

Presentation of

Chiller Plant Optimization: *A Case Study*

Presented by

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PARTNERS FOR WHAT'S POSSIBLE

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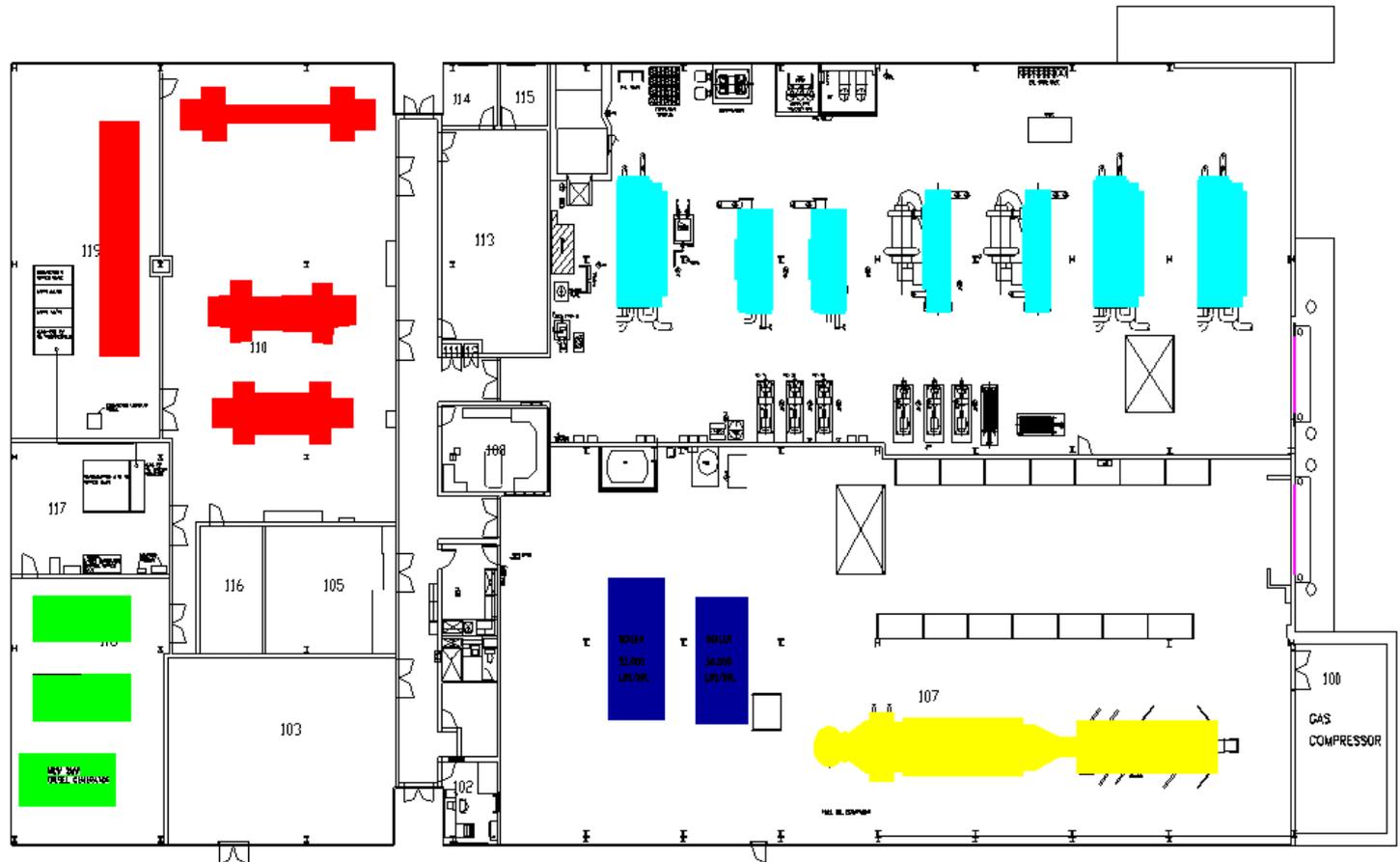
The site

