Estd : 1984

KONGU ENGINEERING COLLEGE
(Autonomous)
PERUNDURAI, ERODE - 638 060, INDIA

CERT No.: 99 -100 -20788
ISO 9001 : 2015

Dr.T.Logeswaran, M.E., Ph.D
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Ref: KEC/GA/2022-2023/723 17/07/2023

GREEN AUDIT CERTIFICATE

This is to certify that, we have conducted a **Green Audit** in **Hajee Karutha Rowther Howdia College**, Uthamapalayam, Tamil Nadu on 14th July, 2023. The audit process investigates the following activities.

I) Coverage of matured trees
II) Reduction of heat island effects
III) Inspection of the water conservation measures
IV) Coverage of turf and landscape
V) Retention of natural landscape
VI) Human well-being facilities

Audited and Accounted for June 2022 to May 2023

Yours Truly

Dr.T.Logeswaran
Certified Energy Auditor EA-13164,
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Environmental Management Systems
Lead Auditor
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Ref: KEC/EA/2022-2023/723 **17/07/2023**

ENERGY AUDIT CERTIFICATE

This is to certify that, we have conducted an **Energy Audit** in **Hajee Karutha Rowther Howdia College**, Uthamapalayam, Tamil Nadu on 14th July, 2023.The audit team has identified energy saving measures and the summary of Energy Audit Process is given below.

S.No.	Description	Parameters
1	Annual Energy/ fuel Consumption	28310 litres diesel,55 LPG cylinders & 203099.4 kWh
2	Present Annual Energy Cost	Rs. 40,85,020.00
3	Proposed cost Savings due to the replacement 50 fans with BLDC fans	Rs. 37,500.00
4	Proposed cost savings per year due to the installation of 50 LED lights	Rs. 32,004.00
5	Initial Investment Required	Rs. 1,34,350.00
6	Total savings ((3)+(4))	Rs. 69,504.00
7	Payback period in years	1.93

Equipment/Systems Audited

Electrical Network
Inverter, UPS and Battery System
Lightings, Fans & Air Conditioning System
Diesel Fuel Consumption

Audited and Accounted for June 2022 to May 2023

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Ref: KEC/EN/2022-2023/723 **17/07/2023**

ENVIRONMENTAL AUDIT CERTIFICATE

This is to certify that we have conducted an **Environmental Audit** in **Hajee Karutha Rowther Howdia College**, Uthamapalayam, Tamil Nadu on 14th July, 2023. This audit process highlights the present CO_2 emission and methods adopted to neutralize the same in the college campus.

S.No.	Description	Type of fuel and their conversion process		
		Electrical energy consumed	Diesel	LPG
1	Annual Energy Consumption	203099.4 kWh	28310 lit	55 Nos.
2	CO_2 Emission standards	0.95 kg/kWh	2.68 kg/lit	56.2 kg/cyl.
3	Total CO_2 emission(tonne/Annum)	271.91		
4	Total No. of students and staff	2861		
5	Per capita CO_2 emission per year	0.095 tonnes (+)		
6	No. of Matured Trees (1 tree absorbs 22 kg CO_2/year)	402		
7	CO_2 neutralised due to matured trees	8.84 tonnes		
8	CO_2 neutralised due to electricity generate by solar and wind energy	14.8 tonnes		
9	CO_2 to be neutralised per capita per year	0.087 tonnes (-)		

Systems Audited
- ✓ Electricity consumption
- ✓ Diesel consumption
- ✓ LPG consumption
- ✓ Solar power plant

Systems Inspected
- ✓ Solid & E waste handling & Management
- ✓ Usage of chemical, salts & acids
- ✓ RO system

Audited and Accounted for June 2022 to May 2023

Yours Truly

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REPORT OF ENVIRONMENTAL/GREEN AND ENERGY AUDIT

of

Hajee Karutha Rowther Howdia College

(Autonomous)

Uthamapalayam, Theni District

EXECUTED BY

DEPARTMENT OF MECHANICAL ENGINEERING
&
ELECTRICAL AND ELECTRONICS ENGINEERING

INDUSTRY- INSTITUTE PARTNERSHIP CELL

KONGU ENGINEERING COLLEGE

PERUNDURAI
ERODE – 638 060
TAMILNADU

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Transform Yourself

July 2023

KONGU
Assuring the Best

Acknowledgement

The Industry Institute Partnership Cell of Kongu Engineering College is thankful to the Management of Hajee Karutha Rowther Howdia College for providing anopportunity to conduct environment/green and energy auditinside their college premises. We express our sincere gratitude to the Principal, faculty members and technicians of Hajee Karutha Rowther Howdia collegefor the support and also for providing various information to the KEC team for successfully carrying out the measurements which have enabled the timely submission of this report. We also thank the following audit team members of Kongu Engineering College in carrying out the audit.The audit was carried out by qualified and experienced Energy Professionals/Engineers, including BEE certified Energy Auditors/Managers.

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Associate Professor/Mechanical Engineering
Kongu Engineering College

Dr.R.Naveen Kumar
Associate Professor/Mechanical Engineering
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ISO 14001:2015- Environmental Management Systems Lead Auditor

1. EXECUTIVE SUMMARY

Hajee Karutha Rowther Howdia College, Uthamapalayam had agreed to provide access to Kongu Engineering College to undertake Environmental/Green and Energy Audit related measurements at their campus. This Audit has been conducted by a team of faculty members from Mechanical and Electrical Engineering Department of Kongu Engineering College. As there is no standard model for such an audit, the committee brainstormed and evolved a questionnaire. The data was collected, compiled and was finally analysed by the audit team members. The remaining data which involved measurement using sophisticated instruments were done by the audit team members. By and large, the audit reveals a healthy environment in the campus. The committee has made short term and long-term suggestions to protect environment at higher levels and it is hoped that this will receive due attention of authorities and all stakeholders of the College.

2. OBJECTIVES OF THE AUDIT STUDY

The goals of the present environmental/green and energy audits typically include:

- To recognize, diagnose and resolve the environmental problems.
- To recognize the effects of an organization on the environment and vice versa.
- To identify and control the impact of activities of organizations on environment.
- To suggest the best protocols for sustainable development of organization and environment.
- To assess environmental performance and the effectiveness of the measures to achieve the defined objectives and targets.
- To identify the different pressures on organization to improve their environmental performance.
- To ensure that the natural resources are utilized properly as per national policy of environment.
- To establish the parameters for maintaining health and welfare of the community of the organization.

- To set the procedure for disposal of all types of harmful wastes.
- To reduce energy consumption.
- To give preference to the most energy efficient and environmentally sound appliances.
- To minimize the consumption of water and monitor its quality.
- To identify the risks of hazards and implement the policies for safety of stakeholders.
- To facilitate the stakeholders with different aspects of disaster management.
- To train all stakeholders of the organization and empower them to contribute and participate in the environmental protection.

To achieve the mentioned objectives, following stages are implemented. It includes three stages viz. pre-audit stage, audit stage and post-audit stage. Each of these stages comprises a number of clearly defined objectives, with each objective to be achieved through specific actions and these actions yielding results in the form of outputs at the end of each stage.

3. INTRODUCTION TO ENVIRONMENTAL/GREEN AUDIT

The various activities carried out in the academic institutions affects the environment in which it is situated. To address the issues, the institutions can successfully use auditing strategies to monitor their environmental-energy related activities. An "environmental audit" is a "systematic, documented, periodic and objective review to meet environmental requirements". Although environmental audits may be performed in many ways for different purposes, the reasons for performing an audit and the goals to be achieved will determine the type of environmental audit to be performed. Green audit is the tool of management system used methodologically for protection and conservation of the environment. It is also used for the sustenance of the environment. The audit suggests different standard parameters, methods and projects for environmental protection. The green audit is useful to detect and monitor sources of environment pollution and it emphasizes on management of all types of wastes, monitoring of energy consumption, monitoring of quality and quantity of water, monitoring of hazards, safety of stakeholders and even the management of disasters.

