Energy Audit Report

Prepared for

Nagar Parishad Shivaji Mahavidyalaya, Mowad.

Date of Audit-24/06/2022

Prepared By,

Saurabh Engineering Services

Shake Hand with Us, To Save Energy

Shake Hand with Us, To Save Life and Property

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ACKNOWLEDGEMENT

We are very grateful for cooperation and assistance received from ***Mr.Kishor Zilpe, Principal*** *and other Team Members of* ***Shivaji Mahavidyalaya, Mowad*** *Nagpur.*

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Executive Summary

Details of electrical system of Shivaji Mahavidyalaya, Mowad are as under

Description	Details
Supply Voltage (V)	440
Sanctioned Load (KW)	9.08 KW
Estimated Annual Electricity Consumption (kWh)	4176
Estimated Annual Electricity Cost (Rs)	16900

- ## Observation and Recommendation:

Field measurements are carried out for Voltage, Current, Power, Harmonics and data is recorded. Power parameters are further analyzed for Voltage Unbalance, Current Unbalance, Total Harmonics distortions, individual harmonics etc.

Following are the observations from Power Measurements at Main Incomer

- Voltage unbalance is within limit.
- Current unbalance is there.
- Average measured power factor is 0.97
- Voltage Total harmonics distortion is within limit.
- Total Current Harmonics distortion is there, electrical component should be loaded considering proper derating factor.

❒ **Energy Bill Analysis**

Energy bills for last one year is analyzed & following are the observations

- Average cost of electricity units is Rs. 7.80/kWh and energy charges is Rs. 4.53/-kWh.
- Demand charges are 25% of total bill amount.
- Energy charges are 58% of total bill amount.
- Other charges are 17% of total bill amount

❒ Lighting System

Energy saving can be achieved by replacement of existing lighting fixture with energy efficient fixture, as under

- Replacement of 1x40 W Fluorescent Lamp with 1x18 W LED Tube Light.
- Replacement of 100 W Incandescent Bulb with 1x18 W LED Tube Light.

By implementation these measures, there is potential of energy saving of about **211 kWh per annum** which will save **Rs. 917/- per annum** with approx. investment of **Rs. 2450/-.**

❒ Saving in Ceiling Fan

Energy saving can be achieved by replacement of Existing Fans by Energy Efficient Brushless DC motors fans.

By implementing the measures, there is potential of energy saving of about **1484 kWh per annum** which will save **Rs. 6722/- per annum** with approximate investment of **Rs. 96,000/-.**

❒ Energy Monitoring, Awareness and Participation of end user in Energy Management Systems

Energy Monitoring and awareness of operating staff & officers towards the Energy management is very important. **"You cannot manage what you don't measure and what you do not understand".**

Awareness, trainings and participation of Technical O & M staff and users who are directly controlling energy consuming equipment's, will definitely improve the energy efficiency because though energy is consumed by technical systems, But technical systems are operated by people. People can dramatically influence the level of energy consumption.

1. Introduction

1.1 Preamble

The energy audit is a feasibility study. It not only serves to identify energy use among the various services and to identify opportunities for energy conservation, but it is also a crucial first step in establishing an energy management programme. The audit will produce the data on which such a programme is based. The study should reveal to the owner, manager, or management team of utility the options available for reducing energy waste, the costs involved, and the benefits achievable from implementing those energy-conserving opportunities (ECOs).

1.2 Objectives

The main objective of this energy audit is to identify the energy conservation opportunities and to evolve measures to minimize energy losses so that energy utilization could be improved and the specific energy consumption can be reduced further.

The report also contains observations and recommendations to minimize the Energy loss, to reduce energy cost and to reduce building down time.

1.3 Introduction:

The energy audit is a systematic study for controlling energy consumption pattern. It is to reduce waste of energy and money to the minimum permitted by the climate. It establishes and maintains an efficient balance between annual functional energy requirements and its annual actual energy consumption.

1.4 Detail of Electrical System:-

Table No. 1.1:

Description	Details
Supply Voltage (V)	440 V
Sanction Load (KW)	9.08 KW
Estimated Annual Electricity Consumption (kWh)	4176
Estimated Annual Electricity Cost (Rs)	16900

Study of Power Parameters

Measurement of Power parameter, Voltage & Current unbalance & Harmonics

Data logging is carried out for different power parameters like voltage, current, PF, kW, Current unbalance, Voltage unbalance, THD, etc.

2.1. About Instruments:-

We have used highly sophisticated instrument ALM 35 from Keycard for the purpose of different power parameters measurement & data logging.

2.2. About Harmonics

What are Harmonics?

In electrical system, Harmonics are multiples of fundamental frequency (i.e.50 or 60 Hz). In simple terminology, it is also known as distortion in sinusoidal waveforms of voltage & current.

What are the sources of Harmonics?

Non-linear loads are principal sources of harmonics, as they draw current that is not proportional to the applied Voltage.

When current is driven by a sinusoidal voltage that is applied across a linear resistance, all of the current flow occurs at the fundamental frequency. In this case there will not be any harmonics.

2.3. Harmonics and their limits as per IEEE for current and voltage:

Harmonics are generated due to the presence of non-linear switching loads such as UPS, VFD, Thyristor drives, display units, PAC, and HVAC controls in the circuit. Harmonics, when exceeding a certain limit in a system cause undesirable effects. The undesirable effects caused by the presence of harmonics are malfunctioning of protective relay equipment, de-rating of equipment capacity, premature failure due to increased stress on the electrical system, energy loss etc.
The presence of higher harmonics affects the power factor negatively and increases the KVA demand requirement for any KW load

IEEE 519 standards specify the limit for both voltage and current harmonics. The current harmonics limit depends on the ratio of Short Circuit Current (SCC) at PCC to average Load Current of maximum demand over 1 year. Thus the current harmonic limit is a function of system design. Also the voltage harmonics depends on the bus voltage. Typically, the voltage harmonic limit at 415V bus is 5%.

Excessive harmonic currents can overload wiring and transformers, leading to additional losses. Therefore, it is necessary to maintain the harmonics levels in the electrical system as recommended in the IEEE 519 standards.

The permissible limit for voltage harmonics varies with the voltage level of operation. Below Table 2.1 shows the permissible voltage harmonic limit in percentage for various distribution voltage levels.

Table No.: 2.1 Voltage Harmonic Levels for various Distribution Voltage Levels

Bus Voltage at PCC (kV)	Individual Harmonic Voltage Distortion (%)	Total Harmonic Voltage Distortion VT (%)
V ≤ 1.0 kV	5	8
1 kV < V ≤ 69 kV	3	5
69 kV < V ≤ 161 kV	1.5	2.5
161 kV < V	1	1.5

The permissible limit for current harmonics as per IEEE standards is specified in table 2.2 Current distortion limits for general distribution systems end user limits (From 120V to 69 kV)

Table No.: 2.2 Allowable Current Harmonic Distortions Limit for various Isc/IL ratios

Maximum harmonic current distortion in percent of *I*L						
Individual harmonic order (odd harmonics)[a,b]						
ISC/IL	3 ≤ h <11	11≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ h ≤ 50	TDD
< 20[c]	**4.0**	**2.0**	**1.5**	**0.6**	**0.3**	**5.0**
20 < 50	7.0	3.5	2.5	1.0	0.5	8.0
50 < 100	10.0	4.5	4.0	1.5	0.7	12.0
100 < 1000	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a] Even harmonics are limited to 25% of the odd harmonic limits above.
[b] Current distortions that results in a dc offset, e.g., half-wave converters, are not allowed.

[c]All power generation equipment is limited to these values of current distortion, regardless of actual $I_{SC}/I_{L.}$

Where,
I_{SC}=Maximum short circuit current at PCC.
$I_{L.}$ =maximum demand load current (fundamental frequency component)
At the PCC under normal load operating conditions.

2.4. Total harmonic distortion (THD)

The Total harmonic distortion (THD) of a signal is a measurement of the harmonic distortion present and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.

- **Study of power parameters for Main Incomer is as follows:**

Table No. 2.3 Measurement of Power Parameters for Main Incomer

Measurement of Power Parameters													
Date (MM/DD/YY)	Time	Frequency	Line Voltage Measurement			Current Measurement			kW/ Phase			Total kW	PF
			U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS					
		Hz	V	V	V	A	A	A	kW	kW	kW	kW	
6/24/2022	12:18:00 PM	50.01	414.6	416.2	420.1	6.33	5.41	7.36	1.51	1.20	1.78	4.49	0.97
6/24/2022	12:19:00 PM	49.99	414.3	416.2	419.8	6.32	5.43	7.35	1.51	1.20	1.78	4.48	0.97
6/24/2022	12:20:00 PM	49.98	415.9	417.6	419.5	6.32	5.49	7.35	1.51	1.22	1.78	4.51	0.97
6/24/2022	12:21:00 PM	50	418	419.1	419.2	6.3	5.58	7.34	1.51	1.25	1.78	4.54	0.97
6/24/2022	12:22:00 PM	50	417.4	418.1	419.3	6.24	5.57	7.35	1.49	1.25	1.78	4.52	0.97
6/24/2022	12:23:00 PM	50.01	418.4	419.5	418.4	6.19	5.6	7.33	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:24:00 PM	50.01	416.9	418.7	417.7	6.18	5.58	7.32	1.47	1.25	1.77	4.50	0.97
6/24/2022	12:25:00 PM	50	418.6	420.3	417.4	6.17	5.6	7.33	1.47	1.26	1.77	4.51	0.97
6/24/2022	12:26:00 PM	50.02	419.9	421.1	417.9	6.18	5.61	7.33	1.48	1.27	1.77	4.52	0.97
6/24/2022	12:27:00 PM	50.01	418.2	419.6	418.3	6.18	5.58	7.33	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:28:00 PM	50.02	417.8	419.2	418.2	6.18	5.58	7.33	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:29:00 PM	50.04	417.9	419.1	418.3	6.19	5.57	7.33	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:30:00 PM	50.03	418.6	419.6	417.9	6.19	5.58	7.32	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:31:00 PM	50.02	419.8	420.5	418.3	6.19	5.59	7.33	1.48	1.27	1.77	4.52	0.97
6/24/2022	12:32:00 PM	50.01	419.4	420.4	418.4	6.19	5.59	7.33	1.48	1.27	1.78	4.52	0.97
6/24/2022	12:33:00 PM	50	419.6	420.4	418.2	6.18	5.58	7.33	1.48	1.26	1.78	4.52	0.97
6/24/2022	12:34:00 PM	49.99	419.2	420.4	417.8	6.17	5.58	7.33	1.48	1.26	1.77	4.51	0.97
6/24/2022	12:35:00 PM	49.95	418.5	420.4	417.3	6.49	5.56	7.34	1.55	1.26	1.78	4.58	0.97
6/24/2022	12:36:00 PM	49.95	417	419.2	417.2	7.06	5.55	7.35	1.67	1.25	1.78	4.70	0.97
6/24/2022	12:37:00 PM	49.95	417.6	419.5	417.6	6.18	5.54	7.35	1.47	1.25	1.78	4.50	0.97

