

Energy Audit Report of

Bharati Vidyapeeth's

College of Engineering for Women

Pune-Satara Road, Dhankawadi, Pune – 411043



**Principal
Prof.Dr.S.R.Patil**

I/C PRINCIPAL
Bharati Vidyapeeth's
College of Engineering for Women
Pune-Satara Road, Pune-411043.

Auditing Agency –
Prathamesh Energy Solution,
A-302, Shiv Unnati Residency,
Kalepadal, Hadapsar
Pune- 411 028

Prathamesh Energy Solution

A-302, Shiv Unnati residency, Kalepadal, Hadapsar, Pune-411028

Ref: PES/BVCOEW/2022-23/14

Date:

To,

The Principal
Bharati Vidyapeeth's
College of Engineering for Women
Pune-Satara Road, Dhankawadi, Pune – 411043

Sub: Submission of Report on Energy Audit of College Campus

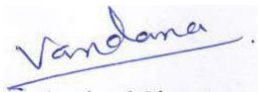
Respected Sir,

Please find enclosed herewith the report

Thanking you

Yours faithfully

For Prathamesh Energy Solution



Authorized Signatory



Prathamesh Energy Solution

A-302, Shiv Unnati Residency, Kalepadal, Hadapsar, Pune 411028

Ref: EC/BVCOEW /22-23/10

CERTIFICATE

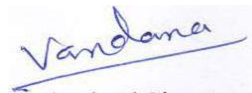
This is to certify that we have conducted Energy Audit at **Bharati Vidyapeeth's College of Engineering for Women, Pune-Satara Road, Dhankawadi, Pune**, in the Academic year 2022-23

.The College has adopted following Energy Efficient practices:

- Usage of Energy Efficient LED Fittings
- Maximum usage of Day Lighting
- Installation of Roof Top Solar PV Plant.
- Green Campus
- Rain water Harvesting system

We appreciate the support of Management, involvement of faculty members and students in the process of making the Campus Energy Efficient.

For,



Prathamesh Energy Solution,



MAHARASHTRA ENERGY DEVELOPMENT AGENCY



Maharashtra Energy Development Agency

(Government of Maharashtra Institution)

Aundh Road, Opposite Spicer College Road, Near Commissionerate of Animal Husbandary,

Aundh, Pune, Maharashtra 411067

Ph No: 020-35000450

Email: eee@mahaurja.com, Web: www.mahaurja.com

ECN/2021-22/CR-13/3273

29th June, 2021

**CERTIFICATE OF REGISTRATION
FOR CLASS 'A'**

We hereby certify that, the firm having following particulars is registered with **MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)** under given category as "Energy Planner & Energy Auditor" in Maharashtra for Energy Conservation Programme of MEDA.

Name and Address of the firm : M/s Prathamesh Energy Solution
A-302, Shiv Unnati Residency,
Opposite to Indryani Managal Karyalya Kalepadal,
Hadapsar, Pune-411028.

Registration Category : *Empanelled Consultant for Energy Conservation Programme for Class 'A'*

Registration Number : *MEDA/ECN/2021-22/Class A/EA-04*

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit at any time without giving prior information to verify quarterly activities performed by the firm and canceling the registration, if the information is found incorrect.
- This empanelment is valid till **28th June, 2023** from the date of registration, to carry out energy audits under the Energy Conservation Programme
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.


General Manager (EC)

INDEX

Sr. No	Particulars	Page No
I	Acknowledgement	6
II	Executive Summary	7
III	Abbreviations	10
1	Introduction	11
2	Study of Connected Load	12
3	Historical Data Analysis- Electrical Energy	13
4	Carbon foot printing	16
5	Electrical Measurements	19
6	Scope of renewable energy and efficient facility at college campus	33
8	Suggestions and Recommendations	38



Principal
Prof.Dr.S.R.Patil

I/C PRINCIPAL
Bharati Vidyapeeth's
College of Engineering for Women
Pune-Satara Road, Pune-411 043.

ACKNOWLEDGEMENT

We at Prathamesh Energy Solution, Pune, express our sincere gratitude to the management and Principal of Bharati Vidyapeeth's College of Engineering for Women, Dhankawadi, Pune for awarding us the assignment of Energy Audit of their College campus located at Pune-Satara Road, Dhankawadi, Pune.

We are very much thankful to Dr. S. R. Patil, Principal, Bharati Vidyapeeth's College of Engineering for Women, Dhankawadi, Pune for giving us opportunity to conduct detailed energy audit of the institute and provide all the required data and information promptly for the smooth conduction of detailed energy and green audit.

We are also thankful to various Heads of Departments, IQAC Coordinator & other Staff members for helping us during the field measurements.

We are also thankful to all the technical staff and office staff for helping during the measurements at the electrical distribution center.

EXECUTIVE SUMMARY

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the CO₂ emissions

1. Bharati Vidyapeeth's College of Engineering for Women, Dhankawadi, Pune, consumes electrical Energy in majority used for various gadgets & office operations.

2. The various projects already implemented by the College are

- Installed solar roof top plant of capacity @50kWp on college of Engineering building roof. At present solar roof top is with net metering and it is meeting requirement of electricity demand of college hostel building in the premises college.
- Installed APFC of 100kVAR at Main electrical distribution to maintain Power factor.
- Usage of natural day lights and natural air circulation
- Usage of Natural Day light in corridors specifically
- Usage of LED lighting for Admin & outdoor lighting
- Fire extinguishers are installed and maintained for fire safety in the college campus.

3. Important Parameters: Electrical Energy:

Electricity is used for different purposes and at different sections in the college campus. The details of electricity distribution as mentioned below.

Sr. No.	Consumer No.	Electrical Meter No.	Location/Purpose	Payee
1	170019005146	055-XD448280	College building/building operation	Principal, Bharati Vidyapeeth

The important parameters of electrical consumption as per Consumer no. in the campus are mentioned as below.

Sr. No	Consumer No.	Parameter	Max	Min	Average
1	170019005146	Units consumed, kWh	15304	4031	9262
		Electricity Bill amount	338063	197052	258911.4
		Total average units consumed per month, kVAh			9262

4. Important Parameters: CO₂ Emissions (Average, MT/Annum)

No	Consumer No.	Particulars	Value MT
1	170019005146	CO ₂ - Emissions- Electricity Usage	88.92
		Total	88.92

On the basis of average electricity consumption CO₂ emission is 59.08MT /annum. In addition to this LPG is being consumed for canteen for food preparation. Nearly LPG consumption annually is 12 commercial cylinders i.e. 228 kg/annum. On the basis of average LPG usage CO₂ emission is 0.68MT/annum.

5. Benchmark: In terms of Electrical Energy & CO₂ emissions:

We now present two important benchmarks in respect of Electrical Energy consumption & CO₂ emissions as under.

No	Particulars	Value	Unit
1	Electrical Energy consumed	0.111	kWh/sq. ft.
3	CO ₂ - Emissions	1.07	Kg per annum /sq. ft.

6. Recommendations:

We present herewith various proposals to reduce the Electrical Energy demand and reduce the CO₂ emissions

No	Recommendation	Annual saving potential in kWh /Kg of LPG	Annual Saving Potential in MT of CO ₂	Annual monetary gain, Rs.
1	Installation of 50kW Solar PV roof top on college building	84000 kWh	67.2	840000
2	Solar street lights	262.8 kWh	0.21	2628
3	Solar powered light for hoarding	-	-	-
4	Solar charging stations	-	-	-
	Total	84262.8	67.41	842628

Notes & assumptions:

- 1 Unit of Electrical Energy releases 0.8 Kg of CO₂ into atmosphere
- 1 Kg of LPG releases 3 Kg of CO₂ into atmosphere

3. Daily working hours-10
4. Annual working Days-280
5. Average Rate of Electrical Energy- Rs 10 per kWh

ABBREVIATIONS

DP	: Double Pole
CFL	: Compact Fluorescent Lamp
EESL	: Energy Efficiency Services Limited
F P	: Feeder Pillar
MSEDCL	: Maharashtra State Electricity Distribution Company Ltd.
MEDA	: Maharashtra Energy Development Agency
MIDC	: Maharashtra Industrial Development Corporation
V	: Voltage
I	: Current
kW	: kilo-Watt
kVA	: Apparent Power
kVAr	: Reactive Power
P F	: Power Factor
kWp	: Kilo Watt peak

CHAPTER-I

ENERGY AUDIT: INTRODUCTION

1.1 Objectives:

1. To study present level of Energy Consumption
2. To Study the present CO₂ emissions
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To measure various Electrical parameters
5. To study Scope for usage of Renewable Energy
6. To study various measures to reduce the Energy Consumption

1.2 Audit Methodology:

1. Study of connected load
2. Study of various Electrical parameters
3. To prepare the Report with various ENCON measures with payback analysis

1.3 Energy Audit Instruments:

1. Portable Power Analyzer
2. Lux meter
3. Anemometer
4. Digital Temperature Indicator
5. CO₂ Meter
6. Water TDS meter

1.4 General Details of Bharati Vidyapeeth's College of Engineering for Women, Pune:

No	Head	Particulars
1	Name of Institution	Bharati Vidyapeeth's College of Engineering for Women, Pune
2	Address	Pune-Satara Road, Dhankawadi, Pune
3	Year of Establishment	2000
4	Salient Features	Affiliated to Savitribai Phule Pune University
4	Courses offered	Computer Engineering, E&TC Engineering Information Technology
5	No of Students	1039
6	Total built up area	82817.53 Sq. ft.

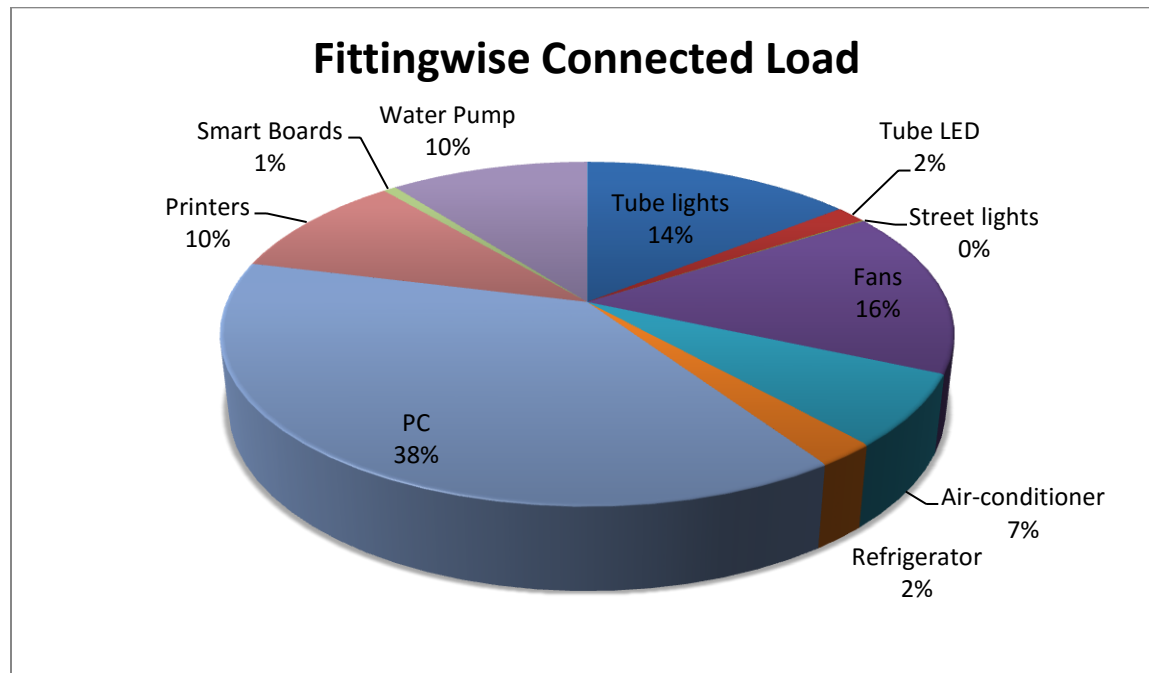
CHAPTER-II STUDY OF CONNECTED LOAD

In this chapter, we present the details of various Electrical loads as under

2.1 Study of Fitting wise Connected Load:

No	Type of Fitting	Load/Unit	Qty	Load in kW
1	Tube lights	40	477	19.1
2	Tube LED	18	124	2.2
3	Street lights	30	3	0.1
4	Fans	66	316	20.9
5	Air-conditioner	1500	6	9.0
6	Refrigerator	1500	2	3.0
7	PC	150	342	51.3
8	Printers	200	67	13.4
9	Smart Boards	220	04	0.9
10	Water Pump	3500	4	14.0
	Total			133.8

