UNDERSTANDING ELECTRICAL COSTS

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Abstract
This paper represents an experience that many energy managers must have for a fundamental understanding of the many variables that make up the costs of electrical energy. Each electrical utility is different. The rate structure, the power generation mix, the reserve capacity, the state regulation under which they operate, the efficiency with which they operate-all are different. For the cost is important to define utilities and find out about their characteristics.

Keywords
Energy, demand, reactive demand, power

1. RATE SCHEDULES

There are three basic measurable components of electrical costs which utilities may include in their rate schedule. They are as follows:

- Energy – expressed in kilowatt-hours
- Demand – expressed in kilowatts
- Reactive Demand – expressed in reactive kilowatts
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In addition to these three, most utilities have a number of other charges that may be included in the overall cost.

These include charges such as the following:

- Fuel adjustment clause
- Seasonal rates
- Ratchet clause
- Time of the day
- Interruptible service
- Cogeneration

This list is certainly not all inclusive, but is intended to point out typical adjustment type clauses that you may find in utility rates. These cannot overlook if it must to calculate the right costs for the electric bill. Fuel adjustment costs for example may be equal to or greater than the costs of the metered kwh.
How many of the above components are included in an electrical bill depends upon the rate schedule under which it is operating.

In rate schedule for small general service, energy (kwh) and demand (kw) are usually the only measured charges. A charge for reactive demand (kvar) is generally limited to the large general service rate schedule, and

then only if the power factor is low. Power factor will be defined also in this paper however is necessary to understanding the motor efficiency.

2. FROM THE UTILITY STANDPOINT

Energy is defined as amount of power expanded over a period of time. In electrical usage, it is obtained by multiplying power by time and using conversion factors, it can be converted to an equivalent amount of Btu s, tones of fuel oil, or other forms of energy. So, the energy cost is calculated taking into account the amount of kwh.

The demand (kw) for the month would be recorded on a specific day of the month. It should be noted that if the facility had been closed every day, but had turned on all equipment for one time interval, the demand meter would have picked it up, and the facility would have been billed for it. In many cases the cost for the demand is equal to or more than the energy cost, so if this has happened, an electric bill for the month could be about half of the usual amount.

In order to better understand the rate structure it is necessary to look at the requirements imposed upon utilities for meeting the electrical needs of the area they serve. In order to obtain the monopoly for electrical service within a given territory, the utility is required to be able to meet the electrical needs of that area at all times. These needs are constantly varying and are depend upon many factors, such as weekly load curve, summer and winter peaking curves and load duration curve. Reactive demand is also a component of the rate structure and is least expressive than the other components. Reactive demand influences the value of power factor. Because of the great number of electrical motors, power companies are concerned about the phase shift caused by inductive load. Therefore, in some rate schedules, there is a charge for lagging reactive demand.

3. HOW TO ANALYSE YOUR ELECTRICAL ENERGY COST

It is possible just from data on the electrical bills to do a detailed analysis of the electrical energy use in a facility without even surveying the facility, or having much knowledge of this operation. Such an analysis should be the first step in conducting an electrical audit. The best way to analyze the data is to display it graphically. From the data on the electrical bill, you can graph the following information:

- Energy use
- Demand
- Load factor
- Utilization factor
- Power factor

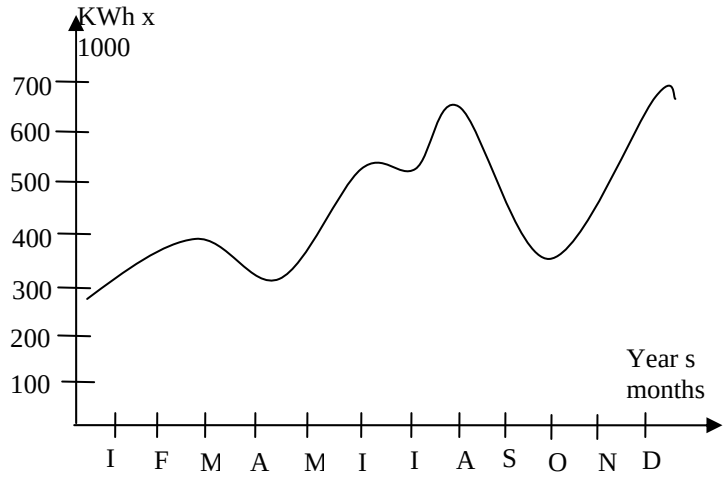

Fig. 1 Electrical energy seasonal fluctuation

In figure 1 we see no seasonal fluctuation, so it is obvious there is no significant air conditioning or electrical heating loads. It can quick discount these as a potential for improved efficiency, better insulation or load shedding.

The steady increase in energy use with time indicates growth of the company with an increasing production. The company had recently moved into the area and was experiencing a growth in sales and producton.

The demand curve can be seen in a

figure 2.