Measurement of Power Parameters														
Date (MM/DD/YY)	Time	Frequency	Line Voltage Measurement			Current Measurement			kW/ Phase			Total kW	PF
			U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS					
		Hz	V	V	V	A	A	A	kW	kW	kW	kW	
6/24/2022	12:38:00 PM	49.96	417.9	419.8	417.1	6.18	5.54	7.34	1.48	1.25	1.78	4.50	0.97
6/24/2022	12:39:00 PM	49.95	417.7	419.9	416.8	6.18	5.54	7.35	1.47	1.25	1.78	4.50	0.97
6/24/2022	12:40:00 PM	49.94	416.4	417.5	417.4	6.18	5.5	7.34	1.47	1.23	1.77	4.48	0.97
6/24/2022	12:41:00 PM	49.93	417.5	418.7	416.6	6.17	5.51	7.34	1.47	1.24	1.77	4.48	0.97
6/24/2022	12:42:00 PM	49.92	418.1	419.7	415.9	6.17	5.53	7.33	1.47	1.25	1.77	4.48	0.97
6/24/2022	12:43:00 PM	49.94	417.8	418.8	416.8	6.17	5.5	7.33	1.47	1.24	1.77	4.48	0.97
6/24/2022	12:44:00 PM	49.95	417.4	418.7	417	6.18	5.49	7.33	1.47	1.23	1.77	4.48	0.97
6/24/2022	12:45:00 PM	49.94	416.6	417.7	417.3	6.19	5.47	7.33	1.48	1.23	1.77	4.47	0.97
6/24/2022	12:46:00 PM	49.93	415.3	415.6	418.1	6.18	5.45	7.31	1.48	1.22	1.76	4.46	0.97
6/24/2022	12:47:00 PM	49.93	417.3	418.4	417.1	6.18	5.48	7.31	1.47	1.23	1.76	4.47	0.97
6/24/2022	12:48:00 PM	49.96	418.4	419.4	416.8	6.18	5.49	7.3	1.48	1.24	1.76	4.48	0.97
6/24/2022	12:49:00 PM	49.99	418.3	419.1	416.7	6.18	5.5	7.3	1.48	1.24	1.76	4.48	0.97
6/24/2022	12:50:00 PM	49.98	416.8	417.8	417.2	6.19	5.48	7.29	1.47	1.23	1.76	4.47	0.97
6/24/2022	12:51:00 PM	50	415.4	416.4	417.7	6.17	5.47	7.3	1.47	1.22	1.76	4.45	0.97
6/24/2022	12:52:00 PM	50.02	415.5	416.2	418.8	6.18	5.45	7.31	1.48	1.22	1.76	4.46	0.97
6/24/2022	12:53:00 PM	50.04	418	419.6	418.8	6.17	5.47	7.33	1.48	1.23	1.78	4.49	0.97
6/24/2022	12:54:00 PM	50.05	415.9	418	418.9	7.05	5.45	7.34	1.67	1.22	1.78	4.67	0.97
6/24/2022	12:55:00 PM	50.05	415.6	417.6	419.6	6.23	5.42	7.34	1.49	1.21	1.78	4.48	0.97
6/24/2022	12:56:00 PM	50.08	417.4	418.3	419.8	6.23	5.43	7.33	1.49	1.22	1.78	4.49	0.97
6/24/2022	12:57:00 PM	50.11	419.8	420.5	419.7	6.23	5.46	7.34	1.50	1.24	1.78	4.51	0.97
6/24/2022	12:58:00 PM	50.14	420	421.1	419.9	6.25	5.45	7.33	1.50	1.23	1.78	4.51	0.97
6/24/2022	12:59:00 PM	50.14	420.1	421.2	419.2	6.24	5.44	7.33	1.50	1.23	1.78	4.51	0.97
6/24/2022	1:00:00 PM	50.13	419.7	420.6	420	6.19	4.66	7.32	1.49	1.03	1.78	4.29	0.97
6/24/2022	1:01:00 PM	50.13	419.9	421.1	420	6.23	4.31	7.32	1.50	0.94	1.78	4.22	0.96

Measurement of Power Parameters													
Date (MM/DD/YY)	Time	Frequency	Line Voltage Measurement			Current Measurement			kW/ Phase			Total kW	PF
			U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS					
		Hz	V	V	V	A	A	A	kW	kW	kW	kW	
6/24/2022	1:02:00 PM	50.09	421.9	423.9	418.8	6.6	4.35	7.32	1.58	0.95	1.78	4.31	0.96
6/24/2022	1:03:00 PM	50.08	421.2	423.6	419	7.02	4.35	7.33	1.67	0.95	1.78	4.40	0.96
6/24/2022	1:04:00 PM	50.07	420.9	423.1	419.1	6.23	4.34	7.32	1.49	0.95	1.78	4.22	0.96
6/24/2022	1:05:00 PM	50.06	420.9	422.8	419.3	6.22	4.33	7.32	1.49	0.95	1.78	4.22	0.96
6/24/2022	1:06:00 PM	50.05	420.4	422.4	419.4	6.22	4.32	7.32	1.49	0.94	1.78	4.22	0.96
6/24/2022	1:07:00 PM	50.05	420.1	422.7	419	6.22	4.29	7.34	1.49	0.94	1.79	4.22	0.96
6/24/2022	1:08:00 PM	50.02	419.9	421.8	418.7	6.22	4.28	7.33	1.49	0.94	1.78	4.21	0.96
6/24/2022	1:09:00 PM	50.03	420.1	422.3	418.4	6.22	4.29	7.34	1.49	0.94	1.78	4.21	0.96
6/24/2022	1:10:00 PM	50.03	419.1	421.1	418.8	6.67	4.31	7.32	1.59	0.94	1.78	4.30	0.96
6/24/2022	1:11:00 PM	50.01	418.6	420.7	418.9	6.22	4.31	7.31	1.49	0.94	1.77	4.20	0.96
6/24/2022	1:12:00 PM	50.01	418.3	420.4	418.6	6.21	4.31	7.31	1.48	0.94	1.77	4.19	0.96
6/24/2022	1:13:00 PM	50	419.8	421.6	418.6	6.22	4.32	7.32	1.49	0.94	1.78	4.20	0.96
6/24/2022	1:14:00 PM	50	421	423	419.2	6.21	4.33	7.33	1.49	0.94	1.78	4.22	0.96
6/24/2022	1:15:00 PM	49.99	421.1	423.3	419.4	6.21	4.32	7.34	1.49	0.94	1.79	4.22	0.96
6/24/2022	1:16:00 PM	50.02	420.6	422.5	419.8	6.21	4.3	7.34	1.49	0.94	1.79	4.22	0.96
6/24/2022	1:17:00 PM	50.03	420.5	422.3	419.8	6.21	4.31	7.34	1.49	0.94	1.79	4.22	0.96
6/24/2022	1:18:00 PM	50.03	420.3	421.8	419.5	6.21	4.29	7.35	1.49	0.94	1.79	4.21	0.96
6/24/2022	1:19:00 PM	50.04	419.2	420.5	419.7	6.21	4.27	7.35	1.49	0.93	1.78	4.20	0.96
6/24/2022	1:20:00 PM	50.05	420	421.9	419	6.21	4.28	7.35	1.49	0.93	1.79	4.21	0.96
6/24/2022	1:21:00 PM	50.06	418.8	420.8	419.7	6.21	4.26	7.35	1.49	0.93	1.79	4.20	0.96
6/24/2022	1:22:00 PM	50.06	417.5	419.8	419.5	6.21	4.24	7.35	1.49	0.92	1.78	4.19	0.96
Average load in kW/PF												**4.41**	**0.97**

Table No. 2.4 Measurement of Harmonics, Voltage & Current Unbalance at Main Incomer

Harmonics & Voltage & Current Unbalance Measurement										
Date (MM/DD/YY)	Time	Frequency	Current Harmonics			Line Voltage Harmonics			Current Unbalance	Voltage Unbalance
			A1 THD	A2 THD	A3 THD	U1 THD	U2 THD	U3 THD	Aunb	Vunb
		Hz	%	%	%	%	%	%	%	%
6/24/2022	12:18:00 PM	50.01	7.6	4.3	3.4	0.9	1	1	12.8	0.7
6/24/2022	12:19:00 PM	49.99	7.5	4.3	3.4	0.8	1	1	12.9	0.7
6/24/2022	12:20:00 PM	49.98	7.4	4.6	3.4	0.8	1	1	12.2	0.4
6/24/2022	12:21:00 PM	50	7.2	4.8	3.4	0.8	1	1	11.7	0.1
6/24/2022	12:22:00 PM	50	6.3	4.9	3.4	0.7	0.9	0.9	11.6	0.2
6/24/2022	12:23:00 PM	50.01	5.5	4.8	3.4	0.7	0.9	0.9	11.3	0.2
6/24/2022	12:24:00 PM	50.01	5.5	5.7	3.5	0.7	0.9	1	11.3	0.2
6/24/2022	12:25:00 PM	50	5.4	5.3	3.5	0.7	0.9	0.9	11	0.4
6/24/2022	12:26:00 PM	50.02	5.4	4.7	3.5	0.7	0.9	0.9	11	0.4
6/24/2022	12:27:00 PM	50.01	5.4	5.2	3.5	0.7	0.9	0.9	11.2	0.2
6/24/2022	12:28:00 PM	50.02	5.4	5.5	3.4	0.7	0.9	0.9	11.2	0.2
6/24/2022	12:29:00 PM	50.04	5.4	5.5	3.4	0.7	0.9	0.9	11.1	0.1
6/24/2022	12:30:00 PM	50.03	5.3	5.2	3.5	0.7	0.9	0.9	11.1	0.2
6/24/2022	12:31:00 PM	50.02	5.3	4.8	3.5	0.7	0.9	0.9	11.1	0.3
6/24/2022	12:32:00 PM	50.01	5.5	5	3.6	0.7	0.9	0.9	11.1	0.2
6/24/2022	12:33:00 PM	50	5.5	4.9	3.7	0.7	1	0.9	11.1	0.3
6/24/2022	12:34:00 PM	49.99	5.4	4.9	3.7	0.7	1	1	11	0.3
6/24/2022	12:35:00 PM	49.95	6.3	4.9	3.7	0.8	1	1	12	0.4
6/24/2022	12:36:00 PM	49.95	5.8	4.9	3.7	0.8	1	1	14.3	0.3
6/24/2022	12:37:00 PM	49.95	5.7	4.8	3.7	0.8	1	0.9	11.1	0.3
6/24/2022	12:38:00 PM	49.96	5.7	4.7	3.6	0.8	0.9	0.9	11.1	0.3
6/24/2022	12:39:00 PM	49.95	5.8	4.6	3.6	0.7	1	0.9	11.2	0.4