- ◆ Large pharmaceutical client
- ◆ 5 MW cogen
- ◆ 88,000 PPH of boiler capability
- ◆ 8,200 tons of chiller capability
- ◆ Free cooling
- ◆ Diverse chillers
- ◆ 4 MW of diesel peak shaving

The site



Plant layout



- Boilers
- Cogen
- Chillers
- Peak Shaving Diesels



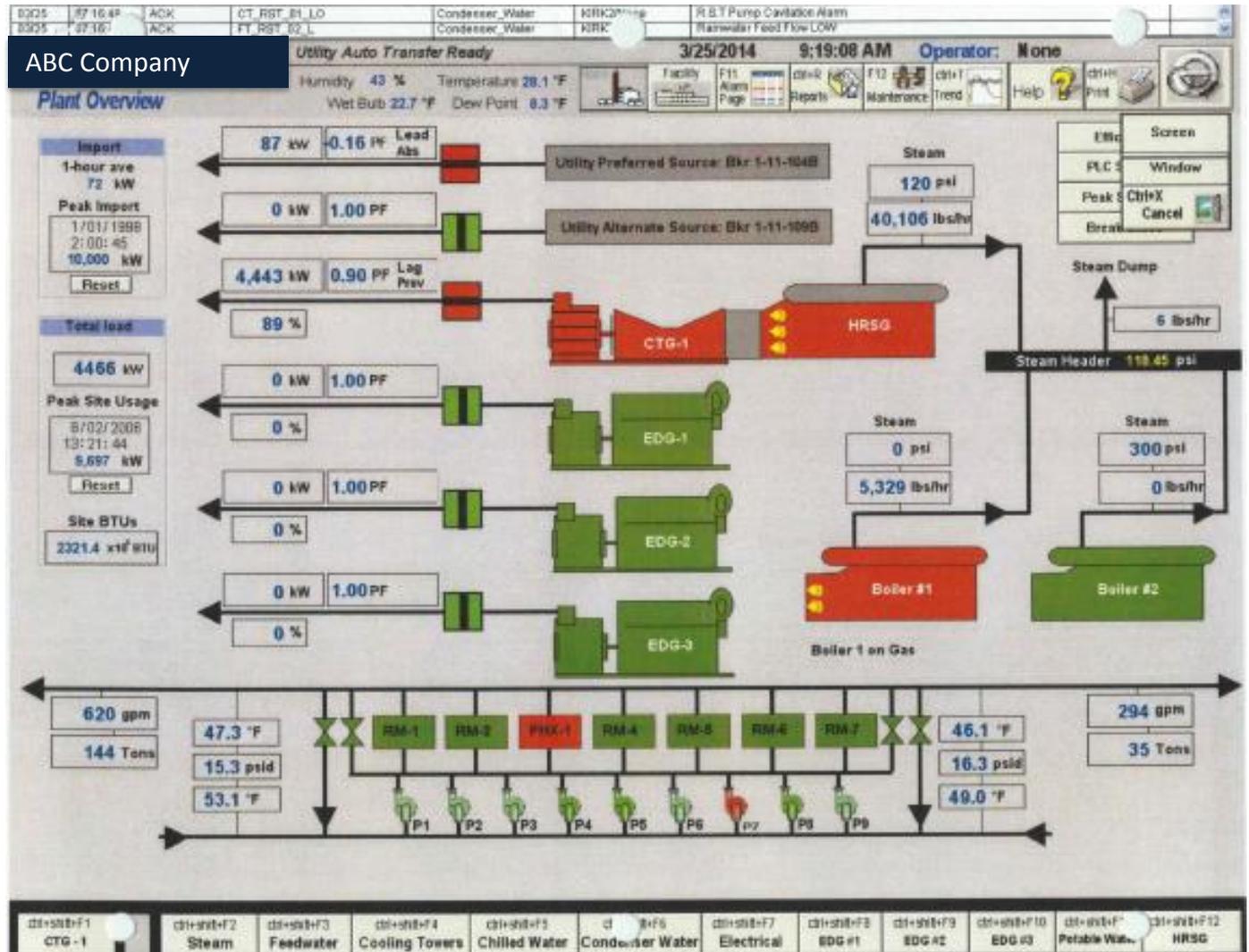
Background

- ◆ **Plant control system was upgraded to PLCs in 2001**
- ◆ **System design was/is robust**
 - ❖ **Flow meters on both sides of each chiller**
 - ❖ **Variable position control valves**
 - ❖ **Pressure, flow, and temperature at critical points in the plant**
 - ❖ **Flow meters on all towers**
 - ❖ **Variable position control valves on all towers**
 - ❖ **Real time KW available from some equipment**

