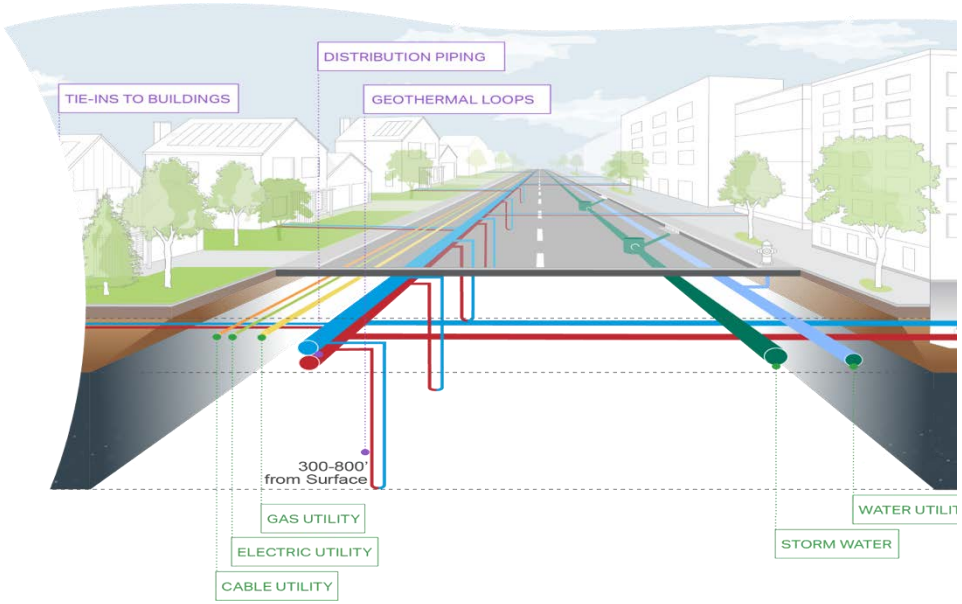
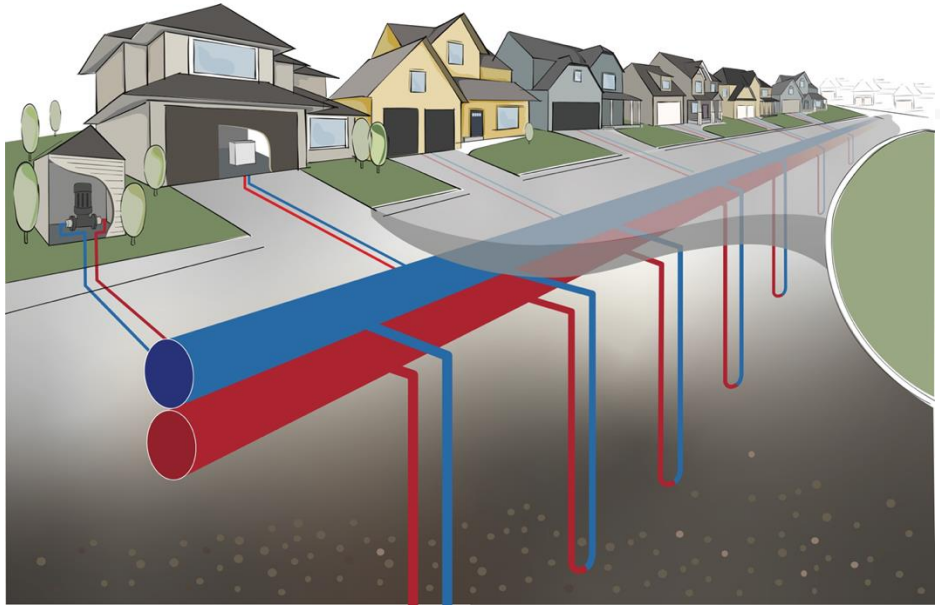




Geothermal Energy Networks (GEN);

Introduction to design of GEN's

PRESENTED BY
Brian Urlaub
Director of Geothermal Operations

Salas O'Brien

Design Considerations

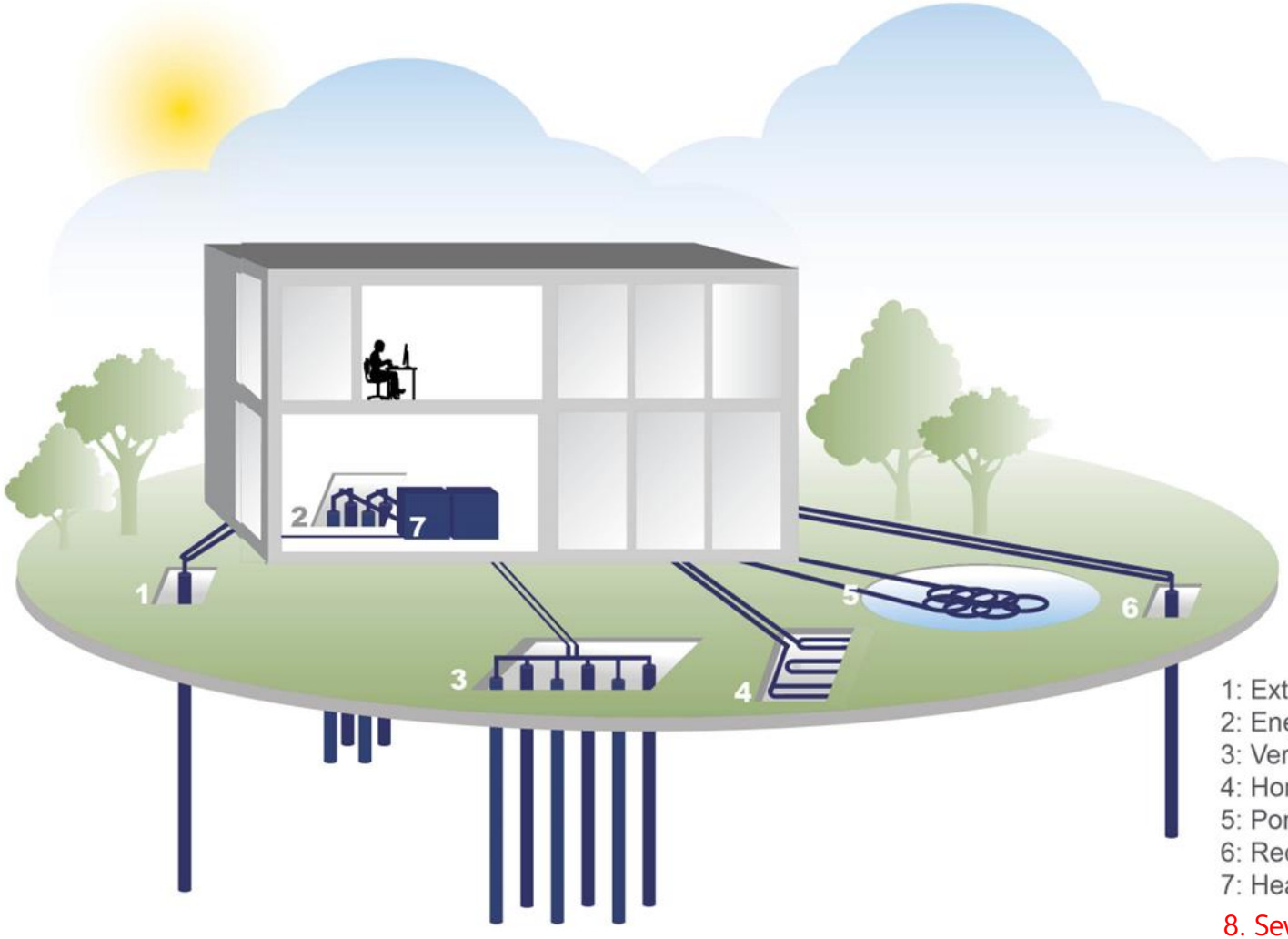
1. Site Selection
2. Thermal Resources
3. Single Pipe vs. Two Pipe
    1) ETS – Yes or No
4. Pump Houses
    1) Above grade or below grade
5. Dynamic Modeling of total system components, loads, and energy sources to provide accurate simulation and optimization.
6. Design for Future Expansion of the system

Site Selection

Finding a site that is most suitable for a GEN system would incorporate the following technical aspects:

1. More than one thermal resource that is available and accessible.
2. Building stock that has a diverse use and load profile, preferrable some larger commercial with residential. Commercial building(s) should be cooling dominant (in heating dominant climate zones).
3. Building density – less piping between buildings to connect reduces overall cost.
4. Site has areas that can be used for infrastructure systems or have the ability to develop access agreements for siting the infrastructure.
5. Building age – older usually means more envelope improvements are needed, and HVAC system is more challenging to retrofit

Thermal Resources



1: Extraction Well
2: Energy Files
3: Vertical Loops
4: Horizontal Loops
5: Pond Loops
6: Recharge Well
7: Heat Pumps
8. Sewage HX
9. Waste Heat

