Enterprise-Wide Deployment of Chilled Water Optimization

2019 Better Project

Nissan North America

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Executive Summary

- Background
  - 3 manufacturing sites with more than 14 million square feet of conditioned space
  - Learned about chilled water optimization through Better Plants and ENERGY STAR partners
  - Realized energy savings from the chilled water optimization system in the Canton Vehicle Assembly Plant
- Implementation and Execution
  - Installed new controllers
  - Replaced valves and actuators
  - Developed new user interface
- Outcomes
  - Energy Savings
    - 2,966 MWh of electric energy savings in 2018
  - Sustained Impact
    - Evaluating chilled water optimization throughout facilities
    - Evaluating optimization options of other facility systems (e.g. hot water systems, air handlers, etc.)

Background

- 3 Manufacturing Sites
  - Located in southeastern United States
    - Hot and humid during cooling season
  - > 14 million square feet of conditioned space
  - Electric load increases immensely for cooling and dehumidification
- Benchmarking and Canton Optimization Pilot Program
  - First learned of chilled water optimization during benchmarking with Better Plants and ENERGY STAR partners
  - Studied and implemented a pilot program at the Canton Vehicle Assembly Plant
  - Realized success of the Canton chilled water optimization and began studying feasibility of chilled water systems in Decherd and Smyrna
- Results of Initial Studies
  - Found the need to automate the chilled water systems
    - Actuating valves, variable speed drives, electric controls
  - Determined that a new user interface (UI) needed to be developed to monitor the system
  - Began implementation process in 2016

Smyrna Fascia and Decherd Chilled Water Optimization

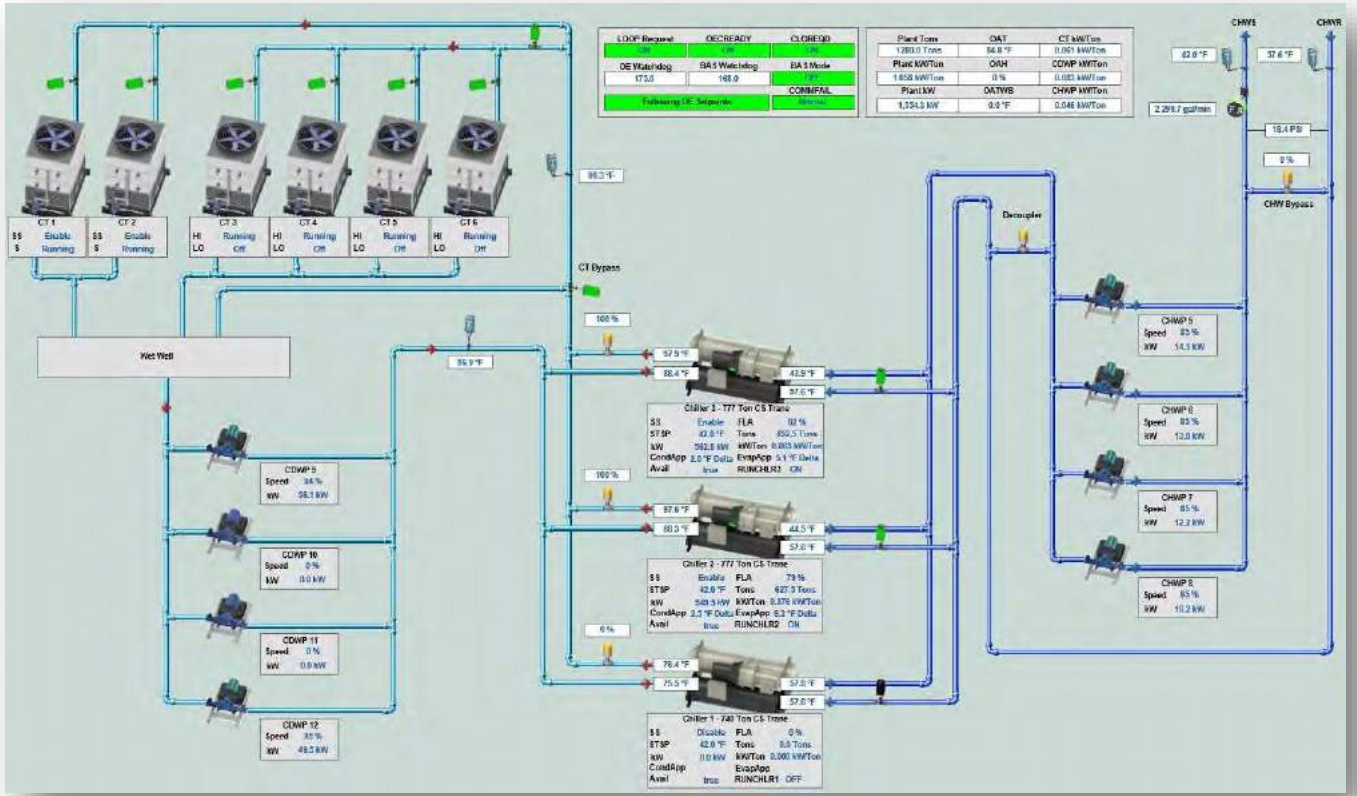
- Smyrna Fascia
  - 2,400 tons of refrigeration
  - Previously operated manually through remote HMI
  - Converted to a variable flow system from a primary-secondary pumping system
    - Determined that the secondary pumps could handle the required flow through the chillers and the chilled water loop
- Decherd
  - 3,800 tons of refrigeration
  - Previously operated manually through remote HMI
- Control System
  - Uses manufacturer data to determine chiller load sharing based on condenser water temperature and chilled water load
  - Coordinates cooling towers and pumps to drive condenser water temperature to allow the most efficient operation at the given chilled water load
  - Controls chilled water pumps to maintain a set differential pressure between the supply and return

