

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

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Cornell University



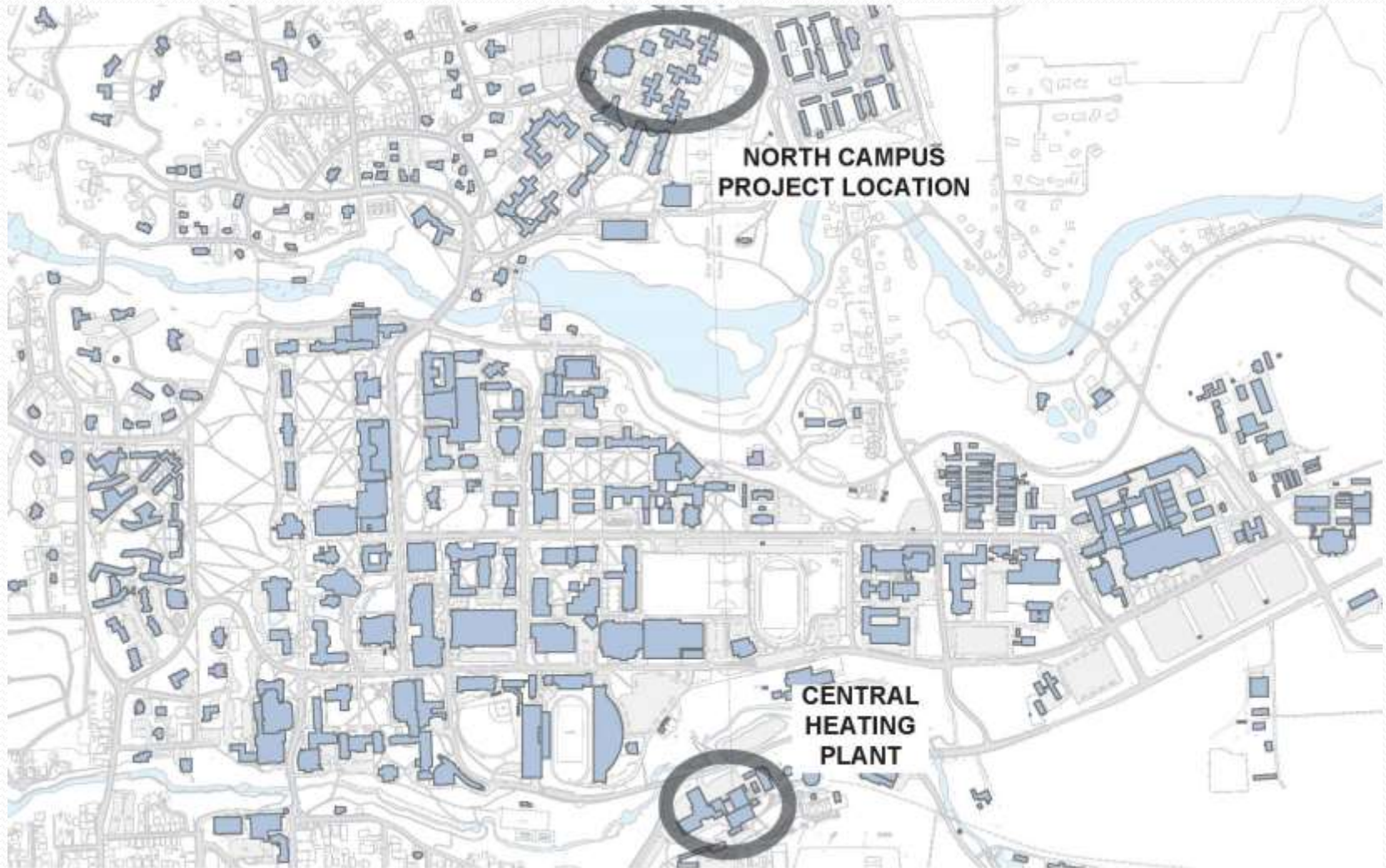
# Cornell North Campus Hot Water System Replacement - Overview

Our discussion will address the following areas:

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



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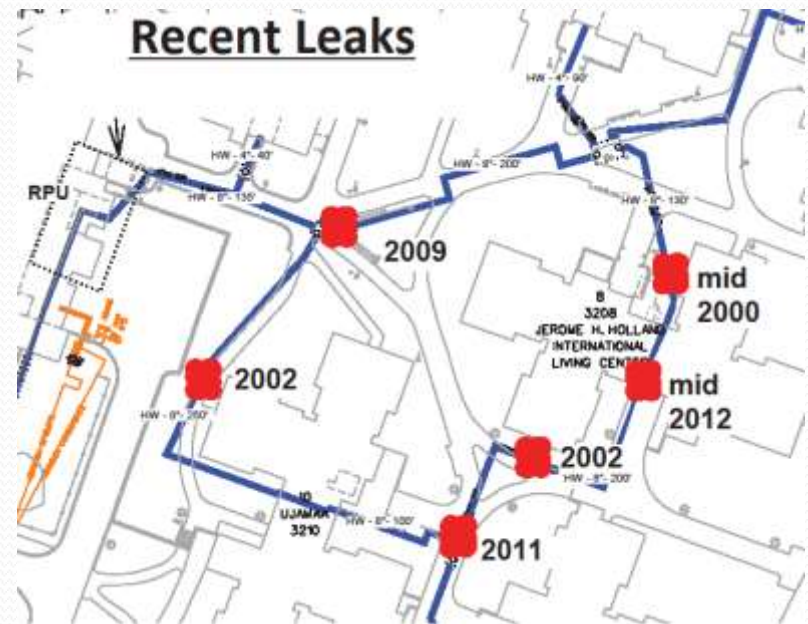


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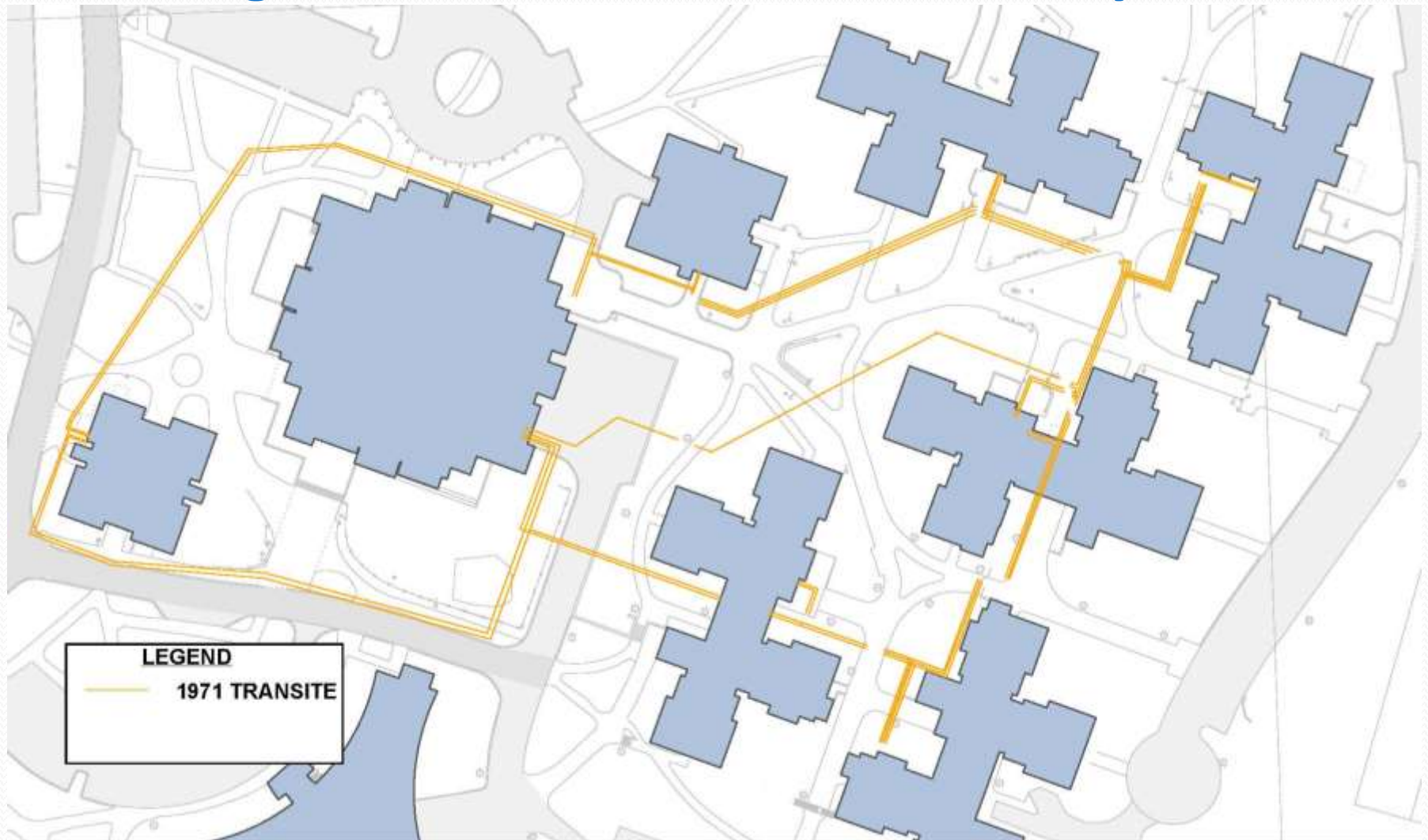
# Project Background

