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Energy
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Two Chilled Water Plants, One System

IDEA's 28th Annual Campus Energy Conference

February 10-13, 2015

The Problem

- Two chilled water plants
- Two different plant designs engineers
- Two types of customers
  - City/County buildings
  - Private buildings
- Two distribution systems
- One system Owner

Objectives

- Expand system to additional customers
- Improve reliability
- Maximize system utilization
- Reduce operating costs

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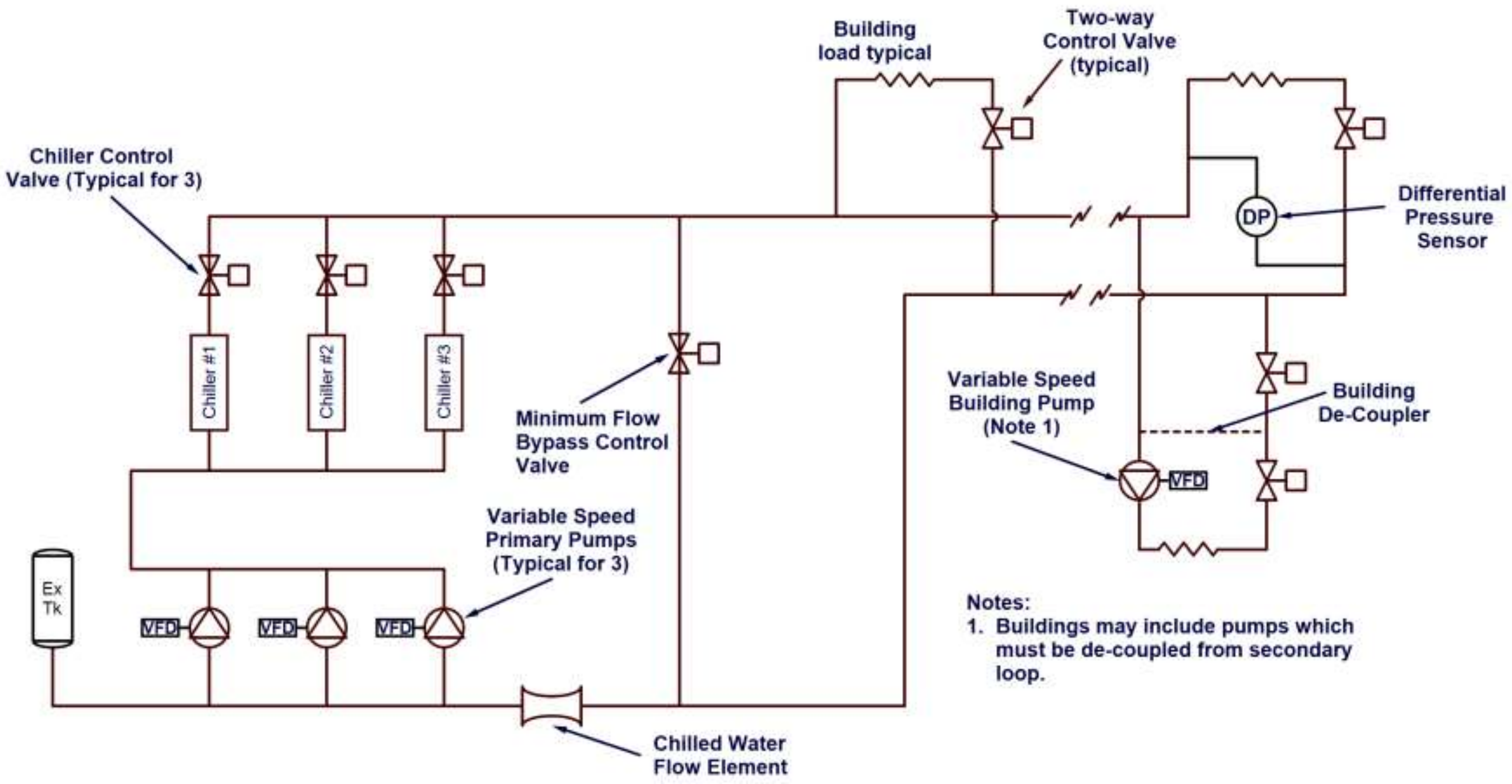
Plant #1

- 7,400 tons installed
- Supply Temperature, 41 °F
- Chilled Water ΔT, 12 °F design
- System design, Variable primary pumping
- Distribution Pumps designed for 180 ft. TDH @ 3600 gpm
- Consists of 4 qty. @1500 ton Chillers

  1 qty @ 1400 ton

Variable Primary Pumping



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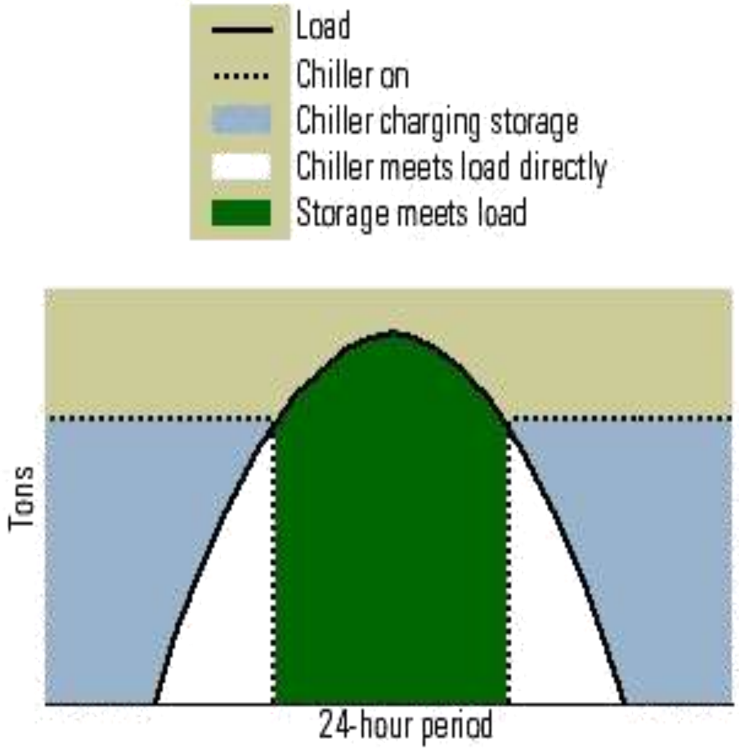
Plant #2

