Energy Audit Report

Energy Audit conducted at ...

K. K. Wagh Arts, Commerce, Science & Computer Science College, Chandori
Tal. Niphad, District - Nashik

- Dr. R K Datir and Team

Energy Audit conducted by ...

ENSUS Consultancy Services – Nashik

- Mr. Sameer Vaze and Team

PO Reference –		
SR	**Description**	**Dates**
1	Site Visit Audit Dates	April 02, 2022
2	Field Trial Dates	NAP
3	Date of 0th Version Audit Report	April 07, 2022
4	Audit Report Review Meeting Date	

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1. Acknowledgement

ENSUS Consultancy Services, Nashik is thankful to the Management of **K. K. Wagh Arts, Commerce, Science & Computer Science College, Chandori** for giving an opportunity to conduct Energy Audit at their premises.

We appreciate and extended our sincere thanks to following authorities of **K. K. Wagh Arts, Commerce, Science & Computer Science College, Chandori** for making all the Data, Facilities and personal support available during the Energy Audit Activity.

- Dr. R K Datir, Principal
- Dr. S G Sawant, Vice Principal
- Prof. P P Aher, Vice Principal
- Dr. H T Waghmare, NAAC Coordinator
- Prof. A B Janjale, IQAC Coordinator
- Dr. N S Jadhav, Criteria 7 Coordinator
- Prf. P S Kadam, Criteria 7 Member
- Prof. Kolhe B B, Physical Director
- Shri. Ramdas Bute, Electrician

We are also thankful to other staff members who were actively involved while collecting the data and doing field observations.

During the audit, every attempt was made to understand the operational features and the actual working in the right perspective.

All analysis is based on the actual data collected, observations on site and data submitted by the Management.

2. Abbreviations

Abbreviations		
CD – Contract Demand	kWH – Active Energy	PF – Power Factor
CL – Connected Load	LF – Load Factor	RkVAH (Lag) – Inductive Reactive Energy
DOL – Direct On Line Starter	LT – Low Tension	RkVAH (Lead) – Capacitive Reactive Energy
HT – High Tension	MCC – Motor Control Sensor	SD – Star Delta Starter
Hz – Frequency	MD – Maximum Demand	SL – Sanctioned Load
I – Current	NAP – Not Applicable	SSB – Sub Station
kVA – Apparent Power	NAS – Not Ascertained	SST – Soft Starter
kVAH – Apparent Energy	NAV – Not Available	V – Voltage
kVAR – Reactive Power	NM – Not Measured	VFD – Variable Frequency Drive
kW – Active Power	PCC – Power Control Center	CH – Chiller
CHW – Chilled Water	CT – Cooling Tower	CTW – Cooling Tower Water
ENCON – Energy Conservation		

3. Disclaimer

Energy Audit Team of ENSUS Consultancy Services has prepared this report for **K. K. Wagh Arts, Commerce, Science & Computer Science College, Chandori** based on input data submitted by the representatives of college complemented with the best judgment capacity of the expert team.

It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

If College wishes to distribute copies of this report external to your organisation, then all pages must be included.

4. Green Audit Conduction Team

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Audit Conducted by ...				
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5. Energy Audit Concept

An **energy audit** is an inspection survey and an analysis of energy usage and flow to identify Energy Conservation (ENCON) Opportunities in an Industry, Commercial Buildings and Educations Campuses.

It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output. It results further into reduction of energy expense and carbon footprint.

Energy audit is an effective tool in defining and pursuing comprehensive energy management programmes. It has positive approach aiming at continuous improvement in energy utilisation in contrast to financial audit which stresses to maintain regularity. Energy audit provides answer to the question – what to do, where to start, at what cost and for what benefits?

Energy audit helps in energy cost optimization, pollution control, safety aspects and suggests the methods to improve the operating and maintenance practices of the system. It is instrumental in coping with the situation of variation in energy cost availability, reliability of energy supply, decision on appropriate energy mix, decision on using improved energy conservation equipment, instrumentations and technology.

The energy audit provides the vital information base for overall energy conservation programme covering essentially energy utilization analysis and evaluation of energy conservation measures.

It aims at:

- Assessing present pattern of energy consumption in different cost centres of operations
- Relating energy inputs and production output
- Identifying potential areas of thermal and electrical energy economy.
- Highlighting wastage in major areas
- Fixing of energy saving potential targets for individual cost centres
- Implementation of measures of energy conservation and realisation of savings.

The overall objectives of the Energy Audit are accomplished by:

- Identifying areas of improvement and formulation of energy conservation measures requiring no investment or marginal investment through system improvements and optimisation of operations.
- Identifying areas requiring major investment by incorporation of modern energy efficient equipment and up-gradation of existing equipment.

Electrical Power Supply is the most important Utility and needs to be managed to optimize the overall system performance. It needs to be utilised properly with Unity Power Factor. Various Benefit Schemes declared by Electricity Service Provider need to be availed while using the Electricity.

6. Overview of Parent Society and College

Parent Society

The K. K. Wagh Education Society started in the Year 1970; a small sapling planted started with only one institute has now spread its wings with 35 different institutes and has become the brand name in the field of education.

The courses like Engineering, Polytechnic, Traditional branches like Arts, Commerce, Science & Computer Science, Education, Nursing and Agricultural studies are offered and being chosen by high-ranking students.

Many of their past students are holding prestigious positions in the reputed organisations within the country and aboard. The K. K. Wagh Education Society is known for the moral values, ethics & contributing a lot for the overall upliftment of the society.

A Small sapling planted by Karmaveer Kakasaheb Wagh has grown in to a full tree with 35 different branches with 21,000 students engaged in studies from K.G to Ph.D. in various fields. there are over 1900 dedicated employees who have been engaged in maintaining quality education.

Vision

Empowering students from rural areas through quality education and to imbibe human values in them.

Mission

To educate youth through quality education for holistic development by imparting value based and skill-based education to transform students into competent responsible citizen.

K. K. Wagh Arts, Commerce, Science & Computer Science College – Chandori

K. K. Wagh Arts, Commerce, Science & Computer Science College – Chandori

The college was established in the year 2004, this institute is started in rural area & the 16-year journey has been a story of hard work, sincere effort toward quality enhancement, quantitative growth & expansion.

During this short span the number of students has increased considerably & characteristically almost 70% of the students have been girl students. Visa-vis there's been growth in infrastructure - a large campus with Gymkhana, Smart Classroom, a large Playground, Computer Lab, well equipped Departments, Language Lab, Commerce Lab and Psychology Lab and experienced qualified faculty.

Courses offered by college ...

SR	Course Name	Intake Capacity
1	Bachelor of Arts	120
2	Bachelor of Business Administration (Computer Application)	80
3	Bachelor of Commerce	120
4	Master of Commerce	60
5	Bachelor of Science	120
6	Bachelor of Computer Science	80
7	Master of Computer Science	30

7. Executive Summary of Energy Audit

7A) Energy Conservation (ENCON) Solutions

ENCON Solutions (Case A)

SR	Description	Existing kWh/Year	New Expected kWh/Year	Saving in kWh/Year	Saving in %
ENCON SOL 01	Switch over from present HT VIII B to LT VII B in MSEDCL Tariff Category	NAP	NAP	NAP	NAP
ENCON SOL 02A	Replace Fluorescent Tubes (36 W) to LED Tube Lights (20 W) @ Rs. 12.69 / kWh	1623.6	902	721.6	44.44
ENCON SOL 03A	Replace existing Regular Ceiling Fans with BLDC Fans @ Rs. 12.69 / kWh	19673.5	8431.5	11242	57.14
ENCON SOL 04	Opearte all Pumps only in the Night Zone 1 i.e., 222:00 to 06:00 Hrs	NAP	NAP	NAP	NAP
Total for Unit Rate @ Rs. 12.69 / kWh with implementaing ENCON SOL 01 to 04		**21297.1**	**9333.5**	**11963.6**	**56.17**

ENCON Solutions (Case A)

SR	Description	Saving in Rs. Lacs/Year	Investment in Rs. Lacs	Simple Pay Back in Months
ENCON SOL 01	Switch over from present HT VIII B to LT VII B in MSEDCL Tariff Category	11.29	2	2.13
ENCON SOL 02A	Replace Fluorescent Tubes (36 W) to LED Tube Lights (20 W) @ Rs. 12.69 / kWh	0.09	0.0315	4.13
ENCON SOL 03A	Replace existing Regular Ceiling Fans with BLDC Fans @ Rs. 12.69 / kWh	1.43	5.39	45.34
ENCON SOL 04	Opearte all Pumps only in the Night Zone 1 i.e., 222:00 to 06:00 Hrs	0.28	0	0
Total for Unit Rate @ Rs. 12.69 / kWh with implementaing ENCON SOL 01 to 04		**13.09**	**7.4215**	**6.80**

In this case, you can replace burnt / damaged Fans only by BLDC Fan. OR Plan replacing by BLDC Fans in Phase wise manner.

ENCON Solutions (Case A)

SR	Heading (All ENCON SOL 01 to 04)	Unit	Value
1	Monthly Avg. Bill (May 21 - Mar 22)	Rs. Lacs/Month	1.19
2	Last Year Average Electricity Bill	Rs. Lacs/Year	14.33
3	Expected Yearly Savings	Rs. Lacs/Year	13.09
4	**% of Saving wrt Yearly Electricity Bill**	**In %**	**91.32**
5	Expected Investment	Rs. Lacs	7.42
6	% of Investment wrt Yearly Electricity Bill	In %	51.77
7	**Yearly Saving / Investment Ratio**	**#**	**1.76**

ENCON Solution 01 ~
Switchover to LT VII B from Existing HT VIII B Category
Maintaining Unity Power Factor by Installing APFC Performance

Solution Description –

The working is done with existing values applied with LT VII B Tariff.

HT VIII B		Charges in Rs. (HT VIII B)							
Month	BD [kVA]	Demand	Wheeling	Energy	TOD (Rs.)	FAC	Duty	Tax	Total
May-21	150	64800	280.56	4614.21	552.2	0	11239.52	72.36	81558.85
Jun-21	150	64800	651.28	10711.23	-248.4	0	12146.26	155.52	88215.89
Jul-21	150	64800	1654.8	27215.55	-1204.9	0	14794.47	406.44	107666.36
Aug-21	150	64800	1602.16	26349.81	-1260	0	14638.72	403.2	106533.89
Sep-21	150	64800	1957.2	32188.95	-1192.2	0	15640.63	499.5	113894.08
Oct-21	150	64800	1406.72	23135.52	-1454.9	0	14061.97	364.5	102313.81
Nov-21	150	64800	1354.08	22269.78	-1264.9	0	13945.43	349.56	101453.95
Dec-21	150	64800	3069.92	50489.22	-2254.7	0	18576.71	485.46	136166.61
Jan-22	150	64800	4096.4	67371.16	-4521.7	0	21079.34	359.46	153184.65
Feb-22	150	64800	3731.28	61366.23	-3750.7	0	20212	352	146891
Mar-22	150	64800	5104.4	83949.15	-4277.5	1823	24223.85	513.54	176136.44
Summation	NAP	712800	24908.8	409660.81	-20877.7	1823	180558.9	3961.54	1314015.53
Minimum	150	64800	280.56	4614.21	-4521.7	0	11239.52	72.36	81558.85
Average	150.00	64800.00	2264.44	37241.89	-1897.97	165.73	16414.45	360.14	119455.96
Maximum	150	64800	5104.4	83949.15	552.2	1823	24223.85	513.54	176136.44

LT VII B		Charges in Rs. (LT VII B)							
Month	MD [kW]	Demand	Wheeling	Energy	TOD	FAC	Duty	Tax	Total
May-21	8	3072	542.7	2906.46	552.2	0	1131.74	72.36	8277.46
Jun-21	11	4224	1166.4	6246.72	-248.4	0	1822.20	155.52	13366.44
Jul-21	20	7680	3048.3	16325.34	-1204.9	0	4135.80	406.44	30390.98
Aug-21	16	6144	3024	16195.2	-1260	0	3856.51	403.2	28362.91
Sep-21	23	8832	3746.25	20063.25	-1192.2	0	5031.89	499.5	36980.69
Oct-21	17	6528	2733.75	14640.75	-1454.9	0	3591.62	364.5	26403.72
Nov-21	22	8448	2621.7	14040.66	-1264.9	0	3815.27	349.56	28010.29
Dec-21	24	9216	3640.95	19499.31	-2254.7	0	4816.25	485.46	35403.27
Jan-22	22	8448	2695.95	14438.31	-4521.7	0	3369.69	359.46	24789.71
Feb-22	19	7296	2644.65	14163.57	-3750.7	0	3256.56	352.62	23962.70
Mar-22	24	9216	3851.55	20627.19	-4277.5	1823	4998.44	513.54	36752.22
Summation	NAP	79104	29716.2	159146.76	-20877.7	1823	39825.9616	3962.16	292700.38
Minimum	8	3072	542.7	2906.46	-4521.7	0	1131.7376	72.36	8277.46
Average	18.73	7191.27	2701.47	14467.89	-1897.97	165.73	3620.54	360.20	26609.13
Maximum	24	9216	3851.55	20627.19	552.2	1823	5031.888	513.54	36980.69

	Present HT VIII B	Expected LT VII B
Total 11 Month Bill in Rs.	1314015.53	292700.38
Total 11 Month kWh	22012.00	22012.00
Effective Rs./kWh	59.70	13.30
Saving Rs. Lacs /Year		11.14

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
NAP	11.14	2	2.15

ENCON Solution 02A ~ [Considering ENCON SOL 01 is implemented, @ Rs. 12.69 / kWh]
Replace Non-LED Tube Lights by LED Tube Lights

Solution Description –

Lighting Data		Building A - GF	Building A - 1F	Building A - 2F	Building A - 3F	Building B - GF	Total / Avg.
Fluorescent Tube Light	Qty	0	0	1	0	20	21
	Watts	36	36	36	36	36	36
	Run Hrs/ Day	4	4	4	4	8	7.81
	kWh/Day	0	0	0.144	0	5.76	5.904
	kWh/Month (25 Days/Month)	0	0	3.6	0	144	147.6
	kWh/Year (11 Months/Year)	0	0	39.6	0	1584	1623.6
New LED Tube Light (Suggested)	Qty	0	0	1	0	20	21
	Watts	20	20	20	20	20	20
	Run Hrs/ Day	4	4	4	4	8	7.81
	kWh/Day	0	0	0.08	0	3.2	3.28
	kWh/Month (25 Days/Month)	0	0	2	0	80	82
	kWh/Year (11 Months/Year)	0	0	22	0	880	902
Saving due to LED Tube Light	Applicable Qty	0	0	1	0	20	21
	Saving in Watts	16	16	16	16	16	16
	Run Hrs/Day	4	4	4	4	8	7.81
	Saving in kWh/Day	0	0	0.064	0	2.56	2.624
	Saving in kWh/Month (25 Days/ month)	0	0	1.6	0	64	65.6
	Saving kn kWh/Year (11 Months/Year)	0	0	17.6	0	704	721.6
	Effective Unit Rate in Rs./kWh	12.69	12.69	12.69	12.69	12.69	12.69
	Saving in Rs./Year	0	0	223.344	0	8933.76	9157.104
	Unit Cost of LED in Rs.	150	150	150	150	150	150
	Investment Cost in Rs.	0	0	150	0	3000	3150
	Simple Payback in Months	NAP	NAP	8.06	NAP	4.03	4.13

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
721.6	0.09157	0.0315	4.13

ENCON Solution 03A ~ [Considering ENCON SOL 01 is implemented, @ Rs. 12.69 / kWh]
Replace Standard Fans by BLDC Fans

Solution Description –

Ceiling Fan Data		Building A - GF	Building A - 1F	Building A - 2F	Building A - 3F	Building B - GF	Total
Regular Ceilimg Fans	Qty	14	31	29	31	49	154
	Watts	70	70	70	70	70	70
	Run Hrs/ Day	6	6	6	6	8	6.64
	kWh/Day	5.88	13.02	12.18	13.02	27.44	71.54
	kWh/Month (25 Days/Month)	147	325.5	304.5	325.5	686	1788.5
	kWh/Year (11 Months/Year)	1617	3580.5	3349.5	3580.5	7546	19673.5
New BLDC Fans suggested	Qty	14	31	29	31	49	154
	Watts	30	30	30	30	30	30
	Run Hrs/ Day	6	6	6	6	8	6.64
	kWh/Day	2.52	5.58	5.22	5.58	11.76	30.66
	kWh/Month (25 Days/Month)	63	139.5	130.5	139.5	294	766.5
	kWh/Year (11 Months/Year)	693	1534.5	1435.5	1534.5	3234	8431.5
Saving due to LED Tube Light	Applicable Qty	14	31	29	31	49	154
	Saving in Watts	40	40	40	40	40	40
	Run Hrs/Day	6	6	6	6	8	6.64
	Saving in kWh/Day	3.36	7.44	6.96	7.44	15.68	40.88
	Saving in kWh/Month (25 Days/ month)	84	186	174	186	392	1022
	Saving kn kWh/Year (11 Months/Year)	924	2046	1914	2046	4312	11242
	Effective Unit Rate in Rs./kWh	12.69	12.69	12.69	12.69	12.69	12.69
	Saving in Rs./Year	11725.56	25963.74	24288.66	25963.74	54719.28	142660.98
	Unit Cost of LED in Rs.	3500	3500	3500	3500	3500	3500
	Investment Cost in Rs.	49000	108500	101500	108500	171500	539000
	Simple Payback in Months	50.15	50.15	50.15	50.15	37.61	45.34
As and when Fan gets burnt and needs replacementor New Fan is requitred, USE BLDC Fan							

Cautionary Note –

Please note that return on Investment is based on Effective Unit Rate of Last Year.
If LT VII B is made applicable then Unit Rate becomes Rs. 12.69 as against Rs. 59.7 and hence Simple Payback in Months would be 45.34 Months as against 9.64 Months.

In this case, you can replace burnt / damaged Fans only by BLDC Fan. OR
Plan replacing by BLDC Fans in Phase wise manner.

