follows:

Table 18. Chiller Primary Pump

Chiller Primary Pump			
Description	UOM	Pump	Pump
Design			
Make			
Model			
Capacity	m ³ /hr	156	156
Head	M	10	10
Power	KW	5.5	5.5
Operating Parameter			
Suction head	m	26	Stand-By
Discharge head	m	34	
Total head	m	8	
Flow rate	m ³ /hr	136	
Power consumption	kW	4.8	
Combined efficiency	%	62%	
Pump Efficiency ($\eta_{\text{Motor}}=89\%$)	%	69%	

- Pump performance found satisfactory

Table 19. Chiller Secondary Pump

Chiller Secondary Pump			
Description	UOM	Pump	Pump
Design			
Make			
Model			
Capacity	m ³ /hr	210	210
Head	M	18	18
Power	KW	15	15
Operating Parameter			
Suction head	m	24	Stand-By
Discharge head	m	40	
Total head	m	16	
Flow rate	m ³ /hr	184	
Power consumption	kW	13.4	
Combined efficiency	%	60%	
Pump Efficiency ($\eta_{\text{Motor}}=89\%$)	%	67%	

- Pump performance found satisfactory

3.8 Air Conditioning System

The building cooling is maintained by air conditioners. List of ACs is given below. It is recommended that all two- and three-star Acs to be replaced with five-star AC.

Table 20. List of ACs

Air Conditioner Details				
Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs
1	Aryabhat (Third Floor)	2	1.8	1
		3	1.5	3
		3	1	2
		2	3	5
2	Bhaskaracharya (Ground, Third)	2	1.5	1
		3	1+1+1.5	3
		3	2	5
3	Arybhat (Second)	5	2	10
4	Bhaskaracharya (Second, First)		2	2
			3.8	2
		3	3	4
		3	1.5	2
		3	1	2
			2	10
5	Aryabhata (Ground)	3	2	6
6	Bhaskaracharya (Fourth, Fifth, Fifth Floor)	3	4 (3 AC) + 2(2 AC)	5
		3	3	4
		3	1.5	2
		3	2	8
		3	1.5	3
7	Arybhat (First, Ground)	3	1	2
			1	1
			1	11
		3	2	2
		3	3	2
		5	2	1
		5	2	1
		5	2	1

Air Conditioner Details

Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs
			2	3
11	Aryabhat (First, Second, Third, Fourth)		2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
			2	4
12	K J SIMSR		Chiller Plant 250 TR, No. 1, 125 HP	
			Chiller Plant 250 TR, No. 2, 125 HP	
13	K J SIMSR		8 TR	
			8 TR	
			4 TR	
			2 TR	
			7.5 TR	
			1.5 TR	
			1 TR	
			1 TR	
			1 TR	
			1 TR	
			1 TR	

Air Conditioner Details					
Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs	
		5 Star	2 TR		
			1 TR		
			1 TR		
			2 TR		
			2 TR		
		5 Star	2 TR		
		5 Star	2 TR		
			2 TR		
			4.5 TR		
			2 TR		
			8 TR		
			1 TR		
			1 TR		
			1 TR		
			1 TR		
			1 TR		
			1 TR		
			1 TR		
			1 TR		
			5 Star	8 TR	
				2 TR	
			5 Star	2 TR	
				1 TR	
	5 Star	2 TR			
		1 TR			
		2 TR			
		1.5 TR			
		4 TR			
		6 TR			
14	Chanakya		160 HP (33.92 TR)		
			14 TR		
15	Maitreyi Hostel		20 TR		
16	K J Somaiya Institute of Management	5	1.5 ton		

Air Conditioner Details				
Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs
17		3	1.5 ton	
		3	2 ton	
		4	8	
		4	8	
		4	8	
		4	7.5	
		4	6	
		4	6	
		4	5.5	
		4	8	
		4	8	
		4	8	
		4	8	
		4	6	
		4	6	
		4	6	
		4	11	
		4	11	
		4	11	
		4	7	
4	7			
4	7			
18	Eklavya		1.5	
			8.5	
			1.5	
19	Bhaskaracharya	3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		

Air Conditioner Details				
Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs
		3		
		3		
		2		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
		3		
20	Madhuban	2		
21	SIRAC	5		
22	Bhaskaracharya	3		
23	SIRAC	3	1.5	
		3	1.5	
		3	1.5	
		3	1.5	
		3	1.5	
		3	1.5	
		5	1.5	
		5	1.5	
		3	1.5	
		3	1.5	
		5	1	
		5	1	
		5	1	
		5	1.5	
3	1.5			
3	1.5			
24	Bhaskaracharya	4	1	
		4	1	
25	MSSMPA	5star	2.0 Tr	

Air Conditioner Details				
Sr. No.	Name of the Building	Star Rating	Tonnage	No. of ACs
		5star	2.0 Tr	
		5star	2.0 Tr	
		3star	2.0 Tr	

4.0 EXECUTIVE SUMMARY OF POWER QUALITY

This report presents the results of the power quality analysis conducted at college, Quality Asia Team on 07th, 08th and 9th July 2025.

The agreed objectives of the assessment include analysing parameters such as frequency, voltage, current, waveforms, Total Harmonic Distortion (THD), and other relevant metrics.

The audit involved a Power Quality and Harmonics Audit at the transformer, UPS, and raw power sources. Measurements were taken using a calibrated Krykard ALM31 Digital Power and Harmonic Analyzer. This Electrical Power Quality Audit report presents the analysis, findings, and recommendations for improving system efficiency.

Summary of measurements & recommendations are below:

The power distribution system is operating inefficiently and may experience accelerated wear and reduced reliability. Immediate corrections are required as per recommendations given in below table.

Location	Category	Observations	Recommendations
Transformer-1, KJ Engineering College 1500 KVA	Power Quality	<ul style="list-style-type: none"> Measured Average Current Harmonics THD (%) is 6.480% in R phase, 8.002% in Y phase & 7.739 in B phase which is little higher than the limits of 8% as well as voltage harmonic within limit. Measured Average Current Unbalance UNB (%) is 18.5 % which is less than the limits of 10% Neutral Current = 89.23 A. This is ~15.5% of average phase 	<ul style="list-style-type: none"> Install Active Harmonic Filters (AHF): To reduce THD below 8% as per IEEE 519. Balance Phase Loads: Redistribute single-phase loads to bring unbalance within 10%. Isolate Non-linear Loads: Feed UPS, VFDs, LED lighting,

Location	Category	Observations	Recommendations
		current, which is above the expected threshold for well-balanced systems (<10%).	etc., through dedicated feeders with filtering.
Transformer-2, SK Somaiya College (Aurobindo) 750 KVA	Power Quality	<ul style="list-style-type: none"> Measured Average Current Harmonics THD (%) is 14.72%(R), 16.14% (Y) & 22.60% (B) which is higher than the limits of 8%. Measured Average Current Unbalance UNB (%) is 38.2 % which is much higher than the limits of 10%. Neutral current = 32.89 A i.e 32% of average phase current, Excessive Neutral Current. 	<ul style="list-style-type: none"> Upgrade Neutral Conductor if Required: Ensure sizing supports continuous high neutral current due to harmonics.
Transformer-3, KJ Somaiya management College, 1600 KVA	Power Quality	<ul style="list-style-type: none"> Measured Average Current Harmonics THD (%) is 5.217 % in R phase, 6.307 % in Y phase & 6.323 % in B phase which is less than the limits of 8% as well as voltage harmonic within limit. Measured Average Current Unbalance UNB (%) is 14.9 % which is higher than the limits of 10%. Neutral current = 105.2 A i.e 17% of average phase current, High Neutral Current. 	
Chiller-250 TR	Power Quality	Measured Average Current Harmonics THD (%) is 4.221 % in R phase, 4.076 % in Y phase & 4.448 % in B phase which is less than the limits of 8% as well as voltage harmonic within limit.	Satisfactory

4.1 Standards for Evaluation

Quality Asia subscribes to the industry wide standards used for the evaluation of the electrical systems, which include but are not limited to: Institute of Electrical and Electronic Engineers Standard 1100-2005, "Powering and Grounding Electronic Equipment", (Emerald Book)

The standards conform to the requirements of the National Electrical Code (NFPA 70).

References:

- IEEE 1100 – 1999 & 2005 Emerald Book
- IEEE 446 - 1995 Orange Book
- Particulate and Gaseous Contamination Guidelines for Data Centres (ASHRAE TC 9.9)
- IEEE 142 – 1991 Green Book

4.2 Background

Power Quality Analysis Audit carried out by using Krykard make ALM31 Load Manager at Institute. This report presents the analysis and the finding based on the analysis of parameters like frequency, voltage, current & waveforms, Total Harmonic Distortion (THD) etc. The details of harmonic analysis are given in Appendix.

4.3 Problems Caused by Harmonics

Harmonics increase losses in the power system and its components. These harmonics also distort the voltage waveform, leading to voltage harmonics. Voltage distortion affects not only sensitive electronic loads but also capacitor banks.

Higher-frequency harmonic currents tend to flow along the outer edges of the conductor due to the "skin effect," effectively reducing the conductor's cross-sectional area and causing heating. Additionally, overheating of neutral wires may occur due to harmonics produced in any phase of a balanced three-phase system. Harmonics can also lead to the false tripping of circuit breakers, with current peaks that can be many times higher than a sinusoidal waveform, resulting in potential data loss and operational delays.

4.4 Effects due to Harmonics

- Blinking on Incandescent Lights - Transformer saturation
- Capacitor Failure - Harmonic Resonance
- Circuit Breakers Tripping - Inductive Heating and Overload
- Conductor Failure - Inductive Heating
- Electronic Equipment Shutting down - Voltage Distortion
- Flickering of Fluorescent Lights - Transformer saturation
- Fuses Blowing for no Apparent Reason - Inductive Heating and Overload
- Motor Failures (overheating) - Voltage Drop
- Neutral Conductor and Terminal Failures - Additive Triplen Currents
- Electromagnetic Load Failures - Inductive Heating
- Overheating of Metal Enclosures - Inductive Heating
- Power Interference on Voice Communication – Harmonic Noise
- Transformer Failures - Inductive Heating

4.5 Power Factor

It is recommended to maintain an average power factor as close to unity as practically possible. This can be achieved by adding additional capacitor banks, ensuring their proper functioning, and keeping system harmonics in check

4.6 Three Phase Current Unbalance

According to standards, the maximum limits for voltage unbalance and current unbalance are specified as 3% and 10%, respectively. Under unbalanced conditions, the power system incurs greater losses, experiences increased heating effects, and becomes less stable. When phases are balanced, the system is better able to respond to emergency load transfers.

