ENERGY AUDIT AND Its RECOMMENDATIONS

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Abstract - Day by day, energy demand keeps rising so that it is essential to reduce energy consumption for that energy conservation is needed. For Conservation of energy the best option is energy audit. Energy audit is a process to determine when, where, why and how energy is used in a plant or building. Using different energy conservation schemes the energy consumption of the electrical appliances can be improved. Energy audit analyzes not only the overall amount of the energy consumption of and Industry or Institution but also at the department level based on the range of the study. Energy Management Program plays a key role in identifying the areas of energy conservation within the particular department, to improve the efficiency of the system.

Keywords: ***Energy audit, Efficiency, Energy conservation, Performance, Energy savings, Economic analysis, Saving proposals.***

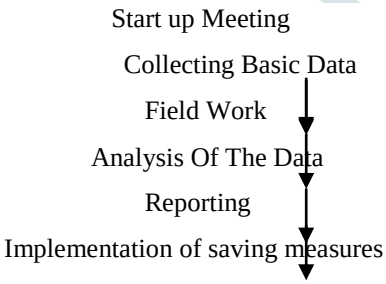
1. INTRODUCTION

Energy Audit is "The verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption."An energy audit is systematic study or survey to identify how energy is being used in a building or plant, and identify energy savings opportunities. Using proper audit methods and an action plan to reduce energy consumption. An energy audit provides the energy manager with essential information on how much, where and how energy is used within an organization (building). This will indicate the performance at the overall college or process level. The energy manager can compare these performances against past and future levels for a proper energy management. The main part of the energy audit report is energy savings proposals comprising of technical and economic analysis of projects. Looking at the final output, an energy audit can also be defined as a systematic search for energy conservation opportunities.

Energy Audit is a vital link in the entire management chain. The energy manager while proposing various courses of action and evaluating their consequences, requires a detailed information base to work from energy audit attempts to balance the total energy inputs with its use and serves to identify all the energy streams in the system and quantifies energy usages according to its discrete function.

Energy audit is an effective tool in defining and pursuing comprehensive energy management programs. It has positive approach aiming at continuous improvement in energy utilization 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?

1.1 ENERGY AUDIT PROCEDURE IN GENERAL



1.2 Energy audit methodology:

The methodology adopted for this audit is

- Formation of audit groups for specific areas and end use.
- Visual inspection and data collection.
- Observations on the general condition of the facility and equipment and quantification.
- Identification / verification of energy consumption and other parameters by measurements.
- Detailed calculations, analyses and assumptions.
- Validation.
- Potential energy saving opportunities.

- As the first step in this regard, 1 team of total 3 students is formed and was assigned a particular area or application of energy in the campus.

1.2.1 Grouping and strategy

The following steps were done with specific target areas and end users assigned

Step 1: Collecting electrical data related to lighting, fans etc. of our college.

Step 2: Data Collection from labs and their specifications

Step 3: Data analyzing by means of calculations

1.2.2 Data Analysis

Detailed analysis of data collected was done. Energy consumption per day in kWh is calculated based on each department i.e block-wise. The analysis of data is done in following way:

- Power Flow diagram.
- Evaluation of collected data department wise analysis, block wise analysis and location wise analysis.
- Reasons for the Variance between connected load and actual consumption was evaluated.
- The database prepared was further studied and the results have been graphically represented.
- This helped to identify the areas with maximum energy saving potential.

2. VARIOUS COMPONENTS IN ELECTRICAL SYSTEM OF AN INSTITUTION

2.1 TRANSFORMER

A transformer is a static machine used for transforming power from one circuit to another without changing frequency. This is a very basic **definition of transformer**. Since there is no rotating or moving part so transformer is a static device. Transformer operates on ac supply. Transformer works on the principle of mutual induction.

Generation of electrical power in low voltage level is very much cost effective. Theoretically, this low voltage level power can be transmitted to the receiving end. This low voltage power if transmitted results in greater line current which indeed causes more line losses. But if the voltage level of a power is increased, the current of the power is reduced which causes reduction in ohmic or I^2R losses in the system, reduction in cross sectional area of the conductor i.e. reduction in capital cost of the system and it also improves the voltage regulation of the system. Because of these, low level power must be stepped up for efficient electrical power transmission. This is done by step up transformer at the sending side of the power system network. As this high voltage power may not be distributed to the consumers directly, this must be stepped down to the desired level at the receiving end with the help of step down transformer. Electrical power transformer thus plays a vital role in power transmission.

Two winding transformers are generally used where ratio of high voltage and low voltage is greater than 2. It is cost effective to use auto transformer where the ratio between high voltage and low voltage is less than 2. Again a single unit three phase transformer is more cost effective than a bank of three single phase transformers unit in a three phase system. But a single three phase transformer unit is a bit difficult to transport and have to be removed from service entirely if one of the phase winding breaks down.