- 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
- 2<sup>nd</sup> System
  - FRP looped distributed heating HW & domestic HW
  - Annual large leaks. Alarm set for 20 gal/hr.

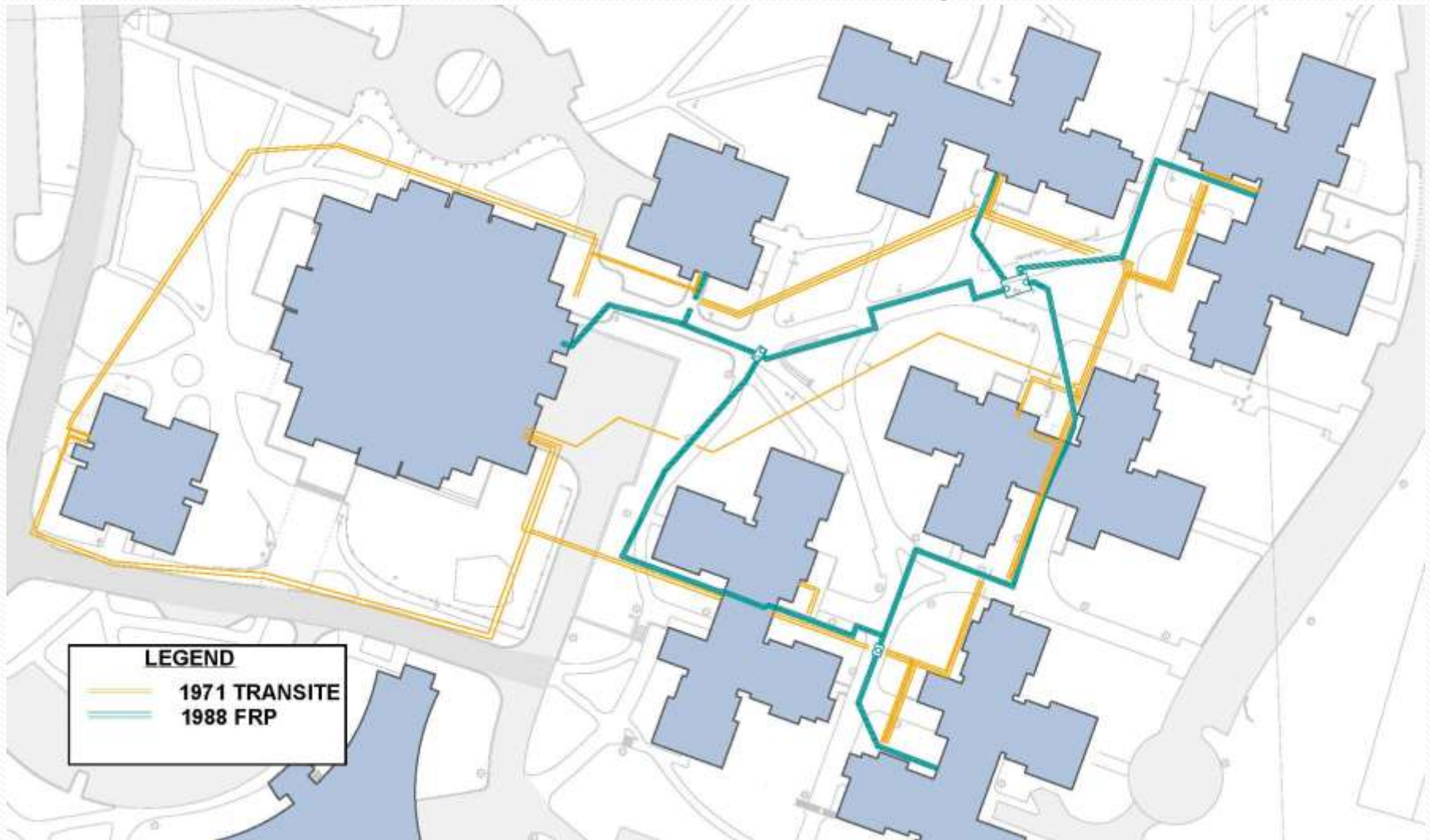




# Original 1971 Transite HW/DHW System

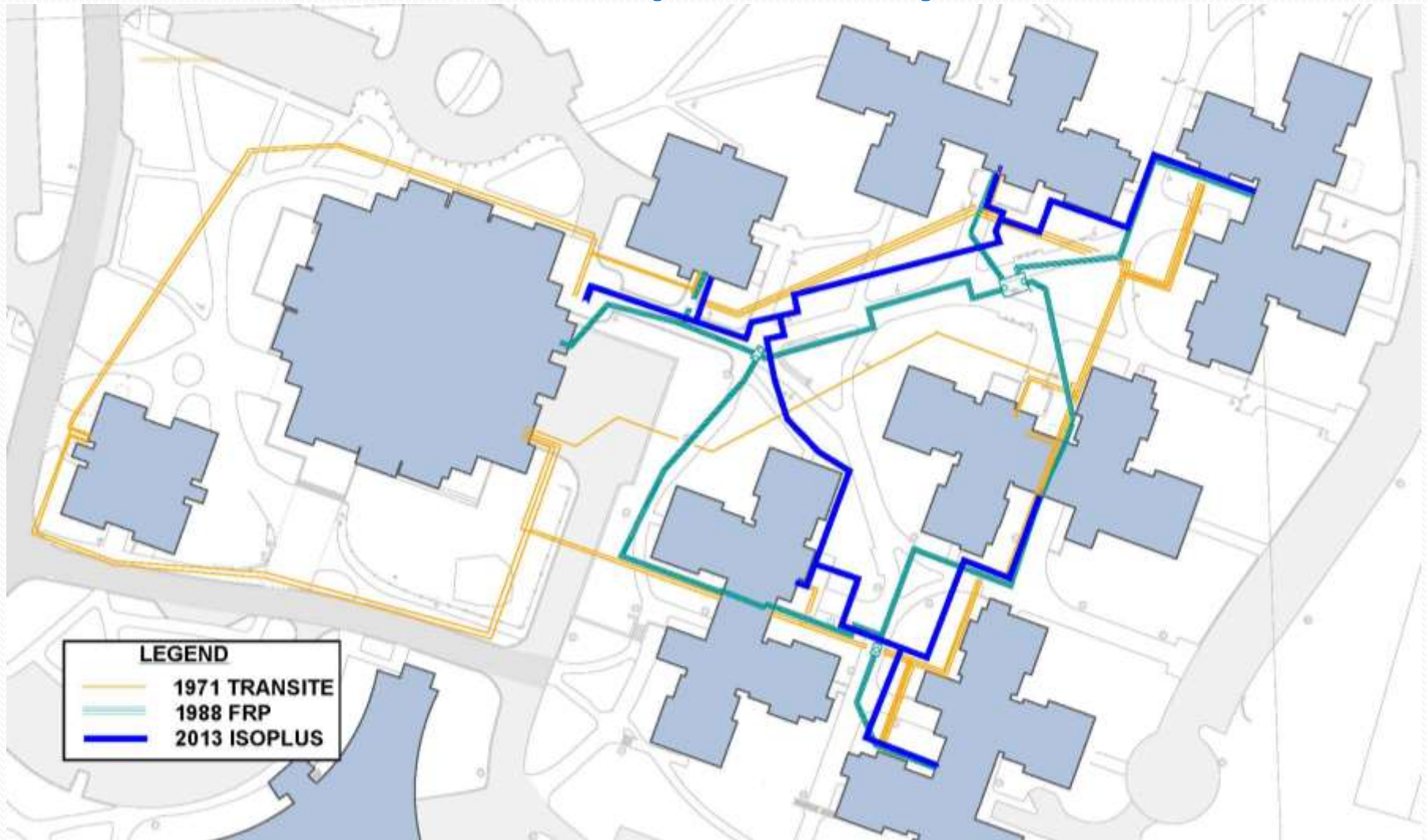


# 1988 FRP HW/DHW System





# 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



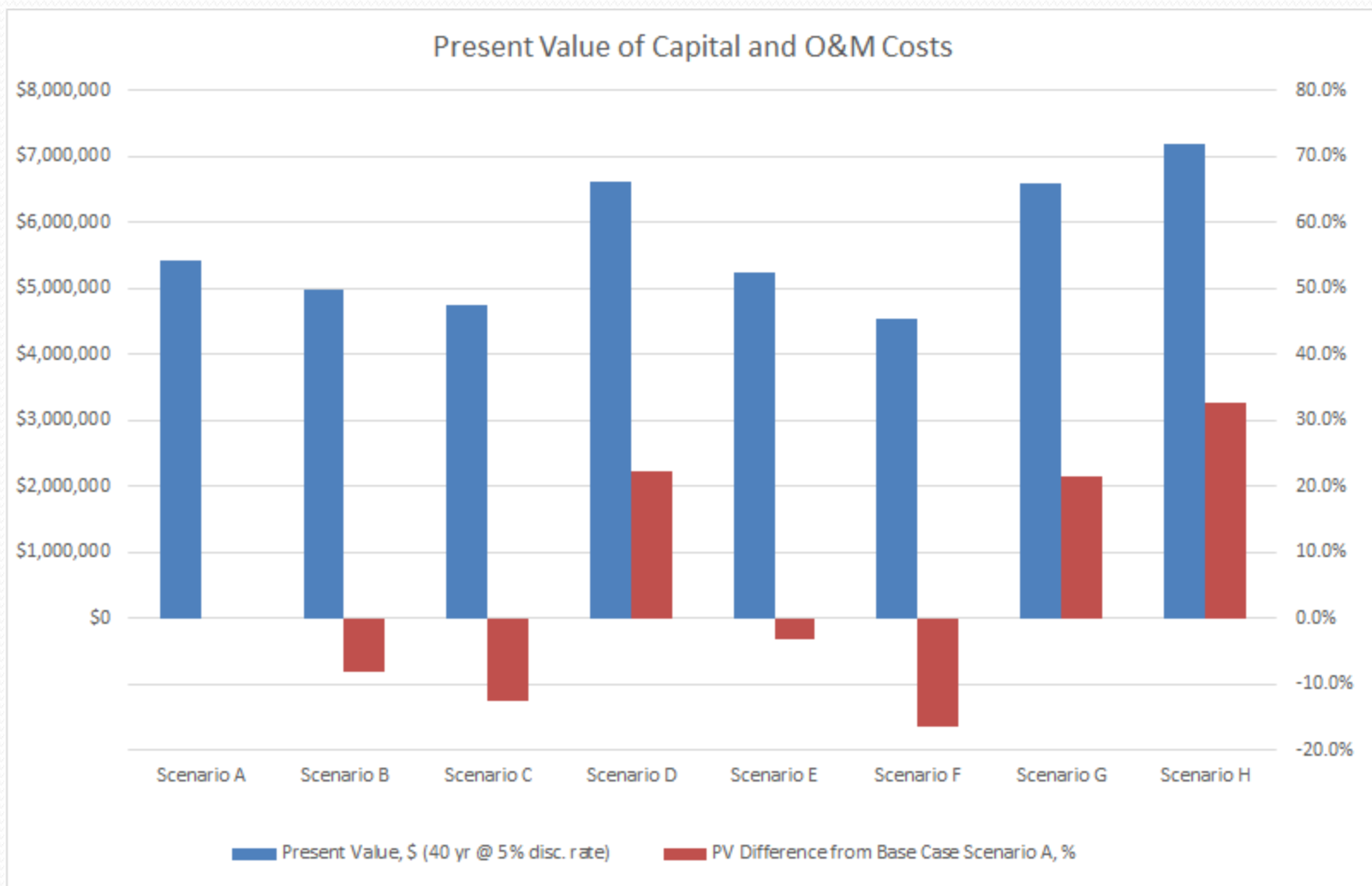