Harmonics & Voltage & Current Unbalance Measurement										
Date (MM/DD/YY)	Time	Frequency	Current Harmonics			Line Voltage Harmonics			Current Unbalance	Voltage Unbalance
			A1 THD	A2 THD	A3 THD	U1 THD	U2 THD	U3 THD	Aunb	Vunb
		Hz	%	%	%	%	%	%	%	%
6/24/2022	12:40:00 PM	49.94	5.7	4.4	3.6	0.8	1	1	11.6	0.2
6/24/2022	12:41:00 PM	49.93	5.8	4.4	3.6	0.8	1.1	1	11.4	0.3
6/24/2022	12:42:00 PM	49.92	5.8	4.3	3.6	0.7	1	0.9	11.4	0.5
6/24/2022	12:43:00 PM	49.94	5.8	4.2	3.6	0.8	1	0.9	11.6	0.2
6/24/2022	12:44:00 PM	49.95	5.9	4.2	3.6	0.7	1	0.9	11.7	0.2
6/24/2022	12:45:00 PM	49.94	5.8	4.2	3.6	0.8	1	0.9	11.9	0.1
6/24/2022	12:46:00 PM	49.93	5.7	4.1	3.6	0.8	1	1	12.2	0.4
6/24/2022	12:47:00 PM	49.93	5.7	4.1	3.6	0.8	1.1	1	11.8	0.2
6/24/2022	12:48:00 PM	49.96	5.8	4	3.6	0.8	1.1	1	11.7	0.3
6/24/2022	12:49:00 PM	49.99	5.9	4	3.5	0.8	1.1	1	11.8	0.3
6/24/2022	12:50:00 PM	49.98	6.1	4	3.5	0.8	1.1	1	12.1	0.2
6/24/2022	12:51:00 PM	50	6	4.2	3.6	0.8	1.1	1	12.4	0.3
6/24/2022	12:52:00 PM	50.02	6	4.2	3.6	0.8	1.1	0.9	12.4	0.4
6/24/2022	12:53:00 PM	50.04	6.1	4.3	3.6	0.8	1.1	0.9	11.9	0.2
6/24/2022	12:54:00 PM	50.05	7.1	4.3	3.6	1	1.1	1.1	15.3	0.4
6/24/2022	12:55:00 PM	50.05	6.9	4.3	3.6	1	1.1	1.1	12.5	0.5
6/24/2022	12:56:00 PM	50.08	6.7	4.2	3.6	0.9	1.1	1	12.4	0.3
6/24/2022	12:57:00 PM	50.11	6.8	4.2	3.6	0.9	1.2	1	12.1	0.2
6/24/2022	12:58:00 PM	50.14	6.7	4.3	3.7	0.9	1.1	1	12.5	0.1
6/24/2022	12:59:00 PM	50.14	6.7	4.4	3.7	0.8	1.1	0.9	12.4	0.2
6/24/2022	1:00:00 PM	50.13	6.1	5.1	3.7	0.8	1.1	0.9	17.7	0.1
6/24/2022	1:01:00 PM	50.13	6.8	5.3	3.7	0.8	1.1	0.9	20.1	0.1
6/24/2022	1:02:00 PM	50.09	6.7	5.3	3.7	0.8	1.1	0.9	20.8	0.7

Harmonics & Voltage & Current Unbalance Measurement										
Date (MM/DD/YY)	Time	Frequency	Current Harmonics			Line Voltage Harmonics			Current Unbalance	Voltage Unbalance
			A1 THD	A2 THD	A3 THD	U1 THD	U2 THD	U3 THD	Aunb	Vunb
		Hz	%	%	%	%	%	%	%	%
6/24/2022	1:03:00 PM	50.08	6.7	5.4	3.7	0.8	1.1	0.9	22	0.6
6/24/2022	1:04:00 PM	50.07	6.7	5.3	3.7	0.8	1.1	0.9	19.8	0.5
6/24/2022	1:05:00 PM	50.06	6.7	5.2	3.6	0.8	1.1	0.9	19.8	0.4
6/24/2022	1:06:00 PM	50.05	6.8	5.3	3.6	0.7	1	0.9	19.8	0.4
6/24/2022	1:07:00 PM	50.05	6.8	5.3	3.7	0.7	1	0.9	19.5	0.5
6/24/2022	1:08:00 PM	50.02	6.8	5.2	3.7	0.7	1	0.9	19.5	0.4
6/24/2022	1:09:00 PM	50.03	6.9	5.2	3.7	0.7	1	0.8	19.5	0.5
6/24/2022	1:10:00 PM	50.03	6.8	5.3	3.6	0.7	1	0.8	21.4	0.3
6/24/2022	1:11:00 PM	50.01	6.9	5.3	3.6	0.8	1	0.8	20.1	0.3
6/24/2022	1:12:00 PM	50.01	6.9	5.4	3.5	0.8	1	0.8	20.2	0.3
6/24/2022	1:13:00 PM	50	6.9	5.3	3.5	0.7	1	0.9	20.1	0.4
6/24/2022	1:14:00 PM	50	6.8	5.2	3.5	0.7	1	0.9	19.8	0.5
6/24/2022	1:15:00 PM	49.99	6.9	5.2	3.5	0.7	1	0.9	19.8	0.5
6/24/2022	1:16:00 PM	50.02	6.9	5.2	3.5	0.7	1	0.9	19.8	0.3
6/24/2022	1:17:00 PM	50.03	6.9	5.2	3.5	0.7	1	0.8	19.9	0.3
6/24/2022	1:18:00 PM	50.03	6.9	5.2	3.5	0.7	1	0.9	19.9	0.3
6/24/2022	1:19:00 PM	50.04	6.8	5.1	3.5	0.7	1	0.9	20	0.2
6/24/2022	1:20:00 PM	50.05	6.8	5.1	3.5	0.7	1	0.9	19.6	0.4
6/24/2022	1:21:00 PM	50.06	6.7	5.1	3.5	0.7	1	0.9	20	0.2
6/24/2022	1:22:00 PM	50.06	6.7	4.8	3.5	0.6	1	0.9	20.1	0.3

❖ Observation:

- Voltage unbalance is within limit.
- Current unbalance is there.
- Average power factor is 0.97
- Voltage Total harmonics distortion is within limit.
- Total Current Harmonics distortion is there.

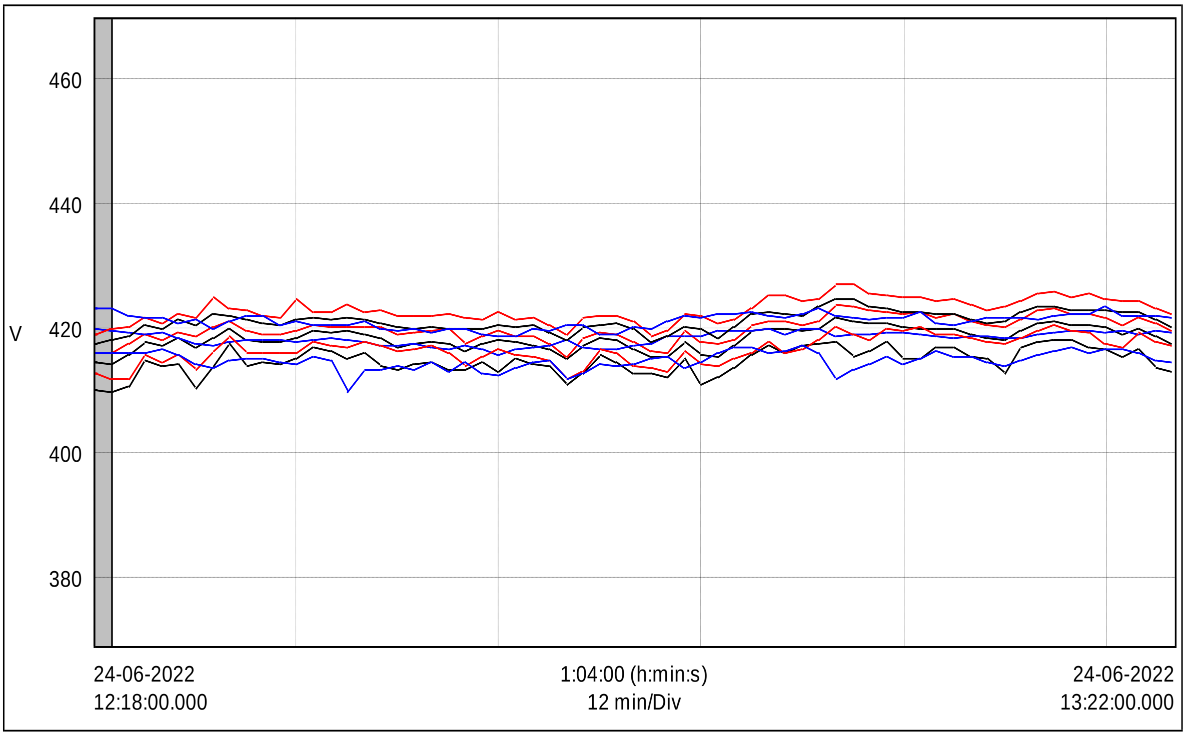
❒ Study of electrical parameters at Main Incomer

