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Energy Audit of P.E.S's Modern College of Engineering Shivajinagar, Pune-05

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ABSTRACT

The world over energy resources are getting scarcer and the energy costs are consistently going up. The share of energy cost in total production cost in most of the industries is rather significant. Reduction in energy cost can, therefore, improve project levels in all the Commercial sector, this reduction can be achieved by improving the efficiency of Commercial equipment and operations. Energy audit plays an important role in identifying energy conservation opportunities in the commercial sector. While they do not provide a final answer to the problem. They do help in identifying the existing potential for energy conservation and inducing the companies to direct their efforts in this area in a focused manner. Energy audit translates conservation ideas into actual money saved. It's more beneficial than a piecemeal introduction of short term measures, as it is a comprehensive strategy that also envisages gearing up of organizational structure and other infrastructure requirements.

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I. INTRODUCTION

A Detailed Energy Audit of P.E.S Modern college of Engineering, Shivajinagar, PUNE-05. Objectives of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exist and prepare proposals for energy/cost saving along with investment and payback periods. The salient observations and recommendations are given below,

1. P.E.S's Modern college of engineering, PUNE-05
Sanctioned Load- 245 KW
Contract Demand- 200KVA
2. Electricity from MSEDCL
3. High Speed Diesel(HSD) Generator

Electrical energy is used for various applications, like

- Computers
- Lighting
- Air-Conditioning
- Fans
- Machines
- Other Lab Equipment

II. AUDITING PROCEDURE

Energy Audit

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream. Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis.

Energy Audit Methodology

I) Preliminary Audit
II) Detailed Audit

i. Preliminary Energy Audit Methodology

- Preliminary Energy Audit is a relatively quick exercise to:
- Establish energy consumption in the organization.
- Identify the most likely and the easiest area for attention.
- Identify immediate (especially no/low cost) improvements/ savings.
- Identify areas for more detailed study/measurement.
- Preliminary energy audit uses existing, or easily obtained data.

ii. Detailed Energy Audit Methodology

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost. In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges.
Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I- Pre Audit phase.
Phase II- Audit phase.
Phase III- Post Audit phase.

1.3 Historical Data Analysis
The historical Data Analysis involves establishment of energy consumption pattern to establish base line data on energy consumption and its variation with the change in production volumes.

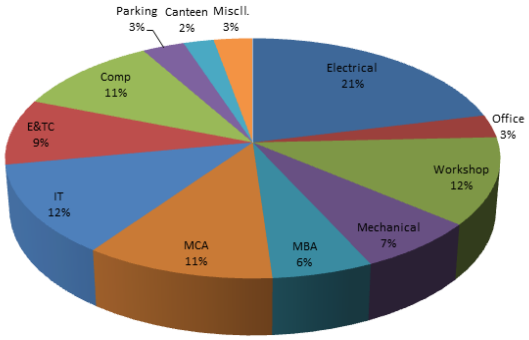
1.4 Actual Measurement and Data Analysis
This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input and output analysis to establish actual operating equipment efficiency and finding out losses in the system.

1.5 Identification and Evaluation of Energy Conservation Opportunities
This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

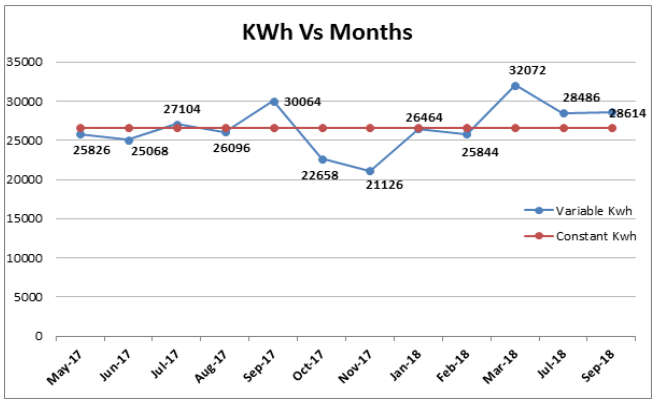
A. College Energy Sources
The electricity for the factory is supplied through a standalone generator and grid connected power system. The data are collected to identify the contribution of energy sources towards the college total energy requirement. Diesel for standby generator and direct electricity form the grid connected supply has following contribution-

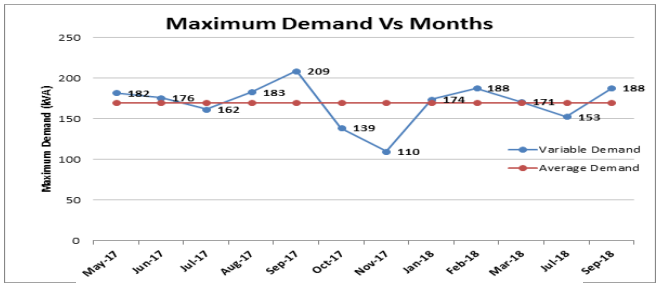
- Electricity grid system- 90%
- Diesel generator- 10%

B. College Energy Consumption
This is department wise connected load. The total connected load of college is 518 KW. In this the static load is 363.76 KW, and rotating load is 155KW.