Hajee Karutha Rowther Howdia College, the first higher educational institution in Cumbum valley is an outcome of founder's passion towards the upliftment of the agricultural families of his native area. The strength of the students and staffs are 2578 and 215, respectively. Taking the green related concepts into consideration the college is committed to protect and to promote greenery in its campus. To maintain its green aim active, the college implements the traditional and scientific methods besides enforcing the legislations laid down by the government. Green Awareness programmes are conducted periodically in the campus for the staffs and students to keep the campus green forever thereby enhancing the beauty of Cumbum valley. Hajee Karutha Rowther Howdia College is making continuous efforts to protect, raise awareness and improve the environment on and off its campus. The inclusion of the Environmental Studies as a compulsory subject in the curriculum reflects the concern of the college for the protection and development of the environment. Government and legal procedures related to this are implemented periodically. The college is moving towards complete purity. The level of CO_2 can be reduced by growing more trees. A total of 388 matured trees are found inside the campus.

Fig.1: Green campus

3.1 WATER MANAGEMENT

The three bore wells inside the campus cater the total requirement of the college by six water tanks of different capacities. The College has a RO plant of 6000 litres capacity which generates 12,000 litres of waste (grey) water and reused for gardening purposes. Recharging of ground water and rainwater harvesting are implemented by the college thereby conserving the water from its inception and practice vigorously. These technologies where surface runoff is effectively collected during yielding rain periods. It has been very helpful to augment the ground water. The college does not depend upon or buy public water supply from outside the campus. The overflow of water from the tank are directed to the garden area. Students and faculty members of the institution are oriented by different programmes about water conservation. 5 number of pumps (1 no. of 7.5 HP, 1 no. of 5 HP, 3 nos. of 15 HP) are used for pumping water in the college and hostel. The total running hours of the pump is approximately 10 hours.

Fig.2: Rain water harvesting system

3.2 SOLID WASTE MANAGEMENT

The campus is cleaned on daily basis. Waste bins are placed in corridors, office and staff rooms. The waste generated in the campus includes wrappers, glass, metals, paper, etc. Old newspapers, used papers and journal files, workshop scrap etc. are given for recycling to external agencies. Glass, metals and other non-biodegradable wastes are given to external agencies where they are segregated and disposed/ recycled according to the nature of the waste. Non-biodegradable and plastic wastes are disposed by municipal collection centre. Leaf litter is allowed to decompose

systematically over a period of time to be used as manure for the gardens in the institute. Sanitary Napkin Incinerators have been installed in the girls' hostels to facilitate disposal of sanitary napkins in an environment-friendly way. A $1m^3$ biogas plant is functioning in the campus for producing biogas using the food waste.

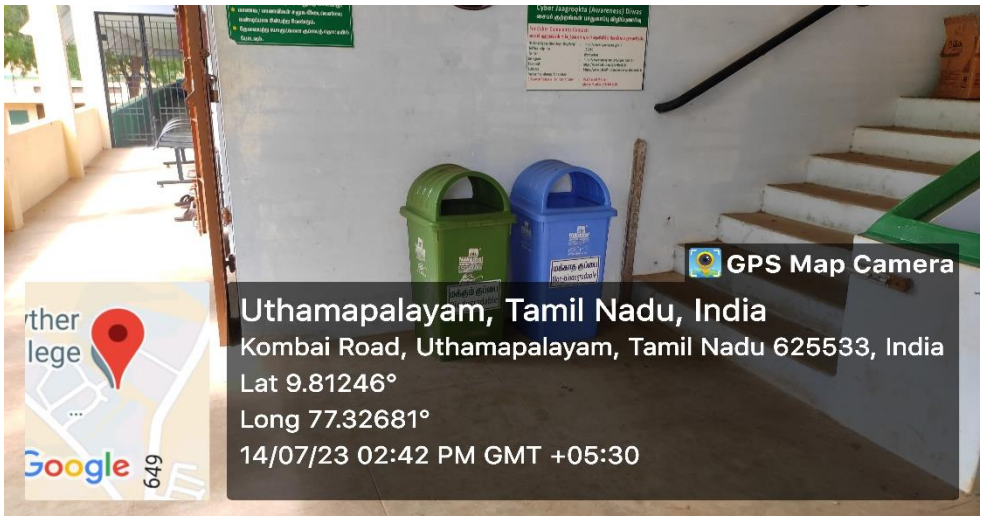


Fig.3: Green and blue colour wastebins to segregate degradable and non-biodegradable wastes

Fig.4: Sanitary Napkin Incinerator

3.3 LIQUID WASTE MANAGEMENT

Sewage, Laboratory, hostel and canteen effluent waste are the major liquid waste. The laboratory waste water does not contain hazardous chemicals and periodical monitoring is done by the maintenance team. The college will be strict on the source reduction of chemical waste.

Laboratories are purchasing smallest quantities of chemicals for particular purposes and share surplus chemicals with other laboratories inside the campus. Laboratories have shifted the experiments from macro scale to micro scale in order to reduce the chemical waste.

3.4 E WASTE MANAGEMENT

Electronic goods are put to optimum use; the minor repairs are set right by the Laboratory assistants and teaching staff; and the major repairs are handled by the Technical Assistant and are reused. Our College has entered into MoU with **Tritech Systems, Porur, Chennai**, which buys our damaged computers and other non-reparable e-waste and issues a Recycling certificate. UPS Batteries are recharged / repaired / exchanged by the suppliers. The waste compact discs and other disposable non-hazardous items are used by students for decoration during college fests as a creative means of showcasing the waste management practice that has been induced in the minds of the students.

4. INDOOR AIR QUALITY

Indoor air quality (IAQ) refers to the quality of the air inside buildings as represented by concentrations of pollutants and thermal (temperature and relative humidity) conditions that affect the health and performance of occupants. It has become one of the most important issues of environment and health worldwide considering the principle of human rights to health that everyone has the right to breathe healthy indoor air. With the help of Indoor Air Quality meter (Extech EA80), CO_2 level, relative humidity, dry bulb and wet bulb temperatures can be measured. The measurements are carried out based on the protocol given by Central Pollution Control Board, Ministry of Environment and Forests, Govt. of India and the norms are discussed briefly in the subsequent sections. Indoor air quality test was carried out at different locations of the institution. Carbon dioxide levels are within the ASHRAE 55-1992 limit in the outdoor and indoor.

The wind speed was measured at three locations as mentioned below.

S. No	Location	Anemometer Reading (m/s)
1	SF Block- Computer lab (M.Com)	6.9
2	SF Block- Computer lab (IT)	3.3
3	Main Block- Photocopy room	2.8

The instrument used in the present audit was Extech Make EA80 Model of Indoor air quality meter. The range of the instrument is given below

- CO_2 range : 0 to 6,000ppm
- Temperature range : -4 to 140°F (-20 to 60°C)
- Humidity range : 10 to 95% RH

Fig.5: Indoor air quality meter

4.1 AIR QUALITY MEASUREMENTS

Standard Level of CO_2	**ASHRAE and OSHA standards: 1000 ppm**
Standard Level of Relative Humidity	**30 – 60 % (ASHRAE)**
Standard Level of Temperature	**26 - 30°C ±3°C (ASHRAE)**

S. No	Location	CO_2 (ppm)	Relative Humidity (%)	Temperature (^oC)		Comments & Recommendation
				Wet	Dry	
Main Block						
1.	IQAC Block	530	49.1	24.1	32.4	Within the limits
2.	Veranda	460	49.4	23.7	32.1	Within the limits
3.	Office	546	51.6	23.7	31.5	Within the limits
4.	Photocopy room	688	51.8	23.6	31.3	Within the limits
1^{st} Floor						
5.	I floor- Veranda	534	51.2	23.6	31.3	Within the limits
6.	Physics Dept-Staff room	520	52.2	23.8	31.5	Within the limits
7.	Tamil Dept-Staff room	443	49.6	23.2	31.1	Within the limits
8.	Class room	468	50.6	23.1	30.9	Within the limits
2^{nd} Floor						
9.	II Floor- Veranda	615	52.5	23.4	30.7	Within the limits
10	English Dept-Staff room	688	51.8	23.6	31.2	Within the limits
11	English Language lab	599	52.5	23.5	30.9	Within the limits
12	Library	489	53.1	23.2	30.3	Within the limits
13	Class room – Maths	505	52.7	24	31.6	Within the limits
Science Block – Ground Floor						
14	Botany Lab-UG	509	53.8	23.1	30.2	Within the limits
15	Chemistry Dept Staff room	592	55.9	22.9	29.5	Within the limits
16	Chemistry Lab	496	55.9	22.8	29.3	Within the limits
17	Research lab-Chemistry	498	56.4	22.9	29.2	Within the limits
18	Veranda	486	55.2	23.8	30.6	Within the limits
Science Block – 1^{st} Floor						
19	Physics lab-UG	610	57.9	23.5	30.4	Within the limits
20	Physics lab-PG	578	50.3	23.7	31.7	Within the limits
21	Research lab	593	52	23.2	30.7	Within the limits
Science Block – 2^{nd} Floor						
22	Computer science – Staff room	492	42.2	19.4	27.9	Within the limits
23	CS-Class room	488	52.5	23.1	30.5	Within the limits
24	Zoology Dept- Staff room	405	53.5	22.7	30	Within the limits