1. Line Voltage

Table No. 2.5: Line Voltage

Name	Date	Time	Avg	Min	Max	Units	Duration	Units
U1 RMS	24/6/2022	18:00.0	421.62	414.3	421.9	V	1:05:00	(h:min:s)
U2 RMS	24/6/2022	18:00.0	423.15	415.6	423.9	V	1:05:00	(h:min:s)
U3 RMS	24/6/2022	18:00.0	421.73	415.9	420.1	V	1:05:00	(h:min:s)

Graph No. 2.1: Line Voltage Variation for the Recorded Time



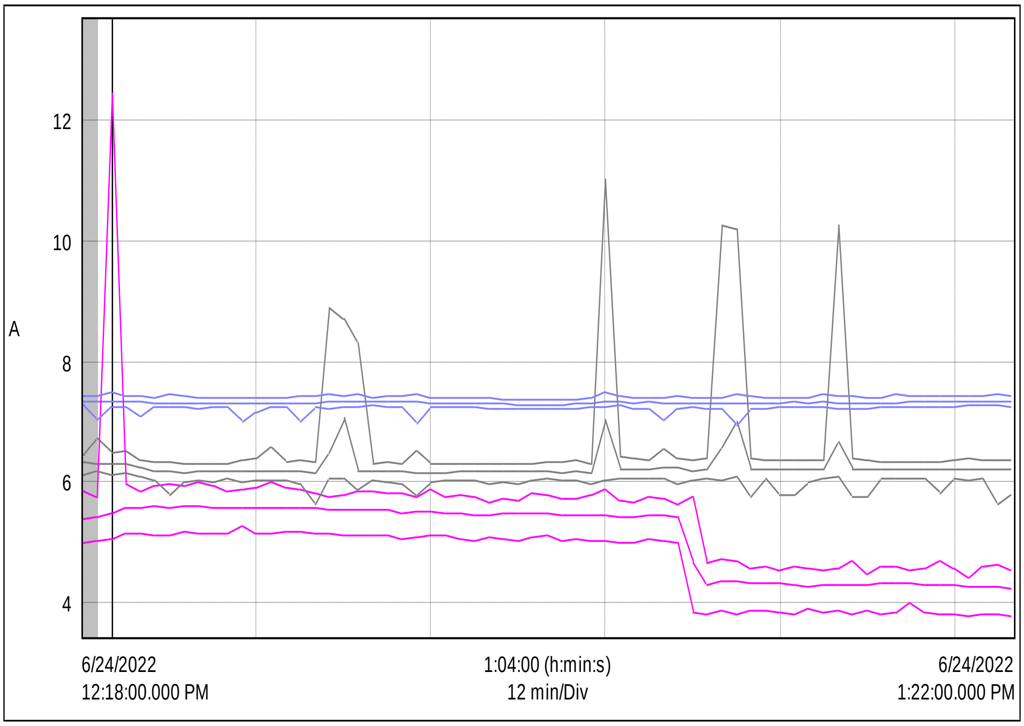
RMS, Max RMS & Min. RMS
Phase voltage variation

2. Current

Table No.2.6: Current

Name	Date	Time	Avg	Min	Max	Units	Duration	Units
A1 RMS	24/6/2022	18:00.0	6.32	6.17	7.06	A	1:05:00	(h:min:s)
A2 RMS	24/6/2022	18:00.0	5.17	4.24	5.61	A	1:05:00	(h:min:s)
A3 RMS	24/6/2022	18:00.0	7.39	7.29	7.36	A	1:05:00	(h:min:s)

Graph No. 2.2: Line Current Variation for recorded time



RMS, Max RMS & Min. RMS Current variation

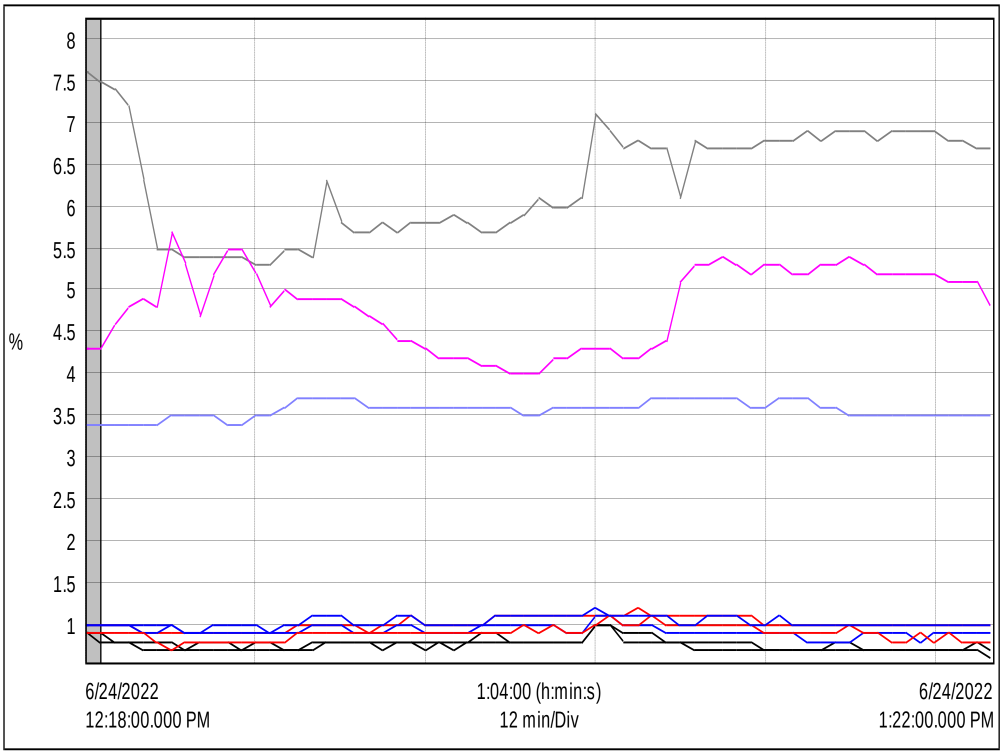
- Current unbalance is not considerable.

3. Total harmonic Distortion (THD).

Table No.2.7: THD

Name	Date	Time	Avg	Min	Max	Units	Duration	Units
A1 THD	24/6/2022	18:00.0	6.30	5.3	7.6	%	1:05:00	(h:min:s)
A2 THD	24/6/2022	18:00.0	4.81	4	5.7	%	1:05:00	(h:min:s)
A3 THD	24/6/2022	18:00.0	3.57	3.4	3.7	%	1:05:00	(h:min:s)
U1 THD	24/6/2022	18:00.0	0.76	0.6	1	%	1:05:00	(h:min:s)
U2 THD	24/6/2022	18:00.0	1.01	0.9	1.2	%	1:05:00	(h:min:s)
U3 THD	24/6/2022	18:00.0	0.93	0.8	1.1	%	1:05:00	(h:min:s)

Graph No. 2.3: THD

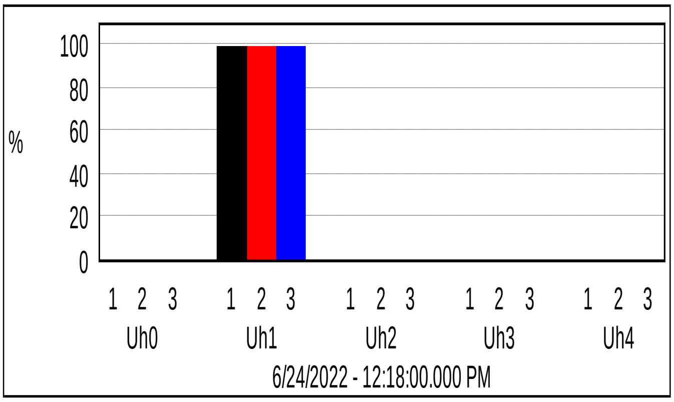


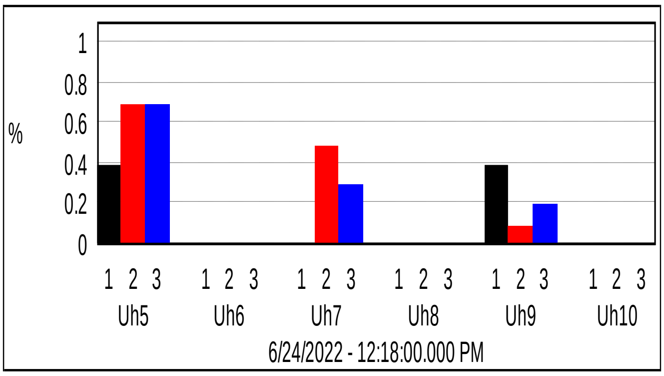
Variation of current, Phase Voltage, Line Voltage Total Harmonic Distortion

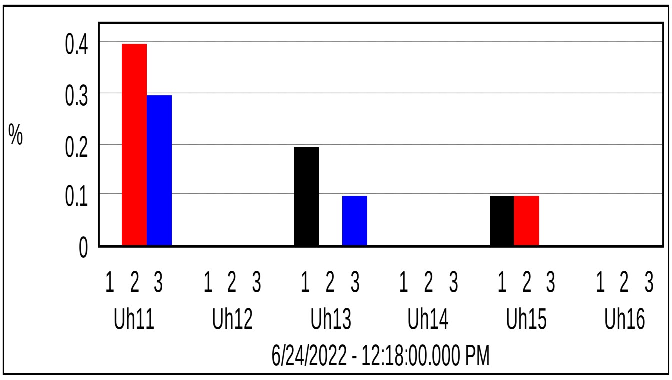
- Current harmonics distortion is there.

