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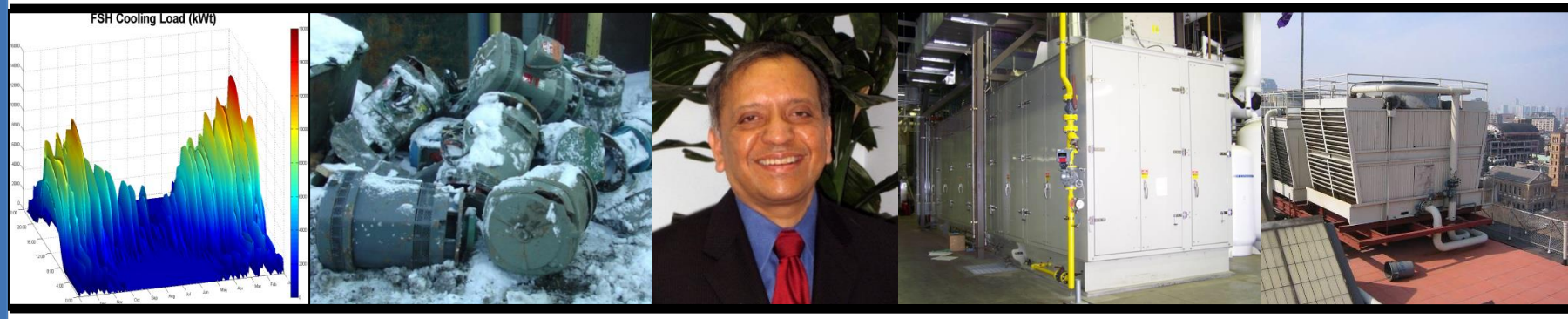

An Alternative Approach to Chilled Water Optimization:

Operator Advisory and On-going Training

A 10,000 ton Central Chilled Water Plant Case Study

BY: Brent Dunham, MS

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Chilled Water Optimization…The Alternative

- There are many advanced platforms and controls systems that allow for Optimization of Chilled Water Systems
- These are great systems but can be very costly and may not fit into near term budgets.

- What can you do now to help reduce energy and lower your carbon footprint!

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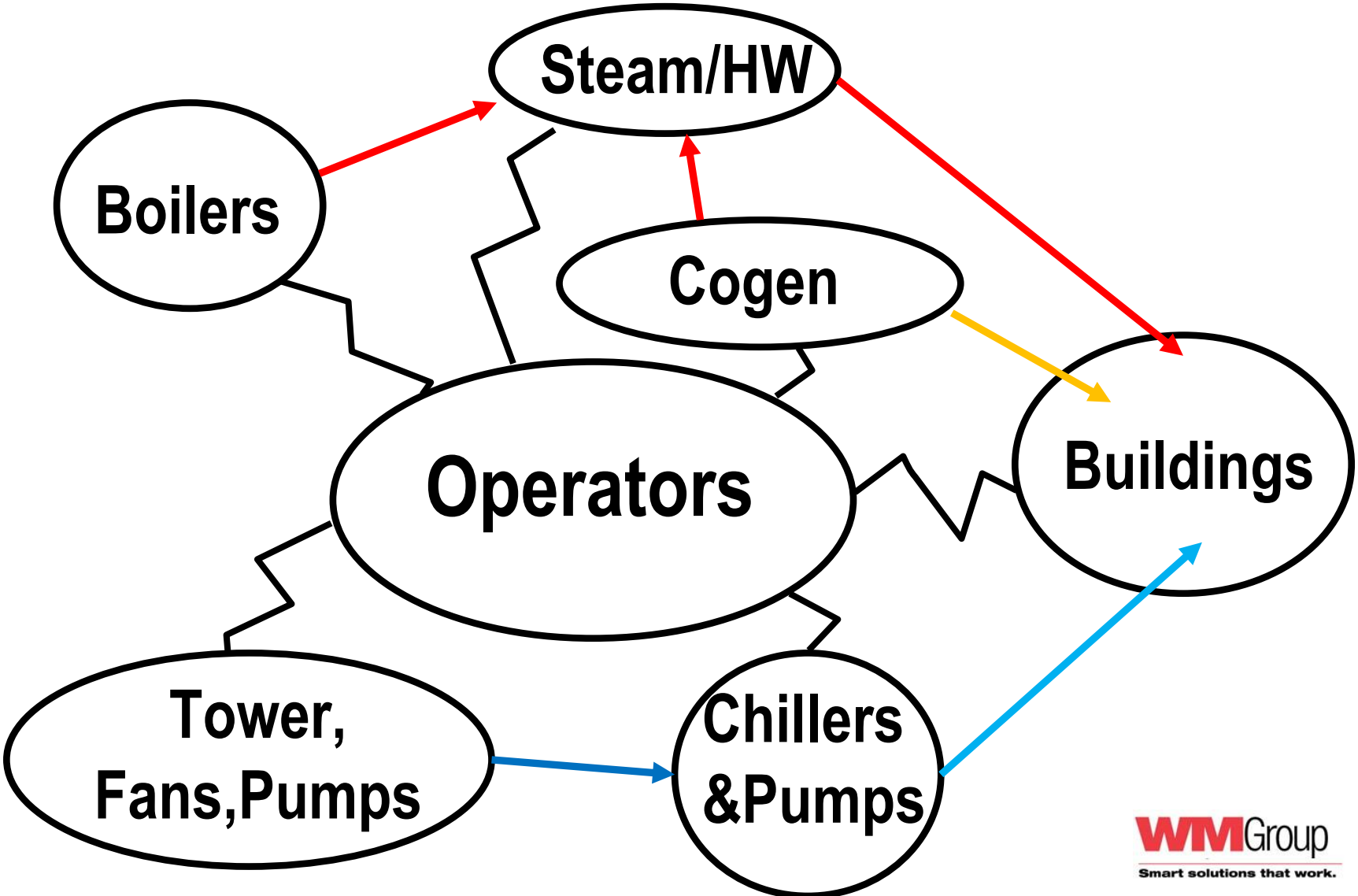
It starts at the center of all systems…