4.7 Selection of New Devices/Equipment

Devices and equipment that generate harmonics are available with Total Harmonic Distortion (THD) ratings. Selecting devices with a THD rating of less than 5% helps maintain good power quality within the system. Therefore, it is recommended to consider the THD rating of new equipment, such as VFDs, UPS systems, and electronic chokes, before installation.

4.8 Power Quality Analysis – Guidelines

4.9 Standards

As per IEEE 519, the maximum permissible limit for voltage harmonics is 8% (less than 1KV).

As per IEEE, the maximum permissible limit for Current Unbalance is 10% and Voltage Unbalance is 3%.

As per IEEE, the maximum permissible limit for Short Term Flickering is 0.65.

As per IEEE 519-1992, the maximum permissible limit for Harmonics Order 2-10 is 7%, Harmonics Order 11-16 is 3.5%, Harmonics Order 17-22 is 2.5% and Harmonics Order 23-34 is 1%.

Table 21. Standards THD & Unbalancing

Sr. No.	Parameters	Value
1	Voltage THD %	8% (Less than 1KV)
2	Voltage Unbalanced %	3%
3	Current Unbalanced %	10%

4.10 Current distortion limits (120 V to 69kV) – User's responsibility

Table 22. Current Distortion Limits

Isc/IL	1<h< 11	11<h<17	17<h<23	23<h<35	35<h	TDD
<20*	4.0	2	1.5	0.6	0.3	5
20<50	7	3.5	2.5	1	0.5	8
50<100	10	4.5	4	1.5	0.7	12
100<1000	12	5.5	5	2	1	15
>1000	15	7	6	2.5	1.4	20

Note: *All power generation equipment is limited to those values regardless their Isc/IL.

Odd harmonics are represented as % of fundamental at Power Control Centre (PCC). Even v harmonics are limited to 25% of odd harmonic's limits.

Table 23. Harmonics Limits

Isc	Short Circuit current at the point of common coupling (PCC), corresponding to system MVA level
IL	Fundamental full load current in Amps
H	Harmonic number
$11 < h < 17$	Limits of individual currents at PCC
THD	Total harmonic distortions

4.11 Summary of Power Quality Analysis

A three-phase power analyser was used to monitor the electrical load and power quality parameters. Summary of the measured parameters is given below:

4.111 K J Engineering College

Parameters	Avg.	Min.	Max.
Frequency	50.05	49.94	50.15
Ampere- R phase (A)	632.0	565.0	773.5
Ampere- Y phase (A)	532.0	468.5	626.5
Ampere- B phase (A)	562.1	507.5	652.5
Ampere- Neutral (A)	89.23	68.70	112.4
Voltage- R phase (V)	412.7	405.6	417.8
Voltage- Y phase (V)	411.1	404.3	416.1
Voltage- B phase (V)	409.8	402.6	414.6
P.F. Total	0.995	0.994	0.996
POWER- Total (KW)	407.6	381.1	437.0
V THD % R phase	1.891	1.700	2.100
V THD % Y phase	1.922	1.600	2.200
V THD % B phase	1.933	1.700	2.200
I THD % R phase	6.480	5.500	8.100
I THD % Y phase	8.002	6.900	9.700
I THD % B phase	7.739	6.700	9.700
Voltage Unbalance %	0.379	0.300	0.500
Current Unbalance %	9.897	6.500	13.70

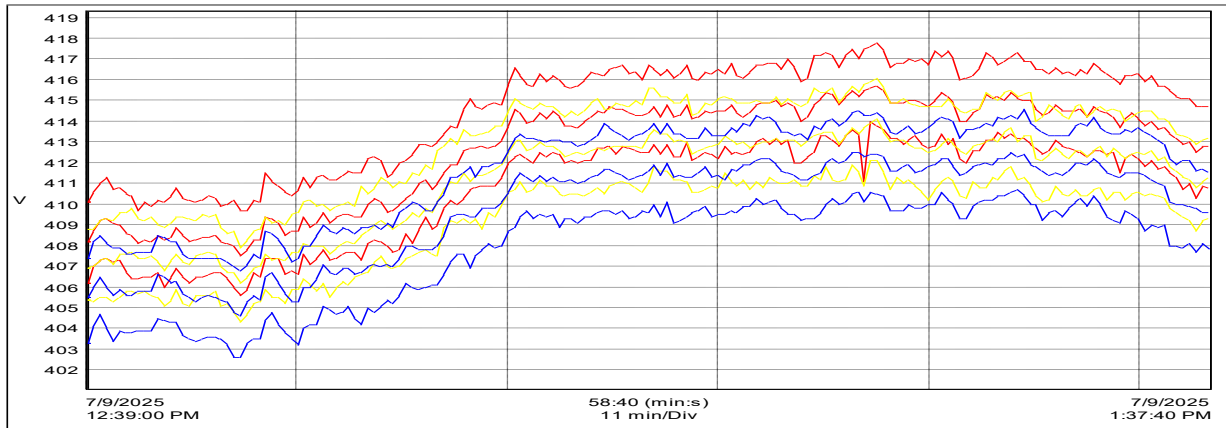
Observations: As per IEEE 519, the maximum permissible limit for Voltage harmonics is 5%. Measured Average Voltage Harmonics THD (%) is 1.891% (R), 1.922% (Y) & 1.933% (B) which is less than the limits of 5% and it is satisfactory.

As per IEEE 519, the maximum permissible limit for current harmonics is 8%. Measured Average Current Harmonics THD (%) is 6.480%(R), **8.002%** (Y) & 7.739 (B) which is less than the limits of 8%.

As per IEEE 519, the maximum permissible limit for Current Unbalance is 10%. Measured Average Current Unbalance UNB (%) is **18.5%** which is double than the limits of 10%.

- Neutral Current = **89.23 A**. This is **~15.5%** of average phase current, which is above the expected threshold for well-balanced systems (<10%).

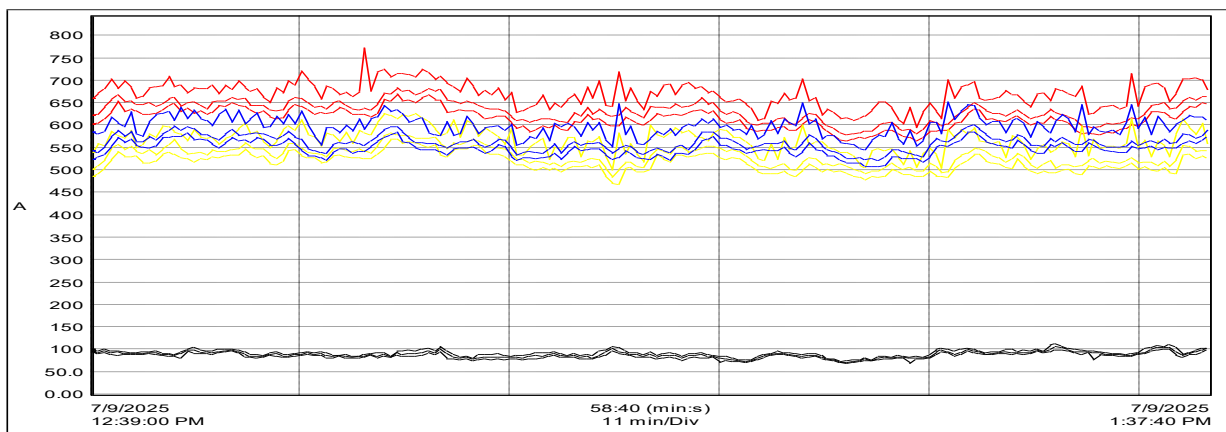
Figure 5. Voltage Profile of K J ENGINEERING COLLEGE



Observation:

- The average voltage in Red phase is 412.7 V and it varies from 405.6 V to 417.8 V.
- The average voltage in Yellow phase is 411.1 V and it varies from 404.3 V to 416.1 V.
- The average voltage in Blue phase is 409.8 V and it varies from 402.6 V to 414.6 V

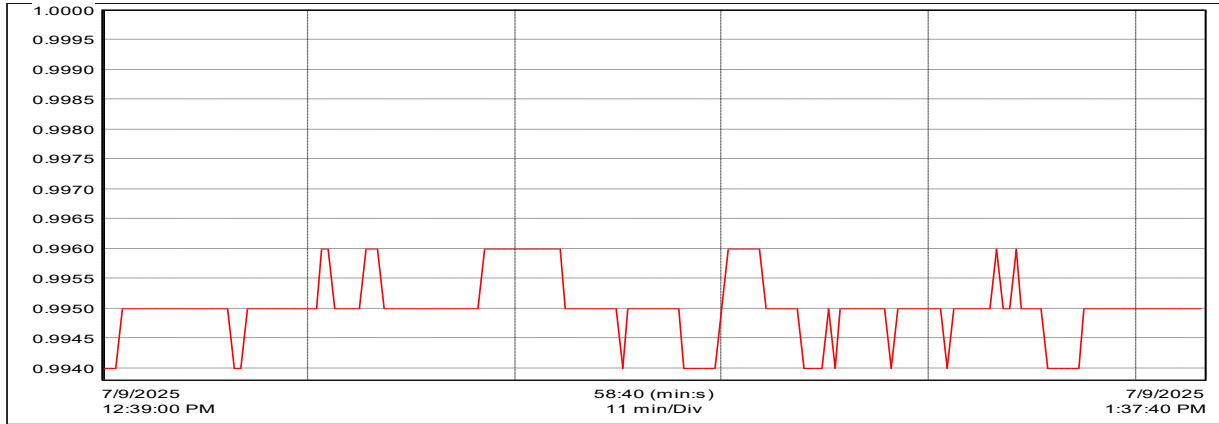
Figure 6. Current Profile of K J ENGINEERING COLLEGE



Observation:

- The average current in Red phase is 632.0 A and it varies from 565.0 A to 773.5 A.
- The average current in Yellow phase is 532.0 A and it varies from 468.5 A to 626.5 A.
- The average current in Blue phase is 562.1 A and it varies from 507.5 A to 652.5 A.