We present the same in a PIE Chart as under



CHAPTER-III

HISTORICAL DATA ANALYSIS: ELECTRICAL ENERGY

In this chapter, we present the analysis of last year Electricity Bills

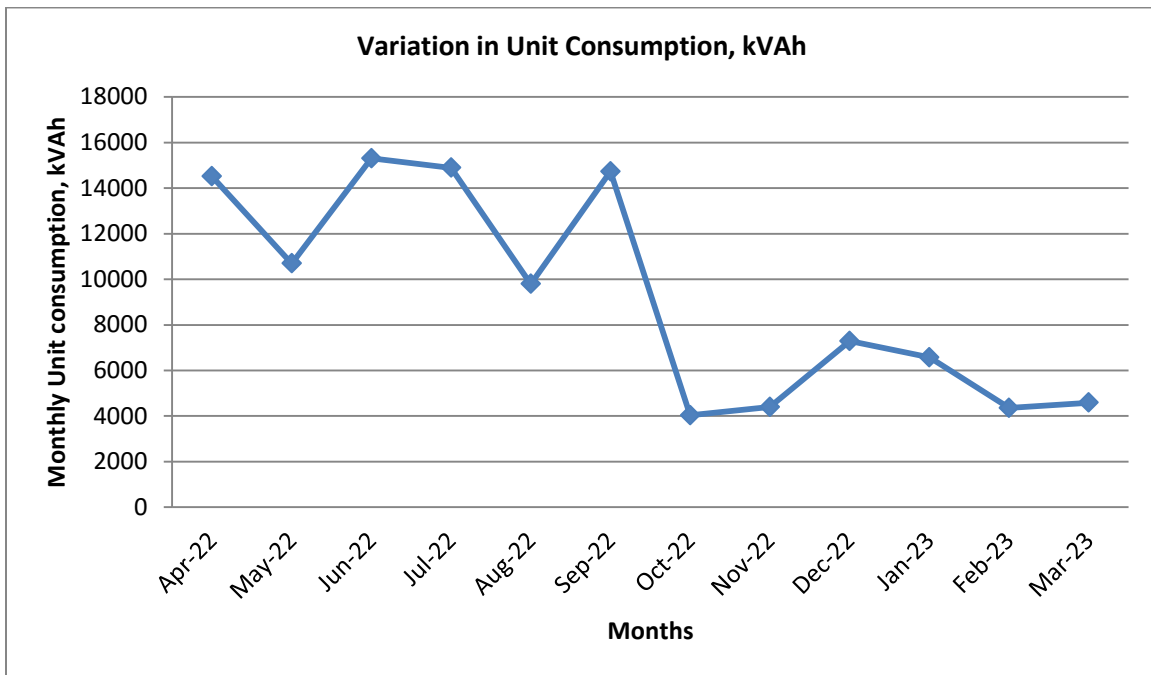
3.1 Consumer No. 170019005146

This consumer is the major contributors for billing. Monthly consumption for last few months and bill amount is as follows.

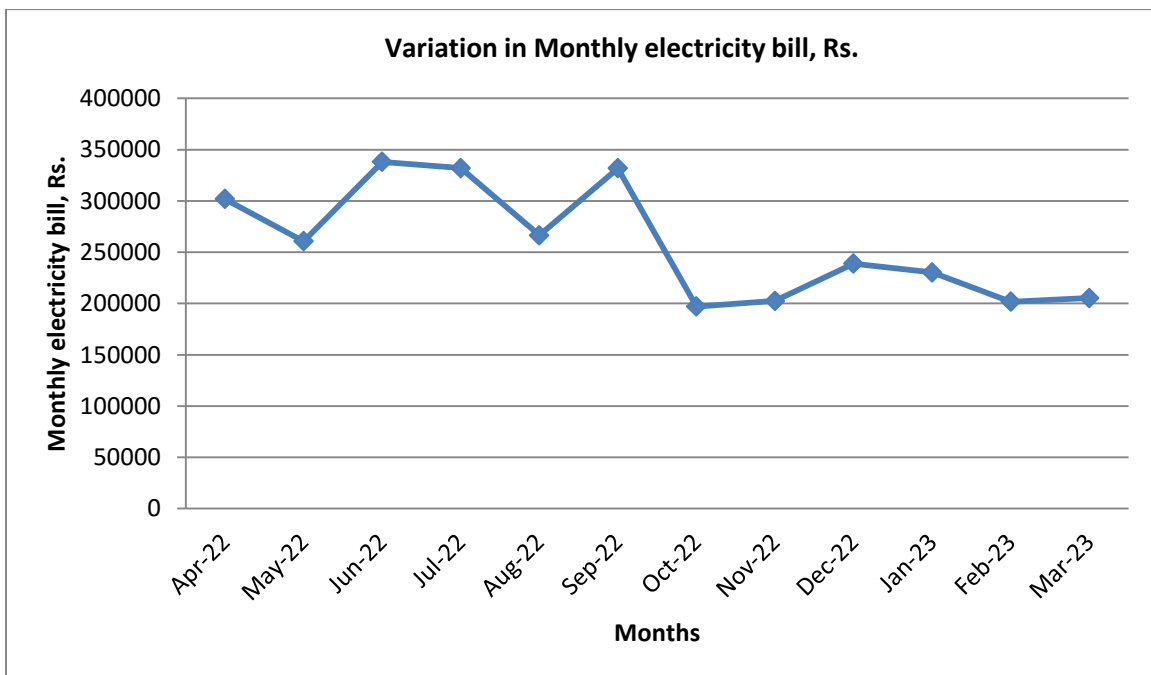
Table No. 1: Electrical Bill Analysis- 2022-23: 170019005146

Sr. No	Month	kVAh	Amount
1	March-23	4583	205282
2	Feb-23	4351	201792
3	Jan-23	6573	230262
4	Dec-22	7286	238828
5	Nov-22	4397	202461
6	Oct-22	4031	197052
7	Sep-22	14731	331950
8	Aug-22	9795	266537
9	July-22	14890	332007
10	June-22	15304	338063
11	May-22	10691	260792
12	April-22	14512	301911
13	Total	111144	3106937
14	Average	9262	258911.4
15	Max	15304	338063
16	Min	4031	197052

3.1.1 To study the variation of Monthly Units' Consumption:



3.1.2 To study the variation of Monthly Electricity Bill:



3.2 Summary:

Sr. No.	Consumer No.	Annual Electricity Consumption, kVAh	Annual Bill, Rs
1	170019005146	111144	3106937

3.3 Key Inference drawn:

From the above analysis, we present following important parameters:

Sr. No	Consumer No.	Parameter	Max	Min	Average
1	170019005146	Units consumed, kWh	15304	4031	9262
		Electricity Bill amount	338063	197052	258911.4
		Total average units consumed per month, kVAh			9262

3.4 Benchmarking:

Now we compute the Electrical Energy Consumed per square feet of the College Building as under

No	Parameter	Value	Unit
1	Units consumed, kWh	9262	kWh
2	College area	82817.53	Sq. ft.
3	Unit consumed/sq. ft.	0.111	kWh/sq. ft.

CHAPTER-IV

CARBON FOOTPRINTING

A **Carbon Foot print** is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities. The college uses electrical energy for operating various electrical gadgets.

We herewith furnish the details of electrical Energy consumption consumer number wise as under

4.1 Month wise Consumption of Electrical Energy: 170019005146

Sr. No	Month	kVAh
1	March-23	4583
2	Feb-23	4351
3	Jan-23	6573
4	Dec-22	7286
5	Nov-22	4397
6	Oct-22	4031
7	Sep-22	14731
8	Aug-22	9795
9	July-22	14890
10	June-22	15304
11	May-22	10691
12	April-22	14512
13	Total	111144
14	Average	9262
15	Max	15304
16	Min	4031

4.2 Basis for computation of CO₂ Emissions:

The basis of Calculation for CO₂ emissions due to Electrical Energy are as under

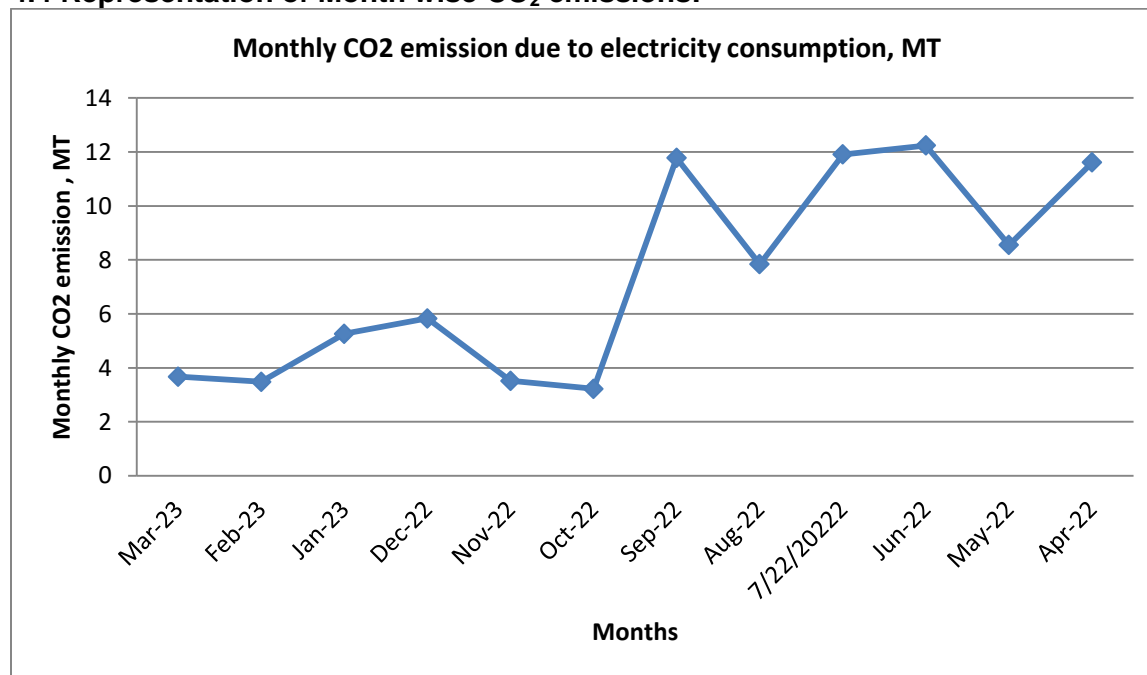
- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of CO₂** into atmosphere

Based on the above Data we compute the CO₂ emissions which are being released in to the atmosphere by the College due to its Day to Day operations.

