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RESEARCH ARTICLE

ENERGY AUDIT OF AN INDUSTRY FOR ENERGY CONSERVATION AND ECONOMICAL OPERATIONS

***Unnikrishnan, V., Syam Prasad, Abdul Azeez, V. A. and Afreedi kinatingal**

Department of Electrical and Electronics Engineering Toch institute of Science and Technology, Kerala, India

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ABSTRACT

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries the energy sector assumes a critical importance in view of the ever increasing energy needs requiring huge investments to meet them. Energy conservation and energy efficiency are separate but related concepts. Energy conservation is achieved when growth of energy consumption is reduced, measured in physical terms. Energy conservation can there for be the result of several processes or development such as productivity increase or technological progress. On the other hand energy efficiency is achieved when energy intensity in a specific product, process or area of production or conception is without affecting output, consumption or comfort levels. Promotion of energy efficiency will contribute to energy conservation and is there for an integral part of energy conservation promotional policies. An energy audit is an inspection, survey and analysis of energy flow in a building, process or system with the objective of understanding the energy dynamics of the system under study. Typically an energy audit is conducted to seek opportunities to reduce the amount of energy input into the system without negatively affecting the outputs. Auditing involves evaluating the information gathered research possible conservation opportunities and make recommendations on mechanical structural operational and maintenance improvement. Energy saving upto 50% or more is often possible in a typical installation using VFDs and distribute the loads connected to a power system to operate at different times(priority based load shedding).

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INTRODUCTION

Energy Audit is the key to a systematic approach for decision-making in the area of energy man- agreement. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy man- agreement program. As per the Energy Conservation Act, 2001, Energy Audit is defined as "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".

Objectives of energy auditing

In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labour and materials.

Corresponding author:* **Unnikrishnan, V.
Department of Electrical and Electronics Engineering Toch institute of science and technology, Kerala, India.

If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists. The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programs which are vital for production and utility activities. Such an audit program will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a "bench-mark" (Reference point) for managing energy in the organization and

also provides the basis for planning a more effective use of energy throughout the organization

Types of energy audits

The energy audit orientation would provide positive results in reduction energy billing for which suitable preventive and cost effective maintenance and quality control programmers are essential leading to enhanced production and economic utility activities. The type of energy audit to be performed depends upon the function or type of industry. T

Here can be Three types of Energy Audit

- Preliminary energy audit
- General energy audit
- Detailed energy audit

Preliminary Energy Audit

A preliminary audit is fieldwork performed by auditors before the end of the period under examination. By engaging in this advance work, the auditors can reduce the volume of activities that must be completed after the client has closed its books,

Which Has The Following Benefits

- The auditors shift work out of their core work period, when many clients want to have audits completed.
- The audit staff can be kept occupied during slack periods.
- The auditors can issue opinions faster than might otherwise be the case. This is a particular concern for public companies, which must issue audited financial statements by mandated deadlines.

There are a number of tasks that can be completed during a preliminary audit, including the following

- Examination of client controls
- Preliminary analysis of account balances
- Adjustment of planning for subsequent audit work, based on the first two items
- No audit report is issued as part of a preliminary audit; instead, this work should be considered an early phase of the regular audit that an organization undergoes.

General Energy Audit

The general energy audit is also called a mini audit or site energy audit or complete site energy audit. It expands on the preliminary audit by collecting more detailed information about facility operation and performing a more detailed evaluation of energy conservation measures identified. Utility bills are collected for a 12 to 36 months period to allow the auditor to evaluate the facility energy/demand rate structure and energy usage profiles. Additional metering of specific energy consuming systems is often performed to supplement utility data. In depth interviews with facility operating personnel are conducted to provide a better understanding of major energy consuming systems as well as insight into variations in daily and annual energy consumption and demand. This type of audit will be able to identify all energy conservation measures appropriate for the facility given its operating parameters. A detailed financial analysis is performed for each measures based on detailed implementation cost estimates, site specific operating cost savings and the customer's investment criteria. Sufficient detail is provided to justify project implementation.

Detail Audit

Detailed energy audit includes a complete description of the facility, including an equipment inventory, an energy balance, detailed energy savings and costs associated with each low-cost and not-cost measure, financial analysis of each recommended measure, identification and rough estimates of capital project costs and savings. Energy savings and economic feasibility are determined as accurately as possible. The reports contain more detailed descriptions of the measures. The portable instruments, trend logs and data loggers are used in detailed energy audits for assessing the current performance accurately.

