LEVERAGING MAINTENANCE AS THE FOUNDATION FOR BUILDING OPTIMIZATION

October 14, 2014
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• Maintain
• Operate
• Optimize
Leveraging Maintenance as the Foundation for Building Optimization

Why Choose this path?

**Campus at Large**

- Over 20 million square feet
- All types of building uses ranging from 100 yr old to new buildings
- Combined Heat & Power Plant distributing chilled water, steam, and electricity to all “on campus” buildings
- 90% of all campus buildings are metered (at the building level)

**Program Background**

- 2007
  - DSEMC formed
- 2008-2009
  - $16.1 spent to:
    - Retrofit lighting
    - Replace failed steam traps
    - Retrofit plumbing fixtures with low-flow fixtures
- 2012
  - Rebirth of demand-side program with EWC
  - Formed by reclassifying existing positions
  - Consists of 8 FTE’s and has two major components
    - Behavioral
    - Technical
  - Emphasis on staffing, rather than on capitol
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Why Choose this path?

Results Since Program Inception

<table>
<thead>
<tr>
<th>Time</th>
<th>Cumulative Avoidance (Fuel Only)</th>
<th>Cumulative Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY09-FY14</td>
<td>$5,900,000</td>
<td>$16,500,000</td>
</tr>
</tbody>
</table>

UT

Where we began

- Focus on low to no-cost ECM's
- HVAC accounts for 75% of total consumption
- Researched typical ECM's such as:
  - Scheduling
  - Cooling & heating resets
  - Economizing
  - Demand control ventilation
- Proof of concept at NOA to demonstrate potential
  - Very successful project and netted a reduction of 50%
- ECM roll out where applicable across campus
- Success of reductions varied from building to building based on:
  - Original design
  - Building use type
  - Condition of equipment

Actionable

CAMPUS ENERGY BREAKDOWN

- Steam 24%
- CHW 54%
- Electricity 22%
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**Building Equipment Condition**

**Cooling & Heating Resets**

**UT**

**Building Equipment Condition**

**Economizing & Demand Control Ventilation**
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**Current Programs**

- EWC Behavioral Conservation Measures
  - Longhorn Lights Out
  - Horns Up, Sash Down
  - Power Down Assessments

**Our Greatest Common Challenge**

What we are striving for

- Optimize
- Efficiency

**Key Takeaways**

- Being lean does not always mean more green
- Proper maintenance is required to successfully reduce and sustain energy avoidance
- The optimal balance between energy & maintenance will lead to sustainable decreases in operating costs
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The MOO Plan

Maintain → Operate → Optimize

Foundation for energy management
The MOO Plan
Each layer has components to build on, all dependent on the prior components

The MOO Plan
Each layer has components to build on, all dependent on the prior components
The MOO Plan
Where we currently are.
Very minimal opportunity for optimization.

Optimize
Operate
Maintain

By first building our maintenance base we can pursue greater levels of energy performance and optimization.

Optimize
Operate
Maintain
Steamb Trap Management

Sample Programs to Support MOO

Steam Trap Management
Global Temp & RH Sensors
Energy Variance Reporting
Retro-commissioning

Why Steam Traps?

- Steam traps can fail without any impact to the end user
- Failures are internal to the system and can be difficult to detect if not proactively maintained
- PM’ing will lead to other findings/corrections for whole steam system
- Can save significant $$
**Steam Trap Management**

Program Milestones

- Partnered with GBA Solutions (Armstrong Distributer)
- Training for EWC & for technical staff
- Field Training with Armstrong Experts
- SteamStar Database
- New/Improved PM procedure

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**Global Outside Temperature & Humidity Sensing**

**Before**

- Currently 200+ OA temp & RH/dew point sensors on campus
- Equipment does not have its own PM procedure
- OA sensors used to control cooling & heating resets & economizing

**After**

- 6 combo temp/RH sensors
- New PM procedure and BAS alarm
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UT Retro-commissioning at Belo Center for New Media

Project Scope & Purpose:

- Decrease energy conservation while increasing occupant comfort and reliability of equipment

Findings:

Deficiencies were found in all areas of construction

- Design:
  - AHU1a sequence
  - OAHU set points

- Controls Integration:
  - VAV’s assigned to the incorrect AHU
  - VAV’s missing for graphics

- Commissioning:
  - Discrepancies in duct size which are used to calculate flows

- Operations & Maintenance:
  - Dampers disabled
  - Temperature set points disabled

UT BMC

Design
UT BMC

Controls Integration

Findings: Deficiencies were found in all categories and impact the ability to sustain conservation measures

UT BMC

Commissioning

<table>
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<tr>
<th>VAV</th>
<th>Mechanical Schedule</th>
<th>Actual Received</th>
<th>OFPC Functional Checklist</th>
<th>TAB &quot;Air Balance Data&quot;</th>
<th>TAB &quot;Full Cooling Table&quot;</th>
<th>BAS</th>
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Findings

- Deficiencies were found in all categories and impact the ability to sustain conservation measures

UT • OFPC engagement • Reshaping commissioning process • Failures occur in “new” buildings • There is still plenty of opportunity • A great opportunity for client engagement while reducing operating costs • Increased need for training for technicians • Need to continue this effort
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**Variance Report - TNH**

Comparing the period: August 16, 2014 through September 1, 2014 versus the period: August 3, 2014 through August 17, 2014

### Chilled Water

<table>
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<tr>
<th>Rank</th>
<th>Bldg</th>
<th>% over average</th>
<th>Cost over expected</th>
<th>Steward</th>
<th>Possible Cause</th>
<th>Details</th>
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### Steam

<table>
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<th>% over average</th>
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<th>Steward</th>
<th>Possible Cause</th>
<th>Details</th>
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**Variance Report - TNH**

Preheat Steam Leak

Preheat temp is much higher than OA temp
Example of Other Problems

- OA flow not meeting setpoint because:
- Mixed air temp inaccurate
- Unit is off

Utility Cost Increases
- $4,114.61 - Steam
- $4,541.11 – CHW
- $8,655.72

$393 per day
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MOO-ving Ahead (Future Goals)

Near Future

- Continue & Grow Efforts
  - Additional staff engagement
  - Funding & Incentives

Long Term

- Fault Detection & Diagnostics
- Optimization

THANK YOU