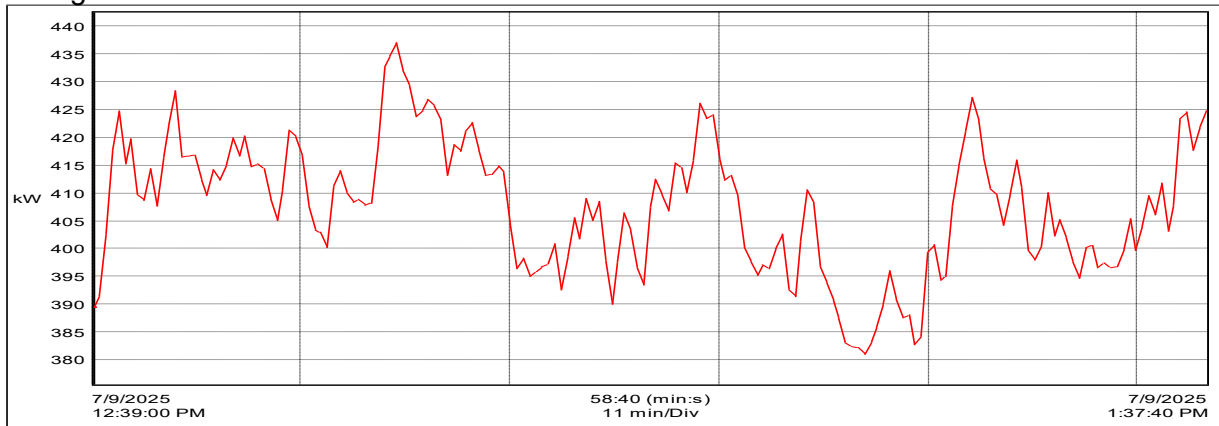
Figure 7. Power factor Profile of K J ENGINEERING COLLEGE



Observation:

- The average power factor is 0.995 and it varies from 0.994 to 0.996

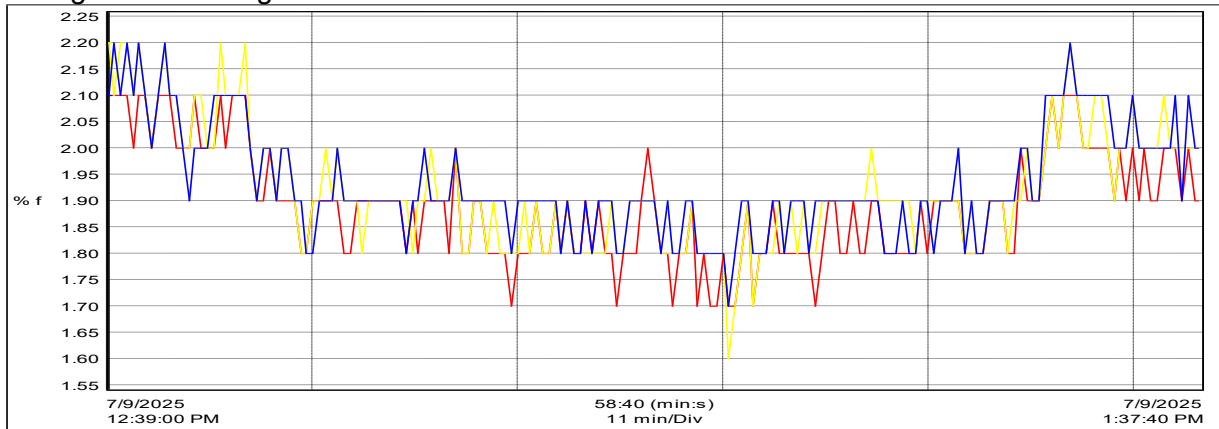
Figure 8. Power Profile of K J ENGINEERING COLLEGE



Observation:

- The average power is 407.6 KW and it varies from 381.1 KW to 437.0 KW.

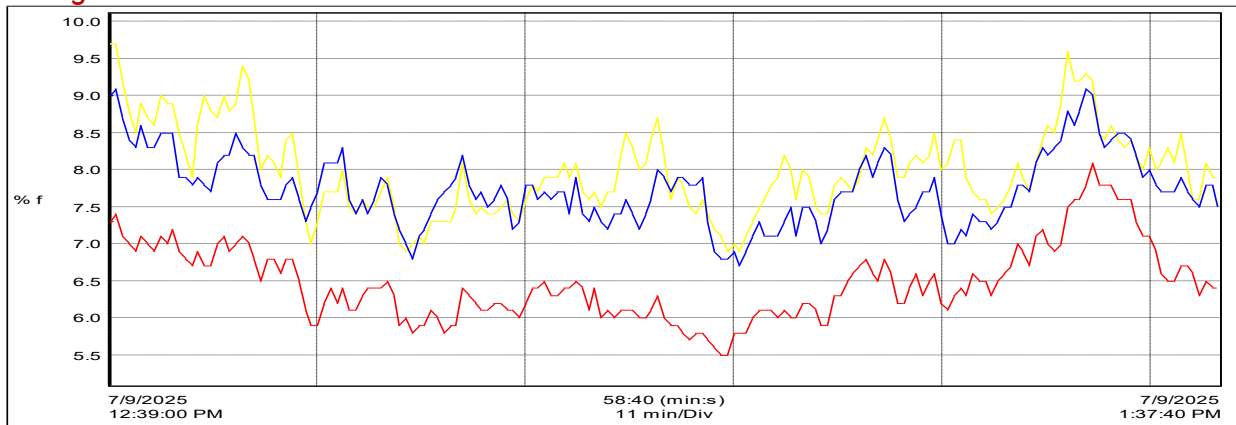
Figure 9. Voltage THD% Profile of K J ENGINEERING COLLEGE



Observation:

- The average THD% of voltage in Red phase is 1.891 % and it varies from 1.700 % to 2.100 %.
- The average THD% of voltage in Yellow phase is 1.922 % and it varies from 1.600 % to 2.200 %.
- The average THD% of voltage in Blue phase is 1.933 % and it varies from 1.700 % to 2.200 %.

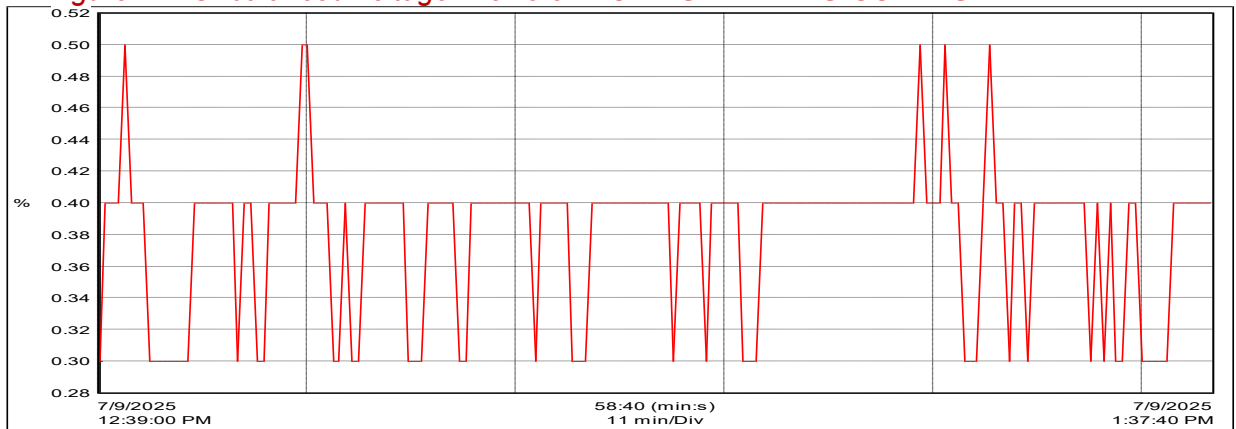
Figure 10. Current THD% Profile of K J ENGINEERING COLLEGE



Observation:

- The average THD% of current in Red phase is 6.480 % and it varies from 5.500 % to 8.100 %.
- The average THD% current in Yellow phase is 8.002 % and it varies from 6.900 % to 9.700 %.
- The average THD% of in current Blue phase is 7.739 % and it varies from 6.700 % to 9.700 %.

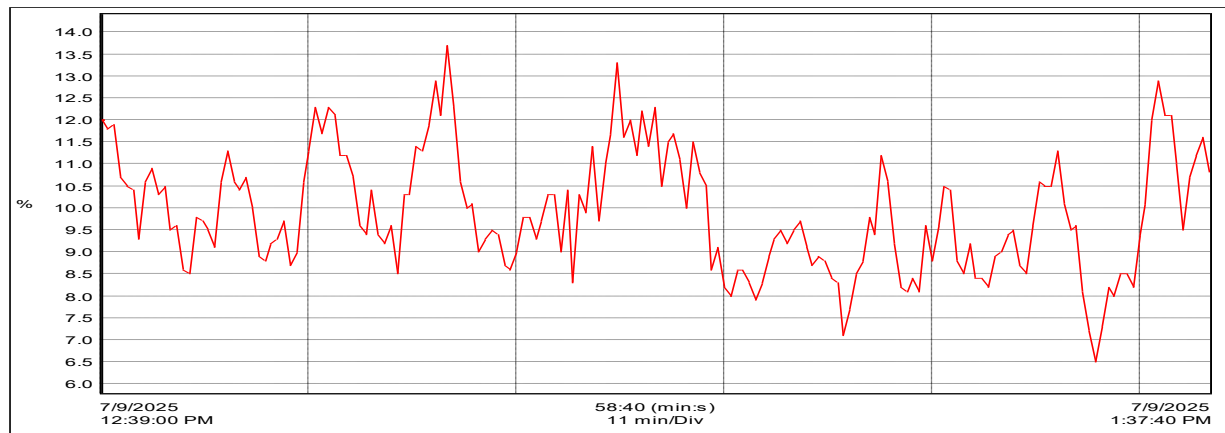
Figure 11. Unbalanced voltage Profile of K J ENGINEERING COLLEGE



Observation:

- The average unbalanced voltage is 0.379% and it varies from 0.300 % to 0.500 %.

Figure 12. Unbalanced Current Profile of K J ENGINEERING COLLEGE



Observation:

- The average unbalanced current is 9.897 % and it varies from 6.500 % to 13.70 %.

4.112 S K SOMAIYA COLLEGE(AUROBINDO)

Parameters	Avg.	Min.	Max.
Frequency	50.04	49.94	50.14
Ampere- R phase (A)	120.6	94.50	233.0
Ampere- Y phase (A)	106.2	79.00	191.5
Ampere- B phase (A)	81.32	46.50	172.5
Ampere- Neutral (A)	32.89	20.80	51.70
Voltage- R phase (V)	423.4	418.6	428.9
Voltage- Y phase (V)	423.0	418.3	428.4
Voltage- B phase (V)	423.2	418.5	429.3
P.F. Total	0.972	0.732	0.990
POWER- Total (KW)	72.58	60.23	93.25
V THD % R phase	1.552	1.200	2.200
V THD % Y phase	1.433	1.100	2.000
V THD % B phase	1.546	1.200	2.100
I THD % R phase	14.72	8.600	27.60
I THD % Y phase	16.14	9.500	31.00
I THD % B phase	22.60	13.70	39.00
Voltage Unbalance %	0.076	0.0	0.200
Current Unbalance %	22.76	10.20	38.20

Observations: As per IEEE 519, the maximum permissible limit for Voltage harmonics is 5%. Measured Average Voltage Harmonics THD (%) is 1.552% (R), 1.433% (Y) & 1.546% (B) which is less than the limits of 5% and it is satisfactory.