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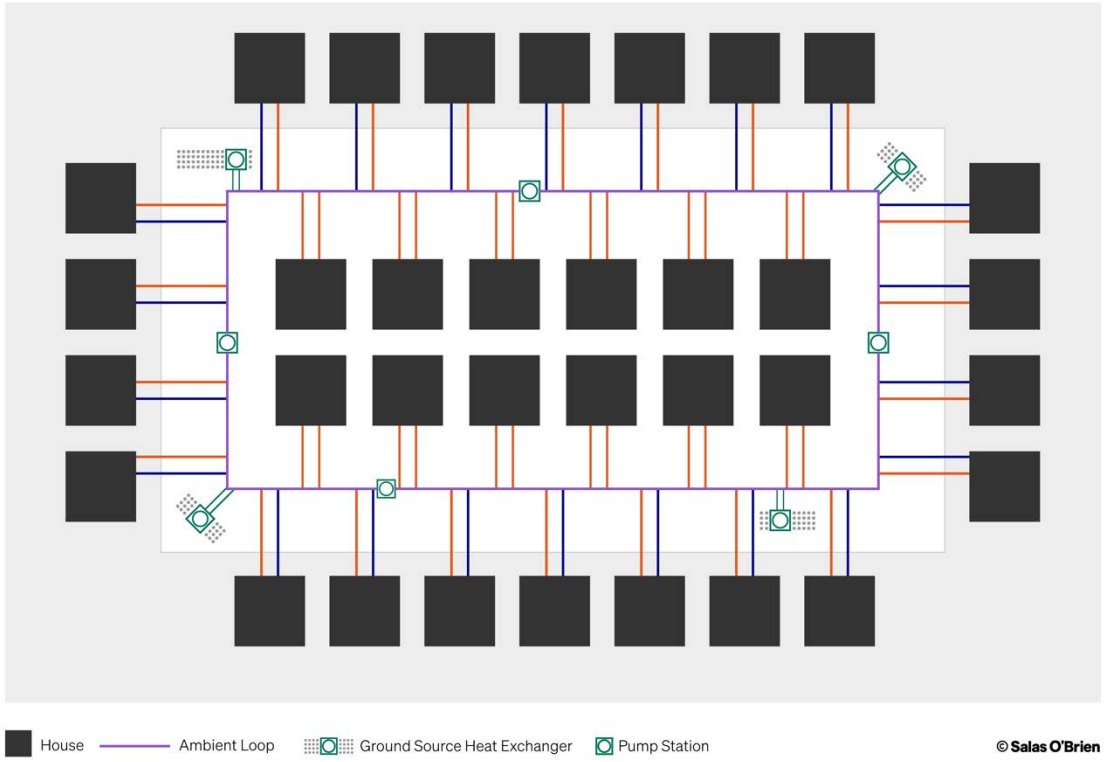
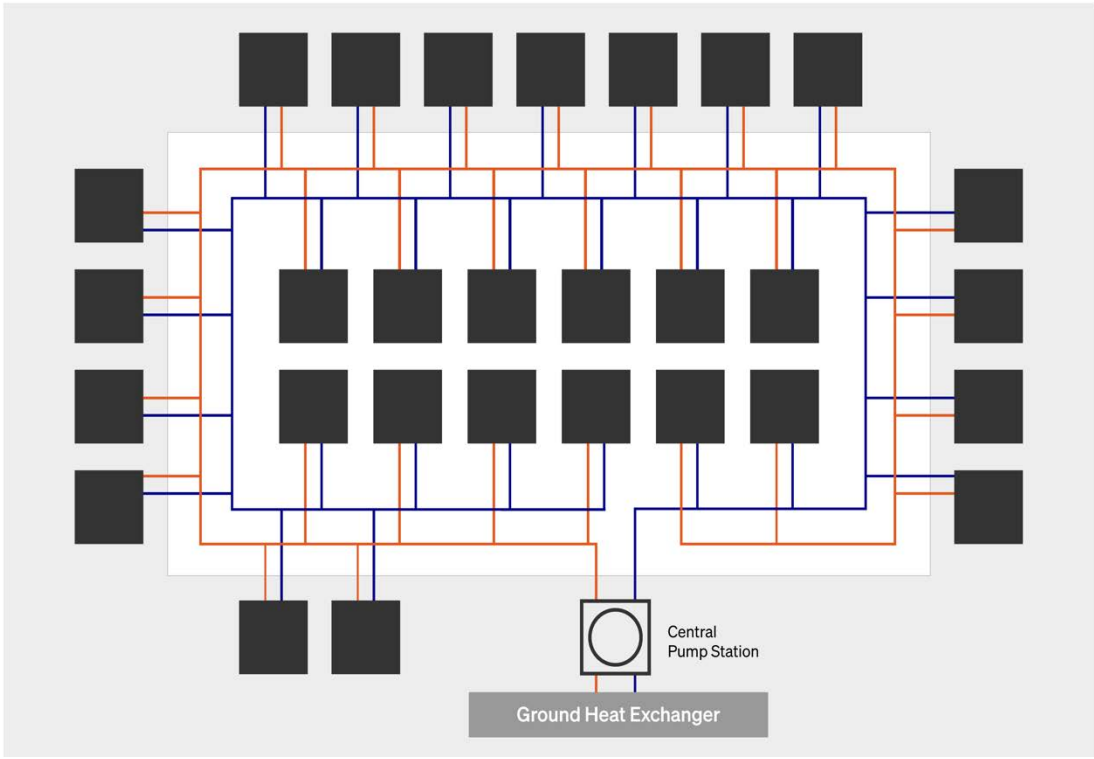
Single Pipe vs. Two Pipe ATL's

One-Pipe Ground Source Heat Exchange System



2-Pipe Ground Source Heat Exchange System



- 1-Pipe offers greater flexibility with locating thermal resources, expansion of the system, as well as easier coordination/installation in streets working around other utilities.
- 1-Pipe has reduced flow rates when designed with multiple thermal resources, which reduces pipe sizes, pump sizes, pump energy, and overall installation costs.
- 2-Pipe provides each end user the same fluid temperature whereas the 1-pipe the temperatures between the first and last end user between each thermal resource would receive +/-5F different fluid temperatures.