# Lifecycle Cost Analysis Scenarios

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



# Lifecycle Cost Analysis Results



## 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

45° T-Branch



Parallel-Branch



Vertical-Branch



T-Piece acc. to DIN EN 10253-2



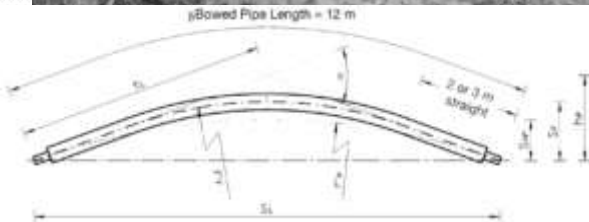
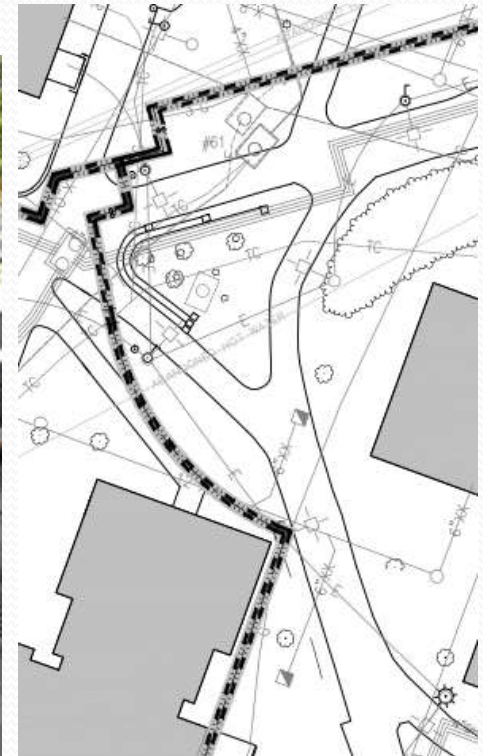


A detailed site map of the University of Maryland Eastern Shore campus. The map shows several buildings, including the Robert Purcell Community Center (3212), Jerome H. Holland International Living Center (3208), and Just About Music (3209). It also shows parking lots, including the temporary Wilson Park and the main parking lot. Construction zones are