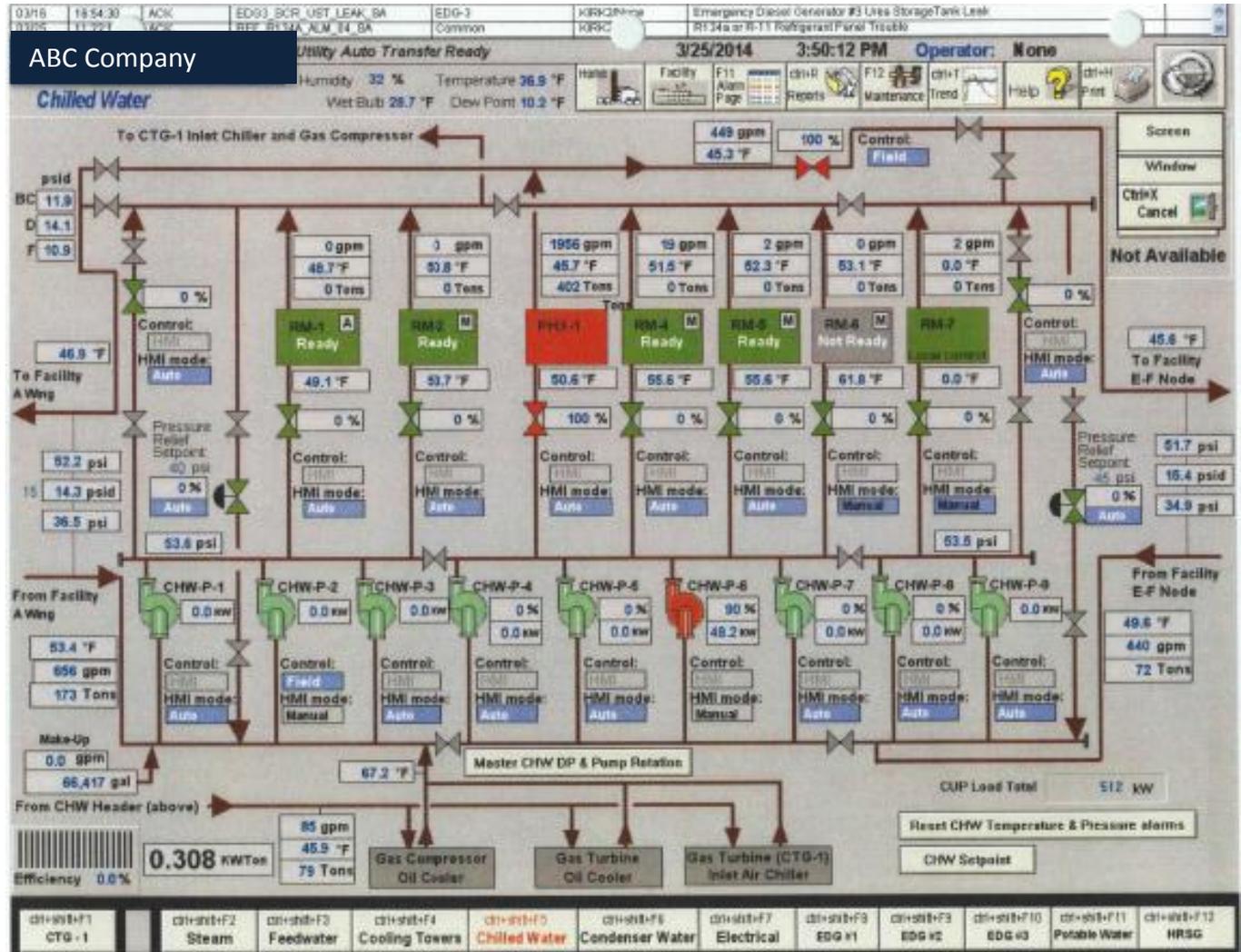
Background

- ◆ Overall the system was in good shape
- ◆ Site operation is largely outsourced
- ◆ Several chillers had been replaced in recent years
- ◆ Cooling tower had been replaced and changed from a four cell to six cell tower
- ◆ VFDs added to five of nine chilled water pumps