4.3 Month wise CO2 Emissions: 170019005146

Sr. No	Month	Electrical Energy Consumed, kVAh	CO2 Emissions due to Electricity, MT
1	March-23	4583	3.67
2	Feb-23	4351	3.48
3	Jan-23	6573	5.26
4	Dec-22	7286	5.83
5	Nov-22	4397	3.52
6	Oct-22	4031	3.22
7	Sep-22	14731	11.78
8	Aug-22	9795	7.84
9	July-22	14890	11.91
10	June-22	15304	12.24
11	May-22	10691	8.55
12	April-22	14512	11.61
13	Total	111144	88.92
14	Average	9262	7.41
15	Max	15304	12.24
16	Min	4031	3.22

4.4 Representation of Month wise CO₂ emissions:



4.5 Benchmarking:

Now we compute the CO₂ emissions per sq. ft. basis as under:

No	Parameter	Value	Unit
1	CO ₂ emissions	88.92	MT/annum
2	College area	82817.53	Sq. ft.
3	CO ₂ emissions/sq. ft.	1.07	Kg of CO ₂ per annum/sq. ft.

CHAPTER-V

ELECTRICAL MEASUREMENTS

In this Chapter, we present the details of measurements at the distribution center and meter room of Bharati Vidyapeeth's College of Engineering for Women, Pune

5.1 Measurement at Main Incomer feeder:

With the help of power analyzer various electrical parameters like voltage, current, KW and PF are measured. The sample extract of measured data is as follows.

Recording																		
Date:	Time:	U12 rms	U23 rms	U31 rms	A1 rms	A2 rms	A3 rms	PT (kW)	PF1	PF2	PF3	PFT	V1 THDf	V2 THDf	V3 THDf	A1 THDf	A2 THDf	
		V	V	V	A	A	A	kW					% f	% f	% f	% f	% f	
22-05-2023	12:15:00	410	411.4	413.5	21.07	21.9	16.01	13.66	0.96	0.98	0.99	0.98	2.3	1.7	1.7	17.3	7.2	
22-05-2023	12:15:05	410	411.9	414.1	20.99	21.9	16.1	13.69	0.96	0.98	0.99	0.98	2.1	1.8	1.6	17.5	6.8	
22-05-2023	12:15:10	411	412.2	414.5	20.96	21.9	16.12	13.7	0.96	0.98	0.99	0.98	2.2	1.8	1.6	17.5	6.7	
22-05-2023	12:15:15	411	412.6	415	20.89	21.9	16.09	13.68	0.97	0.98	0.99	0.98	2.2	1.8	1.7	17.3	6.9	
22-05-2023	12:15:20	411	412.3	414.6	20.85	21.8	16.07	13.65	0.97	0.98	0.99	0.98	2.2	1.8	1.7	17.2	6.9	
22-05-2023	12:15:25	410	412	414.4	20.88	21.9	16.2	13.68	0.96	0.98	0.99	0.98	2.2	1.7	1.7	17.2	6.9	
22-05-2023	12:15:30	411	412.2	414.5	20.9	21.9	16.36	13.73	0.96	0.98	0.99	0.98	2	1.5	1.4	17	6.6	
22-05-2023	12:15:35	411	412.1	414.4	20.88	21.9	16.48	13.76	0.96	0.98	0.99	0.98	2	1.5	1.5	17	6.6	
22-05-2023	12:15:40	410	411.8	414.3	20.83	22	16.55	13.76	0.96	0.98	0.99	0.98	2.2	1.8	1.7	17	7.2	
22-05-2023	12:15:45	410	411.7	414.4	20.79	22	17.13	13.9	0.96	0.98	0.99	0.98	2.2	1.8	1.7	16.8	7.2	
22-05-2023	12:15:50	410	411.9	414.3	20.79	22	17.18	13.91	0.96	0.98	0.98	0.97	2.2	1.8	1.7	17.1	7.4	
22-05-2023	12:15:55	410	411.9	414.2	20.78	22	17.09	13.89	0.96	0.98	0.99	0.98	2.3	1.8	1.7	16.9	7.2	
22-05-2023	12:16:00	410	411.5	413.7	20.78	22	17.19	13.89	0.96	0.98	0.98	0.97	2	1.6	1.6	16.8	6.9	
22-05-2023	12:16:05	410	411.4	413.7	20.78	22.1	17.23	13.92	0.96	0.98	0.98	0.97	2	1.5	1.5	16.9	6.9	
22-05-2023	12:16:10	409	411.1	413.6	20.84	22.2	17.21	13.94	0.96	0.98	0.98	0.97	2.1	1.7	1.7	17	7.1	
22-05-2023	12:16:15	409	411.2	413	20.82	22.1	17.19	13.91	0.96	0.98	0.98	0.97	2.2	1.7	1.8	17.2	7.3	
22-05-2023	12:16:20	410	411.6	414	20.85	22	17.15	13.92	0.96	0.98	0.98	0.98	2.3	1.8	1.7	17.1	7.1	
22-05-2023	12:16:25	411	412	414.7	20.83	22	17.04	13.91	0.97	0.98	0.99	0.98	2.3	1.8	1.7	17	7.2	
22-05-2023	12:16:30	410	412	414.2	20.86	22	17.03	13.9	0.96	0.98	0.99	0.97	2.2	1.7	1.6	17.6	7.3	
22-05-2023	12:16:35	411	412	414.4	20.81	22	17.04	13.88	0.96	0.98	0.99	0.97	2.2	1.7	1.6	17.2	7.1	

22-05-2023	12:16:40	410	411.7	414.1	20.8	22	17.04	13.87	0.96	0.98	0.99	0.97	2.2	1.7	1.7	17.4	7.3
22-05-2023	12:16:45	410	411.7	413.8	20.82	21.9	17.03	13.84	0.96	0.98	0.99	0.97	2.2	1.7	1.7	17.4	7
22-05-2023	12:16:50	410	411.9	413.9	20.82	22.1	17.07	13.92	0.96	0.98	0.99	0.98	2.2	1.8	1.8	17.1	7.1
22-05-2023	12:16:55	410	412	414.1	20.8	22	17.07	13.89	0.97	0.98	0.99	0.98	2.2	1.8	1.8	16.9	7.2
22-05-2023	12:17:00	411	412.4	414.4	20.78	22	17.04	13.89	0.96	0.98	0.99	0.98	2.3	1.8	1.8	17.1	7.3
22-05-2023	12:17:05	411	412.3	414.4	20.78	22	16.98	13.88	0.96	0.98	0.99	0.98	2.3	1.8	1.8	17.1	7.2
22-05-2023	12:17:10	410	412.1	414	20.75	21.9	17.01	13.85	0.96	0.98	0.99	0.98	2.2	1.7	1.8	17	7
22-05-2023	12:17:15	411	413.1	415.2	20.74	22.1	17	13.93	0.96	0.98	0.99	0.98	2.2	1.8	1.6	17.4	7.2
22-05-2023	12:17:20	412	413.5	415.6	20.8	22	16.99	13.93	0.96	0.98	0.99	0.97	2.2	1.7	1.7	17.6	7.3
22-05-2023	12:17:25	411	412.9	415	20.68	22	16.96	13.87	0.96	0.98	0.99	0.98	2.2	1.7	1.6	17.3	7.2
22-05-2023	12:17:30	412	413.3	415.3	20.65	22	17	13.89	0.97	0.98	0.99	0.98	2.2	1.7	1.7	16.8	6.9
22-05-2023	12:17:35	412	413.2	414.7	20.66	21.9	16.99	13.85	0.97	0.98	0.99	0.98	2.1	1.8	1.7	16.9	7
22-05-2023	12:17:40	412	413.3	415.1	20.72	22.2	17.04	13.94	0.97	0.98	0.99	0.98	2.2	1.8	1.8	16.9	7.2
22-05-2023	12:17:45	412	413.2	415.3	20.73	22.1	16.96	13.9	0.97	0.98	0.99	0.98	2.1	1.6	1.5	16.8	7.1
22-05-2023	12:17:50	412	413.6	415.5	20.76	22.1	17	13.95	0.96	0.98	0.99	0.98	2	1.4	1.5	16.9	7.1
22-05-2023	12:17:55	411	413	414.9	20.76	21.9	17.05	13.89	0.96	0.98	0.99	0.97	2	1.5	1.5	17	7.2
22-05-2023	12:18:00	412	413.1	415.2	20.76	21.9	17.05	13.89	0.96	0.98	0.99	0.97	2.2	1.7	1.7	17.1	7.3
22-05-2023	12:18:05	412	414	416.6	20.78	22.2	17.02	14.01	0.97	0.98	0.99	0.98	2	1.6	1.7	16.6	7.3
22-05-2023	12:18:10	412	413.1	415.7	20.79	23.2	16.98	14.16	0.97	0.97	0.99	0.97	2.1	1.6	1.7	16.8	6.7
22-05-2023	12:18:15	411	412.6	415	20.84	23.4	16.94	14.2	0.96	0.97	0.99	0.97	2.3	1.8	1.8	17.2	6.4
22-05-2023	12:18:20	411	412.4	415	20.87	23.5	16.95	14.22	0.96	0.97	0.99	0.97	2.3	1.8	1.7	17.3	6.3
22-05-2023	12:18:25	411	412.7	415.1	20.88	23.5	16.92	14.21	0.96	0.97	0.99	0.97	2.3	1.8	1.7	17.2	6.3
22-05-2023	12:18:30	411	412.4	414.7	20.85	23.5	16.98	14.21	0.96	0.97	0.99	0.97	2.3	1.8	1.8	17.4	6.3
22-05-2023	12:18:35	412	412.7	415.2	20.88	23.4	17.02	14.22	0.96	0.97	0.99	0.97	2.2	1.8	1.8	17.1	6.4
22-05-2023	12:18:40	411	412.3	414.8	20.88	23.4	16.97	14.19	0.96	0.97	0.99	0.97	2.3	1.8	1.7	17.2	6.3
22-05-2023	12:18:45	411	411.8	414.4	20.89	23.4	16.97	14.18	0.96	0.97	0.99	0.97	2.2	1.8	1.7	17.1	6.3
22-05-2023	12:18:50	411	412.2	414.5	20.87	23.4	16.99	14.19	0.96	0.97	0.99	0.97	2.3	1.8	1.7	17.2	6.4
22-05-2023	12:18:55	411	412.2	414.4	20.83	23.4	16.98	14.17	0.97	0.97	0.99	0.97	2.3	1.8	1.7	17	6.5
22-05-2023	12:19:00	411	412.4	414.6	20.81	23.6	16.91	14.21	0.97	0.97	0.99	0.97	2.3	1.8	1.7	16.9	6.5
22-05-2023	12:19:05	410	411.3	413.6	20.82	23.5	16.89	14.14	0.96	0.97	0.99	0.97	2.2	1.8	1.7	17	6.8