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
11242	1.426	5.39	45.34

ENCON Solution 04 ~
Operate all the Pumps in the Night i.e., 22:00 Hrs to 06:00 Hrs

Solution Description –

		Rated					25 Days/Month	11 Months/Year
SR	Location	HP	kW	Qty	Run Hrs/Day	kWh/Day	kWh/Month	kWh/Year
1	Building A	7.5	5.625	1	0.5	2.8125	70.31	773.4375
2	Building A	7.5	5.625	2	0	0	0.00	0
3	Building B	7.5	5.625	1	0	0	0.00	0
4	Building A	3	2.25	1	0.25	0.5625	14.06	154.6875
5	Bore Motor	10	7.5	1	8	60	1500	16500
6	Building A (DW)	2	1.5	1	2	3	75	825
							Total	18253.125

ENCON Solution

Run all the Pumps in the Night i.e., Zone 1 (22:00 ~ 06:00 Hrs)
Average PF is 0.62 (From MSEDCL Bill Analysis)
Get the benefit of Rs. 1.1 / kVAh i.e Rs. (1.1/0.62) / kWh = Rs. 1.77/kWh
Benefit in Rs./Year = 18253.125 x 1.77 x 0.8 = Rs. 28196.1 / Year

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
0	0.281	0	0

7C) Energy Conservation (ENCON) Recommendations

1	Improve operating Efficiency of 20 kW Solar Panels
2	Use Astronomical Timer for Street Lighting
3	Do not use existing Sodium Vapor Lamps on the Street
4	Switch OFF Water Coolers after Working Hours
5	Remove Fix Capacitors (20 kVAR) and use 7% detuned APFC
6	Try to minimize the Use of Lights in Day Time. Limit to Max. 2 Hrs/Day
7	Try to minimize the Use of Fans. Limit to Max. 4 Hrs/Day
8	Try to minimize the Use of Lights and Fans in Gymkhana and Canteen
9	Use Occupancy Sensor for LED Lights and Fans in Gymkhana and Canteen
10	Replace Regular Fans in Gymkhana and Canteen with BLDC Fans
11	Switch OFF Computers and UPS when not in USE
12	Use Solar Operated Pumps

8. Energy Audit – Scope and Methodology

8.1 Audit Fields and Methodology

SR	Energy Audit Field	Methodology & Attributes
1	Electricity Billing (Previous 12 Months)	• Analysis of Demand, kWH, kVAH, Power Factor (PF), TOD Distribution of Energy, Incentives and Penalties • To ascertain Unit Rate realized for Electrical Energy in Rs. / kWh and Rs. / kVAh
2	Energy Consumption Pattern in various Fields	**Load / Filed Sectors List** Energy Consumption in various Fields like ... • Lighting • Fan • AC Systems • Water Pumps • Other relevant Loads / Fields

8.2 Energy Audit Outcome

- ENCON Solutions
- ENCON Recommendations
- ENCON suggested Field Trials (No Field Trials suggested in this audit)

9. Points of Appreciation & Concern

SR	Points of Appreciation	SR	Points of Concern
1	LED Lights are used	1	Fixed Capacitors are used against APFC
2	Natural Light is used to maximum	2	Very Poor Factor
3	Natural Ventilation is used to maximum	3	Very Low Loading of Transformer
4	20 kW of Solar Cell System is installed	4	Solar Cells are not used to their full capacity
5	Very clean campus	5	

10. List of Energy Sources

SR	Source Name	Description in Brief
1	Electricity from MSEDCL	• 11 kV, 250 kVA Transformer • Roof Top Solar Cells – 20 kW Capacity
	Used for various Loads like ... Lighting • Fans • Water Pumps • Laboratory Equipments and Instruments • Water Coolers • Office Equipments like Computers, Printers, Photocopiers etc ...	

11. Electrical Load List

1/4

Location	SR	Block	Flourescent Tube	Fan	Excaust Fan	LCD Projector	LED Tube
Building A - GF	1	A-101 Store Room		1			5
Building A - GF	2	A-102 Zoology Botany Lab					5
Building A - GF	3	A-103 ICT Class Room		2			5
Building A - GF	4	A-10 T&P Cell		2			3
Building A - GF	5	A-105 Incubation Center		2			3
Building A - GF	6	A-106 Class Room		2			5
Building A - GF	7	A-107 NSS and BSD Department		2			5
Building A - GF	8	A-108 Class Room		3			5
Building A - GF	9	Porch					7
Building A - 1F	10	A-201 Class Room		4			5
Building A - 1F	11	A-202 Class Room		4			5
Building A - 1F	12	A-203 ICT Class Room		3		1	4
Building A - 1F	13	A-204 Vice Principal Office		3			5
Building A - 1F	14	A-205 Exam Section		4			4
Building A - 1F	15	A-206 Class Room		4			5
Building A - 1F	16	A-207 ICT Class Room		4		1	5
Building A - 1F	17	A-208 Coomerce & Economics Dept.		5			5
Building A - 1F	18	Porch					7
Building A - 2F	19	A-301 Geography Lab		4			5
Building A - 2F	20	A-302 Class Room		4			5
Building A - 2F	21	A-303 ICT Class Room		4		1	5
Building A - 2F	22	A-304 CAP Room	1	3			5
Building A - 2F	23	A-305 Marathi & English Department		2			3
Building A - 2F	24	A-306 ICT Class Room		4			5
Building A - 2F	25	A-307 Class Room		4			5
Building A - 2F	26	A-308 Class Room		4			5
Building A - 2F	27	Porch					7
Building A - 3F	28	A-401 Computer Lab - 1		5			5
Building A - 3F	29	A-402 Computer Lab 2		5		1	5
Building A - 3F	30	A-403 ICT Class Room		4			5
Building A - 3F	31	A-404 Computer Science Department		2			2
Building A - 3F	32	A-405 Ladies Common Room		2			3
Building A - 3F	33	A-406 Electronic Lab		4			5
Building A - 3F	34	A-407 ICT Class Room		5		1	5
Building A - 3F	35	A-408 ICT Class Room		4		1	5
Building A - 3F	36	Porch					7
Building B - GF	37	B- 101 Principal Office		4		1	6
Building B - GF	38	B-102 Waiting Room		1			1
Building B - GF	39	B-103 Admin. Office		5			6
Building B - GF	40	B-104 IQAC Department	1	1			
Building B - GF	41	B-105 Class Room	4	5			
Building B - GF	42	B-106 Reading Room	4	5			
Building B - GF	43	B-107 Day Care Center		1			1
Building B - GF	44	B-108 Store Room					
Building B - GF	45	B-109 Gents Lavatory					2
Building B - GF	46	B-110 Language LAB		1			1
Building B - GF	47	B-111 Store Room		1			2
Building B - GF	48	B-112 Library	6	6			
Building B - GF	49	B-113 Physics & Mathematics Lab		4			6
Building B - GF	50	B-114 Physics & Chemistry Lab		5	1		8
Building B - GF	51	B-115 Ladies Lavatory					2
Building B - GF	52	B-116 Girls Common Room		1			1
Building B - GF	53	B-117 First Aid Room		1			1
Building B - GF	54	B-118 Chemistry Lab	5	4	2		
Building B - GF	55	B-119 ICT Class Room		3		1	5
Building B - GF	56	B-120 Dept. Of. Chemistry		1			1
Building B - GF	57	Porch					21
Total			21	154	3	8	239

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Location	SR	Block	Computers	Printer	Scanner	Photocopier
Building A - GF	1	A-101 Store Room				
Building A - GF	2	A-102 Zoology Botany Lab				
Building A - GF	3	A-103 ICT Class Room				
Building A - GF	4	A-10 T&P Cell				
Building A - GF	5	A-105 Incubation Center				
Building A - GF	6	A-106 Class Room				
Building A - GF	7	A-107 NSS and BSD Department				
Building A - GF	8	A-108 Class Room				
Building A - GF	9	Porch				
Building A - 1F	10	A-201 Class Room				
Building A - 1F	11	A-202 Class Room				
Building A - 1F	12	A-203 ICT Class Room				
Building A - 1F	13	A-204 Vice Principal Office				
Building A - 1F	14	A-205 Exam Section	2			1
Building A - 1F	15	A-206 Class Room				
Building A - 1F	16	A-207 ICT Class Room				
Building A - 1F	17	A-208 Coomerce & Economics Dept.	8	2		
Building A - 1F	18	Porch				
Building A - 2F	19	A-301 Geography Lab	1			
Building A - 2F	20	A-302 Class Room				
Building A - 2F	21	A-303 ICT Class Room				
Building A - 2F	22	A-304 CAP Room	1			1
Building A - 2F	23	A-305 Marathi & English Department		1		
Building A - 2F	24	A-306 ICT Class Room				
Building A - 2F	25	A-307 Class Room				
Building A - 2F	26	A-308 Class Room				
Building A - 2F	27	Porch				
Building A - 3F	28	A-401 Computer Lab - 1	23			
Building A - 3F	29	A-402 Computer Lab 2	24			
Building A - 3F	30	A-403 ICT Class Room				
Building A - 3F	31	A-404 Computer Science Department	1	1		
Building A - 3F	32	A-405 Ladies Common Room				
Building A - 3F	33	A-406 Electronic Lab	17	2		
Building A - 3F	34	A-407 ICT Class Room	1			
Building A - 3F	35	A-408 ICT Class Room				
Building A - 3F	36	Porch				
Building B - GF	37	B- 101 Principal Office	1	1		
Building B - GF	38	B-102 Waiting Room				
Building B - GF	39	B-103 Admin. Office	4	3	3	1
Building B - GF	40	B-104 IQAC Department	2	1		
Building B - GF	41	B-105 Class Room				
Building B - GF	42	B-106 Reading Room				
Building B - GF	43	B-107 Day Care Center				
Building B - GF	44	B-108 Store Room				
Building B - GF	45	B-109 Gents Lavatory				
Building B - GF	46	B-110 Language LAB	11			
Building B - GF	47	B-111 Store Room				
Building B - GF	48	B-112 Library	6	1		
Building B - GF	49	B-113 Physics & Mathematics Lab	5			
Building B - GF	50	B-114 Physics & Chemistry Lab				
Building B - GF	51	B-115 Ladies Lavatory				
Building B - GF	52	B-116 Girls Common Room				
Building B - GF	53	B-117 First Aid Room				
Building B - GF	54	B-118 Chemistry Lab				
Building B - GF	55	B-119 ICT Class Room				
Building B - GF	56	B-120 Dept. Of. Chemistry	1	1		
Building B - GF	57	Porch				
Total			108	13	3	3

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Location	SR	Block	LAB Equipments	Refrigerator	Water Cooler	Induction Cooker
Building A - GF	1	A-101 Store Room				
Building A - GF	2	A-102 Zoology Botany Lab				
Building A - GF	3	A-103 ICT Class Room				
Building A - GF	4	A-10 T&P Cell				
Building A - GF	5	A-105 Incubation Center				
Building A - GF	6	A-106 Class Room				
Building A - GF	7	A-107 NSS and BSD Department				
Building A - GF	8	A-108 Class Room				
Building A - GF	9	Porch			1	
Building A - 1F	10	A-201 Class Room				
Building A - 1F	11	A-202 Class Room				
Building A - 1F	12	A-203 ICT Class Room				
Building A - 1F	13	A-204 Vice Principal Office		1		
Building A - 1F	14	A-205 Exam Section				
Building A - 1F	15	A-206 Class Room				
Building A - 1F	16	A-207 ICT Class Room				
Building A - 1F	17	A-208 Coomerce & Economics Dept.				
Building A - 1F	18	Porch				
Building A - 2F	19	A-301 Geography Lab				
Building A - 2F	20	A-302 Class Room				
Building A - 2F	21	A-303 ICT Class Room				
Building A - 2F	22	A-304 CAP Room				
Building A - 2F	23	A-305 Marathi & English Department				
Building A - 2F	24	A-306 ICT Class Room				
Building A - 2F	25	A-307 Class Room				
Building A - 2F	26	A-308 Class Room				
Building A - 2F	27	Porch			1	
Building A - 3F	28	A-401 Computer Lab - 1				
Building A - 3F	29	A-402 Computer Lab 2				
Building A - 3F	30	A-403 ICT Class Room				
Building A - 3F	31	A-404 Computer Science Department				
Building A - 3F	32	A-405 Ladies Common Room				
Building A - 3F	33	A-406 Electronic Lab	6			
Building A - 3F	34	A-407 ICT Class Room				
Building A - 3F	35	A-408 ICT Class Room				
Building A - 3F	36	Porch			1	
Building B - GF	37	B- 101 Principal Office				
Building B - GF	38	B-102 Waiting Room				
Building B - GF	39	B-103 Admin. Office				
Building B - GF	40	B-104 IQAC Department				
Building B - GF	41	B-105 Class Room				
Building B - GF	42	B-106 Reading Room				
Building B - GF	43	B-107 Day Care Center				
Building B - GF	44	B-108 Store Room				
Building B - GF	45	B-109 Gents Lavatory				
Building B - GF	46	B-110 Language LAB				
Building B - GF	47	B-111 Store Room				
Building B - GF	48	B-112 Library				
Building B - GF	49	B-113 Physics & Mathematics Lab	6			
Building B - GF	50	B-114 Physics & Chemistry Lab				
Building B - GF	51	B-115 Ladies Lavatory				
Building B - GF	52	B-116 Girls Common Room				
Building B - GF	53	B-117 First Aid Room				
Building B - GF	54	B-118 Chemistry Lab				
Building B - GF	55	B-119 ICT Class Room				
Building B - GF	56	B-120 Dept. Of. Chemistry				
Building B - GF	57	Porch				
Total			12	1	3	0

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Water Pumps

SR	Location		No. of Phases	Rated HP	Rated kW	Qty
1	Building A		3	7.5	5.625	1
2	Building A		3	7.5	5.625	2
3	Building B		3	7.5	5.625	1
4	Building A		3	3	2.25	1
5	Bore Motor		3	10	7.5	1
6	Building A	Drinking Water	1	2	1.5	1

12. MSEDCL – Electricity Bill Analysis

MSEDCL Electricity Bill Analysis ~ Consumer Details and Electricity Billing Tariff

Consumer Information in Brief	
Consumer No.	~ 073079021040
Consumer Name	M/s The President K K Wagh Education society (Polytechnic Campus)
Consumer Address	GAT No. 1 6 8, Chandori, Tal - Niphad, District Nashik 422303
DOD	1/10/2015
Category	Public Services Others
Supply	HT - 11 kV
MSEDCL Tariff	146 HT - VIII B
Sanctioned Load	200 kW
Connected Load	200 kW
Contract Demand	250 kVA

HT VIII B	Unit	Y 20-21	Y 21-22	Y22-23	Y 23-24	Y 24-25
Demand Charges	Rs. / kVA	411	432	454	463	472
X % of CD	In %	55	60	65	70	75
Free Wheeling	Rs. / kVAh	0.57	0.56	0.55	0.54	0.53
Energy	Rs. / kVAh	9.48	9.21	8.96	7.76	7.21
Total (Only Energy)	Rs. / kVAh	10.05	9.77	9.51	8.3	7.74

Billed Demand for HT Consumer ...
Higher of (1), (2) and (3)
(1) Actual Measured MD in Zone 2, Zone 3 and Zone 4
(2) 75% of the highest Billing Demand recorded during the preceding eleven months, subject to the limit of Contract Demand
(2) *X* % of CD
Penalty for MD > CD ~ 150% of MD Rate

- CD – Contract Demand
- MD – Maximum Demand noted over 30 Minutes' Interval
- BD – Billed Demand
- PF – Power Factor

MSEDCL Electricity Bill Analysis ~ Consumer Details and Electricity Billing Tariff

LT VII B (20 - 50 kW)	Unit	Y 20-21	Y 21-22	Y22-23	Y 23-24	Y 24-25
Demand Charges	Rs. / kVA	362	373	384	392	400
Free Wheeling	Rs. / kWh	1.45	1.38	1.35	1.3	1.26
Energy	Rs. / kWh	7.44	7.28	7.23	7.27	7.27
Total (Only Energy)	Rs. / kWh	8.89	8.66	8.58	8.57	8.53

Billed Demand for LT Consumer ...
Higher of (1) and (2)
(1) 65% of Measured MD in Zone 2, Zone 3 and Zone 4
(2) 40% of CD
Penalty for MD > CD ~ 150% of MD Rate

Time of the Day (TOD) Details –

TOD Zone	Timing	Offset in Rs./kWh	Offset in Rs./kWh	Offset in Rs./kWh	Offset in Rs./kWh	Offset in Rs./kWh
Zone 1	22:00 to 06:00 Hrs	-1.5	-1.5	-1.5	-1.5	-1.5
Zone 2	06:00 to 09:00 Hrs 12:00 to 18:00 Hrs	0	0	0	0	0
Zone 3	09:00 to 12:00 Hrs	0.8	0.8	0.8	0.8	0.8
Zone 4	18:00 to 22:00 Hrs	1.1	1.1	1.1	1.1	1.1

PF Incentive and Penalty Tables (Only for LT Consumers) –

SR	Range of Power	Power Factor	Level Incentive
1	0.951 to 0.954	0.95	0%
2	0.955 to 0.964	0.96	0.50%
3	0.965 to 0.974	0.97	1.00%
4	0.975 to 0.984	0.98	1.50%
5	0.985 to 0.994	0.99	2.50%

SR	Range of Power	Power Factor	Level Penalty
1	0.895 to 0.900	0.9	0%
2	0.885 to 0.894	0.89	1.0%
3	0.875 to 0.884	0.88	1.5%
4	0.865 to 0.874	0.87	2.0%
5	0.855 to 0.864	0.86	2.5%
6	0.845 to 0.854	0.85	3.0%
7	0.835 to 0.844	0.84	3.5%
8	0.825 to 0.834	0.83	4.0%
9	0.815 to 0.824	0.82	4.5%

MSEDCL Electricity Bill Analysis ~ Consumer Details and Electricity Billing Tariff

Power Factor Computation Method –

Power Factor Computation

Where the average Power Factor measurement is not possible through the installed meter, the following formula for calculating the average Power Factor during the billing period shall be applied:

$$Average\ Power\ Factor = \frac{Total\ (kWh)}{Total\ (kVAh)}$$

$$Wherein\ the\ kVAh\ is = \sqrt{\sum(\text{KWh})^2 + \sum(\text{RkVAh Lag} + \text{RkVAh Lead})^2}$$

Further, average PF so computed can be considered as leading or lagging based on the following test:

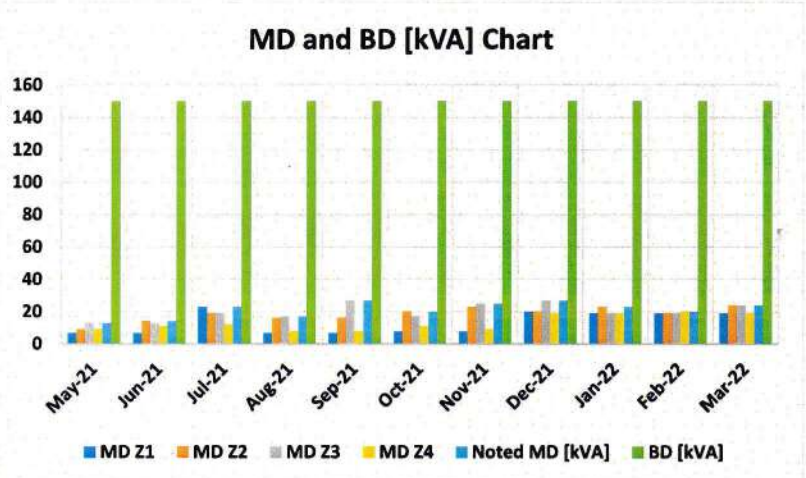
If "RkVAh lead" > "RkVAh lag" then "Average P.F." is to be treated as "Lead P.F."