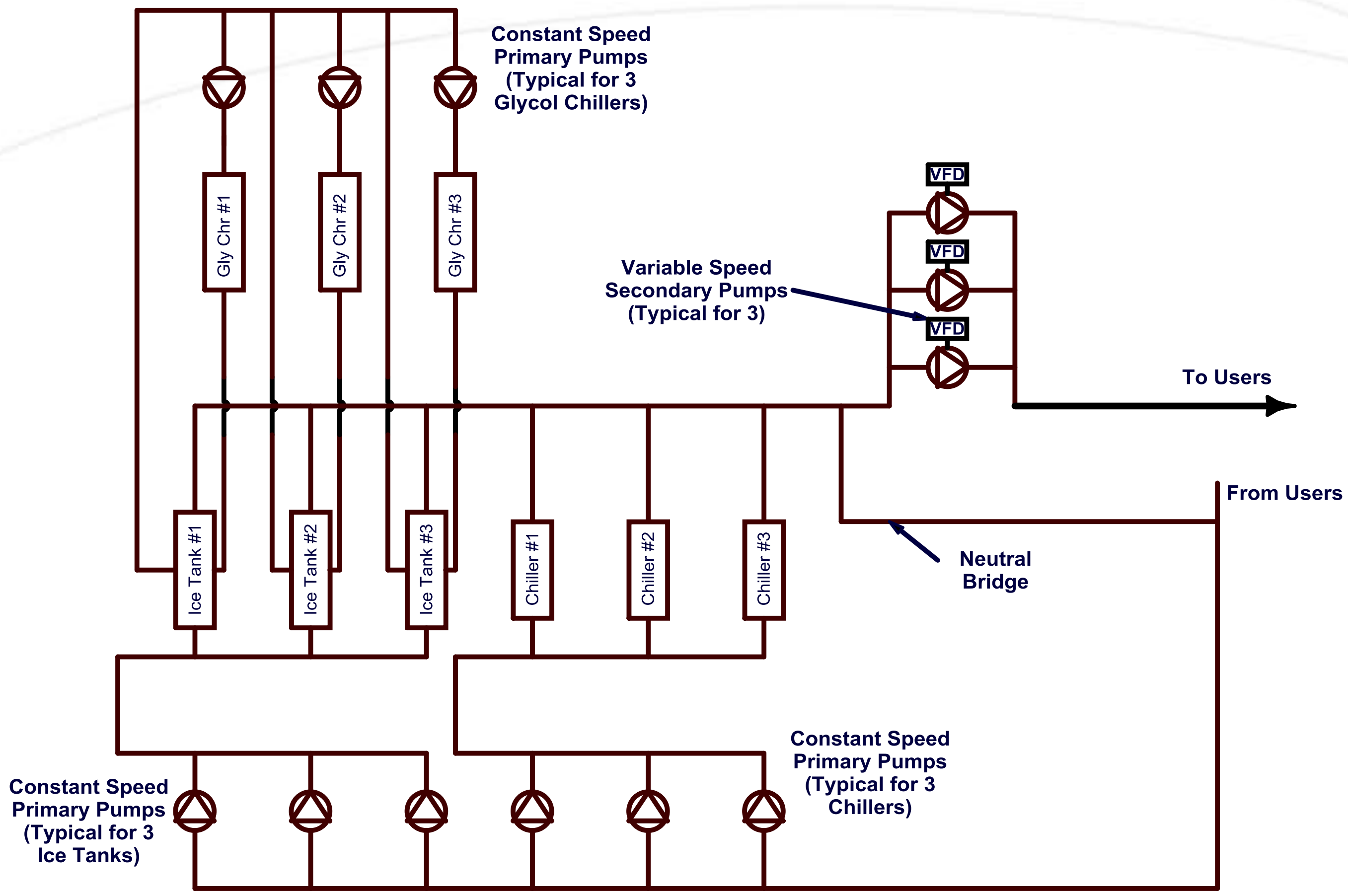
- 8,498 tons installed chilled water
  - 3 @ 1166 tons, 2 @ 2500 tons
- 4,440 tons installed ice making
  - 1@ 850 tons, 1@ 430 tons, 2 @ 1580 tons
- 51,840 ton-hours of ice in 3 tanks
  - Maximum harvest rate of 6480 tons (based on 8 hour operation)
- Supply Temperature, 35 °F
- Chilled Water ΔT, 18 °F design
- System design, Primary/secondary pumping
- Distribution Pumps sized for 250 ft. TDH @ 3200 gpm.

Full Storage (Load Shifting) Operating Strategy

- Shifts the entire on-peak cooling load
- Chiller off during on-peak hours
- Separate chillers for making ice
- Simple control
- Highest
  - Chiller costs
  - TES costs



