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AAR
CONSULTING AND SERVICES PVT LTD

ENERGY AUDIT
EXECUTED AT
BUNTS COLLEGE OF HIGHER EDUCATION NIGHT COLLEGE ,
NAVI MUMBAI
on 1st and 2nd December 2023

Submitted By- AARC

INDEX

Acknowledgement

We AARCS thank M/s. Bunts College of Higher Education Night College for giving us an opportunity to execute the Energy Audit at their Navi Mumbai facility. We are obliged to been associated with the college

We thank M/s Bunts College of Higher Education Night College , Mrs.Sarita Poojary and other facility O & M staff members who had supported us in executing the Audit,

We are also thankful to other facility O & M team members who had extensively supported us in collecting the data.

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1. EXECUTIVE SUMMARY:-

Sr	Saving proposal	Saving in units per annum	Investment in Rs	Payback period in years
1	Installation of solar roof top plant of 10KWp capacity	12775	5 Lacs	4
2	Installation of BLDC energy efficient ceiling fans (total 112 no of fans)	2069	3.92	19
3	Installation of new APFC panel to control power factor and reduce KVAH consumption	1200	1	1
	Total	16044	9.92	

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2. HISTORICAL ENERGY CONSUMPTION

Months	Meter 055-X1805002	
	KVAH Consumption	Amount in Rs.
Sept 22	1185	24327
Oct	1143	23564
Nov	1271	25213
Dec	1414	27096
Jan 23	907	20716
Feb	1055	22626
Mar	1390	26921
April	1222	26406
May	808	20519
Jun	1103	24632
Jul	1071	24306
Aug	1299	24373
Sept.23	1021	23610

Demand found to be 20KVA for all the months.

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TOTAL YEARLY electricity CONSUMPTION and rate Analysis:-

Year	Units consumed
Sept 22- Aug 23	13868

Average rate per unit for Sept 23 in LT VII B II commercial tariff for the connection is Rs.9.4 per unit.

Energy balance calculations with full occupancy and normal working are as below:-

Sr	Description of load	Units per year
1	Air conditioning loads consumption	1000
2	Ceiling fans consumption	4077
3	Lighting load consumption	6250
4	Other Equipment loading	2541

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3. Load Analysis:-

Following are the details of connected loads:-

Floor	AC	Ceiling fan	Wall mounted fans	20W tube light	Water cooler/ Fridge	Computer	Printer	Xerox	Lift
4B		28		42					1
4A		8	15	34					
3A	3	17		45	1	28	2		
3B		23		37					1
2	2	20	1	28	1	12	6	2	1

a. Lighting :-

Total lighting connected load is (186 nos x 20 W) = 3720 Watts = 3.72 KW

Considering average 6 hours running , per day lighting consumption will be 22.32 units per day.

Yearly lighting consumption will be 6250 units considering 280 days running.

Use of occupancy sensors in many areas is recommended to reduce the consumption.

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b. Air conditioning load :-

S. No	Name of the Floor	Information about the AC					
		Total No. of AC	Usage Hours per day	Type of AC (Window/ Split/ Cassette)	Tonnage (TR)	Wattage	Total no. of days used
1	Third	3	1	Split	1.5	1800	250
2	second	2	1	Split	1.5	1800	250

Total AC connected load of split units is 9 KW.

It is informed that these air conditioners are used very rarely and hence the yearly consumption of the same is around 1000 units considering 4 units per day for 250 days.

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c. Equipment loads :-

S. No	Floor	Information about the Equipment				
		Name of the Equipment	Total no. of Equipment	Approximate Wattage (W)	Usage hours/ day	Total no. of days used
1	Third A	Computer	28	120	4	280
2	Second	Computer	12	120	4	300
3	Third A	Printer	2	120	8	300
4	Second	Printer	6	300	12	300
5	Second	Xerox/MFD	2	600	10	300
6	2,3,4	Lifts	5	3000	6	300

Total equipment Connected load is 18 KW.

Peak running load will be around 10% which will be 1.8KW.