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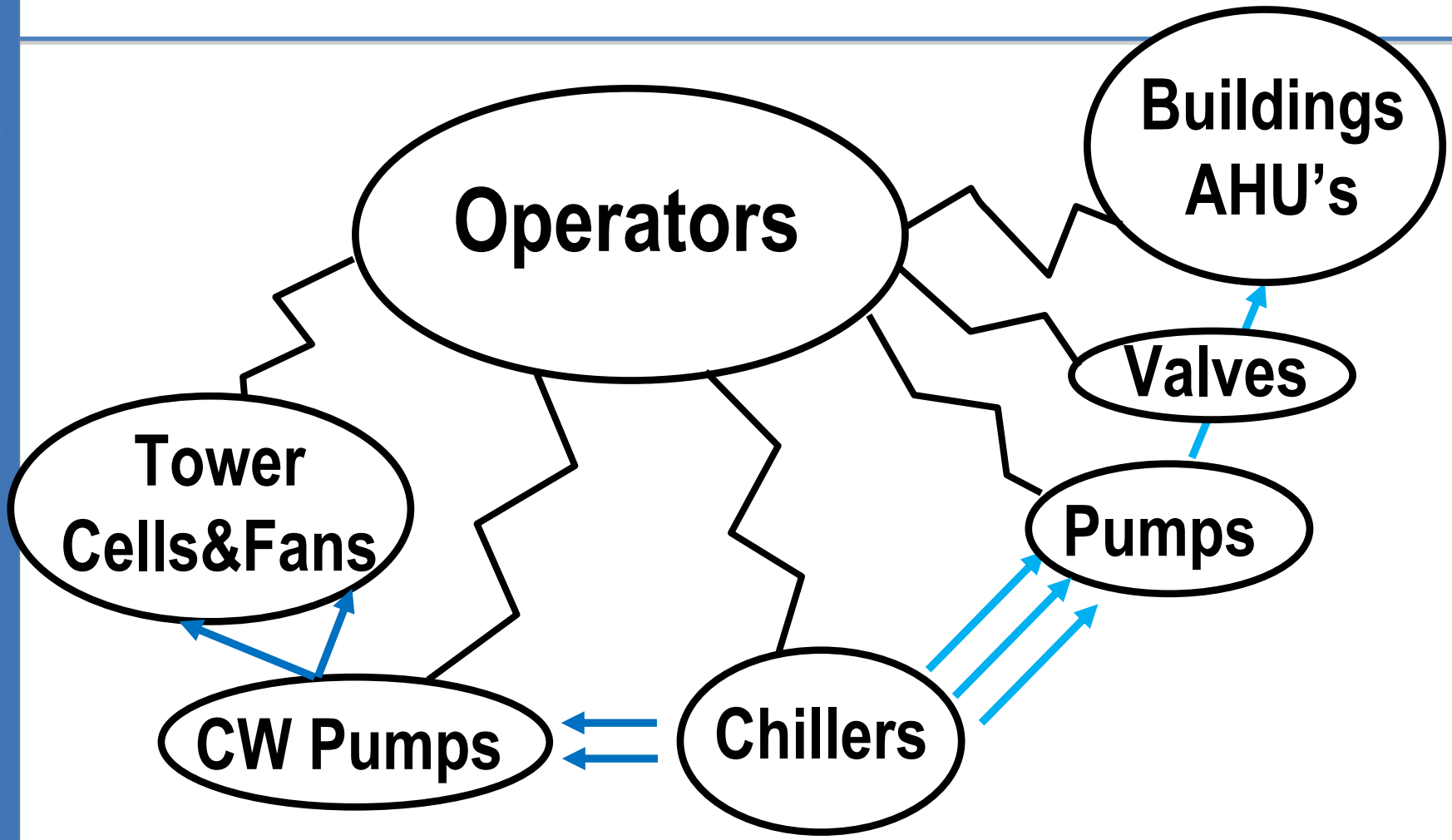
We will focus on one half- Chilled Water



Let's look at each component

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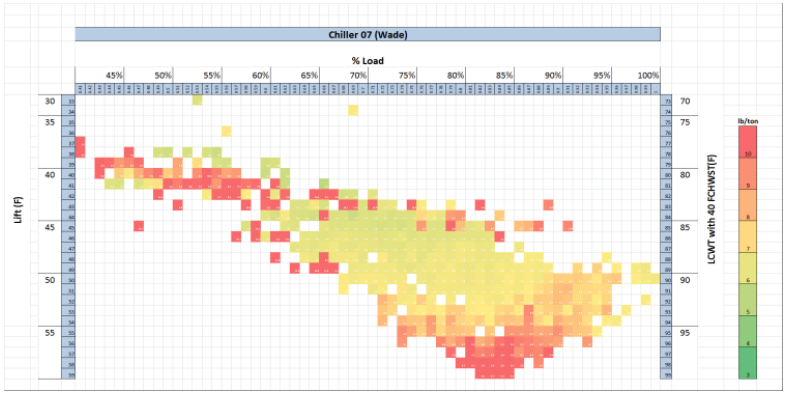
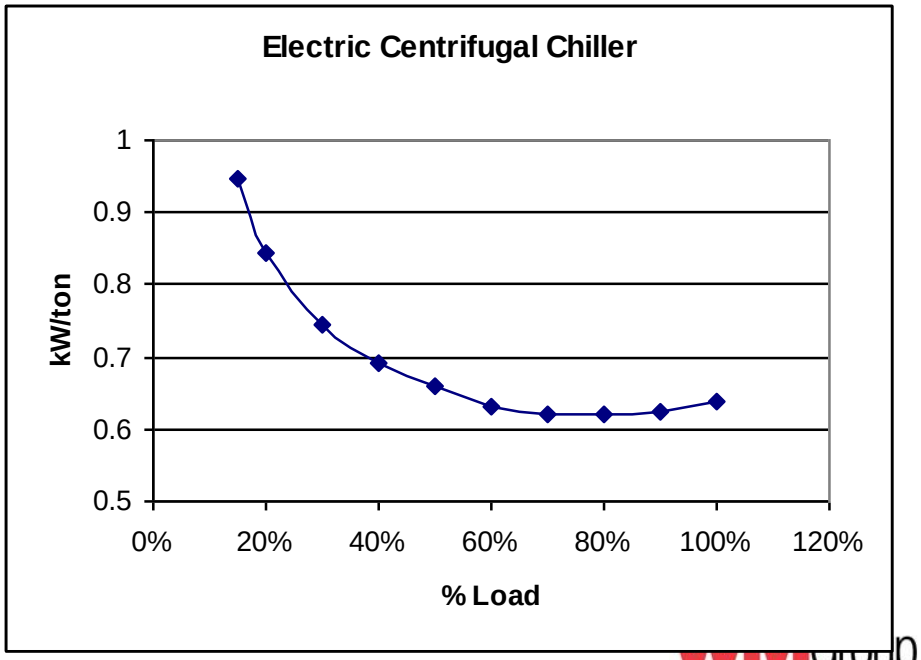
Chillers-Decision Making