22-05-2023	12:19:10	411	412.3	414.6	20.79	23.8	16.94	14.27	0.96	0.97	0.99	0.97	2.3	1.7	1.7	17	6.9
22-05-2023	12:19:15	410	411.6	413.7	20.76	23.6	16.91	14.16	0.96	0.97	0.99	0.97	2.2	1.8	1.8	17.1	6.8
22-05-2023	12:19:20	409	410.8	412.8	20.8	23.5	16.84	14.12	0.96	0.97	0.99	0.97	2.3	1.8	1.8	17.2	7
22-05-2023	12:19:25	410	411.4	413.4	20.75	23.6	16.85	14.14	0.96	0.97	0.99	0.97	2.3	1.8	1.7	17.1	7
22-05-2023	12:19:30	410	411.6	414	20.72	23.5	16.93	14.16	0.96	0.97	0.99	0.97	2.3	1.8	1.8	17	6.8
22-05-2023	12:19:35	411	411.9	414.2	20.74	23.6	16.97	14.2	0.96	0.97	0.99	0.97	2.2	1.8	1.8	17	7.1
22-05-2023	12:19:40	410	411.3	413.5	20.76	23.7	16.95	14.19	0.96	0.97	0.99	0.97	2.2	1.7	1.8	17	7
22-05-2023	12:19:45	410	411.6	413.7	20.73	23.6	16.92	14.16	0.96	0.97	0.99	0.97	2.1	1.7	1.7	16.9	6.9
22-05-2023	12:19:50	410	411.5	413.5	20.72	23.6	16.81	14.14	0.97	0.97	0.99	0.97	2.1	1.7	1.7	16.7	6.8
22-05-2023	12:19:55	410	411.2	413	20.91	23.6	16.81	14.17	0.96	0.97	0.99	0.97	2.2	1.7	1.7	17.1	6.9
22-05-2023	12:20:00	410	411.1	413.6	20.92	23.6	16.82	14.19	0.96	0.97	0.99	0.97	2.2	1.7	1.8	17.1	7.3
22-05-2023	12:20:05	411	412.7	414.9	20.86	23.7	16.89	14.25	0.96	0.97	0.99	0.97	2.2	1.7	1.7	17.1	7
22-05-2023	12:20:10	411	412.1	414	20.86	23.6	16.85	14.2	0.96	0.97	0.99	0.97	2.3	1.7	1.7	17.2	6.9
22-05-2023	12:20:15	410	411.8	413.7	20.94	23.6	16.85	14.21	0.96	0.97	0.99	0.97	2.2	1.7	1.7	17.5	6.8
22-05-2023	12:20:20	410	411.6	413.6	21	23.6	16.25	14.06	0.96	0.97	0.98	0.97	2.1	1.7	1.7	17.7	6.9
22-05-2023	12:20:25	410	411.7	413.6	21.03	23.7	15.88	13.97	0.96	0.97	0.98	0.97	2.2	1.8	1.7	17.9	7.1
22-05-2023	12:20:30	411	412.2	414.3	21.04	23.6	15.82	13.95	0.96	0.97	0.98	0.97	2.2	1.7	1.8	17.8	6.9
22-05-2023	12:20:35	412	413.4	415.5	21.02	23.6	15.85	14.01	0.96	0.97	0.98	0.97	2.2	1.8	1.8	17.7	6.9
22-05-2023	12:20:40	412	413.7	416.1	20.96	23.8	15.87	14.05	0.96	0.97	0.98	0.97	2.1	1.6	1.6	17.5	6.7
22-05-2023	12:20:45	412	413.2	415.4	20.97	23.6	15.8	13.99	0.96	0.97	0.98	0.97	2.1	1.5	1.6	17.6	6.5
22-05-2023	12:20:50	413	413.8	416	20.95	23.6	15.82	14	0.96	0.97	0.98	0.97	2.1	1.7	1.8	17.6	6.9
22-05-2023	12:20:55	412	412.8	415.1	20.91	23.4	15.87	13.93	0.96	0.97	0.98	0.97	2.2	1.7	1.8	17.7	6.5
22-05-2023	12:21:00	412	413	415.1	20.95	23.2	15.86	13.9	0.96	0.97	0.98	0.97	2.2	1.7	1.8	17.7	6.3
22-05-2023	12:21:05	412	412.8	415.3	21.01	23.2	16.15	13.98	0.96	0.97	0.98	0.97	2.2	1.7	1.8	18	6.2
22-05-2023	12:21:10	411	411.9	414.6	21.08	23.3	16.06	13.97	0.96	0.97	0.98	0.97	2.2	1.7	1.8	18.1	6.4
22-05-2023	12:21:15	411	412.5	414.2	21.12	23.3	15.96	13.95	0.96	0.97	0.98	0.97	2	1.4	1.6	17.9	6
22-05-2023	12:21:20	411	411.9	414.3	21.84	23.9	16.44	14.4	0.97	0.97	0.98	0.97	2.1	1.6	1.6	17.1	6.3
22-05-2023	12:21:25	411	411.6	414.2	26.07	28.3	19.75	17.17	0.98	0.97	0.98	0.97	2.1	1.7	1.6	16.1	11.5
22-05-2023	12:21:30	411	412.3	415.1	21.92	24	16.48	14.44	0.97	0.97	0.98	0.97	2.2	1.7	1.8	17.6	6.9
22-05-2023	12:21:35	411	413.2	415.5	21.22	23.3	16.12	14.03	0.96	0.97	0.98	0.97	2.3	1.8	1.7	18.4	6.1

22-05-2023	12:21:40	411	413.2	415.4	21.39	23.3	16.15	14.07	0.96	0.97	0.98	0.97	2.3	1.7	1.6	18.4	6
22-05-2023	12:21:45	411	412.6	414.4	22.77	24.6	16.94	14.91	0.97	0.97	0.98	0.97	2.1	1.5	1.4	16.1	6.5
22-05-2023	12:21:50	411	412.4	414.1	22.08	23.9	16.56	14.48	0.97	0.97	0.98	0.97	2.2	1.6	1.6	17.5	6.5
22-05-2023	12:21:55	411	412.5	414.8	21.79	23.5	16.56	14.32	0.97	0.97	0.98	0.97	2.3	1.7	1.7	18.3	6
22-05-2023	12:22:00	412	413.4	415.8	21.75	23.5	16.58	14.36	0.97	0.97	0.98	0.97	2.3	1.8	1.7	18.1	6.1
22-05-2023	12:22:05	411	412.7	415.1	21.62	23.6	16.56	14.3	0.96	0.97	0.98	0.97	2.3	1.8	1.7	18	5.9
22-05-2023	12:22:10	411	412.5	414.4	21.38	23.3	16.47	14.13	0.96	0.97	0.98	0.97	2.2	1.7	1.6	18	5.9
22-05-2023	12:22:15	411	412.1	414.1	24.16	26.3	18.49	15.98	0.97	0.97	0.98	0.97	2.1	1.7	1.5	15.7	8.4
22-05-2023	12:22:20	411	411.9	413.6	25.93	28	19.73	17.07	0.98	0.97	0.98	0.97	2.1	1.7	1.6	15.6	11.4
22-05-2023	12:22:25	410	411.5	413.4	25.48	27.4	19.35	16.75	0.98	0.97	0.98	0.98	2.2	1.6	1.6	15.3	10.4
22-05-2023	12:22:30	411	412	414.1	21.67	23.5	16.53	14.26	0.96	0.97	0.98	0.97	2.3	1.8	1.7	17.3	6.2
22-05-2023	12:22:35	410	411.8	413.9	21.39	23.3	16.46	14.11	0.96	0.97	0.98	0.97	2.3	1.8	1.6	18.5	6.2
22-05-2023	12:22:40	410	411.8	414.2	21.35	23.3	16.51	14.12	0.96	0.97	0.98	0.97	2.2	1.7	1.6	17.9	6
22-05-2023	12:22:45	410	411.7	414.2	22.21	24.2	17.14	14.7	0.97	0.97	0.98	0.97	2.2	1.7	1.6	17.2	6.3
22-05-2023	12:22:50	410	411.1	413.6	25.05	27	19.2	16.49	0.98	0.97	0.98	0.98	2.2	1.7	1.6	15.3	9.8
22-05-2023	12:22:55	410	411.1	413.6	24.02	26	18.44	15.86	0.98	0.97	0.98	0.98	2.2	1.6	1.6	14.7	8.2
22-05-2023	12:23:00	410	411.4	413.9	22.84	24.8	17.61	15.1	0.97	0.97	0.98	0.97	2.2	1.6	1.6	15.6	7.2
22-05-2023	12:23:05	411	411.8	414.1	21.26	23.1	16.62	14.08	0.96	0.97	0.98	0.97	2.2	1.7	1.7	17.9	6.2
22-05-2023	12:23:10	410	411.5	413.6	21.26	23.1	16.64	14.06	0.96	0.97	0.98	0.97	2.2	1.7	1.7	18.4	6
22-05-2023	12:23:15	410	411.3	413.4	21.29	23.1	16.52	14.04	0.96	0.97	0.98	0.97	2	1.5	1.6	17.9	5.9
22-05-2023	12:23:20	409	410.9	413	22.71	24.6	17.38	14.97	0.97	0.98	0.98	0.97	2.2	1.7	1.6	15.9	6.7
22-05-2023	12:23:25	409	410.4	412.8	21.83	23.7	16.72	14.36	0.97	0.97	0.98	0.97	2.2	1.7	1.7	17.3	6.4
22-05-2023	12:23:30	409	410.5	413.1	21.66	23.5	16.58	14.24	0.97	0.97	0.98	0.97	2.2	1.7	1.7	17.5	6.3
22-05-2023	12:23:35	410	411.1	413.6	21.69	23.5	16.5	14.25	0.97	0.97	0.98	0.97	2	1.5	1.6	17.6	5.9
22-05-2023	12:23:40	410	411.3	413.4	21.62	23.5	16.53	14.25	0.97	0.98	0.98	0.97	2	1.5	1.5	17.5	5.9
22-05-2023	12:23:45	410	411.6	413.6	21.21	23.1	16.51	14.02	0.96	0.97	0.98	0.97	2.2	1.6	1.6	17.9	6
22-05-2023	12:23:50	410	411.5	413.4	21.25	23	16.55	14.02	0.96	0.97	0.98	0.97	2	1.4	1.5	17.7	5.9
22-05-2023	12:23:55	409	411	413	21.32	23	16.47	13.99	0.96	0.97	0.98	0.97	2.1	1.4	1.6	18.2	6
22-05-2023	12:24:00	410	411.3	413.9	21.2	23.1	16.47	14.01	0.96	0.97	0.98	0.97	2.3	1.7	1.8	18	6.2
22-05-2023	12:24:05	409	410.8	413.5	21.19	23	16.48	13.97	0.96	0.97	0.98	0.97	2.3	1.7	1.7	17.9	6.2