25	Zoology lab	543	53.2	22.8	30	Within the limits
26	I B.Sc. Class room	534	53.5	22.9	29.9	Within the limits
27	II B.Sc. Class room	460	54.6	23.4	30.4	Within the limits
SF Block- Ground Floor						
28	Entrance	517	53.9	23.4	30.4	Within the limits
29	Biochemistry Lab	487	61.4	24.6	30.3	Within the limits
30	Seminar hall 2	459	52.8	22.8	30.1	Within the limits
31	II M Com- Class room	555	54	22.8	29.8	Within the limits
SF Block- 1st Floor						
32	M.Com- Staff room	552	44.9	22.6	30.4	Within the limits
33	Class room	514	57.9	23.5	30.4	Within the limits
34	Veranda	509	50.3	23.7	31.7	Within the limits
SF Block- 2nd Floor						
35	Veranda	497	55.2	23.8	30.6	Within the limits
36	Commerce Dept. Staff room	476	54.5	23.2	30	Within the limits
37	IT Lab	609	54.9	23.2	30	Within the limits
38	I M.Sc. Class room	576	55.1	23.2	30	Within the limits
Golden Jubilee Block- Ground Floor						
39	Veranda	592	55.9	22.9	29.5	Within the limits
40	Class room- 1st History	496	55.9	22.8	29.3	Within the limits
41	History Dept. Staff room	498	56.4	22.9	29.2	Within the limits
Golden Jubilee Block- 1st Floor						
42	Veranda	483	54.3	22.8	29.8	Within the limits
43	Arabic Dept. Staff room	497	54.4	22.7	29.5	Within the limits
44	CA-Dept. Staff room	476	54.3	22.8	29.7	Within the limits
Golden Jubilee Block- 2nd Floor						
45	Banking Dept. Staff room	496	61.4	24.6	30.3	Within the limits
46	Class room- Banking	498	52.8	22.8	30.1	Within the limits
47	BBA Dept. Staff room	486	54	22.8	29.8	Within the limits
PG Building- Ground Floor						
48	Veranda	531	51.1	24.2	31.8	Within the limits
49	Class room	468	52.2	23.3	30.8	Within the limits

50	Microbiology- Staff room	540	52.4	23.5	30.8	Within the limits
PG Building- 1st Floor						
51	Biochemistry- Staff room	484	52.3	23	30.3	Within the limits
52	Biochemistry- Class room	453	52.1	23	30.3	Within the limits
53	CERD Tailoring	416	51.4	23.1	31	Within the limits
Indoor Stadium						
54	Ground floor	459	50.6	23	30.7	Within the limits
55	Indoor stadium	498	51.9	23.1	30.2	Within the limits
MP Building						
56	Medical Centre	489	53.5	23.3	30.4	Within the limits
57	E-Service centre	543	54.1	23.3	30.4	Within the limits
58	Library- Entrance	425	52.5	23.4	30.7	Within the limits
59	Library- Digital section	410	51.8	23.6	31.2	Within the limits
60	Library-Stack room	389	52.5	23.5	30.9	Within the limits
61	CoE	780	53.1	23.2	30.3	Within the limits

4.2 OCCUPANT DISCOMFORTNESS

Discomfort can be caused to the occupants due to

- Inadequate ventilation
- High temperature and humidity levels
- High levels of CO_2

Ventilation should be distributed effectively in spaces, and stagnant air zones should be avoided. ASHRAE recommends relative humidity levels between 30 and 60 percent for optimum comfort. Higher humidity may result in microbial growth. A consistently implemented good-housekeeping plan is essential to eliminate or reduce the microbial growth in the building.

Damp indoor environments have been associated with many serious health effects, including asthma, hypersensitivity, and sinusitis. Moisture incursion leading to dampness can result from water leaks and/or by condensation due to high humidity. Common sources of moisture in buildings include: plumbing; roof and window leaks; flooding; condensation on

cold surfaces, e.g., pipe sweating; poorly-maintained drain pans; and wet foundations due to landscaping or gutters that direct water into or under the building. Water vapor from unvented or poorly-vented kitchens, showers, combustion appliances, or steam pipes can also create conditions that promote microbial growth. Well-designed, well-constructed and well–maintained building envelopes are critical to the prevention and control of excess moisture and microbial growth by avoiding thermal bridges and preventing intrusion by liquid or vapor-phase water. Management of moisture requires proper control of temperatures and ventilation to avoid high humidity, condensation on surfaces, and excess moisture in materials.

CO_2 is a colorless, odorless, and tasteless gas. It is a product of completed carbon combustion and the by-product of biological respiration. ASHRAE states that CO_2 concentrations in acceptable outdoor air typically range from 300-500 ppm. Adverse health effects from CO_2 may occur since it is an asphyxiate gas. The CO_2 levels can be used as a rough indicator of the effectiveness of ventilation, and excessive population density in a structure. CO_2 increases in buildings with higher occupant densities, and is diluted and removed from buildings based on outdoor air ventilation rates. Therefore, examining levels of CO_2 in indoor air can reveal information regarding occupant densities and outdoor air ventilation rates. High CO_2 levels may indicate a problem with overcrowding or inadequate outdoor air ventilation rates.CO2, a by-product of normal cell function, is removed from the body via the lungs in the exhaled air. Exposure to high levels of CO_2 can increase the amount of this gas in the blood, which is referred to as *hypercapnia* or *hypercarbia*. As the severity of hypercapnia increases, more symptoms ranging from headache to unconsciousness appear, and it can also lead to death.

The traditional means of dealing with IAQ is through ventilation with outdoor air, but this approach assumes that the outdoor air is cleaner than the indoor air. In many locations and for many contaminants, this is not the case, and insufficiently treated ventilation air can actually make IAQ worse. Poor outdoor air quality includes regionally elevated outdoor contaminant levels, as well as local sources such as motor vehicle exhaust from nearby roadways and contaminants generated by activities in adjacent buildings. Some green building programs recommend across-the-board increases in ventilation rates, but such recommendations may be counterproductive in areas with poor outdoor air quality unless accompanied by appropriate and effective increases in filtration and air cleaning.

4.3 INFERENCE

- Carbon dioxide levels are within the ASHRAE 55-1992 limit in the outdoor and indoor. For indoor condition, CO_2 level should be less than 1000 ppm. CO_2 levels are well within the limits in all places.
- In Computer Centres, the temperature settings of the air conditioners may be adjusted according to the student's occupancy. This will bring better comfort inside the room.
- ASHRAE recommends relative humidity levels between 30 and 60 percent for optimum comfort. The humidity is within the limit in most of the places. The buildings are well planned and natural circulation of air is felt in all places. Even classrooms filled with 60 students have good range of humidity.
- During the occupancy, the windows may be kept open and natural circulation of air may bring the humidity level below 70%.
- The average ambient temperature in the campus is found to be 30°C.

5. INTRODUCTION TO ENERGY AUDIT

An energy audit is an examination of the total energy used in a particular building or industry. The analysis is designed to provide a relatively quick and simple method of determining not only how much energy is being consumed but where and when. The energy audit will identify deficiencies in operating procedures and in physical facilities. Once these deficiencies have been identified, it will be apparent where to concentrate efforts in order to save energy. The energy audit is the beginning of and the basis for an effective energy-management programme. Human settlements encompass a variety of buildings. Regardless of the building involved, the audit procedure is basically the same. No two buildings are identical regarding energy usage. This is due to the possible variables affecting the buildings, e.g., occupancy rates, the building's size and orientation, its geographic location, the type of heating and cooling systems, the amount and types of equipment in use, the type of construction, the level of insulation and so on. Because each building is unique, it is difficult to generalize about energy-consumption patterns, and so it is necessary to conduct an energy audit for each building. Most buildings were probably designed, built and equipped when cheap energy was readily available. Little attention was paid to energy efficiency. Consequently, there is a great potential for improving operating costs of existing buildings.