- Know each machine
- Understanding Sweet spots



- Need to decide when to start/stop chillers
- Need to decide CHW setpoint



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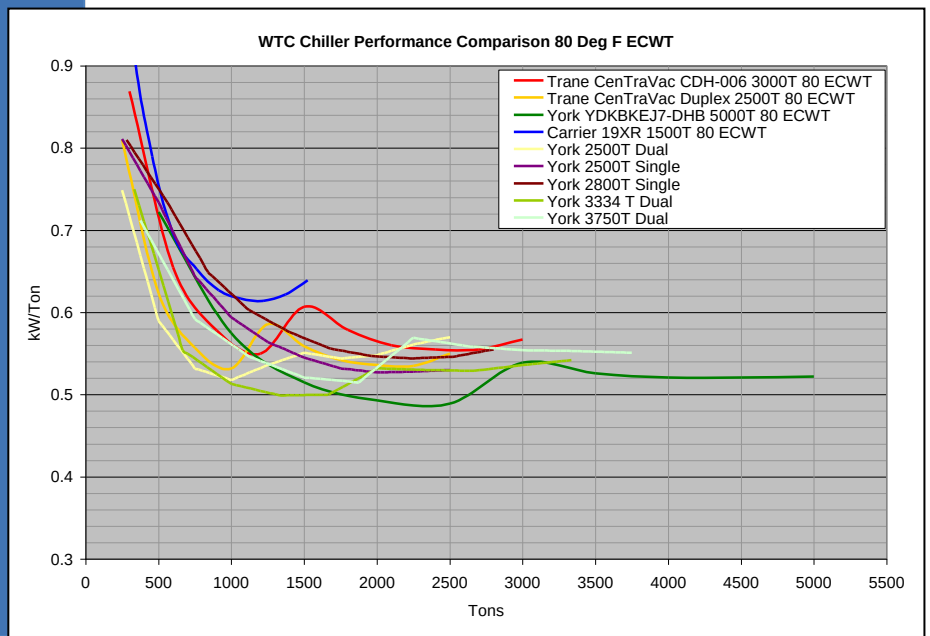
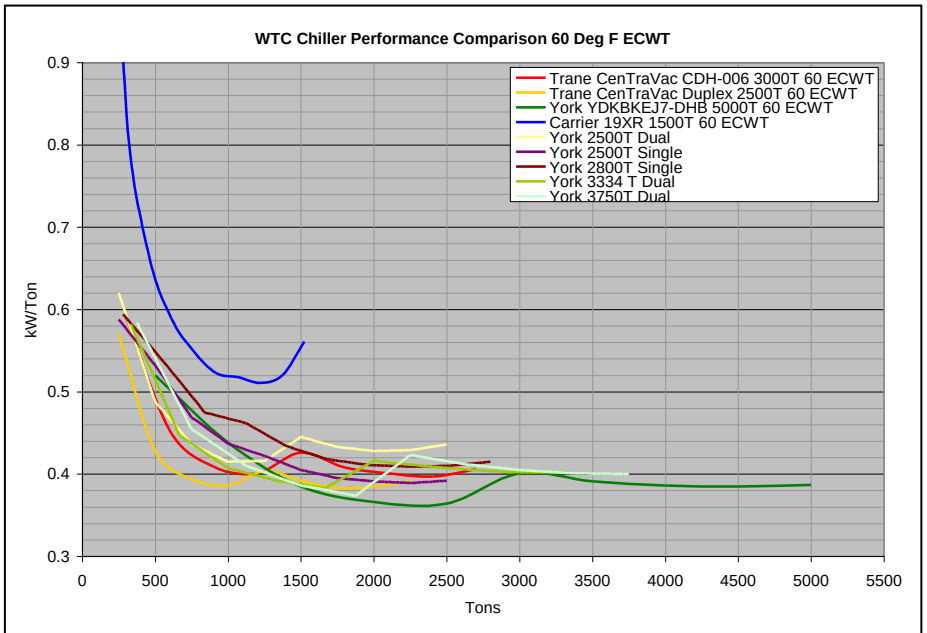
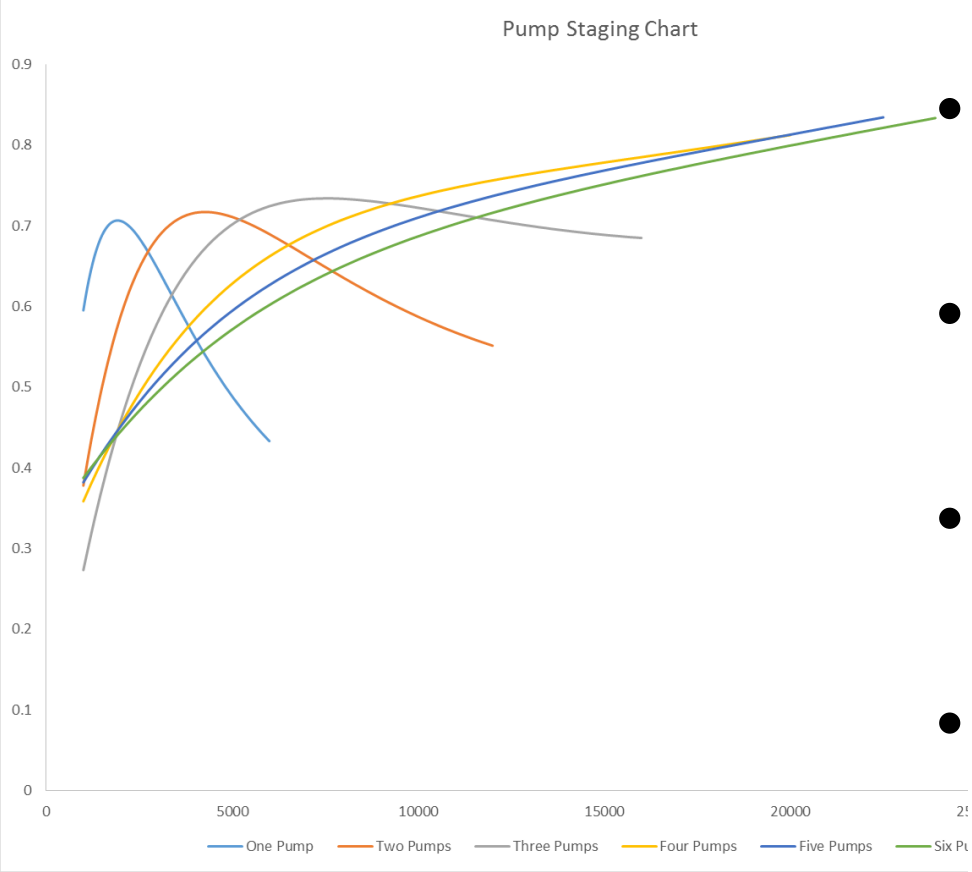
Cooling Towers-Decision Making

- Understanding balance of Fan Energy, Pump Energy, and Chiller Energy
- Need to decide how many cells to run
- Need to decide Condenser Water Flow/ # of pumps
- Need to decide CW Temperature set point





