National Grid
Your Partner in Energy Solutions

Data Center Presentation
February 27, 2013
Presented by: Fran Boucher | National Grid and John Weale | Integral
francis.boucher@nationalgrid.com
Beat the heat with cool cash from utilities
Grow your infrastructure with utility dough $!

1. Two Part Presentation
   - How National Grid efficiency programs benefit data centers beyond saving energy
   - Spotlight on a new Thermal Analysis program National Grid provides
Webinar Objectives

1. Energy efficiency may be just a leveraging point
2. Opportunities for Data Center HVAC and Electric systems
   - Redundancy / Reliability
   - Increasing capacity
3. How to determine if your facility has an opportunity
4. How to get third party capital handed to you with no hitches
Over $200 Million Available In 2013!

Towns with Municipal Electric Companies EXCLUDED
Why Bother If Energy Cost Is Not Your Issue?

IT DEPARTMENT CONCERNS with Facility Infrastructure

1. Reliability
   - Uniform room temperature
   - Adequate HVAC capacity
   - Adequate redundancy of HVAC and UPS
   - HVAC and UPS service outages

2. Capacity for growth (HVAC and UPS)

3. Capital budget constraints
Stretching Your Capital

1. Instead of increasing HVAC capacity by 20% go as high as 100% with 2 to 2.5 year payback

2. A new UPS rather than simply doing a battery replacement
SURPRISE!
We do that!
and we use energy savings as source of funding!
Capacity, Reliability and Redundancy

Our solutions may assist you with existing facilities:

1. Identify hot spots and help fund corrective measures
2. Squeezing an extra 25 to 30% capacity out of your CRAC units
3. Extend capacity out of your generator back up
4. Provide you a completely redundant cooling system
5. Provide you with an additional (back up) cooling tower
6. Provide free cooling which gives you redundancy for chillers 30 to 40% of the hours in the year
Situations Where We Could Help

1. Inability to maintain low enough room temperatures
2. One CRAC unit with service issue creates a high temperature condition
3. Lawn sprinklers running on your roof top HVAC condensers
Op-Ex Reduction

1. Cutting operating expenses for facilities by as much as $500,000 annually
New Data Center Initiative

Targets: New, Existing, Expansions, Renovations
(Note: In NY ground up new construction are by NYSERDA)

• Data centers
• Computer Rooms
• Server farms
• Electronic equipment test rooms

May or may not have; raised floor, drop ceilings, UPS or generator
National Grid Services

1. Free initial walk through or plan review
2. Extensive metering or thermal graphic analysis where applicable
3. Up to 50% share of detailed energy efficiency studies
   - Investment grade technical and economic analysis
4. Incentives $$$$$$ for installing efficient equipment and controls
   - Engineering, labor and materials
     - Incentives up to $1 million / project

You choose your own design engineer and the installing contractor
New Construction / Renovation

Top Opportunities

1. In row / close coupled cooling systems
2. VFD’s on fans
3. Upgrading to include isle containment
4. More efficient UPS Systems
5. Free cooling
Ducted Upflow CRAC System
In Row Cooling Units
**Example: Staples Adaptive Cool**

<table>
<thead>
<tr>
<th>Size:</th>
<th>25,000 SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC:</td>
<td>16-20 to 30 Ton CRAC units</td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$100,000</td>
</tr>
<tr>
<td>Cost:</td>
<td>$271,000</td>
</tr>
<tr>
<td>Incentive</td>
<td>$148,000</td>
</tr>
<tr>
<td>Payback</td>
<td>15 months</td>
</tr>
</tbody>
</table>
Case Study 2: Solution

1. Install hot isle containment
2. Shut off a several CRACs using automated controls
3. Adaptive Cool Panels
4. Install plenum return
Before

After
**University Reheat and Humidification**

<table>
<thead>
<tr>
<th><strong>Size:</strong></th>
<th>approx. 2,000 SF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HVAC:</strong></td>
<td>Multiple CRAH units</td>
</tr>
<tr>
<td><strong>Annual Savings</strong></td>
<td>$7,500/ 67,000 kWh savings</td>
</tr>
<tr>
<td><strong>Cost:</strong></td>
<td>$500</td>
</tr>
<tr>
<td><strong>Incentive</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Payback</strong></td>
<td>1 month</td>
</tr>
<tr>
<td><strong>Modification:</strong></td>
<td>Adjust Controls</td>
</tr>
</tbody>
</table>
### Higher Education: VSDs and Containment / Air Flow Mgmt.