6. LIQUID AND GASEOUS FUEL CONSUMPTION

LPG cylinders are used in the laboratories, girls' hostel and canteen. Diesel and Petrol are being used for vehicles and generator. The number of bikes and cars used per day are 250 and 20 respectively. There are 11 number of college buses. The annual usage of LPG is approximately 11000 kg.

S. No	Purpose	Fuel	Usage in Nos.	Capacity/Specification	Usage period
1.	Laboratories	LPG	7	14.2kg	1 year
2.	Girls Hostel	LPG	3	19 kg	1 month
3.	Canteen	LPG	10	19 kg	1 month
4.	Generator	Diesel	35 lit for 9 hrs	30K – 4KFWN105, Kirloskar	1 month
5.	College Vehicles	Petrol and diesel	20000 lit		1 year

7. ACTUAL MEASUREMENTS IN ELECTRICAL SYSTEM

The electrical energy consumption was verified using electricity bills. The consumption was 6117 kwh for the last assessment period. The measurements of electrical parameters were undertaken using Fluke 435Power Quality Analyzer at the plant PCC. The following relevant electrical parameters were recorded by the above instrument with the set recording sample time of 30sec interval. In addition, additional measurements were undertaken at the downstream feeders having significant Power Quality issues. The parameters monitored are:

- 3 phase average line or phase voltages
- 3 phase average line currents
- 3 phase average fundamental line or phase voltages
- 3 phase average fundamental line currents
- Frequency
- Total 3 phase reactive power in kVAR - in case of four wire output, the total three phase power alone is monitored
- Total 3 phase apparent power in kVA - in case of four wire output, the total three phase power alone is monitored
- Total average Power factor
- Percentage 3 phase voltage THD

➢ Total 3- phase active power in kW - in case of four wire output, the total three phase power alone is monitored	➢ Percentage 3 phase current THD

The summary details of the above measurements are provided in appendix. The college has sanctioned demand of 111kW.The college having the diesel operated gen-set with capacity of 30kVA (24kW) for providing power supply in case of power failure. The college has renewable energy-based power generation plant in their premises. The installed Capacity of Solar Power Plant is 17 kW. The solar panel on grid solar capacity is 12 kW and the solar capacity with UPS is 5 kW. The typical power distribution diagram is shown below.

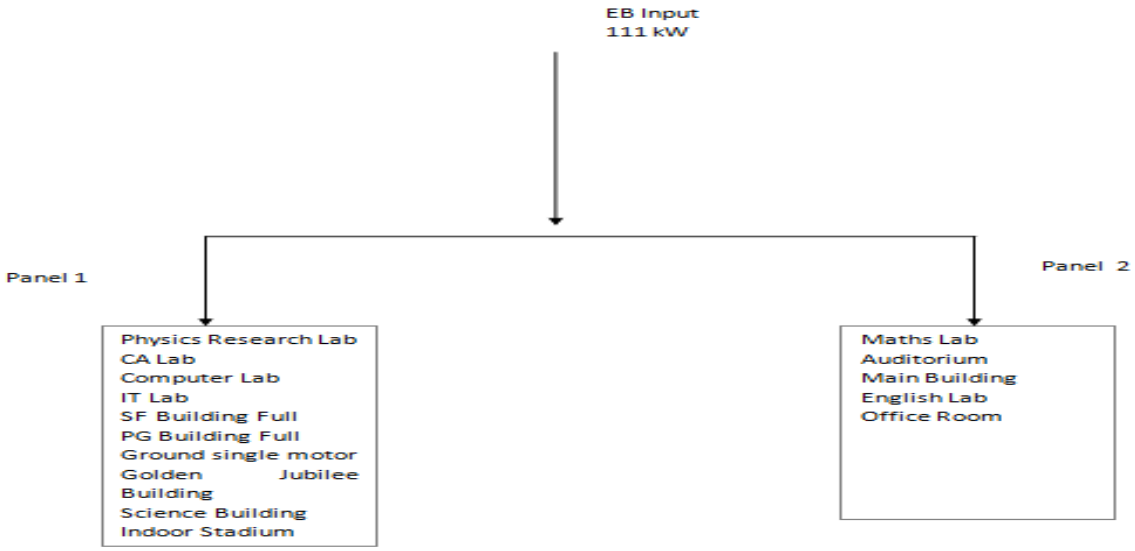


Fig.6: Power Distribution Diagram

Fig.7: Solar Power Plant

Apart for Solar PV, the college also has 2 wind turbines of 2.5 kW each. The wind power generated will be stored into battery. The battery rating used to store the power is 20 numbers with 12V, 100Ah battery.

Fig.8: Battery System

8. ANNUAL ENERGY CONSUMPTION AND CO_2 EMISSION

S.No.	Description	Type of fuel and their conversion process		
		Electrical energy consumed	Diesel	LPG
1	Annual Energy Consumption	203099.4 kWh	28310 lit	55 Nos.
2	CO_2 Emission standards	0.95 kg/kWh	2.68 kg/lit	56.2 kg/cyl.
3	Total CO_2 emission(tonne/Annum)	271.91		
4	Total No. of students and staff	2861		
5	Per capita CO_2 emission per year	0.095 tonnes (+)		
6	No. of Matured Trees	402		
7	CO_2 neutralised due to matured trees	8.84 tonnes		
8	CO_2 neutralised due to electricity generate by solar and wind energy	14.8 tonnes		
9	CO_2 to be neutralised per capita per year	0.087 tonnes (-)		

9. BEST PRACTICES

- The College has given importance to carbon neutralization by installing two wind turbines and solar PV for generating power.
- The energy is also conserved by using natural light in the classrooms. Fixation of sensor lights in the campus is under processing.
- Green transport is often practiced as an active transport system which encourages students to walk or cycle in the campus. The College has made arrangements for the parking of the vehicles of the students and staff near the entrance. With this active transport practice, the use of private vehicles on campus is reduced and thus can be a strategy to reduce traffic congestion and pollution in campus.
- Training programmes conducted on Energy Conservation, Environment Impacts and Fuel Savings for i) Students, Staffs and Faculty Members (for the specified period) by any external agencies

- The college has been maintaining seventeen rain water recharging pits. Buildings in the college are linked to a rain water storage grid with varying capacities. These rainwater recharging systems help to recharge the ground water and thus the campus gets ample increase in the amount of ground water.
- The college herbal garden was setup in an area of 4000 square feet of land where medicinal and nourishment plants are cultivated. The college has four lawns and several hedges, as well as a variety of vegetation, which adds beauty and aesthetics to the campus. A gardener is assigned to guide irrigation, weeding, and manure application.
- Drip irrigation is used as an attempt to keep the hedges and landscaping in excellent condition. In order to maintain gardens and lawns 30sprinklers have been installed. All of them have been in working conditions.

10. RECOMMENDATIONS FOR ENERGY SAVINGS AND SUSTAINABILITY

1. All Class Rooms and labs to have Display Messages regarding optimum use of electrical appliances in the room like, lights, fans, computers and projectors.
2. An internal audit team for energy and environment audit may be formed and meetings may be periodically conducted.
3. The comfort air conditioning temperature to be set between 24˚C to 26˚C.
4. Lights in toilet area may be kept OFF during day time.
5. Energy and water conservation related awareness programmes may be organized periodically.
6. Policies and procedures for handling, storage and disposal of chemicals and all types of wastes may be formulated and the same can be circulated throughout the college after getting approval from the management committee.
7. The power room has to be maintained neatly.
8. The college has APFC with installed capacity of 63 kVAR with different ratings. From the measurements, it has been observed that the power factor is nearly 0.98. But, the meter in APFC panel shows 0.86.
9. The periodic maintenance of solar panel has to be carried out. The maintenance will increase the power production capability.

