Energy Audit Case Study

Based on the energy consumption pattern of hospital buildings

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Abstract : This study has been undertaken to investigate the various aspects that affect the overall monthly electricity bill along with various trends observed throughout the year for the same. A detailed electricity bill analysis helped us understand various factors behind the overall monthly cost.

At the end of it we have suggested various methods and actions that can be adopted in order to cut down on the overall cost of electricity and hence help in energy savings, making the entire facility energy efficient.

IndexTerms **- Component,formatting,style,styling,insert.**

I. INTRODUCTION

An energy audit is a study of a plant or facility to determine how and where energy is used and to

identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exist provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency and the dissemination of these technologies and options. This energy audit of the Bharati Vidyapeeth Hospital,Katraj has been carried out and reported in this paper. We have compiled a list of possible actions to conserve and efficiently utilize our scarce resources and identified their savings potential.

II. BILL AND CONSUMPTION

The total Electricity bill for the year 2017-18 is Rs. 3,58,25,289. In order to manage the power requirements, there is an absolute necessity to save the energy consumption. In order to achieve the required savings in power the different steps need to be taken. The details of all the components and factors involved need to examine.

III. OBJECTIVE

The Energy Audit provides the vital information base for overall energy conservation program covering essentially energy utilization analysis and evaluation of energy conservation measures.These studies are carried out with the sole motive of energy and cost savings along with the study of future scope of expansion.

IV. METHODOLOGY

Guidelines indicating the methodology for such an energy audit is given below. Possible stages for interaction/conference are also indicated.

■ Phase-I

- Collections of data on operational parameters, energy consumption both normal and electrical, coal and power quality etc., through a questionnaire.
- Study the existing plant capacities and their performance to assess plant operations.
- Study of the specific energy consumption (both thermal and electrical) department-wise and plant as a whole.
- Study of the power sources, distribution system and drive controls, load factor and efficiency of large motors (above 10 kW), process automations, plant illuminations etc.
- Collection of requisite data and analysis and identification of specific areas with potential for conservation of thermal and electrical energy.
- Field measurements of operational parameters and carrying out heat and mass balance.
- Study of limitations, if any, in the optimal use of thermal and electrical energy.
- Formulation of specific recommendations along with broad system concept for conservation of thermal and electrical energy.
- Preparation of capital cost estimates and establishing techno-economic feasibility for recommended measures.
- No investment and/or marginal investment by doing system improvements and optimization of operations.
- Major investment due to incorporation of modern energy intensive equipment and upgradation of existing equipment.
- Formulating tentative time schedule for implementation of the recommendation.
- Undertaking broad cost benefit analysis in terms of savings in energy consumption per unit of production and pay-back period.

■ **Phase-II**

Follow-up with the industry on periodic basis to ascertain the level of implementation of recommendation and assist, if require, in implementation of the measures to achieve energy user efficiency.

Assistance required from Client Side:

- Nomination of one engineer as coordinator from your side and to provide the relevant data / record about equipment etc. (maximum available), during course of the Energy Audit. Any other requirement would be conveyed at site, as & when required.
- As and when required, our team of energy auditors will make visits in building / plant therefore arrangement of entry pass and gate pass for instruments carried by our team.

V.Major sources of Energy Consumption In Hospital

HVAC System In many large and centrally air-conditioned hospitals, HVAC systems consume 40% of total electricity consumption. Air Conditioning and Ventilation system in hospitals is required for: • Maintaining the requisite indoor temperature, air distribution and humidity levels for thermal comfort.
• Maintaining indoor air quality, particularly in areas requiring prevention of infection
Building envelope design plays a very important role in the determination of HVAC capacity in the hospital.

5.1 Lighting

Lighting is a major electricity consumer next only to HVAC systems. Requirement of lights in a hospital varies widely depending upon the activity, time of day and the occupancy level. The complexity can be well understood from the simple fact that National Building Code (NBC) 2005 recommends Illuminance level varying from one lux for night lighting in some areas to 750 lux in operation theatres for general requirements. At times special lights are used with illuminance of 10,000- 50,000 lux in operation theatres.

5.2 Water Pumps

Water is consumed in different sections of the hospitals for various requirements. In most hospitals, water pumping systems may account for 5-15% of total electricity consumption and offer scope for reducing energy consumption.
The range of electricity consumption for major end-users can be summarized as under:

- HVAC: 30-65%
- Lighting: 30-40%
- Water pumping: 10-12%
- Others: 5-15%

However, generally lighting and HVAC applications constitute about 75% of electricity consumption in a hospital.

