

BEYOND

SMART CITIES

Distribution marketing participation in the securities market.

Revenue growth drivers.

3 June 2008

2 July 2008

2 August 2008

BUILDING AUTOMATION & CONTROL SYSTEM

CEM REFRESHER TRAINING

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY MANAGEMENT SPECIALIST CURRICULUM





BEYOND

SMART CITIES

BUILDING AUTOMATION SYSTEMS & EMS PROGRAMS

FOR ENERGY PROFESSIONALS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

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WHAT SHOULD YOU LEARN



Building Automation Systems

Basic Functions

EMS Programs



BUILDING AUTOMATION SYSTEMS(BAS)



Floor Level Network
Building Level Network
Management Level Network

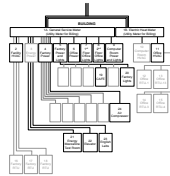
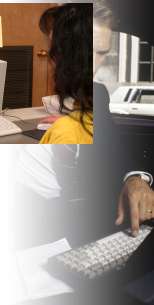
Remote System Access
Remote Alarm Notification
Interoperability with other Buildings/Systems/Networks



BASIC FUNCTIONS

1. Monitoring/Surveillance

- Building Conditions
- Equipment Status
- Utility Sub metering
- Climatic Data
- Fire & Security



BASIC FUNCTIONS

2. Demand Limiting

- Load shedding
- Duty cycling

3. Maintenance

- Remote operation and control of equipment
- Generation of maintenance schedules
- Diagnosing breakdowns

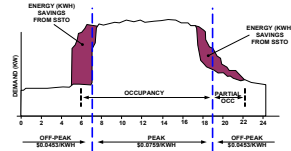
3. Record Generation

- Trends and operation logs
- Utility demand profile ("baseline")
- Modification/replacement analysis
- Energy conservation documentation



START-STOP OPTIMIZATION

- ✓ How It Works Start the equipment at the latest possible time
- ✓ Stop at the earliest possible time



CHILLED WATER RESET

✓ Introduction

- Many buildings' chilled water setting is designed for the heaviest anticipated cooling load. Significant cost savings can result from resetting chilled water temperatures in anticipation of cooling load

✓ How It Works

- When the load, chilled water ΔT , or return chilled water temperature increases, the chilled water set-point is lowered, and vice versa
- A one degree C increase in CWT makes the chiller about 2% more efficient
- You must be able to meet both sensible and latent cooling loads. Also, there may be minimum flow condition on the chiller that limits this change.

CONDENSER WATER RESET

- ✓ The same idea can be used on the other side of the chiller by reducing the temperature of the cooling water from the cooling tower.
- ✓ For every one degree C reduction in the temperature of the cooling water, the chiller efficiency goes up about 1.5 %.
- ✓ Be careful with older chillers, since they can not take too cold cooling water without developing head pressure problems.

SUPPLY AIR RESET

✓ Supply Air Reset Based on Load

- ✓ A good rule of thumb provides for a supply air temperature reset for one-fourth the difference between the supply design temperature and the design space temperature

$$SAR = \left(\frac{\text{Lowest Desired Temp} - \text{Supply Air Design}}{4} \right) + \text{Supply Air Design}$$

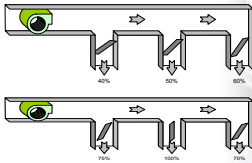
Where:

- Lowest Desired Temp is the temperature of the coolest room
- Supply Air Design is the current temperature of Supply Air

STATIC PRESSURE RESET

✓ How It Works

- ⇒ The DDC system monitors the VAV static pressure and lowers the pressure until only one damper is completely open
- ⇒ The Static Pressure and VFD control sensors must be located on the same DDC control panel



ECONOMIZER FOR HVAC

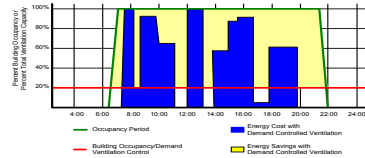
How It Works

- ✓ Reduce cooling & heating energy by optimizing mixed air temperature
- ✓ As the outside air allows, the outdoor air damper opens more
- ✓ Free heating/cooling occurs when occupant comfort is maintained without using mechanical heating or cooling
- ✓ For air conditioning, it is important to use an enthalpy based economizer which has a control unit that operates by comparing the enthalpy of the return air with the enthalpy of the outside air. This keeps the system from letting in a large amount of wet air that will require a lot of latent energy to remove water vapor.