- **Individual Voltage Harmonics**

Name	Avg	Min	Max	Units
U1h0	0	0	0	%
U1h1	100	100	100	%
U1h10	0	0	0	%
U1h11	0.168	0	0.3	%
U1h12	0	0	0	%
U1h13	0.052	0	0.2	%
U1h14	0	0	0	%
U1h15	0.02	0	0.2	%
U1h16	0	0	0	%
U1h2	0	0	0	%
U1h3	0.074	0	0.1	%
U1h4	0	0	0	%
U1h5	0.582	0.4	0.8	%
U1h6	0	0	0	%
U1h7	0.118	0	0.2	%
U1h8	0	0	0	%
U1h9	0.108	0	0.4	%
U2h0	0	0	0	%
U2h1	100	100	100	%
U2h10	0	0	0	%
U2h11	0.249	0.2	0.4	%
U2h12	0	0	0	%
U2h13	0.032	0	0.1	%
U2h14	0	0	0	%
U2h15	0.014	0	0.1	%
U2h16	0	0	0	%
U2h2	0	0	0	%
U2h3	0.008	0	0.1	%
U2h4	0	0	0	%
U2h5	0.845	0.6	1	%
U2h6	0	0	0	%
U2h7	0.372	0.3	0.5	%
U2h8	0	0	0	%
U2h9	0.092	0	0.2	%
U3h0	0	0	0	%
U3h1	100	100	100	%
U3h10	0	0	0	%
U3h11	0.315	0.2	0.4	%
U3h12	0	0	0	%
U3h13	0.083	0	0.2	%
U3h14	0	0	0	%
U3h15	0	0	0	%
U3h16	0	0	0	%
U3h2	0	0	0	%
U3h3	0.089	0	0.2	%
U3h4	0	0	0	%
U3h5	0.615	0.5	0.8	%
U3h6	0	0	0	%
U3h7	0.437	0.3	0.5	%
U3h8	0	0	0	%
U3h9	0.009	0	0.2	%

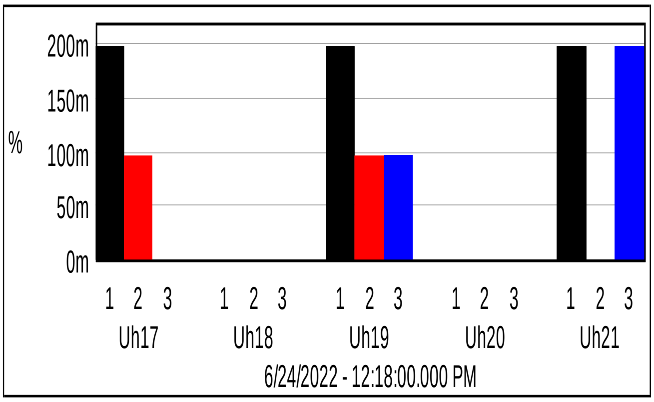


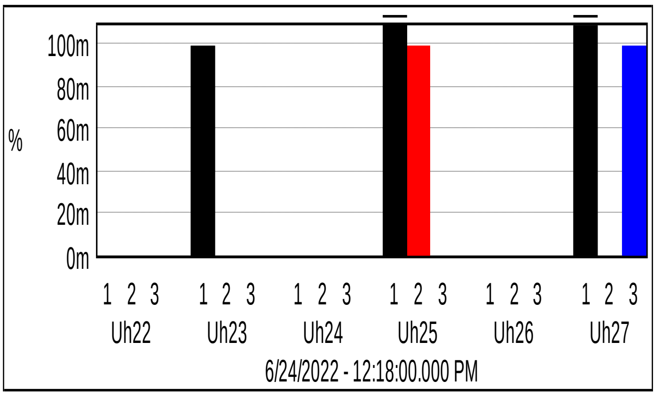


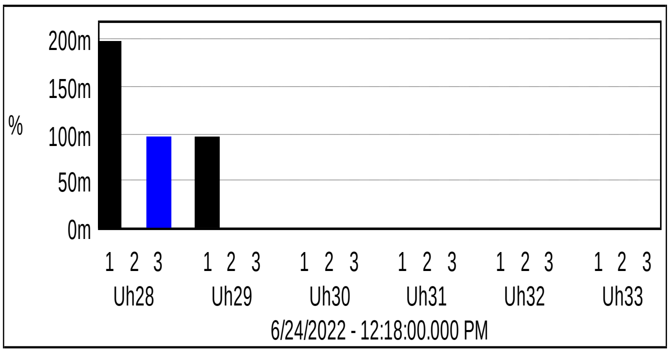


Above individual voltage harmonics are not considerable.

Name	Avg	Min	Max	Units
U1h17	0.02	0	0.2	%
U1h18	0	0	0	%
U1h19	0.02	0	0.2	%
U1h20	0	0	0	%
U1h21	0.018	0	0.2	%
U1h22	0	0	0	%
U1h23	0.005	0	0.1	%
U1h24	0	0	0	%
U1h25	0.02	0	0.2	%
U1h26	0	0	0	%
U1h27	0.012	0	0.2	%
U1h28	0.108	0.1	0.2	%
U1h29	0.012	0	0.1	%
U1h30	0	0	0	%
U1h31	0	0	0	%
U1h32	0	0	0	%
U1h33	0.003	0	0.1	%
U2h17	0.005	0	0.1	%
U2h18	0	0	0	%
U2h19	0.025	0	0.2	%
U2h20	0	0	0	%
U2h21	0.002	0	0.1	%
U2h22	0	0	0	%
U2h23	0	0	0	%
U2h24	0	0	0	%
U2h25	0.002	0	0.1	%
U2h26	0	0	0	%
U2h27	0	0	0	%
U2h28	0	0	0	%
U2h29	0	0	0	%
U2h30	0	0	0	%
U2h31	0	0	0	%
U2h32	0	0	0	%
U2h33	0	0	0	%
U3h17	0.006	0	0.1	%
U3h18	0	0	0	%
U3h19	0.089	0	0.1	%
U3h20	0	0	0	%
U3h21	0.006	0	0.2	%
U3h22	0	0	0	%
U3h23	0	0	0	%
U3h24	0	0	0	%
U3h25	0.026	0	0.1	%
U3h26	0	0	0	%
U3h27	0.002	0	0.1	%
U3h28	0.103	0.1	0.2	%
U3h29	0.006	0	0.1	%
U3h30	0	0	0	%
U3h31	0	0	0	%
U3h32	0	0	0	%
U3h33	0.005	0	0.1	%



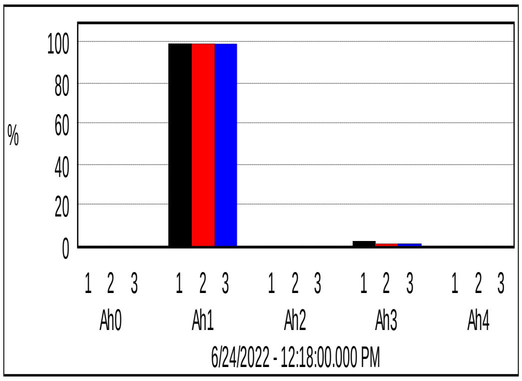


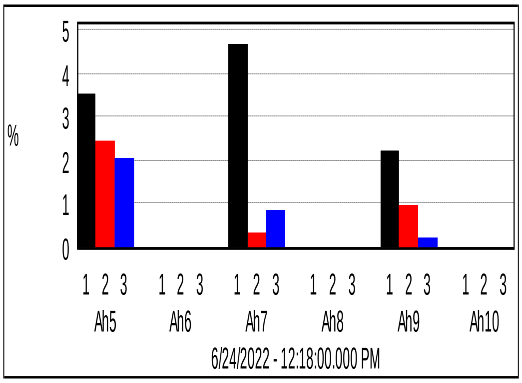


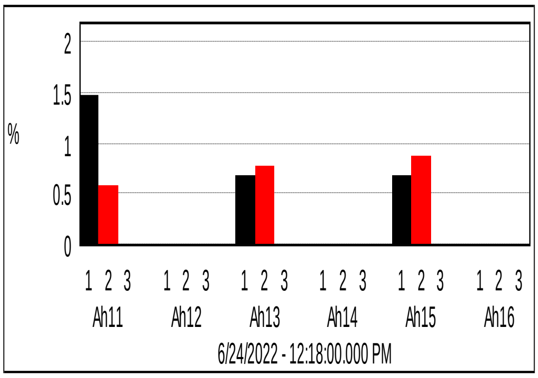
- Above individual voltage harmonics are not considerable. Individual harmonics 34th to 50th order is negligible, hence not given.

➢ Individual Current Harmonics

Name	Avg	Min	Max	Units
A1h0	0	0	0	%
A1h1	100	100	100	%
A1h10	0	0	0	%
A1h11	1.377	1	1.6	%
A1h12	0	0	0	%
A1h13	0.831	0.6	1	%
A1h14	0	0	0	%
A1h15	0.605	0.4	0.9	%
A1h16	0	0	0	%
A1h2	0.037	0	0.4	%
A1h3	1.994	1.3	3.5	%
A1h4	0.015	0	0.3	%
A1h5	2.871	2.4	3.7	%
A1h6	0.003	0	0.1	%
A1h7	4.237	3.7	4.7	%
A1h8	0.002	0	0.1	%
A1h9	1.966	1.6	2.3	%
A2h0	0	0	0	%
A2h1	100	100	100	%
A2h10	0	0	0	%
A2h11	1.157	0.3	1.6	%
A2h12	0	0	0	%
A2h13	1.138	0.6	2	%
A2h14	0	0	0	%
A2h15	1.088	0.7	1.9	%
A2h16	0	0	0	%
A2h2	0.666	0.5	0.9	%
A2h3	1.551	0.1	2.8	%
A2h4	0.026	0	0.1	%
A2h5	3.248	2.3	4.1	%
A2h6	0	0	0	%
A2h7	0.808	0.1	1.4	%
A2h8	0	0	0	%
A2h9	1.143	0	2.1	%
A3h0	0	0	0	%
A3h1	100	100	100	%
A3h10	0	0	0	%
A3h11	0.008	0	0.1	%
A3h12	0	0	0	%
A3h13	0.002	0	0.1	%
A3h14	0	0	0	%
A3h15	0.022	0	0.1	%
A3h16	0	0	0	%
A3h2	0	0	0	%
A3h3	2.491	2.3	2.7	%
A3h4	0	0	0	%
A3h5	2.28	2.1	2.4	%
A3h6	0	0	0	%
A3h7	0.906	0.9	1	%
A3h8	0	0	0	%
A3h9	0.349	0.3	0.4	%