Visibility/Controllability

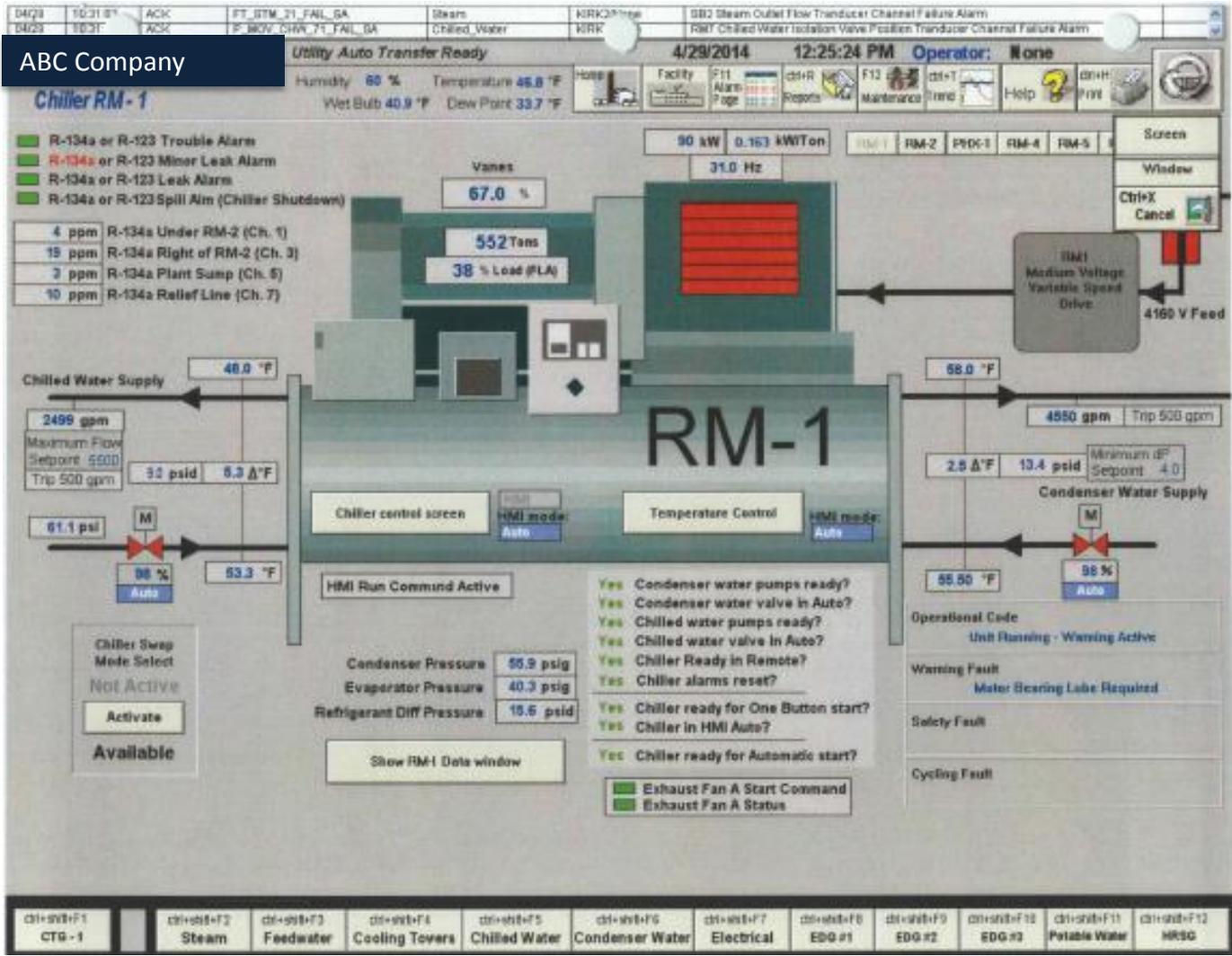


Visibility/Controllability



Visibility/Controllability

ABC Company



What the client was considering

- ◆ A very large investment in a third party chiller optimization program

Our advice

- ◆ They already had the tools to optimize
- ◆ The plant had substantial control flexibility
- ◆ Updates would probably be minor
- ◆ That someone needed to dig into the details
- ◆ They could still consider a larger and more complex project, if warranted

First step

- ◆ Spend time in the plant working with staff to understand current operations
- ◆ Review the original sequence (2001)
- ◆ Review how new equipment was integrated into the original sequence

Second step (minor capital spend)

- ◆ Move the differential pressure sensors from the plant to the most remote location
- ◆ Install VFDs on the four remaining pumps – client had left over VFDs from another project!
- ◆ Install KW transducers on the condenser water pumps - all energy associated with the chiller plant would now be available in real time
- ◆ Total capital investment of \$93,000