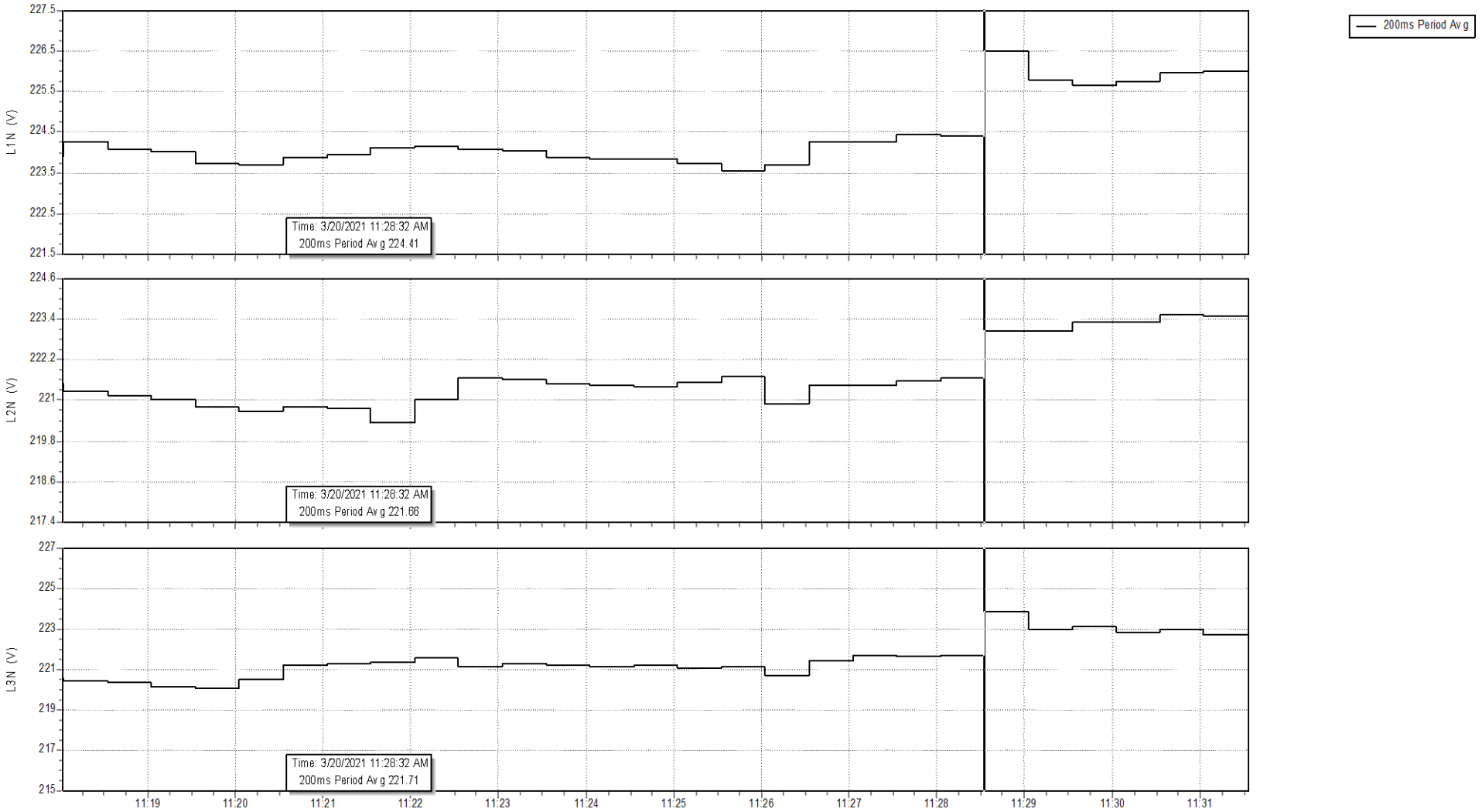
Fig.9: Solar PV

10. For electrical maintenance department, a separate technician with electrical background can be preferred.
11. EB readings, Solar power, Wind power production or consumption has to be entered in separate register and maintained properly and have to be reviewed by some faculty in-charge.
12. The periodic maintenance has to be carried out in UPS batteries and that has to be recorded in separate UPS maintenance chart.