- RATING OF TRANSFORMER :- 500 KVA
- CONTRACT DEMAND :- 325 KVA
- BILLED DEMAND :- 350A

Fig 2.1 Transformer at entrance

2.2 DIESEL GENERATOR

It is a combination of diesel engine and electric generator to generate electric energy. These are used in a place without connection to a power grid or emergency power supply if grid fails. The packaged combination of a diesel engine, a generator and various ancillary devices (control systems, circuit breakers, jacket water heaters and starting system) is referred to as a "generating set". Diesel Generators, sometimes as Small as 200 Kw (250 Kva) are widely used for emergency power.

A diesel generating set should be considered as a system since its successful operation depends on the well-matched performance of the components, namely:

a) The diesel engine and its accessories.

b) The AC Generator.
c) The control systems and switchgear.
d) The foundation and power house civil works.
e) The connected load with its own components like heating, motor drives, lighting etc.
It is necessary to select the components with highest efficiency and operate them at their optimum efficiency levels to conserve energy in this system.

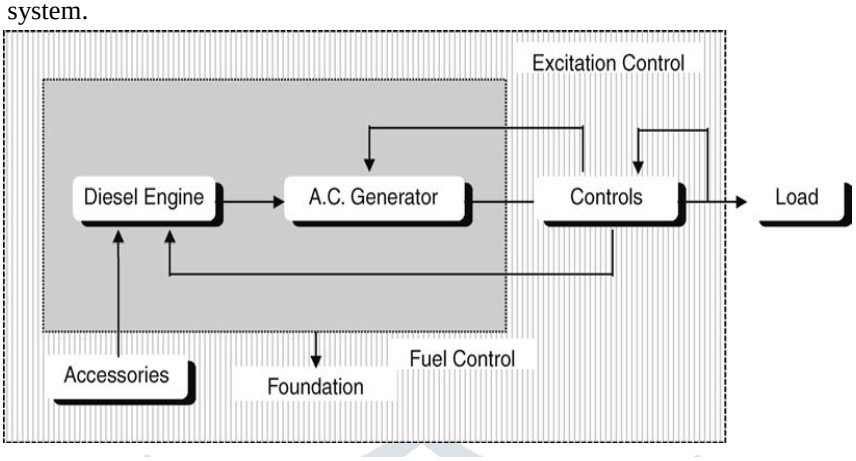


Fig 2.2 Block diagram of DG set

There are 3 DG SETs, in which DG1 and DG2 are connected to the campus and HOSTELS. DG3 is connected to campus. Rating of each DG SET is of 125 KVA.

Fig 2.3 DG set at campus and it's inside view

2.3 CONTROL PANELS

A control panel is a flat, often vertical, area where control or monitoring instruments are displayed. A schematic mimic on the front representing the system being controlled, lamps and indicators to show the status and position of all the elements, switches to control and change the status of these plant items, alarm enunciators and fault recording equipment, full internal wiring and equipment mounted on the front and internally.

There are 3 main control panels from where the total power is supplied to the campus.

Fig 2.5 Control panels in the campus

3.0 ENERGY AUDIT METHODOLOGY

The methodology adopted for this audit was a three step process comprising of:

1. Data Collection –Using different tools such as observation, interviewing key persons, and measurements, the data of all the electrical equipments in each of the block is collected.

2. Data Analysis - By walkthrough approach, the data collected is thoroughly analyzed by our team members and followed by in detail calculation of load.

3. Recommendation – On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

3.1 Data Collection

It is necessary to know the power consumption pattern in detail of each block for suggesting any corrective measures to reduce power consumption. The exhaustive data collection exercise was performed at all the departments, academic centers, hostels, and other supporting entities such as library, institute hospital, computer centre, canteen etc.

Following steps were taken for data collection:

- The team has collected information about the general electrical appliances by observation and interviewing the class rooms, labs, hostels, canteen etc.
- Insulation was checked by visual inspection, in case of Air Conditioning.
- Approximations and generalizations were done at places with lack of information.
- The detailed information about each and every appliance is taken by the guidance of the personnel.

3.2 BLOCK WISE LOAD IN KW:

We are considering only 1ST YEAR block as it has large amount load than any other block.

1ST YEAR	7.72	21.48	29.07	28.975	0.04	1.024

3.2 DATA ANALYSIS:

Effective data analysis is essential but is often not given appropriate priority. In fact, poor analysis of data can destroy the operation of an Energy Management System (EMS) and result in misleading messages. Energy data includes not only energy usage but key influencing factors as well. Data must be collected at an adequately high frequency.

