Designing and Implementing an Ultra Efficient Chilled Water System at Wake Forest University

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Agenda

❖ Campus and Chilled Water System Overview
❖ Design Process and Efficient Equipment Selection
❖ Future Growth Planning
❖ Path to Optimization
❖ Project Results
❖ Project Challenges
❖ Future of CHW System
Campus Overview

Wake Forest University
Private School and Member of the ACC
Located in Winston-Salem, North Carolina
5,225 undergrads, Over 8,400 total students
Main Campus - 3.5 million Sq. Ft.
Carbon Footprint - 5.2 million Sq. Ft.

District Utilities for Main Campus
Steam and Chilled Water Generation
Distribution includes Electrical & Water/Sewer

Growth of connected Chilled Water
10 year growth from 2.5 to 3.2 million Sq. Ft.
Gross Carbon Emissions continue to decrease

Energy Use per Sq. Foot decreases have helped to offset energy use from added space

Campus Overview – Energy Use and Emissions
Chilled Water System Overview

2015 Chilled Water System (Baseline)
- 4 Plants, 10 Chillers, 6700 Tons
- 40 Buildings Totaling 3.1M ft²
- Aging Equipment
- R-11 Refrigerant
- 0.78 kW/Ton Campus CHW Efficiency

Shift System Priorities To Sell Objectives
- Focus on Maintenance/Modernization
- Decommission Old Plants
- Upgrade South Plant
- Replace/Expand North Plant
- Optimize During Upgrades
Design Process – Project Goals

South Chiller Plant (2017)
  • Variable Primary CHW Conversion
  • Variable CDW Pumps

North Chiller Plant (2018)
  • Double Capacity from 1200 to 2400 Tons
  • VFD Chillers
  • Variable Primary CHW
  • Headered Variable CDW Pumping

Campus Chilled Water System
  • Optimized CHW Generation and Distribution
Design Process – Setting A New Standard

Energy Efficient Equipment

• Headered CDW and CHW
• Variable Volume Pumping
• Variable Speed Chillers

Team Effort

• Collaboration between owner and engineering
• Transparency in design and modeling
Design Process – Hydraulic and Distribution Analysis

- Hydraulic limitations on load hours
- Validating Future Projects
- Establish Working Model
Implementation of Optimization

Engineering Analysis

Baseline Measurement

Implement Solution
Develop project scope of work

Model baseline and projected energy

Implement within design strategy

Engineering Analysis
Baseline Measurement

Determine parameters for measurement

Integrate metering devices with BAS

Install Optimization appliance and trend data
Implementation of Optimization Solution

Project Implementation and Commissioning

Custom Optimization programming and deployment

On site testing and continued remote support
Project Results

0.78 kW/Ton Baseline

0.56 kW/Ton Projected

0.54 kW/Ton Actual

$220,000 / year saved
Project Challenges

- Confidence in data, historical and projections
- Staff Adoption
- Funding
- Seasonality
- Future Needs
Future of CHW System – Continued Improvement

Continued Efficiency Improvement as CHW Needs Increase

![Graph showing Chiller Plant kWh vs GSF from FY08 to FY19. The graph displays a decrease in kWh and an increase in GSF (cooling) over the years.](image-url)
Future of CHW System - Expansion

North and South Plant Connector
Distribution Improvements

South Chiller Plant Expansion
Renewal, Capacity, Optimization

New Academic Commons site
Building Efficiencies
Site Utility Improvements
Questions?
Thank you!

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