As per IEEE 519, the maximum permissible limit for current harmonics is 8%. Measured Average Current Harmonics THD (%) is **14.72%**(R), **16.14%** (Y) & **22.60%** (B) which is higher than the limits of 8%.

As per IEEE 519, the maximum permissible limit for Current Unbalance is 10%. Measured Average Current Unbalance UNB (%) is **38.2 %** which is much higher than the limits of 10%.

Neutral current = **32.89 A i.e 32%** of average phase current, **Excessive Neutral Current.**

The load across the three phases is highly unbalanced, with a difference of nearly 40 A between R and B phases.

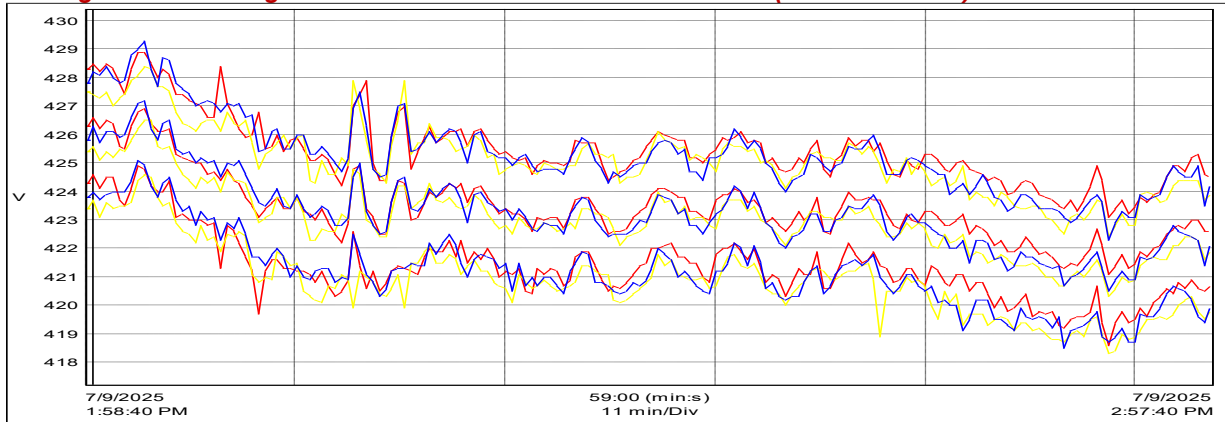
The neutral current is abnormally high, which will lead to:

- Heating in the neutral conductor
- Increased energy losses (I^2R)

- Risk of voltage instability and equipment stress

The power distribution system is operating inefficiently and may experience accelerated wear and reduced reliability.

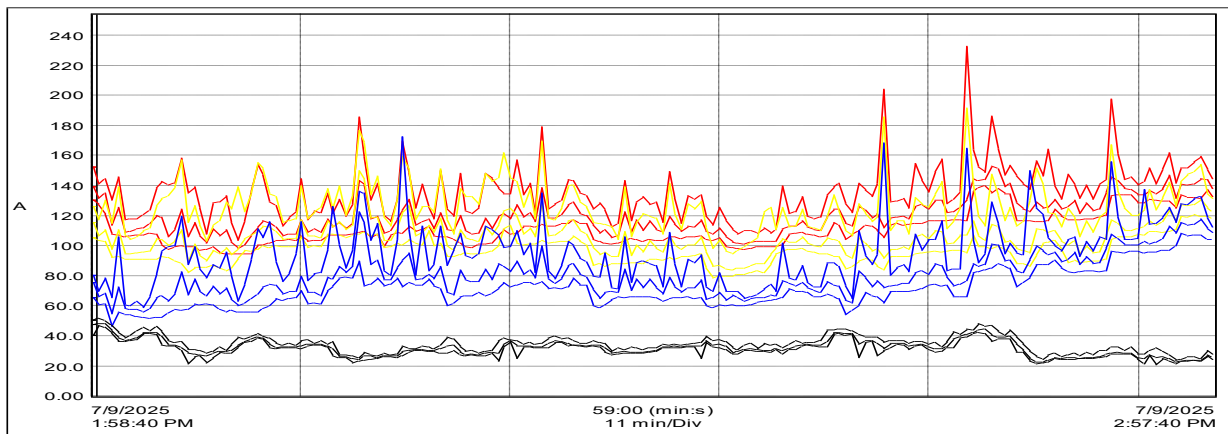
Figure 13. Voltage Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average voltage in Red phase is 423.4 V and it varies from 418.6 V to 428.9 V.
- The average voltage in Yellow phase is 423.0 V and it varies from 418.3 V to 428.4 V.
- The average voltage in Blue phase is 423.2 V and it varies from 418.5 V to 429.3 V.
-

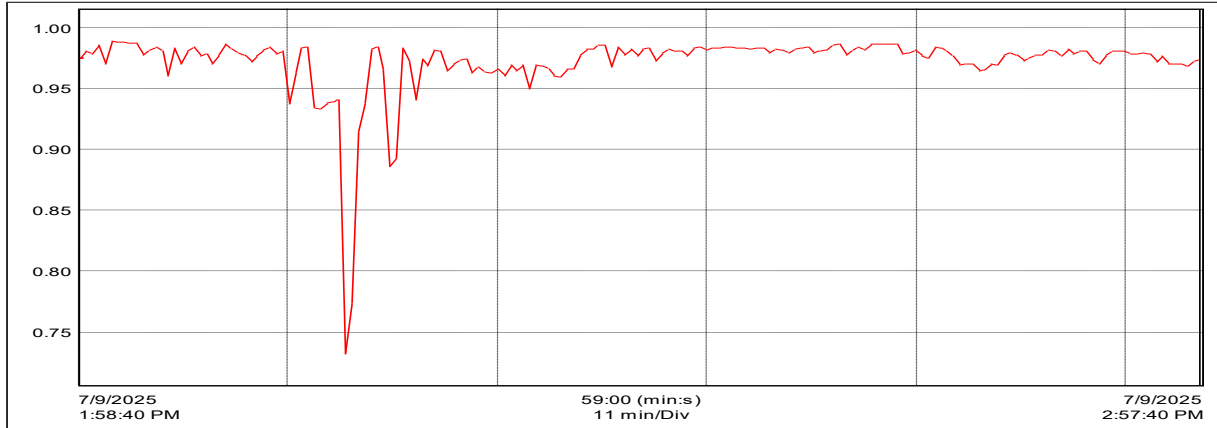
Figure 14. Current Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average current in Red phase is 120.6 A and it varies from 94.50 A to 233.0 A.
- The average current in Yellow phase is 106.2 A and it varies from 79.00 A to 191.5 A.
- The average current in Blue phase is 81.32 A and it varies from 46.50 A to 172.5 A.

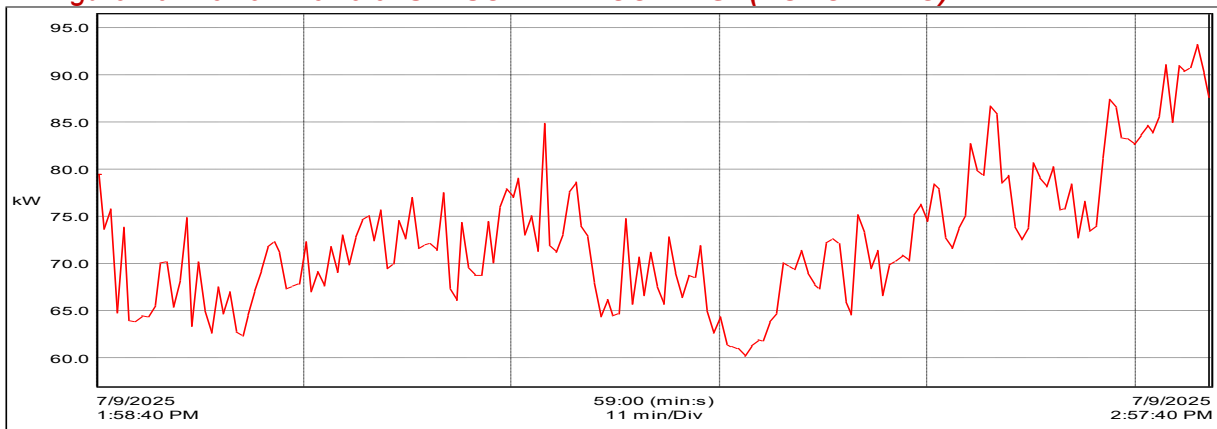
Figure 15. Power factor Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average power factor is 0.972 and it varies from 0.732 to 0.990

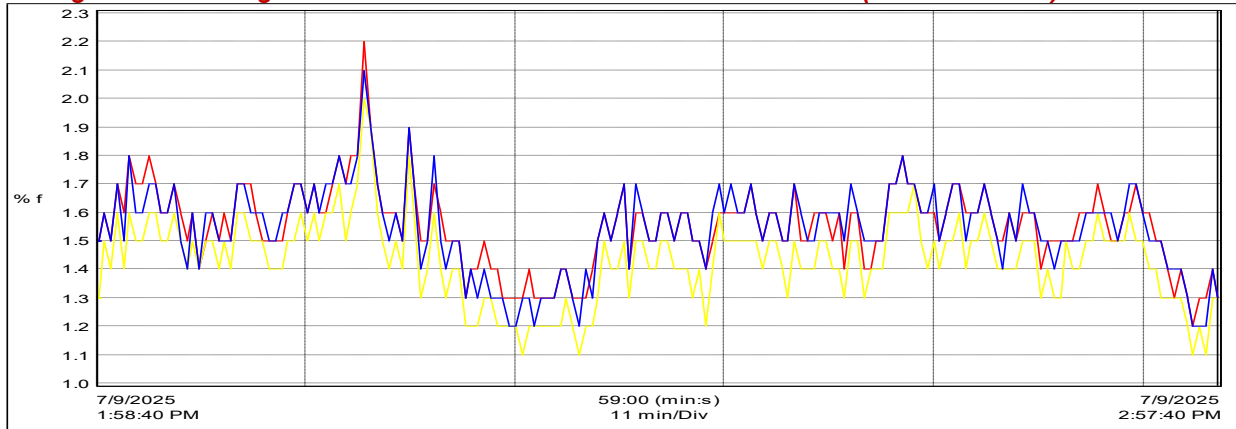
Figure 16. Power Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average power is 72.58 KW and it varies from 60.23 KW to 93.25 KW.