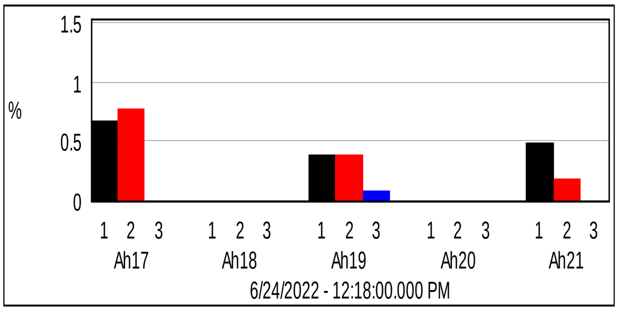


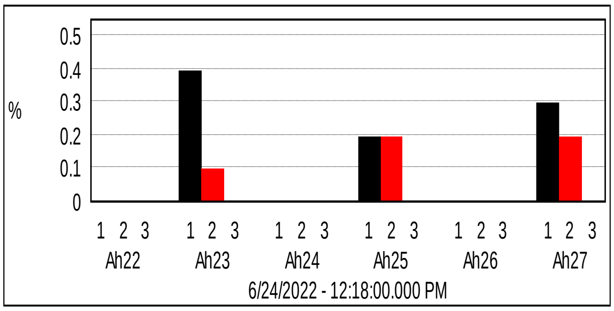


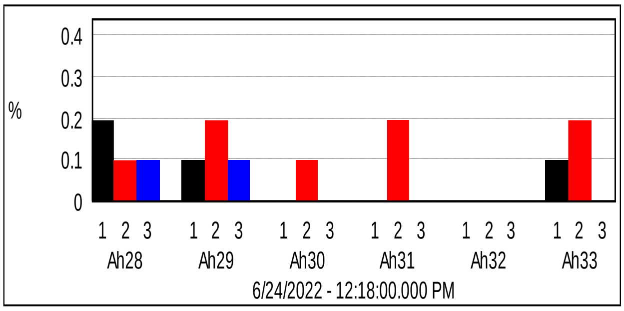


➢ Above individual current harmonics are not considerable.

Name	Avg	Min	Max	Units
A1h17	0.565	0.4	0.9	%
A1h18	0	0	0	%
A1h19	0.342	0.1	0.5	%
A1h20	0	0	0	%
A1h21	0.383	0.2	0.6	%
A1h22	0.049	0	0.1	%
A1h23	0.198	0	0.4	%
A1h24	0	0	0	%
A1h25	0.309	0.2	0.5	%
A1h26	0.003	0	0.1	%
A1h27	0.195	0.1	0.3	%
A1h28	0.249	0.2	0.3	%
A1h29	0.14	0	0.4	%
A1h30	0.005	0	0.1	%
A1h31	0.257	0	0.4	%
A1h32	0	0	0	%
A1h33	0.183	0	0.3	%
A2h17	0.743	0.1	1.4	%
A2h18	0	0	0	%
A2h19	0.332	0.1	0.9	%
A2h20	0.002	0	0.1	%
A2h21	0.231	0.1	0.5	%
A2h22	0.057	0	0.1	%
A2h23	0.209	0.1	0.5	%
A2h24	0.046	0	0.1	%
A2h25	0.097	0	0.4	%
A2h26	0.057	0	0.1	%
A2h27	0.122	0	0.3	%
A2h28	0.149	0.1	0.2	%
A2h29	0.169	0	0.4	%
A2h30	0.098	0	0.1	%
A2h31	0.125	0	0.3	%
A2h32	0.008	0	0.1	%
A2h33	0.102	0	0.2	%
A3h17	0.002	0	0.1	%
A3h18	0	0	0	%
A3h19	0.066	0	0.2	%
A3h20	0	0	0	%
A3h21	0.037	0	0.1	%
A3h22	0	0	0	%
A3h23	0	0	0	%
A3h24	0	0	0	%
A3h25	0.023	0	0.1	%
A3h26	0	0	0	%
A3h27	0	0	0	%
A3h28	0.1	0.1	0.1	%
A3h29	0.069	0	0.1	%
A3h30	0	0	0	%
A3h31	0.002	0	0.1	%
A3h32	0	0	0	%
A3h33	0	0	0	%

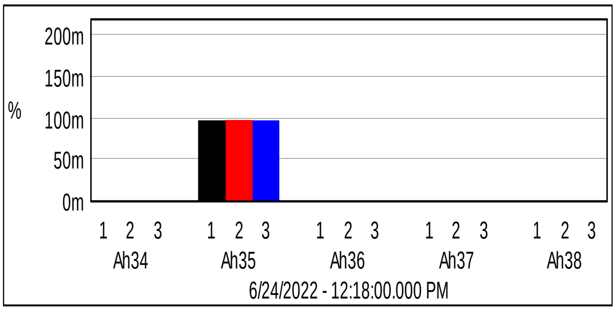


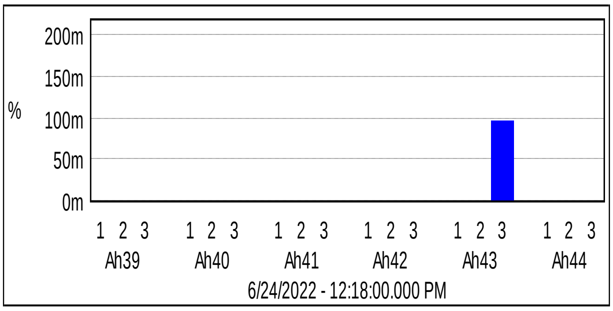


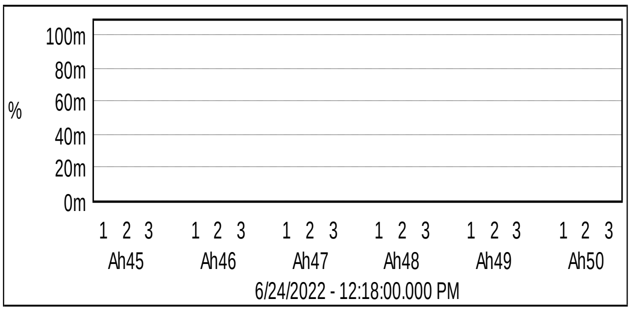


- Above individual current harmonics are not considerable.

Name	Avg	Min	Max	Units
A1h34	0	0	0	%
A1h35	0.108	0	0.2	%
A1h36	0	0	0	%
A1h37	0.078	0	0.2	%
A1h38	0	0	0	%
A1h39	0.069	0	0.2	%
A1h40	0	0	0	%
A1h41	0.045	0	0.1	%
A1h42	0	0	0	%
A1h43	0.002	0	0.1	%
A1h44	0	0	0	%
A1h45	0.002	0	0.1	%
A1h46	0	0	0	%
A1h47	0.003	0	0.1	%
A1h48	0	0	0	%
A1h49	0.054	0	0.1	%
A1h50	0	0	0	%
A2h34	0	0	0	%
A2h35	0.023	0	0.1	%
A2h36	0	0	0	%
A2h37	0.005	0	0.1	%
A2h38	0	0	0	%
A2h39	0.005	0	0.1	%
A2h40	0	0	0	%
A2h41	0	0	0	%
A2h42	0	0	0	%
A2h43	0	0	0	%
A2h44	0	0	0	%
A2h45	0	0	0	%
A2h46	0	0	0	%
A2h47	0	0	0	%
A2h48	0	0	0	%
A2h49	0	0	0	%
A2h50	0	0	0	%
A3h34	0	0	0	%
A3h35	0.066	0	0.1	%
A3h36	0	0	0	%
A3h37	0.011	0	0.1	%
A3h38	0	0	0	%
A3h39	0	0	0	%
A3h40	0	0	0	%
A3h41	0.014	0	0.1	%
A3h42	0	0	0	%
A3h43	0.008	0	0.1	%
A3h44	0	0	0	%
A3h45	0	0	0	%
A3h46	0	0	0	%
A3h47	0	0	0	%
A3h48	0	0	0	%
A3h49	0	0	0	%
A3h50	0	0	0	%







- Above individual current harmonics are not considerable.

3. Energy Bill Analysis

3.1 Electrical Energy

At Shivaji Mahavidyalaya Mowad 440 V supply is provided from Maharashtra State Electricity Distribution Co. Ltd.

3.2 Details of Electrical System

Table No.3.1

Description	Details
Supply Voltage (V)	440 V
Sanctioned Load (KW)	9.08 KW
Estimated Annual Electricity Consumption (kWh)	2166
Estimated Annual Electricity Cost (Rs)	16900

3.3 Electricity Bill Analysis and Power Factor

Electricity Billing

Understanding different components of electrical bill is very important to control the bill. The electricity billing by utilities for medium in Industrial category, is done on two-part tariff structure, i.e. one part for capacity (or demand) drawn and the second part for actual energy drawn during the billing cycle. Capacity or demand is in KVA (apparent power) or KW terms. The reactive energy (i.e.) KVARH drawn by the service is also recorded and billed for in some utilities, because this would affect the load on the utility. Accordingly, utility charges for maximum demand, active energy and reactive power drawn (as reflected by the power factor) in its billing structure. In addition, other fixed and variable expenses are also levied.

Analysis of Electricity Bill

<u>Monthly Electricity Consumption:</u>

Applicable Tariff: 017 LT Public Service Govt. Education

Sanction Load (KW) with MSEB =9.08 KW

The tariff structure generally includes the following components:

a. Maximum demand Charges:-These charges relate to maximum demand registered during month/billing period and corresponding rate of utility.
b. Energy Charges:-These charges relate to energy (kilowatt hours) consumed during month / billing period and corresponding rates.
c. Power factor penalty or bonus rates, as levied by most utilities, are to contain reactive power drawn from grid.
d. Fuel cost adjustment charges as levied by some utilities are to adjust the increasing fuel expenses over a base reference value.
e. Electricity duty charges levied w.r.t. units consumed.
f. Meter rentals.
g. Lighting and fan power consumption is often at higher rates, levied sometimes on slabs is or on actual metering basis.
h. Time of day (TOD) rates like peak and non-peak hours are also prevalent in tariff structure provisions of some utilities.