The objective of data analysis is to better understand energy use and costs and to model energy use. A range of techniques can be utilized, from simple to complex. These should be selected to suit the problems being addressed (rather than selecting an analysis technology and then finding a problem to suit).

A) **Preliminary Energy Use Analysis:**

Involves analyzing the building's historical energy use, benchmarking the building and performing a utility rate analysis. Benchmarking is usually completed using EPA's Energy Star Portfolio Manager, which allows our engineering team to determine what level of effort should be employed for your facility.

B) **Walk Through Analysis:**

Preliminary audit and a site visit by an engineer who focuses on low cost energy conservation measures and potential capital improvements.

C) **Energy Survey and Analysis:**

Identifies all appropriate energy conservation measures for a building and a financial analysis based on implementation costs, operating costs and attainable savings.

D) **Detailed Analysis of Capital-Intensive Modifications:**

Involves more detailed and in-depth field data gathering and engineering analysis along with detailed project cost and savings information sufficient for capital investment decisions.

3.2.1 FIRST YEAR BLOCK

It is at the end of campus beside boys hostel, the electrical utilities of this block are shown in fig 3.2.1.a

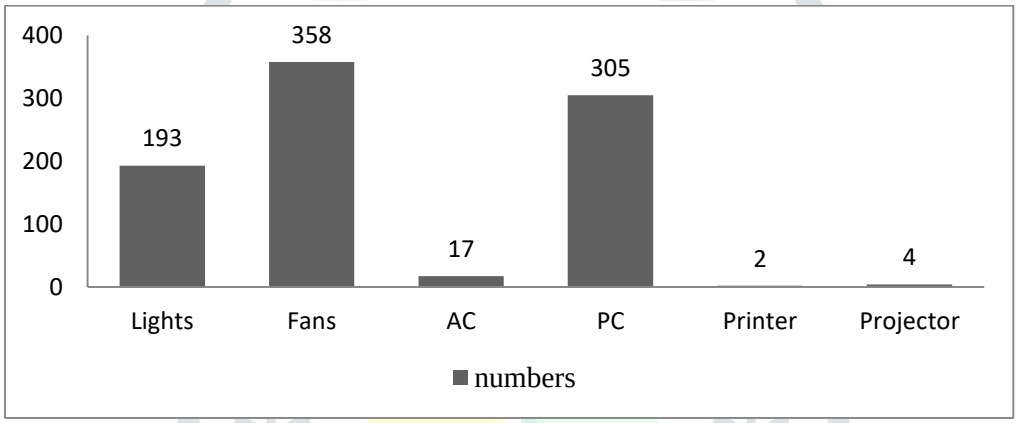


Fig 3.2.1.a Graphical representation showing different electrical equipment in FRIST YEAR block

The major load is due to computers, other loads are shown in fig 3.2.1.b.

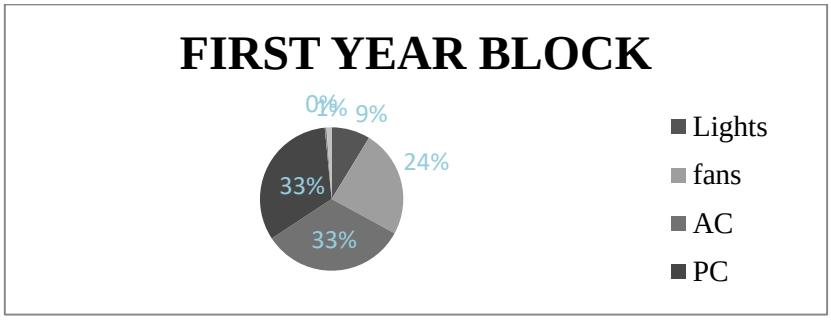


Fig 3.2.1.b Graphical representation showing load distribution between different electrical loads in FRIST YEAR block

4. RECOMMENDATIONS

Do you know in actual we are consuming more electricity or paying more amounts what we actually not use it?

According to the energy auditors we can easily save between 5 and 10% of their energy consumption (and costs) by changing our behavior such as switching electrical equipment off at the mains rather than leaving it on standby, turning off lights when they're not being used.

Saving Electrical Energy will directly save money so it is very necessary to understand bigger unit or amount which we are paying without using the appliances to that level

The major appliances in our college are air conditioners, choke bulbs, fans, computers and they account for a big chunk of the college monthly utility bill. And if the air conditioner or computer is more than a decade old, a lot more is spend on energy than you need to.

Today's major appliances don't hog energy the way older models do because they must meet minimum federal energy efficiency standards. These standards have been tightened over the years, so any new appliance you buy today has to use less energy than the model you're replacing. For instance, if you buy one of today's most energy-efficient air conditioner, it will use less than half the energy of a model that is 12 years older.

