

Energy Saving Opportunity of Lighting System by Energy Audit

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Abstract

Energy saving is the key to a systematic approach for decision making in the area of Energy management. it attempts to balance the total energy inputs, with its use and serve to identify all the energy streams in a facility. Energy audit is been carried out in M/S STI Sanoh India Ltd. is keen to reduce energy cost and hence conduct of this energy audit exercise. in this paper energy audit is done on lighting system& recommendation regarding the implementation & payback period is also given. Two alternate approaches for the cost reduction on current fitting are given here on energy system.

This paper presents a physically based model and formulation for industrial load management. Lighting is an essential service in all the industries. The power consumption by the industrial lighting varies between 2 to 10% of the total power depending on the type of industry. Innovation and continuous improvement in the field of lighting, has given rise to tremendous energy saving opportunities in this area. Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy efficient lamps, luminaries and gears, apart from good operational practices. it provides nearly to indicate some of the options that energy auditor can consider when performing an analysis of an industry.

Keywords: Energy Audit, lighting, Energy Saving .

Introduction

The main focus of an energy audit for the industrial is to find out energy savings opportunities that would reduce their early operating costs Savings such as energy cost and power factor incentives may be identified during the audit process. Critics of energy audit. recommendations often say that auditors overestimate the savings potential available to the customer. This possibility of overestimation concerns utilities who do not want to pay incentives for demand-side management programs if the facilities will not realize the expected results in energy or demand savings. Overestimates also make clients unhappy when their energy bills do not decrease as much as promised. The problem multiplies when a shared savings program is undertaken by the facility and an Energy Service Company. One of these approaches is to collect data on the energy using equipment in an industrial or manufacturing facility and then to perform both an energy and a demand balance to help insure that we have reasonable estimates of energy uses - and therefore, energy savings - of this equipment. In addition, few methods and approaches are given to deal with these potential problems.[1]

Energy Audit

An energy audit is an inspection, survey and analysis of energy flow for energy conservation in an industry, process to reduce the amount of energy input into the system without negatively affecting the output. Energy audit is a testing and analysis of how the enterprises and other organizations use energy. According to national energy conservation laws and regulations for energy consumption, investigation and energy audit management.[2]

Audit activities in general order include:

- Identification of all energy systems
- Evaluation of conditions of the systems
- Analysis of impact of improvement to those systems.
- Preparation of energy audit report

The analysis which includes the economic analysis is done after the audit work using all the data gathered. Studies and researchers have shown that energy auditing and conservation can save India Rs.1800 crore per year as there is a big potential for saving energy in industrial sector. In terms of electricity, these saving are equivalent to installation of 5250MW [3]

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 programmes 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. There can be two types of energy audit.

- Preliminary audit (walk-through audit)
- Detailed audit (diagnostic audit).

a) Preliminary audit (Walk-through audit)

In a preliminary energy audit, readily-available data are mostly used for a simple analysis of energy use and performance of the plant. This type of audit does not require a lot of measurement and data collection. These audits take a relatively short time and the results are more general, providing common opportunities for energy efficiency. The economic analysis is typically limited to calculation of the simple payback period, or the time required paying back the initial capital investment through realized energy savings.

(b) Detailed audit (Diagnostic audit)

For detailed (or diagnostic) energy audits, more detailed data and information are required. Measurements and a data inventory are usually conducted and different energy systems (pump, fan, compressed air, steam, process heating, etc.) are assessed in detail. Hence, the time required for this type of audit is longer than that of preliminary audits. The results of these audits are more comprehensive and useful since they give a more accurate picture of the energy performance of the plant and more specific recommendation for improvements. The economic analysis conducted for the efficiency measures recommended typically go beyond 3 the simple payback period and usually include the calculation of an internal rate of return (IRR), net present value (NPV), and often also life cycle cost (LCC).[4]