Plant #2 Configuration



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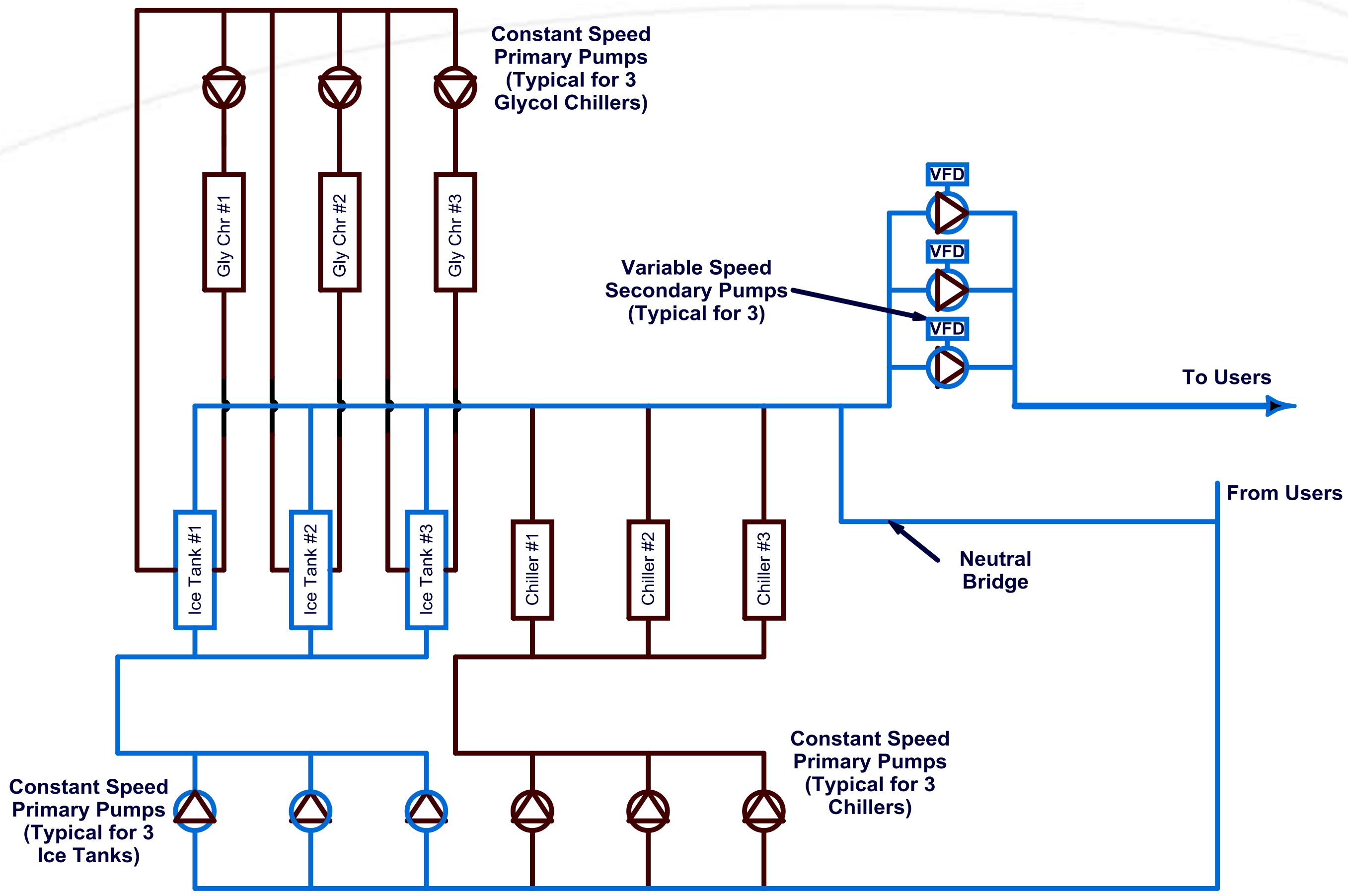
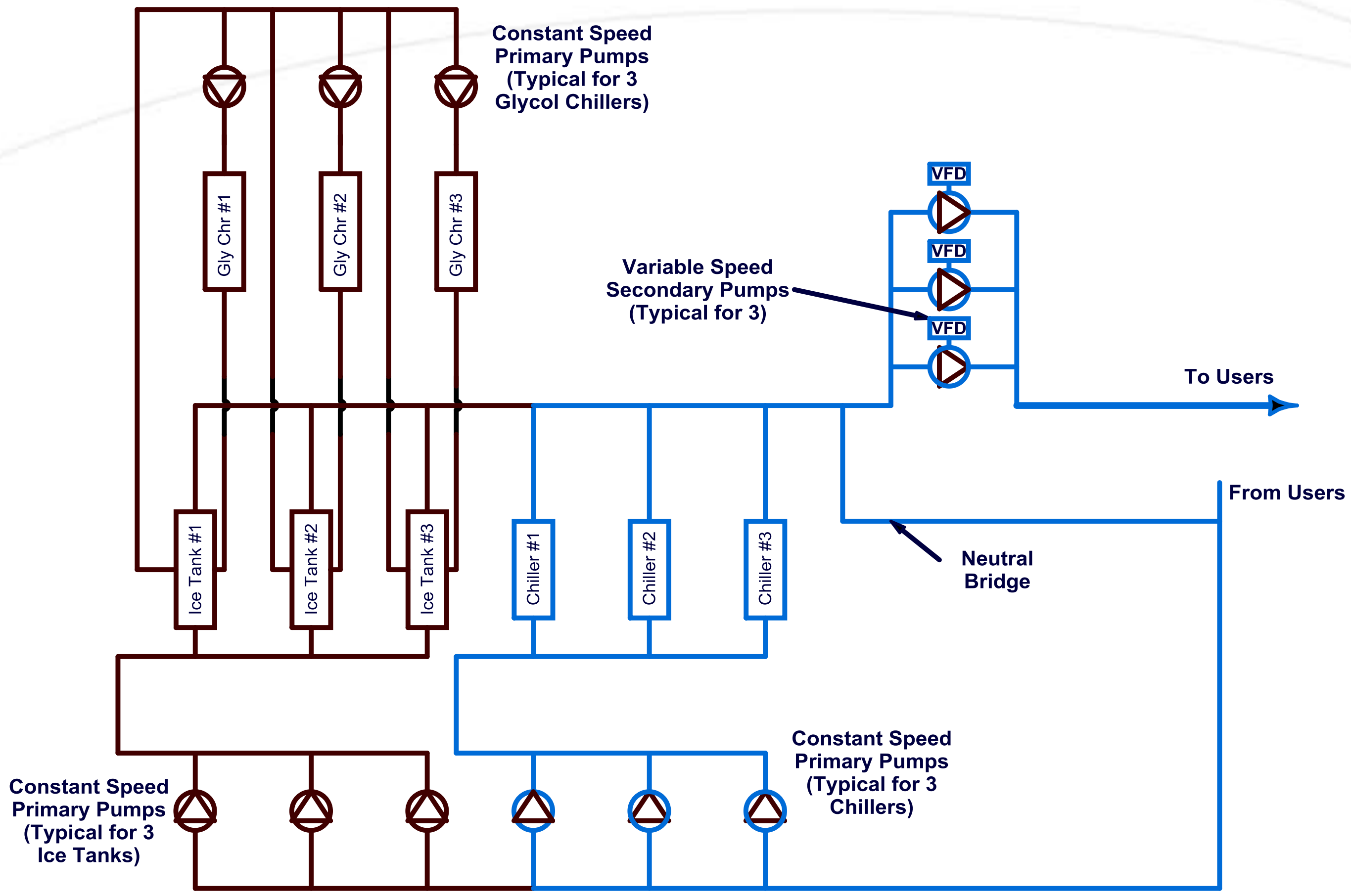
Plant #2,On-Peak Operation



