DOE/GO-102001-1165
NREL/BK-710-29267
May 2001

5.6.1 Energy Management and Control Systems

An energy management and control system, or EMCS, reduces energy use in buildings by monitoring conditions and controlling energy-consuming equipment. An EMCS is typically applied to the largest electrical loads, including HVAC equipment, cooling towers, pumps, water heaters, and lighting. Control functions may include everything from basic stop/start functions to more complex chiller optimization routines. An EMCS can be used in new or existing facilities and can interface with existing controls, such as pneumatic damper actuators. EMCSs typically save money in two ways: by reducing energy use and by reducing labor costs. EMCSs can have very favorable paybacks, especially where existing control systems are lacking or have problems. By tracking system operation using an EMCS, a facility manager can perform diagnostics and optimize system performance.

Opportunities

Facility managers should consider installing an EMCS in any facility expansion. EMCS retrofits are often justified and can involve improving chiller or boiler controls, adding economizer cycles, controlling lighting loads, and limiting electrical demand. An EMCS can be particularly reliable for very large or widely dispersed facilities. Be sure to consider adding an EMCS when modifications to HVAC and lighting systems are being considered for other reasons—such as the downsizing of mechanicals to pay for cooling-load-reduction measures. Strategies for load management are covered in *Section 5.6.2 – Managing Utility Costs*.

Technical Information

An EMCS can perform various functions, from simple single-point control to multifunction systems with complex decision logic. Fully functional EMCSs provide the greatest potential for maximum energy and cost savings.

Hardware varies in complexity. Simple systems include actuators that switch or change loads according to signals from local controllers that contain control logic. More sophisticated systems add sensors or monitoring points, field termination panels for minimizing control wiring, modems, communication links, and central computers. Software often includes sophisticated user interfaces that graphically depict equipment, sensors, and controls.

Distributed or networked systems combine the reliability of local controllers with the advantages of facility-wide monitoring. Centralized control provides facility engineers an immediate interface with remote equipment, allowing quick diagnosis of problems and quick response to complaints.

FUNCTIONAL CAPABILITIES

Many scheduling, optimizing, and reporting functions are available with an EMCS:

Start/stop controls will limit operating hours of equipment according to predetermined schedules.

Optimum start/stop controls delay bringing equipment online until the latest possible time. This is particularly useful in limiting HVAC operation.

Temperature setback/setup saves energy by allowing building conditions to drift (within predefined limits) during unoccupied periods.

Economizer controls turn off chillers during mild weather and allow outside air to provide space conditioning.

Enthalpy control provides more sophisticated economizer control that is based on both temperature and humidity.

HELPFUL TIPS

- Train key employees to use the EMCS once it is installed.
- Have a qualified engineering firm design specifications before bidding any EMCS.
- Require the vendor to fully demonstrate the system and all software before delivery. Videotape the demonstration and training for use during refresher training.
- Design expansions of EMCSs to have a single-user interface system in order to avoid operator confusion.

A sophisticated energy management and control system is helping the Rockland County Community College in New York realize substantial energy savings. Dual-fuel boiler controls allow the college to switch between oil and gas, depending on current market conditions. Source: NYSERDA

Supply temperature reset modulates circulating water temperature based on load sensors and program logic.

Boiler optimization balances fuel and combustion air according to actual heating loads.

Duty cycling can help reduce utility peak demand charges by turning off equipment for a predetermined percentage of time.

Demand limiters shed nonessential equipment, such as water heaters, to reduce peak power demand to a preset level.

Alarm functions alert operators to conditions outside preestablished ranges.

Monitoring provides the capability to track (1) equipment run-time and other parameters for proactive maintenance, and (2) energy consumption for cost containment.

Load management controls stage the start-up of large equipment to avoid power peaks.

OPERATION AND MAINTENANCE

Use in-house staff for day-to-day service requirements, provided that they have adequate skills and are well trained. Service contracts can be very expensive and should be used only when necessary.

Sensors should be checked and calibrated on a regular maintenance schedule. Failed sensors and false readings can waste a considerable amount of energy.

CAUTIONARY NOTES

- New EMCS systems will not necessarily interface properly with existing controllers and other components that are intended to remain in place.
- Be careful about buying "custom-built" systems. Purchase proven systems and software that has a good track record. Request systems with open protocols to improve compatibility with future systems.
- Sole reliance on the EMCS console can lead to misdiagnosis. For example, a temperature alarm would prompt the operator to check the position of the VAV damper for that zone. If the sensor indicated that the damper was fully open and yet the zone was too hot, the operator might reset the chilled water temperature. However, the combination of a stuck damper (cutting off airflow) and a loose damper shaft (allowing the control system to believe the damper is operating normally) might be the real problem. This situation could easily fool both the control system and the operator.

References

"Energy Management Systems" (Technical Brief TB.EMU.121.4.87), Electric Power Research Institute, 3412 Hillview Avenue, Palo Alto, CA 94304; (650) 855-2000; www.epri.com. The EPRI Web site lists summaries of a large number of technical reports available on various aspects of energy management.