PARALLEL TES SYSTEMS: IN IT TO TWIN IT!

Optimizing parallel Thermal Energy Storage tanks at The University of Texas at Austin

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UT Austin Campus Overview

- 60,600 cooling tons capacity (main campus)
- 20M GSF, 2% added annually
- 10MGal Thermal Energy Storage (TES) capacity
- 38k tons, 66MW peak demand (2017)
- 33k tons, 60MW peak demand (2019)
- 0.69kW/Ton Avg. (2017)
- 0.59kW/Ton Avg. (2019)
A Tale of Two Tanks

• First TES Tank Commissioned in 2007
  – Four MGal, 35k ton-hr capacity
  – Manual Dispatch via Operations personnel
  – Automated via Optimum Energy in 2014
  – Benefits include enhanced efficiency, resiliency, mitigate need for new power generation at 1/10th the cost.
TES-2 Commissioned in 2017

- Six MGal, 45k ton-hr capacity
- Provides resiliency to new Dell-Seton Medical Campus
- Automated dispatch via Optimum Energy offsets 6MW peak power demand - 2019
- Hydraulic Diversity from TES-1 necessitated complex controls solutions
Resiliency Benefits

• Added Redundancy: TES operation can supplement outage of largest chilling station
• Allows greater dependency on newer variable speed chillers
• Finite flow variability enhances campus dP control
Efficiency Benefits

- Allows use of most efficient variable speed chillers
- More CHW production at night when WB depressed
- CGT’s maintain higher loads near efficiency peaks – improves heat rate
- Lengthens run time for more efficient CTG-10
Optimized Dispatch Profile - Example
Ultimate Goal: Flat Campus Load

Addition of TES-2 with improved dispatch controls strategy flattens UT Austin’s electrical load profile within a 10% bandwidth.
Realized Efficiency Gains

Normalized space energy use over similar occupancy and weather conditions highlight the reduction in fuel gas consumption.
Regression Modeling

**Actual versus Predicted Campus MW versus OATWB**

- **Average of System MW**
- **Average of Predicted System MW**

**Actual Versus Predicted Campus MW versus Month**

- **Average of System MW**
- **Average of Predicted System MW**
Three phases of TES dispatch optimization highlight achieving ultimate goal of flat electrical generation load profile.
Controls Strategy
Controls Strategy

- **Push-Pull Controller**
  - Pump – Outflow
  - Valves – Inflow

- **Flow bias (Negative = flows out more)**
  - TES tank level
  - CS5 exp. Tank pressure

- **Safety Interlocks (time-inverse)**
  - CHWS pressure
  - CS5 CHWR pressure
Controls/Network Topology

- A website is made available to campus and operations users to check the latest status of campus power.
- Alarm notifications are sent to key subscribers.
- Alarm information is assembled for presentation and made available to power plant operations and campus users.
- OPC tags for each meter and breaker are monitored, logic is performed to evaluate and process alarm information.
- Field data is centralized in an OPC server.
- Smart meters are installed in the power plant and in campus buildings.

Data Flow
Lessons Learned

• Relational Controls inadequately responsive.
• Future-proof – Beneficial system will eventually be essential system.
• Overlapping goals require prioritization and compromise.
• Tanks are beautiful – to engineers.
• Maintenance planning/scheduling still critical.
• Regression modeling requires trial and error.
Questions?

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Thank You!

…and please feel free to reach out to us.

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