Plant #2 Off-Peak Operation



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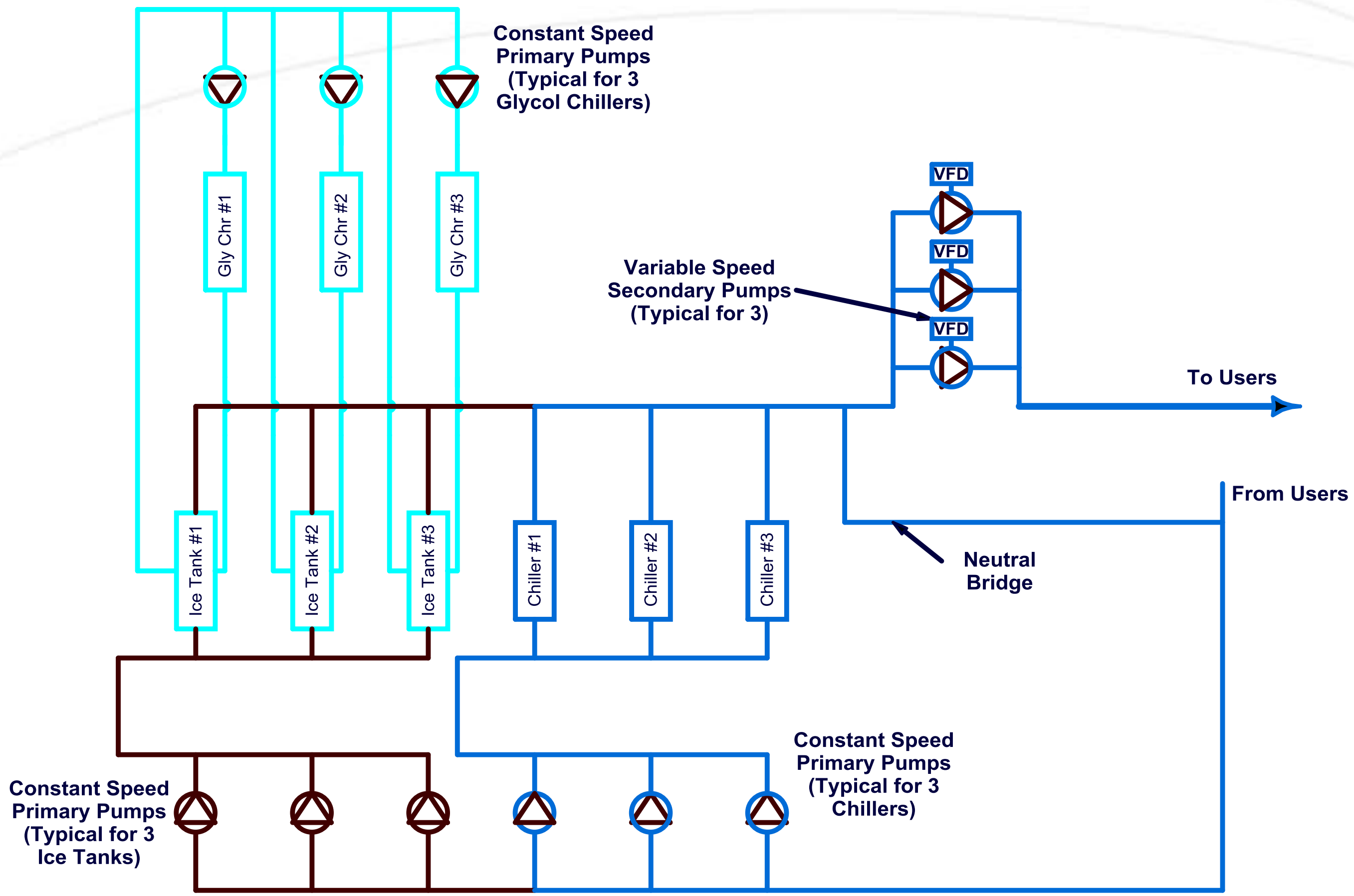
Plant #2 Off-Peak Operation with Ice