If "RkVAh lead" = < "RkVAh lag" then "Average P.F." is to be treated as "Lag P.F."

MSEDCL Electricity Bill Analysis ~ kVA Demand TOD Pattern and Billing Demand

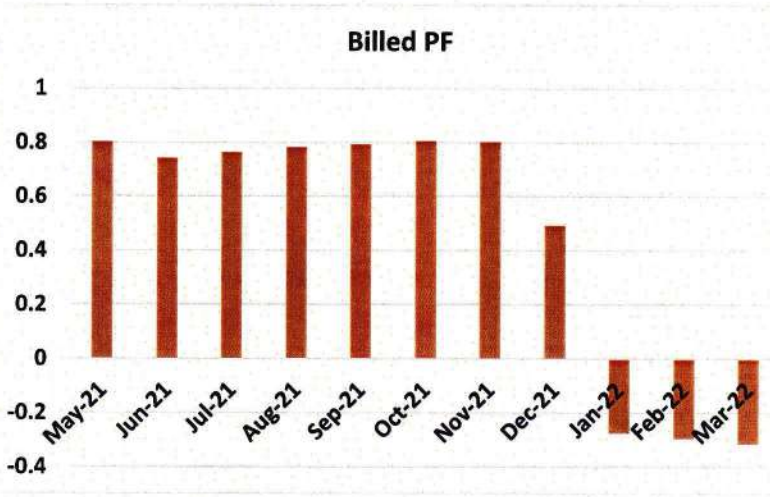
HT VIII B						TOD Zone Timing 22:00 ~ 06:00 Hrs	06:00 ~ 09:00 Hrs 12:00 ~ 18:00 Hrs	09:00 ~ 12:00 Hrs	18:00 ~ 22:00 Hrs
Month	CD [kVA]	60% of CD [kVA]	MD [kW]	MD [kVA]	BD [kVA]	MD Z1	MD Z2	MD Z3	MD Z4
May-21	250	150	8	13	150	7	9	13	9
Jun-21	250	150	11	14	150	7	14	13	11
Jul-21	250	150	20	23	150	23	19	19	12
Aug-21	250	150	16	17	150	7	16	17	8
Sep-21	250	150	23	27	150	7	16	27	8
Oct-21	250	150	17	20	150	8	20	17	11
Nov-21	250	150	22	25	150	8	23	25	9
Dec-21	250	150	24	27	150	20	20	27	19
Jan-22	250	150	22	23	150	19	23	19	19
Feb-22	250	150	19	20	150	19	19	19	20
Mar-22	250	150	24	24	150	19	24	24	19
Summation	NAP	NAP	NAP	NAP	NAP	NAP	NAP	NAP	NAP
Minimum	250	150	8	13	150	7	9	13	8
Average	250	150	18.73	21.18	150.00	13.09	18.45	20	13.18
Maximum	250	150	24	27	150	23	24	27	20

Month	MD Z1	MD Z2	MD Z3	MD Z4	Noted MD [kVA]	BD [kVA]	Extra BD[kVA]	Extra Rs. Lacs/Month
May-21	7	9	13	9	13	150	137	0.592
Jun-21	7	14	13	11	14	150	136	0.588
Jul-21	23	19	19	12	23	150	127	0.549
Aug-21	7	16	17	8	17	150	133	0.575
Sep-21	7	16	27	8	27	150	123	0.531
Oct-21	8	20	17	11	20	150	130	0.562
Nov-21	8	23	25	9	25	150	125	0.540
Dec-21	20	20	27	19	27	150	123	0.531
Jan-22	19	23	19	19	23	150	127	0.549
Feb-22	19	19	19	20	20	150	130	0.562
Mar-22	19	24	24	19	24	150	126	0.544
Summation	NAP	NAP	NAP	NAP	NAP	NAP	NAP	6.121
Minimum	7	9	13	8	13	150	123	0.53136
Average	13.09	18.45	20	13.18	21.18	150.00	128.82	0.56
Maximum	23	24	27	20	27	150	137	0.59184



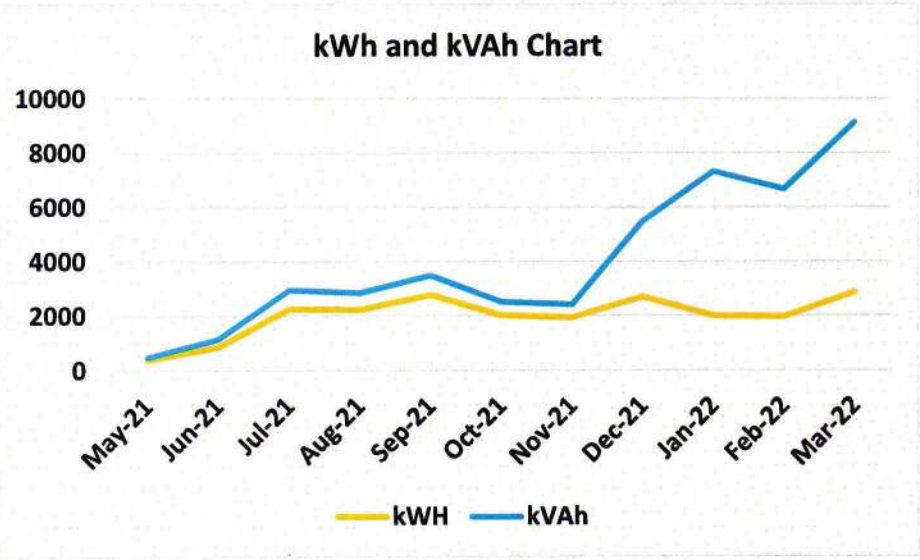
MSEDCL Electricity Bill Analysis ~ kWh, kVAh and Power Factor Pattern

Month	kWH	kVAh	RkVAh (Lag)	RkVAh (Lead)	Billed PF	PF Type
May-21	402	501	1050	0	0.803	Lagging
Jun-21	864	1163	1548	0	0.743	Lagging
Jul-21	2258	2955	2010	0	0.764	Lagging
Aug-21	2240	2861	1915	0	0.783	Lagging
Sep-21	2775	3495	2110	0	0.794	Lagging
Oct-21	2025	2512	1693	0	0.806	Lagging
Nov-21	1942	2418	1740	0	0.803	Lagging
Dec-21	2697	5482	1490	0	0.492	Lagging
Jan-22	1997	7315	0	9373	0.273	Leading
Feb-22	1959	6663	0	8175	0.294	Leading
Mar-22	2853	9115	3	9800	0.313	Leading
Summation	22012	44480	13559	27348	NAP	NAP
Minimum	402	501	0	0	0.273	NAP
Average	2001.09	4043.64	1232.64	2486.18	0.62	NAP
Maximum	2853	9115	2110	9800	0.806	NAP



MSEDCL Electricity Bill Analysis ~ kWh, kVAh Consumption and TOD Pattern

Month	kWH	kVAh	kVAh Z1	kVAh Z2	kVAh Z3	kVAh Z4	TOD (Rs.)
May-21	402	501	0	0	0	502	552.2
Jun-21	864	1163	588	0	0	576	-248.4
Jul-21	2258	2955	1492	412	410	641	-1204.9
Aug-21	2240	2861	1462	470	300	630	-1260
Sep-21	2775	3495	1597	674	477	747	-1192.2
Oct-21	2025	2512	1561	145	0	806	-1454.9
Nov-21	1942	2418	1405	248	0	766	-1264.9
Dec-21	2697	5482	2750	898	494	1341	-2254.7
Jan-22	1997	7315	4707	300	0	2308	-4521.7
Feb-22	1959	6663	3952	568	0	2143	-3750.7
Mar-22	2853	9115	4722	1677	607	2109	-4277.5
Summation	22012	44480	24236	5392	2288	12569	-20877.7
Minimum	402	501	0	0	0	502	-4521.7
Average	2001.09	4043.64	2203.27	490.18	208.00	1142.64	-1897.97
Maximum	2853	9115	4722	1677	607	2308	552.2

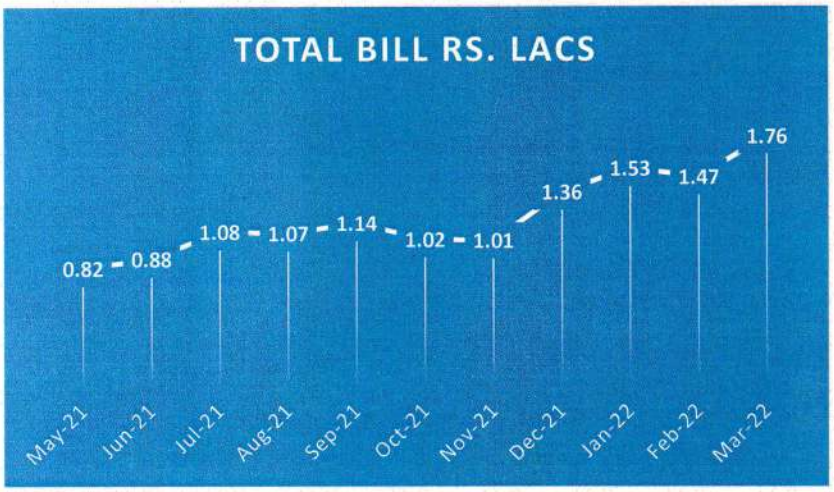


MSEDCL Electricity Bill Analysis ~ Extra kVAh Billed over actual kWh Consumed due to poor PF

Month	kWH	kVAh	kVAh - kWh	kVAh/kWh
May-21	402	501	99	1.25
Jun-21	864	1163	299	1.35
Jul-21	2258	2955	697	1.31
Aug-21	2240	2861	621	1.28
Sep-21	2775	3495	720	1.26
Oct-21	2025	2512	487	1.24
Nov-21	1942	2418	476	1.25
Dec-21	2697	5482	2785	2.03
Jan-22	1997	7315	5318	3.66
Feb-22	1959	6663	4704	3.40
Mar-22	2853	9115	6262	3.19
Summation	22012	44480	22468	NAP
Minimum	402	501	99	1.24
Average	2001.09	4043.64	2042.55	1.93
Maximum	2853	9115	6262	3.66

MSEDCL Electricity Bill Analysis ~ Billing Pattern and Effective Rs. /kWh and Rs. /kVAh

Monthly Electricity Bills in Rs. Lacs



Minimum Rs. Lacs	Average Rs. Lacs	Maximum Rs. Lacs	Yearly Sum Rs. Lacs
0.82	1.14	1.53	11.38

Effective Energy Unit Rates –

Month	kWH	kVAh	Total	Rs./kWh	Rs./kVAh
May-21	402	501	81558.85	202.88	162.79
Jun-21	864	1163	88215.89	102.10	75.85
Jul-21	2258	2955	107666.36	47.68	36.44
Aug-21	2240	2861	106533.89	47.56	37.24
Sep-21	2775	3495	113894.08	41.04	32.59
Oct-21	2025	2512	102313.81	50.53	40.73
Nov-21	1942	2418	101453.95	52.24	41.96
Dec-21	2697	5482	136166.61	50.49	24.84
Jan-22	1997	7315	153184.65	76.71	20.94
Feb-22	1959	6663	146891	74.98	22.05
Mar-22	2853	9115	176136.44	61.74	19.32
			Effective Rate	59.70	29.54
Summation	22012	44480	1314015.5	NAP	NAP
Minimum	402	501	81558.85	41.04	19.32
Average	2001.09	4043.64	119455.96	73.45	46.79
Maximum	2853	9115	176136.44	202.88	162.79

Minimum Rs. / kWh	Average Rs. / kWh	Maximum Rs. / kWh	Effective Rs. / kWh
41.04	73.45	202.88	59.70

This Effective Energy Tariff Value **[Rs. 59.70 / kWh]** will be used to ascertain the Savings observed in Energy Audit.

Comments and ENCON Solution on MSEDCL Electricity Bill Analysis	
1	Maximum Demand is ascertained based on the kVA drawn in Zone 2, Zone 3 and Zone 4. MD recorded in Zone 1 is not considered for Billing Purpose. Actual operating MD is 13 kVA to 27 kVA with Average of 21.8 kVA. MD noted is much lower than the 60% of CD i.e., 0.6 * 250 = 150 kVA Institute ended up in paying the MD Charges based on 150 kVA though it is not drawn. This extra amount is Rs. 6.121 Lacs in 11 Months amount to Rs. 6.67 Lacs / Year.
2	It is observed that till December 2021, PF Improvement System was not in operation and Power was drawn at very-very Low PF on Inductive Side. PF was ranging from 0.492 to 0.806 with Average Value of 0.748. From January 2022 onwards, 20 kVAR Fixed Capacitors were put in operation resulting into Leading Power Factor 0.273 to 0.313 with Average Value of 0.293. A very pathetic situation.
3	kWh is the actual Active Electrical Energy one uses for actual Physical Work in the Institute i.e., for operating various Electrical Loads like Lamps, Computers, Fans, Pumps etc ... kVAh is the Apparent Electrical Energy one uses for Active Electrical Energy and Reactive Electrical Energy (Inductive and Capacitive) combined together. As PF is not controlled and as it is very poor, the Apparent Energy consumed is much more than the Active Energy used in reality. In all additional 22468 Units are billed over 11 Months resulting into effectively more 24511 Units/Year. With Effective Rate of Rs. 29.54 / kVAh, around Rs. 7.24 Lacs / Year.
4	As Actual Demand (13 to 27 kVA) is much less than CD of 250 kVA we suggest to switch over to present HT VIII B Category to LT VII B Category. This will reduce the Bill to a very great extent. The details can be seen in ENCON SOL 01.

ENCON Solution 01 ~
Switchover to LT VII B from Existing HT VIII B Category
Keep CD as 40 kVA
Maintaining Unity Power Factor by Installing APFC Performance

Solution Description –

The working is done with existing values applied with LT VII B Tariff.

HT VIII B		Charges in Rs. (HT VIII B)							
Month	BD [kVA]	Demand	Wheeling	Energy	TOD (Rs.)	FAC	Duty	Tax	Total
May-21	150	64800	280.56	4614.21	552.2	0	11239.52	72.36	81558.85
Jun-21	150	64800	651.28	10711.23	-248.4	0	12146.26	155.52	88215.89
Jul-21	150	64800	1654.8	27215.55	-1204.9	0	14794.47	406.44	107666.36
Aug-21	150	64800	1602.16	26349.81	-1260	0	14638.72	403.2	106533.89
Sep-21	150	64800	1957.2	32188.95	-1192.2	0	15640.63	499.5	113894.08
Oct-21	150	64800	1406.72	23135.52	-1454.9	0	14061.97	364.5	102313.81
Nov-21	150	64800	1354.08	22269.78	-1264.9	0	13945.43	349.56	101453.95
Dec-21	150	64800	3069.92	50489.22	-2254.7	0	18576.71	485.46	136166.61
Jan-22	150	64800	4096.4	67371.16	-4521.7	0	21079.34	359.46	153184.65
Feb-22	150	64800	3731.28	61366.23	-3750.7	0	20212	352	146891
Mar-22	150	64800	5104.4	83949.15	-4277.5	1823	24223.85	513.54	176136.44
Summation	NAP	712800	24908.8	409660.81	-20877.7	1823	180558.9	3961.54	1314015.53
Minimum	150	64800	280.56	4614.21	-4521.7	0	11239.52	72.36	81558.85
Average	150.00	64800.00	2264.44	37241.89	-1897.97	165.73	16414.45	360.14	119455.96
Maximum	150	64800	5104.4	83949.15	552.2	1823	24223.85	513.54	176136.44

LT VII B		Charges in Rs. (LT VII B)							
Month	MD [kW]	Demand	Wheeling	Energy	TOD	FAC	Duty	Tax	Total
May-21	8	3072	542.7	2906.46	552.2	0	1131.74	72.36	8277.46
Jun-21	11	4224	1166.4	6246.72	-248.4	0	1822.20	155.52	13366.44
Jul-21	20	7680	3048.3	16325.34	-1204.9	0	4135.80	406.44	30390.98
Aug-21	16	6144	3024	16195.2	-1260	0	3856.51	403.2	28362.91
Sep-21	23	8832	3746.25	20063.25	-1192.2	0	5031.89	499.5	36980.69
Oct-21	17	6528	2733.75	14640.75	-1454.9	0	3591.62	364.5	26403.72
Nov-21	22	8448	2621.7	14040.66	-1264.9	0	3815.27	349.56	28010.29
Dec-21	24	9216	3640.95	19499.31	-2254.7	0	4816.25	485.46	35403.27
Jan-22	22	8448	2695.95	14438.31	-4521.7	0	3369.69	359.46	24789.71
Feb-22	19	7296	2644.65	14163.57	-3750.7	0	3256.56	352.62	23962.70
Mar-22	24	9216	3851.55	20627.19	-4277.5	1823	4998.44	513.54	36752.22
Summation	NAP	79104	29716.2	159146.76	-20877.7	1823	39825.9616	3962.16	292700.38
Minimum	8	3072	542.7	2906.46	-4521.7	0	1131.7376	72.36	8277.46
Average	18.73	7191.27	2701.47	14467.89	-1897.97	165.73	3620.54	360.20	26609.13
Maximum	24	9216	3851.55	20627.19	552.2	1823	5031.888	513.54	36980.69

	Present HT VIII B	Expected LT VII B
Total 11 Month Bill in Rs.	1314015.53	279337.18
Total 11 Month kWh	22012.00	22012.00
Effective Rs./kWh	59.70	12.69
Saving Rs. Lacs /Year		**11.29**

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
NAP	11.29	2	2.13

13. Solar Cell Operating Efficiency

Solar Cell Operation

In all 60 Solar Cell Panels are installed, each of 320 Watts resulting into 320 x 60 =

	Solar kW installed	Use Factor Assumed	Hrs/Day	Days/Month	Solar Expected kWh/Month	Solar Actual kWh/Month	Operating Efficiency in %
May-21	19.2	0.8	6	31	2856.96	1176	41.16
Jun-21	19.2	0.6	6	30	2073.6	1029	49.62
Jul-21	19.2	0.6	6	31	2142.72	360	16.80
Aug-21	19.2	0.6	6	31	2142.72	430	20.07
Sep-21	19.2	0.6	6	30	2073.6	303	14.61
Oct-21	19.2	0.8	6	31	2856.96	663	23.21
Nov-21	19.2	0.8	6	30	2764.8	703	25.43
Dec-21	19.2	0.8	6	31	2856.96	403	14.11
Jan-22	19.2	0.8	6	31	2856.96	706	24.71
Feb-22	19.2	0.8	6	28	2580.48	601	23.29
Mar-22	19.2	0.8	6	31	2856.96	445	15.58
Summation	NAP	NAP	NAP	NAP	28062.72	6819	24.30
Minimum	19.2	0.6	6	28	2073.6	303	14.11
Average	19.2	0.73	6.00	30.45	2551.16	619.91	24.42
Maximum	19.2	0.8	6	31	2856.96	1176	49.62

During Audit it was observed that only 40 Cells are actually connected. Reworking based on this is as below ...