Considering 6 hrs running for 280 days of the year , the units consumed will be 3024

For energy saving following measures are recommended

1. The monitors should be kept OFF when not in use.
2. The workstation CPU should be kept OFF after the completion of the days work while going out, this will reduce the sleep mode consumptions of the UPS. Except servers all the workstation CPUs can be kept off. Power saving features in Windows or other automation practices can be utilized.
3. Server room and other ac areas heat ingress from outside need to be restricted. Use of suncontrol films (3M or Garware make)on the window glasses is suggested.
4. Use of heating plate should be monitored to avoid wastages.

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Details of Load related to ceiling fans :-

S. No	Floor	Information about the Fans				
		Type of Fan (Ceiling/ Exhaust/ Wall Mounted Fan/ Pedestal Fan)	Total no. of Fans	Approximate Wattage	Usage Hours per day	Total no. of days used
1	4B	Ceiling	28	65 W	8	300
2	4A	Wall mounted	15	65 W	8	300
3	4A	Ceiling	8	65W	8	300
4	3A	Ceiling	17	65 W	8	300
5	3B	Ceiling	23	65 W	8	300
6	2	Ceiling	20	65 W	8	300
7	2	Wall mounted	1	65W	8	300

Total no of ceiling fans are 112 nos ,

Total fan connected load is 7.28 KW.

Considering average 2 hrs of running of the fan per day

Considering annual running days as 280, annual consumption will be 4077

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4. Energy Performance Index

EPI (KWH/Sq.m/ Year) = (Purchased Electricity Units + Units generated through DG sets)/ Useable Built up area

The Relevant band width of the office Buildings for Mumbai Published by BEE is as follows:

Climatic Zone - Warm and Humid (>50% Air Conditioned)	
EPI(Kwh/SqM/Year)	Star Label
200-175	1 Star
175-150	2 Star
150-125	3 Star
125-100	4 Star
Below 100	5 Star

Total Useable area = 1380 Sqmtr

Total Energy Consumption = 13868 KWH (From Sept-22 to Aug– 23)*

***Consumption is low because of the pandemic situation

EPI = Annual KWH/Sq M/ Year = 11

This indicates that the building is in 5 star category.

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Details of consumed power are tabulated below :-

	Voltage in Volts	Current in amps	Power in KW
R ph	241	14.8	3.28
Y ph	238	13.9	3.1
B ph	233	11.4	2.6
Neutral	2.71	53	
Total power consumed			8.98

Power factor observed is 0.9

Neutral to earth voltage is 1.7Volts which is high (standard it should be less than one volt)

There are 5 nos of lifts each with following details

Motor Current drawn found to be normal.

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Air Conditioning system performance measurements:-

Performance Evaluation for Hi wall split type AC units :-

Split Units- Split AC 1.5TR			
Sr. No.	Parameters	Units	AC unit-1
1	Make	-	Voltas
2	Cooling Capacity	Watt	4550.00
3	Type	-	Split
4	Capacity	TR	1.50
	Performance Assessment		
5	Average Air Velocity suction side filter	m/s	1.77
6	Cross sectional area of suction	mm2	53600.00
7	Cross sectional area of suction	m2	0.054
8	supply side temperature-DBT	°C	36.00
9	Outlet side temperature-WBT	°C	29.00
10	Outlet side Enthalpy	kcal/kg	22.44
11	return side inlet temperature- DBT	°C	34.90
12	return side inlet temperature-WBT	°C	26.40
13	Suction side inlet Enthalpy	kcal/kg	19.50
14	Specific volume of Air	m3/kg	0.85
15	Air Flow rate	m3/sec	0.09
16	Air Flow rate	m3/hr	340.90
17	Cooling Effect Delivered	TR	0.39
18	Cooling Effect Delivered	kW	1.37
19	Actual Power Consumption	kW	1.30
20	Specific Energy Consumption	kW/TR	3.3341
21	Energy Efficient Ratio	KW/KW	1.05

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kW/TR is on higher side, with proper maintenance and chemical cleaning and additive treatment the same can be improved

There is one submersible water pumps. At the time of audit it found running , each with running load of around 0.9 KW.