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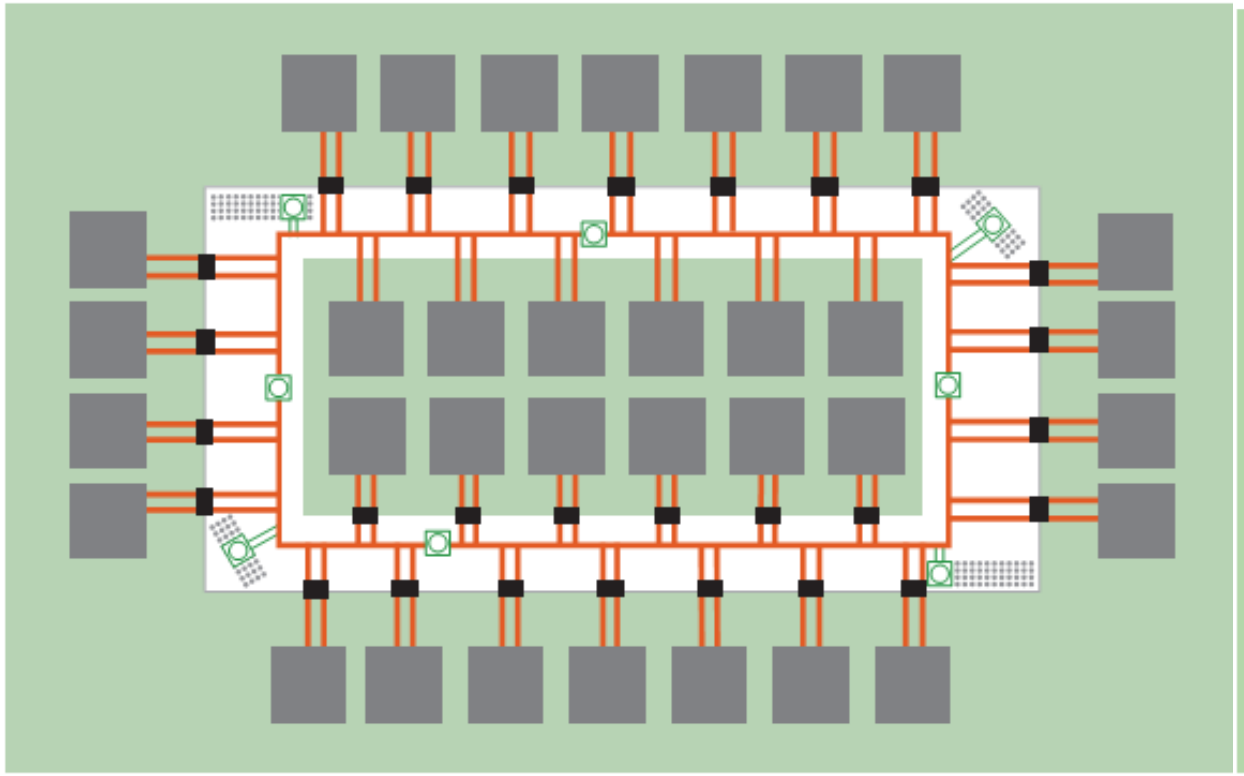
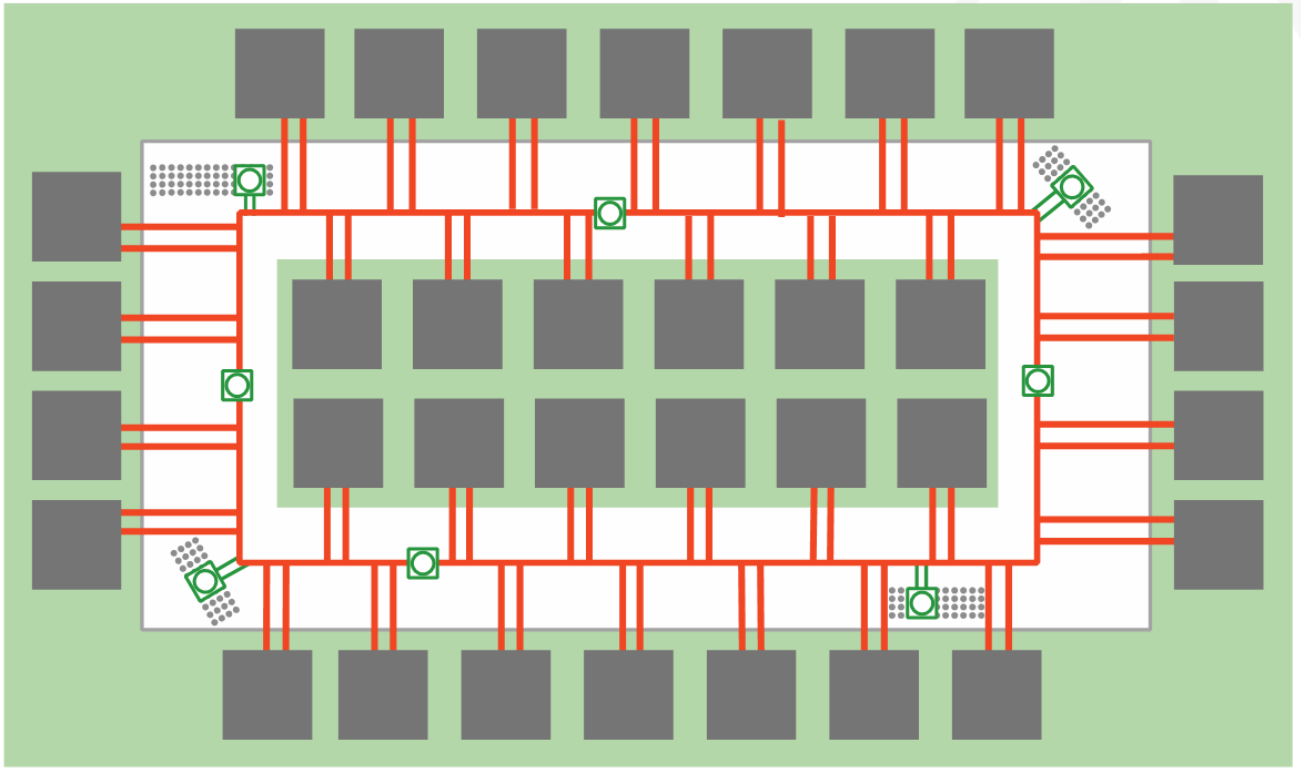
ETS – Yes or NO



1-Pipe GEN with ETS



1-Pipe GEN w/o ETS

ETS = Energy Transfer Station or Heat Exchanger to isolate fluids (usually in the building)

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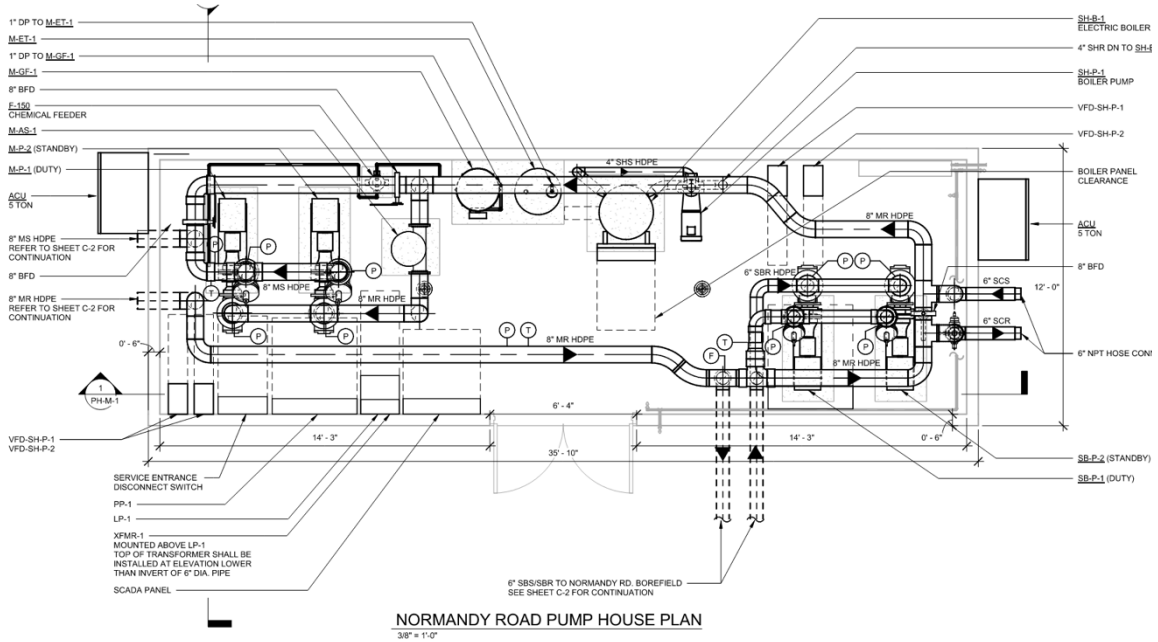
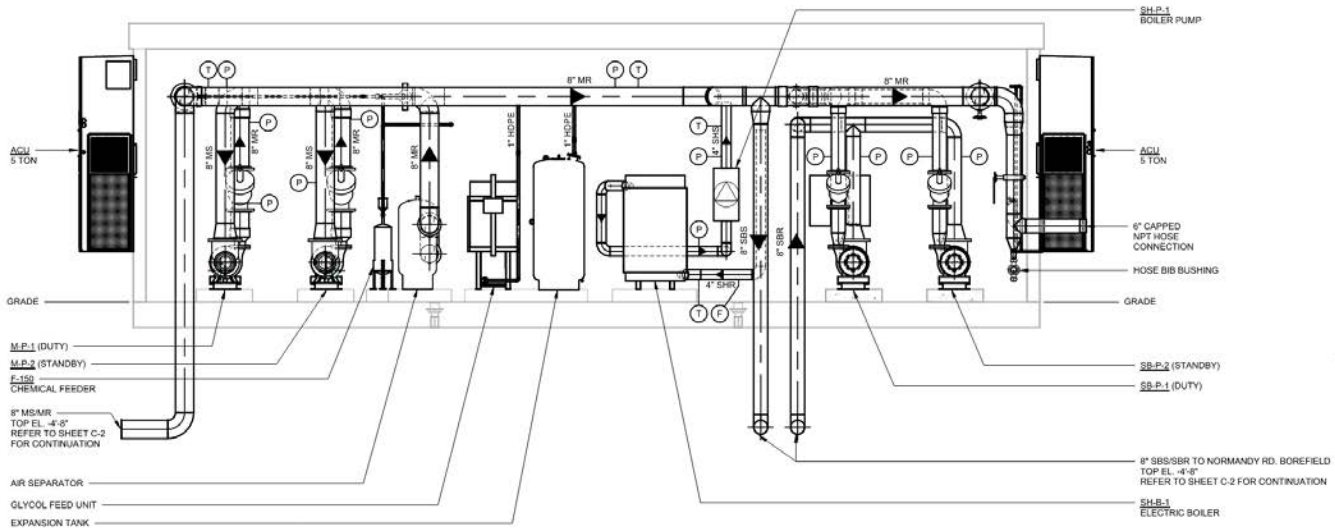
Above Grade Pump House

- Above grade super structure
- Conditioned space
- Controls Hardware location
- Architectural Design to meet city standards



NORMANDY ROAD PUMP HOUSE PLAN
3/8" = 1'-0"



