New Hot Water District Heating System for Cornell’s North Campus Dorms

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Cornell North Campus Hot Water System Replacement - Overview

Our discussion will address the following areas:

- Background & rationale for project
- Lifecycle cost analysis
- Notable project elements
- Design highlights
- Construction experiences & challenges
Project Background

- Robert Purcell Community Center
  - Dining and Common Space
  - Steam supply with central HX’s
- North Campus Dormitories
  - Minimal mechanical space
- Original System
  - Transite looped distributed heating HW & domestic HW
  - Problems with cast iron fittings – Ave. leakage of 1000 gal/day
  - Major failure in 1982
- 2nd System
  - FRP looped distributed heating HW & domestic HW
  - Annual large leaks. Alarm set for 20 gal/hr.
Original 1971 Transite HW/DHW System
1988 FRP HW/DHW System
North Campus HW System
North Campus HW System Replacement Study Phase – Lifecycle Cost Analysis

Evaluated both district heating and distributed boiler options.

Notable items considered in lifecycle cost analysis:

- Initial capital costs
- Renewal and/or replacement capital costs based on expected equipment life
- Heat production energy costs
- Pumping electrical energy costs
- Piping & equipment maintenance costs
- Piping thermal losses
- Gas and electric price forecasts
# Lifecycle Cost Analysis Scenarios

<table>
<thead>
<tr>
<th>Scenario A (Base Case)</th>
<th>Looped, 4-pipe distribution system (separate space heating &amp; DHW pipes); Existing supply &amp; return temperatures</th>
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<tbody>
<tr>
<td>Scenario B</td>
<td>Looped, 4-pipe distribution system (separate space heating &amp; DHW pipes); Increased delta T</td>
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<td>Scenario C</td>
<td>Looped, 2-pipe distribution system; DWH ETS at each dorm; Increased delta T</td>
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<tr>
<td>Scenario D</td>
<td>Looped, 2-pipe distribution system; Electric DWH heaters at each dorm; Increased delta T</td>
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<tr>
<td>Scenario E</td>
<td>Looped, 2-pipe distribution system; DWH ETS at each dorm; Increased delta T; Distribution piping in concrete trench box tunnels</td>
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<td>Scenario F</td>
<td>Radial, 2-pipe distribution system; DWH ETS at each dorm; Increased delta T</td>
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<td>Scenario G</td>
<td>No distribution piping; Single distributed boiler w/ DWH ETS installed at each dorm (no redundancy); DWH ETS at each dorm</td>
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<tr>
<td>Scenario H</td>
<td>No distribution piping; Pair of distributed boiler w/ DWH ETS installed at each dorm (full redundancy); DWH ETS at each dorm</td>
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Notable Project Elements

Pre-insulated EN253 piping supplied by new entrant to the North American market

- European manufacturer of EN253-certified piping partnered with US piping manufacturer to supply piping to the US.
- Cornell North Campus project was the first project to install piping supplied by this vendor partnership.

Packaged ETS substations of European style design

- Packaged substations have design elements and certain components common in European packaged substations.
- Substations are manufactured and supported in the US.
- Second installation in North America of packaged substations of this type.
Pre-insulated EN253 District Heating Piping

- Fully bonded system
- Tested in accordance with EN standards
- Thin-walled steel carrier piping
- Integrated leak detection
- Isolation valves: Pre-insulated, direct buried weld-end ball valve
Pre-insulated Steel Hot Water Pipe Design - Challenges

- Minimize routing in walkways
- Retain access to dorm buildings
- Maintain existing DHW piping
- Avoid tree drip rings
- Minimize piping bury depth
Pre-insulated Steel Hot Water Pipe Design – Curved Piping

- Avoided high stress 45° elbows
- Minimized impact to walkways
Dorm Building Interconnections

- Existing building space heating interconnections & new DHW ETS
Packaged DHW Substations (ETS)

Key components:
- Heat exchanger
- Energy meter
- Control valve
- Strainers
- Isolation valves
- Instrumentation
- Controller
Packaged DHW Substations (ETS)

Packaged substation features/benefits:

- Compact
- Standardized, but can be customized
- Easily repurposed
- Procurement & schedule benefits
Project Construction Challenges

- **Budget** - Set 3 years earlier before rules change
- **Routing** – Maintain DHW & keep walks open
- **Coordination** - Summer Dorm Occupancy
Project Construction Challenges

- **Weather** – Wet Summer
- **Leak Detection** - Unfamiliar
Duct Banks Conflict

- Field adjustment for conflict with electrical and telecom duct banks
- Impact on thermal stresses was analyzed

- Completed field joint
Thank you!

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