Energy conservation in commercial hostel engineering essay

Electrical energy is the most expensive and the most important form of purchased energy. The subject of energy conservation is a concern for most energy users particularly industries, commercial buildings and residential buildings. Energy Conservation becomes even more important for the developing countries, where the rising energy costs and the use of efficient energy apparatus are of significant concern to the utility. Today, energy and environment are two areas that have sought the greatest attention at the international level. With the issue of global environment, becoming important as never before, Energy particularly its conservation in industry and commercial building has become main target for all the parts of world that has to be achieved as soon as possible. In this paper, the application of the Energy conservation techniques by which electrical energy can be saved and made cost efficient for commercial (hostel) building perspective is presented. The selection of a commercial (hostel) building was done because electrical energy constitutes only a major amount of the overall energy used. A complete energy conservation guideline is recommended. Electrical energy management approach for tariff control, power factor control, motor schedule control and lighting is outlined. Recorder data of energy consumption of a building service system are used to diagnose the weak points of the building energy usage system and then a detailed energy audit study are presented.

Key Words: Energy audit, Energy Conservation, tariff control, motor scheduling

1. INTRODUCTION

Electrical energy is the most common and widely used type of energy in the world. It is the most expensive and most important form of purchased energy. For this reason its use must be confined to a minimum for efficient operation. Because of its great flexibility, it offers many advantages over other energy and by doing the efforts to conserve energy can result in significant cost saving. In India, Commercial buildings use large amount of energy that is why, it is important to ensure a loss free and energy efficient system in buildings. In the developing countries where electrical energy resources are scarce and production of electricity is very costly, energy conservation study are of great importance. India is an important stage of rapid development and it has relatively shortage of energy resources. The gap between the power generation and required demand is increasing continuously. Reducing the gap in the generation side is very difficult and more expensive process. The cost of electrical energy will be increased due to the installation of new generating plant because of limited energy resources, scarcity of capital and high interest costs. The important way to reduce the gap between demand and supply is energy conservation.

Energy conservation is necessary to reduce the increasing global warming. Individuals and organizations should conserve energy in order to decrease the energy costs and increase the economic security.

The following two objectives are considered when discussing electrical energy conservation:

Energy saving i. e. kWh saving

Energy cost saving i. e. money saving

2. LITERTURE REVIEWS

Frank kreith, D. Yogi Goswami (2008), have declared that energy is the important factor for production, along with labour, capital, and materials. Energy conservation denotes doing without, maybe giving up facilities to save energy. Due to products diversity and the manufacturing process requirement, the efficient utilization of energy varies with specific industrial operations. The organization of personnel and operations, concerned also varied. Consequently, each company should modify the effective energy management program for its plant operations.

There are some universal guidelines, however, for initiating and implementing an energy management program. Many of the large companies have already used energy management programs and also they have realized substantial savings in fuel and electric costs. But in small industries, due to lacking of technical persons and equipment to implement the energy management program is difficult. In these environments, reliance on external consultants may be appropriate to initiate the program. But for successful operation internal is very essential. A well planned, organized, and executed energy

Management program requires a strong commitment by top management [8].

Wood. G, Newborough. M (2007), have proposed that the suggestion for motivating energy saving behaviors [9].

Dimoudi. A, Kostarela. P (2009), have shown the energy consumption of Institutional buildings, due to their high number in the country, contribute to a considerable overall amount of energy consumption in public buildings that results in an increase of the expenses paid by the national budget. Thus, investigation of alternative solutions for the reduction of energy consumption in Institutional buildings is advisable and necessary. On the other hand, the pedagogic role of Institutional buildings needs the proper regulation of the parameters that influence the internal conditions in classes, as lack of thermal comfort and air quality conditions reduce the learning ability of pupils.

