Real World Application of the Heat Machine
• Serves app. 1 million square feet
• Dorms, classrooms and research labs
• Half a million square feet in research labs
• Once through air has to be de-humidified
• Accomplished by chilling air to 55 and reheating to maintain comfort conditions
• Year round heating demand
• 3600 tons of conventional chillers
• 1300 Boiler horsepower
3600 tons of conventional cooling
1300 horsepower Natural gas/fuel oil boilers
Gas Costs
Raw Electric Costs

Electric Costs

Year 1
Base Year

• Low Delta T syndrome
  • Characterized by:
    • Over pumping primary system
    • Higher chilled water supply temperatures
    • Forcing additional chillers on before chillers are fully loaded.
UAH Chilled Water Plant
• Lowest first cost option
  • Reduced run time on boiler by 3
  • Reduced maintenance on boiler

• Essentially solved low Delta T syndrome
• Allowed Us To Condition Our New Student Center From Our Existing Central Plant
  - No Square Footage Needed for Boiler in New Building
  - No Air-Cooled Chiller Near Building (Noise)

• Lowest Design/Construction Option
  - Total Project Cost ~ $550,000

• Added Cooling and Heating Redundancy
  - ~ 400 Tons of Cooling (4,800,000 BTUH)
  - ~ 180 Boiler Horsepower (6,000,000 BTUH)

• Most Economical Way For Us to Make Hot Water
What Is The Product Of A Water To Water Chiller?
What Is The Product Of A Water To Water Chiller?

COLD WATER
What Is The **BY**-Product Of A Water To Water Chiller?
What Is The **BY**-Product Of A Water To Water Chiller?

Warm/Hot Water
September 21, 2014  Heat-Machine Snapshot

What Is The Product - What Is The By-Product?
### March 26, 2014 Snapshot

**Flow Rates for Heat Machines**
- HM8 EVAP 524 GPM
- HM9 EVAP 558 GPM
- One machine running condenser 442 GPM
- Two machines running condenser 369 GPM

**Product**
- **92.4 Boiler Horsepower**
- **3,723,500 BTUH**

**Trend Studies**
- CP-CHILLER-HEAT
- CP-CHLRS-AMPS Trend
- CP-Total-Tons
- CP-CHWS-Total-Tons
- Tonnage Generated by Chiller
- CP-PRIMARY-CHWST
- CP-CT-MAEKUP-WATER
- CP-HM-HEATING BTUS

**Engine Flow-Valve Output**
- 60.0 %

**CV Flow-Valve Output**
- 0.0 %

**SCST Flow-Valve Output**
- 15.0 % Cmd

**CP-Secondary-Chwst**
- 44.2 deg F

**CP-Schwp3**
- 11 %
- On

**CP-Schwp4**
- 11 %
- Off

**EB-138-RH**
- 15.4 % RH

**CP-HM8-Heating-Cop**
- 3.6

**CP-HM8-Cooling-Cop**
- 2.5

**CP-HM9-Heating-Cop**
- 2.9

**CP-HM9-Cooling-Cop**
- 2.5

**By-Product**
- 200 Tons of Cooling
- 2,425,200 BTUH

**Total COP**

**HM COP Trend Study**

March 26, 2014 @ 08:00
For 1,000,000 BTUs

Electricity  $25.25

Nat. Gas     $8.02

#2 Fuel Oil  $24.51
### Current Fuel Cost

For 1,000,000 BTUs

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cost</th>
<th>Efficiency Cost</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>$25.25</td>
<td>_____</td>
<td>7.09</td>
</tr>
<tr>
<td>Nat. Gas</td>
<td>$8.02</td>
<td>$9.22</td>
<td>85%</td>
</tr>
<tr>
<td>Boiler</td>
<td>$24.51</td>
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</tr>
<tr>
<td>Energy Source</td>
<td>Cost Without Eff.</td>
<td>Cost with Eff.</td>
<td>COP</td>
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</tr>
</tbody>
</table>
HEAT-MACHINES TOTAL COP

September 24 Through October 14

COP TREND DATA
Product:
29,215,200,000 BTUs
872,089 Boiler HP Hours
By-Product:
22,891,836,000 BTUs
1,907,653 Ton Hours

COOLING RESULTS TO DATE (09-21-14)
4,317,691 GALLONS Saved
$6,692.42
Chemical Savings
$8,635.40
Total Chemical and Water Savings
$15,327.82

WATER SAVINGS TO DATE (09-21-14)
Cumulative Savings Since Installation

$291,219

May 13th 2013 To Sep, 21th 2014
$218,412

Annual Savings Rate
Questions