	Solar kW actually put in operation	Use Factor Assumed	Hrs/Day	Days/Month	Solar Expected kWh/Month	Solar Actual kWh/Month	Operating Efficiency in %
May-21	12.8	0.8	6	31	1904.64	1176	61.74
Jun-21	12.8	0.6	6	30	1382.4	1029	74.44
Jul-21	12.8	0.6	6	31	1428.48	360	25.20
Aug-21	12.8	0.6	6	31	1428.48	430	30.10
Sep-21	12.8	0.6	6	30	1382.4	303	21.92
Oct-21	12.8	0.8	6	31	1904.64	663	34.81
Nov-21	12.8	0.8	6	30	1843.2	703	38.14
Dec-21	12.8	0.8	6	31	1904.64	403	21.16
Jan-22	12.8	0.8	6	31	1904.64	706	37.07
Feb-22	12.8	0.8	6	28	1720.32	601	34.94
Mar-22	12.8	0.8	6	31	1904.64	445	23.36
Summation	NAP	NAP	NAP	NAP	18708.48	6819	36.45
Minimum	12.8	0.6	6	28	1382.4	303	21.16
Average	12.8	0.73	6.00	30.45	1700.77	619.91	36.63
Maximum	12.8	0.8	6	31	1904.64	1176	74.44

Comments and Recommendation on Solar Cell Operation	
1	Actual Energy consumed from Solar Cell System will depend on ... • No. of Cells put in Operation • No. of kW Load put on the System From the data, one can conclude that ... • All the Solar Cell Panels are not put in operation • Loads as per Capacity are not put on the Solar System

ENCON Recommendation 01 ~ Solar Cells
Recommendation Description – • Put all the Cells into operation • Load the Solar Cell System as per its Full Capacity

14. Lighting System

Lighting System Description

Location	SR	Block	Flourescent Tube	LED Tube
Building A - GF	1	A-101 Store Room		5
Building A - GF	2	A-102 Zoology Botany Lab		5
Building A - GF	3	A-103 ICT Class Room		5
Building A - GF	4	A-10 T&P Cell		3
Building A - GF	5	A-105 Incubation Center		3
Building A - GF	6	A-106 Class Room		5
Building A - GF	7	A-107 NSS and BSD Department		5
Building A - GF	8	A-108 Class Room		5
Building A - GF	9	Porch		7
Building A - 1F	10	A-201 Class Room		5
Building A - 1F	11	A-202 Class Room		5
Building A - 1F	12	A-203 ICT Class Room		4
Building A - 1F	13	A-204 Vice Principal Office		5
Building A - 1F	14	A-205 Exam Section		4
Building A - 1F	15	A-206 Class Room		5
Building A - 1F	16	A-207 ICT Class Room		5
Building A - 1F	17	A-208 Coomerce & Economics Dept.		5
Building A - 1F	18	Porch		7
Building A - 2F	19	A-301 Geography Lab		5
Building A - 2F	20	A-302 Class Room		5
Building A - 2F	21	A-303 ICT Class Room		5
Building A - 2F	22	A-304 CAP Room	1	5
Building A - 2F	23	A-305 Marathi & English Department		3
Building A - 2F	24	A-306 ICT Class Room		5
Building A - 2F	25	A-307 Class Room		5
Building A - 2F	26	A-308 Class Room		5
Building A - 2F	27	Porch		7
Building A - 3F	28	A-401 Computer Lab - 1		5
Building A - 3F	29	A-402 Computer Lab 2		5
Building A - 3F	30	A-403 ICT Class Room		5
Building A - 3F	31	A-404 Computer Science Department		2
Building A - 3F	32	A-405 Ladies Common Room		3
Building A - 3F	33	A-406 Electronic Lab		5
Building A - 3F	34	A-407 ICT Class Room		5
Building A - 3F	35	A-408 ICT Class Room		5
Building A - 3F	36	Porch		7
Building B - GF	37	B- 101 Principal Office		6
Building B - GF	38	B-102 Waiting Room		1
Building B - GF	39	B-103 Admin. Office		6
Building B - GF	40	B-104 IQAC Department	1	
Building B - GF	41	B-105 Class Room	4	
Building B - GF	42	B-106 Reading Room	4	
Building B - GF	43	B-107 Day Care Center		1
Building B - GF	44	B-108 Store Room		
Building B - GF	45	B-109 Gents Lavatory		2
Building B - GF	46	B-110 Language LAB		1
Building B - GF	47	B-111 Store Room		2
Building B - GF	48	B-112 Library	6	
Building B - GF	49	B-113 Physics & Mathematics Lab		6
Building B - GF	50	B-114 Physics & Chemistry Lab		8
Building B - GF	51	B-115 Ladies Lavatory		2
Building B - GF	52	B-116 Girls Common Room		1
Building B - GF	53	B-117 First Aid Room		1
Building B - GF	54	B-118 Chemistry Lab	5	
Building B - GF	55	B-119 ICT Class Room		5
Building B - GF	56	B-120 Dept. Of. Chemistry		1
Building B - GF	57	Porch		21
		Total	21	239

Non-LED Tube Lights – 21
LED Tube Lights – 239
Total Tube Lights – 260

% Of Non-LED Tube Lights – 8.07 %

Students switch OFF the Tube Lights when not in CLass

Comments on Lighting System Description	
1	Majority (92%) Tube Lights are LED Tube Lights.
2	We suggest remaining 8% Non-LED Tube Lights to be replaced by LED Tube Lights.
3	**LED Lights not considered in Calculations**

SR	Location	Qty	Watts	Run Hrs/Day
1	Gymkhana	15	20	Uncertain
2	Canteen	5	20	Uncertain
3	Street Light	42	72	Uncertain

.

ENCON Solution 02A ~ [Considering ENCON SOL 01 is implemented, @ Rs. 12.69 / kWh]
Replace Non-LED Tube Lights by LED Tube Lights

Solution Description –

Lighting Data		Building A - GF	Building A - 1F	Building A - 2F	Building A - 3F	Building B - GF	Total / Avg.
Fluorescent Tube Light	Qty	0	0	1	0	20	21
	Watts	36	36	36	36	36	36
	Run Hrs/ Day	4	4	4	4	8	7.81
	kWh/Day	0	0	0.144	0	5.76	5.904
	kWh/Month (25 Days/Month)	0	0	3.6	0	144	147.6
	kWh/Year (11 Months/Year)	0	0	39.6	0	1584	1623.6
New LED Tube Light (Suggested)	Qty	0	0	1	0	20	21
	Watts	20	20	20	20	20	20
	Run Hrs/ Day	4	4	4	4	8	7.81
	kWh/Day	0	0	0.08	0	3.2	3.28
	kWh/Month (25 Days/Month)	0	0	2	0	80	82
	kWh/Year (11 Months/Year)	0	0	22	0	880	902
Saving due to LED Tube Light	Applicable Qty	0	0	1	0	20	21
	Saving in Watts	16	16	16	16	16	16
	Run Hrs/Day	4	4	4	4	8	7.81
	Saving in kWh/Day	0	0	0.064	0	2.56	2.624
	Saving in kWh/Month (25 Days/ month)	0	0	1.6	0	64	65.6
	Saving kn kWh/Year (11 Months/Year)	0	0	17.6	0	704	721.6
	Effective Unit Rate in Rs./kWh	12.69	12.69	12.69	12.69	12.69	12.69
	Saving in Rs./Year	0	0	223.344	0	8933.76	9157.104
	Unit Cost of LED in Rs.	150	150	150	150	150	150
	Investment Cost in Rs.	0	0	150	0	3000	3150
	Simple Payback in Months	NAP	NAP	8.06	NAP	4.03	4.13

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
721.6	0.09157	0.0315	4.13

15. Fans (Ceiling)

Fans Description

Location	SR	Block	Fan
Building A - GF	1	A-101 Store Room	1
Building A - GF	2	A-102 Zoology Botany Lab	
Building A - GF	3	A-103 ICT Class Room	2
Building A - GF	4	A-10 T&P Cell	2
Building A - GF	5	A-105 Incubation Center	2
Building A - GF	6	A-106 Class Room	2
Building A - GF	7	A-107 NSS and BSD Department	2
Building A - GF	8	A-108 Class Room	3
Building A - GF	9	Porch	
Building A - 1F	10	A-201 Class Room	4
Building A - 1F	11	A-202 Class Room	4
Building A - 1F	12	A-203 ICT Class Room	3
Building A - 1F	13	A-204 Vice Principal Office	3
Building A - 1F	14	A-205 Exam Section	4
Building A - 1F	15	A-206 Class Room	4
Building A - 1F	16	A-207 ICT Class Room	4
Building A - 1F	17	A-208 Coomerce & Economics Dept.	5
Building A - 1F	18	Porch	
Building A - 2F	19	A-301 Geography Lab	4
Building A - 2F	20	A-302 Class Room	4
Building A - 2F	21	A-303 ICT Class Room	4
Building A - 2F	22	A-304 CAP Room	3
Building A - 2F	23	A-305 Marathi & English Department	2
Building A - 2F	24	A-306 ICT Class Room	4
Building A - 2F	25	A-307 Class Room	4
Building A - 2F	26	A-308 Class Room	4
Building A - 2F	27	Porch	
Building A - 3F	28	A-401 Computer Lab - 1	5
Building A - 3F	29	A-402 Computer Lab 2	5
Building A - 3F	30	A-403 ICT Class Room	4
Building A - 3F	31	A-404 Computer Science Department	2
Building A - 3F	32	A-405 Ladies Common Room	2
Building A - 3F	33	A-406 Electronic Lab	4
Building A - 3F	34	A-407 ICT Class Room	5
Building A - 3F	35	A-408 ICT Class Room	4
Building A - 3F	36	Porch	
Building B - GF	37	B- 101 Principal Office	4
Building B - GF	38	B-102 Waiting Room	1
Building B - GF	39	B-103 Admin. Office	5
Building B - GF	40	B-104 IQAC Department	1
Building B - GF	41	B-105 Class Room	5
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Building B - GF	45	B-109 Gents Lavatory	
Building B - GF	46	B-110 Language LAB	1
Building B - GF	47	B-111 Store Room	1
Building B - GF	48	B-112 Library	6
Building B - GF	49	B-113 Physics & Mathematics Lab	4
Building B - GF	50	B-114 Physics & Chemistry Lab	5
Building B - GF	51	B-115 Ladies Lavatory	
Building B - GF	52	B-116 Girls Common Room	1
Building B - GF	53	B-117 First Aid Room	1
Building B - GF	54	B-118 Chemistry Lab	4
Building B - GF	55	B-119 ICT Class Room	3
Building B - GF	56	B-120 Dept. Of. Chemistry	1
Building B - GF	57	Porch	
Total			154

All Fans are Normal Fans and not latest BLDC Fans.

Speed Regulators are Electronic Regulators

Students witch OFF the Fans when not in Class

Fans not considerd in Calculations

SR	Location	Qty	Watts	Run Hrs/Day
1	Gymkhana	8	70	Uncertain
2	Canteen	3	70	Uncertain
Replace these Fans with BLDC Fans				

ENCON Solution 03A ~ [Considering ENCON SOL 01 is implemented, @ Rs. 12.69 / kWh]
Replace Standard Fans by BLDC Fans

Solution Description –

Ceiling Fan Data		Building A - GF	Building A - 1F	Building A - 2F	Building A - 3F	Building B - GF	Total
Regular Ceilimg Fans	Qty	14	31	29	31	49	154
	Watts	70	70	70	70	70	70
	Run Hrs/ Day	6	6	6	6	8	6.64
	kWh/Day	5.88	13.02	12.18	13.02	27.44	71.54
	kWh/Month (25 Days/Month)	147	325.5	304.5	325.5	686	1788.5
	kWh/Year (11 Months/Year)	1617	3580.5	3349.5	3580.5	7546	19673.5
New BLDC Fans suggested	Qty	14	31	29	31	49	154
	Watts	30	30	30	30	30	30
	Run Hrs/ Day	6	6	6	6	8	6.64
	kWh/Day	2.52	5.58	5.22	5.58	11.76	30.66
	kWh/Month (25 Days/Month)	63	139.5	130.5	139.5	294	766.5
	kWh/Year (11 Months/Year)	693	1534.5	1435.5	1534.5	3234	8431.5
Saving due to LED Tube Light	Applicable Qty	14	31	29	31	49	154
	Saving in Watts	40	40	40	40	40	40
	Run Hrs/Day	6	6	6	6	8	6.64
	Saving in kWh/Day	3.36	7.44	6.96	7.44	15.68	40.88
	Saving in kWh/Month (25 Days/ month)	84	186	174	186	392	1022
	Saving kn kWh/Year (11 Months/Year)	924	2046	1914	2046	4312	11242
	Effective Unit Rate in Rs./kWh	12.69	12.69	12.69	12.69	12.69	12.69
	Saving in Rs./Year	11725.56	25963.74	24288.66	25963.74	54719.28	142660.98
	Unit Cost of LED in Rs.	3500	3500	3500	3500	3500	3500
	Investment Cost in Rs.	49000	108500	101500	108500	171500	539000
	Simple Payback in Months	50.15	50.15	50.15	50.15	37.61	45.34
As and when Fan gets burnt and needs replacementor New Fan is requitred, USE BLDC Fan							

Cautionary Note –

Please note that return on Investment is based on Effective Unit Rate of Last Year.
If LT VII B is made applicable then Unit Rate becomes Rs. 12.69 as against Rs. 59.7 and hence Simple Payback in Months would be 45.34 Months as against 9.64 Months.

In this case, you can replace burnt / damaged Fans only by BLDC Fan. OR
Plan replacing by BLDC Fans in Phase wise manner.

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
11242	1.426	5.39	45.34

16. Water Pumps

ENCON Solution 04 ~
Operate all the Pumps in the Night i.e., 22:00 Hrs to 06:00 Hrs

Solution Description –

		Rated					25 Days/Month	11 Months/Year
SR	Location	HP	kW	Qty	Run Hrs/Day	kWh/Day	kWh/Month	kWh/Year
1	Building A	7.5	5.625	1	0.5	2.8125	70.31	773.4375
2	Building A	7.5	5.625	2	0	0	0.00	0
3	Building B	7.5	5.625	1	0	0	0.00	0
4	Building A	3	2.25	1	0.25	0.5625	14.06	154.6875
5	Bore Motor	10	7.5	1	8	60	1500	16500
6	Building A (DW)	2	1.5	1	2	3	75	825
							Total	18253.125

ENCON Solution

Run all the Pumps in the Night i.e., Zone 1 (22:00 ~ 06:00 Hrs)
Average PF is 0.62 (From MSEDCL Bill Analysis)
Get the benefit of Rs. 1.1 / kVAh i.e Rs. (1.1/0.62) / kWh = Rs. 1.77/kWh
Benefit in Rs./Year = 18253.125 x 1.77 x 0.8 = Rs. 28196.1 / Year

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
0	0.281	0	0

ENCON Recommendation 02 ~
Install Solar Powered Pumps

Description –

We recommend in future you can install Solar Powered Pumps so that this expenditure also will be saved.