Thus, an energy proficient strategy in school buildings has a dual purpose: energy conservation and enhanced indoor conditions in classrooms. Air quality studies performed at institutional buildings revealed that many of them have serious indoor air quality problems, while improvement of indoor

Conditions are associated with considerable reduction in energy consumption and a global environmental quality. Improvement in thermal insulation decreases energy consumption, with the

Case of insulation at the support frame having the highest benefits, resulting a reduction in energy consumption by 13. 34%. Increase in the thickness of the wall insulation decreases the heating requirements and thus, reduces energy consumption up to 5. 58%, a solution that is recommended for

new and old no insulated buildings [10] .

Guozhong Zheng, Y Ouyin Jing, Hongxia Huang, Guohua Shi, Xutao Zhang (2010), have shown that globally one-third of energy consumption is consumed by building sector. In energy conservation assessment, energy conservation star rating is established and used in the assessment. The objective of building conservation assessment is to establish and limit the maximum energy consumption in buildings and to encourage the utilization of renewable energy and new energy

technologies and products [11].

3. ENERGY AUDIT & CONSERVATION

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 ".

Energy Audit will help us to identifying the areas where energy wastage can occur and where scopes for improvement exist.

To test electrical systems and identify conservation

opportunities, the following steps must be carried out:

Form Energy Survey team

Carry out Preliminary Energy Survey

Carry out Detailed Energy Survey

The energy survey is the first step in collecting all the relevant data and after which the conservation techniques are to be applied. Data must be obtained for each type of energy used. Also the actual measurements of the various energy devices such as motors, lighting system and ceiling fan etc should be included as part of the energy survey. The energy survey team has the task to explore the potential areas of energy conservation based on the findings of the survey. This could involve energy management with motors, lighting system, tariff control and power factor management, the use of energy efficient devices, the possibility of cogeneration and the use of technical awareness and motivation programs for the industry personnel.

How best to manage our energy consumption?

We have four steps to manage best energy consumption in any organisation. These are listed as follows:

Metering your energy consumption and collecting data

Finding opportunities to save energy, and estimating how much energy each opportunity could save

Tacking action to target the opportunities to save energy (i. e. tackling the routine waste and replacing or upgrading the inefficient equipment). Typically you’d start with the best first

Tracking your progress by analyzing your meter data to see how well your energy saving effort work

The above four step process applies either way, it’s entirely up to you whether you consider you consider energy saving measures that involves buying new equipment or upgrading building fabric.

In energy audit process we need to collect statistical data and finding the opportunities to save energy. But just finding the opportunities to save energy won’t help us to save energy. We have to take action to target them.

3. ELECTRICAL ENERGY CONSERVATION FOR A HOSTEL BUILDING

Background: In India, there are many institutes which have the hostel facilities. My institute is one of the best institutes in Haryana state. It has 10 hostels.

In this paper energy conservation of one hostel is presented. By similar manner we do energy conservation of other hostel. This hostel was open for student use in 2002.

4. ANALYSIS AND METHODLOGY

The objective here is to study and analyze the use of

Electrical energy in the hostel building so as to;

Determine the energy inputs to the various stages in the process carried out in the industry, thereby arriving at the energy content of the major products, and in particular identifying the process stages for which the largest amount of energy are needed.

Decide where the most significant energy savings are possible, quantifying such savings and the cost of achieving them.

Assist the industry administration in making

recommendations on energy savings and in

its policy and plans for energy conservation.

A: Reduce fixed charges in Electricity Bill.

To analyze the utility electricity bill, the tariff structure was studied. The tariff structure in Haryana state consists of the following charges:

Energy (kWh) charges (varies as consumption increases)

Fixed charges depend upon maximum demand

Fuel adjustment charges (consumption dependant)

B: REPLACE INEFFICIENT MOTORS WITH ENERGY EFFICIENT MOTOR AND CHANGE OPERATION SCHEDULE

The average operating efficiency of the motor was very low and thus need to replace them with the energy efficient motors could improve energy savings significantly.