Lighting

An energy-efficient lighting system is one in which there required amount of light illuminates the subject at the proper level and color with the minimum amount of energy. A lighting system consists of more than just a lamp and a fixture above a working station. A well-designed lighting system considers the use of natural light, the proper direction and or dispersion of light from the fixture, the effect of reflections off various surfaces, flexibility, cleaning, switch ability, dimming, ambient versus task light, etc. In other words, there is more to light efficiency than lumens of light output per watt of input .The number of reasonable options is a function of whether alighting system is being designed for a new building, an existing building, or a renovation project. The engineer should consider only those options that can reasonably be achieved within the restrictions of his budget, the plant's physical characteristics, and other influencing factors such as the effect on production and employee attitude. Common lighting systems can be grouped into four different categories: incandescent, fluorescent, high-intensity discharge(HID), and low-pressure sodium. All of the sources excepting and ascent require ballasts. All of the aforementioned light sources are capable of providing an efficient lighting system in different situations. [5]

Methodology

This work for M/S STI Sanoh India Ltd.Dewas plant, presents the analysis of the data collected, observations made and field trials undertaken on lighting system for energy saving and reducing bill by carried out two approaches. which is shown by table 1 & table 2

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

Industry-to-industry, the methodology of Energy audits needs to be flexible. Following steps are adopted methodology for detailed energy audit.

Step 1 : In this step study of process and energy uses are taken from employees, this understanding helps in planning the resources available and time required for conducting energy audit.

Step 2 : In this step importance of energy uses are discussed with the section officers so that awareness could be build this will also help in future cooperation. (Kick off meeting)

Step 3 : In this step collect the plant data and electric bill find out the more energy uses of area, which are using and work properly for different process and collect name plate review and some data use with the help of measurement device.

Step 4 : In this step measurement are taken with the help of portable instrument such as lux meter, tachometer, power analyzer etc. The energy is mainly being use in pumping and other process for purification of water. This data is compare with operating design data and baseline energy use is determined.

Step 5 : In this step calculation of all performance data(standard parameters) involve in the process is prepared and present performance data is compared with baseline data(design). Based on technology availability and compression, recommendations are proposed to save /conserve energy. These recommendations are as investment grade (payback period). Reduction in energy consumption will take place after implement of recommendation.

Step 6 : In this step flow up the methodology & technical advice on the plant than rapid will be concur best result.

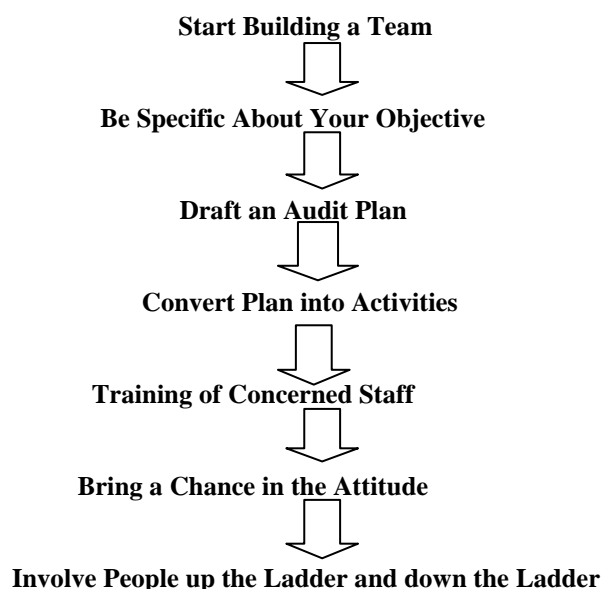


Fig. :1 Process diagram

Energy Saving On Lighting Systems

Lighting energy consumption of the whole factory is limited to the 17 00 of the total electrical energy consumption. During the factory audit several places are identified as the places where the savings are easily guaranteed. A count on lighting is needed to be done, after identifying the proper locations. As a rule of thumb, the followings are the common methods of energy saving on the lighting systems.[4]

- Halogens (spot lights) are replaced with infra read
- Coating halogens.
- Incandescent lamps are replaced with compact
- Fluorescent lamps (CFL).
- Halogens (flood type) are replaced with metal halides.
- Replacement of the magnetic ballast from electronic Ballast.

Reporting on energy conservation

- Switch off lights when absent from your work area for more than 30 minutes including in bathrooms, meeting rooms, lecture theatres and corridors.
- Maximize the use of natural light and turn on lights only when there is inadequate lighting.
- Promote CFL, LED lamps instead of incandescent bulbs.
- Promote electronic chokes for florescent lamps instead of EMT chokes.