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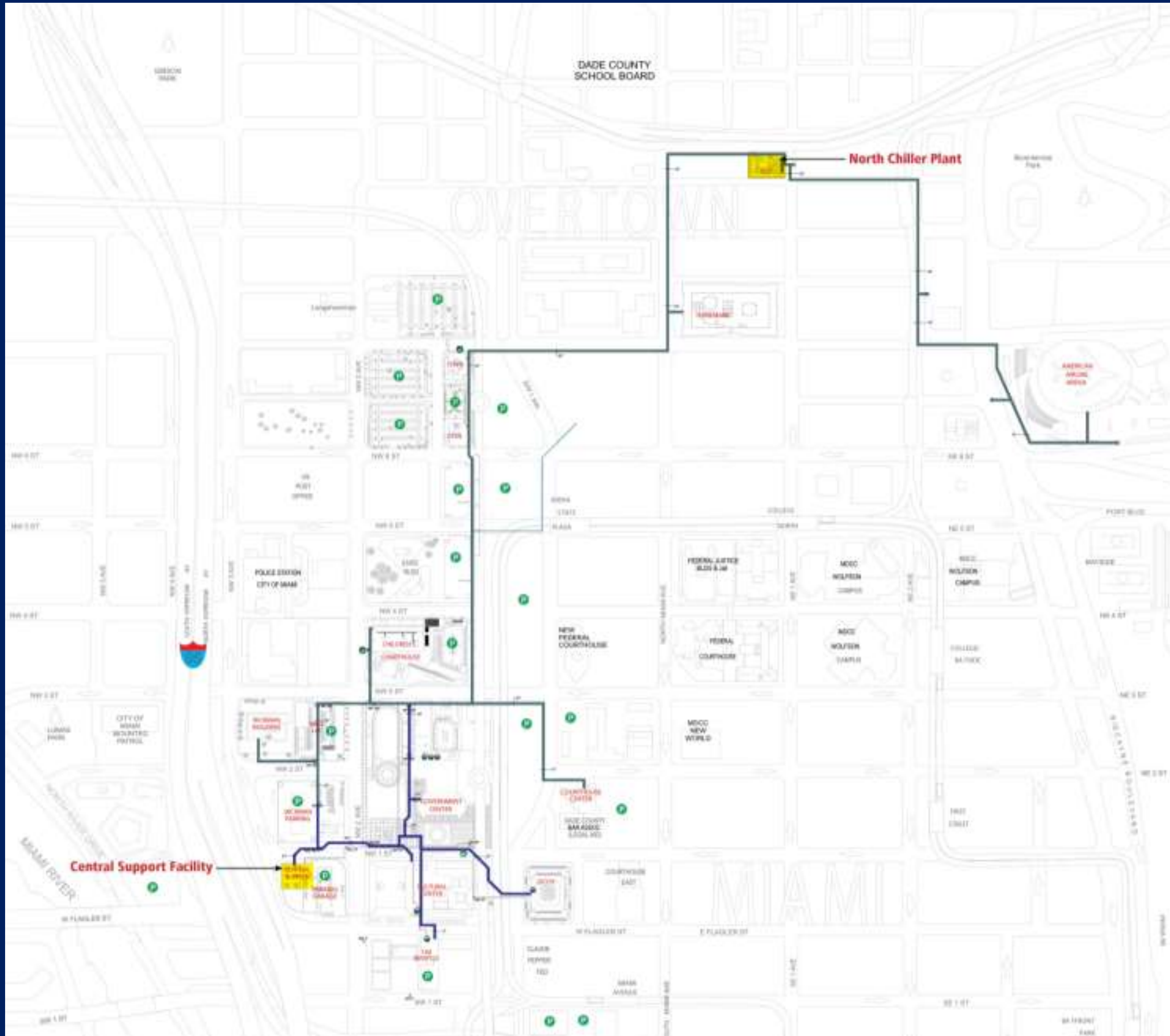
Chilled Water Supply Temperature

- Plants produce two different chilled water supply temperatures.
- Contractually, only one user requires 35 °F chilled water
- Plant #2 is only facility that can produce 35 °F chilled water.
- Most Facilities only require 41 °F chilled water.


DADE COUNTY
SCHOOL BOARD
North Chiller Plant
OVERTOWN
Central Support Facility
MIAMI

Temperature Solution

- Plant #2 must always supply chilled water to AAA.
- Blended temperatures to remaining customers is acceptable. (Lower Temperatures will increase heat exchanger (or Coil) performance)
- Do not contract for any new users at 35 °F supply temperature
- Address supply water temperature with AAA if upgrades or modifications are planned to facility.

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Chilled Water Pressure Issues

- Two plants/ Two Expansion Tanks
- Different Pump Differential Pressure Design Points

Can systems operate interconnected without significant equipment changes?

Dealing with Multiple expansion Tanks

- Easy answer: Don't have multiple expansion tank locations. Select one set of expansion tanks and utilize them as the location of no pressure change. (In this case Plant #1 due to the higher set point to serve high rise buildings)
  - Must be careful if system operation near pressure ratings of equipment.
- Both tanks connected to the system the location of the point of no pressure change moves throughout the system as the operation of the system changes. (hard to predict)
  - Difficult to control makeup (What pressure do we control to)

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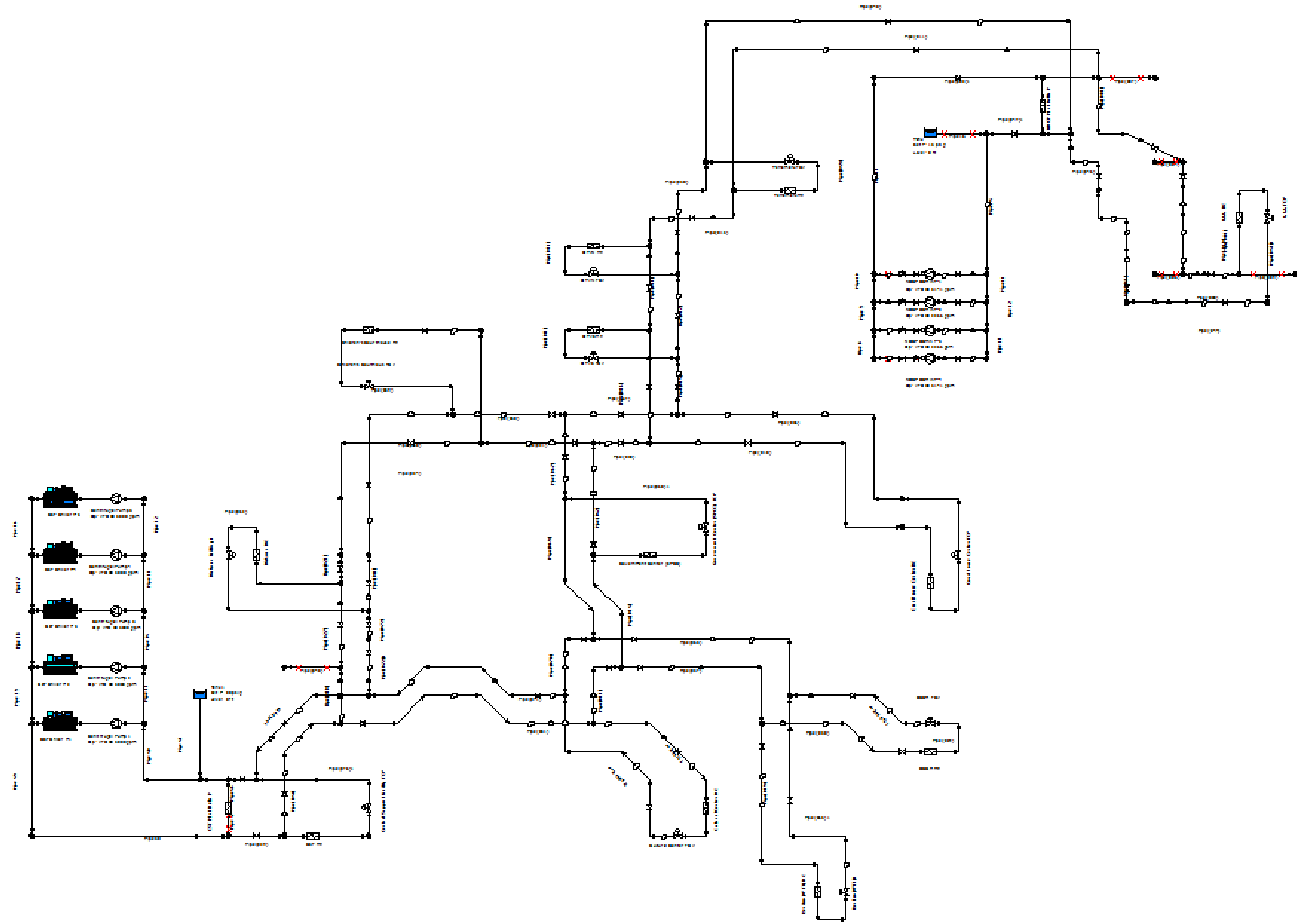
Hydraulic Model