The energy cost savings by replacing an old motor with an energy efficient motor is given by the following formula

S = P*L*C*T (100B – 100/A)

Where S = Annual savings ($/year)

P = kW rating of motor B (old inefficient) = 15 kW

C = Average Electricity cost ($/kWh)

L = load factor (avg) =. 80

T = running time (hour year)

A = Efficiency of motor A (New EEM)

B = Efficiency of motor B (Old inefficient)

The efficiency of old motor was 75% and efficiency of new motor is 90%. The motor operate in a day is 7-8 hr. Then total operating period in a year is 2800hr.

Total cost saving: Using above formula, the total cost saving is R 26133. 33

Total investment cost: The total price of new Energy Efficient motors of the rating given above was to be found to be R 24000. The payback period and return on investment is 11. 02 month.

Operating schedule suggestion: Motor operate mostly in peak period so operation cost is high. We need to operate in off period it reduce the operation cost.

C: Change lighting system.

The existing lighting scheme at the hostel building was studied carefully and measurements were taken for each light levels and fixture ratings. A new

scheme with consideration to maintain or enhance the existing lighting levels and reduce the kW rating was presented. The existing system of incandescent and mercury lighting was found to be consuming extra energy at the expense of lighting level. It was suggested to increase the light level while at the same time reduce the overall energy consumption.

Existing

system

Proposed

system

Saving in

kWh

Incandescent

300 fixtures

100 watt each

1100hr/year

Florescent

300 fixture

20 watt each

hr/year

Calculations:

Kilowatt saving:

This is calculated by the formula given by

= (No. of fixture) [(present input watts/fixture)-(proposed input watt/fixture)]

= watt/1000= KW

KWh saving:

This is calculated by the formula given by

= (KW saving)*(annual operating hour) = kWh/year

Power Factor Improvement

Findings: The average power factor of the hostel varies between 0. 85 and 0. 87 since its commencement, which was well above the requirement of the SEB. The average power factor of the industry was 0. 86 and the Maximum demand reached has been read as 260 KVA from the Load duration curve. The load level reached above the sanctioned demand of 260 KVA on certain short period of time was not considered for the power factor improvement project. So, at the average power factor, the load in KW was found to be 260* 0. 86= 223. 6 KW.

Recommendations: We decided to improve the power factor to an average value of 0. 98. The best locations for the capacitors were identified as

i) at the sub-station itself to compensate the base load and

ii) at the loads supply side as per the KW capacity,

So that only when the load is on, the capacitors will be on. Additional capacitors were required to improve the power factor to 0. 98.

Benefits: For a load of 223. 6 KW, the KVA demand at 0. 98 power factor is (223. 6/0. 98) = 228. 16

Therefore, saving in KVA is (260 -228. 16) = 31. 83

Annual saving in cost due to KVA reduction= $3. 75*31. 83*12= $1432. 65
Cost on additional capacitors @ $35 per KVAR is

$(30* 50) =$1500

Payback period (1500/1432. 65)* 12= 12. 56 say 13 months.

Return on investment 1/13= 7. 7% per month.

Saving Through Peak Shaving

As per the norms of the SEB, the maximum demand charges for any month at the point of supply shall be based on the highest KVA demand recorded during any consecutive thirty minutes in that month or 100% of the sanctioned demand, whichever is higher. In addition, for exceeding the sanctioned maximum demand, the charges per exceeded KVA shall be at double the normal rate (say penalty).

Findings: The Maximum Demand during the financial years 1995-1996, 1996-1997, 1997-1998 and 1998-1999 has exceeded the Sanctioned Demand in March and April, due to the early summer peak loads, and the production

target initiative at the beginning of the financial year. During the EC project period (1998-1999), the peak demand was found to be 2750 KVA. The industry did not want to apply for increased Sanctioned demand since for the rest of the period of 10 months, the load was well within the Sanctioned demand. It was noticed that the available Diesel generators were used only at the time of power-cut and at grid failure cases.