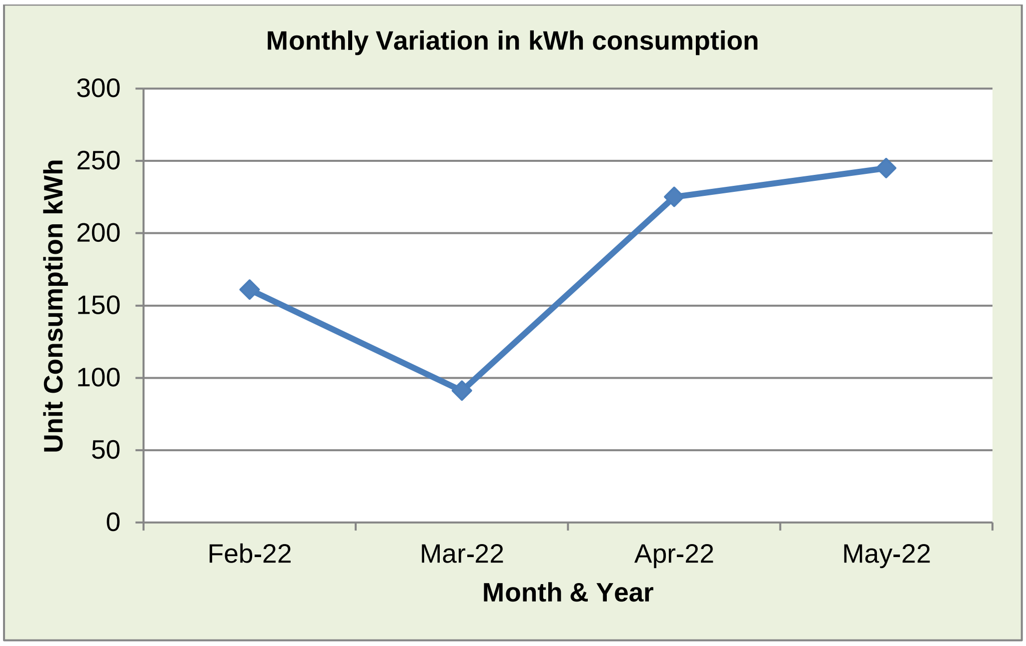
Table No. 3.2: Details of Applicable Tariff

S. N.	MSEDCL Tariffs with effect from 1 April, 2022 to 31 March, 2023			
	Consumption Slab (kWh)	**Fixed / Demand Charge**	**Wheeling Charge (Rs/kWh)**	**Energy Charge (Rs/kWh)**
	LT VII (A): LT - Public Services – Government Educational Institutions and Hospitals			
i)	< 20 kW	Rs.353.00 /Month	1.35	3.18
ii)	>20 - ≤ 50 kW	Rs.353.00/kW/Month	1.35	4.57
iii)	> 50 kW	Rs.353.00/kW/Month	1.35	5.73
ToD Tariffs (in addition to above base Tariffs) (Rs/kWh)				
	2200 Hrs-0600 Hrs			-1.50

Table No. 3.6 Energy Consumption Sheet

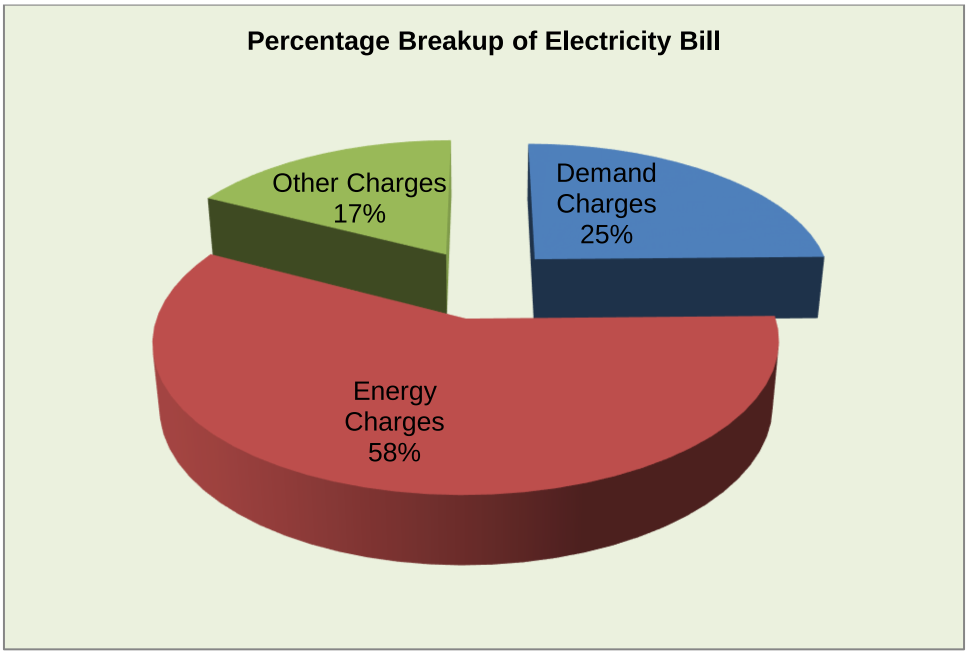
Energy Consumption Sheet Consumer ID-426503503481, LT Public service govt. Education											
Months	**Unit Consumption KWH**	**Sanction Load**	**Demand Charges in Rs.**	**Wheeling Charges in Rs.**	**Energy Charges in Rs.**	**TOD Tarif EC in Rs.**	**FAC in Rs.**	**Electricity Duty in Rs.**	**Tax On Sale in Rs.**	**Total Amount in Rs.**	**Avg. Unit in Rs.**
Feb-22	161	9.08	343	222	502	0	0	171	31	1269	7.88
Mar-22	91	9.08	343	126	283	0	14	122	17	905	9.94
Apr-22	225	9.08	353	304	715	0	34	225	43	1673	7.44
May-22	245	9.08	353	331	779	0	37	240	47	1786	7.29
Total	**722**		**1392**	**982**	**2279**	**0**	**84**	**758**	**137**	**5633**	
Average										**1408**	**7.80**
Estimated Annual	**2166**		**4176**		**6838**					**16900**	

Graph No.3.1. Monthly Variation in kWh consumption



From the above graph it is clear that energy consumption is more during the month of May-22.

Graph No. 3.3. Percentage break - up of Electricity Bill



❖ Observations:

- Average cost of electricity units is Rs. 7.80/kWh and energy charges is Rs. 4.53/- kWh.
- Demand charges are 25% of total bill amount.
- Energy charges are 58% of total bill amount.
- Other charges are 17% of total bill amount.

4 Lighting, Fan & Air Conditioning

4.1 Introduction

Lighting is an essential service in all the building, industries & utilities. Innovation and continuous improvement in the field of lighting has given rise to energy saving opportunities in this area.

At Nagar Parishad Shivaji Mahavidyalaya, Mowad, Lighting system consists of mainly following type of luminaries. Inventory for lighting & other load is studied & tabulated as under

Table No. 4.1 List of lighting load

Location	Wattage	18	100	40	12	60	24
	Type of Lamp	LED TL	Lamp Bulb	TL Copper	CFL	LED Bulb	LED Bulb
	No. of Lamp per Fixture	1	1	1	1	1	1
Class Room-1		2					
Class Room-2		2					
Class Room-3		2					
Class Room-4		1	1				
Toilet 1 Ladies			1				
Toilet 2 Male			1				
Room-5		2					
Library		3		2	1		
Dept Physics				2	2	**1**	
Computer Lab					1		
Principal Sir Room		2					
Printer Room							1
Record Room					1		
Principal Sir Toilet					1		
Office		2					
Passage		4			3		
TOTAL		**20**	**3**	**4**	**9**	**1**	**1**
TOTAL WATTAGE		**0.36**	**0.3**	**0.16**	**0.108**	**0.06**	**0.024**
TOTAL LOAD IN KW		**1.01**					

Energy Saving in Lighting

Energy saving can be achieved by replacement of existing lighting fixture with energy efficient fixture. As under

- Replacement of 1x40 W FTL by 1x18 W LED Tube Light
- Replacement of 100 W Incandescent Bulb with 18 W LED Tubelight.

Table No. 4.2 Potential Saving by replacement of Lighting Fixture

Potential for Energy Savings by various Energy Efficient Lighting Measures								
Description	Existing		Description	Proposed		Saving in Kwh/ annum	Unit Rate	Approximate investment Rs.
	Qty.	Actual power consumption Considering 40% Utilization		Qty.	Actual power consumption Considering 40% Utilization			
Tube light Fitting 1x40 W	4	115	Providing 1x18 W LED Tubelight	4	40	75	350	1400
Bulb 100 W	3	166	Providing 18 W LED Tubelight	3	30	136	350	1050
		280			**70**	**211**		**2450**
Annual Estimated saving potential for Energy saving in Kwh						**211**		
Average Energy Cost (Rs)						**4.35**		
Annual potential for Energy saving in Rs.						**917**		
Pay Back Period in months						**32**		

4.2. Energy Saving in Fan

The existing fans installed at Nagar Parishad Shivaji Mahavidyalaya, Mowad premises are of conventional type, having a power consumption of 70 W. Location wise installed number of fans is tabulated as under:-

Table No. 4.2: List of Fan Load

Location	Nos.	Type of Fan Ceiling / wall / Exhaust	Old/New	Make	Wattage of Fan	Regulator / Resistance /Electronic	Total Load in Watt
Class Room 1	4	Ceiling fan	New	Orient	70	No	280
Class Room 2	4	Ceiling fan	New	Orient	70	No	280
Class Room 3	5	Ceiling fan	New	Orient	70	No	350
Class Room 4	2	Ceiling fan	New	Orient	70	No	140
Toilet Ladies	1	Ceiling fan	New	Orient	70	No	70
Room 5	2	Ceiling fan	New	Orient	70	No	140
Library	4	Ceiling fan	New	Orient	70	No	280
Dept. Computer	4	Ceiling fan	New	Orient	70	No	280
Principal Room	1	Ceiling fan	New	Orient	70	No	70
IQAC	1	Ceiling fan	New	Orient	70	No	70
Principal Room	1	Ceiling fan	New	Orient	70	No	70
Printer Room	1	Ceiling fan	New	Orient	70	No	70
Office	2	Ceiling fan	New	Orient	70	No	140
Record Room	1	Stand Fan	New	Orient	70	No	70
							2.31

BEE Star Rated BLDC Fans

BLDC fan has a Brushless DC electronic motor that is super-efficient. The fan does not need a regulator and works with remote control. Power consumption for 1200 mm sweep ceiling fan, at different speed is given as under

Table No.: 4.3 Comparisons of Ordinary Fan and BLDC Fan

Speed	1	2	3	4	5
Wattage	3.8 Watts	13.7 Watts	13.8 Watts	22.7 Watts	35.8 Watts

Energy saving potential by replacement of Existing Fans by Energy Efficient BLDC Fan is tabulated as under.