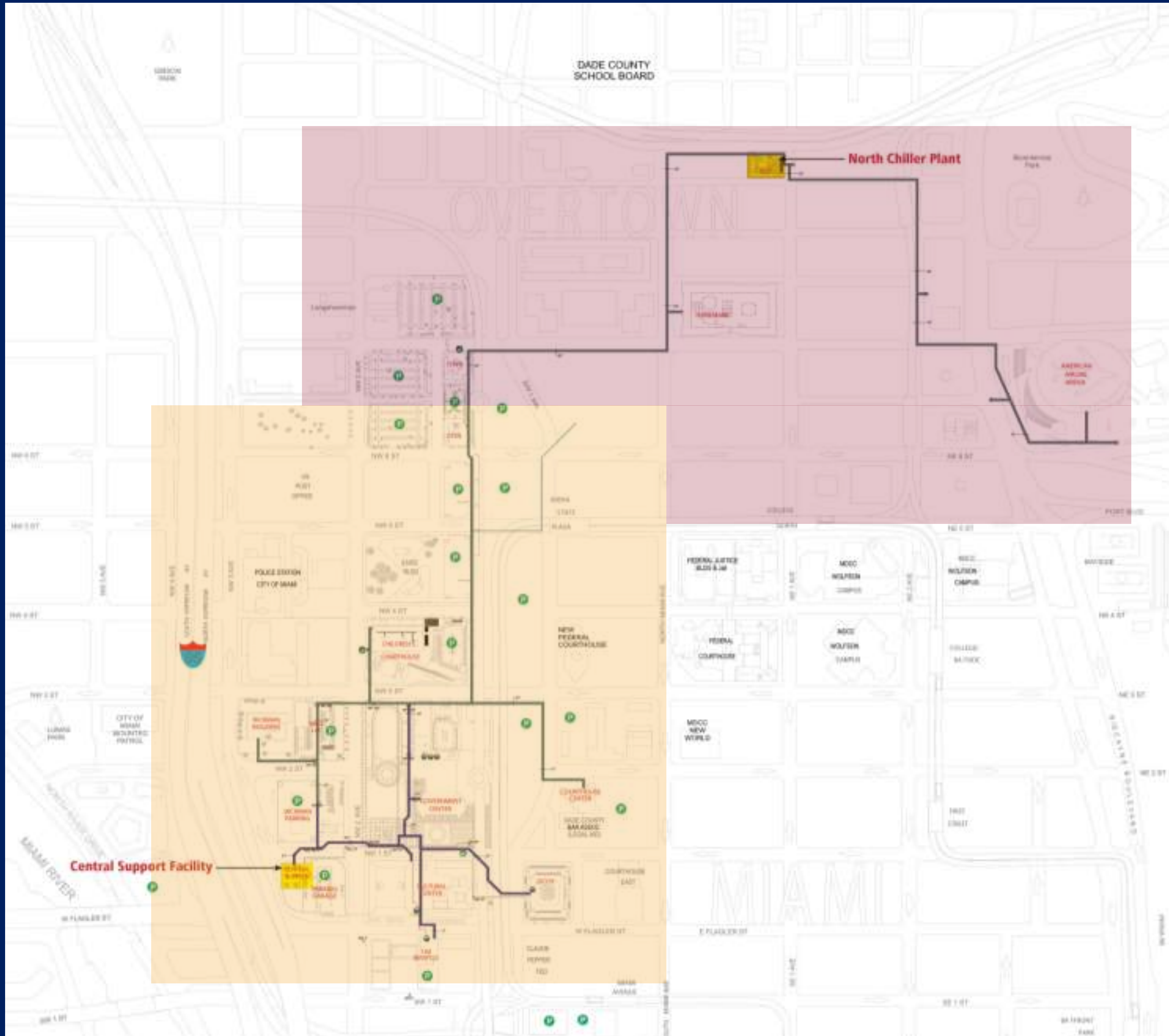
- Modeled the entire system
- Verified that System can operate interconnected without changing out equipment
- Control loading of plants by sequencing of distribution pumps.   (Turn on/off pumps based on Load Demand)
- Control of pumps does not change.
  - try to maintain a differential at most remote point in system (Monitoring multiple locations to verify what is the remote point)