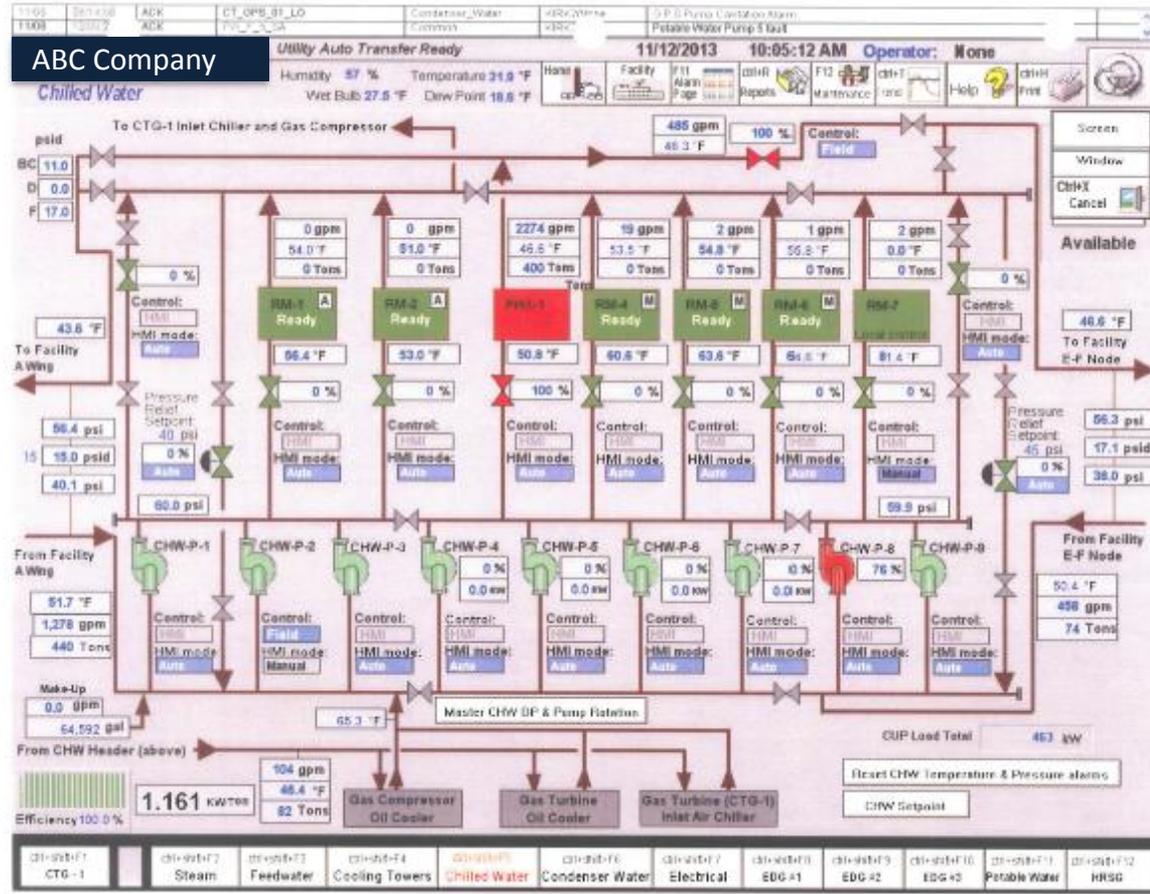
Third step

◆ Document, implement, test

- ❖ Plant PLC automatically selects the lowest remote DP, failure modes programmed
- ❖ Pump control algorithm updated to fully utilize all eight VFD pumps
- ❖ Tower sequence updated to actively control flow to all six cells (smart to flow)
- ❖ Counter flow tower used for winter mode
- ❖ Corrected tower winter mode selection, which had been looking at wet bulb
- ❖ Free cooling: all interlocks removed; corrected the logic which was forcing the system out of plate and frame mode when temperature was below 18 degrees
- ❖ Automatic chilled water reset instituted
- ❖ Automatic condenser water reset instituted
- ❖ Condenser water pump selection updates
- ❖ Duct burner control and chiller/steam dump logic improved