indicated by dashed lines and hatched areas, with labels for 'CONTRACTOR SITE ACCESS/FIRE LANE' and 'KEEP DIST. MIN. OF DRIVE OPEN'. The map includes a north arrow in the top left corner and a scale bar in the bottom right corner.

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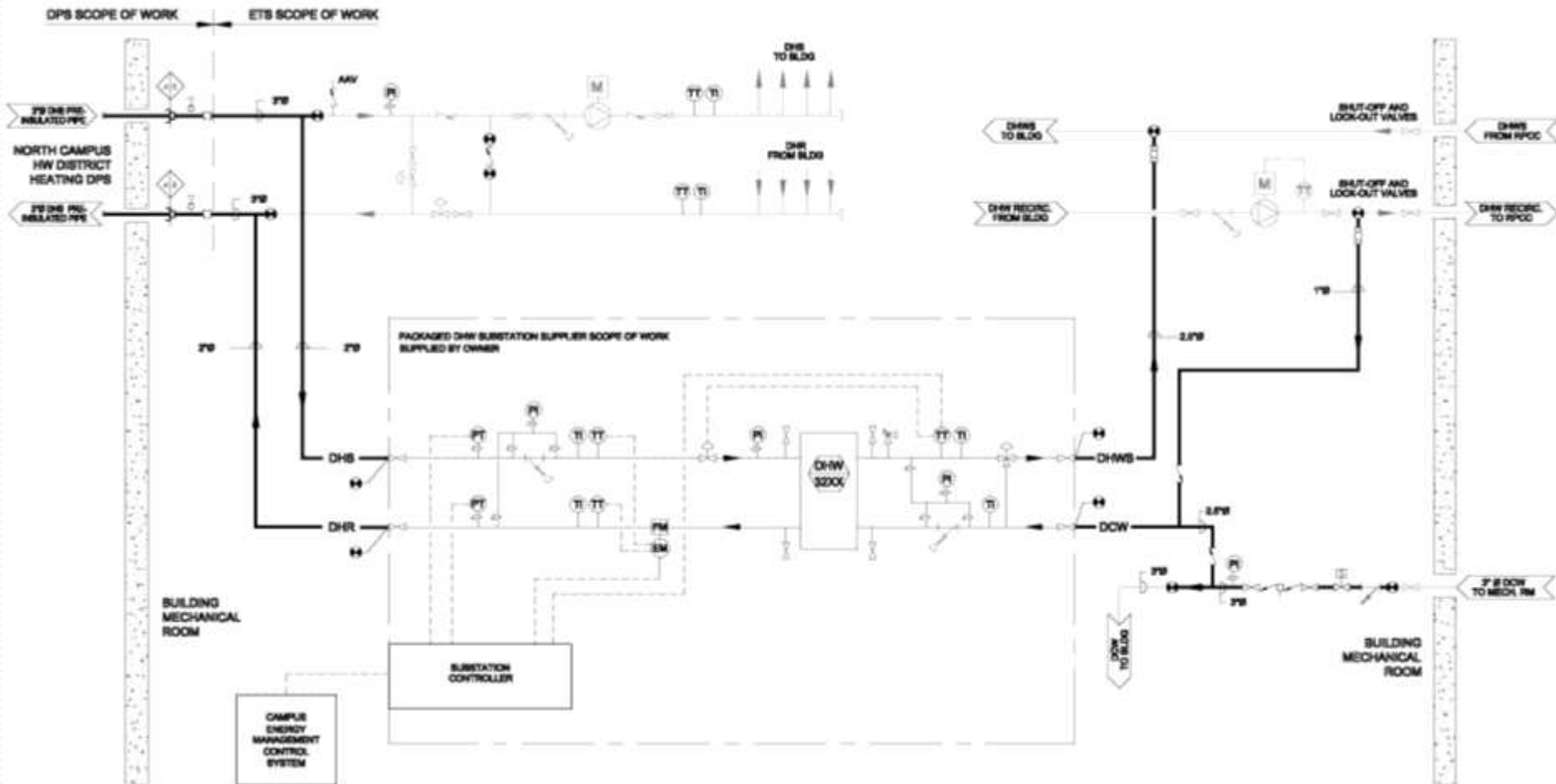
# Pre-insulated Steel Hot Water Pipe Design – Curved Piping