The plant operates in night shift as well and thus consumes lighting in production areas, security lighting, admin, yard, etc for which the total lighting load during normal plant operating condition at night was measured and company is having day time lighting load of 27 kW. Night time load is marginally higher at around 32 kW. The lighting load profile is presented below:

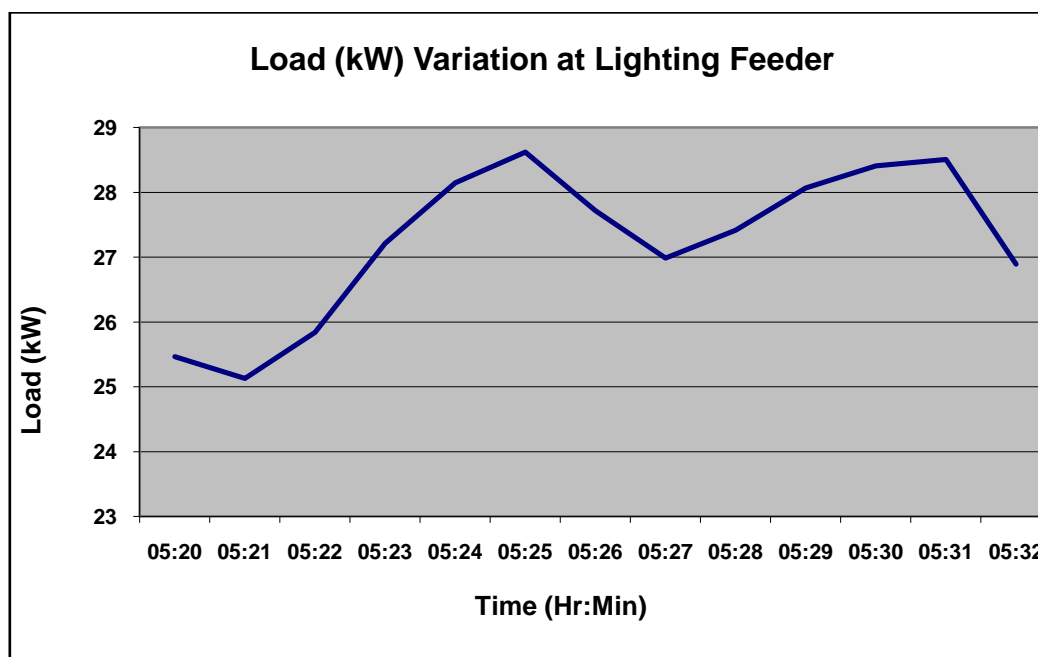


Fig. 2: load (KW) variation at lighting feeder

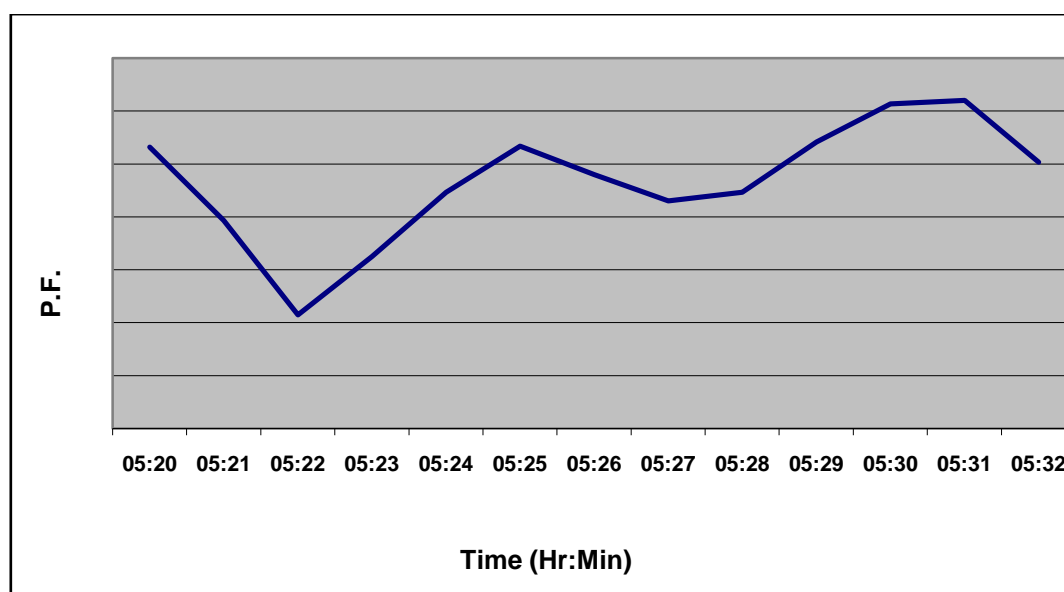


Fig. 3: PF variation on lighting feeder

- The lighting loads across the plants are not always powered through dedicated lighting transformers and these transformers often contain other mixed loads. Hence any opportunity for voltage reduction in lighting systems cannot be affected, as it would hamper the operation of the other loads. It is proposed to segregate other single phase loads from the lighting DB and install voltage chopper device / lighting energy savers at the main lighting feeder to reduce supply voltage and thereby lighting power consumption without affecting lux levels appreciably. This gives an opportunity to reduce the supply voltage from present 240 Volts to 220 Volts, which will give approximately 15 - 17 % power saving in lighting. The monetary savings for this is Rs. 3.7 lakh annually, with an investment of Rs. 3 lakh giving a simple payback of 10 months. Table below gives the savings working.

Table 1: Estimated Cost Savings by installing voltage chopper at LDB

Sr. no.	Particulars	Value
1.	Average lighting load of plant (P_1) - in kW	40
2.	Present average voltage at the mains (V_1)	420
3.	Equivalent Voltage at Single phase (V)	242
4.	Proposed Operating Voltage at lighting energy saver (V_2)	380
5.	Equivalent Voltage at Single phase (V)	219
6.	Power relation ($P=V^2/R$)	
	$P_2/P_1 = (V_2/V_1)^2$	
	Revised consumption at lower Voltage, P_2 (in kW)	33
7.	Power Saving (in kW)	7
8.	Annual Operating hrs (24 x 350 days)	8400
