EMERGENCY CONDENSATE LINE REPLACEMENT;
UNIQUE SOLUTIONS UNDER DIFFICULT CONDITIONS
• Condensate Corrosion Issues
• Preliminary Study
  • Pipe Material Options
  • Installation Routing & Techniques
• Project Scope and Schedule
• Design Challenges
Condensate Corrosion Issues
Prefabricated 8” stainless steel (2001)

Critical during cooling season

Minor leaking at vault

Cost of sewered condensate

Below road and drive that are heavily salted

Corrosion analysis
Engineering Study

Pre-Insulated Piping

Steel Pipe w/Insulation Envelope

PP-RCT (ASTM F2389)
<table>
<thead>
<tr>
<th></th>
<th>Temperature Rating</th>
<th>Pressure Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Design Standard</td>
<td>500°F</td>
<td>175 psig</td>
</tr>
<tr>
<td>Actual Operating Conditions</td>
<td>180°F</td>
<td>&lt;50 psig</td>
</tr>
<tr>
<td>PP-RCT Ratings (SDR-11)</td>
<td>203°F</td>
<td>75 psig</td>
</tr>
</tbody>
</table>

**PP-RCT**

- Corrosion resistant
- Good insulator (200x > carbon)
- Light weight (5x < steel)
- Resistant to stray currents
- Cost effective
Flash Steam/Steam Traps

Thermal Expansion

- PP-RCT expands 2X as stainless steel; 3X carbon steel
- PP-RCT exerts 85x less longitudinal force; cannot overcome soil friction

<table>
<thead>
<tr>
<th>Material</th>
<th>Coefficient of Thermal Expansion</th>
<th>Movement in/100ft @ 200°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Steel</td>
<td>$6.7 \times 10^{-6}$</td>
<td>1.2</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>$9.6 \times 10^{-6}$</td>
<td>1.7</td>
</tr>
<tr>
<td>PP-RCT</td>
<td>$1.94 \times 10^{-5}$</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Open Cut Installation
Bore and Jack Installation
Horizontal Directional Drilling Installation
Estimated Costs

- Open Cut –
  - Pre-Insulated Stainless Steel
- Bore and Jack –
  - Pre-Insulated Stainless Steel
- Horizontal Directional Drilling –
  - PP-RCT

Relative Estimated Costs

- 1.0X
- 0.86X
- 0.60X
Design Challenges

PROJECT SCHEDULE

Start Survey and Design: February 2, 2018
Submit Bid Documents: February 15, 2018
Bids Received: February 28, 2018
Substantial Completion: April 27, 2018

*Condensate to be Energized for Cooling Season
Design Challenges

Newton Parking Ramp
Westlawn
Carver Biomedical Research Facility
Newton Road
Pappajohn Biomedical Discovery Building
Design Challenges

Newton Parking Ramp

Westlawn

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Newton Road
Design Challenges

Newton Parking Ramp

Westlawn

Carver Biomedical Research Facility

Pappajohn Biomedical Discovery Building
Design Challenges
### Contractor Familiarity with the product

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Allowable Pullback Force (lb)</th>
<th>Minimum Bending Radius (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td>27,600</td>
<td>23</td>
</tr>
<tr>
<td>Fused PVC</td>
<td>25,000</td>
<td>190</td>
</tr>
<tr>
<td>PP-RCT</td>
<td>21,450</td>
<td>215</td>
</tr>
</tbody>
</table>

*Anticipated pullback force of 5,500 lb per design calculations*
Design Challenges
Summary

- Quick installation
- Cost effective
- Corrosion resistant
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PROFILE - DIRECTIONALLY DRILLED 8" PP-RCT CONDENSATE