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<tr>
<td>HVAC:</td>
<td>Multiple CRAH units</td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$16,000/ 153,000 kWh savings</td>
</tr>
<tr>
<td>Cost:</td>
<td>$72,000</td>
</tr>
<tr>
<td>Incentive</td>
<td>$36,000 (50%)</td>
</tr>
<tr>
<td>Payback</td>
<td>2.4 years after incentive</td>
</tr>
<tr>
<td>Modification:</td>
<td>VSDs on CRAH units and air flow management</td>
</tr>
</tbody>
</table>
## Multi-Tenant Retrofit Free Cooling

<table>
<thead>
<tr>
<th>Size:</th>
<th>approx. 20,000 to 30,000 SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC:</td>
<td>More than 12 CRAH units</td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$64,000/ 636,000 kWh savings</td>
</tr>
<tr>
<td>Cost:</td>
<td>$305,000</td>
</tr>
<tr>
<td><strong>Incentive</strong></td>
<td>$150,000 (50%)</td>
</tr>
<tr>
<td>Payback</td>
<td>2.5 years after incentive</td>
</tr>
<tr>
<td>Modification:</td>
<td>Adding dedicated tower to current under-utilized economizer.</td>
</tr>
</tbody>
</table>
Major Legacy DC Retrofit

Size: 100,000 SF

HVAC: 90-30 Ton CRAC units

Annual Savings $470,000 / 420,000 kWh savings

Cost: $1.4 million

Incentive $930,000 !!!!!

Payback 1.0 years

VFD’s on Fans, Containment, Blanking panels etc.
Most Common Opportunities and Solutions

**TOP RETROFIT OPPORTUNITIES** (Things to fix)

1. Existing water side economizers grossly underutilized
2. Overhead supply CRAC systems not meeting load supplementing CRAC units with $Dx$ close coupled cooling units.

**RETROFIT SOLUTIONS**

1. Using ceiling plenums as return air path for downflow CRACs (reducing number of on line CRAC units)
2. Controls putting excess capacity on stand by (in excess of N+1)

90% of jobs we’ve looked at have had opportunities to save energy
In Row Cooling Units
Solution Adaptive Cool

• 2’x 2’ Floor tile with a VSD fan that pushes extra air where needed.
• Eliminates hot spots, reduces need for general overcooling
• For under floor cooling systems
Underestimating the Range of Solutions

What’s your reason for not acting?

1. No water in data center
2. Floor space constraints
3. Can’t get Hot Isle / Cold Isle configuration
4. Fire department objection to containment curtains
5. Plastic containment curtains unsightly?
6. Mismatched server cabinet dimensions?
   - There are “countless” products and approaches.
   - Each constraint can be overcome.
New National Grid Metering Pilot

Free to first 10 customers ($3,500 to $6,500 value)

1. Wireless metering of CRAC unit electric use
2. Temporary wireless sensors produce a “thermal image”

$5,000 to $7,500 Value
Metering Offer

Requirements

1. Facility must have sufficient cooling load to justify study

2. Metering Offer
   • Smaller sites: CRAC power monitoring (30 days)
   • Larger Computer room or Telcom sites: Thermal Graphic (6 hr.)

3. Includes initial summary of opportunities and high level analysis

4. Prepares you for consideration of full detailed study
Wireless Metering Option

Wireless power monitoring for CRACs

Typically for smaller projects with 3 to 6 CRAC Units

Wireless Current Transformer

Measure reheat use, humidification power and compressors
What is the Potential?

Our nine most recent surveys collectively identified $1.0 million in annual savings.
Bonus Incentives
For MA and RI
for many new projects completed in 2013!
Introducing

John Weale

Integral Group
Thermal Mapping And

Efficiency Opportunities
Details: What is Thermal Mapping?

- Identifies hot spots by measuring the temperature across the entire floor
- 200 – 300 wireless temperature sensors deployed to make map
- Provides hard data on effectiveness of datacenter conditioning
- Attractive product to datacenter operators, emphasizes respect for critical nature of temperature control
Can map underfloor pressure distribution
Sign Up for Free Metering Offer

LIMITED TIME OFFER!