END OF REPORT

ENERGY AUDIT REPORT OF

K. K. WAGH EDUCATION SOCIETY'S CHANDORI CAMPUS

PREPARED BY

PROF. DR. B. E. KUSHARE
CERTIFIED ENERGY AUDITOR,
PROFESSOR AND HEAD OF ELECTRICAL ENGG.DEPARTMENT
K. K. WAGH INSTITUTE OF ENGINEERING EDUCATION AND RESEARCH,
NASHIK

November - 2020

KKWIEER, Nashik, Hirabai Haridas Vidyanagari , Amrutdham, Panchawati , Nashik-422003

"A Mission made programme can be created for energy conservation. We have to set yearly target of saving twenty-five billion units per year from the present 3.2 billion units, so that we can wipe out the existing shortage within the next four years"

Dr. APJ Abdul Kalam
Ex. Hon. President of India
Address at National Energy Awards Function,
Dec.15, 2005

ACKNOWLEDGEMENT

Energy Management Cell of K K Wagh Institute of Engineering Education and Research, Nashik places sincere thanks to Management of K. K. Wagh. Education Society, Nashik, Coordinator of Chandori Campus and Principal of various institutes for providing opportunity to conduct Energy Audit. We are thankful to all Heads of Department and Staff and in-charge of various sections for providing required support during Field Measurements and Preparation of Energy Audit Report.

Prof. (DR.) B. E. KUSHARE
Certified Energy Auditor
Head Energy Management Cell
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CHAPTER – 1

INTRODUCTION

CHAPTER – 1

GENERAL:

K. K. Wagh Education Society is a leading educational trust in Nashik District. It was established in 1970 by the visionary leader Late Padmashree Karmaveer Kakasaheb Wagh. Campus at Chandori comprises educational institutes in the field of Arts, Commerce, Science & Computer Science,Education, Nursing and Agricultural. Out of various sections major Energy is consumed in Building A & B main building and sheds. Management of K K Wagh Education society is proactive towards Energy and Environment Conservation. Focus is given to Eliminate wastages by good housing keeping techniques and use of renewable energy resources. Principal and Coordinator of campus plans and monitors energy consumption and identifies Energy conservation opportunities. Energy audit of Chandori campus was carried out to identify opportunities to further reduce Energy consumption and identify areas for energy substitution and use of renewable energy sources to reduce use of Electrical Energy from Conventional Sources.

1.1 OBJECTIVE OF ENERGY AUDIT

To undertake energy audit to identify the various energy conservation opportunities (ECO's) such as lighting system, HVAC pumping, transformer and computer systems, water pumps, reactive power management by conducting field measurement, detailed analysis and suggest energy conservation measures to reduce energy consumption with detailed techno-economic analysis

To identify the areas of energy saving with no investment and with investment

To prioritize distinct areas identified for energy saving depending upon saving potential, skills and time frame for execution, investment cost, payback etc.

To identify energy consumption of various major equipments.

Attempt fine-tuning of certain parameters aimed at saving power.

To identify opportunities for Energy substitution

To identify areas of Reuse and Recycle

To identify potential for use of Renewable Energy Sources

1.2 SCOPE OF ENERGY AUDIT:

To study the energy consumption analysis of the building such as lighting, water pumping, motor, reactive power management, HVAC and Laboratory Equipments.

1.2.1 ELECTRICAL ENERGY

To study electrical energy metering, monitoring and control systems are existing in the both units and to recommend the suitable system for future monitoring.

To study the monthly power factor, maximum demand, working hours, load factors etc. for reference period along with monthly electricity consumption and to establish scope for optimization of load factor through detailed load management study.

To recommend a specific rationalization/optimization programmed based on measurement of power factors at various PCC points, existing capacitor systems and its maintenance, automatic/manual control required etc.

To undertake the detail motor load assessment on all the motors above 5HP to study the loading patterns of the motors to identify the oversized and undersized motors.

To study water pumping system.

To undertake Illumination audit of all the section including lux measurement with the help of lux meter to recommend the specific plan for energy conservation.

Comparison of actual level of illumination with recommended level of illumination for various activities.

Study of efficiency of existing lamps and ballast used.

Study of voltage profile of all feeders.

Identification of energy conservation opportunities of lighting systems.

Performance evaluation of windows, split, air conditioners.

Recommend immediate low cost / no cost energy conservation measures.

Recommend medium term energy conservation measures.

Recommend long-term energy conservation measures.

To identify opportunities for energy substitution

To identify opportunities for use of renewable energy

To identify opportunities for recycle and reuse

Evaluation, Implementation and monitoring: To identify, evaluate and prioritize energy saving opportunities through above into short, mid and long-term time basis depending upon investments, quantum of savings, skills and time required for implementation etc. To recommend a time bound action plan for implementation of accepted measures.

1.3 METHODOLOGY:

FOLLOWING METHODOLOGY WAS FOLLOWED DURING ENERGY AUDIT

Held preliminary discussion with production and maintenance in charge and his team to understand electric supply distribution network feeding power to various Section and energy consumption pattern of various utilities, energy accounting system and various energy management systems employed for energy conservation.

Gathered all relevant data related to conduction of detailed energy audit pertaining to electrical system, connected load, monthly energy bills, single line diagram of distribution system, HVAC system, Lighting system.

Detailed measurement was conducted with the help of various instruments and expert staff. The various equipment's used during measurements are advanced power quality analyzer HIOKI-3198, lux meter, anemometer and clamp on meter.

On the basis of measurement result and data collected performance of room wise lighting system, motor driven system and street light are calculated.

Recommendations are given based on techno economic analysis to reduce energy consumption.

Cost benefits analysis on account of improved efficiency is done.

The various equipment's used during measurements are listed in table 1.0

TABLE 1.0: INSTRUMENTION USED DURING ENERGY AUDIT

Sr. No	Instrument	Specifications
1.	Advanced power quality analyzer	HIOKI 3198, Japan, 8 channels, four for voltage and 4 for currents, facility of measurement of 180 electrical parameters and different wiring configuration. Sampling frequency 6M samples per second. Facility of voltage sag, swell, flicker, harmonics, inter-harmonics, transients and all other electrical parameters.
2.	Clamp on meter	0-1200KW 0-600V AC 0-800V DC 0-2000A, current AC/DC
3.	Lux meter	0-10,000 lux level, non-contact type
4	Digital Clamp on Earth tester	Make: MOTWANI, Range: 1500Ω

5	Digital clamp ON leakage meter	Rishabh
6	Anemometer	
7	IR camera	Make: FLIR
8	Temperature Gun	HIOKI

1.4 ENERGY SCENCE

Primary Energy sources used is various departments and sections is for illumination, ventilation, computers, other Lab. equipment's and air conditioning. In hostels major energy required for water heating, followed by lighting and ventilation. Other major loads are mess, work shop machines, water pumping.

1.5 ENERGY: SOURCES AND UTILIZATION

ELECTRICAL ENERGY: The main source of power to Sarswatinagar campus is through 11KV HT supply. 300KVA , 11KV /0.415 KV , Dyn11 , ONAN packaged Substation is installed with fixed capacitor bank reactive power compensation scheme to cater electricity Requirement of various sections. DG back up power is provided by using 160KVA DG set with AMF panel .

CHAPTER 2
ENERGY CONSERVATION OPPORTUNITIES IN MOTOR DRIVEN SYSTEMS
(OBSERVATION, FIELD TRIALS, ANALYSIS AND KEY RESULT AREAS)

2.1 ENERGY CONSERVATION OPPORTUNITIES IN MOTOR DRIVEN SYSTEMS

INTRODUCTION

Motor driven system consists of electrical power supply, the electric motor, the motor control and a mechanical transmission system. There are several ways to improve the system efficiency. The cost effective way is to check each component of the system for an opportunity to reduce electrical losses. Poor power distribution within a facility is common cause of energy losses.

Electric motors consume 70% of total electricity used in the industrial sector. Majority of motive loads use squirrel cage induction motor as a driving element, because of low capital, maintenance costs and rugged design. Electric motors are used to provide motive power to equipment such as compressor, pumps, blowers etc. that finds application in industry. It is important that the industrial user defines his need accurately to enable proper selection of motor for a particular application. When selecting a motor for any application, the following points should be considered.

Process requirements: Flow, automatic/non automatic control, variable speed etc.

Technical aspects: Breakdown torque, start-up torque, duty load cycle and operating conditions.

Electrical system requirement

Availability, reliability, inventory and maintenance.

Price of motor

The general observation in the industry is that motors of higher rating than is required for given applications are used because of several reasons, which result into under loading of motors. Good knowledge of process parameters and better understanding of plant power system can help in reducing the over sizing of motor without loss of reliability. Rewinding of the motors results into poor energy efficiency, which leads to more energy consumption and energy costs. Therefore improvement of efficiency of motor must be part of any comprehensive energy, conservation effort. Load losses and hence efficiency of any motor varies in accordance with motor loads. For operating loads in the range of 60%-100% rated load, the reduction in motor efficiency is not very significant but the power factor drops considerably on further reducing the load, both power factor and efficiency decrease and the effect is significant at very low loads.

Motor performance is also affected considerably by service conditions such as voltage, frequency, and voltage unbalance across the motor terminal and % total voltage harmonic distortion.

RECOMMENDATIONS:

The power supply is one of the major factors affecting the operation and maintenance of an electrical motor driven system. To get better performance from motor it is necessary to operate all motors.

Within tolerance of ±10% of rated voltage.

Operation from a sinusoidal voltage supply.

Operation within a tolerance of ±5% frequency.

Operation within a voltage unbalance of 1% or less.

Operation of motors at other than usual service conditions may result in consumption of additional energy. Nameplate values for current, power factor, efficiency and torque are based on operation at rated voltage and frequency. Using motor at a different voltage will change its performance.

2.2 EFFECT OF VOLTAGE VARIATIONS

The effect of voltage variations on motor operation are

EFFECT OF REDUCED VOLTAGE

Increase in operating temperature

Reduction in starting torque

Reduction in running torque

EFFECT OF INCREASED VOLTAGE

Decrease in power factor

Increase in starting and running torque

Increase in starting current

2.3 EFFECT OF UNBALANCED VOLTAGE

The effect of voltage unbalance between phase voltages is more serious. The current unbalance will be in the order of six times the voltage unbalance. The effects on the motors are reduced efficiency and increased operating temperature. For voltage unbalance above 1% it is necessary to de-rate motor as a square of unbalance and motor operation above 5% unbalance is not recommended. The locked motor torque and breakdown torque are decreased when voltage is unbalanced. If voltage unbalance is extremely severed the torque might not be adequate for the application.

FREQUENCY VARIATIONS: Motor currents, torque, efficiency, power factor and speed are all affected by frequency.

2.4 EFFECT OF HARMONIC VOLTAGE DISTORTION

The efficiency of electric motors designed for sinusoidal conditions when operated on distorted voltage results into decrease in efficiency and increase in temperature rise. Induction motor operation above 5% total voltage harmonic distortion is not recommended as per IEEE STD 519-1992.

Even a modest improvement in the energy efficiency of the motor driven systems can produce significant energy savings.

IMPORTANT NOTE: When employing electric motors for air moving equipment, it is important to remember that performance of fans and blowers is governed by certain rules. For centrifugal loads even a minor change in the motor speed translates into significant saving in energy.

2.5 ENERGY SAVING OPPORTUNITIES IN ELECTRIC MOTORS

The main opportunities for energy saving in electric motors are

Stopping idle or redundant running of motors

Matching motor with driven load

Improving drive transmission efficiency

Use of energy efficient motors

Improvement in motor systems

2.6 ENERGY SAVING OPPORTUNITIES BY MOTOR DRIVE MAINTENANCE AND ALIGNMENT

Operation of a motor is affected by maintenance; simple and regular maintenance and inspection will not only provide longer motor life but can also save on operating costs.

Temperature: The most important factor affecting life of a motor is temperature of the insulation. Increasing the insulation temp. by 10°C will reduce the motor life by half. Ensure motors are well ventilated.

Dirt: If screens, filters or air vents become clogged motors may overheat and eventually fail.

Moisture: Intermittent use or standby motors are prone to the problems with moisture in the windings. The windings insulation resistance measurement is a good indicator of the presence of moisture. Remedial action should be considered if the insulation resistance is less than 1 Ohm per KV.

Greasing: Over greasing of antifriction bearings increase friction-causing bearings to overheat and motor losses to increase and is the most common cause of bearing failure.

Vibration: A noticeable increase in motor drive vibration is an indication of trouble-checks should be made of mounting bolts, shaft alignment, and bearings. Vibration can be difficult problem to resolve and increases motor losses.

Starting: Excessive starting is a prime cause of motor failure through overheating from high starting currents the motor should not exceed more than 150 start seconds a day.

Table 2.0: Power quality analysis at Motor Terminals

Pump Details	VRY/IR	VYB/IB	VBR/IB	Actual Power consumed (KW)
Water Tank Motor (Pharmacy)	393 / 24.7 A	393 / 23.1 A	393 / 23.1 A	4.1 KW
Under Ground Water Tank Pump	406/5.97 A	406/5.71 A	406/5.71 A	2.33 KW

2.7: CONCLUSION OF MOTOR INPUT POWER QUALITY ANALYSIS:

RMS Voltage variation is within the recommended limit. Average value of % Voltage unbalance factor is less than 1% at motor terminals and it is as recommended by NEMA MG standard. There is no need to carry out De-rating of motors.

All motors are corrected loaded

Recommended to operate all water pumps in off peak period of TOD tariff

Recommended to install water level controller

TABLE 2.1: EFFECTS OF VOLTAGE AND FREQUENCY VARIATION ON MOTOR PERFORMANCE

Variation	Starting & Running torque	Synchronous Speed	% Slip	Full load Speed	Full load Efficiency	Full load Power factor	Full load Current	Starting Current	Temp. rise Full-load	Max. Overload Capacity	Magnetic Noise no-load On particular
Voltage variation 120%	Increase 44%	No change	Decrease 30%	Increase 1.5%	0-6 % decrease	Decrease 5-15 points	Increase 12%	Increase 20%	Increase 5-6°C	Increase 44%	Noticeable increase
110% voltage	Increase 21%	No change	Decrease 17%	Increase 1%	Slight decrease	Decrease 5-15 points	Increase 2-4%	Increase 10-12%	Increase 3-4°C	Increase 21%	Increase slightly
Functions of voltage	$(\text{voltage})^2$	Constant	———	Synchronous speed slip	----	---	---	Voltage	---	$(\text{voltage})^2$	---
90% voltage	Decrease 19%	No change	Increase 23%	Decrease 1.5%	Decrease 2 points	Increase 5 points	Increase 10-11%	Decrease 10-12%	Increase 6-7°C	Decrease 19%	Decrease slightly
Freq. Variation: 100% Freq.	Decrease 10%	Increase 5%	Practically No change	Increase 5%	Slight increase	Slight increase	Decrease slightly	Decrease 5-6%	Decrease slightly	Decrease slightly	Decrease slightly
Function of Frequency	———	Frequency	------	Synchronous speed slip	----	---	----	———	----	---	---
95% Freq.	Increase 11%	Decrease 5%	Practically No change	Decrease 5%	Slight decrease	Slight decrease	Increase slightly	Increase 5-6%	Increase slightly	Increase slightly	Increase slightly
1% Unbalance	Slight decrease	Slight decrease	----	Slight decrease	2%	5-6% decrease	1.5%	Slight decrease	2% decrease	---	---
2% Unbalance	Slight decrease	Slight decrease	---	Slight decrease	8% decrease	7% decrease	3% increase	Slight decrease	8% increase	---	---

CHAPTER – 3

ENERGY CONSERVATION OPPORTUNITIES IN LIGHTING AREA

(Observations, Field Trials, Analysis and Key Result Areas)

3.0 ENERGY SAVING OPPORTUNITIES IN LIGHTING AREA:

Illumination requirement of various sections are met by use Conventional T8 36 W true Light fixtures with low loss and electronic ballast. Maximum use of day light is done for indoor illumination during day. Tube light fixtures are used in the classroom when daylight is not sufficient to maintain the required level of illumination. Detailed illumination Audit was carried out by measurement of illumination levels by use of lux meter. Details of light fixtures with hours of use was recorded during Energy Audit.