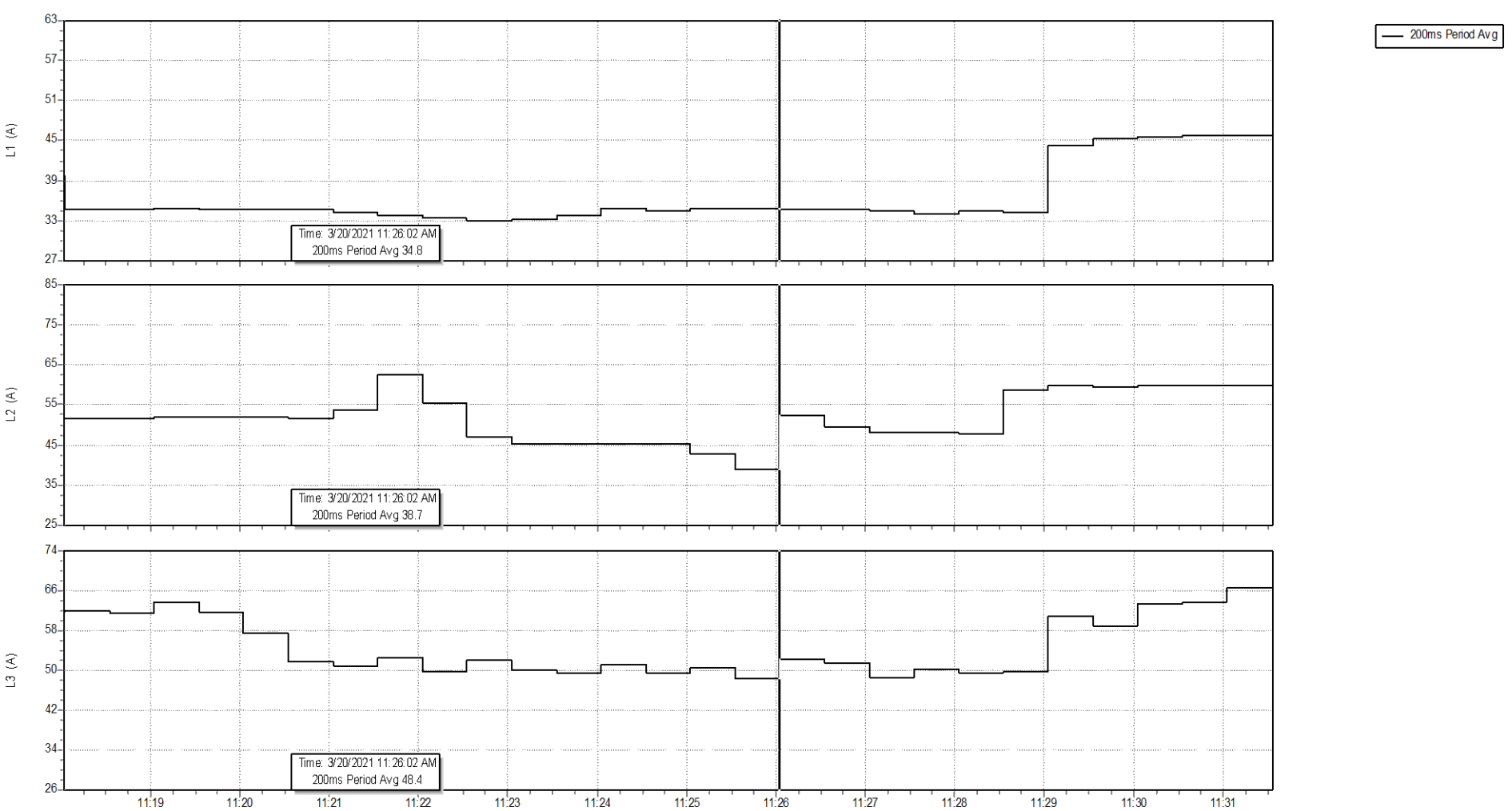
APPENDIX A-SUMMARY SHEET OF EB INPUT
BASIC ELECTRICAL PARAMETERS

Phase Voltage (L1,L2,L3) Avg V	Line Current (L1,L2,L3) Avg A	Phase Voltage (L1,L2,L3) Fundamental Avg V	Line Current (L1,L2,L3) Fundamental Avg A	%-age Voltage Un balance	%-age Current Un balance	Frequency In Hz	Active Power Total Avg in kW	Reactive Power Total Avg in kVAR	Apparent Power Total Avg in kVA	DPF	TPF	THD V Avg % age	THD A Avg % age
221.98	51.10	221.93	50.67	0.46	15.32	49.96	33.19	4.72	33.59	0.99	0.98	1.59	12.93
222.00	49.43	221.97	48.93	0.53	18.97	49.95	32.16	4.43	32.53	0.99	0.98	1.58	13.26
221.86	49.27	221.83	48.80	0.52	18.87	49.95	32.03	4.41	32.40	0.99	0.98	1.58	13.15
221.73	50.20	221.70	49.73	0.52	19.44	49.93	32.64	4.40	33.01	0.99	0.98	1.60	13.25
221.53	49.43	221.50	48.93	0.51	18.97	49.92	32.11	4.36	32.48	0.99	0.98	1.58	13.18
221.64	48.00	221.57	47.53	0.49	17.31	49.92	31.19	3.92	31.48	0.99	0.98	1.61	13.52
221.96	46.00	221.97	45.53	0.48	15.34	49.94	29.96	3.57	30.23	0.99	0.98	1.61	14.09
222.00	46.33	221.93	45.80	0.50	16.47	49.94	30.16	3.63	30.43	0.99	0.98	1.60	14.05
221.95	49.73	221.93	49.33	0.60	21.02	49.95	32.44	3.84	32.72	0.99	0.98	1.61	13.26
222.25	46.13	222.20	45.67	0.51	18.03	49.95	29.95	3.41	30.19	0.99	0.98	1.55	12.96
222.30	44.00	222.30	43.33	0.45	15.82	49.96	28.36	4.11	28.79	0.99	0.97	1.64	15.60
222.32	42.80	222.30	42.20	0.42	13.68	49.97	27.83	3.69	28.12	0.99	0.98	1.62	15.41
222.21	42.83	222.17	42.20	0.40	12.86	49.98	27.83	3.63	28.11	0.99	0.98	1.63	15.70
222.14	43.77	222.13	43.07	0.40	12.50	49.97	28.43	3.63	28.71	0.99	0.98	1.66	16.32
222.15	43.10	222.13	42.47	0.41	12.67	49.97	27.97	3.68	28.27	0.99	0.98	1.64	16.29
222.12	42.70	222.07	42.20	0.36	11.44	49.97	27.81	3.03	28.03	0.99	0.98	1.62	15.32
222.13	40.63	222.10	40.27	0.34	9.21	49.98	26.73	2.08	26.81	1.00	0.99	1.50	12.68
221.78	46.37	221.73	45.33	0.53	18.39	49.99	29.39	5.21	30.08	0.98	0.96	1.75	18.51
222.39	45.13	222.33	44.40	0.47	15.43	49.99	29.16	4.40	29.59	0.99	0.97	1.73	17.59
222.47	43.70	222.43	43.13	0.45	13.89	49.99	28.40	3.81	28.72	0.99	0.97	1.66	16.13
222.54	44.07	222.50	43.47	0.45	14.11	49.99	28.68	3.81	28.99	0.99	0.98	1.67	16.10
222.59	43.87	222.50	43.27	0.44	13.67	50.00	28.52	3.73	28.83	0.99	0.98	1.66	16.08
224.48	47.53	224.40	46.87	0.54	18.88	50.00	31.17	4.29	31.53	0.99	0.98	1.67	15.33
223.95	54.97	223.93	54.47	0.48	12.97	49.99	36.01	5.56	36.49	0.99	0.98	1.64	13.18
224.04	54.60	224.00	54.00	0.46	11.70	49.96	35.79	5.72	36.29	0.99	0.98	1.61	13.04
223.98	56.23	223.93	55.67	0.49	12.31	49.97	36.89	5.84	37.39	0.99	0.98	1.64	12.92

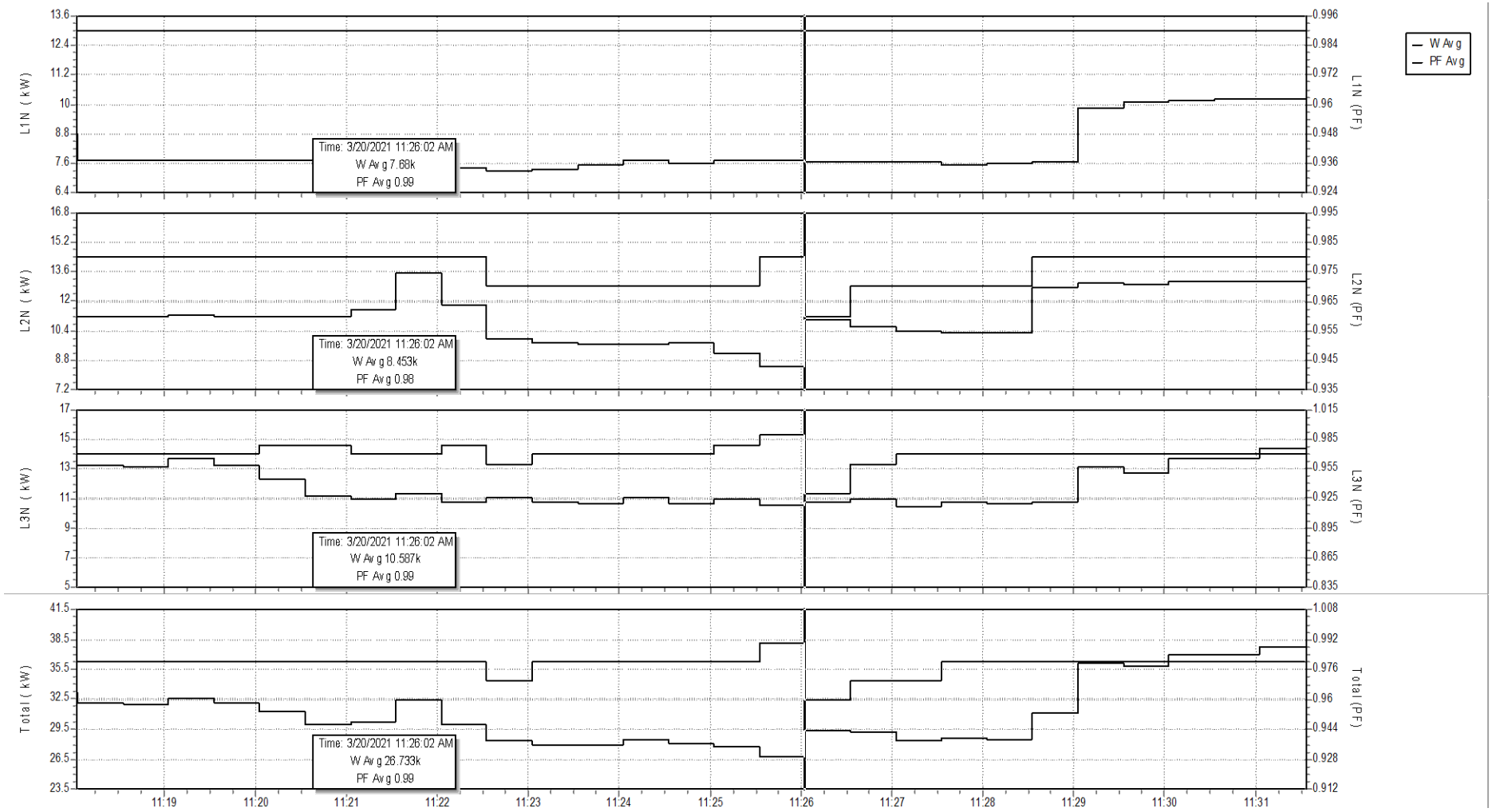
APPENDIX B-TREND CURVES FOR VARIOUS PARAMETERS (VOLTAGE CURVE)