5.3 Energy Saving Approaches

In each of the key end-use areas, there are three basic approaches to save energy (Carbon Trust, 2007).
• Switching off — All energy-consuming equipment should be switched off when not in use. This can be done manually by hospital staff or automatically with special devices.
• Maintenance — A number of energy efficiency measures can be carried out as part of routine maintenance procedures at no extra cost.
• Refurbishment — Energy saving measures can be extremely cost-effective when planning for refurbishment in the hospital.

5.4 Indoor Climate Requirement

All hospital buildings can be unique in design and size, and the different specialized services they provide. Their technical systems must be designed and adjusted to meet the facilities requirements and needs of indoor environment. Many countries have regulations that outline how these requirements are to be fulfilled, through proper design and operation of medical and technical facilities and the building itself.

5.5 Thermal Insulation

The thermal properties of the building envelope are very important, as a well air conditioned hospital often requires a temperature level of 21-22°C throughout the year, but is limited to a maximum of around 26°C during the warmer months. In several countries' regulations are usually in the form of mandatory maximum levels for U-values (coefficients of thermal transmittance) for the entire building envelope, including walls, foundations, roof and windows. In India, this is being currently attempted by Energy Conservation Building Code (May 2007) particularly for new buildings, having a connected electricity load of 500 kW or more or a contract demand of 600 kVA or more.

5.6 Ventilation

For hospitals, it is not always the heat generated that decides the ventilation and cooling/heating rates (as is normal for commercial buildings, such as offices), but the hygiene considerations. As indoor air is contaminated by occupants (some of them may be patients) and activities in the hospital, it must be renewed in order to eliminate contaminants, odours and pollutants. In many European Countries, room ventilation levels typically range from 35-140 m3 per person/hour depending on the function of the room (e.g. general or intensive-care). Operating theatres are usually among the rooms having the highest demands, with ventilation rates around 30-55 m3/square meter/hour. In India, National Building Code (2005) recommends 6-8 air changes per hour in hospital wards, and 15-25 air changes per hour in sterilizing departments of the hospitals.

5.7 Temperature

To maintain comfort levels for patients, a typical temperature for patients' rooms and recovery rooms is 24-26°C during summer months. This value could be maintained at 21-23°C during the colder part of the year.
When temperature discomfort is identified, it is usually more efficient to localize the sources of discomfort and treat these, rather than to increase or decrease the room temperature. This can be done, for example, by covering cold walls, erecting screens against cold drafts from windows, window frames and badly positioned air vents, and minimizing isolation by installing sunshades.

5.8 Indoor Air Humidity

Indoor air should neither be too dry (which causes dehydration) nor too humid (which causes perspiration and increases the risk of fungal growth). The comfort range covers, relative humidity of 45-55%, at temperatures of 24-26°C normally required in patients and recovery rooms. Strict hygrometric controls are often only applied in rooms where conditions are more critical, i.e. in operation theatres, intensive-care wards, etc.

VI. BILL ANALYSIS

6.1 ELECTRICAL PARAMETERS

1-) CONTRACT DEMAND

Contract Demand means the kW (or kVA) demand used to calculate the Demand Charge in each billing period. Contract Demand is always greater than or equal to the Maximum Demand.

2-) SANCTIONED LOAD

It means that you are allowed to use that much load which is sanctioned. You are charged 'fixed charges'/meter rent according to sanctioned load. If you exceed the sanctioned load then your service provider may impose some penalty on you.

3-) CONNECTED LOAD

It is the sum of all the loads connected in the circuit irrespective of the fact that whether it is being currently operated or not.

4-) SANCTIONED DEMAND

It means the load in kW/HP (kilo Watt/ Horse-Power) which the Licensee has agreed to supply from time to time subject to the governing terms and conditions.

5-) BILL DEMAND

The "demand" or "bill demand" term in your electricity bill is the peak electrical power in KW that you have demanded from the power grid during the billing period which is usually one month.

This term is there in your electricity bill because your bill amount is calculated like this:

Bill amount = (A x no. of units in KWH) + (B x maximum demand in KW)

where, A and B are your tariff rates.

