E-Notes

Energy Efficiency Notes

The Effect of Scheduling, Demand, and Consumption on Electrical Utility Billing

Background

In some facilities, electrical energy use changes on a seasonal basis, for example:

- ice rink plants starting up in the fall,
- air conditioning for large buildings starting up in spring,
- schools shutting down for summer vacation,
- swimming pools shutting down for winter.

The timing of starting or stopping electrical equipment can greatly affect electrical utility charges.

Electrical Energy Consumption

Energy consumption is the amount of electricity consumed, and is usually expressed in kilowatt hours (kWh). In most industrial and commercial buildings in Saskatchewan energy consumption costs approximately $ 0.08 per kWh for the first 10,000 kWh and $0.033 per kWh for remaining consumption over 10,000 kWh as of 1997. In addition there are electrical demand charges.

Electrical Demand

Demand is the rate at which electric energy is delivered to a load. Demand is expressed in kilovolt-amperes (kVA) and refers to the maximum amount of power drawn through a meter during a billing period. Billing periods are usually one month long. SaskPower and other utilities in Saskatchewan charge for demand over 50 kVA to compensate for the cost of providing power lines, transformers, etc., large enough to handle a customer's peak demand.

Figure 1. Front face of an analog electrical demand meter (Diagram courtesy of SaskPower)

The demand charges also compensate for having to produce the peak demand which is usually needed at the same time as other customers are registering their peak demand. For most commercial and industrial customers all demand over 50 kVA costs approximately $13 per kVA as of 1997. Electric utilities average the power reading over a time interval, so that very short fluctuations do not adversely affect customers. For Instance: After 1 minute, the demand reading is 25% of the actual demand; after 4.5 minutes it registers 50% of the actual demand; after 15 minutes, 90%; and after one half hour, 99%. Thus, the customer is billed for demand for a month based on the maximum average of their power use.

Daily Scheduling

Example: Comparison of electrical charges between two billing periods for a building. Consider a facility that had two electrical motors, each of which has a peak demand of 50 kVA.

Month 1

- The facility ran one motor 6 hours a day, consumed 9,000 kWh of electricity and had a peak demand reading of 50 kVA.
- The utility company charged $821 for consumption and $0 for demand.

Total electrical cost = $821

Month 2

- The facility ran two motors at the same time for 3 hours a day, consumed 9,000 kWh of electricity and had a peak demand reading of 100 kVA.
- The utility company charged $821 for consumption plus $741 for demand.

Total electrical cost = $1,562

Month 2 incurred much higher electrical costs due to demand charges even though the kilowatt-hours were identical to Month 1.

Energy demand charges can be significant and should be closely monitored!

Monthly Scheduling

Example: Two ice rinks are identical to each other and both have their electrical demand meters read at the end of the month. Both rinks start making ice at the end of October.

- Rink 1 turns on its ice plant October 30, one day before the demand meter is read.
- Rink 2 turns on its ice plant October 31, five minutes after the demand meter has been read.
- The electrical bill for October for Rink 1 is much higher than Rink 2 because it incurred demand charges in October.

Both rinks have the same billing throughout the winter because they operate their rinks in the same way and both rinks shut off their ice plants at the end of March.

- Rink 1 shuts off its ice plant March 31, one day after the meter was read.
- Rink 2 shuts off its ice plant, March 30, 1 hour before the meter was read.
- Rink 1 has a much higher electrical bill in April because of demand charges.

Attention to when demand meters are being read and when starting large seasonal equipment such as ice plants, large air conditioners, and fans can make a big difference in electrical billing.

Summary

1. Always co-ordinate the seasonal shutdown and startup of large electrical equipment with the electrical demand meter readings.
2. Operate electrical equipment in your facility to minimize the peak electrical consumption. Demand charges are important!
3. Power factor correction equipment is another approach that can be used to reduce electrical demand. (See E-Note on Power Factor Correction)

Reference

Energy Management Handbook, Wayne C. Turner, School of Industrial Engineering and Management, 1993, The Fairmont Press, Inc., 700 Indian Trail, Lilburn, GA.

Demand Meters, SaskPower, 1991, 04/91-5M.