3.1 Area Wise Light Fixture Details and Measured Illumination Level

Table 3.0: Area Wise Light Fixture Details and Measured Illumination Level

Senior College

Fourth Floor

Sr No	Area	Lux
01	Senior Class Room 01	248,560,535,284
02	Class Room 02	221,375,409,196
03	Physics Lab	164,688,628,178
04	Ladies Stop Room	161,349,268
05	IQAC Hall	161,440,194
06	Class Room 03	318,296,386,408
07	Computer Lab	244,242,454,504
08	Class Room 04	323,255,427,518
09	Passage	969,1060,202,1610
10	Steps	104,280

Third Floor

Sr No	Area	Lux
01	Class Room 01	242,478,525,268
02	Class Room 02	158,205,310,377
03	Class Room 03	191,151,297,455
04	Staff Room	129,289,373
05	Exam Hall	56,79,71,291,301
06	Class Room 04	182,266,293,254
07	Class Room 05	158,205,307,357
08	Class Room 06	182,266,292,252
09	Steps	88

Second Floor

Sr No	Area	Lux
01	Gymkhana	92,113,218,105
02	Reading Room	148,207,391,184
03	Library	96,87,45,31
04	Office	163,194,222,266
05	Principal Office	174,72,51,122

06	Staff Room	98,221,89,317
07	Class Room	291,347,338,252
08	Class Room	256,291,347,338
09	Passage	1197,808623
10	Steps	129,107

Ground Floor

Sr No	Area	Lux
01	Class Room	108,89,149,138
02	Class Room	224,384,116,646
03	Class Room	161,271,372,153
04	Office 01	66,173,224
05	Office 02	48,54,128
06	Class Room	88,127,228,264
07	Class Room	96,83,302,215
08	Class Room	137,112,590,299
09	Passage	79,490,1139
10	Porch	882,253

Shed

Sr No	Area	Lux
01	Class Room	393,181,306,1590
02	Activity Room	207,192,470,176,855
03	Class Room	261,173,189,728
04	Class Room	933,432,656,348

Polytechnic Building

Fourth Floor

Sr No	Area	Lux
01	Passage	480,641,345,104,32
02	Computer Center-Language Lab	137,291,441,315
03	Machine Room	319,485,281
04	Exam Control Room	336,846
05	Practice Lab	272,282,277,249
06	Office	317,71,142,298
07	Principal Office	93,157,104
08	Practical Room	240,971,644
09	Practical Room	446,554,1068,936
10	Laboratory	574,742,1192,749
11	E Library	234,612
12	Common Hall	133,178
13	Class Room	134,249,304,296
14	Chemistry Lab	39,211,193,60,131,1201
15	Practical Lab	99,111,109,161,716
16	Class Room	151,181,367,585
17	Store Room	70,131,59
18	Department Office	190,426,327

Fifth Floor

Sr No	Area	Lux
01	Instrument Lab	737,1106,1531,1446
02	Seminar Hall	315,196,495,117
03	Computer Center Room	948,1314,239,1196

Third Floor

Sr No	Area	Lux
01	Practical Lab	296,615,1310,513

Table 3.1: Recommended illumination levels as per National Building Code (NBC)

Activity	Recommended illumination level
General lighting: Illuminated tables	200-300-500
General office	300-500-750
Pump room	200-300-500
Toilet	50-100-150
Library	200-300-500
Reading rooms	200-300-500
Entrance lobbies	150-200-300
Entrance desk	300-500-750
Gate houses	150-200-300
Lift	50-100-150
Corridors, passages, staircases	50-100-150
Changing /locker rooms	50-100-150
Canteen	150-200-300
Food preparation	300-500-750
Food store	100-150-200
Electrical power supply and distribution room	100-150-200
Mechanical plant room	100-150-200
Covered car parks floor	5-20

3.2 Energy Conservation Opportunity in Lighting Area

Table No 3.2: Total light fixture

Sr. No.	Name of Area	Light Fixture Details	Number of Light Fixture
1	Workshop, Canteen, Civil lab	1XTL36 W	14
2	Universal School	1XTL36 W	39
3	Jr. College	1XTL36 W	16
4	Sr. College - First floor	1XTL36 W	38
5	Sr. College - Second floor	1XTL36 W	37
6	Sr. College - Third floor	1XTL36 W	22
7	Room 101, 102	1XTL36 W	10
8	Poly Bldg. First floor	LED TL 18W	39
9	Poly Bldg. Second floor	LED TL 18W	103
10	Poly Bldg. Third floor	LED TL 18W	120
11	Poly Bldg. Fourth floor (D. Pharm)	LED TL 18W	84
12	Poly Bldg. Fifth floor	LED TL 18W	26

Summary of Light Fixture Connected

Sr. No.	Fixture detail	Number of Fixture
1	1XTL36 W	176
2	LED TL 18W	372

3.2: ENERGY CONSERVATION LIGHT FIXTURES

Table 3.3: Energy conservation by replacement of 1XTL 36W EB /Low loss tube Light Fixtures by T8 18W LED light fixtures linkable in same fixture

Sr. No	Description	
1	Total power consumption of 176 number of 1XTL36W tube light fixtures.	(176x50/1000) = 8.8KW
2	Total power consumption number of 176 Number of T8 18W LED tube	(176x18/1000) = 3.168KW
3	Power consumption reduction by replacement of 1XTL 36W EB/ Loss light fixture by T8 18W LED Tube light in same light fixture	= 5.632KW
4	Energy saving per year considering 6 hours operation per day and 270 days in year	=5.632 X 6 X 270 = 9123.84KWH
5	Total energy cost saving/year considering energy cost Rs 20.64/ KWH including demand charges and electricity duty	= 9123.84 X 20.64 = Rs. 1,88,316/-
6	Total cost of T8 18 W LED tube light fixture	176 X Rs. 280 = Rs 49,280/-
7	Payback period	0.261 Year or 3.14 Months
8	% Return on investment	382%

Table 3.4: Summary of Total Energy saving in lighting

Sr. No.	Energy conservation measures	Energy saving per Year In KWH	Energy cost Saving per Year in Rs	Investment Rs	Payback period Year	%ROI
1	Replacement of 1XTL36W tube light fixtures by T8 18W LED linkable tube light in same light fixture	9123.84KWH	1,88,316/-	Rs 49,280/-	0.261 Year or 3.14 Months	382%
Total		9123.84KWH	1,88,316/-	Rs 49,280/-	0.261 Year or 3.14 Months	382%

Table No 3.5: Reduction in connected lighting load after replacement of conventional light fixtures by LED light fixtures

Sr. No.	Recommended Energy Conservation Measures	Reduction in load in KW
1	Replacement of 1XTL36W Tube by T8 18W tube light in same light fixture	5.632KW

Specifications of proposed LED lights:

Technical Specification of T8 18W LED tube Light: Rated wattage :18W, Voltage Range: 190-300V, CRI :80 , Lumen output :2000

Recommended LED light fixture Makes:

PHIPLIPS

WIPRO

CROMPTON GREAVES

CHAPTER -4

POWER QUALITY AUDIT FINDINGS AND RECOMMENDATIONS

CHAPTER -4
POWER QUALITY AUDIT FINDINGS AND RECOMMENDATIONS

4.1 NEED OF POWER QUALITY AUDIT

There are several important reasons to conduct power quality audit. The various reasons are:

To avoid financial loss due to process disruption: - The various cost of disruption is a) Lost work: The product or service is not generated for a period of time until the recovery is complete. The various cost related to lost work are idled labour, lost production hence lost profits, overtime labour and premium charges, overtime operating cost, late delivery fees. b) Cost of repair of the damaged equipment: - The various costs involved in repairing of damaged equipment due to power quality problem are repair, cost of labour, cost of replaced spare parts, cost of replacement part availability. c) Cost of recovery: - Cost involved in recovery of secondary equipment failures, recovery of labour inefficiency. d) Cost of scrap and product quality: - The various cost involved are replacement value of scrap (BOM value + labour value, product lost profit margin and rework costs. e) Miscellaneous cost: - The various miscellaneous costs are customer's dissatisfaction, lost business, avoided customers due to longer lead time, fines and penalties etc.

Considering the huge financial losses related to a power quality event causing process disruption to industry, it is necessary to monitor power quality to provide cost effective solution to avoid financial losses. The various effects of power quality event on equipment and process operation include miss-operation, damage, process disruption, and other anomalies.

4.2 IMPACT OF POWER QUALITY PROBLEMS ON THE OPERATIONS OF VARIOUS EQUIPMENTS

The growing percentage of sensitive equipment's and process downtime due to power quality problems has pointed out an incompatibility between the tolerances of electronics appliances to power disturbances and the expected electric environment. Power quality audit helps to study various power quality problems present in electric supply distribution system and to take appropriate remedial actions. With a better understanding of the electrical environment, end users can request improvements in the tolerance of electrical appliances to power quality disturbances to ensure electrical power system compatibility. In order to mitigate these power quality anomalies a statistical knowledge base of frequency, voltage profiles as a function of time of the day is required. The harmonics present in the electrical distribution are undesirable for the operation of various equipment's. They cause frequent failure of equipment's due to excessive heating, over loading of transformers and cables, malfunctioning of electronic equipment's and increase in line loss etc.

Some symptoms caused by power quality include:

Malfunction of equipment.

Frequent system reboots becoming necessary.

High failure rate of electronic systems.

Overheating of transformers, cables, motors and capacitor banks.

A.C coil contactor disengagement and tripping of ASD's.

Inaccuracy of testing and measuring equipment.

Light dimming or blinking.

The level of power quality required is that level which will result in proper operation of equipment at a particular facility. It is the susceptibility of end use equipment that defines the necessary level of power quality. The various power quality problems with their characteristics are tabulated in following tables.

4.3 RESULTS OF POWER QUALTIY ANALYSIS

Power quality analysis was conducted at 315KVA transformer LT incomer. The result of power quality analysis conducted at Incomer is presented below.

4.4: Power Quality analysis of main LT panel incomer

Table 4.0: Power Quality analysis of main LT panel incomer

Parameter	CH1			CH2			CH3		
	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
RMS VOLTAGE (V)	449.64	423.27	395.34	454.7	429.91	401.36	453.44	422.3	395.04
RMS CURRENT (A)	46.69	9.69	4.09	41.83	8.69	3.51	36.68	4.58	0
RMS VOLTAGE AVG.(V)	452.54	425.16	398.71	---	---	---	---	---	---
RMS CURRENT AVG.(A)	40.73	7.65	2.55	---	---	---	---	---	---
ACTIVE POWER (KW)	26.59	4.91	1.52	---	---	---	---	---	---
REACTIVE POWER (KVAR)	12.09	-0.07	-2.18	---	---	---	---	---	---
APPARENT POWER (KVA)	28.84	5.62	1.82	---	---	---	---	---	---
POWER FACTOR	0.972	---	-0.985	---	---	---	---	---	---
K.F.	36.15	14.7	1.53	15.6	7.83	1.16	128.02	48.15	1.41
%Vunb	2.25	1.265	0.27	---	---	---	---	---	---
%Iunb	56.79	19.058	0.77	---	---	---	---	---	---
%VTHD	2.56	1.54	0.97	2.09	1.25	0.8	2.36	1.51	0.89
%ITHD	57.89	36.93	6.82	69.4	34.22	4.77	265.5	97.08	6.06

4.5: Conclusion of power quality analysis at Main LT Panel Incomer 2:

RMS voltage variation is within recommended limit of 390V to 415V .RMS voltage within recommended limit provide better efficiency and better life . .

% Voltage unbalance factor is 0.91% and is beyond 1% recommended limit as per NEM MG standard. `

% Current unbalance factor is 15.42% and is higher than recommended limit and is due to non-uniform distribution of single phase loads.

% Total voltage harmonic distortion is 3.22% which is less than 8% recommended limit as per IEEE 519-2014 standard for rated system voltage below 1KV.

% Individual voltage harmonic distortion of 2^{nd} order to 50^{th} order is less than recommended limit of 5% as per IEEE 519-2014 standard for rated system voltage below 1KV.

Reactive power compensation is adequate.

% Total current harmonic distortion is higher than 5% recommended limit for ISC/IL ratio for general distribution voltage below 69KV for ISC/IL ratio Less than 20

% Individual current harmonic distortion of 3^{rd}, 5^{th} , 7^{th} , 11^{th} and 13 th order harmonics are higher than recommended limit for ISC/IL ratio less than 20 for rated system voltage between 1KV to 69 KV as per IEEE 519-2014 standard

%Individual Voltage Harmonic Distortion at CHANDORI

Harmonic Order	CH1			CH2			CH3		
	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
2	0.9	0.08	0.02	0.96	0.08	0.02	0.98	0.09	0.02
3	2.42	1.06	0.05	1.81	0.86	0.05	3.09	1.42	0.07
5	10.63	5.54	0.75	9	4.49	1.14	9.54	5.19	0.98
7	4.72	2.22	0.54	3.38	2.2	0.22	4.1	2.62	0.54
9	0.92	0.51	0.04	1.24	0.34	0.02	1.2	0.4	0.02
11	1.61	0.81	0.2	1.52	0.53	0.03	1.65	0.85	0.21
13	1.11	0.52	0.11	1.11	0.63	0.11	1.1	0.67	0.23
15	0.66	0.25	0.02	0.98	0.36	0.1	0.77	0.19	0.02
17	1.01	0.57	0.35	0.7	0.37	0.05	1.08	0.67	0.46
19	1.12	0.27	0.02	0.96	0.38	0.1	0.61	0.38	0.07
21	0.81	0.19	0.03	0.64	0.22	0.07	0.5	0.21	0.06
23	0.79	0.32	0.03	0.63	0.24	0.03	0.83	0.45	0.06
25	0.98	0.28	0.03	0.64	0.28	0.03	0.91	0.29	0.07
27	0.43	0.08	0.01	0.45	0.15	0.02	0.43	0.17	0.02
29	0.51	0.13	0.01	0.48	0.14	0.01	0.39	0.16	0.02
31	0.59	0.24	0.02	0.35	0.19	0.02	0.46	0.11	0.01
33	0.48	0.09	0.01	0.3	0.08	0.01	0.46	0.11	0.01
35	0.39	0.18	0.04	0.54	0.15	0.01	0.45	0.13	0.02
37	0.57	0.16	0.03	0.46	0.1	0.01	0.37	0.14	0.02
39	0.41	0.1	0.02	0.36	0.1	0.01	0.38	0.17	0.02
41	0.45	0.22	0.04	0.38	0.17	0.03	0.36	0.11	0.01
43	0.47	0.12	0.01	0.41	0.11	0.02	0.22	0.08	0.01
45	0.36	0.08	0.01	0.31	0.12	0.03	0.29	0.14	0.03
47	0.37	0.09	0.01	0.45	0.09	0.01	0.26	0.11	0.01
49	0.33	0.06	0.01	0.29	0.08	0.01	0.13	0.06	0.01

%Individual Current Harmonic Distortion at Chandori

Harmonic Order	CH1			CH2			CH3		
	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
2	0.57	0.08	0.04	0.87	0.07	0.01	0.48	0.03	0.01
3	6.69	1.14	0.06	6.87	1.92	0.86	1.89	0.82	0.4
5	4.88	1.39	0.26	6.95	1.21	0.03	1.56	0.98	0.08
7	3.93	1.2	0.32	4.85	1.22	0.5	1.14	0.63	0.31
9	2.3	1.18	0.38	2.9	0.68	0.13	1.01	0.8	0.48
11	1.3	0.83	0.51	1.52	0.43	0.19	1.1	0.62	0.34
13	1.15	0.71	0.45	0.65	0.15	0.02	0.97	0.65	0.44
15	0.7	0.46	0.04	1.04	0.23	0.05	0.54	0.44	0.22
17	0.66	0.36	0.12	0.76	0.22	0.06	0.61	0.48	0.43
19	0.6	0.25	0.09	0.8	0.19	0.02	0.43	0.34	0.07
21	0.71	0.25	0.06	0.38	0.22	0.09	0.47	0.34	0.27
23	0.37	0.17	0.01	0.44	0.16	0.03	0.39	0.26	0.07
25	0.63	0.16	0.01	0.49	0.19	0.03	0.32	0.17	0.08
27	0.26	0.12	0.02	0.34	0.14	0.05	0.31	0.13	0.03
29	0.25	0.06	0.01	0.31	0.08	0	0.14	0.07	0.01
31	0.37	0.08	0.01	0.31	0.13	0.01	0.12	0.05	0
33	0.34	0.08	0.01	0.24	0.05	0	0.08	0.02	0.01
35	0.23	0.06	0.01	0.27	0.08	0	0.17	0.06	0.01
37	0.24	0.1	0.04	0.28	0.07	0.02	0.09	0.06	0.02
39	0.19	0.07	0.01	0.18	0.03	0	0.13	0.06	0.02
41	0.18	0.08	0.01	0.2	0.08	0.01	0.11	0.06	0.01
43	0.16	0.05	0	0.2	0.05	0.01	0.09	0.04	0
45	0.13	0.05	0.02	0.18	0.04	0	0.08	0.05	0.01
47	0.1	0.03	0	0.16	0.03	0	0.1	0.03	0
49	0.08	0.03	0.01	0.15	0.02	0	0.06	0.02	0

CHAPTER -5

REACTIVE POWER MANAGEMENT

5.1 REACTIVE POWER MANAGEMENT

An improvement of power factor can provide both economic and system advantages. The various operational benefits are improved system efficiency, release of system capacity, reduction of power losses and voltage improvement. The energy saving is dependent on

The percentage reduction in ampere due to additional KVAR

Motor design, conductor size and conductor length.

Capacitor watt loss.

REDUCED POWER LOSSES WHEN CAPACITORS ARE LOCATED AT THE LOAD:

Since power losses are proportional to the current squared and the current is proportional to the power factor, an improvement in power factor will cause a reduction in system losses and reduced power bills.

$$\% \text{ Loss reduction} = 100 \times \left(1 - \frac{\text{Original power factor}^2}{\text{Desired power factor}^2}\right)$$

DR. BEKA

Table 5.2: Monthly HT bill Details (Chandori Campus) – October 2019-September 2020 (SCD - 250kVA)

Month	Billed MD in KVA	Actual MD	Difference	Recorded Avg. P.F.	Calculated Demand in KVA considering P.F. As One	Difference in billed MD and actual MD at unity Power factor	KVA @Rs XXXX from Bill Data	TOD KWH Zone				TOD MD Zone				Monthly KWH consumption	KVAH	Electricity Board Bill Amount
								A	B	C	D	A	B	C	D			
Oct-19	125	30	95	0.531	66.375	58.625	391	1,115	2,005	1,091	539	6	30	29	6	4749	4753	138105.33
Nov-19	125	31	94	0.558	69.75	55.25	391	1065	1960	1146	527	13	28	31	13	4021	7763	139010.52
Dec-19	125	29	96	0.638	79.75	45.25	391	1,295	2,264	1,123	643	13	29	28	21	5325	9080	144152.41
Jan-20	125	30	95	0.594	74.25	50.75	391	1,200	2,138	1,146	578	13	29	30	13	5062	9214	144012.12
Feb-20	125	25	100	0.622	77.75	47.25	391	1,277	711	397	607	13	24	25	13	2992	5789	110035.38
Mar-20	125	27	98	0.742	92.75	32.25	391	609	0	0	588	13	27	19	15	1195	3403	78,094.77
Apr-20	138	15	123	0.799	110.262	27.738	411	0	0	0	645	7	14	15	7	514	643	74,204.51
May-20	138	23	115	0.587	81.006	56.994	411	0	0	0	891	12	23	15	12	521	888	77,375.88
Jun-20	138	26	112	0.405	55.89	82.11	411	2827	489	116	1235	18	26	19	18	1889	4664	117,492.27
Jul-20	138	24	114	0.278	38.364	99.636	411	4712	1504	935	2061	19	20	24	19	2560	9209	168,910.84
Aug-20	138	23	115	0.273	37.674	100.326	411	4835	1967	1253	2227	19	19	23	19	2807	10282	181757.23
Sep-20	138	21	117	0.277	38.226	99.774	411	4542	1347	794	2159	19	21	21	19	2448	8838	164855.56
		Unit Price per kWH		Rs. 20.64/ unit											Total	**34083**	**74526**	**1538006.82**

Observations:

Difference between kVAh & kWh per year = 40443 units.

Yearly saving potential by adequate compensation = Rs. 20.64 × 40443 = Rs. 834743.52

Reactive power compensation is not adequate and power factor is not maintained at Unity. Full benefits of reactive power compensation are required to be availed every month.