CHW Pumps-Decision Making



- Understanding Pump Efficiencies
- Pumping System Type

- Need to decide when to start/stop pumps
- Need to decide what Speed set point

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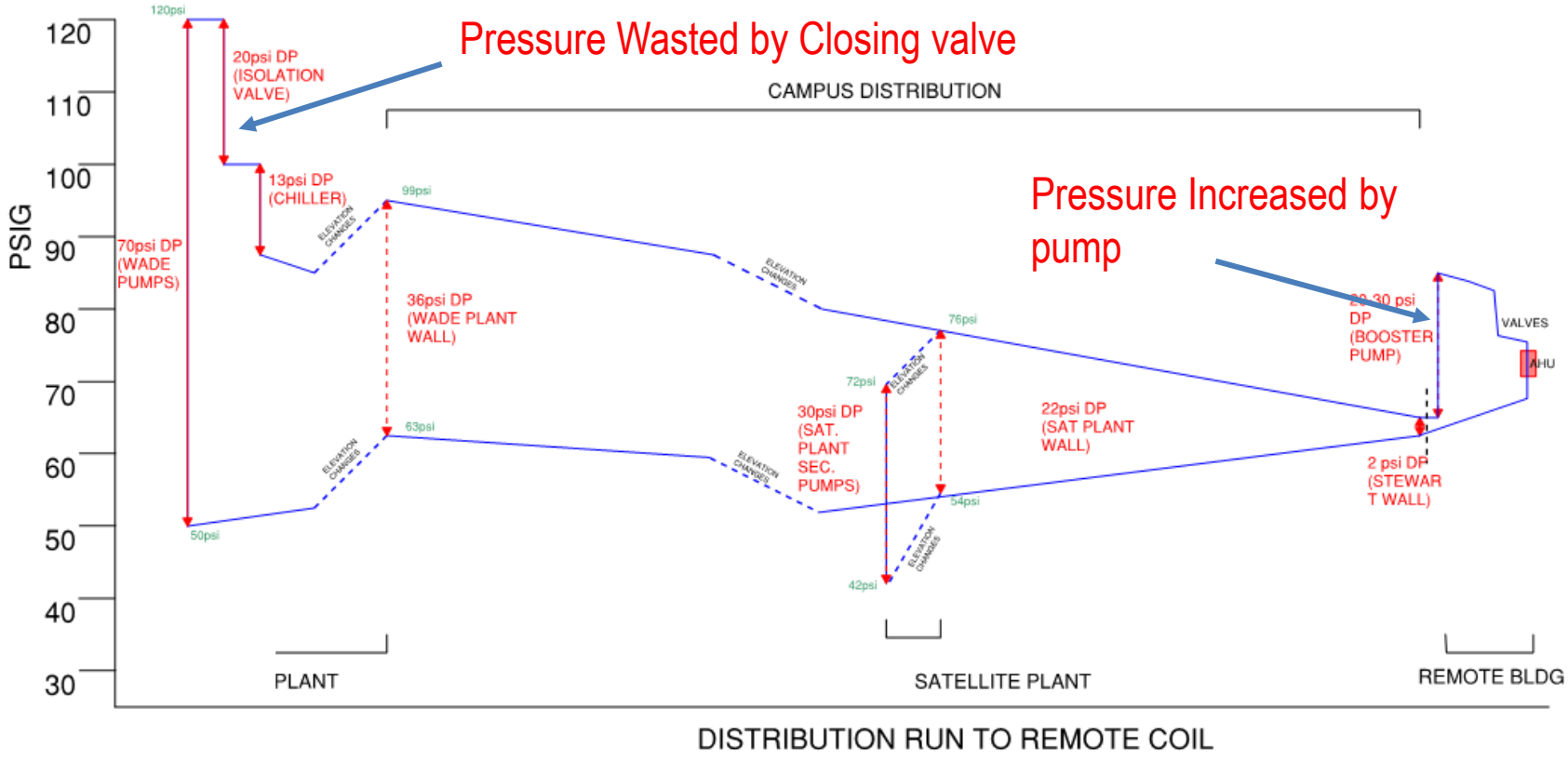
Valves-Decision Making

- Valves in the distribution can be the death of a system.
- Understanding to only use when absolutely required.

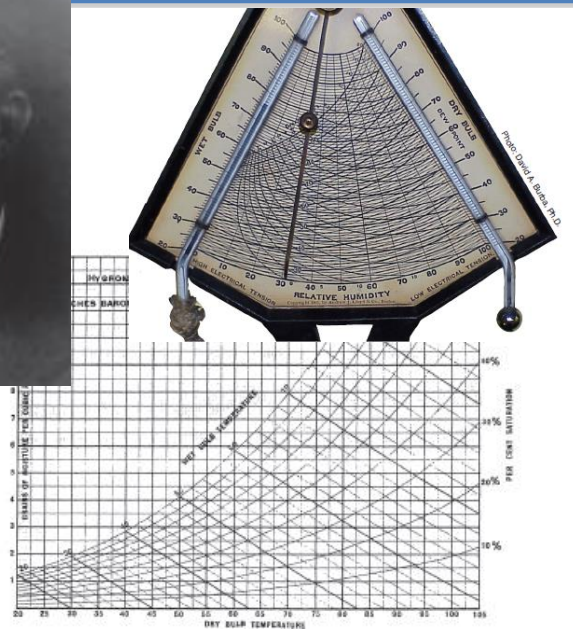


Building AHU's – Decision Making

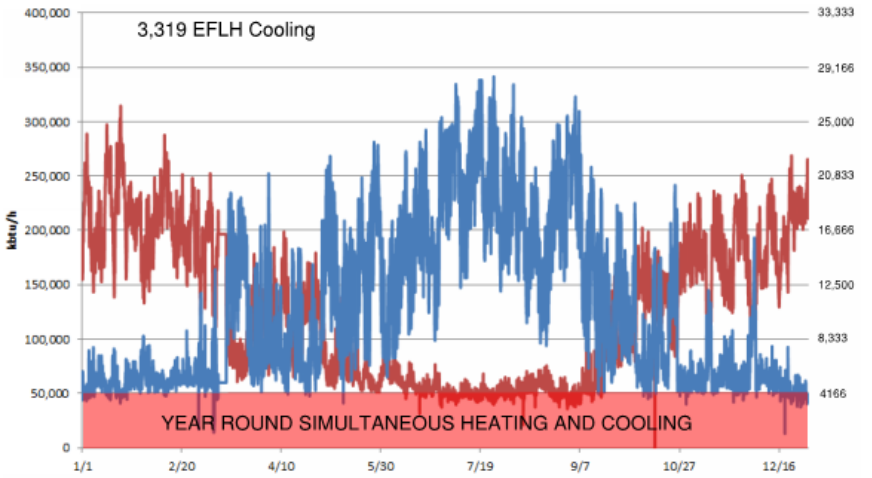
2 Reasons for Cooling:

1. Dehumidify (most important)
2. Maintain space temperature

- Willis Carrier- "The father of air conditioning"
  - "<u>The principal function of air conditioning is the control of moisture</u>"



- Need to decide cooling valve set point



Seems easy right?!?
What can you do? Where to Start?

- Operator Advisory
- On-going Training

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Operators Culture?