1 NORMANDY ROAD PUMP HOUSE FRONT VIEW
3/8" = 1'-0"

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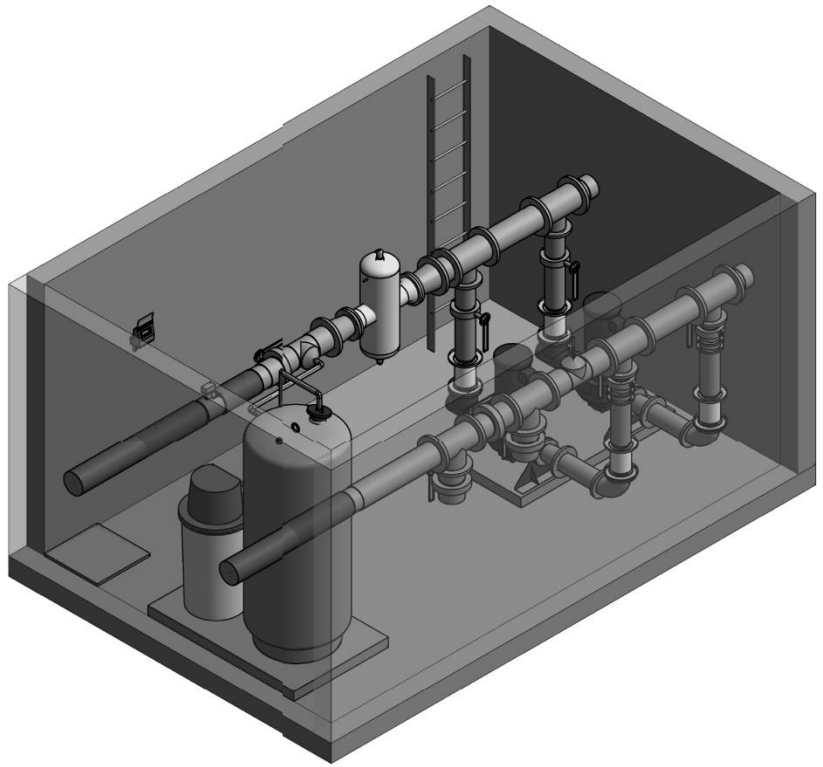
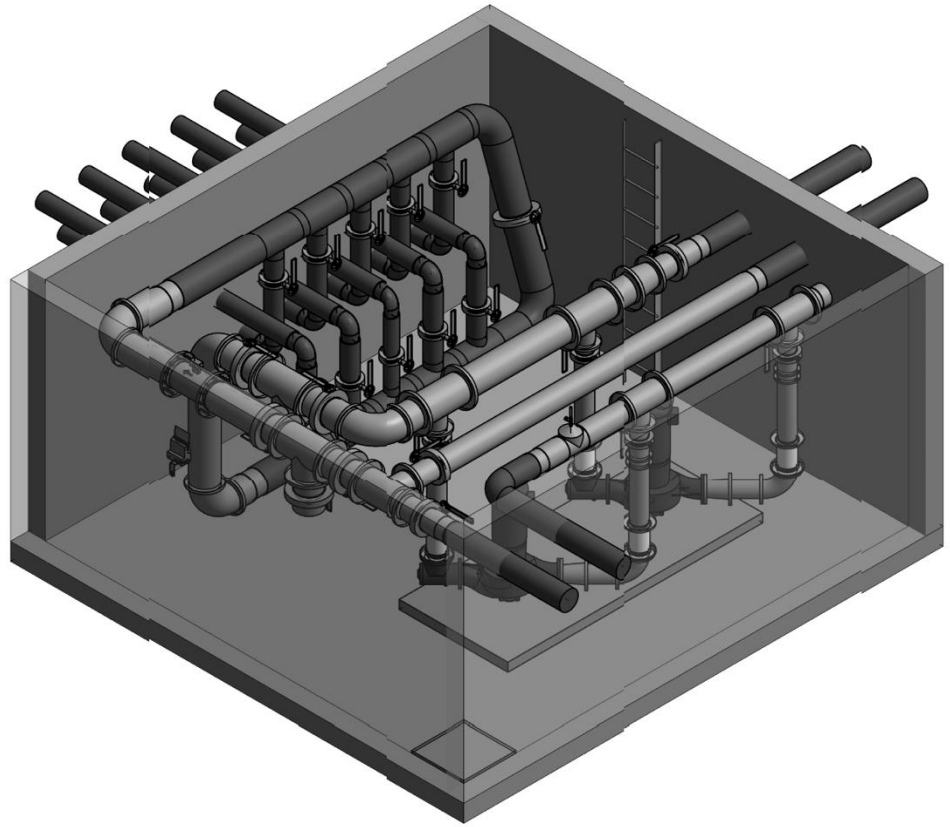
Below Grade Pump Vaults

3/4" = 1'-0"



3 AMBIENT LOOP VAULT ISOMETRIC VIEW

3/4" = 1'-0"



3 GEOTHERMAL PUMP AND MANIFOLD VAULT ISOMETRIC VIEW

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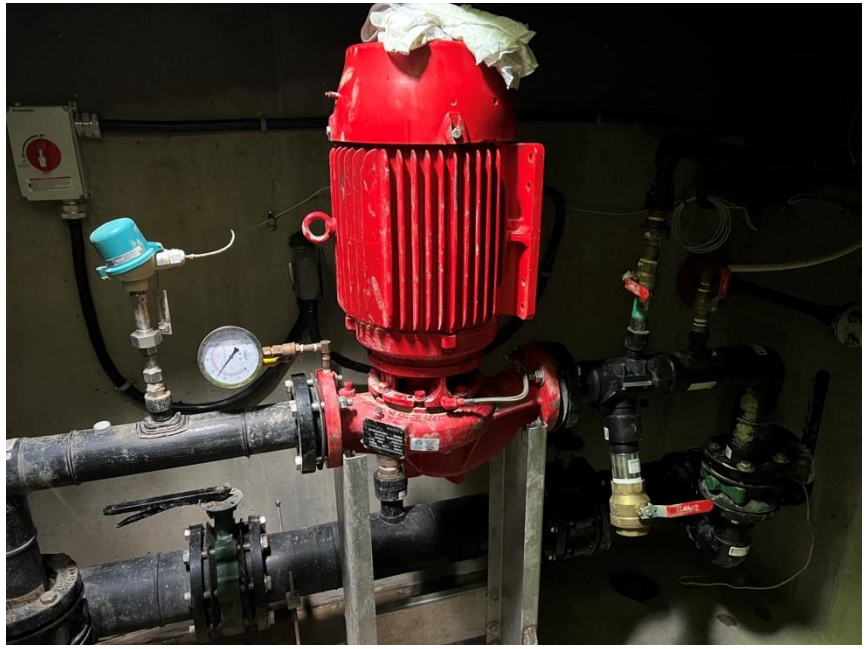

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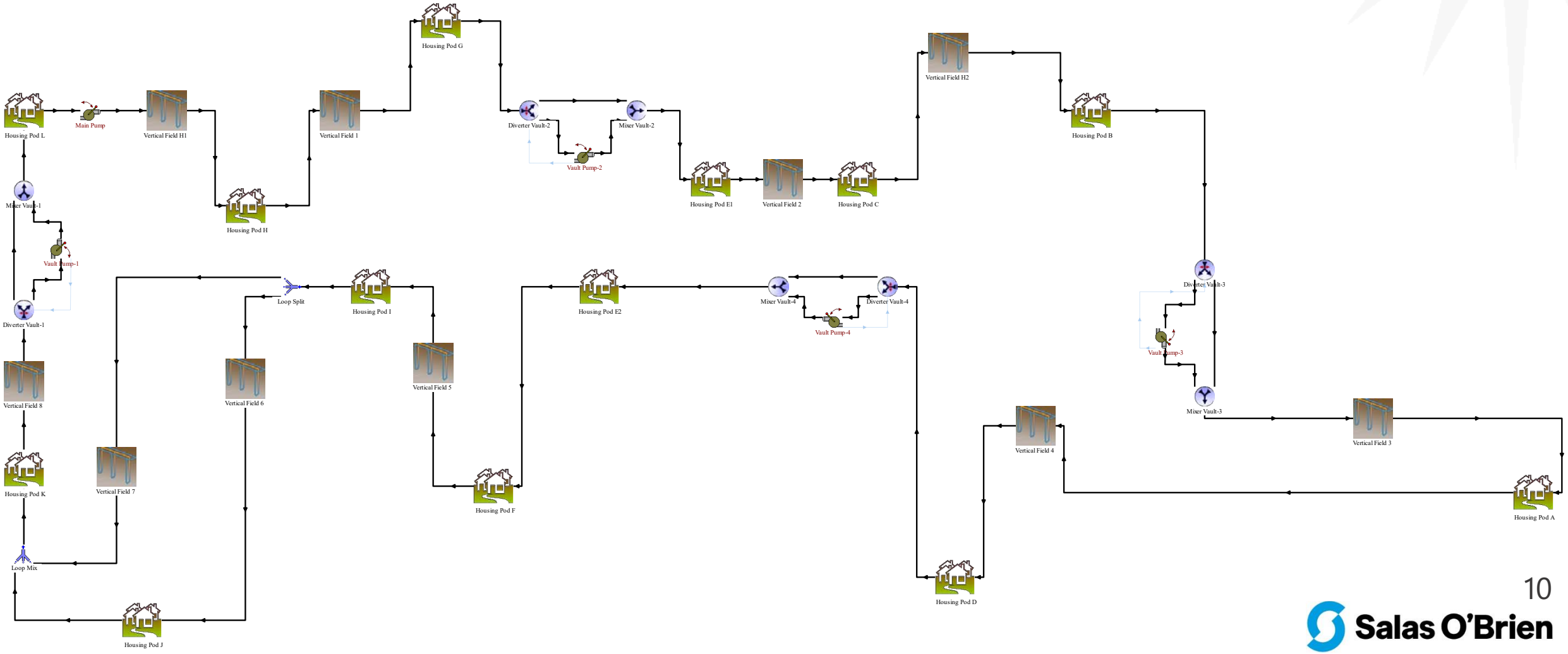
Dynamic Transient Modeling