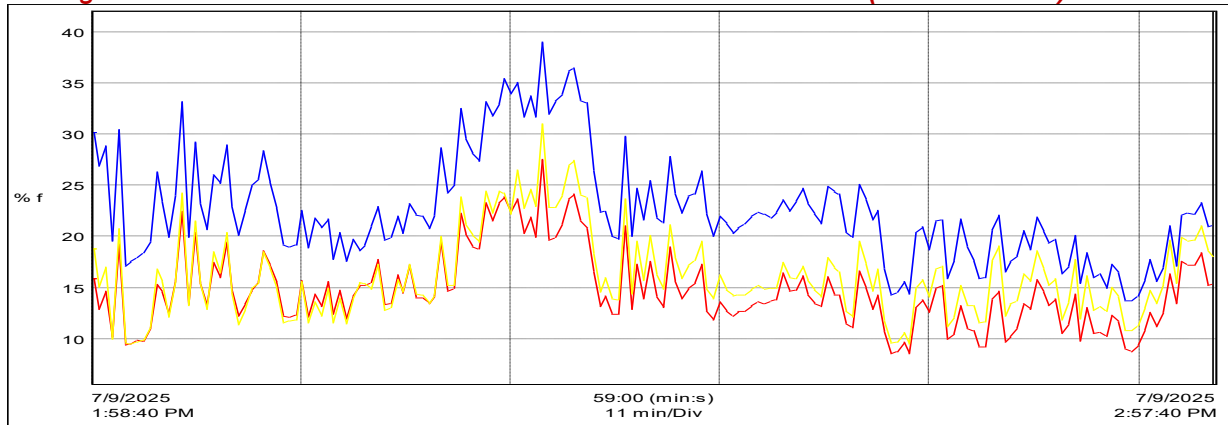
Figure 17. Voltage THD% Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average THD% of voltage in Red phase is 1.552 % and it varies from 1.200 % to 2.200 %.
- The average THD% of voltage in Yellow phase is 1.433 % and it varies from 1.100 % to 2.000 %.
- The average THD% of voltage in Blue phase is 1.546 % and it varies from 1.200 % to 2.100 %.

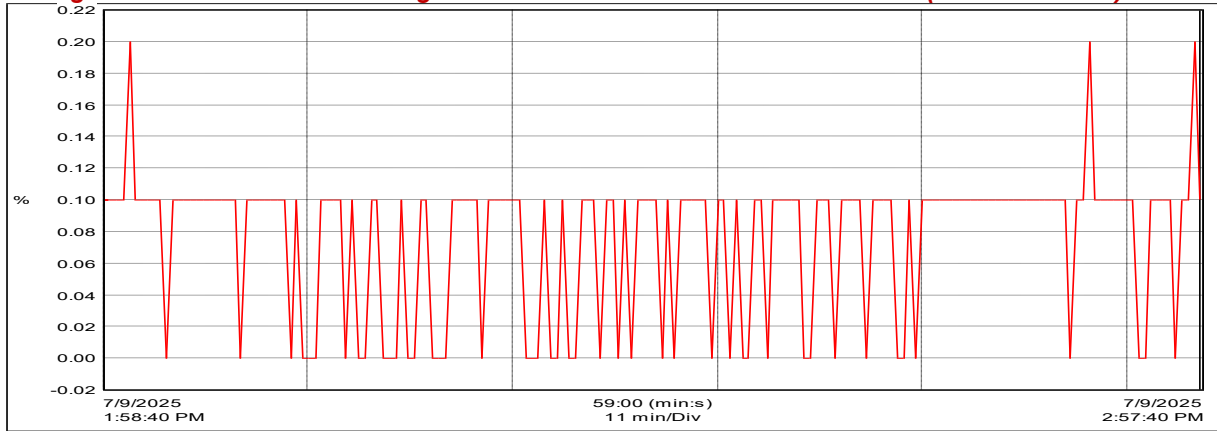
Figure 18. Current THD% Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average THD% of current in Red phase is 14.72 % and it varies from 8.600 % to 27.60 %.
- The average THD% current in Yellow phase is 16.14 % and it varies from 9.500 % to 31.00 %.
- The average THD% of in current Blue phase is 22.60 % and it varies from 13.70 % to 39.00 %.

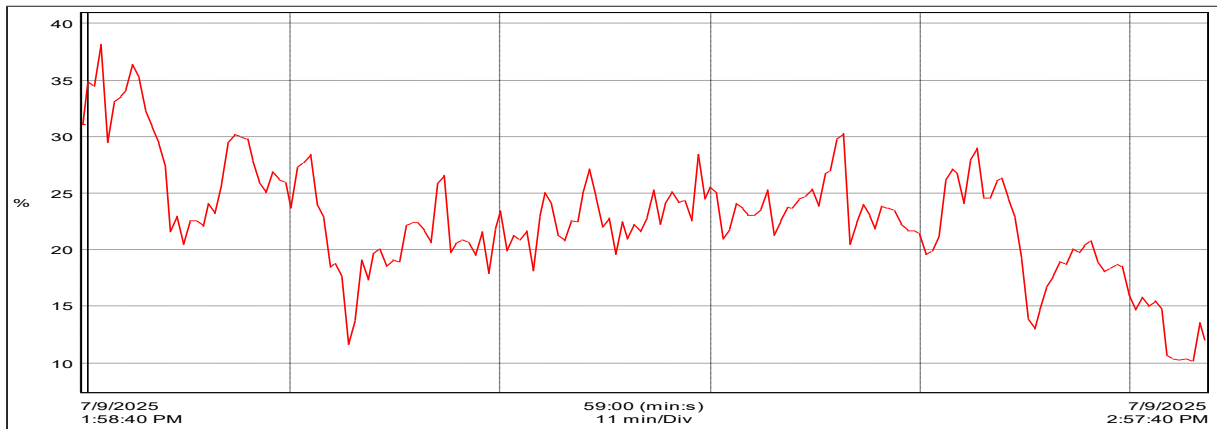
Figure 19. Unbalanced voltage Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average unbalanced voltage is 0.076% and it varies from 0.0 % to 0.200 %.

Figure 20. Unbalanced Current Profile of S K SOMAIYA COLLEGE(AUROBINDO)



Observation:

- The average unbalanced current is 22.76 % and it varies from 10.20 % to 38.20 %.

4.113 K J Somaiya Management College

Parameters	Avg.	Min.	Max.
Frequency	50.01	49.94	50.11
Ampere- R phase (A)	671.8	585.5	811.5
Ampere- Y phase (A)	587.0	502.5	736.0
Ampere- B phase (A)	580.7	512.5	729.5
Ampere- Neutral (A)	105.2	70.10	138.2
Voltage- R phase (V)	425.5	421.9	429.1
Voltage- Y phase (V)	426.3	422.9	429.7
Voltage- B phase (V)	425.5	422.1	428.8
P.F. Total	0.967	0.956	0.972
POWER- Total (KW)	437.0	399.6	483.2
V THD % R phase	1.065	1.000	1.200
V THD % Y phase	0.984	0.800	1.100
V THD % B phase	1.134	1.000	1.300
I THD % R phase	5.217	4.400	6.400
I THD % Y phase	6.307	5.000	7.800
I THD % B phase	6.323	4.900	8.100
Voltage Unbalance %	0.130	0.0	0.300
Current Unbalance %	9.601	4.600	14.60

Observations: As per IEEE 519, the maximum permissible limit for Voltage harmonics is 5%. Measured Average Voltage Harmonics THD (%) is 1.065% (R), 0.984% (Y) & 1.134% (B) which is less than the limits of 5% and it is satisfactory.

As per IEEE 519, the maximum permissible limit for current harmonics is 8%. Measured Average Current Harmonics THD (%) is 5.217% (R), 6.307% (Y) & 6.323% (B) which is less than the limits of 8%.

As per IEEE 519, the maximum permissible limit for Current Unbalance is 10%. Measured Average Current Unbalance UNB (%) is **14.9 %** which is higher than the limits of 10%.

Neutral current = **105.2 A i.e 17%** of average phase current, **High Neutral Current.**

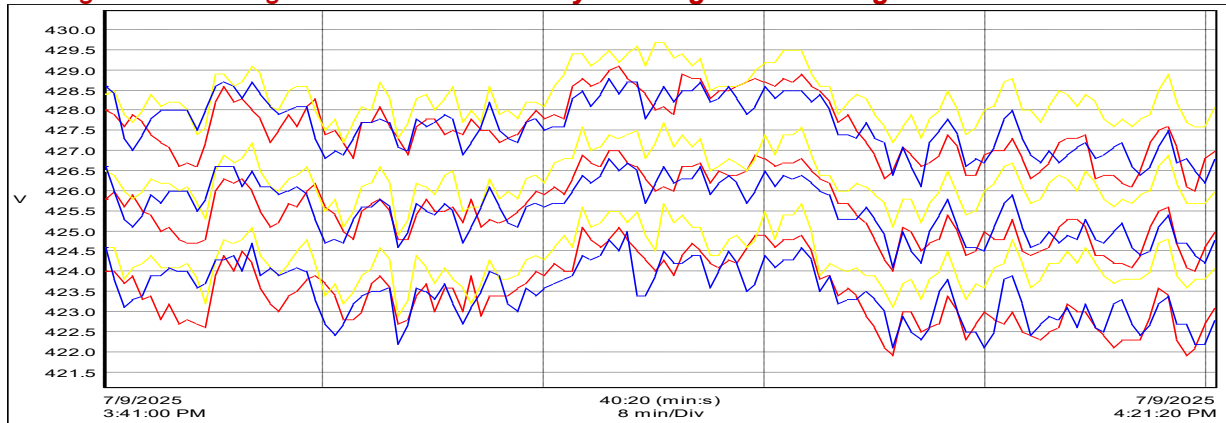
The load across the three phases is unbalanced, with a difference of nearly 90 A between R and B phases.

The neutral current is abnormally high, which will lead to:

- Heating in the neutral conductor
- Increased energy losses (I^2R)
- Risk of voltage instability and equipment stress

The power distribution system is operating inefficiently and may experience accelerated wear and reduced reliability.