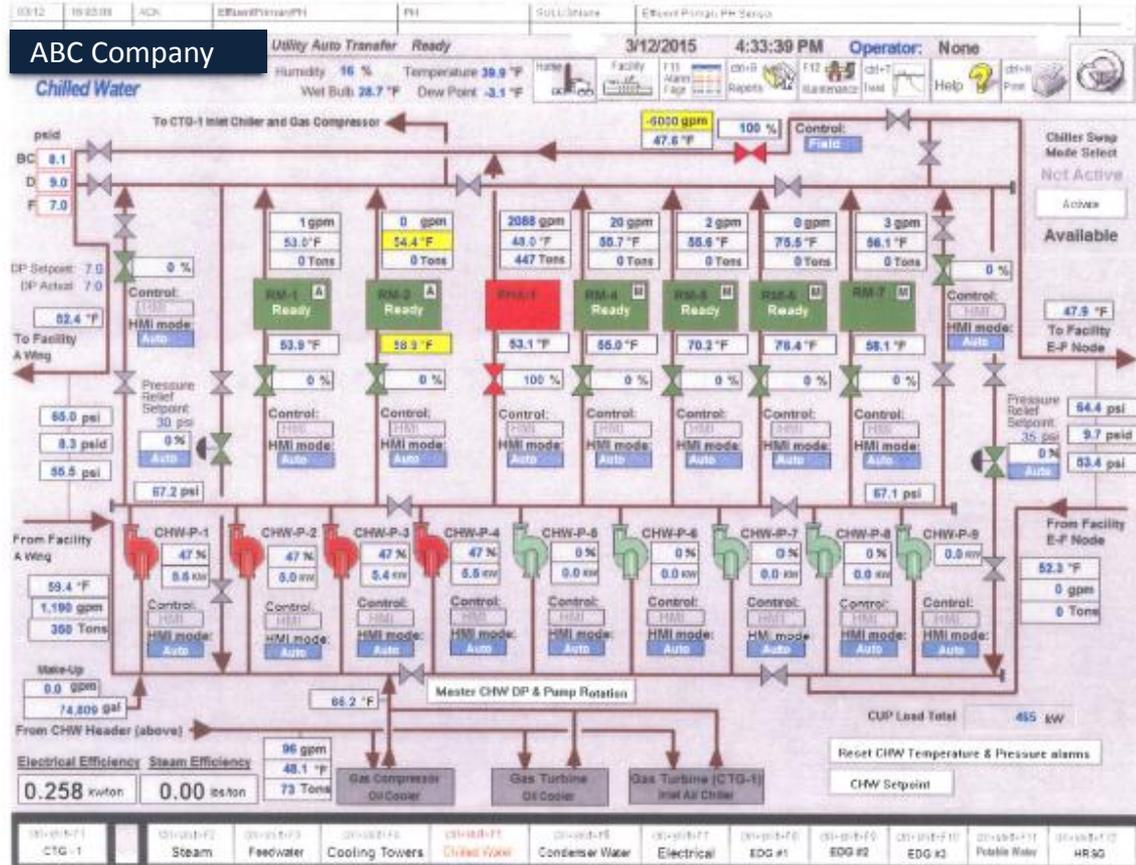
CHW Pump Savings

Winter Mode with Plate and Frame On Line-Base Case