Recommendations: The EC team recommended for the use of one 900 KVA Generator at the time of peak loads during 1998-1999 and to transfer the excess loads to the generator supply so as to avoid the excess KVA penalty charges. If critical

loads also contribute to facility peaks, consider shifting these loads to generator power during peak periods. In case, if emergency backup power is needed, the remaining two Diesel Generators

shall be put in service even during peak periods. Note:

For the present project, the concept of Peak shaving was applied only for the loads exceeding the Sanctioned demand and not for all the loads above the base load.

Benefits: Considering the peak demand during March-April of the financial year 1998-1999, i. e., 2750 KVA exceeding the Sanctioned demand by 150 KVA for duration of 3 hours/day:

SEB Supply: Maximum demand charges payable to

SEB/month $3. 75 (2750 +2 *150) = $11 437. 5. Energy consumption charges/month for a load of 2750 KVA at 0. 92 power factor @ $0. 0875/kWh is $159 390. Total charges payable/month is $170827. 5.

Generator Supply for a Load of 150 KVA: Maximum Demand charges $3. 75* 2600= $9750. Energy consumption charges/month for the energy fed by SEB for a load of 2600 KVA at 0. 92 power factor @ $0. 0875 per kWh $150 696. Energy generated by the generator/month @ 3 hours/day for the peaking load of 150 KVA at 0. 92 power factor lagging 150*0. 92* 3* 30= 12420 kWh.

Considering the capital investment, life time, the load factor, the annual operation and maintenance cost, the labour cost, the depreciation and the diesel fuel cost, the average energy cost for the Diesel generator supply is worked out to be $0. 19/ kW-hr.

Therefore, energy cost for the generator supply is $0. 19*12420= $2359. 8 and hence total charges incurred/month for the peak shaving option is $162 805. 8. The EC team suggested the Board that more saving in energy cost could have been obtained through Renewable energy sources compared to the

Diesel generator supply due to reduced generation cost.

Net saving by peak shaving per month is $8021. 7 and $96 260. 4 for the whole year if peak shaving is applied for the entire 12 months @ 3 hours/day.

D: Explore cogeneration feasibility:

For the cocking purpose in hostel, we require fuel such as coal or LPG (liquid petroleum gas). If we use coal, it is more carbon intensive than oil or natural gas. It produce large amount of carbon dioxide. So, we uses natural gas i. e. LPG but it is more costly than coal. So, this problem we need to setup a goober gas plant in hostel. The input to the goober gas plant is human waste. The gas produce by the plant is used for cocking purpose. It reduces the fuel cost and carbon dioxide emission.

1) Intake tank

2) Mixture of dunk and water

3) Brick walls

4) Metal cover

5) Valve

6) Used sludge

7) Pipe to kitchen

8) Input pipe

9) Brick wall

10) Ground level

CONCLUSIONS

The analysis and calculation of electrical energy

conservation of the glass sheet industry for a developing country were carried out, even though the amount of the electrical energy used was low (1. 77%) compared to the gas energy (98. 23%) provided to the said industry, remarkable energy cost savings were demonstrated and is accounted for some 49. 23% of the total annual industry electricity cost.

Adapting and following the electrical energy conservation guidelines are recommended for a developing country glass industry. These recommendations if applied to any similar industry in other developing countries may also lead to very reasonable cost savings. Having listed all the different remedies which should be taken to have electrical energy conservation, the implementation and the application of these recommendations is very crucial in the glass industry of developing countries to reach the desired cost savings.

Focus should be directed to the demand side management, and the use advanced electronic programmable switching for achieving the desired savings. Gas heat energy is a potential savings even though its cost is less than fossil oils. A developing country which does not possess these raw materials may face higher energy prices in this sector.

Therefore, instead, a complete updating, maintenance and the use of energy efficient equipment may reduce energy costs.

The limited capital and investment become an obstacle for applying a comprehensive conservation plan in developing countries. Therefore partial solutions if followed may give pronounce energy cost savings. Generally, in a developing country, capital, raw material and the lack of advanced

Technology equipment is of a direct relationship to energy cost savings.