STRATEGICALLY TRANSITIONING FROM STEAM TO HOT WATER
OUTLINE

• Brief History
• Hot Water Advantages
• Site Distribution Analysis
• Summary
A BRIEF DISTRICT HEATING HISTORY

• Holly Steam Combination Company – First Commercial District Heating (1877)
• Denver’s District Steam System – Oldest in Operation (1880)
• Post WWII Era – Low Cost Energy
• District Energy St Paul – Largest North American Hot Water District Heating (Present)
HOT WATER SYSTEM ADVANTAGES

• Less required maintenance
• Less steam knowledge in developing workforce
• Modern buildings utilizing hot water heating
HOT WATER SYSTEM ADVANTAGES – GENERATION

• Steam System Components:
  – Boiler
  – Deaerator
  – Feedwater Pumps
  – Blowdown Vessel
  – Flash Tanks
  – Condensate Receivers
  – Condensate Pumps
  – Water Treatment
HOT WATER SYSTEM ADVANTAGES – GENERATION

• HW System Components:
  – Boiler
  – Primary/Secondary Pumps
  – Air Separator
  – Expansion Tank
HOT WATER SYSTEM ADVANTAGES – GENERATION

• Lower flue gas temperature increases combustion efficiency
• Supply water reset control
• Less idle/cycling losses
• Lower conductive losses to ambient
• Little/no make-up water costs
• Lower chemical treatment costs
HOT WATER SYSTEM ADVANTAGES – GENERATION

• Increased System Efficiency
  – Solar Thermal Heating
  – Geothermal
  – Cogeneration
  – Condensing Boilers
  – Thermal Storage
  – Heat Recovery Chillers
  – Waste Heat Recovery
HOT WATER SYSTEM ADVANTAGES – DISTRIBUTION

• Lower temperatures = less heat loss
• Utilize lower cost insulating materials
• Safety – System leaks are less dangerous
• Higher likelihood of corrosion in condensate return system
• Reduced number of expansion loops
• No condensate recovery vaults.
HURDLES IN CONVERSION

• Replacement of existing Steam Distribution piping.
• Heat Transfer stations and customer connections must be replaced.
• Higher pumping energy
SITE DISTRIBUTION ANALYSIS - STEAM

- 10 Buildings
- ~1 Mile of Distribution Piping
- 150 psig Distribution
- 15 psig at Building
- Steam-to-Hot Water Heat Exchangers at Building
- Atmospheric Pumped Condensate

### Distribution Type

<table>
<thead>
<tr>
<th>Distribution Type</th>
<th>Total Building Demand</th>
<th>Distribution</th>
<th>Condensate Return</th>
<th>Heat Input Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat Load</td>
<td>Mass Flow</td>
<td>Losses</td>
<td>Total Flow</td>
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SITE DISTRIBUTION ANALYSIS – HOT WATER

- Same Network as Steam
- 2,400 MBH in Steam Demand Savings
- 149.6°F at furthest building.

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<td>-</td>
<td>2,300</td>
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<td>75</td>
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- **5% Reduction in Heating Demand**
SITE DISTRIBUTION ANALYSIS - CONSUMPTION

- Heating Consumption
  - 950MMBTU peak difference
  - 505MMBTU average difference
SITE DISTRIBUTION ANALYSIS - CONSUMPTION

- Heating Consumption
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## SITE DISTRIBUTION ANALYSIS – COST ANALYSIS

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<th>Option</th>
<th>Cost Difference</th>
<th>Simple Payback</th>
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<tr>
<td></td>
<td>Capital</td>
<td>Energy</td>
</tr>
<tr>
<td>Steam vs Hot Water</td>
<td>($1,859,123)</td>
<td>($3,973)</td>
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- 20 Year Life Cycle Considered
- 49 Steam Traps (Five Year Life Expectancy)
- New Water to Water Heat Exchangers
- New Variable Volume Hot Water Pumps (60 HP ea)
SUMMARY

• Less Maintenance Required on Hot Water Systems

• Hot Water Distribution is more Energy Efficient