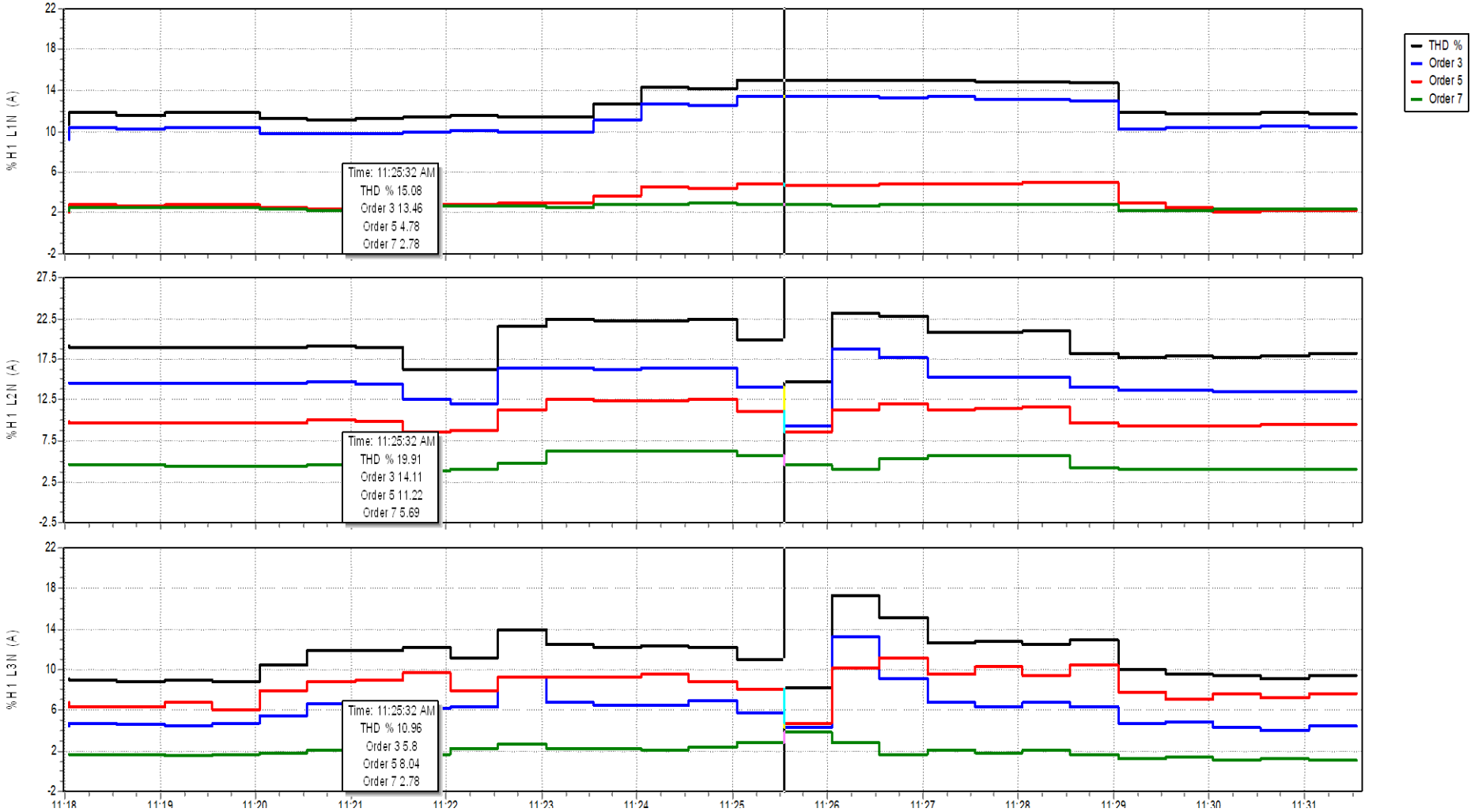
APPENDIX C-CURRENT CURVE



APPENDIX D -POWER AND POWER FACTOR



APPENDIX E -CURRENT HARMONICS CURVE

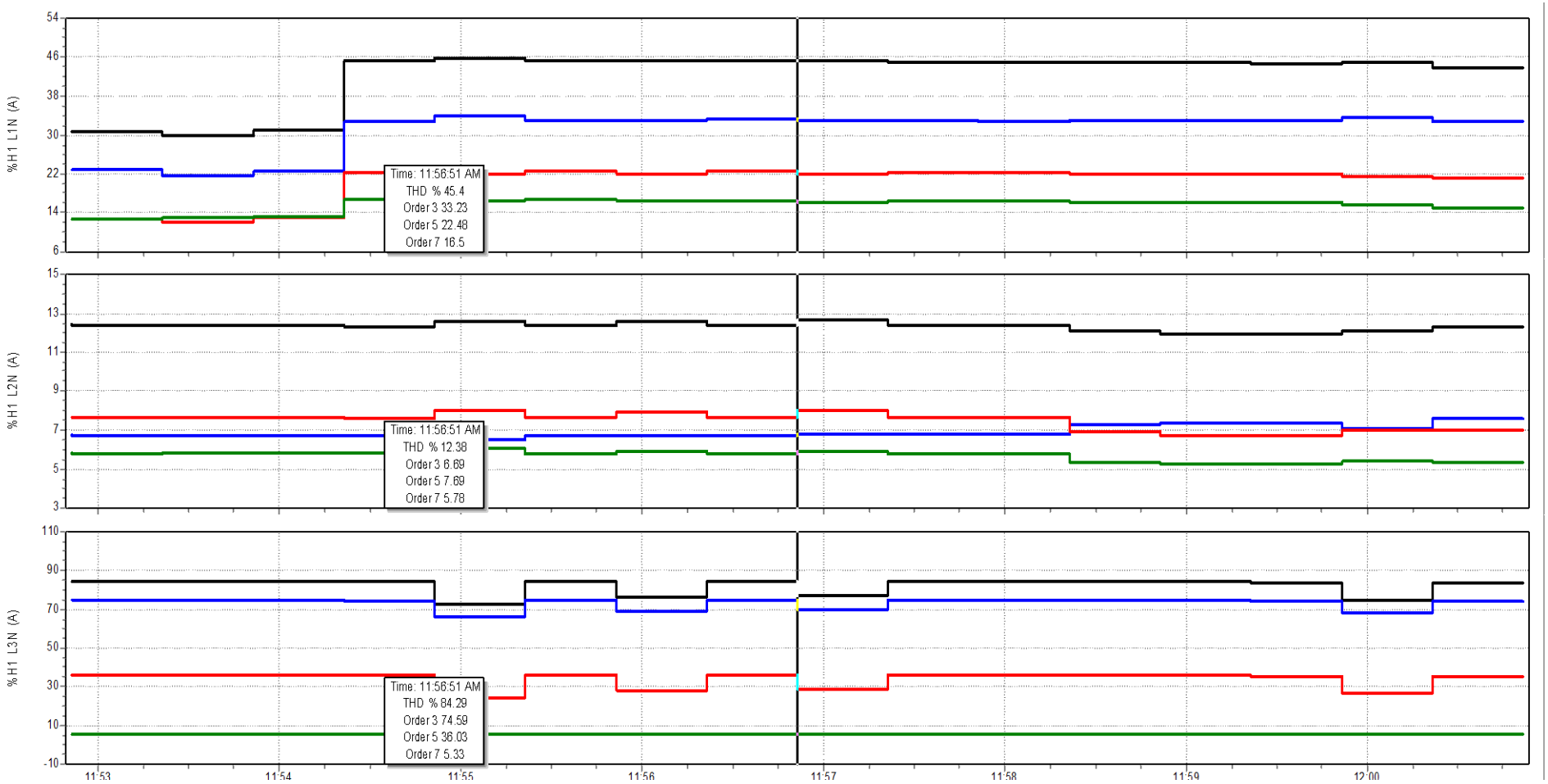


APPENDIX F -SUMMARY SHEET OF BASIC ELECTRICAL PARAMETERS IN AUDITORIUM

Phase Voltage (L1,L2,L3) Avg V	Line Current (L1,L2,L3) Avg A	Phase Voltage (L1,L2,L3) Fundamental Avg V	Line Current (L1,L2,L3) Fundamental Avg A	%-age Voltage Un balance	%-age Current Un balance	Frequency In Hz	Active Power Total Avg in kW	Reactive Power Total Avg in kVAR	Apparent Power Total Avg in kVA	DPF	TPF	THD V Avg % age	THD A Avg % age
222.30	8.73	222.30	7.93	0.67	91.43	49.95	4.61	0.89	5.21	0.89	0.79	1.75	42.57
222.16	8.73	222.13	7.87	0.68	91.43	49.96	4.60	0.88	5.20	0.88	0.79	1.75	42.57
221.97	8.73	221.93	7.93	0.57	91.59	49.96	4.60	0.89	5.20	0.88	0.79	1.75	42.22
222.04	8.70	222.00	7.80	0.58	91.97	49.96	4.59	0.89	5.19	0.88	0.79	1.73	42.65
221.99	8.90	221.97	8.07	0.59	93.52	49.97	4.59	0.99	5.20	0.88	0.78	1.73	47.20
221.89	10.10	221.87	9.13	0.60	92.10	49.99	4.99	1.44	5.80	0.86	0.77	1.72	43.65
222.00	8.67	221.97	7.73	0.58	93.72	49.99	4.51	0.93	5.11	0.88	0.78	1.72	47.38
222.01	9.80	222.00	8.87	0.61	92.49	50.01	4.88	1.31	5.63	0.87	0.77	1.73	44.75
222.12	8.60	222.07	7.73	0.65	93.69	50.02	4.48	0.93	5.08	0.88	0.78	1.74	47.36
222.01	9.63	222.00	8.67	0.72	92.71	50.01	4.80	1.27	5.53	0.87	0.77	1.75	44.90
222.04	8.63	222.00	7.67	0.71	93.80	49.99	4.48	0.93	5.08	0.88	0.78	1.74	47.29
222.21	8.63	222.17	7.67	0.70	93.86	50.02	4.48	0.93	5.08	0.88	0.78	1.74	47.27
222.26	8.70	222.23	7.73	0.71	93.92	50.02	4.52	0.93	5.12	0.88	0.78	1.75	47.21