Lighting

- Get into the habit of **turning lights** off when you leave a room. —-Saving Energy 0.5 %
- Use task lighting (table and desktop lamps) instead of room lighting.
- Take advantage of daylight
- De-dust lighting fixtures to maintain **illumination**——Saving Energy 1 %
- Compact fluorescent bulbs (CFL):

1. CFL use 75% less energy than Normal bulbs.
2. CFL are four times more energy efficient than Normal bulbs.
3. CFL can last up to ten times longer than a normal bulb.

- Use electronic chokes, in place of conventional copper chokes.—-Saving Energy 2 %
- Get into the habit of turning lights off when you leave a room.
- Use only one bulb for light fittings with more than one light bulb, or replace additional bulbs with a lower wattage version.
- Use energy-saving light bulbs that can last up to ten times longer than a normal bulb and use significantly less energy. A single 20 to 25 watt energy-saving bulb provides as much light as a 100-watt ordinary bulb.
- Use tungsten halogen bulbs for spotlights—they last longer and are up to 100% more efficient.
- Fit external lights with a motion sensor.

➢ **0.9871yr.**

- Hence, the capital cost recovery time for replacing all conventional Ballast [Choke] FTLs of the campus is around 0.9871 years.

Air Condition Unit

- Replace air conditioner filters every month.
- Turn off central air conditioning 30 minutes before leaving your home.
- Consider using ceiling or portable fans to circulate and cool the air.
- Try increasing your air conditioner temperature. Even 1 degree higher could mean significant savings, and you will probably not notice the difference.
- Keep central air conditioner usage to a minimum—or even turn the unit off – if you plan to go away.
- Consider installing a programmable thermostat. Just set the times and temperatures to match your schedule and you will save money and be comfortably cool when you return back.
- Replace air conditioner filters every month.
- Buy the proper size equipment to meet your family's needs – an oversized air conditioner unit will waste energy.
- If you have a furnace, replace it at the same time as your air conditioner system. Why? Because it is your furnace fan that blows cool air around your home, and a newer furnace fan provides improved air circulation all year round, plus saves energy costs.

Computer / Laptop

- Buy a laptop instead of a desktop, if practical. —-Saving Energy 5 %.
- If you buy a desktop, get an LCD screen instead of an outdated CRT.
- Use sleep-mode when not in use helps cut energy costs by approx 40%.

- Turn off the monitor; this device alone uses more than half the system's energy.
- Screen savers save computer screens, not energy.
- Laser printers use more electricity than inkjet printers.

Fan

- A ceiling fan in operation throughout night will gobble up 22 units in a month.
- There is a wrong notion that fan at more speed would consume more current.
- Fan running at slow speed would waste energy as heat in the regulator.
- The ordinary regulator would take 20 watts extra at low speed.
- The energy loss can be compensated by using electronic regulator.

Insulate the ceiling/roof:

Buy efficient electric appliances:

- They use two to 10 times less electricity for the same functionality, and are mostly higher quality products that last longer than the less efficient ones. In short, efficient appliances save you lots of energy and money.
- In many countries, efficiency rating labels are mandatory on most appliances. Look Energy Star label is used.
- The label gives you information on the annual electricity consumption. In the paragraphs below, we provide some indication of the consumption of the most efficient appliances to use as a rough guide when shopping. Lists of brands and models and where to find them are country-specific and so cannot be listed here.
- Average consumption of electric appliances in different regions in the world, compared with the high efficient models on the market.
- Educate everyone in the home, including children and domestic helpers.

5. CONCLUSION

An energy audit is a tool, which is the start of every activity to improve energy efficiency. Under the concept of an energy audit, many activities actually take place – from simple analyses of energy consumption, which are implemented within expert groups in organizations, to comprehensive energy audits, which enable the creation of a quality mid-term energy strategy.

If a comprehensive review of possibilities for energy consumption optimization isn't implemented, some opportunities are lost, which is evident in higher energy costs. When conducting an energy audit, it is important to ensure suitable expertise and independence of the contractor. Based on good cooperation with expert groups within organizations, we can identify and also implement simpler measures that don't require higher investments.

Within the energy audit, we create a plan, which proposes possible organizational and investment measures and also enables **systematic achievement of savings**. With every measure, the level and return of investment and a sensible priority of measure implementation are determined alongside energy and cost savings.

Recorded energy cost savings, which fluctuate between 5 and 15 percent of total energy cost in organizations, depend on multiple factors. These factors are mostly energy complexity of organizations, existing energy use control and organizational and expert qualifications of responsible persons.

A well implemented energy audit is a foundation for an efficient upgrade of an energy management system, which is a tool for continued increase of energy efficiency and cost reduction.

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