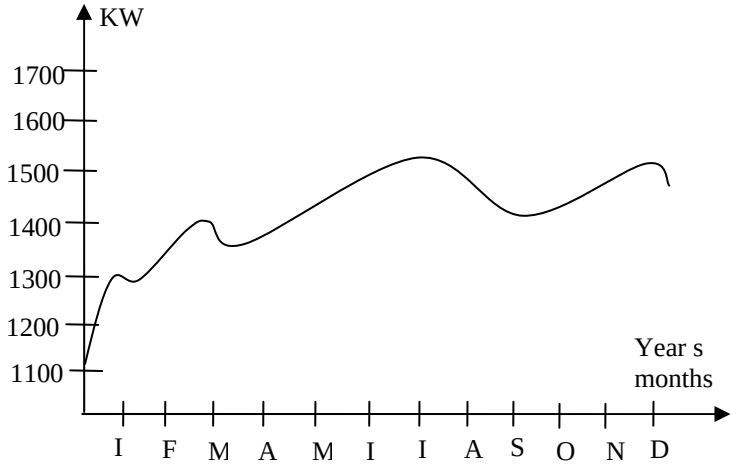

Fig. 2 The demand curve

The demand curve of figure 2 indicates new equipment being added to meet increased production demands. By examining the power factor curve we see that when the demand went up, the power factor went down slightly. This indicates an inductive load, most probably large motors. The question is arising –is a second shift be added rather than buy additional equipment which will drive up demand?.

The load factor variation and the electrical utilization curve from figure 3 provide answers for this.

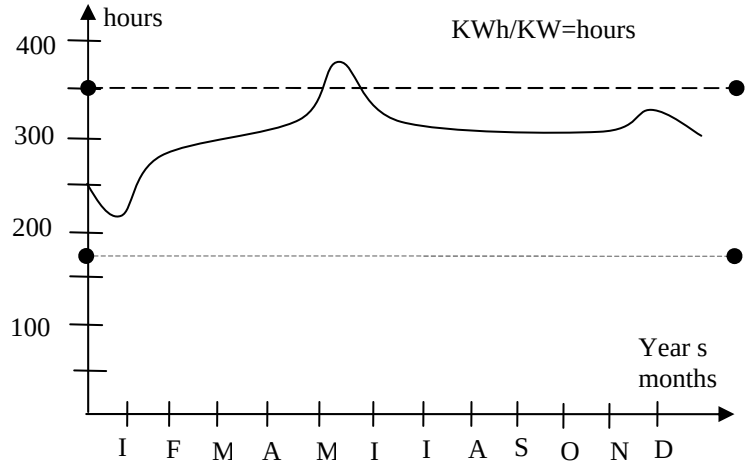

Fig. 3 The electrical energy utilization

Load factor is an indication of how much of the total energy is being used. It is obtain by dividing the total energy used monthly by that amount that would have been used if it had been consumed at maximum demand for every hour in the month.

Another load factor can be developed whereby the demand is multiplied by the actual operating hours during the month. This value then is divided into the total KWhs used monthly to determine the load factor. If it is over one, this indicates that electrical equipment is running beyond working hours.

Looking into the electrical utilization graph it is noticed that the points on this curve are obtained by simply dividing KW of peak demand for the month into KWh of energy for month. The answer is in hours and represents the number of hours you would have to run the equipment ay peak demand in order to use the same amount of energy you actually used.
It can be noticed, in figure 3, that the electrical utilization is somewhere between the first and second shift, with one peak going into the second shift.

This can be discussed with the management an ca be determined that there was some second shift operation, but not as much as indicated by the graph. Than can start looking for a culprit. A substantial amount of equipment could be operated after normal working hours.
Usual there are situations when maintenance people were leaving fans running after hours and are coming very early to start up the equipment long before production started. Maintenance work is often done on the weekend in which the equipment was run for a considerable length of time.

After will see this information displayed graphically , management is able to reduce the overall running time of large pieces of equipment by re-scheduling and simply making people aware of the cost of operation of equipment.

Another example involved a sawmill operation. As we saw, the company has three separate meters for which they are billed. It is better for them to combine these three meters into one if is possible. The total cost for demand would go down if the peaks were not appearing simultaneously. Also, the declining step rate for KWh would provide a savings. It is also possible that they would be eligible for a new rate schedule which could be beneficial. The operation at the first two meters is probably a one shift operation. However, that at meter three is obviously operating part time during the month. It is obvious that the operating at meter three should be combined with the other two for billing proposes, or else the value product produced there evaluated very carefully.

These are examples of saving located just from analyzing the electrical bill. If utility can provide with 15 or 30 minutes breakdown of demand an energy use-or if it can be measured-it is possible to do further analysis such as pinpoint pieces of equipment that are used for a very short duration of peak times.

4. CONCLUSIONS

Electrical costs are at present rising faster than other energy sources. Some are taking quantum jumps as new generating facilities come on line. This means that a good understanding of your electrical charges and ways in which they can be reduced is of prime importance.

BIBLIOGRAPHY

[1] Benedict, R.P, *Definite strategy to improve energy management*, McGraw Hill NY, 1995
[2] Mashburn,W.H, *Managing energy resources in DC*, Lilburn GA, 2002