PEAK LOAD SHAVING

INTRODUCTION

The cost of electrical power is sure to increase over the long term. In addition, the trend toward deregulation rewards facilities for efficient use of electrical power and, conversely, heavily penalize inefficient use of electricity. Future use and management of electric power will have high dollar returns.

ELECTRIC UTILITY RATES

Regulated electric utilities, which include all electric utilities in the state of Wisconsin, have a rate structure governed by the Public Service Commission. The Public Service Commission is an agency that represents the citizens of Wisconsin and must approve all electric rate increases and changes to the rate structure. Currently, most states use a similar method of governing and managing regulated utilities.

The electric rate structure consists of two components: *electric usage* and *peak demand* as shown in **Figure 1**. Electric usage measures and bills a facility based on the ***amount*** electric power used in a given period (typical is monthly). The charge is designated as kilowatt-hours (kWh) on an electric bill. In addition, the electric usage for large facilities is further divided into on-peak and off-peak electric usage. The on-peak usage is at a higher billing rate than the off-peak rate and are differentiated by when the electric power is used. The on-peak rate typically is a 12 hour window during the day time hours. The reason for on-peak hours is that during the off-peak hours an electric utility is generating electricity that cannot be sold. This rate structure serves two purposes: first to encourage electric power consumers to use electricity during off-peak hours and, second to attribute the cost of electric power to those facilities that increase the amount of needed electrical generating capacity.

The second component of electric rate structure is the peak demand charge. The peak demand charge measures the kilowatts consumed over a 15 minute time window. It is a monthly charged based on the maximum kW consumed by a facility. The 15 minute window is sliding, meaning that highest 15 minutes can occur any time throughout the month. For example, a 15 minute kW measurement window occurs at 8:00 am to 8:15 am. The next window occurs from 8:01 am to 8:16 am, then from 8:02 am to 8:17 am, next from 8:03 am to 8:18 am and the pattern continues.

Customer: Cutler-Hammer Payment To: Southern Power

Billing Period From: 9/1/00 Billing Period To: 9/30/00

DEMAND	**Peak At**	**kW**	**Rate ($/kW)**	**Charge**
	1:05 pm	2496	9.60	$23,961.60
ENERGY		**kWh**	**Rate ($/kWh)**	**Charge**
Off-Peak		224,600	$.0369	$8,287.74
On-Peak		458,800	$.052	$23,857.60
CHARGES				
Connection Charge				$500.00
Power Factor				$390.00
Taxes				$3178.04
			TOTAL DUE	$60,174.98

FIGURE 1 - Sample Electric Utility Bill

The Culter-Hammer Softload Autotransfer Switch provides parallel operation of generators and utility service

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Typically, the peak demand accounts for approximately half of the total cost of electricity in a given month. The justification for this charge is electrical generating capacity needs to match the total peak demand for an electric utility's service territory. As the long term peak demand increases, the electric utility is forced to add more electrical generating capacity, which means more capital cost expenditures to build power plants. Therefore, the peak demand charge transfers these capital cost to the facilities that increase peak demand.

ELECTRICAL DEMAND MANAGEMENT

Electrical demand is controlled by two methods: load shedding and peak shaving. Load shedding involves reducing facility demand. Simply explained, load shedding systematically turns off electrical loads when the desired maximum demand is in danger of being exceeded. Unfortunately, often this is not an option.

For example in a hospital or office facility, mechanical refrigeration (centrifugal chillers, direct expansion chillers) using electric motors as part of the air conditioning process and accounts for nearly 40% of the electrical demand with remaining 60% attributed to lighting, computers and other essential building equipment. The peak demand most often occurs on the hottest summer days and allowing the building temperature to rise by turning off air conditioning is not an option. Therefore, load shedding is of limited effect and is an unreliable method.

The second method, **peak shaving**, uses an alternate electric source to supplement utility electric power. This alternate source can be the facility emergency generator. The generator is started and, when up to full speed, is operated in parallel with the electric utility thereby reducing need for purchased utility electric power.

The peak shaving method has several advantages. First, the **operation of the facility is not compromised**. All loads can function normally; no loads need to be turned off. Second, the amount of peak reduction is known. For example, if the emergency generator system is sized for 500 kW, operating in parallel with the utility will reduce kW demand by 500 kW. Should several the facility include several emergency generators, the number of operating are staged to match the needed reduction in peak kW demand.