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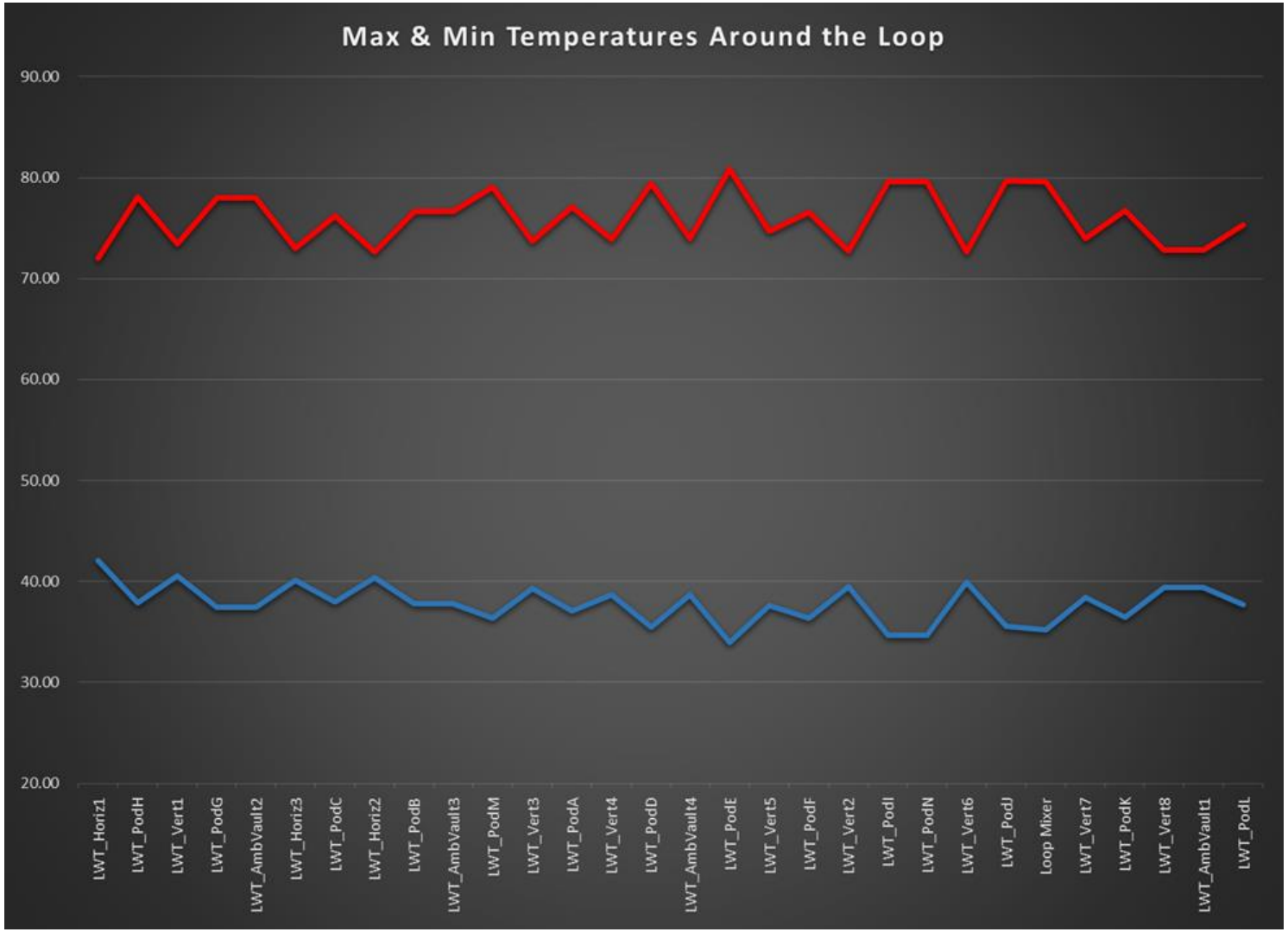
Temperature Profile of Ambient Loop



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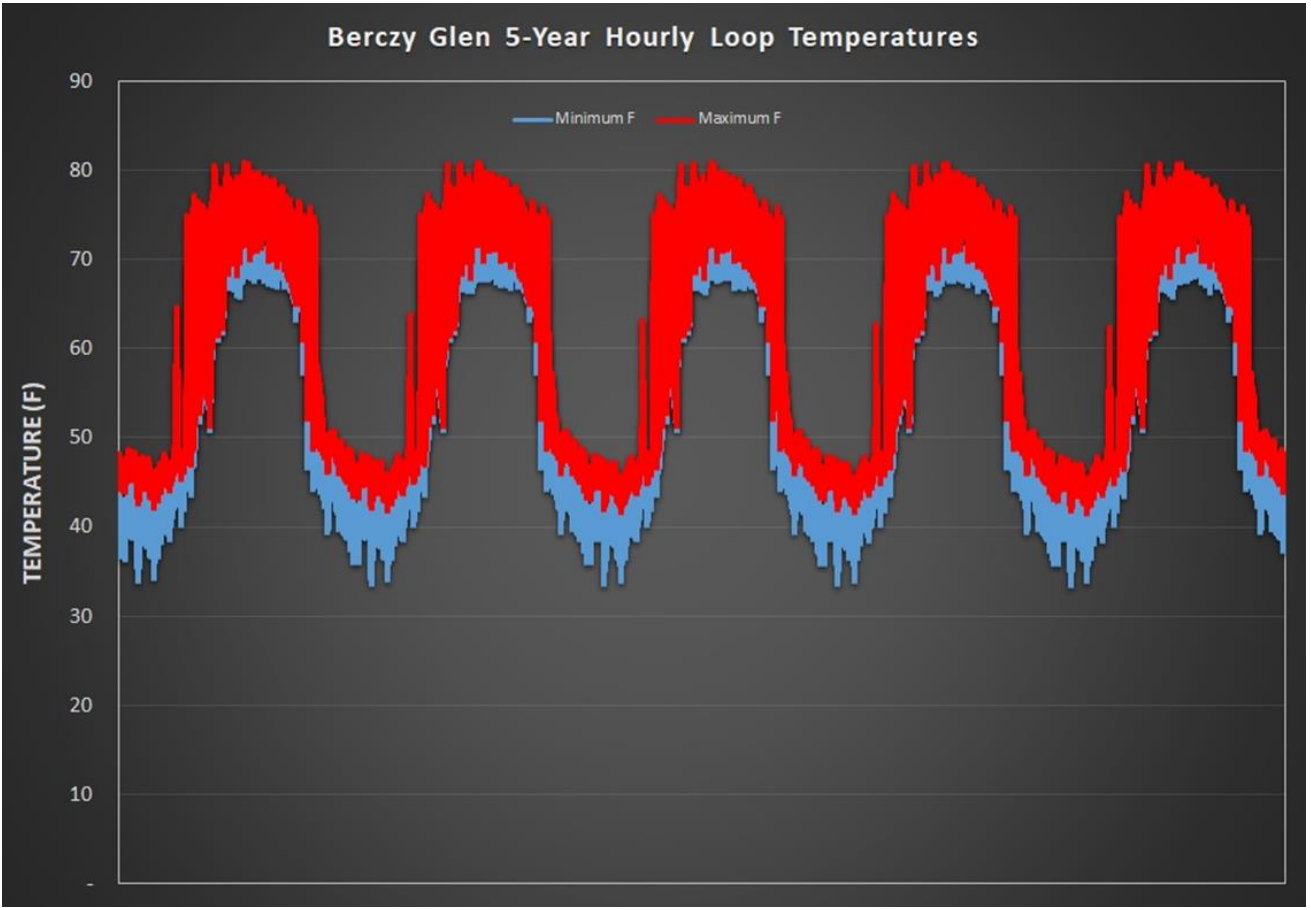
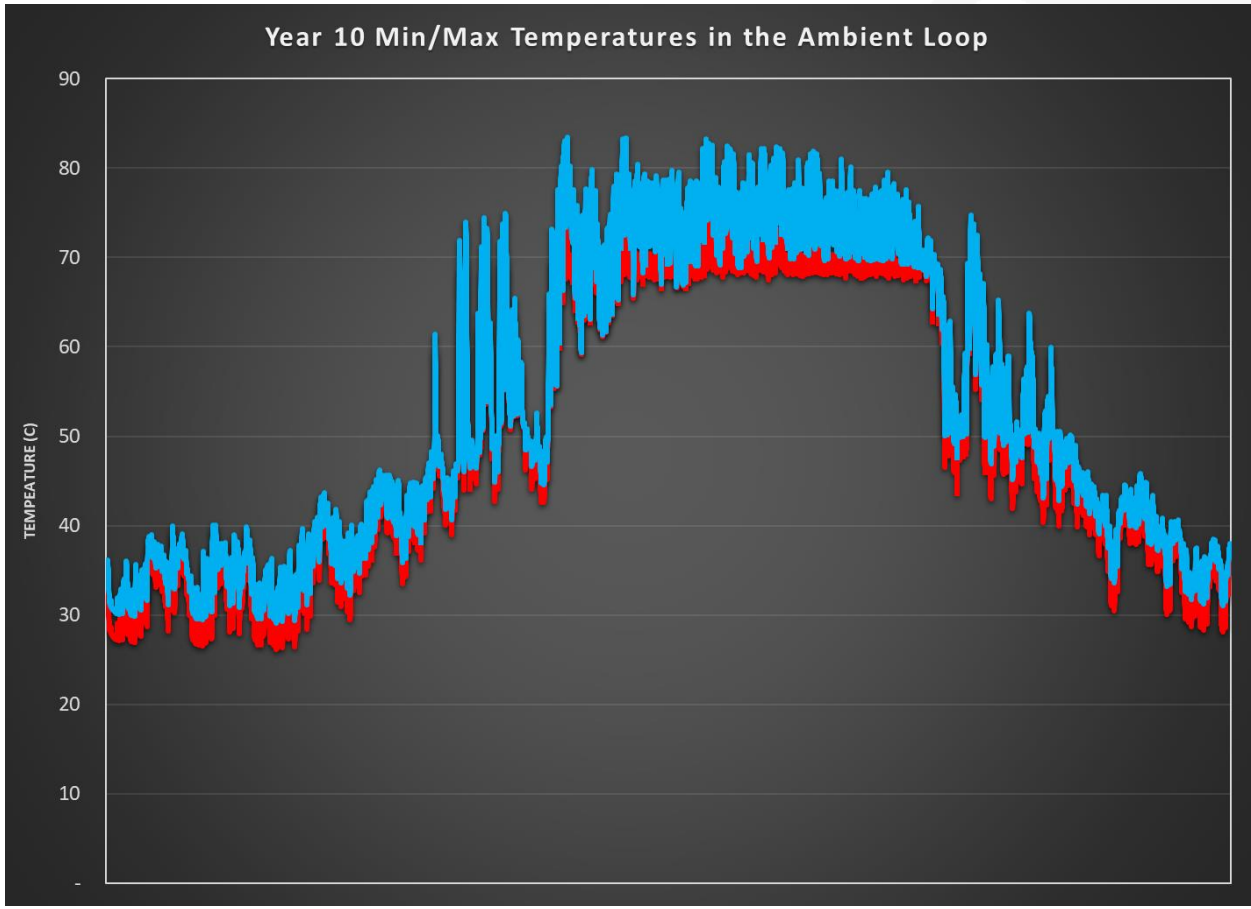
Long Term GLHE Temperature Profiles