- Avoided high stress 45° elbows
- Minimized impact to walkways



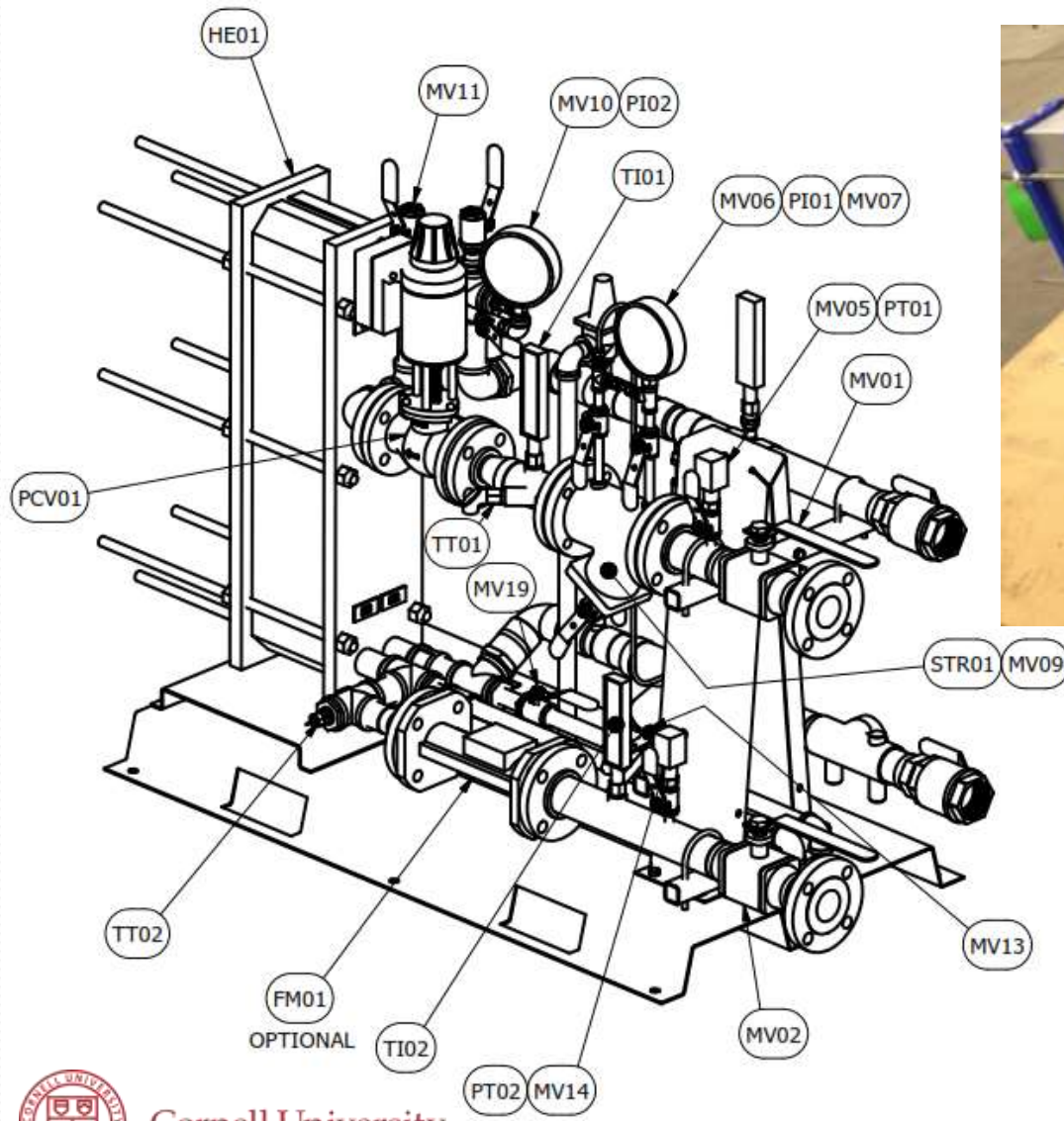
# Dorm Building Interconnections

- 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



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# Packaged DHW Substations (ETS)

Packaged substation features/benefits:

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



