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Intellidyne®

Using HVAC Controls to Reduce Energy Consumption and Environmental Impact

Energy Efficiency Portfolio Standard
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"Building" vs. "HVAC" ***Optimization***

Typical "<u>Building</u>" Optimization Strategies:

- Building Envelope
  - New Windows
  - More Insulation
- BAS/DDC Control System
  - Optimum Start
  - Time of Day Control
  - Optimum Stop
  - Night Setback
- Lighting Re-Lamping

“Building” vs. “HVAC” *Optimization*

Typical “HVAC” Optimization Strategies:

- “Optimize” Heating & Cooling Equipment
  - Control runtime based upon actual building “load”
  - Use latent heat and cooling in system
  - Delay cycle start times of burners & compressors
- Result:
  - Substantial reduction in fuel & power
  - No effect on comfort

"HVAC" Optimization
General

Consider these facts:

- A heating or cooling system must be able to provide acceptable comfort at the lowest / highest anticipated outdoor temperature. This worst-case scenario (Design Day) occurs only a small fraction of the time.
- In the U.S. and abroad, most boilers have a heat capacity <u>between 1.5 to 2 times larger</u> than that needed to maintain the space temperature on these extreme days.

"HVAC" Optimization
General

Consider these facts (cont.):

- At all other times this design consideration renders the system grossly over-sized for the demand, which causes the system to run, or cycle, in less than an optimum manner.

"HVAC" Optimization
Heating

Heating System facts:

- Due to over-sizing of the boiler, the burner cycles on and off continuously – "off", to prevent overheating of the system water during any call for heat.

- The Burner cycling rate is directly proportional to the Heating load and System losses.

"HVAC" Optimization
Heating

Heating System facts (cont.):

- There is substantial energy stored in the heating medium (water / steam) that can be extracted and used during a "hold-off" period (delay the on-cycle) without any substantial loss of output.

- This is due to the fact that not only can the boiler generate heat faster than it can be extracted, it also generates <u>more</u> heat than what <u>can</u> be extracted. Those two facts are why the burner cycles and why the space temperature doesn't change.

"HVAC" Optimization
Heating

How optimization can be accomplished:

- In the case of a heating system, the load, or demand, needs to be analyzed by monitoring the out-flow water temperature or steam pressure.
- The absolute value of the water temperature or steam pressure, and the rate that it's changing, is indicative of the building's load.
- An heating system algorithm is used to calculate the "hold off" period.

NYSERDA STUDY*

Two year study confirms significant benefits for Heating Systems:

I. 8% to 15% reduction in Energy Consumption

II. Up to 62% reduction in cycling

III. 40+% reduction in Particulates

IV. 31+% reduction in Hydrocarbon

V. 47+% reduction in CO

Heating System Optimization: *BENEFITS*

- Reduced Fuel Consumption 10 to 20%.
- Short Payback Period - Typically 6 to 18 Months
- Extends Boiler Life by Reducing Burner Cycling
- Reduced Burner Emissions Dramatically by Reducing the Number of Burner Starts.
- Reduced System Maintenance.

"HVAC" Optimization
Cooling

Cooling System facts:

- In the case of a cooling system, the rate and quantity of heat that a cooling system can remove during a given period of time, is greater than the amounts of heat that can be gained by the load (space) for the same period of time.

- This requires the system (compressor) to be cycled in order to maintain the desired temperature or the space would be over-cooled.

- The media used to extract heat from the space is air. Air has a very low mass and thus short time-constant (change in temperature per unit of time) compared to items with considerably more mass and thus a longer time-constant (i.e. people, objects, walls, furniture, etc.)

“HVAC” Optimization
Cooling

Cooling System facts (cont.):

- The items with a higher mass have a much greater thermal inertia. Thermal inertia is a property of an item to resist a change in temperature [for a given period of time].

- When the compressor is held off for only a small percentage of time, relative to the time-constants of the higher mass items temperature fluctuations are virtually non-existent.

- On a cooling system, a “real time” algorithm is used to calculate the “hold off” period and optimize the compressor output.

NYSERDA STUDY*

Two year study confirms benefits for Cooling Systems:

I. 10% to 19% reduction in compressor run time on AC Systems (Electricity Consumption)

II. 10% to 12% reductions in compressor run time on Refrigeration Systems (Electricity Consumption)

Cooling System Optimization: ***BENEFITS***

- Reduces Compressor Electric Consumption 10 to 20%.
- Short Payback Period - Typically 12 to 24 Months.
- Longer Compressor Life.
- Reduces System Maintenance Requirements.

Conclusions

The application of existing Control Technology can have a **dramatic** and **immediate** impact on energy consumption and the environment:

I. Reduce Oil and Gas consumption by heating systems by as much as 15%

II. Reduce Electricity consumption of compressors in air conditioning and refrigeration systems by as much as 20%

III. Reduce Particulates and Green House Gas emissions by as much as 47%.

*NYSERDA Study Report
REFERENCE

A Technology Demonstration and Validation Project for the New York State Energy Research and Development Authority.

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