Chapter 2

EMS Overview

Energy conservation through management has been, and remains, one of the most viable energy resources available to all sectors of the energy consuming building community. By minimizing energy consumption and still maintaining the posture required for our business activities, we can save money and therefore survive our respective market areas.

An EMS is one energy conservation alternative that can provide a means to control, reduce and perhaps eliminate energy waste.

HISTORY

There are a multitude of EMSs on the market today ranging from residential EMS to large facility management systems. Several types of EMS are available. Most major control firms and other companies in this field have introduced families of building automation systems intended for a wide range of building sizes. These systems can be classified as follows.

Class I Systems

These consist of small monitoring and control systems that can be used in buildings with floor areas up to about 100,000 ft^2. The basic component is a microprocessor preprogrammed to start/stop different

HVAC system components according to a preselected schedule. The systems can be designed to perform other operations such as monitoring fire alarms and smoke detectors, security checks, and load cycling.

Class II Systems

These systems are similar to those in Class I except that they can serve larger buildings and some building complexes. The available software packages provide functions such as: executive and operating instructions, scheduled start/stop operations, load rotation and shedding, control points resetting, optimization of start time, enthalpy optimization, and fire alarm and life-safety system monitoring.

These systems can usually monitor about 2000 addressable points. When these systems are used for a group of buildings or building complexes, the central control facility is connected to remote data gathering panels by means of one or more types of data communication links. Because more than one data gathering panel is served by a central facility, each panel is allotted an equal amount of time in direct communication with the central facility.

Class III Systems

These are referred to as "direct digital control" (DDC) systems, and are the most sophisticated type of EMS. DDC systems are used for building complexes such as medical institutes and university campuses. In addition to the basic functions described earlier, it is possible to include the following programs: reset of supply air system; optimization of cooling and heating plants operation; building management; lighting control; preventative maintenance; energy auditing; and efficient bookkeeping.

When did "centralized management of energy" begin? (See Table 2-1.)

As can be seen in the table, centralized monitoring and control of equipment and conditions for HVAC systems has been around since the 1950's in various forms.

In addition to reducing energy costs, the centralized monitoring and control of mechanical equipment gives an organization additional benefits of improved labor efficiency, reduced maintenance costs, and extended equipment life. With alarm reporting capability, mechanical equipment problems can be noted and corrected more expeditiously.

Table 2-1. EMS History—Five Generations

1st Generation (1950's)

Remote monitoring panel using temperature sensors and switches to manually read conditions and start or stop motors.

2nd Generation (1960's)

Use of electronics, introduced low voltage circuits to automate or speed up monitoring of panel functions.

3rd Generation (1960's-1973)

Multiplexed systems consisted of groups of sensing and control points tied into a local system panel and a pair of wires that run back to a central console from multiple panels. Scanning the points in a system was accomplished electronically (response time was slow and failure of the Central Processor meant total system down).

4th Generation (1983)

Individual building panels become electronically smarter with their own stand-alone minicomputer. They can carry out most functions that the central computer used to do, and also relay information back to a central console. The processing of system functions is throughout the system.

The speed of the electronics, as well as software, and hardware reliability soon "over powered" conventional pneumatic control systems with simple proportional control and offset. EMS sensor locations were duplicated with pneumatic and electronic sensors.

5th Generation (1987)

Direct Digital Control (DDC) uses a small microprocessor and software for system sensing and control. DDC units can stand alone to provide various digital control sequences, or several DDC units can be tied to a central operator station. On any size system, this could be an IBM-PC or compatible. Most EMS manufacturers have their own software packages which results in the EMS becoming proprietary, as does the DDC system.

FUNCTIONAL CAPABILITIES

In his zeal to conserve precious fuels and keep down growing fuel bills, the engineer often specifies the latest and most advanced EMS. What he gets is likely to be a much more complex system than is really necessary, one capable of performing an unneeded variety of sophisticated operations.

How can this be avoided, and what steps must be taken to properly specify a system to assure that he gets exactly what is needed—no less and no more?

Following is a brief list of events that should serve as a guide to the overall EMS project (covered in greater detail in Chapter 11):

1. Initial Concept
2. Information Retrieval
3. Candidate Buildings and System Selection
4. Field Survey
5. Design
6. Contract Documents Preparation
7. Contract
8. Installation and Training
9. Acceptance
10. Operation and Maintenance

FUNCTIONS

The *specific functions* implemented in any EMS design are established by a thorough study of the building(s) and system(s) to be controlled. The most common EMS software functions are listed below:

- Programmed Start/Stop: Occupancy schedules
  - Fans: save HP and heating/cooling
  - Pumps: can be interlocked with fans
  - OA Dampers: "less than" occupancy schedules
  - Air Compressors: blow down moisture

- Optimized Start/Stop: Based on indoor/outdoor temperatures to achieve a comfort level. Can be stopped early.

- Temperature Setback/Setup: Change temperature set points of thermostats when building is unoccupied.
- Economizer Control: Use "free cooling" from outdoors when temperature is suitable (and) place dampers at minimum position when cooling.
- Enthalpy Control: Sophisticated economizer control using temperature and humidity (indoors and outdoors).
- Discharge Air Reset: Reduce excessive heating and cooling in HVAC systems.
- Hot Water Reset: Reset hot water from outdoor air temperature.
- Chilled Water Reset: Reset supply from return water temperature.
- Chiller Optimization: Balance chiller operation to load demand.
- Boiler Optimization: Balance boiler operation to loads and control combustion air.
- Demand Control: Reduce peak electrical loads (kW savings).
- Duty Cycling: Turn off equipment a percentage of the time according to an established schedule to reduce energy use (code compliance?).
- Monitoring/alarm: Logging conditions, on-off/high-low alarms, trend logs over time, equipment run time, energy use, etc.
- Fire Notification: Parallel with building alarm system (or) fire alarm must be UL approved for this application.
- Security: Alarm notification/door switches/voice synthesizers/pagers.
- Card Access: Card readers, exit doors, supervised door contacts, separate programming modules.