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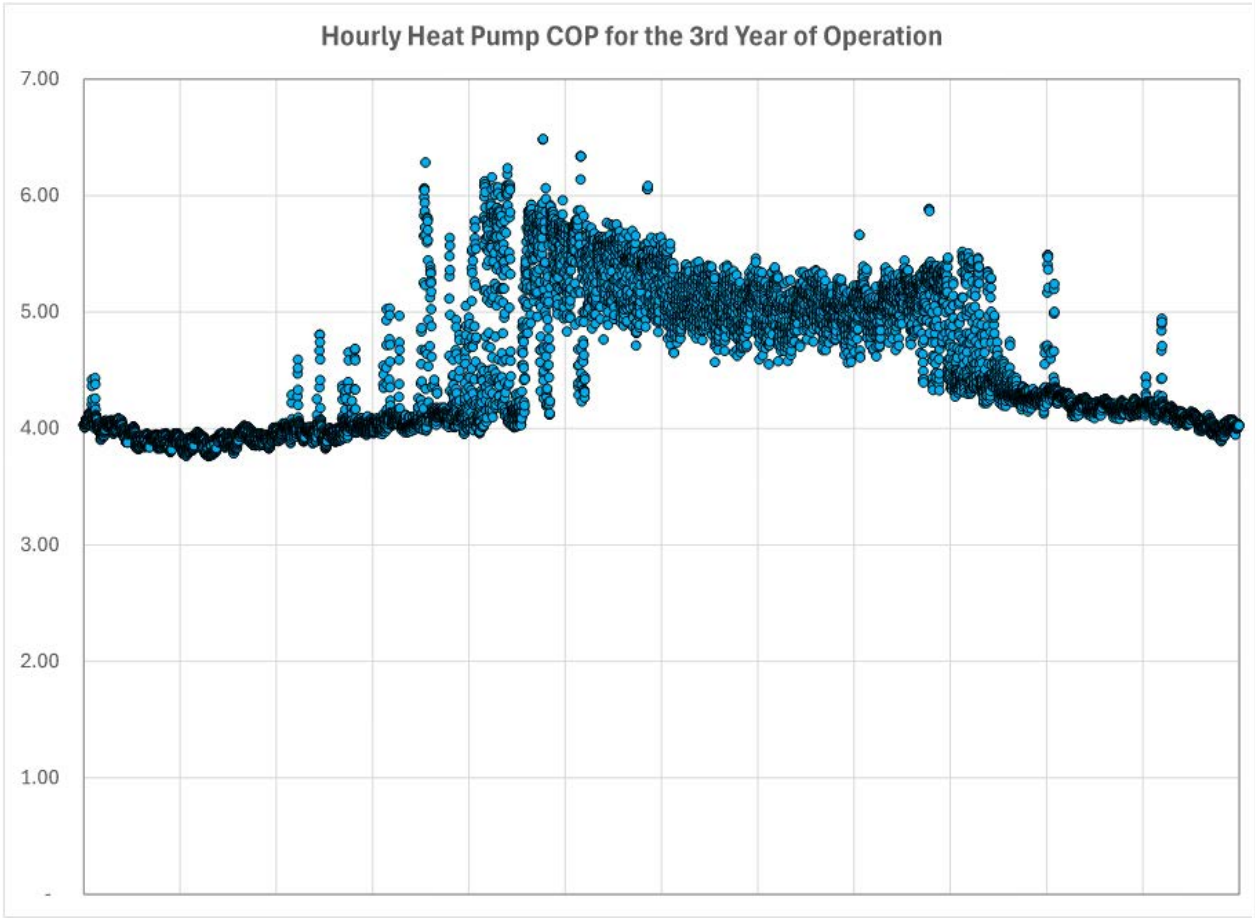
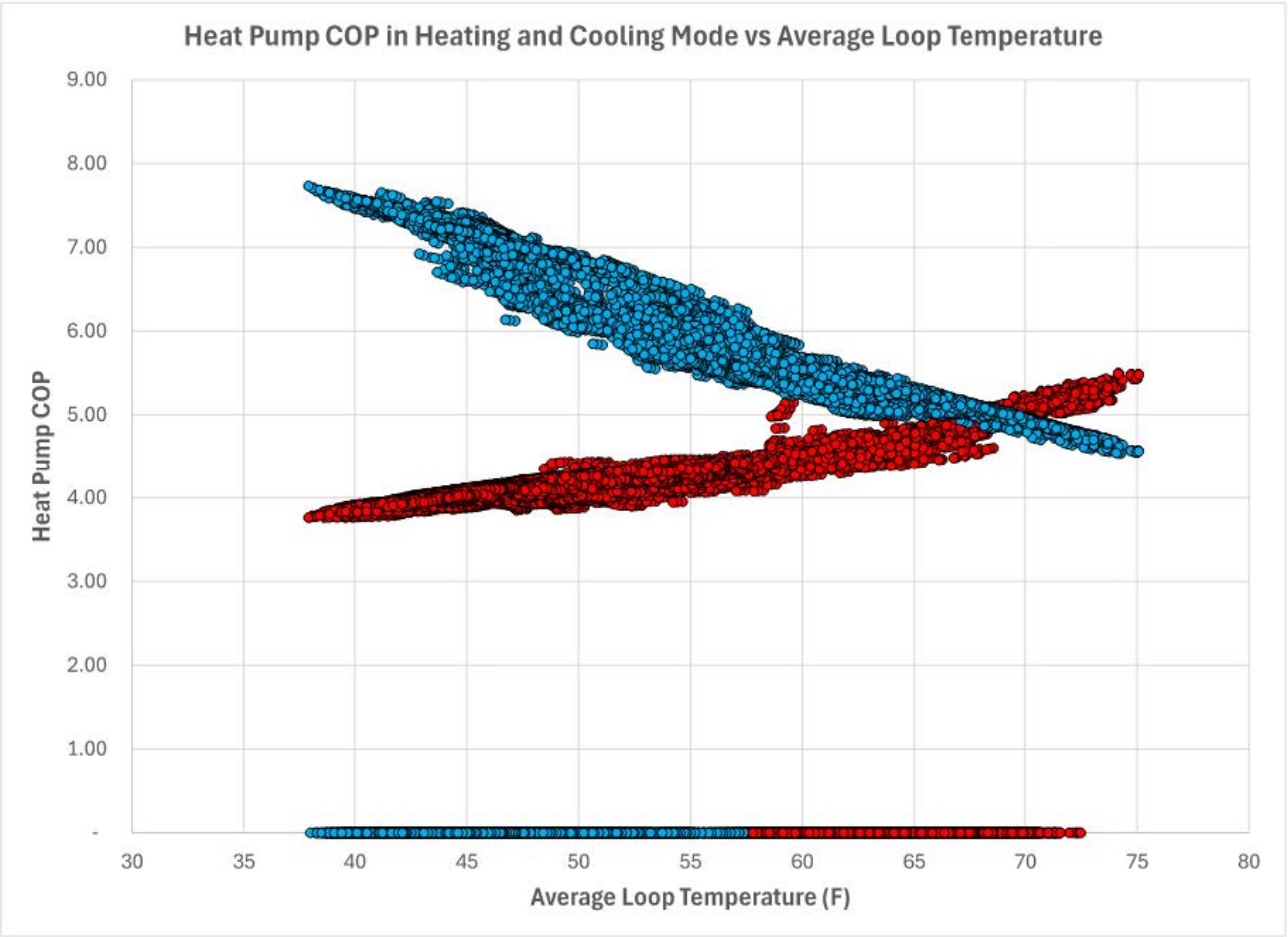
Aggregate COP of the System (hourly)