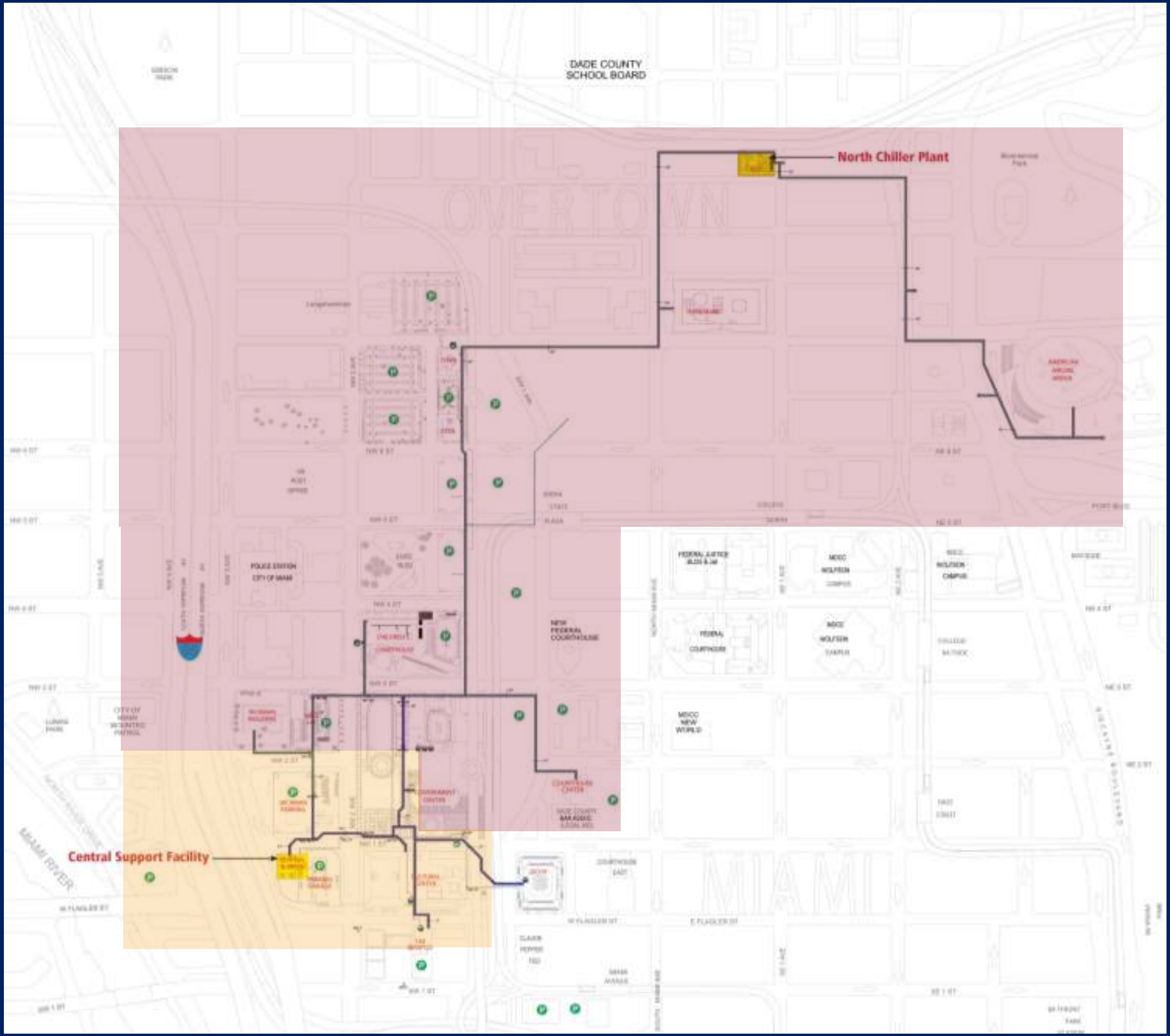


PIPE-FLO Professional 12	
Program Version:	12.1.21412
Calculation Method:	Darcy-Weisbach
Maximum Iterations:	100
Iteration Tolerance:	0.01
Laminar Cutoff Re:	2100

Units Used			
Flow rate:		Power:	
Velocity:	ft/s	Temperature:	°F
Pressure:	psi g	Density:	lb/ft³
Elevation:		Viscosity:	cP
Length:	ft	Atmospheric Pressure:	14.7 psi a
Size:	in		

Project Information	
Company:	Stanley Consultants Inc
Project:	25512 Miami Dade Chilled Water Loop
Drawn by:	M. Wagner
File Name:	MD CHW LoopIDEA.pipe
Lineup:	Maximize CSF
Print Date:	Wednesday, January 21, 2015 09:34 PM


DADE COUNTY
SCHOOL BOARD
North Chiller Plant
Central Support Facility


DADE COUNTY
SCHOOL BOARD
North Chiller Plant
OVERTOWN
Central Support Facility
MIAMI RIVER
MIAMI
NEW
FEDERAL
COURTHOUSE