9.	Total saving potential, kWh	60952
10.	Per Unit Charge (Rs./kWh), excluding demand charges	6
11.	Annual Monetary Savings (Rs. Lakhs)	3.66
12.	Cost of installing Lighting Energy saver MLDB, Rs Lakhs	3
13	Estimated simple payback period (in months)	10

BELOW TABLE: 2

If the reduced I^2R losses, reduced maintenance cost of Igniters, capacitors, chokes, lamps & reduced heat load, reduced cost of man hours etc. are considered then the payback will be further reduced down.

Table 2: Component Specifications

Parameters	Existing fitting	Option I	Option II
	250 W HPMV Overhead fittings	EELS 436 SL (TG) (Economical)	EELS 336 SL (TG) (Economical)
No of fittings*	35	35	35
Wattage (Including choke losses)*	280	144	108
Current per fitting (Amp) *	1.5	0.6	0.6
Total current (Amp)	52.5	21	21
Power factor *	0.8	0.95	0.95
VA per fitting	350	152	114
Total KVA	12.25	5.3	4.0
Working Hrs *	14	14	14
Working days *	28	28	28
Consumption / month (Units)	3842	1976	1482
Electricity Tariff *	6	6	6
Electricity bill / month	23050	11854	8891
Net saving per month		11196	14159
Price per fitting *		5,700	4,900
Total Investment		199500	171500
Return on Investment (In months)		18	12

CONCLUSION

From the data which has been obtained from the auditing can conclude that a reduction in the supply voltage from present 240 Volts to 220 Volts, which will give approximately 15 - 17 % power saving in lighting. The monitory savings for this is **Rs. 3.7 lakh** annually, with an investment of Rs. 3 lakh giving a simple payback of 10 months.& also the investment of two approaches of energy audit on lighting system are given is Rs 199500 & Rs 171500 with a payback period is 18 & 12 months .

The approaches can be useful for an industry in combating essential energy cost and also raps several other benefits like improved production, better quality, higher profit and most important satisfaction of heading towards contributing in world energy saving.

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