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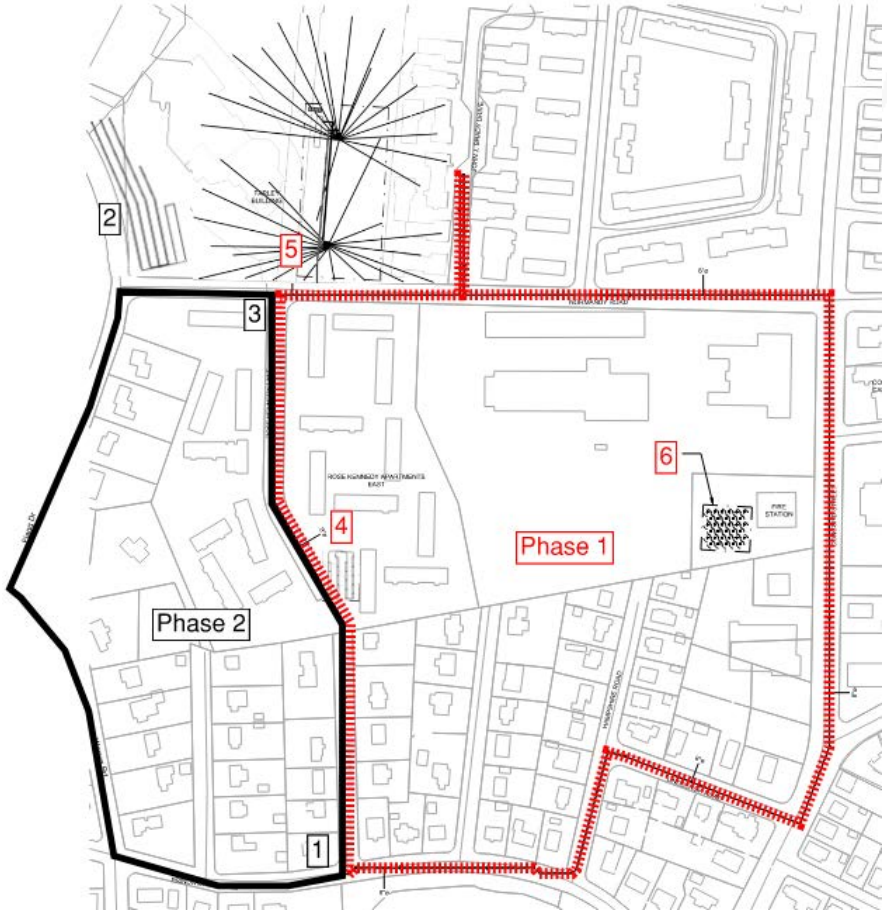
Expansion of GEN's

- 1: Phase 1 and 2 converge into one pipe.
- 2: Phase 2 GLHX by Farley Building
- 3: Phase 1 and 2 converge into one pipe.
- 4: Phase 1 GLHX by Rose Kennedy
- 5: Phase 1 GLHX by Farley Building
- 6: Phase 1 GLHX by Fire Station



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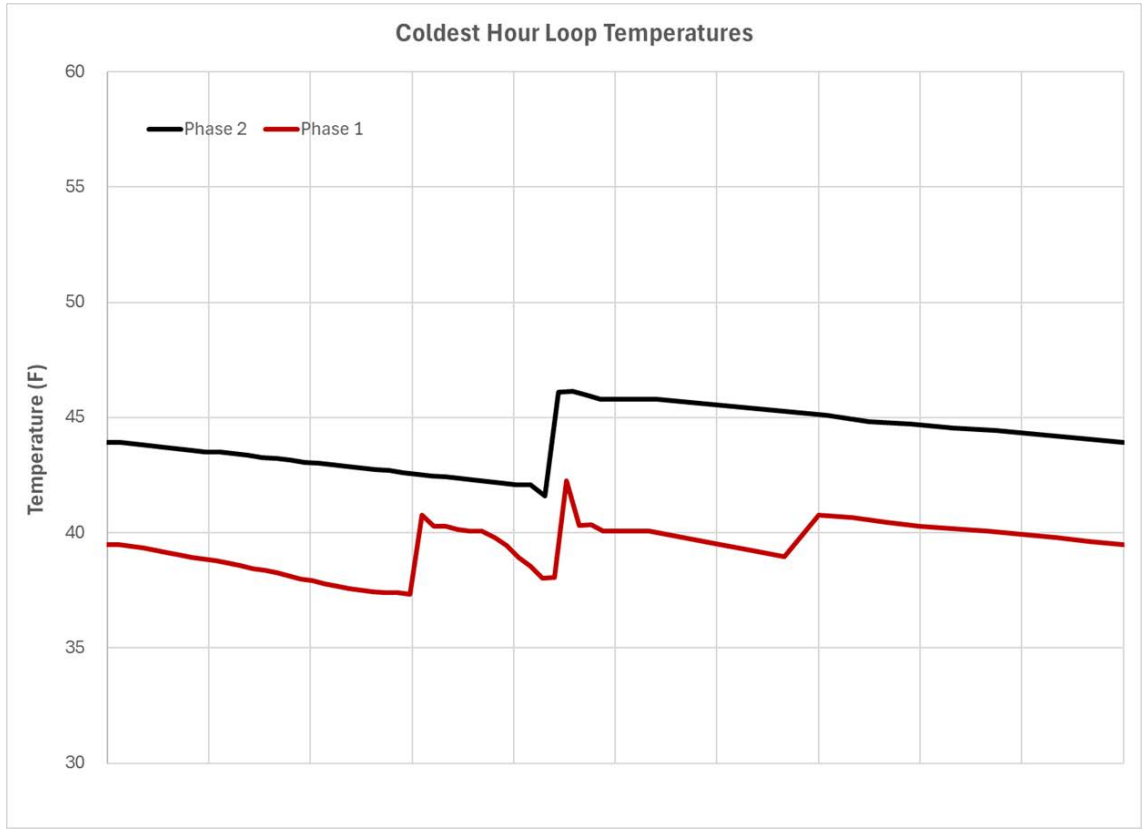
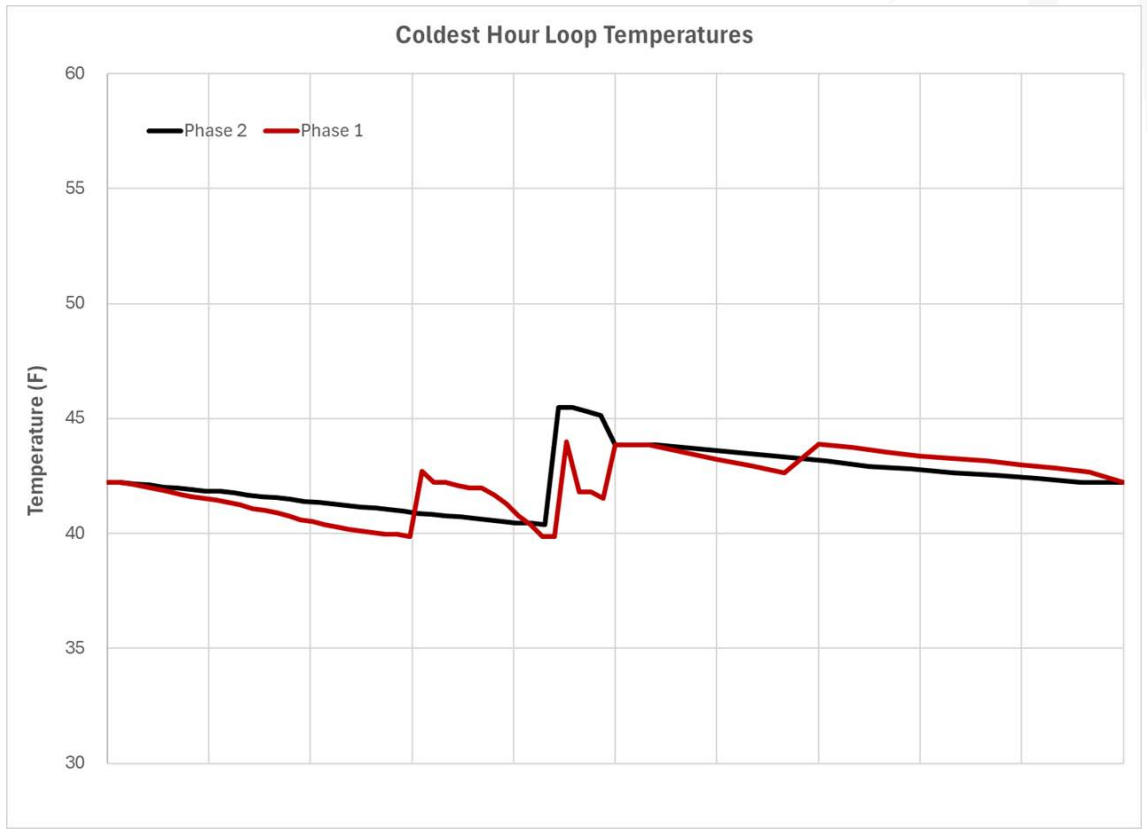
Sharing energy through mixing loops