The scope of an energy audit includes an examination of the following areas

- Energy generation/conversions equipment's like boilers, furnaces, Heaters, pumps, fans, compressors, transformers etc.
- Energy distribution network of electricity, water, steam, condensate, compressed air etc.
- Energy utilization efficiency of all equipment and buildings.
- Efficient planning, operation, maintenance and housekeeping
- Management aspects of design and operating data collection, field measurements, data analysis, and training

Detailed energy audit is carried out in three phases

- Phase1: Pre audit phase
- Phase2: audit phase
- Phase3: post audit phase

Observations and analysis

In this the Observations and Analysis of Previous Bill DG Sets, Capacitor banks, Transformers has been done.

Bill

Collected and analyzed the previous bills of company from March 2016 to February 2017 have been done.

Motor systems

Energy conservation in motor is done to produce more useful mechanical work from less electrical energy. The use of less efficient motors, over –loaded/under –loaded motor, improper

Particulars	Present HPSV-250W	Proposed energy efficient LEDs
Life burning Hrs.	5000	20000
Actual operation Hrs.	4380	4380
Usage in years	1.14	4.56
Bulb and ballast cost	450	4000
Replacement cost/year (Rs.)	395	3300

Load shifting and losses

Transformer name	No load losses	Full load losses	Actual operating KVA	Expected KVA	Expected % KVA	Actual % load	Total losses
Transformer1	1.3	12	265.056	494	33	17.671	1.675
Transformer2	1.3	12	199.110	494	33	13.281	1.512
Total Losses							3.187

supply voltage, voltage fluctuation are the main cause of energy wastage in motors. Electricity use and load in motor can be reduced by improving the efficiency of motor s and motor driving system.

The different conservation measures are

Power factor improvement

Low power factor is highly undesirable as it causes an increasing in current, resulting in addition losses of active power in all the of power system. For the rating of the motor if power factor is improved, the load current can be reduced, thereby reducing the losses.

Replacement of less efficient motors

Efficiency curve for high efficiency motors is usually flatter, so that motor car be operated at lower loads without appreciably increasing the losses in the motor.

Installation of soft starter for highly loaded motors

This results in improvement in power factor and efficiency and reduction in power consumption in motor. it is used for high starting torque applications

Energy Efficient Motors

- Energy efficient motor is best suited for new projects
- When old motor is rewound for more than five times, it can replaced by an energy efficient motor

Lighting system

An efficient lighting system is one, which provides illumination of sufficient quantity and quality for the task being performed at the lowest cost. This depends upon the elements constituting the lighting system i.e. lamps, ballasts, fixtures – lamp holders, starters. From economic point of view our focus should be at lamp life and its performance. Using latest technologies like LED's instead of incandescent lamps, Proper illumination with less number of light sources etc helps to reduce lighting consumption.

Transformers

Two transformers each of 1500KVA are used in parallel, In case of a failure in any of the transformer, other works alone and this alone suits for the running of company while the other transformer can be corrected in parallel.

While the shifting of loads between transformers losses occurs and this causes a loss of huge amount to the industry.

Conclusion

A famous quote "Energy saved is Energy generated", shows that apart from increasing the generation capacity at higher cost, one must go for the energy audit to save the electricity at much lower cost. Because the demand for electricity is continuously growing and it is putting stress on the power utilities to increase the capacity to meet the load demand. With this aim the authors have undertaken a case study of an industrial unit because industries are the major power consumers. The data provided in this paper after a deep analysis based on collected and measured data ,shows that how we can save electric energy by incorporating some changes in the installation and making it energy efficient. The government should make it mandatory for every industrial house in the country for energy audit.

Suggestions

Suggestions based upon the analysis that we carried out in the industry are as follows

- The faulty capacitor banks have to be replaced and other banks need to be tuned well. As he Capacitor banks give out waste power, and since they are continuously used, the magnitude is quite high. This waste power damages the dielectric of the capacitor and further deteriorates it.
- Use of NCES or Hybrid systems to provide power to a part of the load to save on electricity bills and also the environment.
- LED lamps should be used for lighting to reduce consumption.
- Proper Training to Employees should be given to make judicious use of power.
- Temperature of the compressor room has to be reduced for optimum performance.
- Minimize maximum demand by tripping loads through a demand controller.
- Properly size the motors to the load for optimum efficiency. High efficiency motors offer of 4 - 5% higher efficiency than standard motors.
- Operate pumping near best efficiency point & modify pumping to minimize throttling.
- Use variable-speed drives for large variable loads.
- Change the Compressor Oil Filter regularly.

- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Insulate exhaust pipes to reduce DG set room temperatures.
- Master Switch - Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.
- Corridors and toilets have large potential of saving energy by use of automation tools.
- Motion sensors can be used there to automatically switch on the light when there is any movement and switch off the light when there is no movement. This can greatly reduce the total load in corridors and toilets.
- Window AC should be replaced with Split AC in view of proper ventilation to fan for heat exchange.

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