222.55	8.70	222.50	7.80	0.71	93.97	50.02	4.53	0.93	5.13	0.88	0.78	1.75	47.13
222.53	8.77	222.50	7.80	0.71	93.98	50.05	4.56	0.96	5.17	0.88	0.78	1.78	46.89
222.19	10.17	222.20	9.20	0.71	92.44	50.08	5.03	1.40	5.81	0.87	0.77	1.76	43.99

APPENDIX G -TREND CURVES FOR VARIOUS PARAMETERS

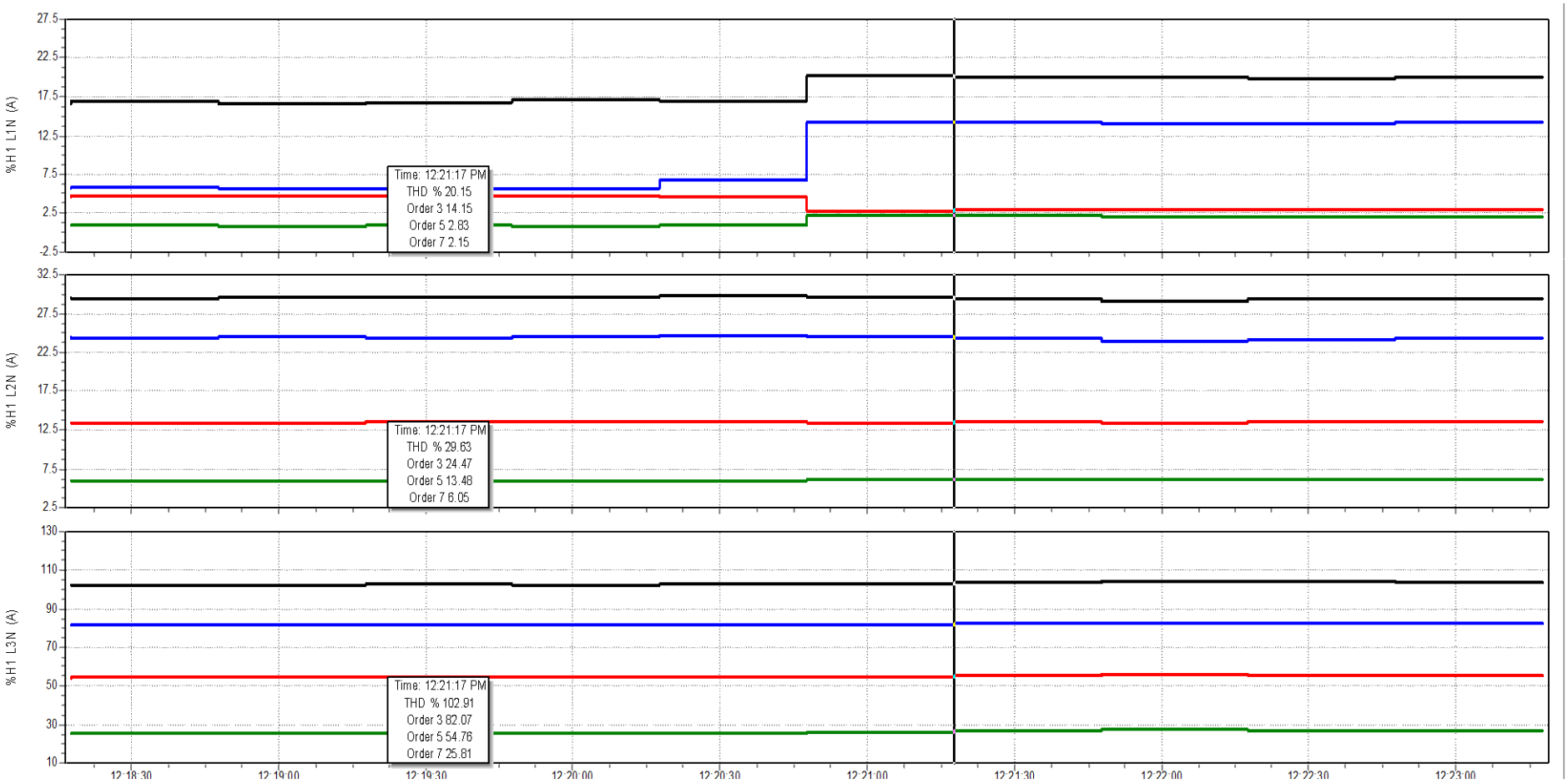
CURRENT HARMONICS CURVE



APPENDIX H -SUMMARY SHEET OF BASIC ELECTRICAL PARAMETERS IN IT LAB

Phase Voltage (L1,L2,L3) Avg V	Line Current (L1,L2,L3) Avg A	Phase Voltage (L1,L2,L3) Fundamental Avg V	Line Current (L1,L2,L3) Fundamental Avg A	%-age Voltage Un balance	%-age Current Un balance	Frequency In Hz	Active Power Total Avg in kW	Reactive Power Total Avg in kVAR	Apparent Power Total Avg in kVA	DPF	TPF	THD V Avg % age	THD A Avg % age
222.16	15.57	222.10	14.13	0.59	62.71	49.91	7.92	2.84	9.39	0.84	0.76	1.70	49.42
222.41	15.53	222.37	14.13	0.58	63.07	49.91	7.89	2.85	9.36	0.84	0.76	1.69	49.50
222.42	15.50	222.37	14.00	0.59	62.70	49.90	7.91	2.83	9.36	0.84	0.77	1.70	49.46
222.56	15.47	222.53	14.00	0.56	62.66	49.89	7.91	2.83	9.36	0.85	0.77	1.71	49.62
222.45	15.47	222.43	13.93	0.56	62.67	49.90	7.88	2.83	9.33	0.84	0.76	1.70	49.75
222.80	14.80	222.73	13.33	0.59	76.05	49.90	7.16	2.67	8.60	0.83	0.74	1.72	49.78
223.21	12.23	223.17	10.47	0.65	107.97	49.90	5.59	2.27	6.97	0.80	0.69	1.72	50.90
223.51	12.07	223.43	10.33	0.66	107.91	49.90	5.53	2.24	6.89	0.80	0.69	1.71	51.03
223.63	11.97	223.60	10.20	0.64	107.84	49.92	5.51	2.19	6.83	0.81	0.69	1.71	51.22
223.71	12.03	223.67	10.27	0.64	107.88	49.92	5.52	2.23	6.87	0.80	0.69	1.70	51.09

APPENDIX I -CURRENT HARMONICS CURVE



End of the Report

Thank You