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Computerized energy management can cut costs and optimize comfort

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Energy management is a new dimension added to country club management in recent years because of a sharp rise in energy costs. A corresponding drop in microprocessor costs has put energy management technology with reach of organizations such as Brookhaven Country Club. Our goal is to reduce the total cost of energy while optimizing the services to our club members.

Brookhaven, like many small commercial businesses, is charged for electrical energy in two ways. One charge is for actual energy consumed as measured in kilowatt-hours (KWH). An additional charge is made for the rate of consumption or demand, and is measured in kilowatts (KW). Demand charges are based on a peak value occurring in any 15 minute period and "set" a "rachet" value that determines the demand charge for a period of several months.

The system

The energy management system at Brookhaven consists of a central computer, remote sensors and controllers, and a communications system. The function of this system is to sense the state of the energy system, make decisions according to predetermined guidelines, and to control energy consuming loads.

The state of the energy system is ascertained remotely by sensors at specific locations throughout the club. Energy consumed and demand are sensed at the power meter and transmitted on a pair of wires to the computer as pulses. Each pulse represents some quantity of energy (KWH), while the pulse rate is proportional to demand (KW). Temperatures are sensed in individual rooms or areas and transmitted to the computer as current signals on individual pairs of wires. Humidity is treated in the same way as temperatures.

The computer

The central computer consists of a microprocessor and its associated memory. To aid the computer operator, there is a group of ancilliary equipment designed to interface between the operator and the computer. The CRT (cathode-ray tube) terminal consists of a video screen and keyboard. A printer logs the status of the system and changes in status as they occur. Manual switches allow the operator to control each load individually by selecting ON, OFF, or AUTO. Lamps associated with each switch indicate the status of that load. Alarm lamps indicate when an alarm condition exists.

The system consists of a computer, remote sensors and communication

Individual loads are controlled by the computer via a pilot relay. The computer causes the relay to open or close by its command. The relay contacts are in series with the control circuit or power circuit for each load. The relay is wired in such a way that if the computer fails or loses power, the local control circuit will assume normal operation.

Communications between the sensors and the computer or between the computer and the pilot relays is normally done on a twisted pair of wires that is shielded against outside noise. In some cases, when the sensor or pilot relay is a large distance from the computer, or a large number of wires would be required to one location, a telephone circuit is used with some type of interface equipment. The remote water well pumps are controlled via a telephone circuit. The golf cart garage and the tennis facilities communicate with the computer via a multiplexer and four-wire voice grade telephone lines with modems.

Facilities

The Brookhaven system includes two centrally located buildings, two separate tennis/raquetball facilities, a golf cart garage, and two remote water well pumps. Each group consists of distinct combinations of location and types of loads.

The two main buildings consist entirely of heating, ventilating, and air conditioning (HVAC) units and their associated temperature sensors. The sensors and pilot relays are linked to the computer by shielded, twisted pairs of wires.

The two tennis/raquetball facilities have HVAC units, air handling units (AHU), and light to be controlled. In addition, the lights at the old tennis facility are controlled remotely from the Pro Shop in the new tennis/raquetball facility. All of these tasks are accomplished via multiplex (MUX) units on four-wire, voice grade telephone circuits.

The golf cart garage contains 16 groups of battery chargers and is linked via the multiplexer unit and telephone lines. The two remote water well pumps are started/stopped via a special telephone control circuit.

Management techniques

To achieve energy savings, both the consumption of electricity and the rate of consumption must be reduced. Typically, the amount of energy consumed can be most effectively reduced by turning off loads when they are not being used. This function is called scheduled start-/stop. Using the computer to control this function, the HVAC's and AHU's are turned off during periods when their respective rooms and areas are unoccupied and unused. Additionally, tennis and raquetball court lighting can be turned off after their

Rate of consumption must be reduced

usage is complete.

To effectively reduce the rate of consumption, or demand for electricity, nonessential loads must be turned off when the demand is highest. At Brookhaven, the golf cart battery chargers are shed first, then the water well pumps, and later the HVAC's and AHU's are shed. Typically, this will keep the power demand below a predetermined limit during the peak demand period. After the peak, typically less than one hour, the loads are turned on again in reverse order.

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A third technique used to reduce demand and to a lesser degree, consumption, is load cycling. By this means, loads are cycled off for some part of a cycle. For example, a HVAC unit may be cycled off for five minutes out of every hour. That is a 1/12 savings in consumption. If other HVAC units are cycled also, but at different times throughout the same hour, then demand is reduced likewise.

Other computer techniques can further reduce consumption and demand by optimizing use of particular loads.

Using the computer, there are other techniques available that further reduce consumption and demand by optimizing the use of the particular loads. For instance, a HVAC unit may be started at an optimum time before occupancy to assure that the occupants will be comfortable, yet no unnecessary energy is used. This is done by sensing indoor and outdoor temperature as well as humidity and predicting the optimum start time. Another technique is to modify the cycle time for a HVAC unit to regulate the temperature with the area it serves.

One of the major additional benefits of an energy management computer such as the one at Brookhaven is the awareness of the various energy loads and their characteristics. With the monitoring capability of the system, we are able to modify our program to optimize the energy savings and comfort of the club members. We expect the system to improve our savings over several years to come. **GB**