6. Lighting Levels:-

Lux Level Details		
Sr. No.	Description	Lux
1	Fourth floor	340
2	Third floor	360
3	Second floor	315

Illuminations

As per National Building Code of India 2005, the recommended values of illuminance for commercial office are defined as follows:

Extract from National Building Code - 2005 (Part -8 Section - 1)		
Sl.No	Type of Interior or activity	Range of Service Illuminance
17	COMMERCE	
17.1	Offices	
17.1.1	General Offices	300-500-750
17.1.3	Computer Work Station	300-500-750

Observations :-

Lighting fixtures of fluroscent type are being replaced by new LED fixtures and hence the same are not recommended in the report. The replacement work was found to be in progress.

Energy Conservation Measures :-

1. Installation of solar roof top plant of 10KWp capacity

At present the total connected load is 45 kW. But actual consumption and demand found to be low. Though it is possible to install higher capacity of solar roof top , we have suggested for 10KW capacity .

Sr	Description	Details
1	Present annual consumption	13868 KWH
2	Annual savings because of solar generation in units	12775 KWH
3	Annual savings in Rs	Rs. 120085
4	Estimated investment in Rs	Rs. 500000
5	Payback period	4 years

Proposal no. 2 :- Installation of energy efficient ceiling fans :-

It is recommended to install super efficient ceiling fans , it has BLDC motors and consumption of 20Watts only instead of 65Watts of the present fans. Also it has the advantage of speed control using remote which can further save energy.

Sr	Description	Details
1	Present annual consumption for Ceiling fans considering 280 days and 4 hours working and 112 nos. (assuming only 40% fans run at a time)	4077
2	Annual consumption after installation of BLDC fans	2008
3	Annual savings in units	2069
4	Annual savings in Rs	20000
5	Estimated investment in Rs.	392000
6	Payback period	19

If the running hours are more (present considered only 2 hours), then payback period will reduce considerably.

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7. Instruments used during the Audit

The Instruments used during the Audit which is as follows:-

- Power & Harmonic Analyzer Fluke Make 434 Series II.
- Clamp – on type Power/Energy meter.
- Clamp On Earth Tester Meggar Make.
- Thermal Imager Fluke Make Tis-10 Series.
- Anemometers – to measure velocity of gases Luthron Make.
- Digital Manometers & Pressure Gauges.
- Tachometers – Contact /Non contact Type.
- Digital Thermometers for liquid /surface temperature.
- Lux meter Luthron Make.
- Pressure Gauges.
- Digital Hygro-temp meter (For Temp & RH measurement) Kussum Meco Make.

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The aim of any efficiency drive is obviously to deliver the biggest savings for the least cost and effort.

In relation to cooling plant, a number of relatively simple measures, each yielding a few percentage points in energy use, can combine to make a very significant impact on the energy bill.

1. **Reduce the condensing temperatures and increase refrigerant liquid sub cooling**

   the number one tip for saving money on cooling costs is to reduce the condensing temperatures and increase refrigerant liquid sub cooling. For every 2deg C reduction in condensing temperature energy consumption is reduced by approximately 3per cent. On some applications it may be possible to cut condensing temperature by as much as 10deg C, which translates into a 15 per cent saving in the energy bill. With the average UK temperature in the region of 12 deg.C this is easily achieved.
2. **Make sure the refrigeration evaporating temperature or chilled water temperature is as high as possible**

   The second key advice is make sure the refrigeration evaporating temperature or chilled water temperature is as high as possible, subject to meeting the cooling needs of the application. For example - A 2 deg C increase can result in an increase in energy efficiency of around 5%. This can represent many thousands of pounds off the power bill.
3. **An undercharged refrigeration system can result in a significant loss of capacity**

   An undercharged refrigeration system can result in a significant loss of capacity. In some cases this can be as much as 15%. It is therefore essential to ensure that the charge is optimized and sight glasses/liquid lines kept full.
4. **Expansion valves should be carefully adjusted**

   Expansion valves should be carefully adjusted so that just the right amount of refrigerant is flowing through the evaporator. Too little refrigerant flow starves the evaporator resulting in a loss of cooling capacity. Too much refrigerant will result in flooding back which could damage the compressor so take care!
5. **Check regularly for blocked or obstructed airways at air cooled condensers**

   Check regularly for blocked or obstructed airways at air cooled condensers. Even partially obstructed units suffer a double penalty due to wasted fan power and the increased

work required of the compressor. Accumulated autumn leaves, weeds and crisp packets come with a heavy energy penalty. Remove them!