Energy Saving in Ceiling Fan

Table No.:4.4:- Potential Saving by replacement of Conventional Ceiling Fan by Energy Efficient BLDC Fan

Potential Saving By Replacement of Existing Fan with Energy Efficient BLDC Fan												
Sr.No.	Location	Existing Ceiling Fans Wattage with no of Fans 70	Wattage of New Fan	Average Working Hours Per Day	Annual operating day	Existing Consumption in kWh	Proposed Consumption in kWh	Annual kWh Saving	Annual Saving Rs.	Unit Rate in Rs.	Fan Qty.	Approximate investment Rs.
1	Nagar Parishad Shivaji Mahavidyalaya, Mowad	32	35	6	230	2473	1236	1236	5601	3000	32	96000
	Total					**2473**	**1236**	**1236**	**5601**		**32**	**96000**
Considering 20% Saving by use of Remote Regulator								**247**	**1120**			
Total Saving								**1484**	**6722**			
Considering 80 % utilization of connected load												
Total Potential Saving due to Replacement of Existing Fan with Energy Efficient BLDC Fan (kWh)								**1484**				
Total Potential Saving due to Replacement of Existing Fan with Energy Efficient BLDC Fan (Rs.)								**6722**				
Investment in Rs.								**96000**				

Considered:-

- 80% utilization/working of fans.
- 6 hours working per day.
- 230 working day per annum.
- Energy Cost is considered including Energy Charges + Wheeling Charges (3.18++1.35=4.53)

4.3 Energy Saving in Computers

Due to increasing population of PC is the commercial building, manufacturing and operation of computer hardware may be a significant contributor to global warming.

Considerable energy can be saved by practicing following measures for computer.

1. Monitor should be combined turn off or enter power-saving mode after 20 minutes (or less) of inactivity, and hard drive to turn off after 30 minutes of inactivity. This can be done from the Power Options icon located in Windows Control Panel.
2. The brightness should be Adjust on monitor. The brighter a monitor, the more energy it uses. A monitor's brightness can be reduced dramatically if used in a dark room, for example.
3. Shut down computer when leave the office for more than two hours. An alternative would be to place it in hibernation or standby mode. Despite popular belief, powering computer on and off daily is a good habit for proper PC maintenance.
4. Consider enabling a monitor's power-saving mode that places the monitor in a "sleep" state until activity from the mouse or keyboard is detected.
5. Screensavers are not energy savers; they continually use the monitor at full power and were originally designed to prevent "burn in."
6. If available laptop computer. Laptop should be used. Laptops use less energy than desktops and are equally suitable for most users.
7. Turn off the laptop's Bluetooth or wireless capabilities when not in use to get some extra minutes, or even hours, out of the device before the battery dies.
8. Configure of monitor to turn off after 20 minutes of inactivity, hard drive to turn off after 30 minutes of inactivity, and desktop computer or laptop to go into a standby or sleep mode after 90 minutes of inactivity.
9. Do not turn on computer, monitor, or printer in the morning until actually need is there.

5. Energy Monitoring and Awareness

5.1 Energy Monitoring

Introduction

Energy monitoring and targeting is primarily a management technique that uses energy information as a basis to eliminate waste, reduce and control current level of energy use and improve the existing operating procedures. It builds on the principle "you can't manage what you don't measure and what you do not understand".
Energy Monitoring essentially combines the principles of energy use and statistics.

Elements of Monitoring & Targeting System

The essential elements of M&T system are:

- Recording-Measuring and recording different energy parameters like Maximum Demand, Power Factor, KWh Etc on Hourly/shift wise/daily etc. Installation of power analyzer which can be interface with Computer will help to do this job.
- Analyzing-Correlating energy consumption to a measured output, such as production quantity machine and equipment wise specific consumption.
- Comparing- Comparing energy consumption to an appropriate standard or benchmark past consumption
- Setting Targets - Setting targets to reduce or control energy consumption
- Monitoring- Comparing energy consumption to the set target on a regular basis
- Reporting -Reporting the results including any variances from the targets which have been set
- Controlling- Implementing management measures to correct any variances, which may have occurred
- Checking the accuracy of energy invoices
- Allocating energy costs to specific departments (Energy Accounting Centers)
- Determining energy performance/efficiency
- Recording energy use, so that projects intended to improve energy efficiency can be checked
- Highlighting performance problems in equipment or systems

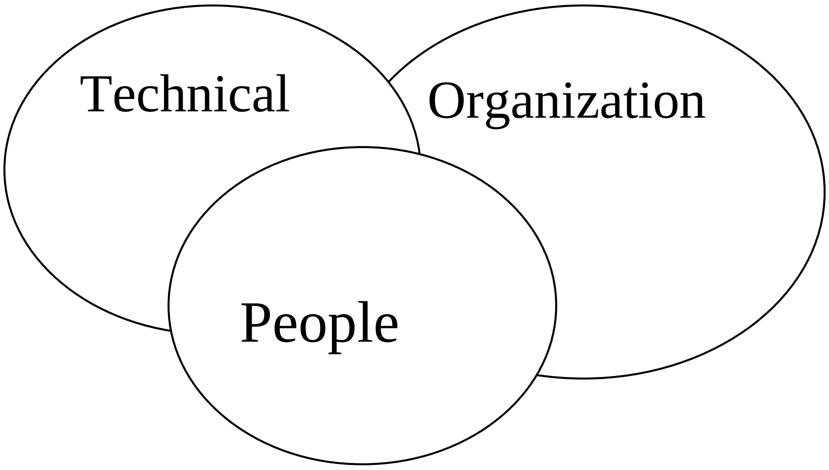
5.2 Awareness and Involvement of Management and operating staff.

Energy Management has technical issues because energy is consumed by technical systems. But technical systems are operated by people, and people can dramatically influence the level of energy consumption. Energy management in industrial, Commercial and institutional organizations can be regarded as having three key elements, as figure below illustrates:

- **Technical** — the energy consuming device and systems that energy efficiency, or inefficiently
- **Organization** — the structure and management system that can support or hinder the achievement of energy efficiency goals
- **People** — the personal values, attitude and practices of individuals in the organization that impact on energy use

The experience of organization that successfully manage their energy use suggests that technological solution alone do not achieve maximum energy saving, and are less likely to be sustained in the long term. There are instances that illustrate that a focus on people alone—their awareness of energy efficiency as an issue, their values and attitude towards energy use, and their skills and knowledge related to energy system –can achieve significant and sustainable saving of source, the combination of these two approaches—technological and human resources—will likely yield the optimum result.

Awareness trainings and participation of end users who are in directing controlling major energy consuming machines/equipments, will definitely improve the energy efficiency.



5.3 Energy Management System

It has, hence, become imperative for Industries and Commercial Establishments and to establish systems to measure monitor, implement and verify efficient use of energy & its conservation and EMS is the first right step in this direction.

Introduction

Electrical energy is one of the major consumables, which Form a large cost component for Industries and Commercial Establishments Particularly in Industries and Commercial Establishments, the rate at which power is made available can make all the difference in cost. The Electricity Bill has a fixed component (proportional to the sanctioned Maximum Demand) and a variable one (proportional to the units consumed). We need to look at both when trying to cut costs. Before one attempts optimization of machinery and processes it is essential to have consumption data and trends on which improvement techniques can be applied.

Only then, can one have, a continuous Energy improvement programmer based on real-time & on-line, plant data collection, data analysis, data interpretation, decision-making and energy saving implementation, in a closed loop.
The problem starts here. Industries and Commercial Establishments today, have lagged behind in basic techniques of measurement and centralized data collection and need to quickly correct this situation.

Some of the problem areas are:

- Use of analog meters, which are inherently not as accurate as digital metering
- A few standalone KWH meters are provided while many other essential parameters like PF, V, I, VAR are not measured / monitored
- There is no provision / system for on-line measurements; readings are taken by manual logging. The off-line monitoring of energy parameters is not synchronized real-time with the production other data. This leads to errors in energy readings. Also, there can be human errors in reading or writing of energy readings
- Greater emphasis on process efficiency than on energy efficiency. Energy loop. optimization is not a p art of the control
- Many of the equipment capacities are overrated by a factor of 3 or higher, to ensure continuous production with little concern for energy consumption

What needs to be done in order to take action for optimization and savings, is to install an on-line Energy Management system.

5.4 Components of an Energy Management Network

The main components of a modern EMS include:

a) Energy Management Software (EMSTM).
b) A computer system with the desired Energy data generators
c) Remote meters, which constitute the main electrical
d) Network components like data cables, data converters, data repeaters and data concentrators (SCMTM) as the physical media.

Today, electric meters are microprocessor-based and available in a variety of configurations, which give information of multiple parameters, which were earlier unimaginable with conventional meters. A typical industry standard meter like the Quasar of L & T reads voltage, current, active / reactive /apparent energy and power, power factor, phase angles, frequency, power demand (max), voltage & local monitoring. Current fundamental and distortion etc. with display for

The meters will be located at remote locations like load centers, power control centers, main receiving station and motor control centers. They read the desired electrical data pertaining to that feeder and send the data to the centralized computer software via the network cables. These meters support industry standard open protocol like Modbus, which allows the EMSTM software to read and configure the meters. The computer receives the data and delivers it to the Energy Management Software, which processes the data and gives the required reports for decision making. EMSTM is based on a Windows Operating System, user-friendly & easy to learn graphic user interface and menu-based configuration. It uses a back-end database for storage and has a robust communication engine for data acquisition with real time capabilities.

The salient features of EMSTM are:

a. Historic trend chart
b. On-line trend charts
c. Performance reports
d. Energy reports
e. Cost reports
f. Budget reports
g. Alarm reports
h. Specific energy consumption reports
i. Run hour reports

EMS indicates the areas of energy saving and helps in identification of specific nodes (locations/users/processes) on which improvements are required. Data collected by the EMS can be suitably used for Energy Management, and hence provides an effective indicator of the industry's energy efficiency.