# Project Construction Challenges

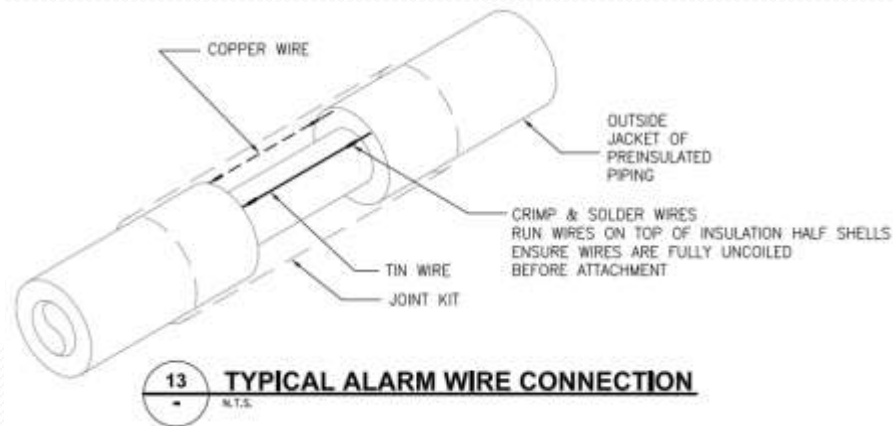
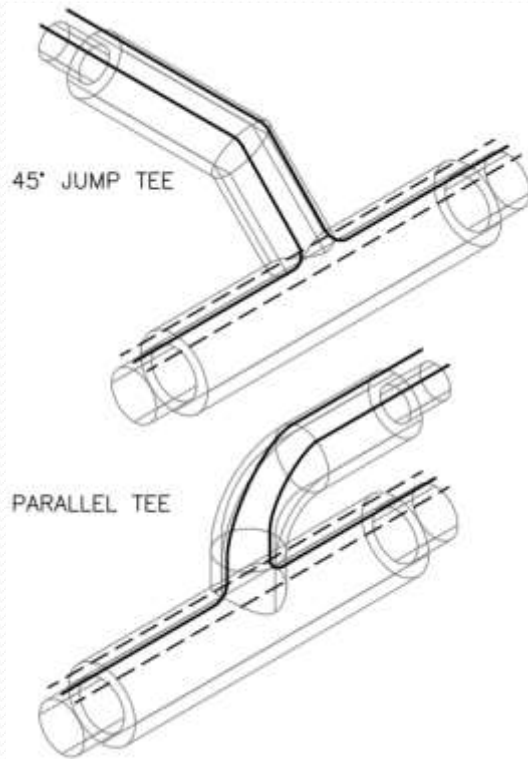
- Budget - Set 3 years earlier before rules change
- Routing – Maintain DHW & keep walks open
- Coordination - Summer Dorm Occupancy





# 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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