Recommended to operate water pumps to take advantage of off-peak lower tariff and Reduce MD during night 10.00PM to 6.00AM. Establish SOP of pump operation only during off peak period.

Recommended to install 75KVAR, 7%Detuned RTPFC for adequate reactive Power compensation. Approximate Cost – 3,00,000/- (ROI 4.31 months)

Recommended to revise sanction contract demand from 250 kVA to 150 kVA.

MD cost reduction potential for one year = Rs. 38,223/-.

CHAPTER 6

ENERGY CONSERVATION OPPORTUNITIES
AIR CONDITIONING
(OBSERVATION, FIELD TRIALS, ANALYSIS AND KEY RESULT AREAS)

6.0 FACTORS GOVERNING ENERGY EFFICIENCY OF AIR CONDITIONING SYSTEM

In any commercial buildings power consumption of air conditioning system is major component. Proper design of building, use of energy efficient air-conditioning systems and regular maintenance leads to substantial saving in energy cost.

The various factors governing energy consumption of air-conditioning systems are;

Building design: Orientation of building plays a key role in the air-conditioning requirement. Excessive use of glass especially on the western side adds high air-conditioning heat loads. Use of materials such as foam concrete, double wall glazing, hollow concrete blocks or foam insulated roofing will help to improve the insulation of building and save energy.

Energy efficient air-conditioning equipment's: It is recommended to use the air-conditioning equipment's with the best energy efficiency ratio (EER). Window ACs using rotary compressors are more energy efficient than those with reciprocating compressors. Packaged air-conditioners/ducted splits are available with reciprocating compressor as well as scroll compressors. Scroll compressors are capable of higher EER which leads to saving in energy for higher tonnages screw and centrifugal equipment are most preferred because of low operating costs. Where heat source such as steam or hot water is available as a byproduct or economically, absorption type units are a good energy saving choice. Though the initial cost of energy efficient air conditioning unit is high but the energy consumption is less. Considering the life cycle cost, it is always recommended to use energy efficient air conditioning equipment's.

Regular Maintenance: Periodical maintenance helps to ensure efficient operation of air-conditioning equipment. During periodical maintenance, it is necessary to carry out cleaning of filters, de-scaling of heat exchangers, lubricating friction point, such as fans, motors and shafts. Setting of indoor temperatures at the highest point acceptable to the largest segment of occupants, and shutting off the system when not in use will lead to energy saving.

The performance of given system depends upon the performance of equipment used. The parameters needed to be looked into are:

Inside and outside design conditions.

Measured flows and capacities of all the equipment used in the system.

Comparison of the measured and design capacities.

Comparison of energy consumption with design values.

Key factors in evaluating and better utilization of the HVAC system are as follows

Are there obstructions in the ventilation system?

Do filters, radiator fins or coils need cleaning?

Are ducts, dampers or passages and screens clogged?

Is the wrong amount of air being supplied at various times?

Are dampers stuck?

Is exhaust or intake volume is too high or too low?

Are all dampers functioning in the most efficient manners?

Can the system exhaust only the area needing ventilation?

Can the system intake only the amount required?

Can air be recycled rather than exhausted?

Can the system be turned OFF at night?

Is the temperature being right for the area of use?

Can temperature setback be used effectively?

Can heat be redirected?

Is the proper system is being used?

Is there too much or too little ventilation?

Can the natural environment be used more effectively?

Are doors, windows or other openings letting out valuable heat?

Can weather strip, caulking or other leaks be repaired?

Can additional insulation be justified/

6.3: Energy saving potential by increase in temperature set point of room Air conditioners from existing 26 Degree Centigrade:

Energy saving potential per year by increase in temperature set point from existing to 26 degrees Centigrade = ((35x1.2x 0.06x 7X10X0.84X300) +(13X1.2X0.06X 5X10X0.84X300)) = 44452.80 +11793.60 = 56246.40 KWH

Energy cost saving considering energy cost of Rs 9.86 per KWH per Year = Rs 9.86 x56246.40 = Rs 554589.504

Investment: Nil

Table 6.2: Area Wise List of ceiling Fans

Sr. No.	Name of Area	Number of Ceiling fans
1	Workshop, canteen, civil lab	07
2	Universal school	21
3	Jr. college	03
4	Sr. College First floor	16
5	Sr. College Second floor	07
6	Sr. College Third floor	13
7	Sr. College	11
8	Poly. Bldg.	15

9	Poly. First floor	18
10	Poly. Second floor	43
11	Poly. Third floor	52
12	Poly. Fourth floor	73
13	Poly. Fifth floor	17
Total		296

Observations and Recommendations:

Replace conventional ceiling Fans by star Rated Ceiling fans

6.4: Energy conservation by replacement of conventional ceiling fans by BLDC ceiling Fans

Power consumption of conventional ceiling fan = 80 W

Total power consumption of 296 number of ceiling fans = 80/1000x296 = 23.68KW

Total power consumption of 296 number of BLDC ceiling Fans = 28 /1000x296 = 8.288 KW

Energy saving potential per year considering 10 hours of use per day = 15.392x10x300 = 46176KWH

Energy cost saving potential considering energy cost of Rs 20.64 per KWH per Year = Rs 20.64x46176 = Rs 9,53,072.64

Cost of 296 number of BLDC ceiling Fans = Rs 2750x296 = Rs 8,14,000.00

Payback period = 11 Months

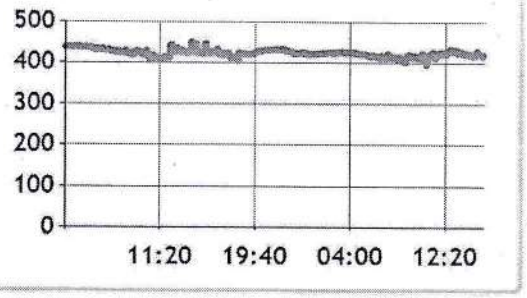
% ROI = 117%

Table No.6.3: Summary of Energy conservation potential in Air conditioners.

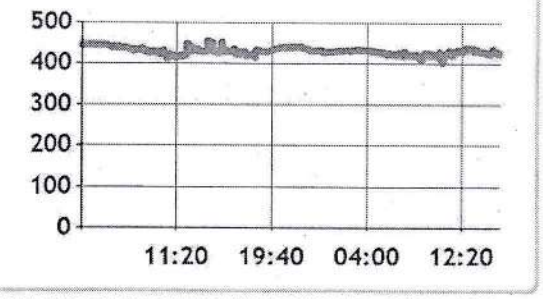
Sr. No	Energy Conservation Measures	Energy Saving potential per Year in KWH	Energy cost saving per year considering Energy cost of Rs	Investment Rs	Payback period	% ROI
1	Replacement of conventional ceiling Fans by BLDC energy efficient ceiling Fans	46176	Rs *9,53,072.64*	Rs *8,14,000.00*	11 Months	117%

APPENDIX

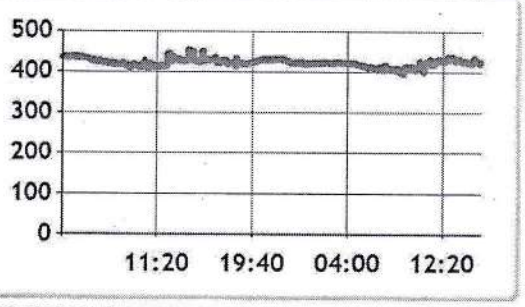
E:\Chandori Campus Audit\B1012500.CSV



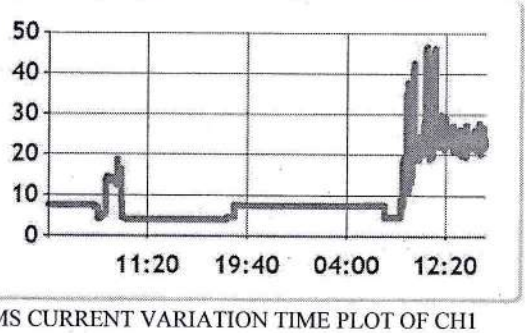
RMS VOLTAGE VARIATION TIME PLOT OF CH1
Max Val. : 449.64 V
Avg. Val. : 423.27 V
Min Val. : 395.34 V



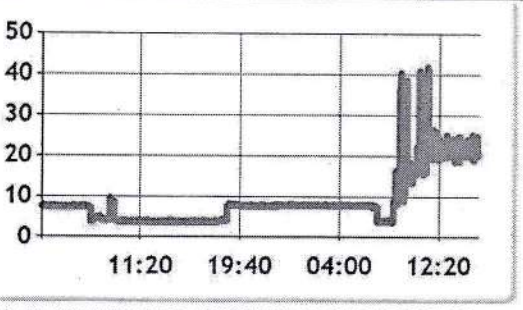
RMS VOLTAGE VARIATION TIME PLOT OF CH2
Max Val. : 454.7 V
Avg. Val. : 429.91 V
Min Val. : 401.36 V



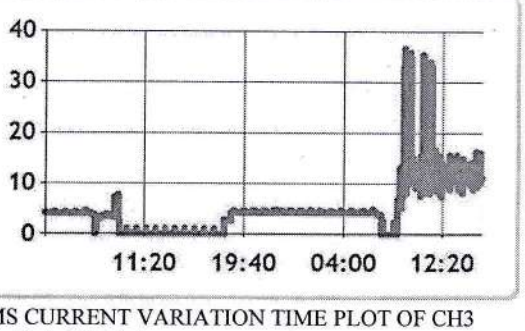
RMS VOLTAGE VARIATION TIME PLOT OF CH3
Max Val. : 453.44 V
Avg. Val. : 422.3 V
Min Val. : 395.04 V



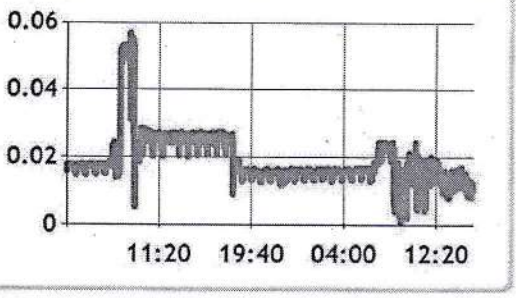
RMS CURRENT VARIATION TIME PLOT OF CH1
Max Val. : 46.69 A
Avg. Val. : 9.69 A
Min Val. : 4.09 A



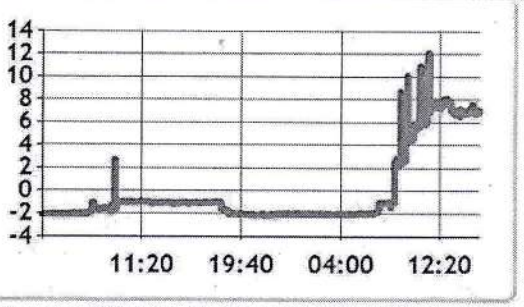
RMS CURRENT VARIATION TIME PLOT OF CH2
Max Val. : 41.83 A
Avg. Val. : 8.69 A
Min Val. : 3.51 A



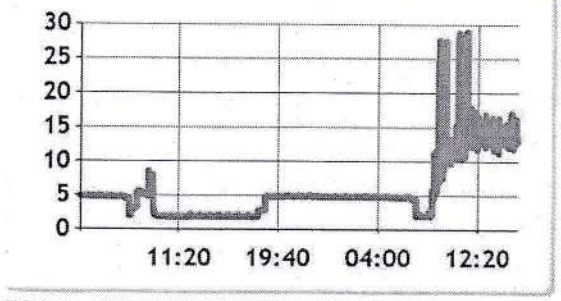
RMS CURRENT VARIATION TIME PLOT OF CH3
Max Val. : 36.68 A
Avg. Val. : 4.58 A
Min Val. : 0 A



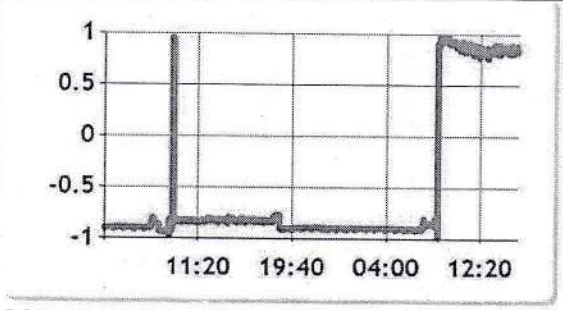
TOTAL ACTIVE POWER VARIATION TIME PLOT
Max Val. : 26.59 KW
Avg. Val. : 4.91 KW
Min Val. : 1.52 KW



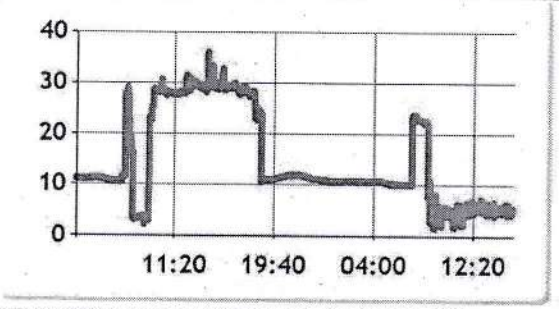
TOTAL REACTIVE POWER VARIATION TIME PLOT
Max Val. : 12.09 KVAR
Avg. Val. : -0.07 KVAR
Min Val. : -2.18 KVAR



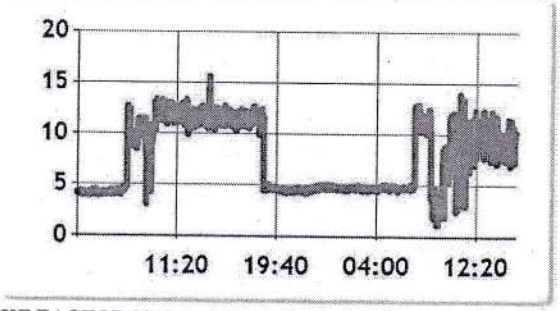
TOTAL APPARENT POWER VARIATION TIME PLOT
Max Val. : 28.84 KVA
Avg. Val. : 5.62 KVA
Min Val. : 1.82 KVA



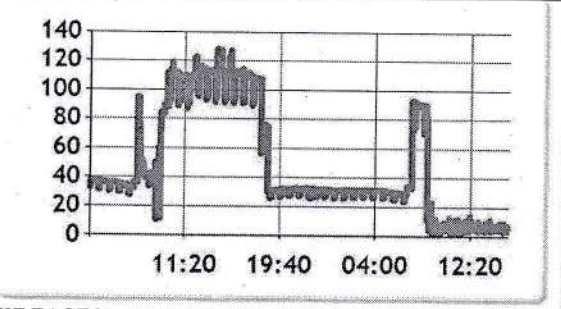
POWER FACTOR VARIATION TIME PLOT
Max Val. : 0.97
Avg. Val. : -0.53
Min Val. : -0.99



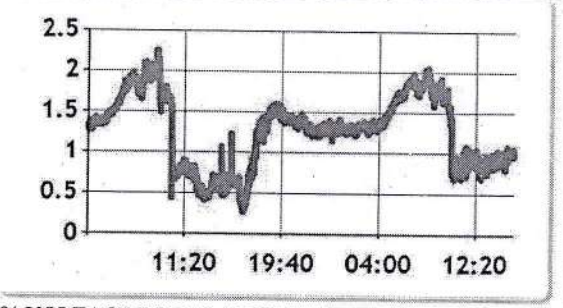
KF FACTOR VARIATION TIME PLOT OF CH1
Max Val. : 36.15
Avg. Val. : 14.7
Min Val. : 1.53



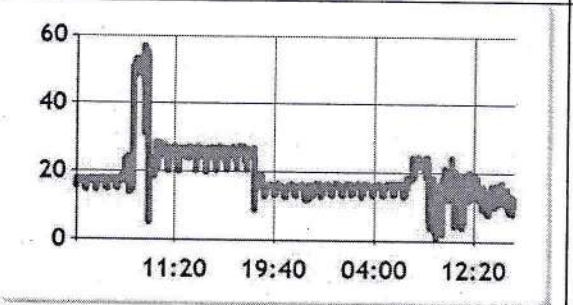
KF FACTOR VARIATION TIME PLOT OF CH2
Max Val. : 15.6
Avg. Val. : 7.83
Min Val. : 1.16



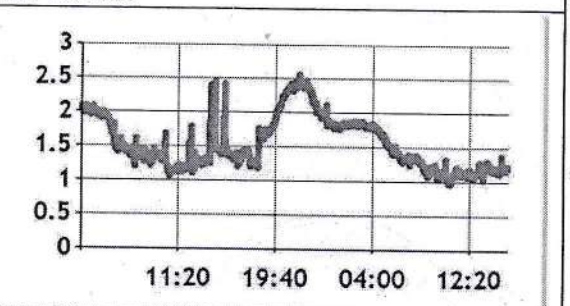
KF FACTOR VARIATION TIME PLOT OF CH3
Max Val. : 128.02
Avg. Val. : 48.15
Min Val. : 1.41



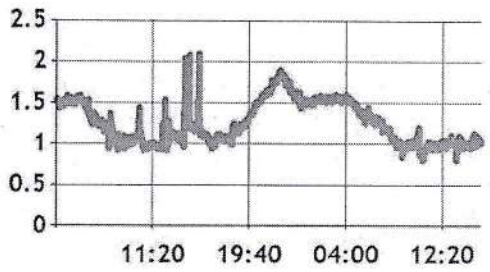
% VOLTAGE UNBALANCE FACTOR VARIATION TIME PLOT
Max Val. : 2.25
Avg. Val. : 1.26
Min Val. : 0.27



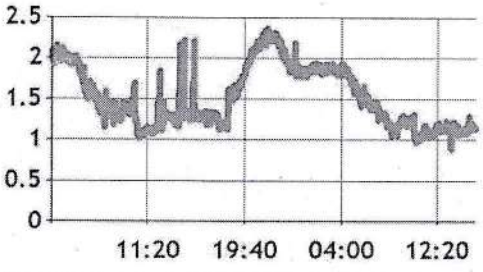
% CURRENT UNBALANCE FACTOR VARIATION TIME PLOT
Max Val. : 56.79
Avg. Val. : 19.06
Min Val. : 0.77