This type of billing is called two-part tariff. It means that you are not only billed for the energy consumed but also for the maximum load that you put on the grid.

TARIFF - HT IX-B PUBLIC SERVICE

Applicability –

This tariff category is applicable for electricity supply at high voltage for
For educational institutions such as school and colleges: health care facilities such as hospitals, dispensaries, clinics, primary health care centres, diagnostic centres and pathology laboratories.

RATE SCHEDULES

Supply voltage level	(RS./kwh)
66kv and above	NIL
33kv	0.09
22kv or 11kv	0.83

Demand /fixed charge and energy charge (for all supply voltage levels)

Consumption slab (kwh)	Demand charge (Rs./kVA/month)	Energy charge (Rs./kWh)
All units	250	9.10
TOD Tariff(In addition to above base tariffs)	-	-
2200Hrs-0600Hrs	-	-1.50
600-900Hrs & 1200-1800Hrs	-	0.00
900-1200Hrs	-	0.80
1800-2200Hrs	-	1.10

6.2 ELECTRICITY BILL ANALYSIS

BILLING HISTORY

Bill Month	Units	Bill demand (KVA)	Bill Amount
JAN-18	268030	601	2787658
FEB-18	250750	634	2628250
MAR-18	311440	654	3216025
APR-18	318150	697	3338837
MAY-18	356490	770	3789716
JUN-18	324820	770	3515500
JUL-18	291470	628	2991368
AUG-18	298140	642	3106013
SEP-18	286560	629	3758379
OCT-18	322180	662	3526894
NOV-18	276180	579	3256897
DEC-18	280552	601	3289752

In the monthly electricity bill analysis containing monthly and average cost per unit has been observed that the total bill is high during the peak summer season due to additional cooling demand and excessive use of air conditioning and fans.
Unchecked use of water coolers also plays a major role in increasing the overall cost during the summer season.

VII. RECOMMENDATIONS AND SUGGESTIONS

7.1 Install Low-Energy Lighting

Upgrade lights to the most efficient suitable options. For example, at many locations in the hospitals, any 'standard' tungsten light bulbs can be upgraded directly to energy saving compact fluorescent lamps (CFLs) which use 75% less energy, produce less unwanted heat and last 8–10 times longer. Replace blackened, flickering, dim or failed fluorescent tubes with triphosphor coated ones. Triphosphor coating provides a more natural, brighter light for the whole life of the tube. If the tubes are 38mm (1.5 inch), replace them with slimmer 26mm (1 inch) tubes or T5, (5/8th of an inch) fluorescent lamps.

7.2 Occupancy Sensors

Occupancy sensors ensure lights only operate when there is somebody there to require them. These are especially useful in, for example, the following spaces:
• Intermittently used office areas
• Toilets and washroom facilities
• Storerooms
• Areas where lighting is zoned.

7.3 Turn off and Power Down

Where equipment is left on unnecessarily there are opportunities to make significant savings. Switch off all equipment when not in use and enable power-down modes. This reduces the energy consumption and heat produced by equipment, lowering cooling costs and improving staff and patient comfort. The lifespan of this equipment will also be extended, and the risk of breakdown reduced.

7.4 Raise Awareness Amongst Kitchen Staff

•Do not switch on too soon — most modern catering equipment reaches optimum temperature quickly. Label equipment with its preheat time and educate staff to switch on only when required
•Avoid using catering equipment to warm the kitchen space on staff arrival in winter months
• Switch off heating and cooking equipment immediately after use
• Avoid overfilling saucepans and kettles, and use lids where possible
• Keep fridge and freezer doors closed and defrost at manufacturers' recommended intervals to save energy and prolong equipment lifetime
• Switch off equipment, lights and exhaust fans when they are not being used.

7.5 Monitor with Sub-Meters

Sub-metering kitchen areas can provide an extra incentive for staff to be efficient, by showing how energy is used in this facility and how subsequent efforts have paid off. Catering in hospitals is at times outsourced so there is the additional benefit of allowing for budget allocation and charging to take place.

7.6 Undertake Regular Maintenance

Identify potential building envelope problems as part of routine maintenance and deal with them promptly. In particular, repair gaps or holes in walls, windows, doors and skylights immediately. Preventing the loss of heated or cooled air provides instant savings and also improves the appearance of a hospital. It is more comfortable for staff and patients too.

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