

ENERGY EFFICIENCY ENHANCEMENT OF A COMMERCIAL ESTABLISHMENT

By G.A.M.D.wickramathilaka, K.I.Yapa, T.J.E.Yasapalitha, T.Atapattu

Supervised by Prof.Priyantha.D.C.Wijayathunga

Overview

Aim of this project was to study about the techniques of enhancing the efficiency of a particular energy system and any other methods of reducing the energy cost of an establishment. Another objective was to develop software for the same purpose.

Galle-face hotel, Colombo was selected as our client owing to several reasons. We were encouraged to carry out the project by the Demand Side Management branch of Ceylon Electricity Board with their personnel and technical assistance. Ultimately we were able to come out with a plan of saving Rs. 2 Million per annum.

About the Project...

Galle-face Hotel is a construction of the 19th century. Therefore it still possesses an ancient look in appearance wise as well as technology wise. Importance of this ancient look was a barrier to make some new proposals regarding the replacement.

Although there is no proper power distribution system, we prepared a single line diagram for our ease as follows.

It is necessary to note here that a refurbishment project has been going on since the days we started the project.

Energy Audit

We were provided with the data loggers, current transformers, computers etc. by the DSM branch. Before connecting them to the relevant feeders, we talked to the engineering staff of the hotel and got a rough idea about the load centers of the hotel. Though there are some outgoing feeders from the main bus bar, they did not seem to be connected to the identified load centers. Hence we connected all the loggers at kitchen, laundry and chiller room instead of sub feeders at the main panel.

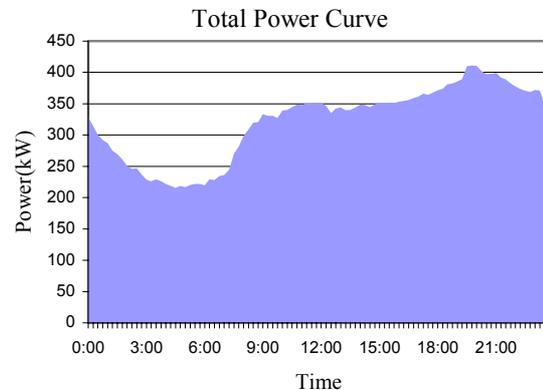
Lighting seemed to be a key component in the hotel load curve, which would influence the peak energy consumption as well as the maximum demand. Since there was no way to measure the lighting load separately we decided to count them section wise and got a rough curve for lighting load. Spot measurements were taken at lifts, pool water pumps, etc.

Analysis

The load curve of the hotel would be as follows.

Average monthly electricity cost (Rs.) = 2,229,339.53
Average annual electricity cost (Rs.) = 26,752,074.36

Proposals for energy cost reduction and proper energy management are discussed in detail in the following paragraphs.



These proposals are of different kinds such as tariff changes, Replacement of luminaries, Re-connection of capacitor banks, Amendment of working schedules etc.

Tariff

According to the customer classification of CEB, the hotel belongs to the Industrial, low-tension, bulk consumer category. Within that category they are free to choose one of the two tariff structures; time of day and flat rate. Present load curve is more appropriate for the flat rate tariff and therefore we suggest changing the existing tariff structure as our principal proposal. Major component of the expected saving is obtained from the above issue.

If the hotel does not like to change the tariff due to a plan of rehabilitating the consumption pattern they can run the two diesel generators in peak hours as a short-term solution. But we don't suggest that because the generators are designed for emergency operation and it is not advisable to put them in continuous operation in long term. Uncertainty of Diesel price also influenced us for not highlighting this as a major proposal.

Laundry

When compared with its size and nature laundry is responsible for a considerable portion of the total energy consumption. In a hotel most of the units are functioning in an uncontrollable manner and hence we cannot rigidly schedule activities in departments like kitchen and guest area. Laundry is a very important unit in this regard as we can adjust the working schedule of it in order to reduce the energy cost.

Therefore we suggest stopping all the work in laundry within peak hours (7pm-10pm). The laundry staff should be capable of managing the missed workload during the off-peak hours. If this proposal is implemented it would definitely bring down the maximum demand and hence the electricity bill. If we continue the same tariff structure it will reduce the energy cost as well due to the shifted load from peak to off-peak regions.