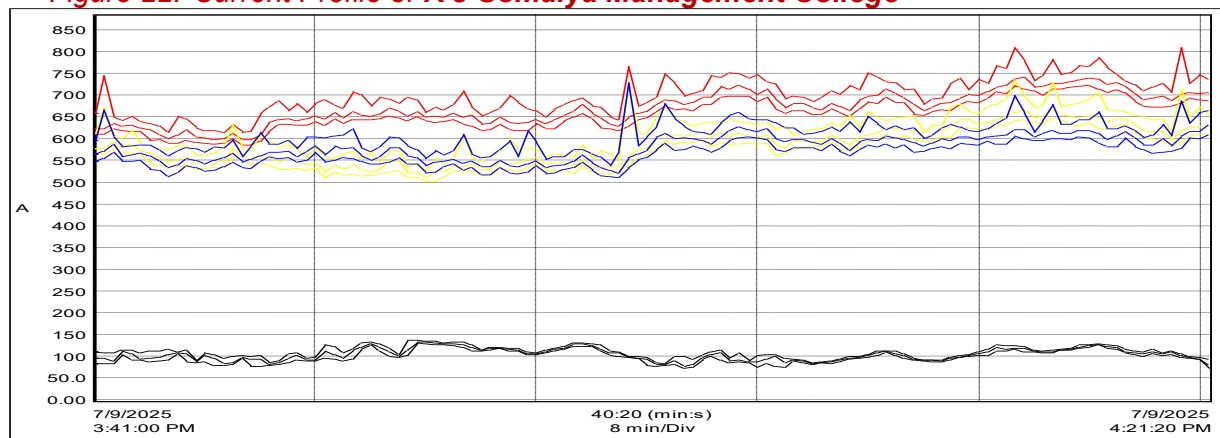
Figure 21. Voltage Profile of K J Somaiya Management College



Observation:

- The average voltage in Red phase is 425.2 V and it varies from 421.9 V to 429.1 V.
- The average voltage in Yellow phase is 426.3 V and it varies from 422.9 V to 429.7 V.
- The average voltage in Blue phase is 425.5 V and it varies from 422.1 V to 428.8 V.

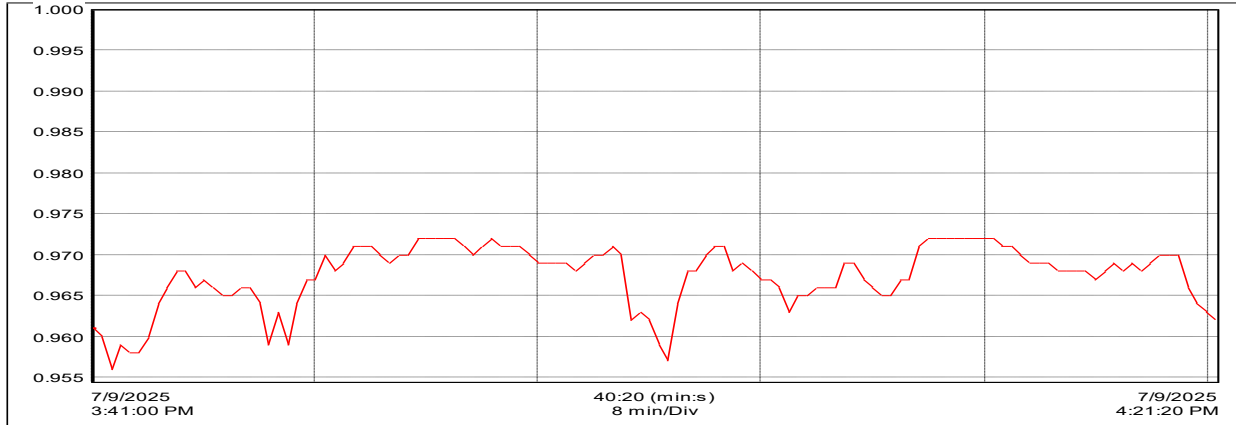
Figure 22. Current Profile of K J Somaiya Management College



Observation:

- The average current in Red phase is 671.8 A and it varies from 585.5 A to 811.5 A.
- The average current in Yellow phase is 587.0 A and it varies from 502.5 A to 736.0 A.
- The average current in Blue phase is 580.7 A and it varies from 512.5 A to 729.5 A.

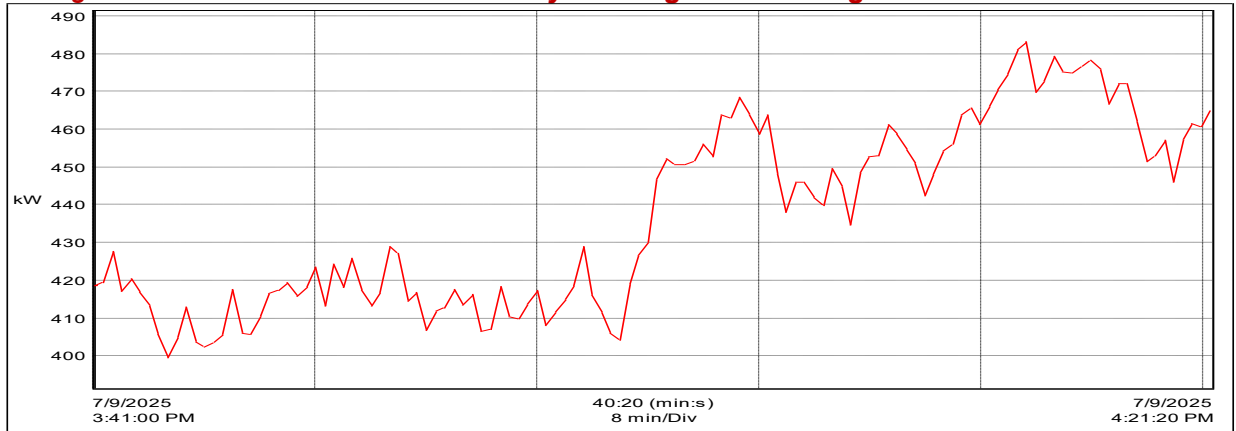
Figure 23. Power factor Profile of K J Somaiya Management College



Observation:

- The average power factor is 0.967 and it varies from 0.956 to 0.972

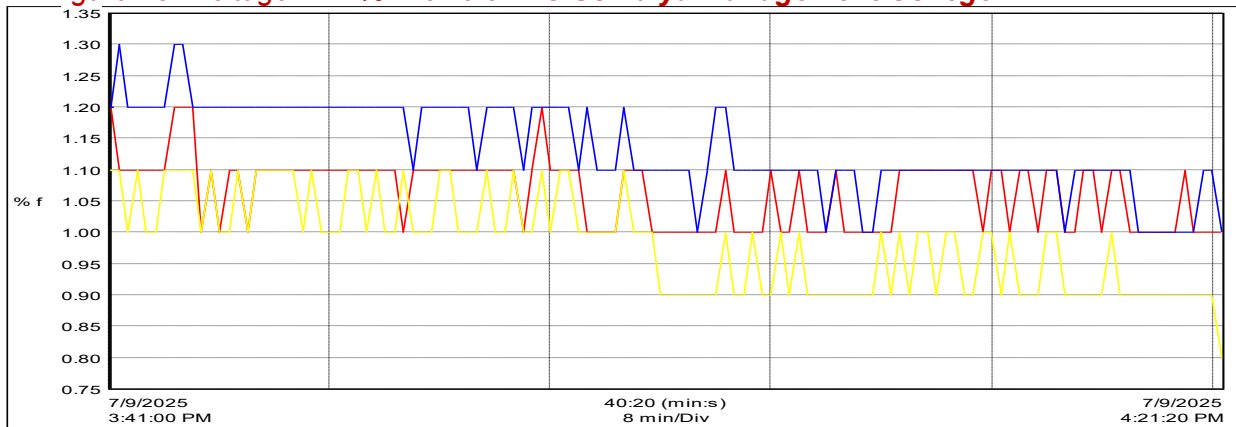
Figure 24. Power Profile of K J Somaiya Management College



Observation:

- The average power is 437.0 KW and it varies from 399.6 KW to 483.2 KW.

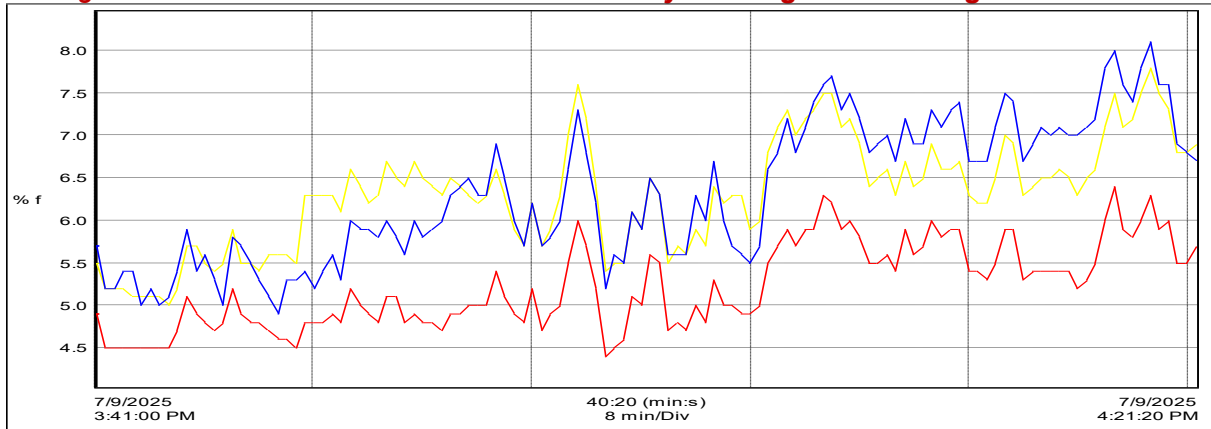
Figure 25. Voltage THD% Profile of K J Somaiya Management College



Observation:

- The average THD% of voltage in Red phase is 1.065 % and it varies from 1.000 % to 1.200 %.
- The average THD% of voltage in Yellow phase is 0.984 % and it varies from 0.800 % to 1.100 %.
- The average THD% of voltage in Blue phase is 1.134 % and it varies from 1.000 % to 1.300 %.

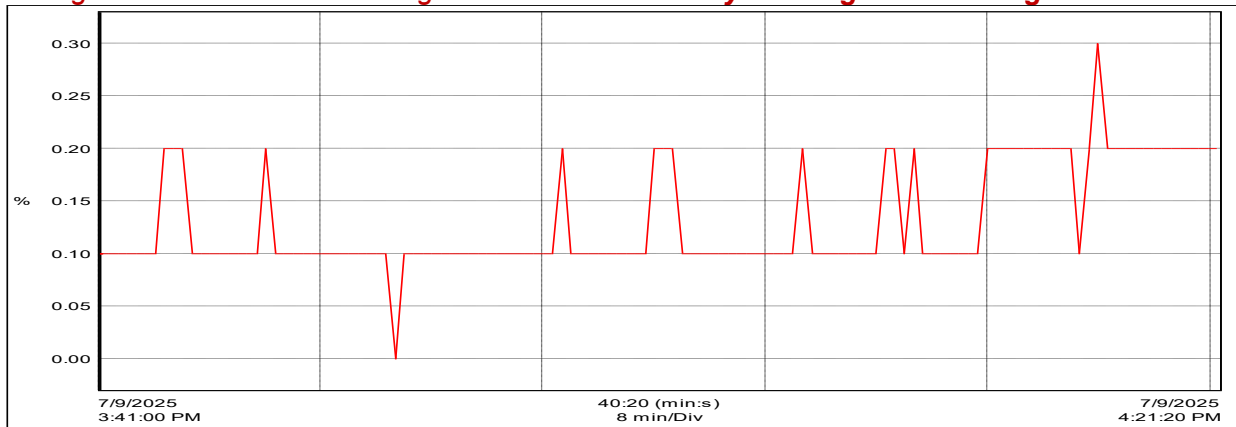
Figure 26. Current THD% Profile of K J Somaiya Management College



Observation:

- The average THD% of current in Red phase is 5.217 % and it varies from 4.400 % to 6.400 %.
- The average THD% current in Yellow phase is 6.307 % and it varies from 5.000 % to 7.800 %.
- The average THD% of in current Blue phase is 6.323 % and it varies from 4.900 % to **8.100 %**.