6. **Condenser air recirculation is another energy sapping situation**

   Condenser air recirculation is another energy sapping situation. It's easy to check if recirculation is evident by measuring air temperatures on to the condenser(s) and comparing them with the local ambient temperature. If the air on condenser temperature is more than the ambient temperature then air recirculation is more than likely occurring. Consider ways in which to get the condenser air discharge clear away from the equipment. This could be done by using a simple sheet metal air baffle or hood on top of the condenser framework. Condenser air recirculation during peak summertime ambient temperatures not only saps energy can also result in catastrophic failure of the plant just when you need it!

7. **Improved logic control can ensure compressor run time is minimized**

   on the controls side, improved logic control can ensure compressor run time is minimized. In the case of multiple fixed speed compressor systems it is important to switch compressors on and off in the right way so as not to cause short cycling. On variable speed compressor systems it is often more advantageous to operate all compressors at lower speed to benefit from improved isentropic efficiency.

8. **Hygiene on the other side of the system is equally important**

   Hygiene on the other side of the system is equally important. A partially blocked air conditioning evaporator again wastes fan power, and demands higher compressor pumping energy to deliver the required conditions. As well as compromised efficiency, blocked or dirty heat exchangers may result in inadequate duty output with resultant problems for building occupants or the process application being cooled by the plant.

9. **Ensure that water flows through evaporators and condensers are in accordance with specification**

   where chillers are installed it is important to ensure that water flows through evaporators and condensers are in accordance with specification. If water flows are too high this puts more than necessary pressure on the pump(s) with a corresponding increase in power. In extreme cases tube erosion and or excessive water turbulence can result in premature failure of the heat exchanger. Closing down the DR valve will not achieve any power savings. Reduce the speed of the pump(s) instead.

10. **The Final Tip**

Moving up the scale in terms of cost and time, it may be worth investigating the options for improved speed control for fans and/or compressors. Moving to inverter control, in the case of plant without it, can make a big difference to power use. Where plant is equipped with standard "phase chop" inverters, it is worth considering switching to frequency inverters, which deliver better control and offers improved energy savings over the operating range.

8. Vendor Coordination:-

For executing the above recommendation activity following are the vendors which can be coordinated.

1. For air conditioning refrigerant additives of M/s Fridgitech M/s Greenwave products Vadodara Mr.Rahul Doshi 9825041981/ 0265 2326120
2. For Energy efficient fans M/s Atomberg and Versa drives dealers can be contacted

9. BASIC ENERGY SAVING TIPS

- Consider Using the AC optimally – for an hour or two less everyday. An AC switched off for an hour can keep a 40 watt tube light on for 50 hours!
- Maintain the A/c Temperature around 24°C - 25°C (Human Comfort Level).
- Keep windows shut after switching off the AC to keep the room cool for some more time. You would be saving significantly on power consumption.
- Clean the AC filter at least once a fortnight. A choked filter means poorer quality of cooling and more power consumed
- Keep windows shut after switching off the AC to keep the room cool for some more time.
- Switch off lights and fans: switch off light and fans when leaving a room
- Lubrication saves: clean and lubricate your fans regularly

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- Replace old regulators with Electronic regulators: this will help reduce Electricity consumption significantly
- Switch off the PC when not in use.

Disclaimer:

Kindly note that AAR Consulting and services have taken all the readings with the help of calibrated meters the list of which is given separately as on date of the audit. All these readings are generally correct to the best of our knowledge and abilities. All the inferences drawn are based on these readings. This audit report is a system health check report as on the date of audit. This audit report is to be referred for your internal use only and may not be used for any other purpose.

The readings taken are valid on the day of the audit as these are dependent on many factors such as ambient temperature and humidity, water seepages , plumbing and fire fighting piping leakages etc. Any changes, rework, alteration and modification work done in any part of the electrical and fire system will affect the readings. AAR will not be responsible for any eventuality because of the same.

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