Coffee Shop

Barristar coffee shop is a newly constructed building that is beside the hotel but it is powered from the same line that comes to the main panel of the hotel power system. Coffee shop is constructed with the application of all new technologies and hence there is no opportunity for any replacement. But a simple mistake has been done when connecting the coffee shop feeder to the main line by neglecting the capacitor bank so that the capacitor bank itself corrects the power factor of the system excluding the coffee shop we can correct this by re-connecting the relevant feeder to the point of the main bus bar where other feeders are connected.

Chillers

Chillers are consuming considerable amount of energy from hotel energy consumption. Therefore reducing the energy cost of chillers by increasing its efficiency is identified as a crucial factor.

At present, hotels' AC system consists of two chillers which having two compressor units each. Air conditioning temperature is controlling by switching of compressor units. Here chilled water flow rate is not controlled according to the air conditioning load. Therefore we suggest the method of introducing variable speed drives (VSD) for chilled water pumps to controlled circulating chilled water flow rate.

Cooling towers installing series with the each chiller contain fixed speed fan units. But if the 1st proposal is introduced, then it is recommended to install variable speed drives (VSD) with fan units too.

Lighting

Area	Saving per day	Saving per annum
Guest Rooms	1,126.77	405,638.98
Rest. Gar.	163.95	59,021.57
Patio	110.58	39,809.66
Pool Area	223.20	80,351.42
Hotel Face	694.40	249,982.85
Reception	505.99	182,155.39
Halls	72.21	25,996.88
Sea Spray	53.84	19,381.25
Main Buffet	72.78	26,201.09
Other	327.93	118,055.89
Total Saving	3,351.65	1,206,594.98

As a standard 40 W incandescent lamps are used throughout the hotel. All of them can be replaced by 8W Compact Florescent Lamps to save energy by 80%. But considering the occupancy rates at different locations we advice to replace the incandescent lamps only in the sections; Guest rooms, Garden, Pool area, Hotel face, Reception, Main buffet and Sea spray.

The investment for the replacement can be recovered within six months. This can be considered as the second major proposal came out of the analysis.

Problems

We would like to maintain same problems we had to face carrying out the project with possible selections to overcome such problems in future.

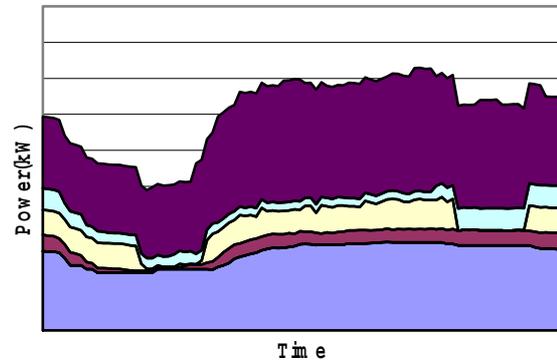
The biggest problem was the lack of a proper power distribution system. As a result of this we had to create an artificial distribution system to be used for our analysis. We had to do a lot of assumptions and manual countings of instruments etc. So we suggest to rehabilitate the distribution system properly and install energy meters departmentwise.

In general, any hotel could not manage their energy consumptions beyond a certain level. The areas that we occupied by customers are out of the control of hotel management and there is no point of assigning operation schedules or regulations.

In addition to that general problems are faced some special problems in this hotel. Elevators that are used in the hotel belong to the British Victorian architecture and the management is very much aware of that architectural importance. That avoided us thinking of a modern elevators of high efficiency.

Conclusion

If all the under mentioned proposals are implemented, the total load curve will be adjusted to the following state.



Even now they can switch to the flat rate tariff or continue with the time of day tariff.

The new annual electricity cost (under present tariff) = Rs. 24,814,344.23

Hence, the annual saving = **Rs.1,937,730.13**

The new annual electricity cost (under flat rate tariff) = Rs. 24,142,700.82

Hence, the annual saving = **2,609,373.54**

Therefore we suggest to implement all the above proposals as well as switch to the flat rate tariff structure as our final recommendations.