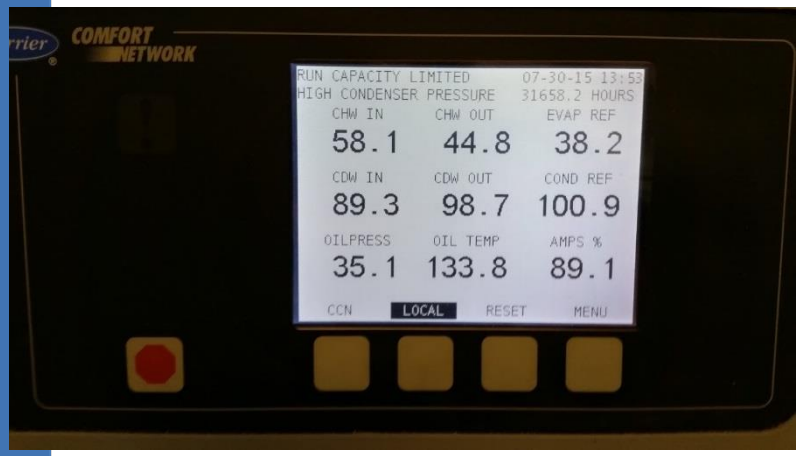
- Operators have their own way on how to operate plant
- Quite often the same plant is operated differently by each shift operators.
- The goal for the operators is to avoid telephone calls
- Optimizing the operation takes back seat
- First we need to work with operators to build their confidence ant trust

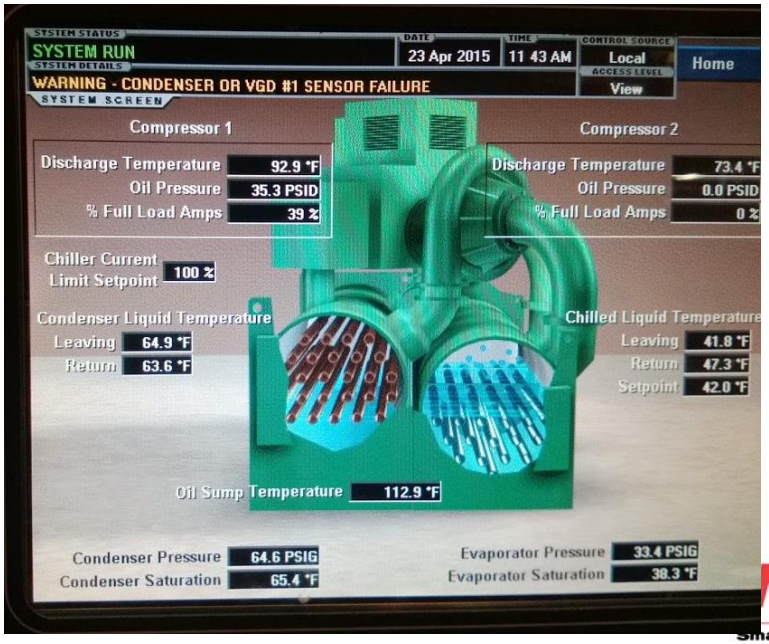
How to empower operators and change their culture?

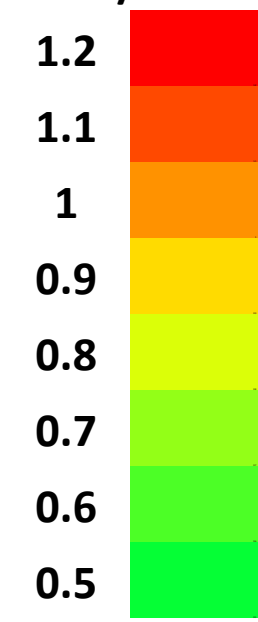
- First we need to work with operators to build their confidence ant trust
- Repeated demonstration of energy savings and teaching with respect is a must.
- Rewards are tremendous
- After a while you feel great about making a change and empowering operators

Step 1: Baseline Your System

- Understand where you are at and where you can go- to set goals
- Plant kW/ton is a great measure to use, and kW readings are relatively easy to capture.
- Take some snapshots off the energy meters and/or amp readings.







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Step 2: Develop Decision Making Process

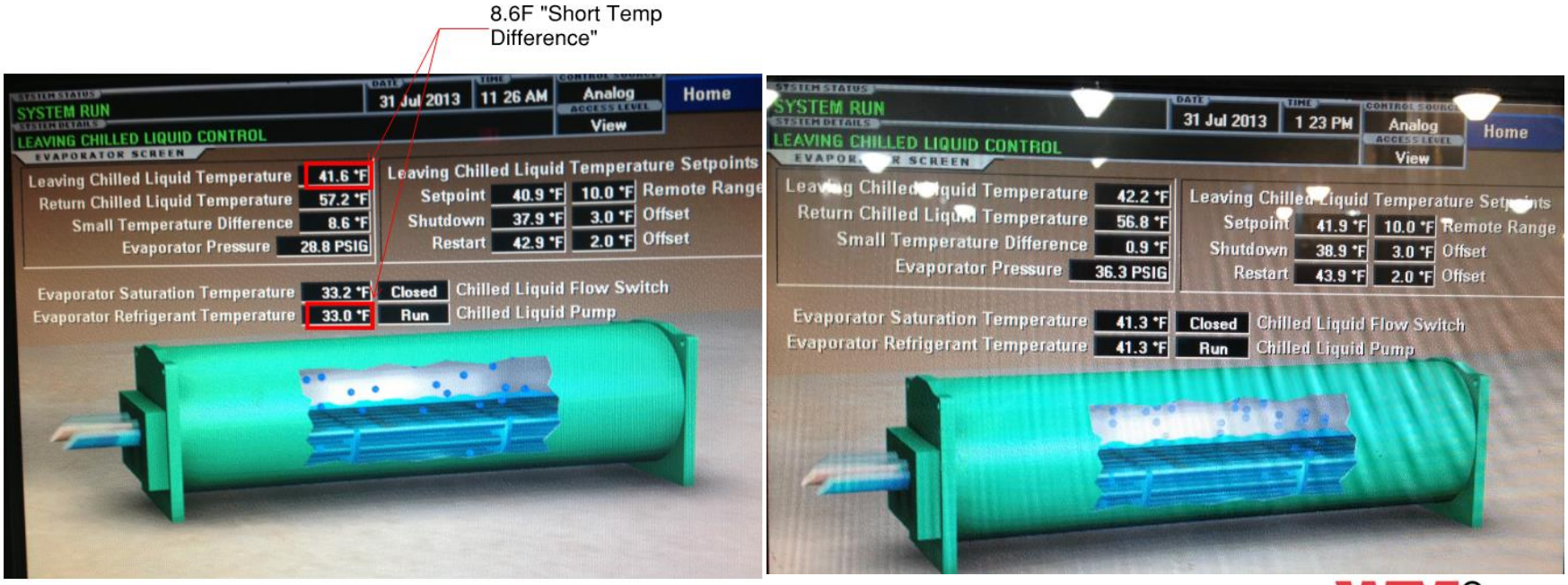
- Determine all factors that drive the decision making process, What works for **YOU!**
- Identify all controllable components
- Data and Surveying
- Understand energy impacts of each component
- Red flags for equipment operation, poor efficiency
- Develop Sequencing for Operators
- Operators always like easily understandable, useful tools for guidance and reference

Step 3: Working in the Operator Room

- Work with operators and change operations with their help.
- Traditions take time to overcome
- Discuss and educate operators in ***layman*** language to build his/her confidence.

Step 3: Working in the Operator Room

- Operators must be trained by showing them.
- Remove fear from operators.
- Show them the results.



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Step 4: Continue to Train and Advise

- On-going Training is a must.
  - One and done will set you up for failure.
- Develop annual training plan for a weekly, monthly, yearly basis.
- Update Tools as the system is updated.

- When Optimization is added, the operators will have a much better foundation, and you will see enhanced acceptance.

