Grocery Store Commissioning

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Agenda

Grocery Store Overview

Energy Commissioning

Commissioning Persistence
Why Grocery Commissioning?

Potential for energy savings / energy cost avoidance
  ○ 7% - 25% impact

Optimize equipment operation
  ○ Lower energy usage
  ○ Extend equipment life
  ○ Ensure quality of perishable foods

Increase / Sustain NET PROFIT
Typical Grocery Store

50,00-60,000 sq. ft
3,000,000 annual KWh
54 KWh/sq. ft.
Grocery Stores

35,000 stores

Median sales = $400,000/ week

Net profit = $380,000 / 2% sales

Source: 2009 Food Market Institute survey
Store Energy Use

3,000,000 annual KWh

$300,000 + annual electrical expenses

National 2,000 store chain = $700 million
Grocery Commissioning
Grocery Store Energy Use Profile

Source: EPA, 2007
Refrigeration System

Heat Transfer Equipment

Control Equipment
Heat Transfer Equipment

Condenser

Cases/Evaporators

Compressors
Parallel Rack

Store: 4 racks, 16-30 compressors
Air Cooled Condenser

Store: 4 condensers, 30-40 fan motors
Display Cases

Store: 145 cases, 500-600 fan motors
Storage Box Evaporator Coil

Store: 15 evaporators, 40-50 fan motors
Control Equipment

Evaporator Pressure Regulator
Store: 40 valves

Head Pressure Control Valve
Store: 4 valves

Thermo Expansion Valves
Store: 145 valves

Energy Mgt panels:
Store: 4-5
EMS Control Algorithms

PID algorithms for control of:

- Compressor cycling
- Discharge pressure
- Suction pressure
- Condenser fans
- Anti sweat heaters
- HVAC
- Lighting
Energy Commissioning

HVAC

Anti Sweat Heaters

Refrigeration Control Equipment
Key HVAC Commissioning Tasks

Fresh air damper adjustment

Compressor unloader adjustment

Night setback / Blower motor night cycle
Key Anti Sweat Heater Commissioning

Optimize heater control strategy to space dew point
Anti Sweat Heater Control

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<table>
<thead>
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<tbody>
<tr>
<td>Yearly Heater Power with</td>
<td>535,395</td>
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<tr>
<td>Einstein (kwh)</td>
<td></td>
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<tr>
<td>Yearly Heater Power with</td>
<td>676,000</td>
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<tr>
<td>Fixed Heater (kwh)</td>
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<tr>
<td>% Savings (Einstein/Fixed)</td>
<td>38.9%</td>
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![Graph showing heater power comparison between Einstein and Fixed control systems.](image-url)

Courtesy, Emerson
Refrigeration System Energy Commissioning
Compressor Power Equation

\[ P_c = m_R \cdot P_s \cdot \frac{\alpha}{\alpha - 1} \cdot \frac{1}{\rho_s} \cdot \left[ \left( \frac{P_d}{P_s} \right)^{\frac{\alpha - 1}{\alpha}} - 1 \right] \] (1)
System Energy Optimization

Reduce system energy use:

- Lower discharge pressure
- Increase suction pressure
- Increase refrigerant density

Reduce the amount of refrigerant being pumped
Key Commissioning Tasks

Control Valves

• Adjust EPR valves

• Adjust head pressure controls

• Adjust TEV superheat
Evaporator Superheat
Energy Management System

Calibrate sensors

Program for:
- Floating suction pressure
- Floating head pressure
- Compressor staging
- Compressor cycles
- Condenser fan staging
Effect Of Floating Suction On Compressor Efficiency

Courtesy, Emerson
Effect of Floating Head Pressure
On Compressor Efficiency

![Graph showing the effect of condensing pressure on compressor efficiency. The graph plots condensing temperature in °F against compressor EER (Btu/W-hr) with a downward trend as condensing pressure increases.

Courtesy, Emerson

18th National Conference on Building Commissioning
Measuring Results
Suction Pressure Log

Before

After

- Tighter Suction Pressure
- Higher Avg. Suction Pressure
- Tighter Case Temperature

80% Avg Cycle Reduction!
Suction pressure – R 507

Post Commissioning

Pre Commissioning

Date
The Value of Energy Commissioning

Commissioning Impacts Energy Consumption

Pre Commissioning

Post Commissioning

25% reduction
Case Study: Commissioning Results, S. California  #480

730,000 kwh @ $.10/kWh = $73,000/yr savings

Additional savings in maintenance costs

Courtesy, Albertson’s
Persistence
Energy Monitoring

System Operation Changes

System Operation Restored!

Commissioning

Courtesy, Aztec Energy Partners
Key Takeaways

• Grocery store commissioning is unique

• Opportunity for energy savings / cost avoidance directly related to level of system optimization

• Commissioning performed by, or in partnership with, grocery experts

• Persistence programs are essential for sustaining savings / costs avoidance
Questions
Thank-you
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