International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

RESEARCH ARTICLE OPEN ACCESS

Implementation of Energy Auditing and Energy Conservation Techniques in Thermal Generating Stations

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Abstract:
This paper presents the techniques for electrical energy conservation in electrical motors and lighting system. In this paper an algorithm is formulated to check whether the existing standard electrical motors can be replaced by lower rated standard motors and lower rated energy efficient motors and there by calculating the energy savings in kw, kwh per year, rupees per year and pay back period. In this paper an algorithm is formulated to check whether the existing fluorescent lamp can be replaced by lower rated fluorescent lamp and there by calculating the energy savings in kw, kwh per year, rupees per year and pay back period

Keywords:- Energy audit, energy conservation, energy efficient motor (EEM), standard motor (SM),fluorescent lamp.

I. INTRODUCTION

Energy is present in nature in various forms. It is used by mankind in several forms for various purposes such as lighting, heating, cooking, manufacturing, transportation and so on. Energy is used in different spheres of activities by mankind such as domestic, industrial, agricultural, commercial and transportation.

Due to increase in population of the world and increase in standard of living of human beings, the energy crisis is increasing. The rapid increase in the energy consumption is causing fear because the energy sources are limited. India has poor resources of fossil fuels compared to U.K and U.S.A. In view of limited nature of conventional energy sources, it becomes imperative to take suitable measures for avoiding impending energy crisis.

II. ENERGY CONSERVATION

Energy conservation is the wise and efficient usage of energy in order to ensure that for a given amount of energy maximum activities, production work and profitability are achieved. Energy conservation is thus slightly different from the word 'saving' which may in a strict sense mean avoiding and spending or consumption of, suppression of demand, while the word conservation denotes efficient, economical and careful usage of energy.

The availability of conventional sources of energy i.e., coal, oil and gas are rapidly dwindling. The cost of imports is very high and steeply increasing. It has been established that the gap between our future demand and supply of energy is growing.The availability of our own resources of conventional energy against our present demands will cope up our resources at the present use.

III. ENERGY AUDIT

Energy audit may be defined as an audit which serves the purpose of identifying where a building or plant facility uses energy and identifies energy conservation opportunities. Energy audit is the key to a systematic approach for decision-making in the area of energy management. It balances the total energy inputs with its usuage and serves to identify all the energy streams in a facility.

An energy audit identifies the costs of energy where and how it is used. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management programs. The basic functions of management like planning, decision-making, organizing and controlling apply equally as any other management subject. These functions can be performed based on reliable information, which can be made available to the top management by applying energy auditing techniques.

IV. ENERGY CONSERVATION IN ELECTRICAL MOTORS

In industrial sector, more than 75% of energy is utilized by electrical motors [2]. Moreover, because of impending energy crisis and rapidly increasing population and substantially increasing energy costs, conservation of electrical energy is very important.

The values of efficiency used in calculations are taken from the efficiency versus load characteristics for standard motors and energy efficient motors. [1]

For any percentage of load the efficiency of energy efficient motor is more than efficiency of standard motor. The algorithm formulated for energy conservation in electrical motors consists of four steps.

Step 1: Check whether the existing standard electrical motor is over rated or not.
If yes, then determine by what lower rated standard electrical motor the existing over rated standard electrical motor can be replaced with.
If no,then goto step4.

Step 2: Calculate the energy savings in kw, kwh per year, rupees per year and payback period obtained by replacing the existing over rated standard electrical motor with lower rated standard electrical motor.

Step 3: Calculate the energy savings obtained in rupees per year and pay back period by replacing the existing over rated standard electrical motor with lower rated energy efficient motor.

Step 4: End.

To implement energy conservation in electrical motors, a Boiler Feedwater Pump Motor (BFP motor) in a thermal generating Station is considered. The purpose of BFP motor is to pump feed water to the boiler. For the selected BFP motor, rated kw=4200 kw.

Step 1: To Check whether the existing standard electrical motor is over rated or not.

For BFP motor, rated kw=4200kw and rated current = 425A.
Measured values are,
Actual Voltage = 6.6KV
Actual Current = 320A
Power factor = 0.864
Input to motor = $\sqrt{3}$ VI cosø

= $\sqrt{3}$X6.6 X 320X 0.864
= 3160.59kw

$$\text{Percentage of loading} = \frac{\text{Actual Current}}{\text{Rated Current}}$$

$$= \frac{320}{425}$$

= 75.3%

Percentage efficiency at 75.3% loading = 88.37%
Out put of motor = Input X efficiency

= 3160.59 X0.8837

= 2793.01kw
With 110% safety margin,
Out put of motor = 1.1 X 2793.01
= 3072.31kw

Recommended motor capacity = 3100kw

Hence existing 4200kw standard electrical motor is over rated and can be replaced by 3100kw lower rated standard electrical motor.

Step 2: To calculate the energy savings in kw, kwh per year, rupees per year and payback period obtained by replacing the existing over rated standard electrical motor with lower rated standard electrical motor.