Experience and Case Studies

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A 10,000 ton CHW Plant Case Study

- Unique Project
- Client wanted to ensure that operators were well trained, and knowledge was sustained for long term
- Engaged in a year long Operational Oversight
  - Daily Review of System Operation-interact with operators
  - Cheat Sheet for System Operations based on Big Data Analytics
  - On site monthly/weekly for additional training and review
- Immediate Project Payback

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Existing Plant

Day One

Example Chiller Plant:	10,000 Ton system
Average Energy Rate:	0.778 kW/ton
Average Generation Rate:	$0.12/kWh
Cost Per Hour:	$934/hr.

Equivalent Annual Rate:

$2,054,800/yr.

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First Operating Training

Day Two

Example Chiller Plant: 10,000 Ton system

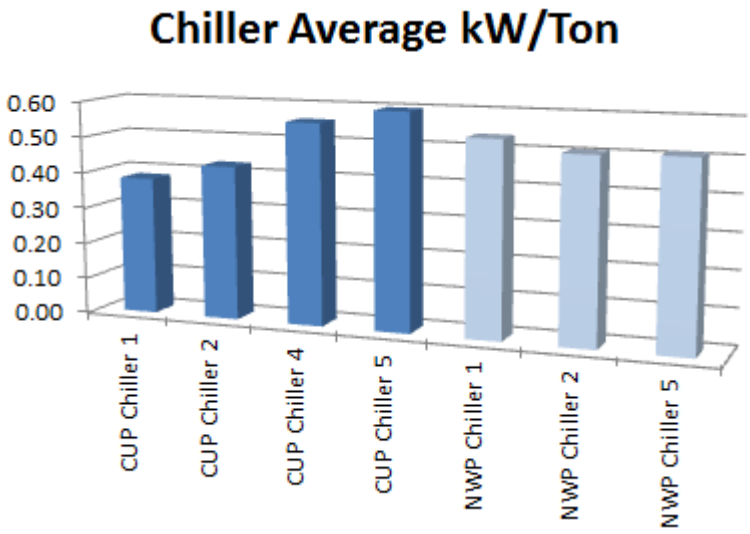
Average Energy Rate: 0.668 kW/ton

Average Generation Rate: $0.12/kWh

Cost Per Hour: $801/hr.

Equivalent Annual Rate:

$1,763,520/yr.



Savings: $291,280/yr.

14% Reduction in one day!

No Capital Investment cost!

Payback in Months

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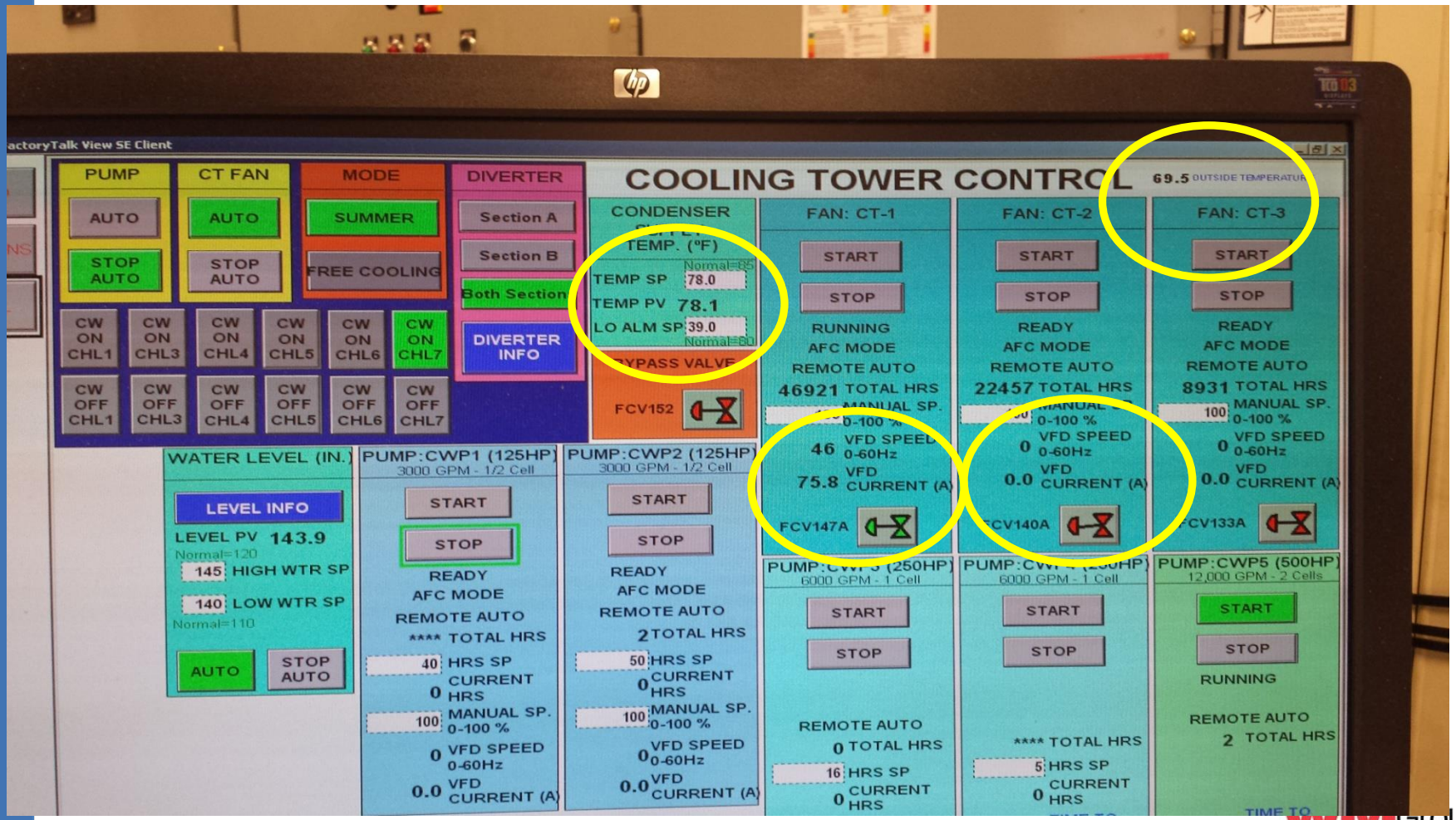
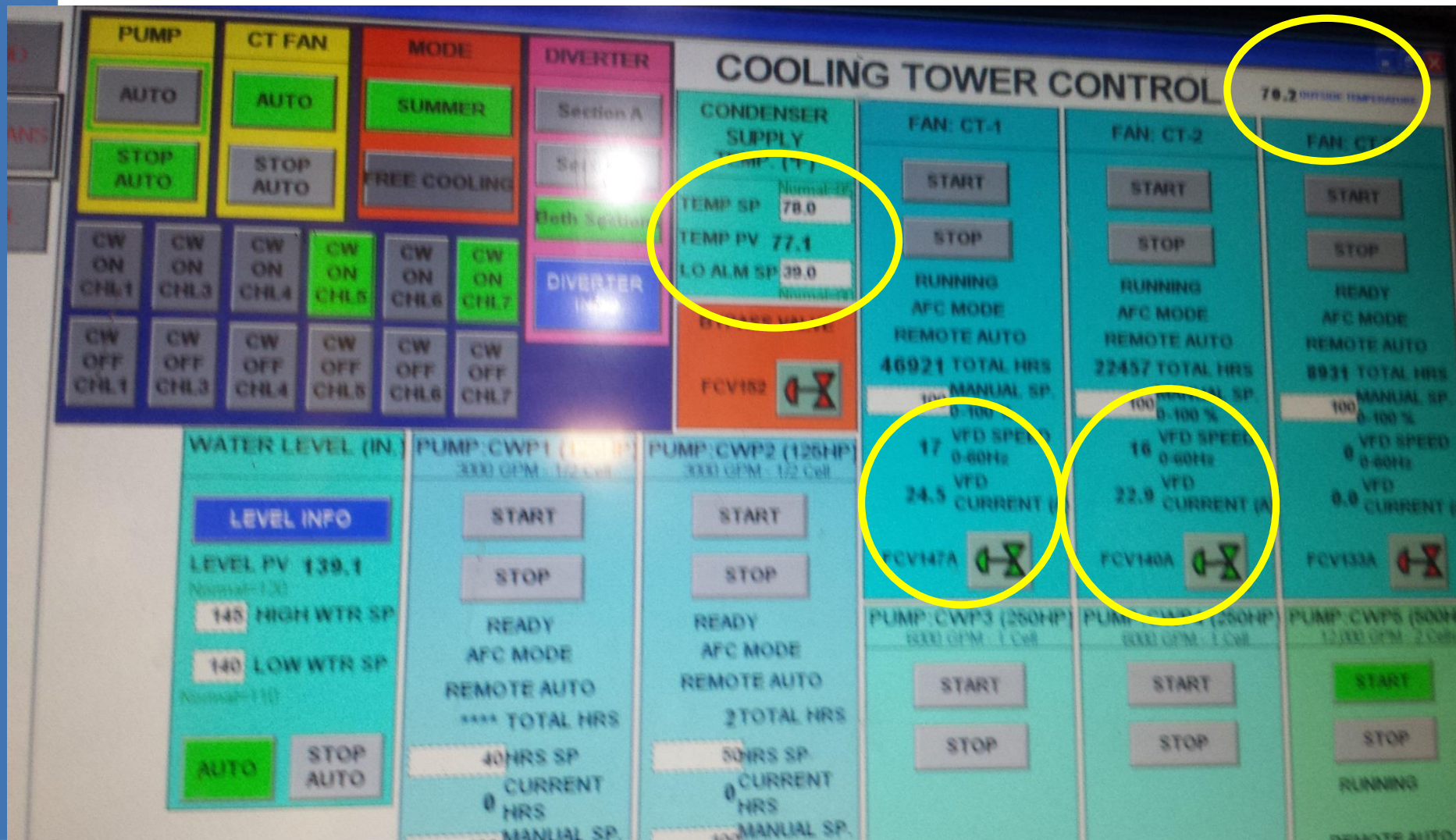
Cooling Towers - Before