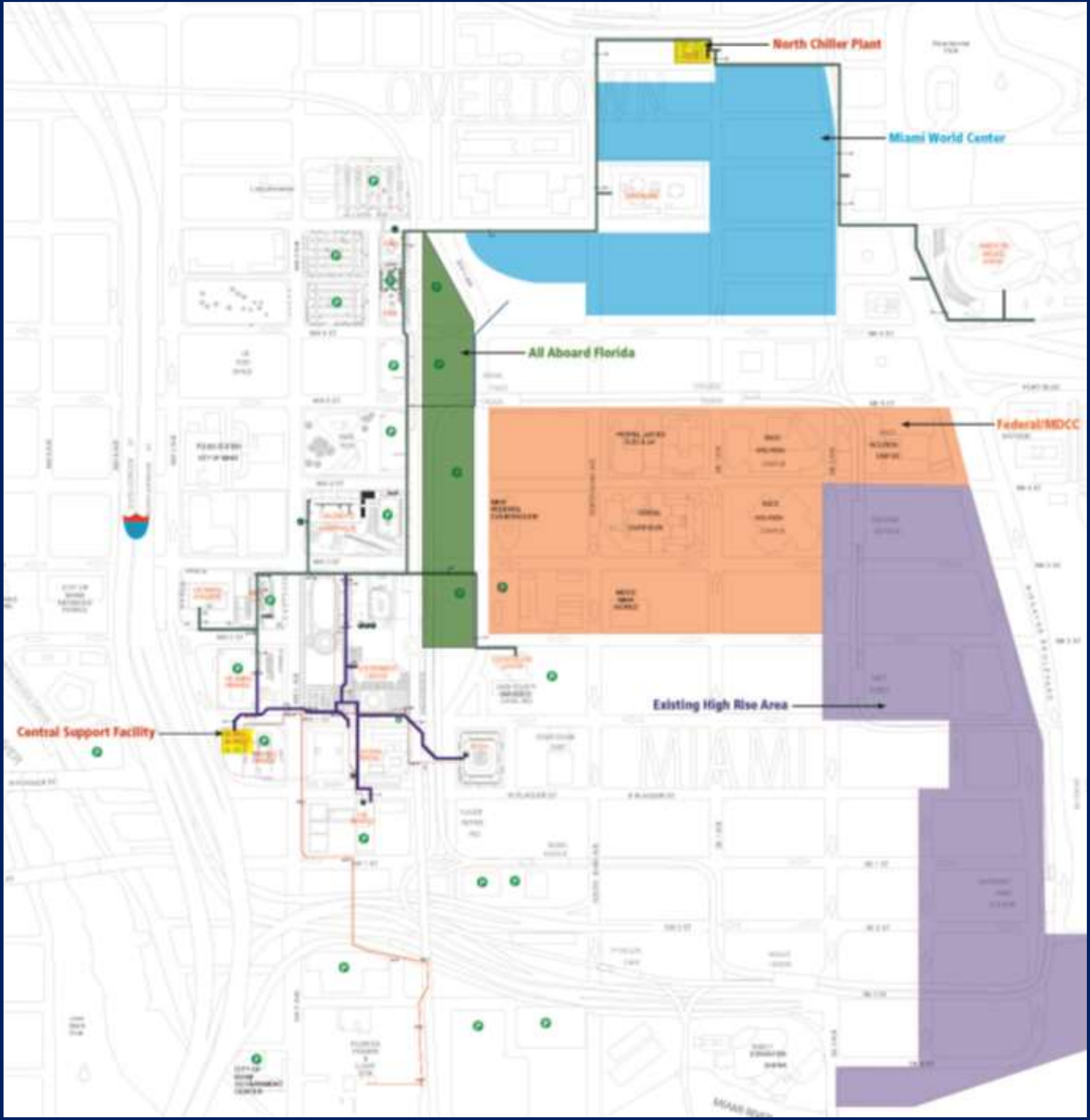
System Capacity

- Buildings served, 12
- Average summer load, 5,800 tons
- Peak theoretical load, 11,100 tons
- Peak plant load with diversity, 8,350 tons

- Plant #1 capacity, 7,400 tons installed, 5,900 firm
- Plant #2 capacity, 8,498 tons installed, 6,000 firm
- Total system capacity, 15,098 tons
- Capacity with N+1 chillers, 13,400 tons firm

System Expansion

- All Aboard Florida Complex
- Miami World Center
- Federal/MDCC Area
- Existing High Rise Area


North Chiller Plant
OVERTOWN
Miami World Center
All Aboard Florida
Federal/MDCC
Existing High Rise Area
Central Support Facility
MIAMI

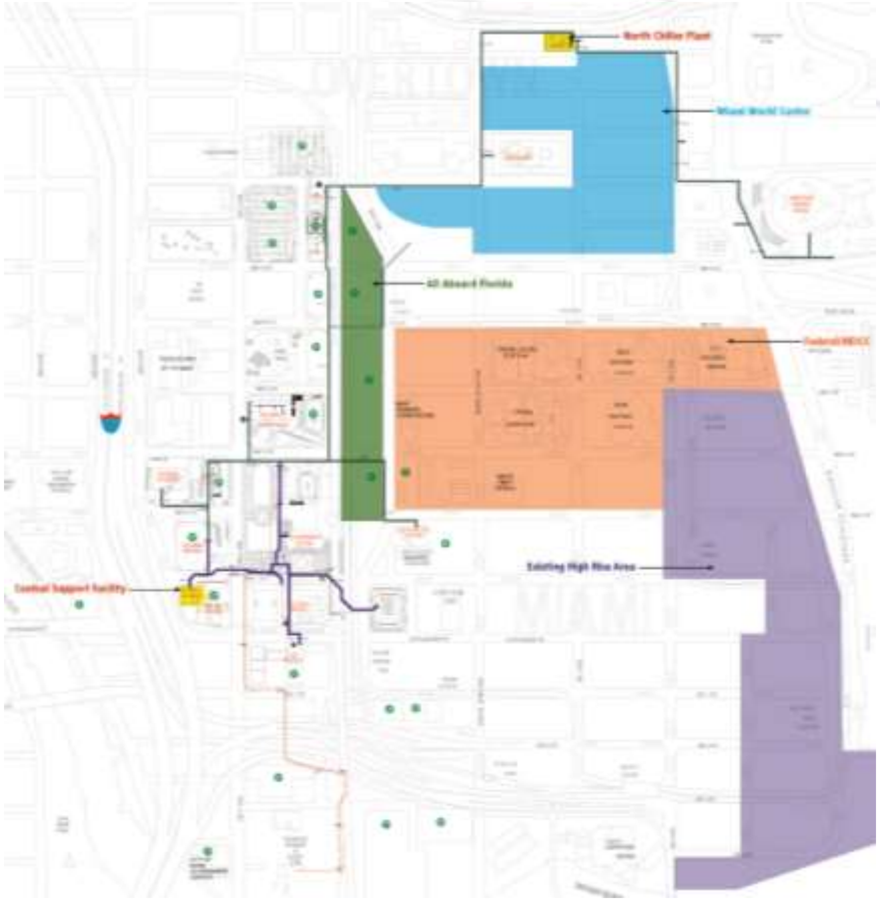
Electricity Use and Cost

- Plant #1
  - Use, 0.85 kW/ton
  - Electricity Cost, $0.75/kWh
- Plant #2
  - Use, 1.02 kW/ton
  - Electricity Cost, $0.45/kWh *

* Almost no demand component because all chilled water production is done during off-peak periods.

Conclusions

- Systems can be combined
- Temperature and pressure differences are not insurmountable
- Combined system has increased firm capacity and improved reliability
- Combined system better suited for further system expansion



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Thank You!