Contact:

Fran Boucher

Francis.boucher@nationalgrid.com

Or contact me via Linked in
Fan Optimization

6/25/2012
1. Reheat is unnecessary but often on (and energy intensive)
2. Overly tight humidity bounds can result in fighting, uncontrolled dehumidification
3. Incentive “Problem”: Payback is too low

6/25/2012
Case Study Results, *Combined Measure*

<table>
<thead>
<tr>
<th>Site #</th>
<th>Measure</th>
<th>Cost Estimate</th>
<th>Annual Savings (kWh; $)</th>
<th>Payback (before incentive)</th>
<th>Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disable reheat, add VFDs to CRAHs, airflow management</td>
<td>$73,000</td>
<td>220,000; $23,000</td>
<td>3.2</td>
<td>$36,500</td>
</tr>
<tr>
<td>2</td>
<td>Disable reheat, airflow management, disable 1 CRAH</td>
<td>$120,000</td>
<td>290,000; $30,000</td>
<td>4</td>
<td>$60,000</td>
</tr>
</tbody>
</table>

1. 2,000 SF Datacenter, CHW CRAHs and DX CRACS, Rhode Island
2. 7,000 SF Datacenter, 9 CRAHs, Andover MA
Air Management: Typical Data Center

Standard CRAC Unit Cooling Strategy

CRAC

90°F

60°F

Servers

90°F

60°F

Raised Floor
The Breakdown of the Hot Aisle/Cold Aisle Configuration
“Retrofit” Chilled Water to Increase Capacity
## Case Study, Drycooler Free Cooling

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<th>Incentive</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Install air cooled chiller with free cooling</td>
<td>$290,000</td>
<td>600,000; $63,000</td>
<td>4.6 years</td>
<td>$145,000</td>
</tr>
<tr>
<td>1</td>
<td>Install in-row coolers to increase capacity</td>
<td>$170,000</td>
<td>580,000; $61,000</td>
<td>2.8 years</td>
<td>$78,500</td>
</tr>
<tr>
<td>1</td>
<td>Combined</td>
<td>$460,000</td>
<td>1,180,000; $124,000</td>
<td>3.7 years</td>
<td>$230,000</td>
</tr>
</tbody>
</table>

1. One MW Datacenter, DX CRACs & In-row CHW, Marlboro MA
Air Side Economizing Potential;

<table>
<thead>
<tr>
<th>Supply Air Temp.</th>
<th>Full Economizing</th>
<th>Mechanical Cooling Only</th>
<th>Percent of Annual Load Covered by Chillers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hours</td>
<td>% of year</td>
<td>hours</td>
</tr>
<tr>
<td>55</td>
<td>5,200</td>
<td>59%</td>
<td>2,000</td>
</tr>
<tr>
<td>70</td>
<td>6,700</td>
<td>76%</td>
<td>50</td>
</tr>
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Free Cooling
## Case Study, Cooling Tower Free Cooling

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<tr>
<td>1</td>
<td>Renovate abandoned free cooling system</td>
<td>$45,000</td>
<td>330,000; $35,000</td>
<td>1.3 years</td>
<td>$ 0</td>
</tr>
<tr>
<td>2</td>
<td>Add new free cooling system</td>
<td>$1,000,000</td>
<td>1,300,000; $140,000</td>
<td>7 years</td>
<td>$ 500,000</td>
</tr>
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1. 50,000 SF Datacenter, AHUs and CRAHs
2. Two MW Datacenter, CHW CRAHs
### UPS Opportunities: Case Study Results

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<tr>
<td>1</td>
<td>Install high efficiency UPS</td>
<td>$80,000</td>
<td>285,000; $30,000</td>
<td>2.7 years</td>
<td>$35,000</td>
</tr>
<tr>
<td>2</td>
<td>Install high efficiency <em>modular</em> UPS</td>
<td>$29,000</td>
<td>320,000; $34,000</td>
<td>.9 years</td>
<td>$0</td>
</tr>
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1. 1 MW Datacenter, DX CRACs & In-row CHW
2. 400kW UPS load increase, datacenter expansion
Sign Up for Free Metering Offer

LIMITED TIME OFFER!

Contact:

Fran Boucher

Francis.boucher@nationalgrid.com

Or contact me via Linked in
Thank you for participating today

Contact: Fran Boucher
Data Center Initiative Manager
National Grid
Francis.boucher@nationalgrid.com
781-907-1571
Hot Aisle & Cold Aisle – Plenum Return or Overhead Supply

85°F

Hot Aisle

Physical Separation

Cold Aisle

70°F
Cold Aisle Containment –
Underfloor Supply, Space Return
Containment Can Increase Capacity

CRAC Unit Return Air Temperature vs. Design Capacity

CRAC Unit Coil Performance Curve

Actual Operating Condition
## Case Study Results, Combined Measure

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