22-05-2023	12:24:10	410	411.9	414.1	21.41	23.2	16.5	14.12	0.96	0.97	0.98	0.97	2.3	1.8	1.6	18.1	6.1
22-05-2023	12:24:15	410	411.5	413.7	21.31	23.2	16.5	14.07	0.96	0.97	0.98	0.97	2.3	1.8	1.6	18.4	6.1
22-05-2023	12:24:20	410	411.4	414	22	23.3	16.54	14.28	0.97	0.97	0.98	0.97	2.1	1.4	1.4	17.5	6
22-05-2023	12:24:25	410	411.6	414.3	23.03	23.3	16.47	14.52	0.97	0.97	0.98	0.97	2.2	1.7	1.7	16.8	6.2
22-05-2023	12:24:30	411	411.9	414.4	22.23	23.2	16.53	14.33	0.97	0.97	0.98	0.97	2.3	1.7	1.7	17.3	6.2
22-05-2023	12:24:35	410	411.4	413.9	21.96	23.3	16.5	14.24	0.96	0.97	0.98	0.97	2.3	1.7	1.7	17.5	6.2
22-05-2023	12:24:40	410	410.9	413.4	25.56	27.5	19.59	16.79	0.97	0.97	0.98	0.97	2.2	1.7	1.7	16.2	10.4
22-05-2023	12:24:45	410	411.4	413.8	26.39	27.2	19.26	16.88	0.98	0.97	0.98	0.98	2.2	1.7	1.6	14.8	10.1
22-05-2023	12:24:50	410	411.6	413.8	26.47	27.1	19.24	16.89	0.98	0.97	0.98	0.98	2.2	1.6	1.7	14.7	10
22-05-2023	12:24:55	410	410.9	413.1	25.81	27	19.15	16.65	0.98	0.97	0.98	0.97	2.1	1.6	1.6	15.1	10
22-05-2023	12:25:00	410	410.9	413.2	25.11	26.7	19.13	16.43	0.98	0.97	0.98	0.98	2.1	1.6	1.6	15.3	9.7
22-05-2023	12:25:05	410	411.2	413.4	21.95	23.7	16.92	14.42	0.97	0.97	0.98	0.97	2.2	1.6	1.7	17.9	6.8
22-05-2023	12:25:10	410	411.6	413.8	21.12	23.2	16.6	14.06	0.96	0.97	0.98	0.97	2.2	1.6	1.7	18.1	6.1
22-05-2023	12:25:15	411	412.2	414.6	21.1	23.2	16.57	14.05	0.96	0.97	0.98	0.97	2.2	1.6	1.7	17.6	6.2
22-05-2023	12:25:20	411	412.3	414.6	21.07	23.2	16.63	14.08	0.96	0.97	0.98	0.97	2.2	1.7	1.7	17.4	6.2
22-05-2023	12:25:25	411	412	414.4	21.05	23.1	16.63	14.03	0.96	0.97	0.98	0.97	2.2	1.7	1.7	17.2	6.3
22-05-2023	12:25:30	411	412.1	414.5	21.92	23.9	17	14.57	0.97	0.97	0.98	0.97	2.1	1.6	1.7	15.6	6.1
22-05-2023	12:25:35	411	411.9	414.3	22.02	24.1	16.89	14.6	0.97	0.98	0.98	0.97	2.1	1.6	1.7	15.7	6.7
22-05-2023	12:25:40	411	412.1	414.7	21.52	23.5	16.54	14.26	0.97	0.97	0.98	0.97	2.2	1.7	1.8	16.9	6
22-05-2023	12:25:45	411	412.9	415.1	21.87	23.5	16.6	14.37	0.97	0.97	0.98	0.97	2.3	1.8	1.7	16.9	5.9
22-05-2023	12:25:50	411	412.8	414.8	22.32	23.5	16.69	14.55	0.98	0.97	0.98	0.98	2.3	1.8	1.7	16.8	5.9
22-05-2023	12:25:55	411	412.8	414.9	22.38	23.6	16.68	14.59	0.98	0.97	0.98	0.98	2.3	1.7	1.7	16.4	5.9
22-05-2023	12:26:00	411	412.8	414.9	21.88	23	16.6	14.32	0.98	0.97	0.98	0.98	2.2	1.6	1.8	16.7	6
22-05-2023	12:26:05	412	413	415.1	22.24	23.1	16.64	14.43	0.98	0.97	0.98	0.98	2.2	1.7	1.7	16.5	6
22-05-2023	12:26:10	411	412.9	414.4	23.22	23.9	16.96	14.95	0.98	0.97	0.98	0.98	2.2	1.7	1.7	15.7	6.1
22-05-2023	12:26:15	411	412.7	414.6	25.12	25.8	18.24	16.15	0.99	0.97	0.98	0.98	2.1	1.6	1.6	13.9	8.3
22-05-2023	12:26:20	411	412.8	414.7	23.92	24.7	17.41	15.41	0.99	0.98	0.98	0.98	2.1	1.6	1.7	13.9	6.5
22-05-2023	12:26:25	411	412.9	415.1	23.85	24.7	17.49	15.44	0.99	0.98	0.98	0.98	2.2	1.6	1.7	13.8	6.4
22-05-2023	12:26:30	412	413	415.4	23.44	24.4	17.23	15.2	0.99	0.98	0.98	0.98	2.1	1.6	1.7	14.5	6.3
22-05-2023	12:26:35	412	413.2	415.3	23.64	23.4	16.59	14.83	0.98	0.97	0.98	0.98	2.2	1.6	1.7	15.8	5.8

22-05-2023	12:26:40	411	413.1	414.9	25.2	25.1	17.64	15.85	0.99	0.97	0.98	0.98	2	1.4	1.5	14.6	7.1
22-05-2023	12:26:45	411	412.9	414.7	24	24	16.96	15.13	0.98	0.97	0.98	0.98	2.2	1.6	1.6	15.2	6.5
22-05-2023	12:26:50	412	413.1	415.1	22.42	23.1	16.65	14.47	0.98	0.97	0.98	0.98	2.3	1.7	1.7	16.9	6.1
22-05-2023	12:26:55	412	413.6	415.8	22.16	23.3	16.7	14.49	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.6	5.8
22-05-2023	12:27:00	412	414	415.9	21.98	23.2	16.67	14.42	0.98	0.97	0.98	0.98	2	1.5	1.6	16.7	5.8
22-05-2023	12:27:05	413	414.2	416.5	22	23.1	16.8	14.46	0.98	0.97	0.98	0.98	2	1.5	1.6	16.8	5.7
22-05-2023	12:27:10	413	414.2	416.5	21.98	23.2	16.75	14.45	0.98	0.97	0.98	0.98	2	1.6	1.7	17	5.8
22-05-2023	12:27:15	413	414.9	417	21.96	23.1	16.8	14.45	0.98	0.97	0.98	0.98	2.1	1.7	1.7	16.8	5.9
22-05-2023	12:27:20	413	415	416.9	22	23.3	16.8	14.52	0.98	0.97	0.98	0.98	2.1	1.7	1.7	16.9	5.9
22-05-2023	12:27:25	413	415.1	417.3	22.81	23.2	16.87	14.69	0.98	0.97	0.98	0.98	2.2	1.7	1.8	16.7	5.9
22-05-2023	12:27:30	413	414.9	416.8	23.29	23.2	16.89	14.81	0.98	0.97	0.98	0.98	2.2	1.7	1.8	16.6	5.8
22-05-2023	12:27:35	413	414.7	416.5	23.37	23.2	16.8	14.79	0.98	0.97	0.98	0.98	2.2	1.7	1.8	16.8	5.9
22-05-2023	12:27:40	413	413.9	416.1	23.47	23.1	16.73	14.75	0.98	0.97	0.97	0.97	2.2	1.7	1.8	17.3	5.8
22-05-2023	12:27:45	413	413.7	416.1	23.13	23.1	16.82	14.7	0.98	0.97	0.97	0.97	2.3	1.6	1.8	17.1	6.1
22-05-2023	12:27:50	413	413.7	416.2	22.54	23.3	16.86	14.61	0.98	0.97	0.98	0.98	2.2	1.6	1.7	17.2	5.8
22-05-2023	12:27:55	413	413.9	416.4	23.63	24.5	17.61	15.4	0.99	0.97	0.98	0.98	2.2	1.5	1.7	15.1	6.5
22-05-2023	12:28:00	413	414.3	416.4	22.68	23.3	16.79	14.67	0.98	0.97	0.98	0.98	2.2	1.6	1.8	16.5	5.6
22-05-2023	12:28:05	414	414.8	418.3	22.45	22.9	16.85	14.57	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.7	5.9
22-05-2023	12:28:10	413	414.4	416.9	22.32	22	17.02	14.36	0.98	0.98	0.97	0.98	2.2	1.6	1.8	16.9	6.7
22-05-2023	12:28:15	413	414.6	417.8	22.74	22.4	17.8	14.79	0.98	0.98	0.98	0.98	2.2	1.6	1.7	15.8	6.8
22-05-2023	12:28:20	413	413.9	416.2	24.02	23.5	18.66	15.53	0.98	0.98	0.98	0.98	2.2	1.6	1.7	14.8	7.7
22-05-2023	12:28:25	413	414.1	416.4	22.87	22.3	17.91	14.81	0.98	0.98	0.98	0.98	2.2	1.6	1.8	15.6	6.7
22-05-2023	12:28:30	413	414.3	417	23.69	22.5	17.77	15.01	0.98	0.98	0.98	0.98	2.3	1.6	1.8	15.3	6.7
22-05-2023	12:28:35	413	414.1	416.5	23.21	21.9	17.66	14.71	0.98	0.98	0.98	0.98	2.3	1.6	1.9	16.3	6.8
22-05-2023	12:28:40	412	414.1	416.1	23.26	22	17.62	14.72	0.98	0.98	0.98	0.98	2.3	1.6	1.8	16.3	7
22-05-2023	12:28:45	413	414.3	416.7	23.23	21.9	17.66	14.71	0.98	0.98	0.98	0.98	2	1.4	1.7	16.4	6.7
22-05-2023	12:28:50	413	414.5	416.8	23.08	21.9	17.68	14.67	0.98	0.98	0.98	0.98	2.2	1.5	1.7	16.5	6.6
22-05-2023	12:28:55	413	414.5	416.9	23.21	21.9	17.74	14.72	0.98	0.98	0.98	0.98	2.3	1.6	1.8	16.5	6.8
22-05-2023	12:29:00	414	415	417.7	22.46	21.9	17.66	14.57	0.98	0.98	0.98	0.98	2.2	1.5	1.8	16.8	6.8
22-05-2023	12:29:05	413	414.9	417	22.05	21.9	17.72	14.46	0.98	0.98	0.98	0.98	2.1	1.4	1.7	16.4	6.6

22-05-2023	12:29:10	414	415.3	418	21.97	21.9	17.73	14.47	0.98	0.98	0.98	0.98	2.1	1.4	1.6	16.8	6.7
22-05-2023	12:29:15	414	415.2	417.4	22.04	22	17.75	14.49	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.6	6.8
22-05-2023	12:29:20	414	415.5	417.8	22.13	21.9	17.73	14.5	0.98	0.98	0.98	0.98	2.3	1.6	1.8	16.9	6.7
22-05-2023	12:29:25	414	415.8	418.2	22.23	21.9	17.73	14.54	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.9	6.8
22-05-2023	12:29:30	414	415.6	417.6	22.3	21.8	18.58	14.72	0.98	0.98	0.98	0.98	2.3	1.6	1.8	17.2	6.9
22-05-2023	12:29:35	414	415.7	418.2	23.22	21.9	18.75	15.01	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.7	6.6
22-05-2023	12:29:40	414	415.6	417.8	22.99	22	18.68	14.96	0.98	0.98	0.98	0.98	2.3	1.6	1.8	16.6	6.9
22-05-2023	12:29:45	415	415.8	418.2	22.36	21.9	18.62	14.8	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.8	6.8
22-05-2023	12:29:50	415	416	418.2	22.29	21.9	18.66	14.78	0.98	0.98	0.98	0.98	2.2	1.7	1.8	16.8	6.8
22-05-2023	12:29:55	415	416.1	418.5	22.15	21.9	18.7	14.77	0.98	0.97	0.98	0.98	2.2	1.6	1.8	17.1	6.8
22-05-2023	12:30:00	415	416.2	418.6	22.19	21.9	18.62	14.77	0.98	0.98	0.98	0.98	2.2	1.7	1.9	16.8	6.8
22-05-2023	12:30:05	415	416.3	418.5	22.2	22	18.56	14.78	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.8	6.7
22-05-2023	12:30:10	415	416	418.1	25.19	25.1	20.75	16.72	0.98	0.97	0.98	0.98	2.1	1.6	1.8	15.1	9.4
22-05-2023	12:30:15	414	415.3	417.4	26.37	26.1	21.5	17.41	0.99	0.97	0.98	0.98	2.1	1.6	1.7	14.5	11.5
22-05-2023	12:30:20	414	415.5	417.5	25.96	25.9	21.27	17.22	0.99	0.97	0.98	0.98	1.9	1.3	1.5	15.1	11.3
22-05-2023	12:30:25	414	415.8	418.1	23.33	23.3	19.42	15.57	0.98	0.98	0.98	0.98	2.1	1.5	1.7	15.6	8.2
22-05-2023	12:30:30	415	415.8	418.1	22.04	21.9	18.61	14.72	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.7	6.7
22-05-2023	12:30:35	414	415.8	418	22	21.9	18.66	14.71	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.8	6.5
22-05-2023	12:30:40	415	415.9	418.2	22.25	22.2	18.66	14.86	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.7	6.3
22-05-2023	12:30:45	415	416.5	418.7	23.46	23.5	19.4	15.68	0.99	0.98	0.98	0.98	2.1	1.5	1.7	14.8	7.3
22-05-2023	12:30:50	416	416.9	419.2	22.23	22.3	18.66	14.91	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.6	6.6
22-05-2023	12:30:55	415	416.6	418.6	21.86	21.9	18.68	14.72	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.8	6.5
22-05-2023	12:31:00	415	416.7	418.5	21.87	22	18.61	14.74	0.98	0.98	0.98	0.98	2.2	1.6	1.8	16.6	6.5
22-05-2023	12:31:05	415	416.9	419	21.82	21.9	18.59	14.69	0.98	0.97	0.98	0.98	2.1	1.6	1.8	16.9	6.7
22-05-2023	12:31:10	415	416.9	419	21.71	21.8	18.59	14.65	0.98	0.97	0.98	0.98	2.1	1.6	1.8	16.6	6.4
22-05-2023	12:31:15	416	417	419	21.75	21.8	18.67	14.66	0.98	0.97	0.98	0.98	2.1	1.6	1.8	16.4	6.4
22-05-2023	12:31:20	416	417.2	419.7	21.79	21.8	18.65	14.69	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.5	6.3
22-05-2023	12:31:25	416	417.4	419.6	21.81	22.1	18.69	14.77	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.8	6.6
22-05-2023	12:31:30	416	417.2	419.4	21.89	22	18.67	14.77	0.98	0.97	0.98	0.98	1.9	1.4	1.6	16.6	6.4
22-05-2023	12:31:35	416	417	419.1	21.77	21.9	18.61	14.7	0.98	0.97	0.98	0.98	1.9	1.3	1.5	16.5	6.4