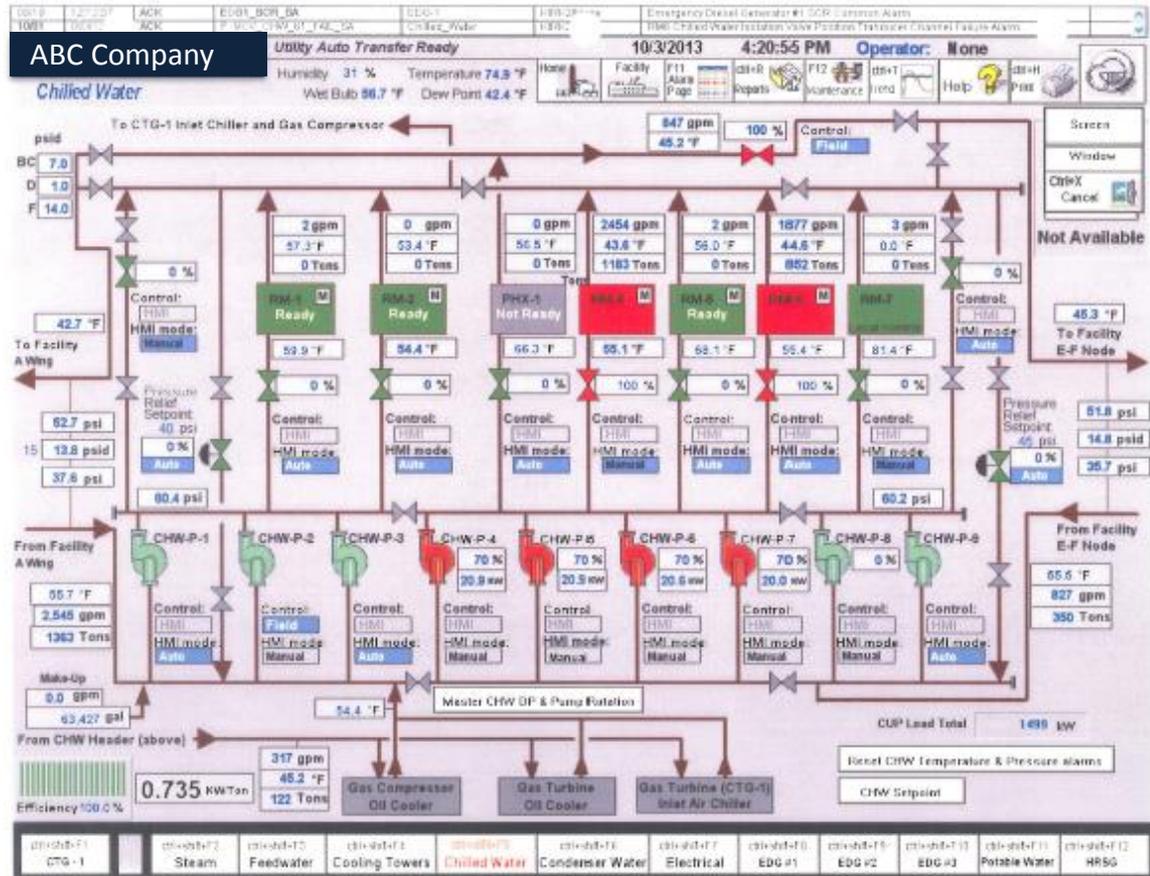
CHW Pump Savings

Winter Mode with Plate and Frame On Line-Revised Sequence