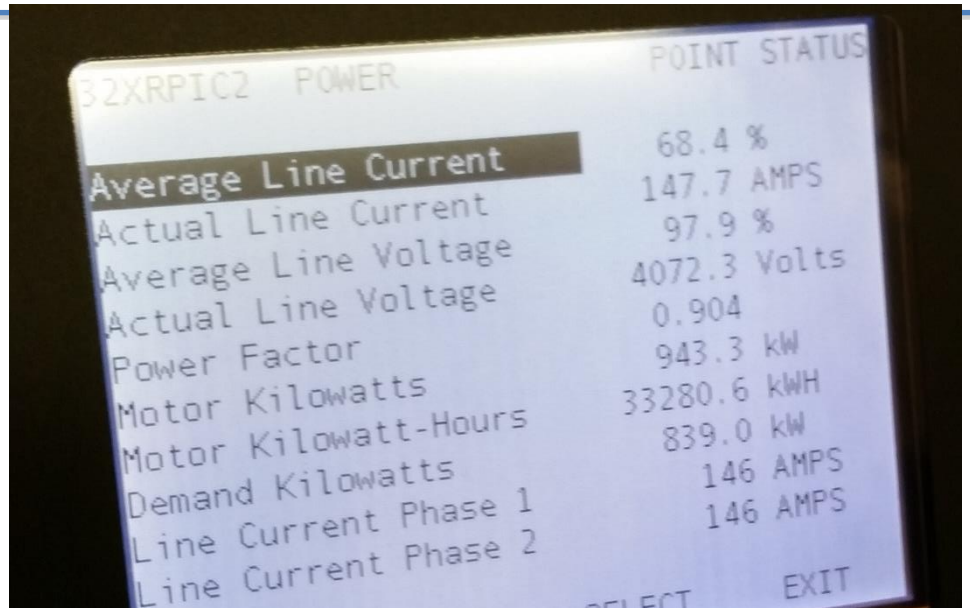


Cooling Towers - After

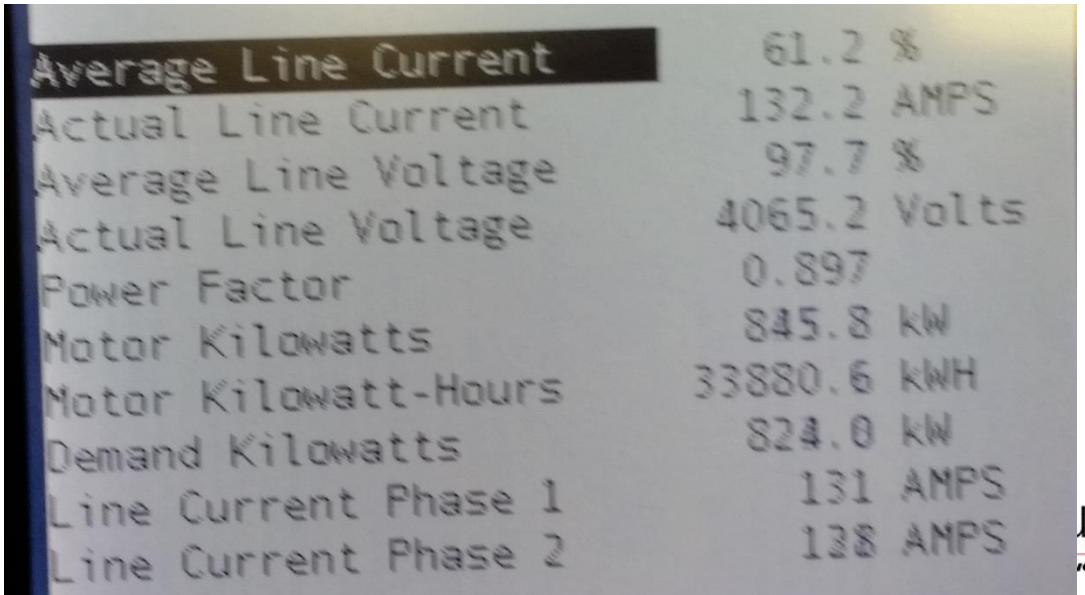


Reduction in Tower Temp reduces chiller energy

Before



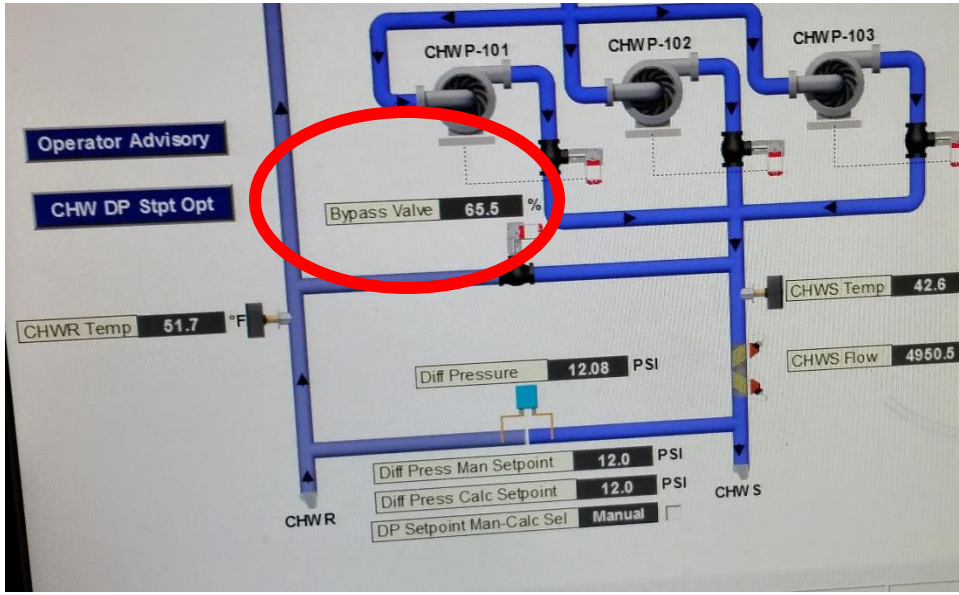
After



Minimum flow bypass valve

- Minimum flow bypass valve would always stay wide open due to set point.
- WM Group evaluated chiller requirements and identified set point was 400% of what it should have been
- Just by changing the set point the valve closed and remained closed during all operations, even winter

- **Actual Savings:**
  - **15$/hr**
  - **Estimated Potential: $130,000**



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AHU in Buildings can greatly impact the system

- Poor delta T in shoulder season, due to poor control

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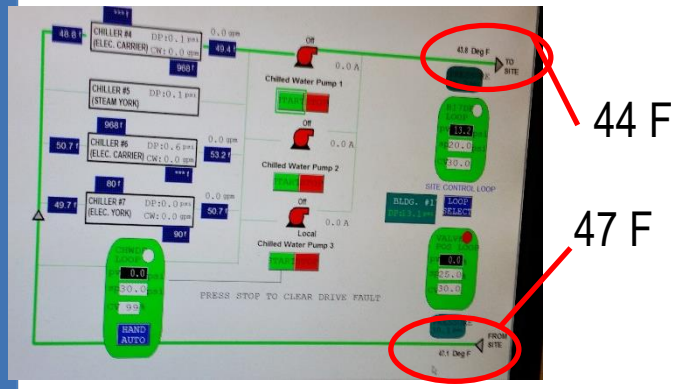
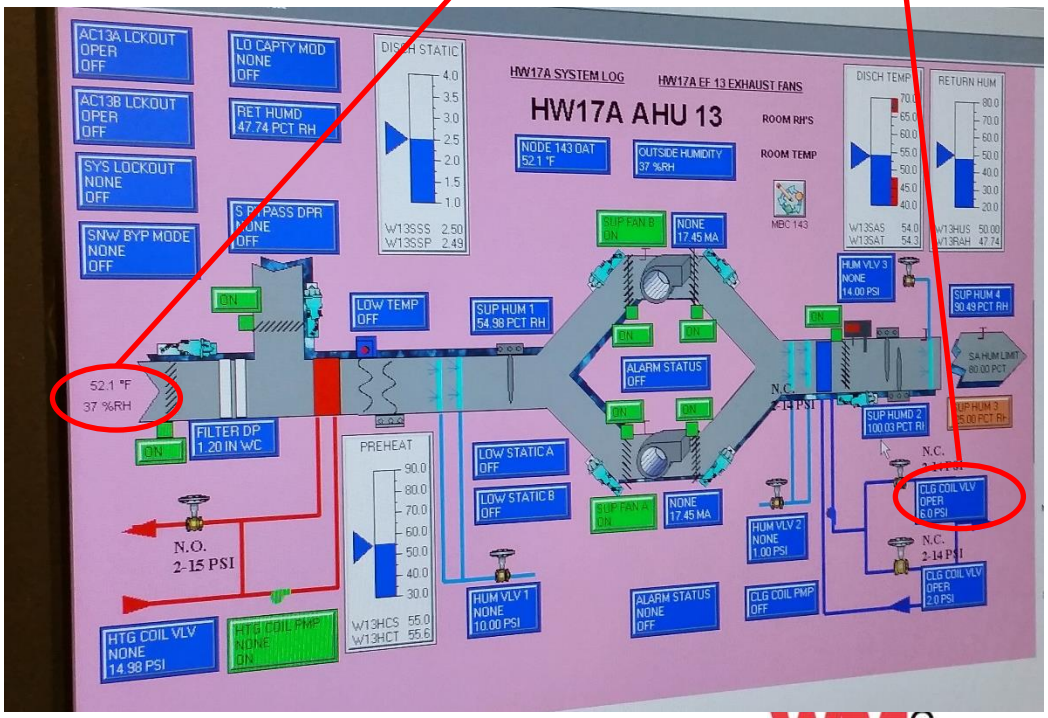


52 OAT
37% RH

45% open



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Fouling and Heat Transfer

- Tube and plate fouling causes high approach temperatures.
- Rule of thumb, every degree above the design short temperature is an increase in power by 1.5%

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Valves – Be on the look out

- A partly Closed valve represents an energy loss – The valve pictured left represented a 50HP loss.
- Pictured below, taps left open.

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Case Study Summary

- Great Relationships established with Operators
- Contract was extended with great success
- Identified ECM's with potential of $400,000/yr savings
- No Capital Funds
- Quick Payback
- Future projects were realized and documented by having our engineering team onsite

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Summary: How to get your system in shape

1. Bridge of Time – Change *culture and habits*
2. Provide ongoing *System training* to operators
3. *Confidence* to make changes in controls
4. Ongoing *Data Analytics* to find deficiencies
5. Measure, Verify, and *Maintain* system improvements

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WM Approach to Optimizing System

- Train your operators
  - Make it a requirement
  - Educate operators on system optimization
  - Change of habits
- A difference in Manpower
  - People who think beyond equipment level
  - Can visualize system as a whole
  - Engineering oversight

An ECM you can't turn down….Operator Training.

Thank You

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