PEAK SHAVING EXAMPLE

The sample electric bill shows the peak demand and energy usage. **Figure 1** stamps the time when the peak, 15 minute kW consumption occurred. Note that the demand accounts for nearly half of the total monthly cost of electric power.

If a peak shaving strategy is used and assuming the facility has one, 500 kW emergency generator, theoretically the peak demand can be reduced by 500 kW which means a cost savings of $4,800.

However, as detailed in **Figure 2**, a realistic estimated kW savings accounts for inaccurate or the absence of energy monitoring. Therefore only an incremental peak demand is avoided. For example, should a facility manager recognize all hotter than normal days to address peak demand, the full 500 kW peak shaving benefit. Realistically, only a smaller portion is realized on a monthly basis.

Month	kW Savings	kW Cost Savings	Cost to Operate Generator	Total Cost Savings
January	50	$480	$160	$320
February	50	$480	$160	$320
March	60	$576	$192	$384
April	70	$672	$224	$448
May	120	$1,152	$384	$768
June	150	$1,440	$480	$960
July	500	$4,800	$1,600	$3,200
August	400	$3,840	$1,280	$2,560
September	300	$2,880	$960	$1,920
October	50	$480	$160	$320
November	30	$288	$96	$192
December	30	$288	$96	$192
TOTAL	1810	$17,376	$5,792	$11,584

FIGURE 2 - Sample Demand Savings

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Figure 2 details avoiding an average of 300 kW in peak demand costs in four air conditioning months, a more realistic amount. In addition, the cost of operating the emergency generator is subtracted from the electrical cost savings.

Because an automatic transfer switch is needed for the emergency generator system, the incremental cost of the soft load transfer switch only (not the total cost) is used to make a payback comparison. In this example, the **payback is 18 months**. The cost of a soft load transfer switch is approximately 2x the cost of an open transition automatic transfer switch. The reason, as will be described below, is the need for relaying to assure proper conditions and safety checks for parallel operation with the electric utility service.

Cutler-Hammer Soft Load Transfer Switch

The Cutler-Hammer Closed Transition Soft Load Switch as shown in **Figure 3**, utilizes an integrated microprocessor based power controller making active paralleling of two power sources possible. The controller manages the generator speed governor and generator voltage regulator to assure synchronization of the two sources. This approach allows the transfer switch to operate in parallel with utility service making it ideal in peak shaving applications.

A unique and cost effective microprocessor based generator controller enables the Cutler-Hammer soft load switches take active control of the generators speed governor and voltage regulator allowing for dual source synchronization.

Product Description - The CT series closed transition Soft Load transfer switch with active generator control is the ideal solution for applications requiring seamless transfers, critical power availability, energy management and generator set testing. Active control is the fastest and most reliable method of power source synchronization.

The following are standard sequences of operation:

Loss of Normal Power – The loss of phase to phase or phase to neutral from the normal source initiates the transfer to emergency generator power. The users adjusts the time delay before transfer (to prevent transfer on momentary dips), the voltage amount of voltage drop, and time delay before connection of alternate source to load.

FIGURE 3 - Soft Load Transfer Switch

Return to Normal Power (Both Close and Open Transition) – When the normal source is restored, the load is transferred from the emergency source to utility power. Again, fully adjustable retransfer times and voltage levels are included.

Test Mode – Two test modes are available: "Engine Run" and "Transfer Test". The Transfer Test mode is delectable as either open or closed

Features, Benefits and Functions

- Insulated case switching devices designed specifically for UL 1008.
- Drawout mounted SPB insulated case switches.
- High withstand, interrupting and closing ratings.

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- "Seamless" transfer between power sources.
- Fastest switching time available (under 5 cycles).
- Mechanical and electrical interlocks.

Equipment Ratings

- Ratings available from 800 - 4000 amps.
- Available up to 600Vac.
- 2, 3, or 4 pole.
- Enclosures - NEMA 1 and 3R.
- Optionally Rated as Suitable for Service Entrance Equipment - no additional disconnect required.

Standards and Certifications

- Meets or exceeds all applicable standards.
- UL 1008, UL 489, CSA, UBC and BOCA Seismic Zone 4, NFPA 110 and 99 (with certain options), EGSA 100S, NEMA ICS10, NEC Articles 517, 700, 701 and 702, ISO 9001, ISO 9002.