This is KWH vs Months variation





This is KVA Demand vs Months variation.

III. ENERGY SAVING POTENTIAL

ESP - 1: Replacement of energy inefficient old centralized AC plant with energy efficient inverter variable refrigerant flow (IVRF) system.

The tropical climate of College makes air conditioning one of the major energy consumers during summer months. Presently the building is using a centralized air conditioning plant, vapor compression type. The centralized ac unit consisting of 3 separate units and has the capacity of running with 3 nos. of 22TR refrigerant compressors in each unit. The present conventional system installed runs with full speed at all the times. Manual intervention is required to change the operating condition of compressor system.

The main advantage of IVRF system is that the speed of the compressor motor can be varied from 3% to 100% and maintains constant room temperature throughout the period of operation. The work of heat transfer fluid and working fluid refrigerant is done by refrigerant itself thus increasing efficiency. IVRF reduces duct losses. An experiment conducted by the team revealed that IVRF air conditioning systems consume 40-50% less power than centralized air conditioning system currently installed. The study revealed that the air conditioning systems are not being used properly. The employees sometimes leave their rooms without closing the doors and windows which causes the cool air to escape. Thus general awareness is to be created which will lead to energy saving without any investment. Poor maintenance of the old air conditioning units is causing less overall efficiency. Thus proper maintenance will ensure a long life of system and increased efficiency as well.

ESP - 2: Energy Saving on Standalone AC Units by improving the overall performance.

The unit used for describing the heat extraction capacity of an air conditioner is ton of refrigeration (TR). It was observed from the results of measurement that the overall specific power consumption (SPC), kW ITR of connected standalone ac units was varying from 0.60 to 1.47kW/TR. The average specific power consumption was found to be 0.935kW/TR. It is possible to maintain the specific power consumption as 0.8kW/TR or even below up to 0.6kW/TR if the stand alone AC units are maintained well, by effectively using the thermostat control, removal of dust accumulated in the filter, maintaining the refrigerant gas pressure, slightly increasing the room temperature setting by 2 to 3°C during favorable ambient condition and switching off the individual ac units when not required etc.

ESP-3: Energy Savings on UPS by optimum loading

Most manufacturers test their UPSs at full load to show high efficiency of their product. But in real world most UPSs are generally operated at 25 percent to 60 percent of full load. Hardly any system runs at full load. This results in less efficiency of UPS system than expected.

It is known that the efficiency of UPS at 100% loading would be 93%, there would be meager 3% reduction in efficiency up to 30% loading and if the UPS is loaded less than 30% there would be drastic reduction in efficiency. It was proposed to operate the installed UPSs at atleast 50% load always by shifting loads from very lightly loaded UPS to another lightly loaded UPS, which is proposed to be operated at 50% or more loading .Thus it saves the no load losses of lightly loaded UPSs. The no load losses due to heat dissipation would be 750W to 1kW for 10kVA UPS.

ESP-4: Installation of Capacitor Banks at User End to Improve the Power Factor.

Real power is the power that performs the actual work. Reactive power (kVAr) is not the useful work but is required to sustain mainly inductive loads like motors. The power actually consumed includes both real power and reactive power and is called as apparent power. Power factor is the ratio of real power to apparent power. During the energy audit the power factor at most of the places was found to be less than 0.8. The total reactive power needed to increase the power factor to 0.98 was calculated and equivalent capacity of capacitor banks was proposed to be installed. This exercise will cause reduction in I2R energy loss where I is the expected reduced current due to improved power factor and R is corresponding cable resistance.

ESP-5: Energy saving by having Separate Lighting Feeder with Servo Voltage Stabilizer.

The voltage of the power supply varies between high and low throughout the day and is not constant. There are many disadvantages of variable voltage. Most frequent of which is breakdown of the electrical equipment. Servo voltage stabilizer gives a constant output voltage even when the input supply voltage varies. It reduces breakdown of machinery and equipment. It has high efficiency so will lead to energy saving. During the audit, the potential to reduce the voltage variation in lighting loads was discovered. The voltage measured continuously on 200k V A transformer L T side varies from 370 to 470V. It was suggested to installing a separate 3 phase lighting feeder with a servo voltage stabilizer to control the voltage variations. At higher voltage, for every I % voltage reduction there would be a saving of 1 to 1.2% energy consumed by the lighting loads at higher voltage. The servo voltage stabilizer would provide stabilized voltage for the lighting equipment. The performance of chokes and ballasts would also

improve due to the stabilized voltage supply to the lighting loads.

IV. CONCLUSION

The data for energy consumption of the college building were collected and analyzed. A detailed energy audit was carried out which was followed by in-depth analysis of the data obtained. This was done to find out the energy consumption by various equipment installed in the building. This led to identification of opportunities for energy saving. Energy saving proposals that were cost effective were proposed.

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