22-05-2023	12:31:40	415	416.9	419	21.84	21.8	18.64	14.69	0.98	0.97	0.98	0.98	2	1.4	1.6	16.5	6.4
22-05-2023	12:31:45	415	416.9	419	21.77	22	18.6	14.7	0.98	0.98	0.98	0.98	2.1	1.5	1.6	16.6	6.5
22-05-2023	12:31:50	415	416.6	418.7	21.8	22	18.65	14.7	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.9	6.5
22-05-2023	12:31:55	415	416.7	418.7	21.8	21.8	18.65	14.67	0.98	0.97	0.98	0.98	2.2	1.6	1.7	17	6.5
22-05-2023	12:32:00	415	416.8	418.7	22.23	22.3	18.81	14.94	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.6	6.7
22-05-2023	12:32:05	414	416.3	418	26.64	26.9	21.85	17.74	0.99	0.97	0.98	0.98	2.1	1.6	1.6	14.9	12.1
22-05-2023	12:32:10	415	416.3	418.1	24.57	24.5	20.24	16.34	0.99	0.98	0.98	0.98	2	1.4	1.5	14.4	9.3
22-05-2023	12:32:15	415	416.1	418	23.05	21.9	18.56	14.94	0.98	0.98	0.98	0.98	1.9	1.3	1.5	15.9	6.2
22-05-2023	12:32:20	415	416.3	418.2	22.89	22	18.56	14.92	0.98	0.98	0.98	0.98	2.1	1.5	1.6	16.5	6.5
22-05-2023	12:32:25	414	415.7	417.6	23.91	23.1	19.22	15.6	0.98	0.98	0.98	0.98	2.2	1.5	1.6	14.7	7.3
22-05-2023	12:32:30	414	415.4	417.6	22.28	22	18.56	14.8	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.2	6.3
22-05-2023	12:32:35	414	415.5	417.6	22.03	22.1	18.63	14.76	0.98	0.98	0.98	0.98	2.1	1.6	1.7	16.3	6.4
22-05-2023	12:32:40	414	415.2	417.4	21.77	21.8	18.61	14.6	0.98	0.98	0.98	0.98	2	1.4	1.6	16.4	6.2
22-05-2023	12:32:45	414	415.6	417.7	21.81	21.8	18.49	14.59	0.98	0.98	0.98	0.98	2	1.5	1.6	16.4	6.3
22-05-2023	12:32:50	414	415.6	417.6	22.74	22.6	18.95	15.15	0.98	0.98	0.98	0.98	2.1	1.5	1.6	15.1	6.6
22-05-2023	12:32:55	414	415.4	417.5	22.78	22.7	18.94	15.17	0.98	0.98	0.98	0.98	2.1	1.6	1.6	15.4	7.1
22-05-2023	12:33:00	414	415.3	417.5	22.25	22.2	18.49	14.81	0.98	0.98	0.98	0.98	2.1	1.6	1.7	16.5	6.4
22-05-2023	12:33:05	414	414.9	417.1	22.2	22.1	18.49	14.77	0.98	0.98	0.98	0.98	2.1	1.6	1.6	16.7	6.2
22-05-2023	12:33:10	414	415.3	417.4	22.18	22.1	18.65	14.79	0.98	0.98	0.98	0.98	2	1.5	1.6	16.4	6.2
22-05-2023	12:33:15	415	416.1	418.4	21.94	21.8	18.67	14.69	0.98	0.98	0.98	0.98	1.9	1.5	1.6	16.5	6.2
22-05-2023	12:33:20	415	416.4	418.6	21.89	22	18.73	14.75	0.98	0.98	0.98	0.98	2.1	1.7	1.7	16.6	6.4
22-05-2023	12:33:25	416	416.9	419.3	21.8	21.9	18.81	14.73	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.7	6.3
22-05-2023	12:33:30	416	417.1	419.3	21.92	21.8	18.65	14.71	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.8	6.4
22-05-2023	12:33:35	416	416.9	419.2	21.94	21.8	18.67	14.7	0.98	0.97	0.98	0.98	2.2	1.7	1.7	16.9	6.3
22-05-2023	12:33:40	416	416.9	419.4	21.92	21.8	18.68	14.7	0.98	0.97	0.98	0.98	2.2	1.7	1.7	16.7	6.3
22-05-2023	12:33:45	416	417	419.7	21.89	21.9	18.69	14.73	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.5	6.3
22-05-2023	12:33:50	416	417.3	420	21.85	21.9	18.64	14.73	0.98	0.97	0.98	0.98	2.1	1.6	1.6	16.4	6.4
22-05-2023	12:33:55	416	417.5	420.2	21.78	21.8	18.68	14.71	0.98	0.97	0.98	0.98	2.1	1.6	1.6	16.5	6.4
22-05-2023	12:34:00	416	417.9	420.4	22.74	22.7	19.16	15.29	0.98	0.98	0.98	0.98	2.1	1.5	1.6	15.7	6.6
22-05-2023	12:34:05	416	417.5	419.8	26.54	26.8	22.01	17.78	0.99	0.97	0.98	0.98	2	1.5	1.6	14.8	12.5

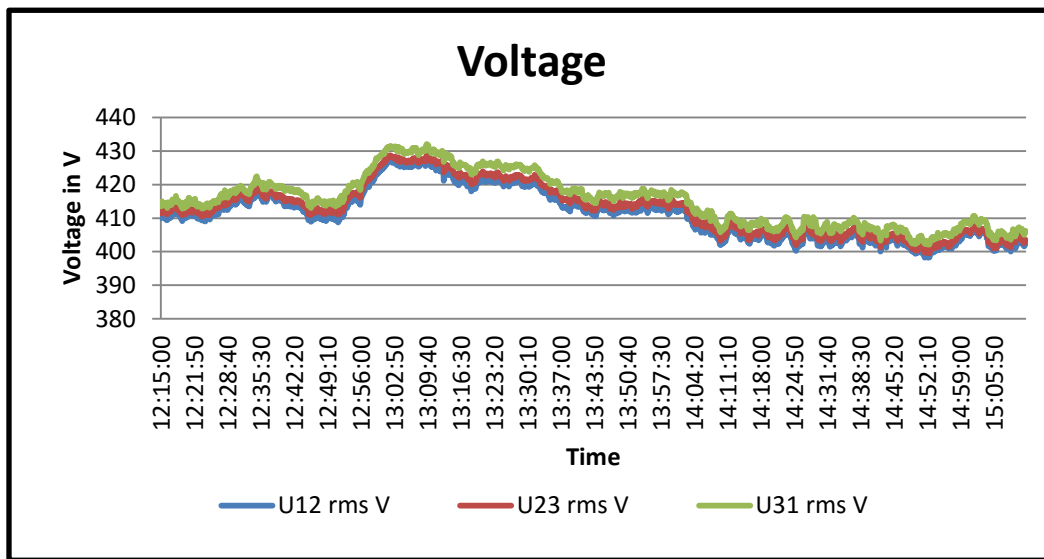
22-05-2023	12:34:10	416	417.6	420	25.54	25.7	21.15	17.13	0.99	0.97	0.98	0.98	2	1.5	1.5	14	10.8
22-05-2023	12:34:15	416	417.6	420.1	25.33	25.4	21.07	17.01	0.99	0.97	0.98	0.98	2	1.5	1.6	13.7	10.6
22-05-2023	12:34:20	417	418	420.5	25.3	25.4	21.03	16.98	0.99	0.97	0.98	0.98	1.8	1.3	1.4	14.7	10.7
22-05-2023	12:34:25	418	419.3	422	25.23	25.3	20.92	16.99	0.99	0.97	0.98	0.98	2	1.5	1.5	13.7	10.3
22-05-2023	12:34:30	418	419.5	422.2	24.9	25	20.65	16.79	0.99	0.97	0.98	0.98	2.1	1.5	1.6	13.6	10.1
22-05-2023	12:34:35	418	419.8	422.4	21.99	22.1	18.75	14.93	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.2	6.2
22-05-2023	12:34:40	418	420	422.4	21.78	21.9	18.75	14.83	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.4	6.1
22-05-2023	12:34:45	418	419.4	421.8	21.75	21.9	18.69	14.78	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.3	6.2
22-05-2023	12:34:50	418	419	421.4	22.32	22.5	18.88	15.13	0.98	0.98	0.98	0.98	2.2	1.6	1.7	15.6	6.3
22-05-2023	12:34:55	417	418.5	420.9	23.13	23.2	19.38	15.59	0.99	0.98	0.98	0.98	2	1.6	1.6	14.4	7.4
22-05-2023	12:35:00	417	418.4	420.9	22.17	22.2	18.64	14.94	0.98	0.98	0.98	0.98	2.1	1.6	1.6	15.8	6.3
22-05-2023	12:35:05	417	418.6	421	22.09	22.2	18.7	14.93	0.98	0.98	0.98	0.98	2.2	1.6	1.7	16.1	6.3
22-05-2023	12:35:10	417	418.5	420.8	21.91	22.1	18.62	14.82	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.3	6.4
22-05-2023	12:35:15	417	418.1	420.4	21.82	21.9	18.67	14.74	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.3	6.2
22-05-2023	12:35:20	416	418	420.4	21.8	21.9	18.63	14.72	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.2	6.3
22-05-2023	12:35:25	416	418	420.4	21.84	21.8	18.63	14.72	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.3	6
22-05-2023	12:35:30	416	417.8	420.2	21.73	21.8	18.61	14.68	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.5	6.2
22-05-2023	12:35:35	416	417.7	420	21.74	21.7	18.66	14.66	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.7	6.2
22-05-2023	12:35:40	416	417.1	419.6	21.77	21.6	18.62	14.62	0.98	0.97	0.98	0.98	2.2	1.6	1.6	17	6.2
22-05-2023	12:35:45	416	417.3	419.8	21.78	21.6	18.63	14.63	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.7	6.2
22-05-2023	12:35:50	416	417.3	419.8	21.92	21.7	18.56	14.67	0.98	0.97	0.98	0.98	2	1.4	1.5	16.3	6.6
22-05-2023	12:35:55	415	416.3	418.5	21.77	21.6	18.37	14.53	0.98	0.97	0.98	0.98	2.1	1.6	1.7	16.3	6.2
22-05-2023	12:36:00	417	417.7	420.5	21.74	21.6	18.16	14.51	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.3	5.9
22-05-2023	12:36:05	416	417.3	420.2	21.74	21.6	18.46	14.58	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.2	6
22-05-2023	12:36:10	416	416.8	419.7	21.93	21.7	18.4	14.6	0.98	0.97	0.98	0.98	2.2	1.6	1.7	16.9	6.1
22-05-2023	12:36:15	416	416.6	419.5	21.87	21.7	18.43	14.58	0.98	0.97	0.97	0.98	2.2	1.6	1.6	16.5	5.8
22-05-2023	12:36:20	416	416.6	419.5	21.73	21.7	18.51	14.57	0.98	0.97	0.97	0.98	2	1.4	1.5	16.4	5.8
22-05-2023	12:36:25	416	416.7	419.4	22.81	21.7	18.44	14.82	0.98	0.97	0.97	0.98	2.1	1.6	1.7	15.7	6
22-05-2023	12:36:30	415	416.2	418.9	22.77	21.7	18.42	14.79	0.98	0.97	0.97	0.98	2.2	1.6	1.8	15.9	6
22-05-2023	12:36:35	415	415.8	418.4	22.69	21.9	17.9	14.68	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.1	6.4

