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315 - "Best Practices" for Plant Organization & Operations

This session will examine Texas Tech University's approach to optimizing central plant utility production. The session will begin with a discussion of the ongoing journey of continuous improvement. It will focus on the strategy used to achieve cost savings even after what was thought to be the low hanging fruit was had. This class will review both a plant and larger scale campus, data driven, approach to optimization practices where seasonal operating matrices are adjusted based on data collected. This concept can be applied in other areas of facilities management where data is collected but not made actionable.

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Suzanne Kitten, Managing Director Utilities

Texas Tech University

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Change is good!

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Change According to TTU Utilities

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Course Description

This course provides an overview of best practices for central utility plant optimization. Examples from Texas Tech University's ongoing journey of continuous improvement at its Central Heating & Cooling Plants will be presented.

Learning Objectives

1. Establish Operational Baselines
2. You've got the data, now let's use it!
3. The need for Continuous Improvement

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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1882 – Thomas Edison opens the world's first power plant.

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Texas Tech University Central Heating & Cooling Plant 1

- Provides heating & cooling for 10 million square feet
- 3 steam turbine-powered centrifugal chillers (3000T, 4500T, 6000T and 2 electric chillers (3000T ea)
- 3 natural gas-fired boilers (125KPPH, 175KPPH, 200KPPH), 600psi / 750F reduced to 80psi / 350F for campus supply
- 1MW BPT Generator for internal plant use
- 7.75mi Utility Tunnels, 7.5M gallons CW, Compressed Air & RO Water
- 20MW Cogeneration Plant?

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TTU CHACP1 Safety Video

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Establishing Operational Baselines

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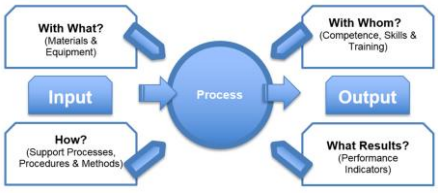

First things First - What's our Process?

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We've got the data, now let's use it!

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How do we know when change is necessary?

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Empowering a More Efficient Future.

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"The Dog"

"The Tail"

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Agenda

A. Plant Operating Costs and Savings
B. Chilled Water Optimization
C. Utilizing Performance Metrics in Real Time

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Plant Operating Costs & Savings

- Average Cost to Generate Chilled Water/Year ~$4.5M (CHACP 1 and 2)
- Through continuous monitoring and improvement within the past 3 years (with re-established baseline), TTU has saved $1,040,379 or 8% in generation costs without major capital expenditures.

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Chilled Water Optimization

- **Implemented Chilled and Condenser Water Reset Schedules based on seasonal load profiles and building schedule requirements.**
  - Linear Temperature Resets for both Chilled and Condenser Water
    - Increased both Chiller and Auxiliary Efficiencies
  - Differential Pressure Resets for both Chilled and Condenser Water.
    - Individual building loads were monitored to ensure discharge temperatures were being maintained in addition to sustaining increased CHW Delta Ts.
- **Utilizing software to forecast tonnage and performance models, operators were able to refine Chiller sequence/staging (while still meeting campus demand) based on cost and efficiency.**

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Utilizing Performance Metrics in Real Time

- **CHWP/Chiller Sequencing from CHWP kW/ton and GPM/Ton**
  - Utilizing these metrics, building outliers were identified and corrected.
  - Ex. High CHWP GPM/Ton identified CHW Control Valve tuning issue.
- **CWP/Chiller Sequencing vs. load vs. Header Pressure**
  - Identified higher head pressures had no additional flow output.
  - Operators are now cognizant of when pressure increases, therefore reduce pump speeds/# of Cooling Tower Cells
- **Chiller Performance vs. Design (and year over year) to modify sequence based on improvements**

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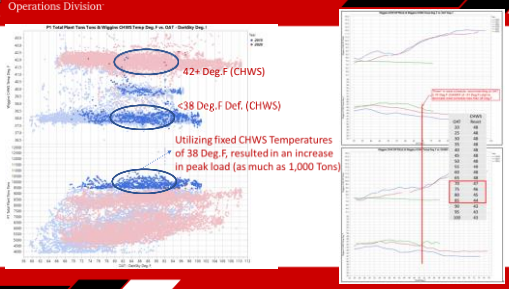

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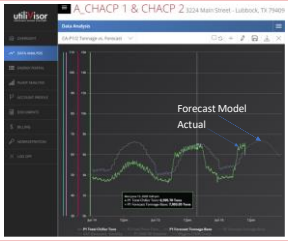
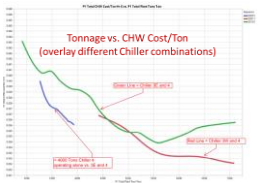


Operators utilize utiliVisor Forecast/Performance Models to determine optimal Chiller Selection based on Cost/Ton



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Breakpoint (WSE vs. Electric Chiller)

From: Chris Angerame
Subject: Breakpoint (WSE vs. Electric Chiller)
Date: 12/16/2021 2:07 PM -06:00
Attachment: P1 Efficiency.svg

Afternoon All,
As a follow up to our conversation this morning, utilizing Chiller Efficiency as a breakpoint may misleading.
Per the attachment:

- WSE is the most cost effective < 3,700 Tons
- At 3,700 Tons, Total Chiller Efficiency - 0.2563 kW/ton*
- *The best Chiller Efficiency we have seen is ~0.22 kW/ton around 2,500 Tons (however total kW/ton was > 0.6 kW/ton)
- **If Cost/Ton-Hr on the WSE > 3,000 Tons is > $0.036/Ton-Hr switch to Electric Chillers**
- **If P1 Plant Efficiency on the WSE > 3,000 Tons is > 0.42 kW/ton switch to Electric Chille**

I added two notes on the Plant Analysis Banner for reference.
Regards,
Chris Angerame

P1 Efficiency.svg

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THANK YOU

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Credit(s) earned on completion of this course will be reported to American Institute of Architects (AIA) Continuing Education Session (CES) for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

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