DEMAND CONTROL VENTILATION

How It Works

- ✓ DCV provides just the right amount of outside needed by occupants
- ✓ Modulates ventilation to main target cfm/person ventilation based on actual occupancy
- Less than 700 ppm above outside CO2 concentration



HOT WATER RESET - HOW IT WORKS

Hot water boilers are very efficient at partial load

- ✓ Distribution losses are less when temperature is reduced
- ✓ Hot water reset conserves energy by reducing the boiler's operating temperature
- ✓ Hot water reset reduces thermal shock because it does not involve drastic temperature fluctuations
- ✓ To minimize flue gas corrosion, do not reset lower than 60 °C

Energy Savings Estimate

$$\text{Annual Savings (\$)} = (\text{HL (MMBtu)}) \times \% \text{ BENI}$$

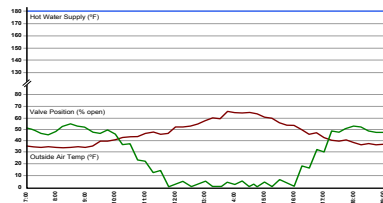
Where: HL = Heating Load BENI = %Boiler Efficiency Net Increase BE = Existing % Boiler Efficiency ABHL = % Average Boiler Heat Loss FC = Fuel Cost

$$\times \left(\frac{1}{\% \text{ BE} - \% \text{ ABHL} + \% \text{ BENI}} \right) \times \text{FC} - \frac{\$}{\text{MMBtu}}$$

HOT WATER RESET

Proof of Performance

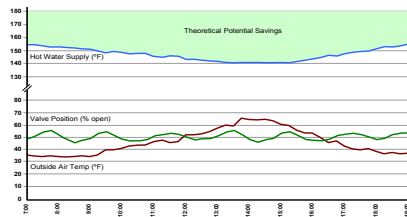
- ✓ Maintaining 180°F (82 °C) water temperature forces the heating valves to cycle open and closed



HOT WATER RESET

Proof of Performance

- ✓ Resetting the hot water temperature allows heating valves to operate in more efficient mid-actuation positions



OTHER EMS PROGRAMS

- ✓ Scheduled Start/Stop - Starting and stopping equipment based upon the time of day, and the day of the week.
- ✓ Duty Cycling - Shutting down equipment for predetermined short periods of time during normal operating hours.
- ✓ Demand Limiting - Temporarily shedding electrical loads to prevent exceeding a peak value.
- ✓ Unoccupied Setback - Lowering the space heating setpoint or raising the space cooling setpoint during unoccupied hours.
- ✓ Warm Up/Cool Down Ventilation & Recirculation - Controls operation of the OA dampers when the introduction of OA would impose an additional thermal load during warm-up or cool-down cycles prior to occupancy of a building.

OTHER EMS PROGRAMS +

- ✓ Hot Deck/Cold Deck Temperature Reset - Selects the zone/area with the greater heating and cooling requirements, and establishes the minimum hot and cold deck temperature differential which will meet the requirements.
- ✓ Steam Boiler Optimization - Implemented in heating plants with multiple boilers. Boiler plant optimization is accomplished through the selection of the most efficient boiler to satisfy the space temperature requirements during the building occupied period.
- ✓ Reheat Coil/Reset - Selects the zone/area with the greatest need for reheat, and establishes the minimum temperature of the heating hot water so that it is just hot enough to meet the reheat needs for that time period.

OTHER EMS PROGRAMS +

- ☑ Chiller &/or Boiler Optimization – For facilities with multiple chillers &/or boilers, the most efficient chiller(s) &/or boiler(s) are selected to meet the existing load with minimum demand and or energy.
- ☑ Chiller Demand Limiting – The chiller electrical load is reduced at certain times to meet a maximum pre-specified chiller kW load.
- ☑ Lighting Control – Turns lighting off and on according to a pre-set time schedule.
- ☑ Remote Boiler Monitoring and Supervision – Uses sensors at the boiler to provide inputs to the EMCS for automatic central reporting of alarms, critical operating parameters, and remote shutdown of boilers.
- ☑ Maintenance Management – Provides a maintenance schedule for utility plants, mechanical and electrical equipment based on run time, calendar time, or physical parameters.



REVIEW BAS

1. Distinguish between analog and digital control.
2. Devices using 4-20 mA current loops are using digital data transmission. (A) True (B) False
3. A facility is heated by fan coil units using hot water pumped from a central boiler system. List some EMS controls that could reduce the facility energy costs.
4. List some maintenance aids that could be provided by an EMS.
5. An optimum start device is a control function that:
 - (A) Shuts off the outside ventilation air during start up of the building.
 - (B) Shuts off equipment for duty cycling purpose.
 - (C) Senses outdoor and indoor temperatures to determine the minimum time needed to heat up or cool down a building.
 - (D) Compares the enthalpy of outdoor and return air and determines the optimum mix of the two streams.



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THANK YOU



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