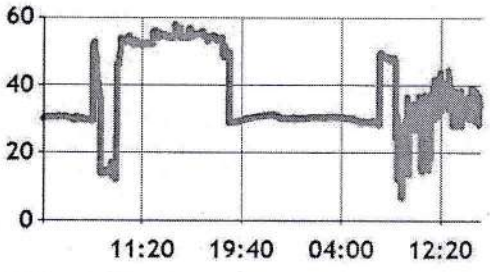
% TOTAL VOLTAGE HARMONIC DISTORTION VARIATION TIME PLOT OF CH1
Max Val. : 2.56
Avg. Val. : 1.54
Min Val. : 0.97



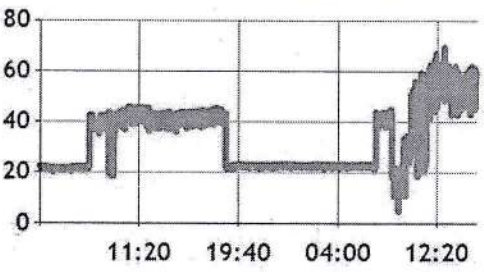
% TOTAL VOLTAGE HARMONIC DISTORTION VARIATION TIME PLOT OF CH2
Max Val. : 2.09
Avg. Val. : 1.25
Min Val. : 0.8



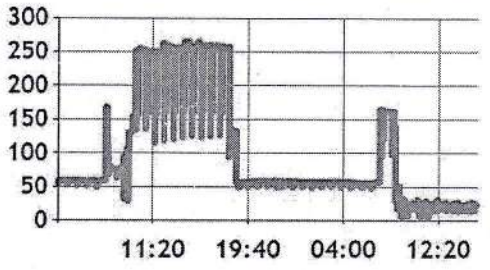
% TOTAL VOLTAGE HARMONIC DISTORTION VARIATION TIME PLOT OF CH3
Max Val. : 2.36
Avg. Val. : 1.514
Min Val. : 0.89



% TOTAL CURRENT HARMONIC DISTORTION VARIATION TIME PLOT OF CH1
Max Val. : 57.89
Avg. Val. : 36.93
Min Val. : 6.82



% TOTAL CURRENT HARMONIC DISTORTION VARIATION TIME PLOT OF CH2
Max Val. : 69.4
Avg. Val. : 34.223
Min Val. : 4.77



% TOTAL CURRENT HARMONIC DISTORTION VARIATION TIME PLOT OF CH1
Max Val. : 265.5
Avg. Val. : 97.08
Min Val. : 6.06

EXECUTIVE SUMMARY:

Energy audit round of lighting system, air conditioning system and other office and laboratory load, transformers, reactive power management was carried. After conduction of detailed audit of various sections and analysis of performance of various equipment, various energy conservation opportunities are identified and energy conservation measures are recommended for each ECO with economic analysis.

Energy Management initiatives completed before recent energy audit:
Use of LED light Fixtures in D. Pharm. building

The various finding of Energy audit with suggested Energy conservation measures and Pay back analysis for each type of load in summarised in following section.

Use of renewable Energy:
Recommended to install 100KWp roof top solar PV grid interactive system on Building roof.

Recommendations
Use of double dial timer to switch off alternate /Zig/Zag light fixture after 10.00PM

LIGHTING SYSTEM: After detailed illumination audit, various Energy conservation opportunities were identified and following Energy conservation measures are recommended. Summary of energy saving in illumination is tabulated in the following section.

Recommended value of Watts/Sq. meter/100 lux are tabulated in following table

TABLE 10.2 Target lux/W/m² (W/m²/100lux) values for maintained illuminance on horizontal plane for all room indices and applications:

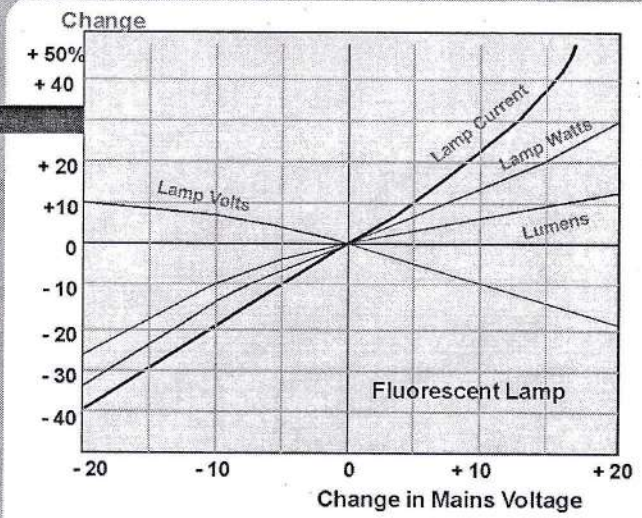
Room Index	*Commercial lighting. (Offices, Retail stores etc.) & very clean industrial applications, Standard or good colour rendering. Ra: 40-85*	*Industrial lighting (Manufacturing areas, Workshops, Warehousing etc.) Standard or good colour rendering. Ra: 40-85*	*Industrial lighting installations where standard or good colour rendering is not essential but some colour discrimination is required. Ra: 20-40*
5	*53 (1.89)*	*49 (2.04)*	*67 (1.49)*
4	*52 (1.92)*	*48 (2.08)*	*66 (1.52)*
3	*50 (2.00)*	*46 (2.17)*	*65 (1.54)*
2.5	*48 (2.08)*	*44 (2.27)*	*64 (1.56)*
2	*46 (2.17)*	*42 (2.38)*	*61 (1.64)*
1.5	*43 (2.33)*	*39 (2.56)*	*58 (1.72)*
1.25	*40 (2.50)*	*36 (2.78)*	*55 (1.82)*
1	*36 (2.78)*	*33 (3.03)*	*52 (1.92)*

Ra : Colour rendering index

Sr. No.	Energy conservation measures	Energy saving per Year In KWH	Energy cost Saving per Year in Rs	Investment Rs	Payback period Year	%ROI
1	Replacement of 1XTL36W tube light fixtures by T8 18W LED tube light in same light fixture	9123.84KWH	1,88,316/-	Rs 49,280/-	0.261 Year or 3.14 Months	382%
Total		9123.84KWH	1,88,316/-	Rs 49,280/-	0.261 Year or 3.14 Months	382%

Effect of Voltage on lamp performance for florescent lamps are indicated by following characteristics:

Lamp Performance with change in mains voltage



11

EFFECT OF VOLTAGE ON POWER CONSUMPTION OF LAMPS

Particulars	10% lower voltage	10% higher voltage
Fluorescent lamps		
Light output	Decreases by 9 %	Increases by 8 %
Power input	Decreases by 15 %	Increases by 8 1%
HPMV lamps		
Light output	Decreases by 20 %	Increases by 20 %
Power input	Decreases by 16 %	Increases by 17 %
Mercury Blended lamps		
Light output	Decreases by 24 %	Increases by 30 %
Power input	Decreases by 20 %	Increases by 20 %
Metal Halide lamps		

Reactive power compensation and MD, TOD, PF billing:

Table No 3.5: Reduction in connected lighting load after replacement of conventional light fixtures by LED light fixtures

Sr. No.	Recommended Energy Conservation Measures	Reduction in load in KW
1	Replacement of 1XTL36W Tube by T8 18W tube light in same light fixture	5.632KW

Specifications of proposed LED lights:
Technical Specification of T8 18W LED tube Light: Rated wattage :18W, Voltage Range: 190-300V, CRI :80, Lumen output :2000

Recommended LED light fixture Makes:
PHIPLIPS
WIPRO
CROMPTON GREAVES

RMS Voltage variation:
RMS voltage variation is within the recommended limit.

INPUT VOLTAGE VARIATION	% OF REDUCTION IN BREAKDOWN POSSIBLE	APPROX POWER SAVING POSSIBLE
380-420 Volts	No reduction in breakdown of electrical equipment's	No requirement of stabilizer
380-440 Volts	Upto 20% reduction in breakdown of electrical equipment's	Up to 5%
380-460 Volts	Upto60% reduction in breakdown of electrical equipment's	Up to 7%
380-470 Volts	Upto 80% reduction in breakdown of electrical equipment's	Up to 10%

ABBREVIATION

Symbol	Abbreviation
A	Ampere
V	Volts
KV	Kilo volts
KVA	Kilo volt ampere
KVAR	Kilo volt ampere reactive
KW	Kilo watts
MD	Maximum demand
%THD	Percentage Total harmonic distortion
% THDv	Percentage voltage Total harmonic distortion
% THDi	Percentage current Total harmonic distortion
% TIHDv	Percentage voltage Total inter harmonic distortion
% TIHDi	Percentage current Total inter harmonic distortion
Voltage sag	Reduction in RMS voltage from 90% to 10% for the time period from 10 msec. to 1 min.
Voltage swell	Increase in RMS voltage from 110% to 180% for the time period from 10 msec. to 1 min.
Transient	Sudden non power frequency change in the voltage or current from steady state.
%Vunb	Percentage voltage unbalance factor
%Iunb	Percentage current unbalance factor
KF	Crest factor
%U2, U3, …., U50	Percentage individual voltage harmonics from 2 order to 50 order
%I2, I3, ……., I50	Percentage individual current harmonics from 2 order to 50 order
Max.val.	Maximum value of the parameter over the measurement period
Avg. val.	Average value of the parameter over the measurement period
Min.val.	Minimum value of the parameter over the measurement period

SUMMARY OF OUTCOME:

Sr. No	Energy conservation Measures	Energy saving per year KWH	Amount saved/year Rs.	Investment required (Rs.)	Payback period.	% ROI	ECM Type
1	Replacement of 1XTL36W Tube Light Fixtures by T8 18W Linkable LED tube light in same light fixture	9123.84K WH	1,88,316/-	Rs 49,280/-	0.261 Year or 3.14 Months	382%	Short Term
2	Replacement of conventional ceiling Fans by BLDC energy efficient ceiling Fans	46176	Rs *9,53,072.64*	Rs *8,14,000.00*	11 Months	117%	Short Term
3	Providing adequate compensation	40443	Rs. 8,34,743.52	Rs. 3,00,000/-	0.431 Years or 4.312 Months	278%	*Short Term*
4	Revision of Sanction Contract Demand during COVID-19	---	Rs. 38,223/-	---	---	---	---
Total		98,023.8	Rs 20,61,092.08	Rs 11,63,280 /-	0.56 Years or 6.77 Month	177%	

Total Electricity bill of last Year = Rs. 15,38,006.82/-
Energy saving with and without investment = Rs. 20,61,092.08/-

Workshop Equipments and Other Labs Equipments:

Recommended to switch off Labs, Class Rooms, Faculty Rooms and other equipments during idle operation.

Switch off computers during off office hours.

K. K. Wagh Education Society's
Karmaveer Kakasaheb Wagh Arts, Commerce, Science & Computer Science College
CHANDORI, Tal. Niphad, Dist. Nashik - 422 201. (Affiliated to Savitribai Phule Pune University)
(02550) 233439, 233438 Fax. No. (02550) 233438
10 No.(PU/NS/AC/01912003) Email : principal-seniorchandori@kkwagh.edu.in
Website : www.ascc.kkwagh.edu.in

Energy Audit Action Taken Report

The Energy Audit of the College was conducted in 2020-21 through Electrical Engineering Department, K. K. Wagh Institute of Engineering Education and Research

Recommendation

According to the Energy Audit, the following suggestions have been made.

1. Recommended to operate water pumps to take advantage of off-peak lower tariff and Reduce MD during night 10.00P.M. to 6.00A.M. Establish SOP of pump operation only during of peak period.
2. Replacement of 1XTL36W Tube by T8 18W tube light in same light fixture.
3. Replace conventional ceiling fans by star rated ceiling fans.
4. Recommended to Install 75KVAR, 7% Detuned RTPFC for adequate reactive Power compensation. Approximate Cost – 3,00,000/- (ROI 4.31 months)
5. Recommended to revise sanction contract demand from 250 kVA to 150 kVA

Action taken in above recommendation

1. Arrangements have been made to start the water pump in the college before 6 am.
2. T8 types of tube lights have been installed in the college building.
3. Energy saving fans have been installed in the college building.

TAX INVOICE

Original

NASIK CABLES & ELECTRICALS

56555

Address: Kanda Batata Bhavan, "kalpataru" 2954-E
New Agra Road Nashik - 422011
Tel : 9595313034, Tel2 : 9370313033, Fax : 0253-2592492
email : nasikcables@gmail.com
GSTIN : 27AAMFN7238F1ZZ

TAX INVOICE

Customer Name
K.K.WAGH ARTS COMMERCE SCIENCE
~~AMRUTDHAM,NASIK~~ Chandori.
GSTIN/UIN : **27AAATK4127G1ZT**
State : **Maharashtra** StateCode : **27**

No. : **NCE-CREDIT-9112** Date : **9-Dec-2021**
Disp Thru. : **MR.V K DATE-9011078445**
Contact Person : **MR.AGALE SIR**
Phone : **9011078443**

Sr. No.	Description of Goods / Services	HSN/ SAC	Quantity	Rate	GST	Amount
1	**CT Meter** *HPL 100/5*	902830	1 NOS	3,750.00	18%	3,750.00
2	**CT Coil** *200/5*	850410	3 NOS	380.00	18%	1,140.00
			4	4,890.00		4,890.00

Our Bank Details
Bank Name : **HDFC Bank Ltd.**
A/c No. : **50200020266011**
Brnch-IFSC Code : **Takli Road, Nasik/HDFC0002802**

Sales@18%	4,890.00	TAX	880.20	SGST	440.10
				CGST	440.10
				Rounding	(-)0.20
Total	4,890.00	TAX	880.20	Grand Total	5,770.00

Total Amount in Words : **Five Thousand Seven Hundred Seventy Only**

Declaration: We declare that this invoice shows the actual price of the goods described and that all particulars are true and correct.

1. Goods once sold will not be taken back without our consent.
2. 24% interest will be charged if the payment is not made within 30 days.
3. Our responsibility ceases once the goods have left our premises.

ARTS, COMMERCE & SCIENCE & COMPUTER CHANDORI 422 201 TAL. TRIMBAK DIST NASHIK

NASIK CABLES & ELECTRICALS NASHIK

Receiver's Seal and Signature

Subject to Nashik Jurisdiction

For NASIK CABLES & ELECTRICALS

के. के. वाघ शिक्षण संस्था, नाशिक

मध्यवर्ती कार्यालय,

जा. क्र.: के.के.वाघ एज्यु.सो./खरेदी विभाग/ २३ /२०२१ दिनांक :- 1 JAN 2022

ऑफिस नोट

संदर्भ : १) कार्यकारी मंडळ मिटींग, मंगळवार, दि.१५/०९/२०२०, विषय व ठराव क्रं.२३/२.
२) के.के.वाघ वरिष्ठ महा. चांदोरी यांचे पत्र क्रं.के.के. वाघ महा.चांदोरी/८०५/२०२१, दि.१८/१२/२०२१.

अ) के. के. वाघ तंत्रनिकेतन, चांदोरी यांच्या डेडस्टॉक रजिस्टर वरून खालील प्रमाणे साहित्य कमी करुन के.के. वाघ कला, वाणिज्य, विज्ञान व संगणक विज्ञान महाविद्यालय चांदोरी यांच्या फर्निचर डेडस्टॉक रजिस्टरला हस्तांतर करण्यास मंजुरी देण्यात येत आहे.

अ.क्रं	साहित्य तपशिल	एकुण संख्या
1.	U.P.S 7.5 KV UPS Agasti Online Sr.No. MSPL/2009/047	02 Nos.
2.	Battery Rack	01 Nos.
3.	Printer HP Laserjet 1020/P1007	06 Nos.

ब) के. के. वाघ तंत्रनिकेतन, चांदोरी यांचेकडून खालील प्रमाणे साहित्य के.के. वाघ कला, वाणिज्य व संगणक विज्ञान महाविद्यालय, चांदोरी यांना हस्तांतर करण्यास मंजुरी देण्यात येत आहे.

अ.क्रं	साहित्य तपशिल	एकुण संख्या
1.	Practical Steel Table with Glass Top (42'' x 21'' x 30'')	04 Nos.
2.	Centre Table	02 Nos.
3.	Computer Tables with Glass Top	25 Nos.
4.	Steel Library Book Case	01 Nos.
5.	Wooden Rack (60'' x 40'' x 33'')	01 Nos.
6.	Wooden Rack (71'' x 84'' x 60'')	01 Nos.
7.	Wooden Rack with 3 Self	02 Nos.
8.	Table Side Wooden Rack with Door	02 Nos.
9.	Library Reading Table with Glass	06 Nos.
10.	LED Tube	110 Nos.
11.	Readymade Plywood Table with one shelf	06 Nos.

स्टोअर विभाग प्रमुख, के. के. वाघ शिक्षण संस्था, नाशिक यांना कळविण्यात येते की, डेडस्टॉक ट्रान्सफर फॉर्म भरुन पुढील कार्यवाही करावी.

टिप : वर नमुद वस्तु सध्या वापरात नाहीत. त्या वस्तुंचा वापर चालु न ठेवल्यास किंवा दिर्घ काळ बंद ठेवल्यास त्या निकामी व निरुपयोगी होतील, परिणामी संस्थेचे आर्थिक नुकसान होईल. त्यामुळे मे. उच्च न्यायालयाच्या अंतिम आदेशाला अधिन राहुन तात्पुरत्या स्वरूपात वरील संदर्भिय निर्णयानुसार हस्तांतर करण्यास मंजुरी देण्यात आलेली आहे.

1) श्री.
2) श्री. भावसार
कार्यवाहीस्तव

K. K. Wagh Senior College
Chandori, Tal.Niphad, Dist.Nashik
Date: 01/01/2022
Inward No.:.....
Initial:.....

(प्रा.के.एस.बंदी)
सचिव
के. के. वाघ शिक्षण संस्था,
नाशिक

C:\Purchase Dept\Office Note 2020\Samora Office Note 2020

T8 types of tube lights have been installed in the college building.

LED Tube Light In College Class Room

LED Tube Light In Principal Cabin

Energy saving fans have been installed in the college building.