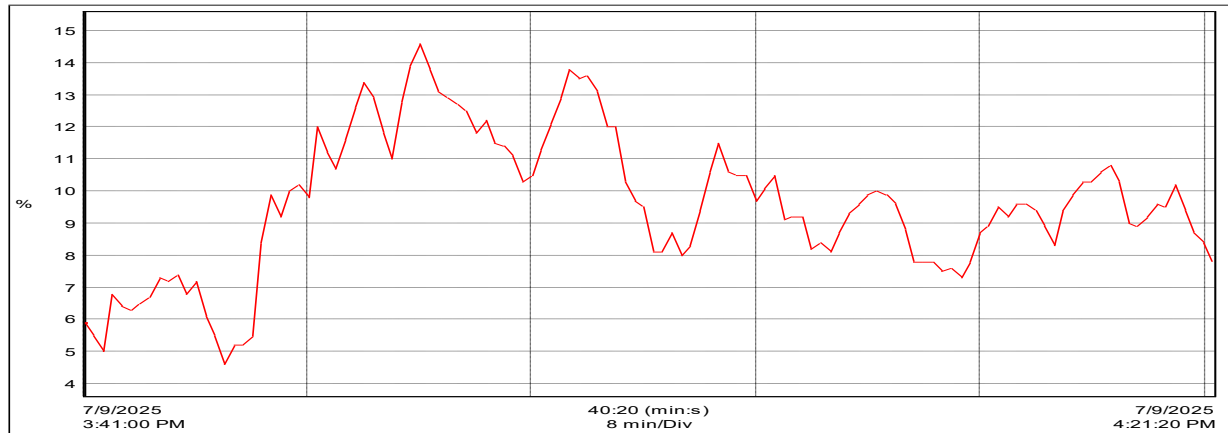
Figure 27. Unbalanced voltage Profile of K J Somaiya Management College



Observation:

- The average unbalanced voltage is 0.130% and it varies from 0.0 % to 0.300 %.

Figure 28. Unbalanced Current Profile of K J Somaiya Management College


Observation:

- The average unbalanced current is 9.601 % and it varies from 4.600 % to 14.60 %.

4.114 Chiller

Parameters	Avg.	Min.	Max.
Frequency	49.99	49.91	50.04
Ampere- R phase (A)	201.5	191.5	209.0
Ampere- Y phase (A)	214.6	204.0	221.5
Ampere- B phase (A)	208.7	198.5	216.0
Ampere- Neutral (A)	0.0	0.0	0.0
Voltage- R phase (V)	424.9	421.7	428.1
Voltage- Y phase (V)	425.7	422.5	428.9
Voltage- B phase (V)	424.6	421.5	427.8
P.F. Total	0.705	0.690	0.712
POWER- Total (KW)	108.3	103.9	110.3
V THD % R phase	1.048	0.900	1.200
V THD % Y phase	0.941	0.800	1.100
V THD % B phase	1.069	1.000	1.200
I THD % R phase	4.221	3.900	4.600
I THD %Y phase	4.076	3.700	4.400

Parameters	Avg.	Min.	Max.
I THD % B phase	4.448	4.100	4.700
Voltage Unbalance %	0.145	0.100	0.200
Current Unbalance %	3.331	2.900	4.100

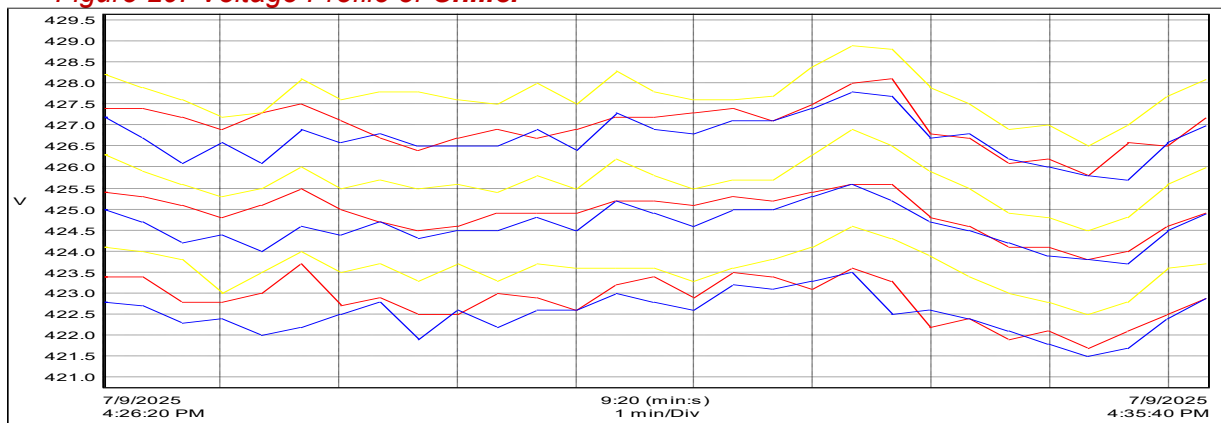
Observations: As per IEEE 519, the maximum permissible limit for Voltage harmonics is 5%. Measured Average Voltage Harmonics THD (%) is 1.048% (R), 0.941% (Y) & 1.069% (B) which is less than the limits of 5% and it is satisfactory.

As per IEEE 519, the maximum permissible limit for current harmonics is 8%. Measured Average Current Harmonics THD (%) is 4.221% (R), 4.076% (Y) & 4.448% (B) which is less than the limits of 8%.

As per IEEE 519, the maximum permissible limit for Current Unbalance is 10%. Measured Average Current Unbalance UNB (%) is 3.331% which is less than the limits of 10%.

The system is in a healthy operating state. Phase currents are balanced, and neutral current is zero — indicating **excellent load distribution and minimal losses.**

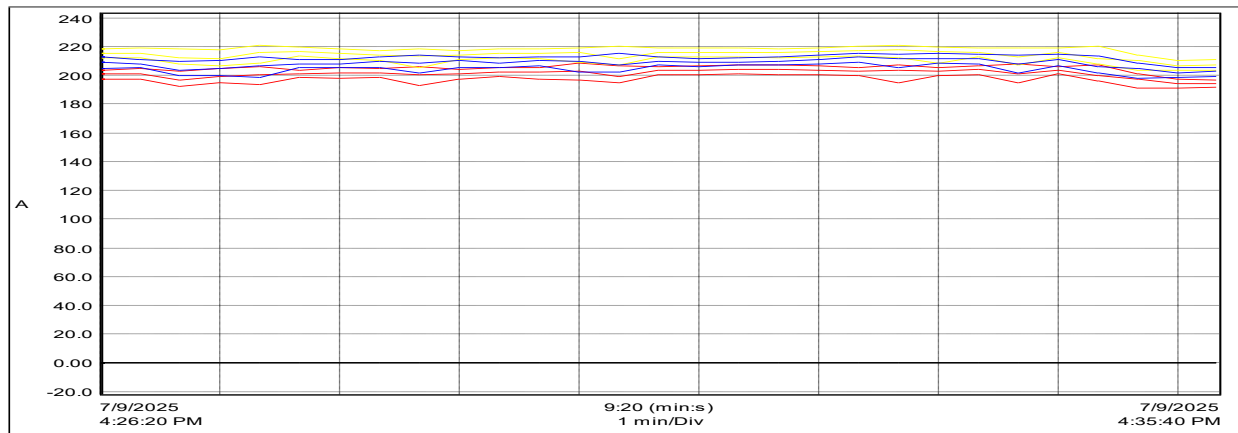
Figure 29. Voltage Profile of Chiller



Observation:

- The average voltage in Red phase is 424.9 V and it varies from 421.7 V to 428.1 V.
- The average voltage in Yellow phase is 425.7 V and it varies from 422.5 V to 428.9 V.
- The average voltage in Blue phase is 424.6 V and it varies from 421.5 V to 427.8 V.

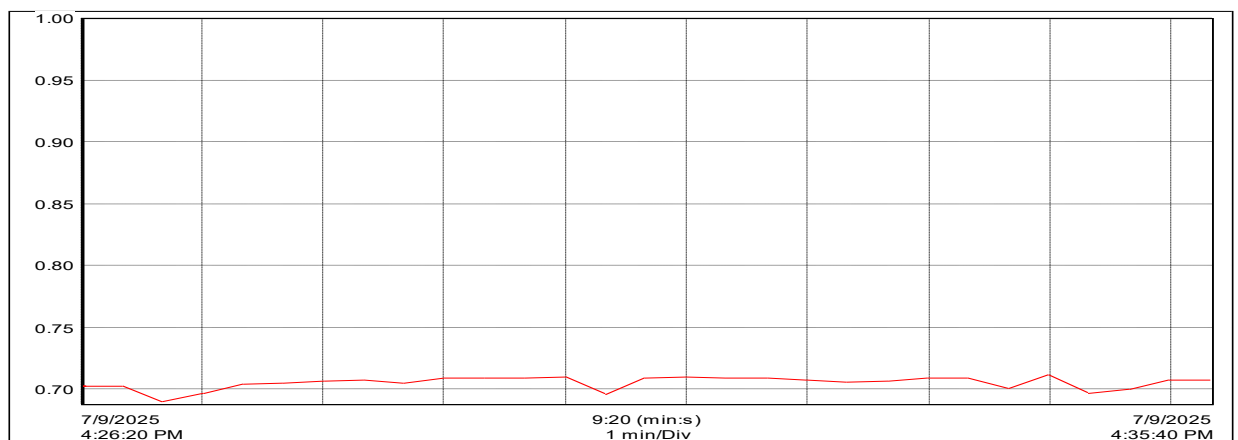
Figure 30. Current Profile of Chiller



Observation:

- The average current in Red phase is 201.5 A and it varies from 191.5 A to 209.0 A.
- The average current in Yellow phase is 214.6 A and it varies from 204.0 A to 221.5 A.
- The average current in Blue phase is 208.7 A and it varies from 198.5 A to 216.0 A.