Smyrna Central Utilities Plant Condenser Water Optimization

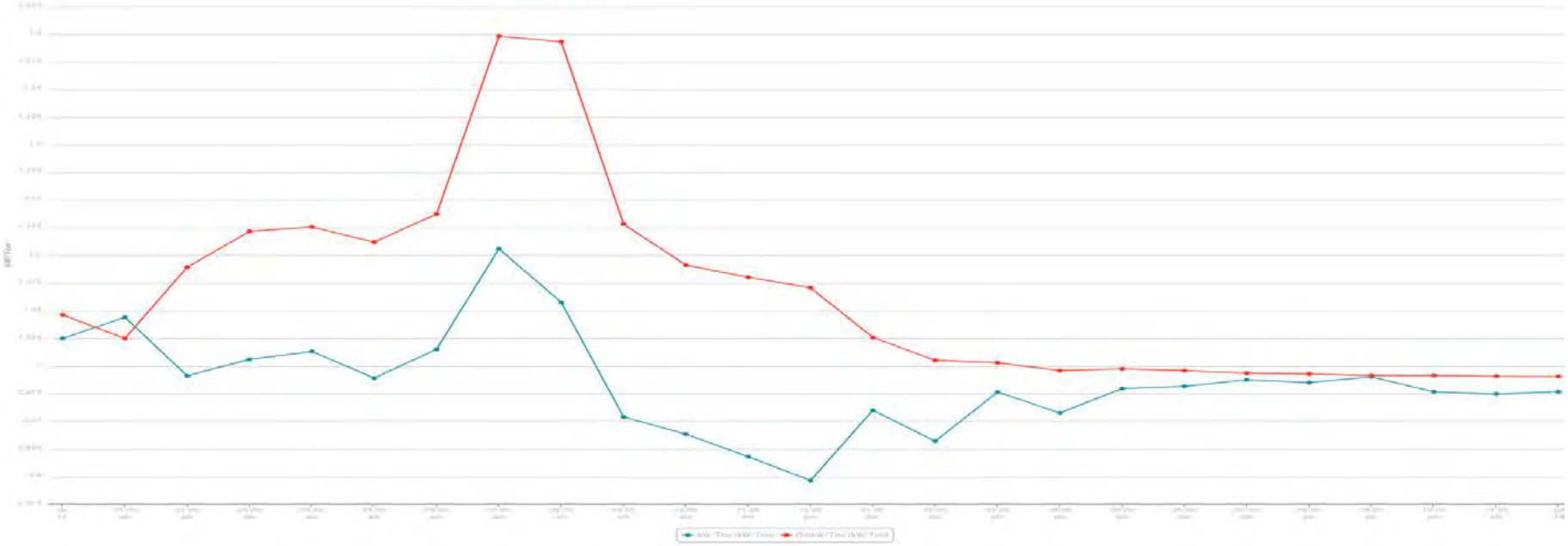
- 17,000 tons of cooling capacity
- Manually controlled through a remote HMI
- Tied to both the compressed air system and the chilled water system
  - Needed to ensure that condenser water temperature was not driven too low in order to maintain compressor oil temperature
- Controls
  - Coordinates cooling towers and condenser water pumps to drive the condenser water sump temperature to allow for the most efficient operation of the chillers at the given chilled water load
  - Added a schedule to the existing remote HMI that allowed for automatic staging of chillers instead of manually staging
  - Included a minimum condenser water sump temperature to avoid adversely impact the air compressors

User Interface

- Focused on UI after completing controls design
- Graphics includes pumps, valve, chillers, cooling towers, and expansion tanks (where applicable)
- Primary KPI is kW/Ton



Trending Data



- Multiple equipment and system trend points including motor speeds, percentage of full-load amps, efficiencies, power, loads, and energy consumption
- Calculates an “Old kW” based on the Operator’s sequence of operations and equipment specifications

Challenges Faced

- Old Equipment
  - Valves with deteriorated seats
    - Replaced as they were found
  - Pneumatic actuators
    - Replaced with electric actuators
  - Outdated controls

- “Old Habits”
  - Manually operating an automated system
    - Taking the system out of automatic control and controlling using the remote HMI
  - Setting VFDs in hand and increasing pump speeds
    - Increasing pump speeds when supply pressure is too low
  - Turning on chillers locally

Outcomes and Sustained Impact

Outcomes

- Energy Savings
  - 2,966 MWh in 2018
  - 3,661 MWh since start of operation at Smyrna Fascia
- Large step toward carbon footprint reduction efforts
  - Nissan Green Program 2022
- Increased direct and indirect efficiencies
  - Frees operators from constantly monitoring systems

Sustained Impact

- Studying possible applications for other chilled water systems
- Studying and implementing projects to automate and optimize other systems such as air handlers, hot water systems, etc.
- Using the extensive data collected to justify the replacement of aged equipment

Questions?

Thank you