No Mixing



Mixing



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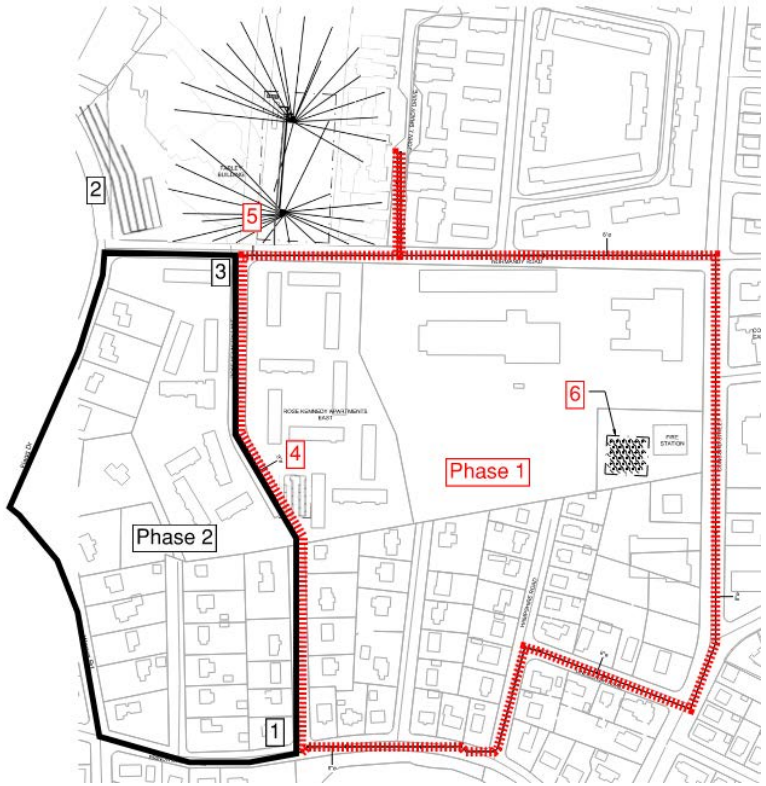
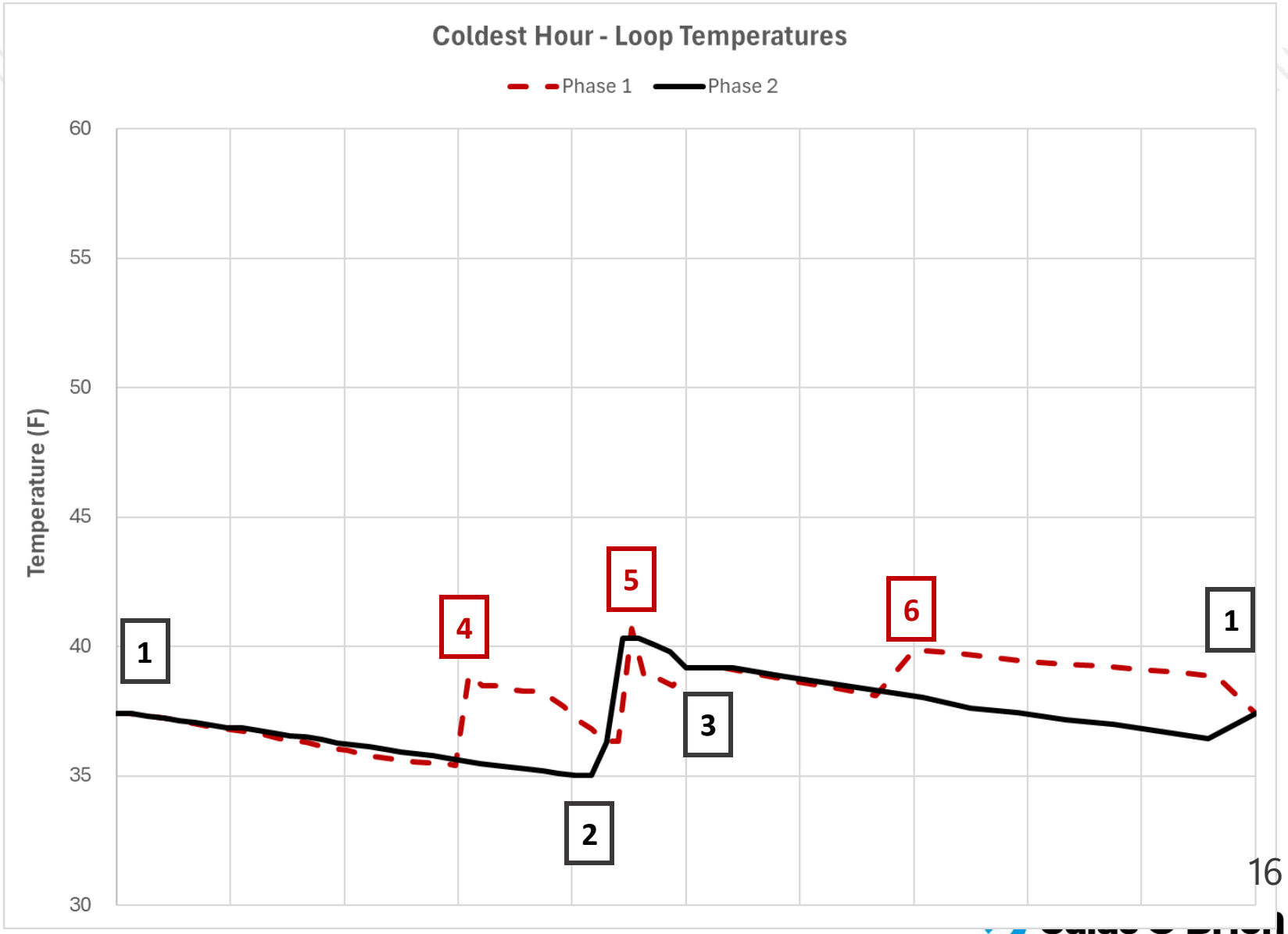
TRNSYS Runs v19 Graph – Coldest Hour

- Coldest hour loop temperatures
- GLHX Phase 2: 80 Bores
- Minimum Temperature: 35.02°F





Q & A?

Thank You!

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RES.ENV 007 Geothermal Energy Networks (GENs): Transforming our Thermal Energy System

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