22-05-2023	12:36:40	415	416.2	418.7	22.6	21.9	17.85	14.66	0.98	0.97	0.97	0.98	2.3	1.7	1.8	16.1	6.4
22-05-2023	12:36:45	415	416.3	419	21.92	21.8	17.83	14.48	0.98	0.97	0.97	0.98	2.2	1.6	1.7	16	6.3
22-05-2023	12:36:50	416	416.6	419.3	21.8	21.7	17.83	14.43	0.98	0.97	0.97	0.98	2.2	1.6	1.7	16.8	6.3
22-05-2023	12:36:55	417	417.4	420.3	21.76	21.9	18.02	14.53	0.98	0.97	0.97	0.98	2.2	1.6	1.7	16.7	6.5
22-05-2023	12:37:00	417	417.4	420.4	21.74	22	18.05	14.58	0.98	0.97	0.97	0.98	2.2	1.6	1.7	16.2	6.4
22-05-2023	12:37:05	417	417.8	420.7	21.81	22.1	18.12	14.64	0.98	0.97	0.97	0.98	2.1	1.5	1.7	15.9	6.4
22-05-2023	12:37:10	417	417.8	420.7	21.93	22	17.99	14.62	0.98	0.97	0.97	0.98	2.1	1.7	1.7	16	6.5
22-05-2023	12:37:15	417	417.9	420.8	21.84	21.9	18.02	14.58	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.1	6.5
22-05-2023	12:37:20	417	418.1	420.8	21.83	22.1	18.06	14.64	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.3	6.5
22-05-2023	12:37:25	417	417.9	420.5	21.85	22	18.05	14.62	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.3	6.6
22-05-2023	12:37:30	417	417.9	420.4	21.93	22.1	18.03	14.63	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.3	6.5
22-05-2023	12:37:35	417	417.6	420.2	21.82	22.1	18	14.59	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16	6.6
22-05-2023	12:37:40	417	417.8	420.3	21.89	22	18.04	14.61	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.8	6.6
22-05-2023	12:37:45	417	417.6	420	21.85	22	18.04	14.6	0.98	0.97	0.97	0.98	2.2	1.7	1.8	16.2	6.5
22-05-2023	12:37:50	417	417.6	420	21.77	22.1	18.04	14.6	0.98	0.97	0.97	0.98	2.1	1.6	1.8	16	6.8

5.2 Variation in Electrical Parameters

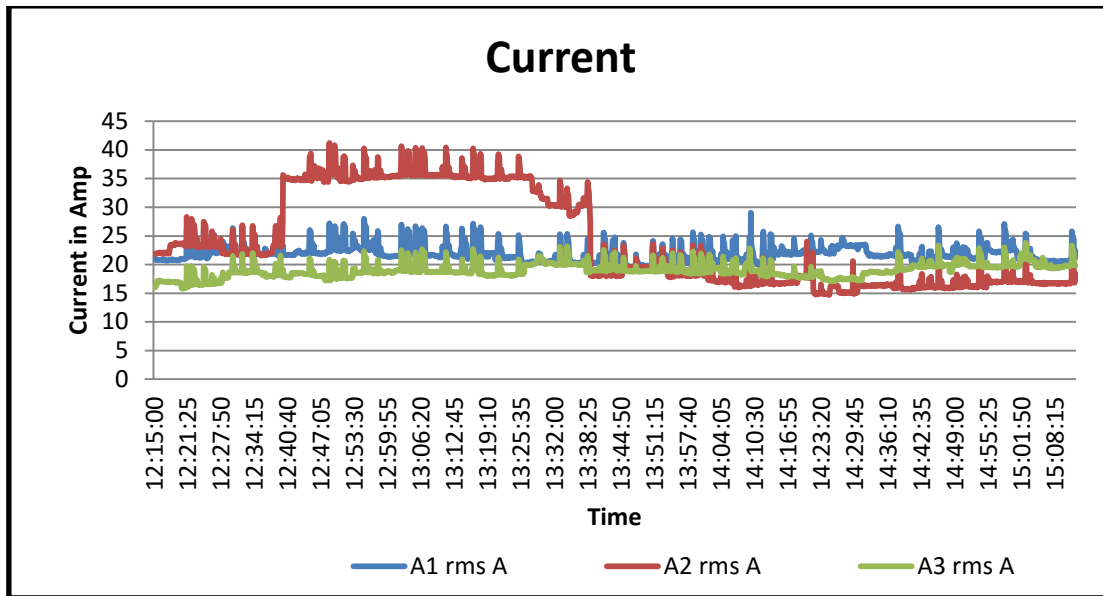
Now we present the variation in various Electrical parameters as under.

5.2.1 Voltage



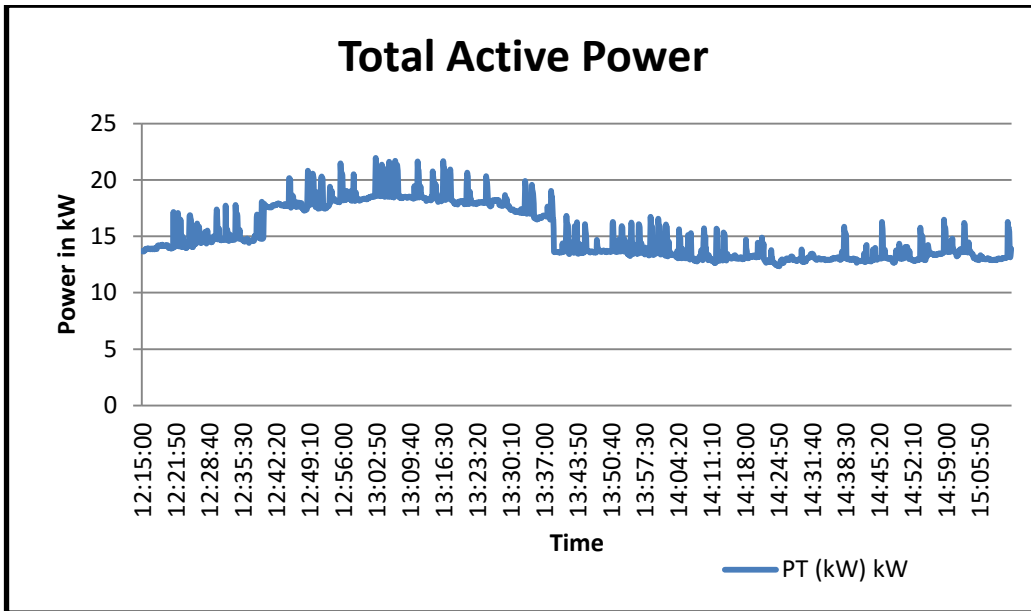
Average voltage is around 413.0 V of transformer.

5.2.2 Current



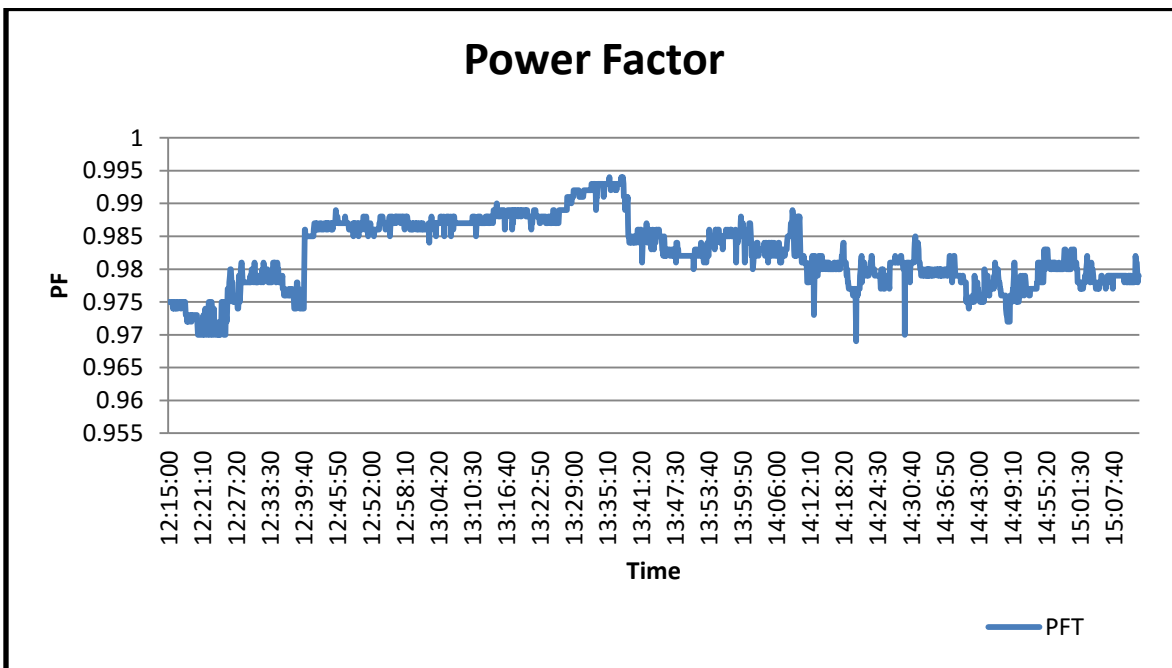
Current variation is load variation. Average current is around 21.62A.