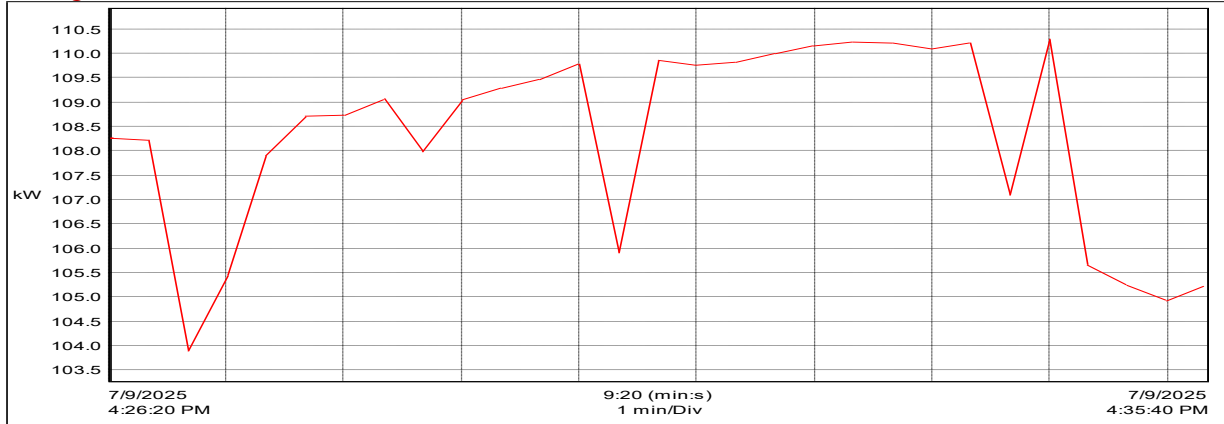
Figure 31. Power factor Profile of Chiller



Observation:

- The average power factor is 0.705 and it varies from 0.690 to 0.712

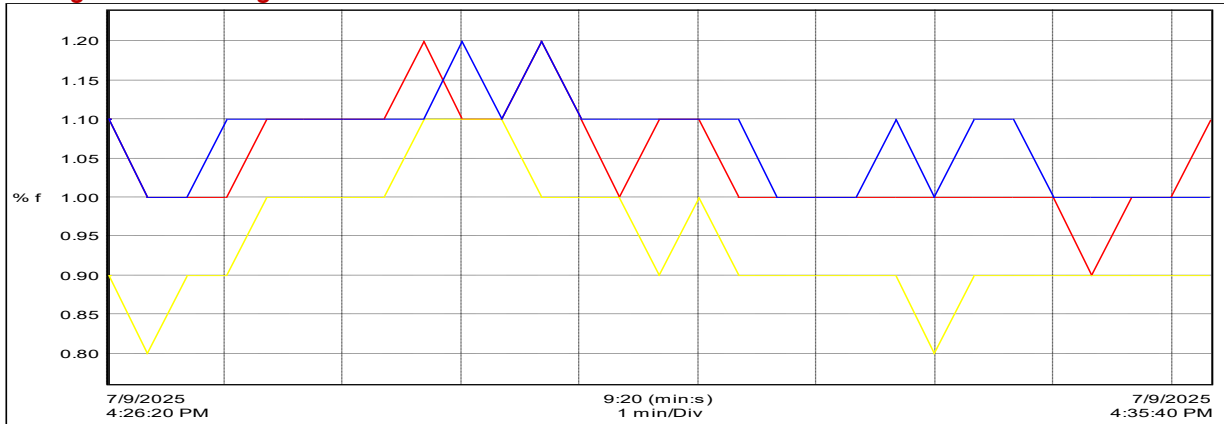
Figure 32. Power Profile of Chiller



Observation:

- The average power is 108.3 KW and it varies from 103.9 KW to 110.3 KW.

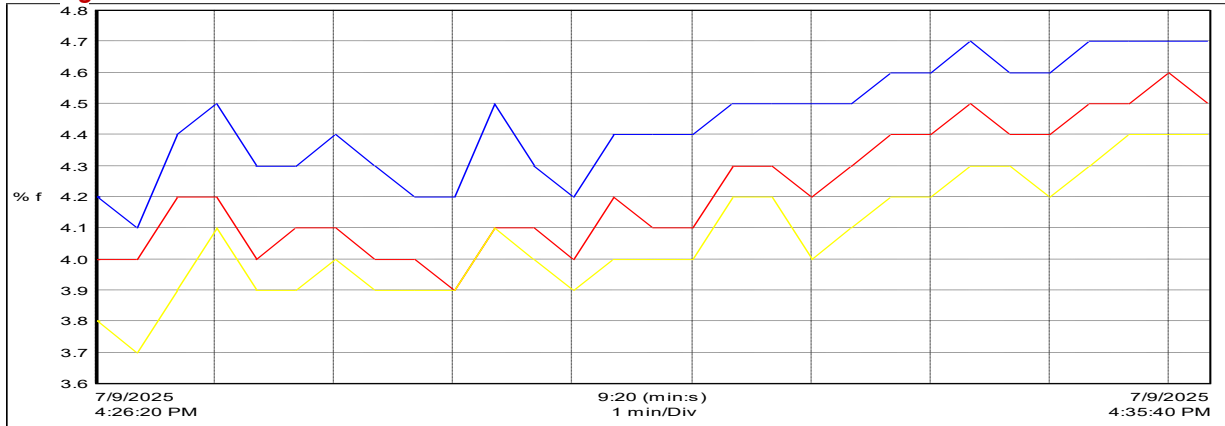
Figure 33. Voltage THD% Profile of Chiller



Observation:

- The average THD% of voltage in Red phase is 1.048 % and it varies from 0.900 % to 1.200 %.
- The average THD% of voltage in Yellow phase is 0.941 % and it varies from 0.800 % to 1.100 %.
- The average THD% of voltage in Blue phase is 1.069 % and it varies from 1.000 % to 1.200 %.

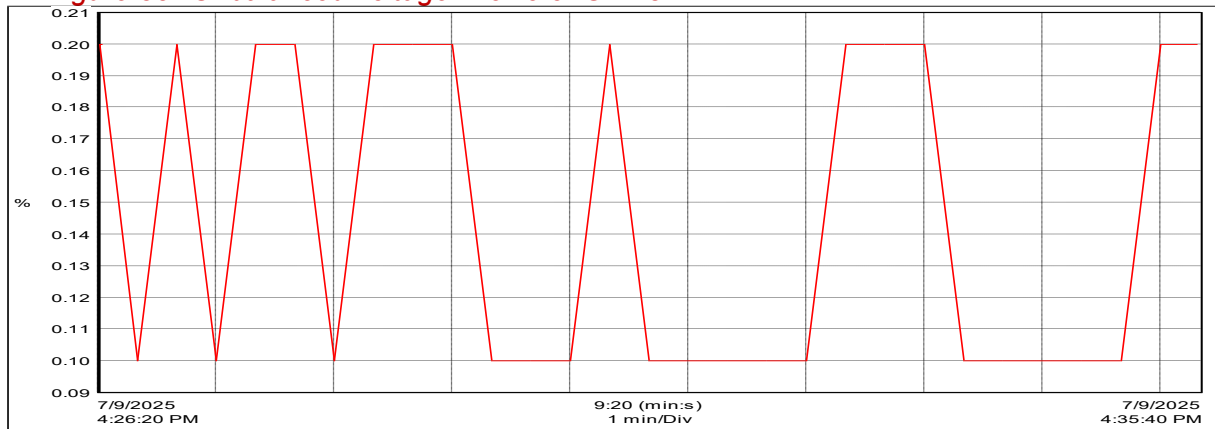
Figure 34. Current THD% Profile of Chiller



Observation:

- The average THD% of current in Red phase is 4.221 % and it varies from 3.900 % to 4.600 %.
- The average THD% current in Yellow phase is 4.076 % and it varies from 3.700 % to 4.400 %.
- The average THD% of in current Blue phase is 4.448 % and it varies from 4.100 % to 4.700 %.

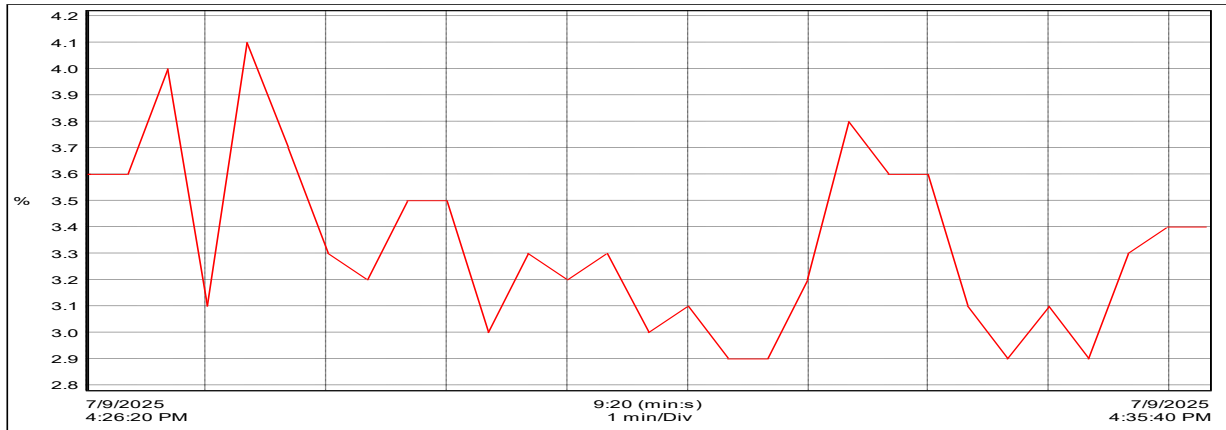
Figure 35. Unbalanced voltage Profile of Chiller



Observation:

- The average unbalanced voltage is 0.145 % and it varies from 0.100 % to 0.200 %.

Figure 36. Unbalanced Current Profile of Chiller



Observation:

- The average unbalanced current is 3.331 % and it varies from 2.900 % to 4.100 %.

5.0 DISCLAIMER

In line with our methodology for conducting the energy and power audit study at the client site, our key findings and recommendations in this report are based on the field observations, and discussions with client representatives. The observations in this report are indicative of the Institute's performance based on our assessment and should not be construed as a comment on the Institute's overall functioning. The details presented are derived from parameters during our visit; therefore, the findings of this report are valid as of the date of the visit and the study period.

We believe that our observations represent the normal operations at the site, and we stand by the technical content of this report. We have exercised all reasonable skills, care, and diligence in conducting the study. However, this report should not be considered an undertaking, warranty, or certification.

While the report analyses equipment and technology from various Indian and foreign manufacturers/suppliers installed at the site, it is not our intention to comment positively or negatively on the capabilities of these suppliers or their technology. The outcomes are purely based on the parameters recorded at that specific time. The names of technologies or equipment mentioned belong to their respective suppliers.