High Performance Energy Recovery in Climates requiring Dehumidification

Tom McGee Konvekta USA, Inc.
Learning Objectives

• Comparison of standard run-around energy recovery design to a high performance energy recovery system designed specifically for a dehumidification application

• How can the selection of an enhanced energy recovery system designed for dehumidification applications result in lower initial capital expense and improved financial payback in comparison to a standard design

• What are the benefits of high performance energy recovery beyond annual energy savings
• Comparison of standard run-around energy recovery design to a high performance energy recovery system designed specifically for a dehumidification application
Building/Project Description:
- Research Lab Building
- Atlanta, Georgia
- Dehumidification Requirement
- 110,000 cfm Make-up Air
- 90,000 cfm Exhaust Air

**ER Design Objectives**
- Reduced Energy Cost
- Minimize CO2 Impact
- Peak Demand Reduction
- Redundancy / Reliability
- Utility Rebates

**ER Design Analysis**
- ALTERNATE – Enhanced High Eff. WRAP Design with “Dual Coil”

**Learning Objective – Performance of Standard vs. Enhanced**
Energy Recovery Coil Design

Learning Objective – Performance of Standard vs. Enhanced

Fin Tube Heat Exchanger with Headers at both Ends

Direction of Airflow

Cascading several tube bundles Virtually perfect counter-current
Performance Schematic @ Summer Design Temp = 93.6°F

Design Benefits:
+ Chilled Water Coil Inlet Air 87.9°F
+ Potential to downsize Cooling Coil
+ 116 Tons of Peak Savings
Learning Objective – Performance of Standard vs. Enhanced

Standard “Single Coil” Design

Performance Schematic @ Winter Design Temp = 10F

Design Benefits:
+ 94% heating effectiveness
+ Eliminates separate heating coil
+ Reduce length of AHU by 6ft
+ Less fan energy req. – no htg. coil dp
Learning Objective – Performance of Standard vs. Enhanced

WRAP “Dual Coil” Design

Performance Schematic @ Summer Design Temp = 93.6F

Design Benefits:
+ Chilled Water Coil Inlet Air 83.2F
+ Use Recovered Energy for Reheat
+ 235 Tons of Peak Savings
Learning Objective – Performance of Standard vs. Enhanced

WRAP “Dual Coil” Design

Performance Schematic @ Winter Design Temp = 10F

Design Benefits:
+ 98% heating effectiveness
  added 2 row coil = > surface area
+ Remove glycol from HW sys.
+ Optimize cond. Boilers <140F HWR-T
Learning Objective – Performance of Standard vs. Enhanced

“A primary GOAL of any energy recovery system design is to MAXIMIZE the number of hours of beneficial operation?”

Additional Benefits:
+ Optimized Financial Payback
+ Max Peak Load Reductions
+ Increased hours of operation
How can the selection of an enhanced energy recovery system designed for dehumidification applications result in **lower initial capital expense** and **improved financial payback**
Learning Objective – Financial Comparison

Central Plant Design Without ER System

<table>
<thead>
<tr>
<th>PEAK LOAD REQUIREMENTS</th>
<th>MBH</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler Sys.</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Chiller Sys.</td>
<td>1200</td>
<td></td>
</tr>
</tbody>
</table>

Note: Boiler Capacity Estimated @ $24/MBH
Chiller Capacity Estimated @ $1,000/ton

1200 Tons

1200 Tons

1200 Tons

STANDARD DESIGN (NO ENERGY RECOVERY)

<table>
<thead>
<tr>
<th>Boilers</th>
<th>MBH</th>
<th>Cost @ $24/MBH</th>
<th>Chiller</th>
<th>Tons</th>
<th>Cost @ $1000/Ton</th>
<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>B-1</td>
<td>2500</td>
<td>$60,000</td>
<td>CH-1</td>
<td>1200</td>
<td>$1,200,000</td>
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<tr>
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CAPACITY 7500

$2,580,000
Learning Objective – Financial Comparison

Central Design With “Single Coil” ER System

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<tr>
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1100 Tons

ER System
Peak Savings
3254 MBH - Heating
116 Tons - Cooling
First Cost Savings From ER System

Note: Boiler Capacity Estimated @ $24/MBH
Chiller Capacity Estimated @ $1,000/ton

Financial Results:
+ ER Cost (uninstalled) $533,000
+ CAPITAL SAVINGS ($284,000)
+ NET ER Cost $249,000

> 10 year payback due to minimal climate zone heating req. & # hours of beneficial operation (2,722 hours OFF)

Same Level of Redundancy with Less Chiller and Boiler Capacity
Central Plant Design With “WRAP” ER System

Learning Objective – Financial Comparison

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<td>1000</td>
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N+1 Redundancy

ER System
Peak Savings
3448 MBH - Heating
235 Tons - Cooling
First Cost Savings From ER System

Financial Results:
- ER Cost (uninstalled) $719,000
- CAPITAL SAVINGS ($484,000)
- NET ER Cost $235,000
- Combined Annual Gas & Elect. Savings $170,000

Same Level of Redundancy @ < 1.5 year payback of ER COST!!!
Comparative Analysis:
The addition of a 2-row energy recovery coil downstream of the cooling coil, results in going from a financial payback of > 10 years with a standard “single coil” design to less than 1.5 years with the WRAP option at a lower initial cost after accounting for central plant savings!!!!!
Why Is It Important To Consider Energy Recovery Options Early in the Design Phase?

Enhanced ER Technology Advantages:

- Annual Heating & Cooling Cost Reductions
- Carbon Footprint Reduction
- LEED Points
- Utility Company Rebates
- Boiler & Chiller Capacity Requirements
- **Cooling Tower Capacity**
- Central Plant Efficiencies
- **Replacement of Underground Chilled Water & Steam Piping**
- Physical Space Needed For Air Handlers
- Ductwork Requirements
- Sizing Fans, Heating Coils & Cooling Coils
- Free Cooling Opportunities
- Ability To Use Available Waste Heat
- **Size of Electric and Gas Service**
- Modification of Refrigerant Exhaust System
- **LEED Points**
- **Utility Company Rebates**
- **Boiler & Chiller Capacity Requirements**
- **Central Plant Efficiencies**
- **Replacement of Underground Chilled Water & Steam Piping**
- **Physical Space Needed For Air Handlers**
- **Ductwork Requirements**
- **Sizing Fans, Heating Coils & Cooling Coils**
- **Free Cooling Opportunities**
- **Ability To Use Available Waste Heat**
- **Size of Electric and Gas Service**
- **Modification of Refrigerant Exhaust System**
Questions:
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