5.2.3 Total Active power (kW)



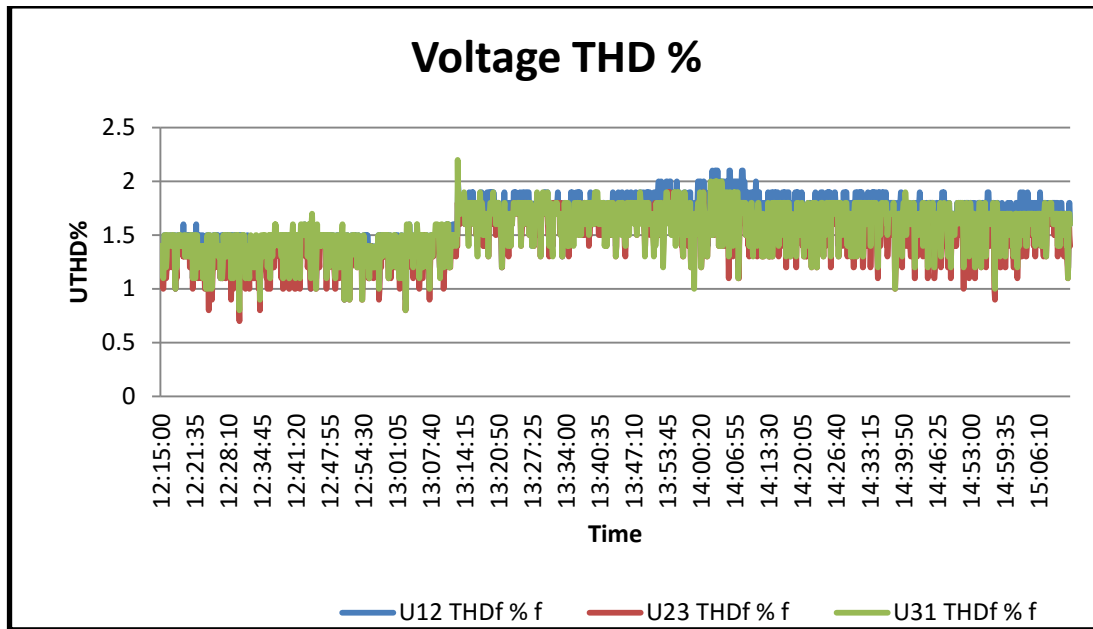
Variation in load demand can be observed in the graph. Average power consumption of the facility is around 15.23 kW.

5.2.4 Power factor



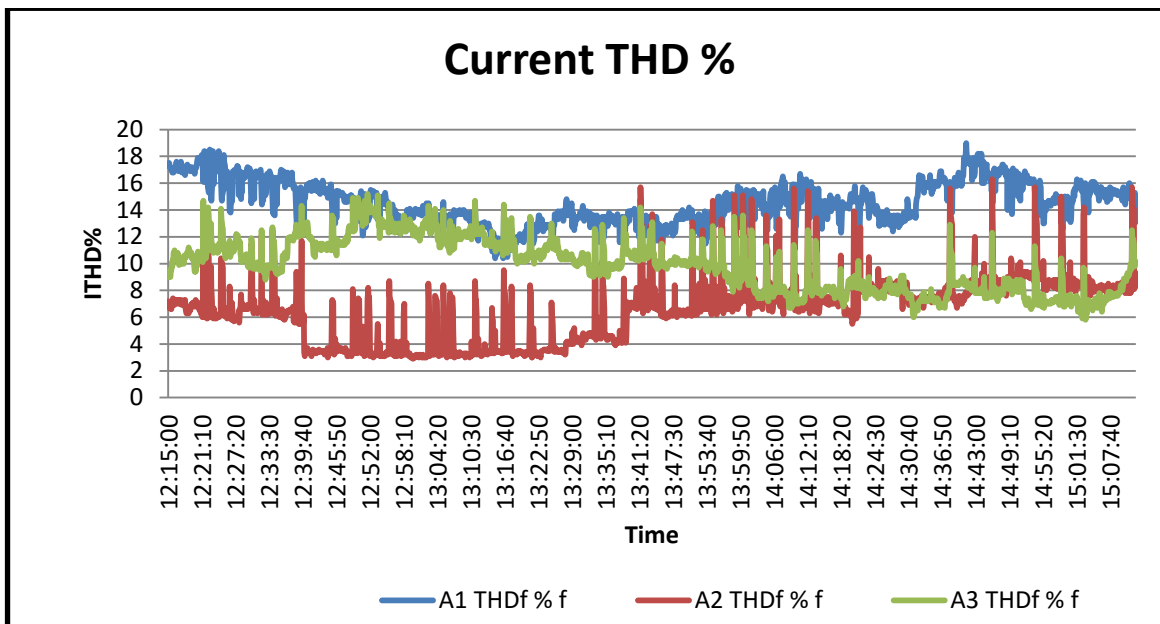
Average power factor is 0.982.

5.2.5 Voltage THD%



Average voltage harmonic distortion is 1.55 %.

5.2.6 Current THD%



Average current harmonic distortion is 10.32% whereas peak is 19%.

Existing APFC panel –

APFC Panel of 100kVAR capacity installed at main distribution with steps 15kVAR five steps and fixed 25kVAR steps at Bharati Vidyapeeth's College of Engineering for Women, Pune. This APFC is working in proper way and maintain average power factor about more than 0.98 which is indicated in monthly electricity bill.



Photo-1: APFC 125kVAR at Bharati Vidyapeeth's College of Engineering campus

CHAPTER-VI

SCOPE OF RENEWABLE ENERGY AND EFFICIENT FACILITY AT COLLEGE CAMPUS

6.1 Installation of 50 kWp Solar PV Power Plant:

Solar roof top power plant having capacity 50 kWp is installed on College of Engineering building, at college campus which meets the requirement of electricity demand of the that building. The Solar roof top plant is successfully installed and it is in operation to meet the requirement of electricity of institute campus building. The existing solar roof top installed technical specifications and details are given below.

Technical Specifications:

Bharati Vidyapeeth's College of Engineering for Women, Pune has installed solar roof top power plant. The brief specifications and details of the plant are mentioned below.

- **System Capacity:** 50 kW
- **PV Module:** Model-Canadian Solar Type C56K-295MS-295Wp X 173 nos.
- **Output:** 5.5 kWh/Sq.m/day (All output is under STC, 25°C)
- **Inverter:** SMA Inverter, SUNNY TRIPOWER



Photo-2: 50 kW solar roof top on hostel building roof.

6.3. DG sets

DG set, of capacity 125kVA installed at Bharati Vidyapeeth's College of Engineering for Women, Pune as backup for provision of electricity.



Photo-4: DG set set up at Bharati Vidyapeeth's College of Engineering for Women campus

6.4 Solar powered light for hoarding

Lighting solar systems are the fixed installations designed for domestic as well as small scale commercial application. The component of the solar lighting system includes solar PV module (solar cells), charge controller, solar battery and lighting system (lamps & fans). Modules are installed in the open on roof/terrace - exposed to sunlight and the charge controller and battery are kept inside a protected place in the house.



Figure-1: Solar powered light for Hoarding

This system comes with multiple benefits such as:

- **Economical:** Since the sun provides energy free of charge, 30% power savings on the electricity bill can be availed with longer back up lighting system at zero running cost.
- **Non-Polluting:** Powered by the sun's renewable energy, the system is energy neutral and an absolutely clean source of illumination. 1kWp solar installation reduces 1/2 ton of CO₂ (carbon dioxide) per annum.
- **No Maintenance:** The system has few moveable parts – reducing the risk of breakage. Once installed, it lasts for long time and requires little attention.

This system can be used to power the huge hoardings in the college campus.

Solar powered hoarding lighting system proposed will provide a better, faster, cheaper (and cleaner) alternative with solar. Since this product competes with diesel or conventional fuels, we needed to ensure we beat the cost of a diesel solution. In order to achieve that with solar, we consider the following system:

1. Highly Efficient Solar Panel

2. Charge Controllers with MPPT Technology – increases solar electricity production by up to 30% compared to conventional charge controllers

3. LED Projection Light – consumes 10-times less electricity compared to conventional bulbs, and has a 50,000 hour warranty.

Features:

- Auto on off
- 4 Days Battery Back Up
- Robust housing
- Weather proof

With this entire put together, we ended up with systems that provide 6 hours of lighting each night with 4 -lamp system to light up boards up to 15'x30', and a 8-lamp system to light larger boards up to 20'x40'. More importantly, with these options, payback of the system will come around 2.5 years. This system provides a way to reduce the lightings costs, get rid of all the operational hassles of owning a diesel generator, plus brand benefits from being "green" with the use of renewable energy like solar powered light hoarding board.

6.5 Solar charging stations

Solar cell phone chargers use solar panels to charge cell phone batteries. They are an alternative to conventional electrical cell phone chargers and in some cases can be plugged into an electrical outlet. Solar mobile charger is a device which can charge mobile phones using solar radiation. Its major component is a compact solar panel. This solar panel traps solar energy and produces an output voltage. But, since the light radiations falling on the solar panel can vary, the output voltage becomes unstable. For charging a mobile phone, stable voltage is required. So, to

make the output voltage stable and regulated, voltage regulator circuit along with the solar panel is used.

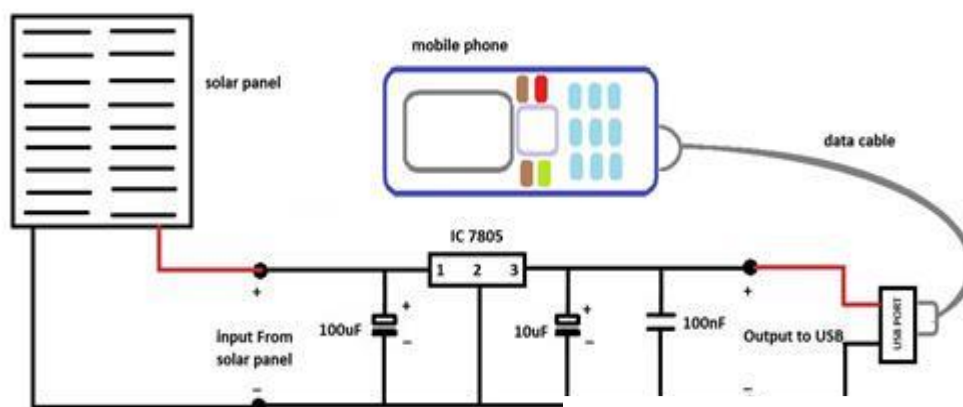


Figure-4: Solar charging Stations

Most of the mobile phones have computer connectivity via USB cable. USB port establishes 4 connection terminals. The connection terminals at the two extreme ends are the supply terminals. In a female USB connector (port via which we plug in USB devices to computer), these terminals carry 5V DC. When a mobile phone is connected to the USB port of a computer, it utilizes this 5V supply to recharge battery. This feature is used in a solar mobile charger. It converts and regulates solar energy to 5V DC and the output will be available through the female USB connector. To this connector, we can easily connect a mobile phone via data cable.

6.7 Installation of 50 kWp Solar PV roof Top on Bharati Vidyapeeth's College of Engineering for Women college building:

During the Audit, it was revealed that the College has ample space on the Terrace. It is proposed to install a Solar Photovoltaic roof top with net meter of capacity **50 kWp**. The system will cater the Day load Demand of the College.

We furnish herewith the saving potential as under

No	Particulars	Value	Unit
1	Installed Capacity of Solar PV Pack	50	kWp
2	Daily working period	6	Hrs./Day
3	Daily units generated	300	kWh/Day
4	Annual working days	280	Day/annum
5	Annual saving in Grid Electrical Energy	84000	kWh/annum
6	Annual CO ₂ saving potential	67.2	MT/Annum

7	Present Energy Charges	10	Rs/kWh
8	Annual monetary Gain	840000	Rs/Annum
9	Investment required	22,50000	Rs lump sum

Chapter VII

SUGGESTIONS AND RECOMMENDATIONS

Following Energy Conservation Opportunities and actions on the basis of energy audit are suggested to implement in the campus on the basis of funds availability and institute preferences.

a) Energy Audit: Energy Conservation opportunities:

- Energy efficient tubes and fans can be replaced. Already the phasing out of old tubes has been undertaken during regular maintenance practices.
- Installation of 50 kW solar roof top system as ample space available on the roof of the college building. As sanctioned load is 291kW, the solar roof top of 50 kW capacity with net meter can be installed in the college campus to meet the requirement of electricity.
- Installation of Solar powered light for hoarding.
- Installation of 05 Nos. solar mobile phone charging stations in the college campus.
- Water management system must be in place. Overhead tanks can be with float control and Time of the day (TOD) can be implemented for water pumping for filling the overhead water tanks.