Energy savings in KW $= \frac{3100}{\eta} - \frac{3100}{\eta FL}$

$$= \frac{3100}{0.8837} - \frac{3100}{0.892}$$

= 32.64 kw

Energy savings in kwh per year= Energy savings in kw X number of working hours per year

= 32.64 X 8760

= 285926.4 kwh per year

Energy savings in rupees per year = Energy savings in kw . X cost of energy per unit

= 285926.4 X 4

= Rs. 11,43,705.6 per year

Cost of 3100kw standard motor = Rs. 45,00,000/-

Payback period =

$$\frac{Costofmotor}{Energysavinginrupeesperyear}$$

$$= \frac{45,00,000}{11,43,705.6}$$

= 3.93years.

Step 3: To calculate the energy savings obtained in rupees per year and pay back period by replacing the existing over rated standard electrical motor with lower rated energy efficient motor.

Energy savings obtained by selecting lower rated energy efficient motors in rupees per year [1]

=Recommended motor output $X\left(\frac{1}{\eta_s}-\frac{1}{\eta_e}\right)$

X Number of working hours per year

X Cost of energy per unit

$$= 3100\,x\left(\frac{1}{0.892}-\frac{1}{0.935}\right)x8760\,x4$$

= Rs. 56,10,383.7 per year

Cost of 3100kw energy efficient motor = Rs. 56,25,000/- (25% more than SM)

Pay back period =

$$\frac{Costofmotor}{Energysavinginrupeesperyear}$$

$$= \frac{56,25,000}{56,10,383.7}$$

= 1.004 years.

V. TEST RESULTS

Type of Motor	Savings in			Pay back Period
	kw	kwh per year	Rupees per year	
Standard Motor	32.64	285926.4	11,43,705.6	3.93years
Energy Efficient Motor	_	_	56,10,383.7	1.004 years

VI. ENERGY CONSERVATION IN LIGHTING

In India, lighting consumes about 17% of total electrical energy [2]. In the industrial sector, lighting system adopted and its periodic maintenance has a profound impact on energy consumed. Good lighting practice results in savings of electrical energy. Poor and improper lighting not only affects the performance of workers but is also a health hazard. Lack of maintenance contributes to inadequate illumination. Therefore proper standards of lighting is essential for safety, comfort and productivity. The cost opportunities are to be identified while maintaining the standard levels in the system.

The algorithm formulated for energy conservation in lighting system consists of the following step.

Step 1:Since 40w fluorescent lamp and 36w fluorescent lamp has nearly same luminous efficacy [2],energy savings obtained in kw, kwh per year, rupees per year and payback period by replacing 40w fluorescent lamp with 36w fluorescent lamp are calculated.

Therefore, Energy savings due to each lamp in watts = 4w

Energy savings in kwh per year = Number of Lamps
X Number of working hours per year
X energy savings in watts
= 250 X 8760 X 4

= 8760kwh/year.

Energy savings in rupees.per year = Energy savings in kwh per year
X cost of energy per unit
= 8760 X 4
= Rs.35,040
per year cost of 250 lamps = cost of 1 lamp X 250
= 48 X 250
= Rs.12,000
Payback period =

$$\frac{Costofflourescentlamp}{Energysavinginrupeesperyear}$$

$$= \frac{12000}{35040}$$

= 0.339 yrs.

VII. CONCLUSIONS

A. Savings in electrical motors:

It is found that the motor is oversized. Standard motors working on partial loads results in wastage of electrical energy predominantly in the form of losses. Energy savings can be obtained by replacing over rated motors. The energy savings obtained in kw, kwh per year, rupees per year are more when existing over rated standard electrical motor is replaced with lower rated energy efficient motor than with lower rated standard electrical motor. The pay back period obtained by replacing existing over rated standard electrical motor with lower rated energy efficient motor is less when compared with the pay back period obtained by replacing existing over rated standard electrical motor with lower rated standard electrical motor.

B. Savings in lighting systems:

Significant energy savings are obtained by replacing 40w fluorescent lamps with 36w fluorescent lamps.

REFERENCES

[1] John C.Andreas, Energy Efficient Electrical Motors, Marcel Dekker, Inc; 1982.
[2] Energy Management Hand Book –Ed. By Wayne C. Tumer, John Wiley and Sons, 1982.
[3] Energy management, Murphy W.R. And Mckay G.Butterworths, London, 1982.
[4] E.L.Wakill, Power Plant Technology, Mc Graw Hill Company.
[5] H.R.Kapoor, Thermal Engineering, Tata Mc Graw Hill Company, 1988.
[6] M.P.M Murgai Ramachandram, Boiler Operations, Weiley, Eastern Ltd., 1990.
[7] Albert Thumann, Hand Book of energy audits, The Fairmount Press Inc., Atlanta Georgia, 1979.
[8] C.P.Kothandaraman & S.Subramanyam, Heat and Mass Transfer Data Book, Wiley Eastern Ltd., 1989.
[9] Energy Conservation Booklets.
[10] Energy Handbook after Smith, 1978.
[11] Energy Audits., E.E.C. – Booklets, U.K., 1988.