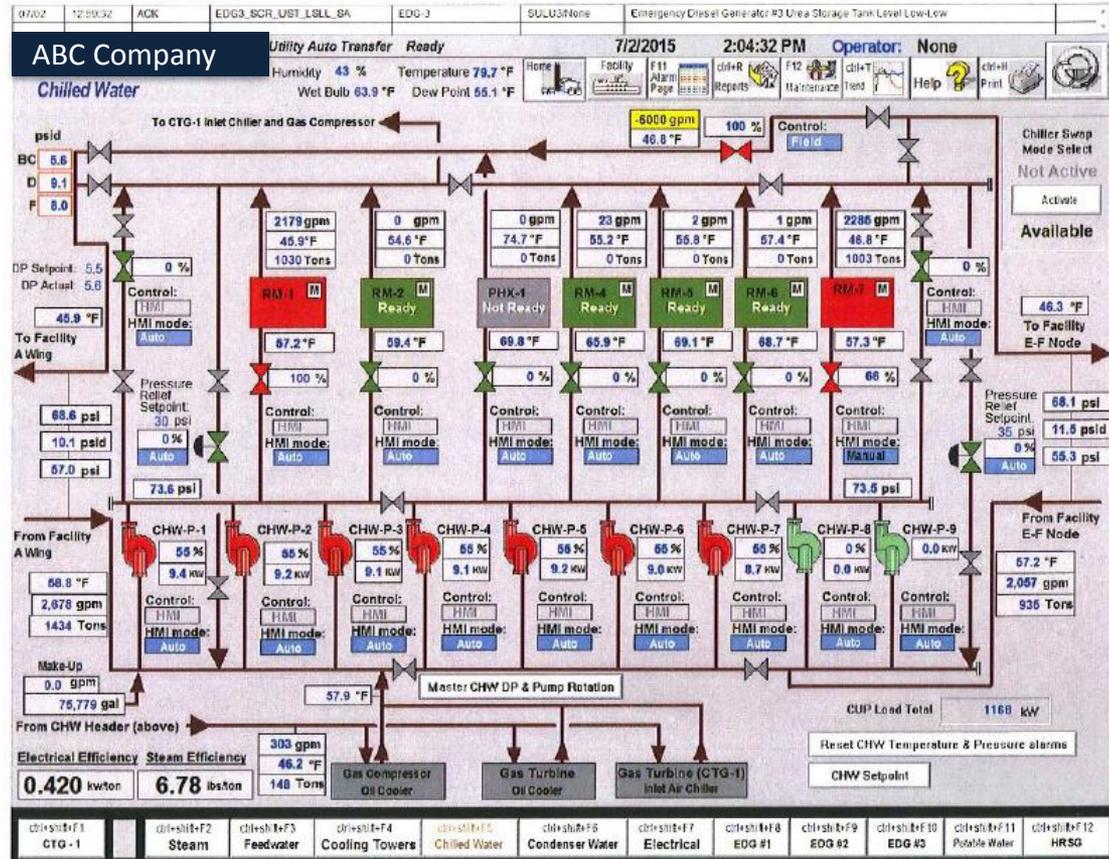
CHW Pump Savings

Shoulder Season with Two Chillers On Line – Base Case



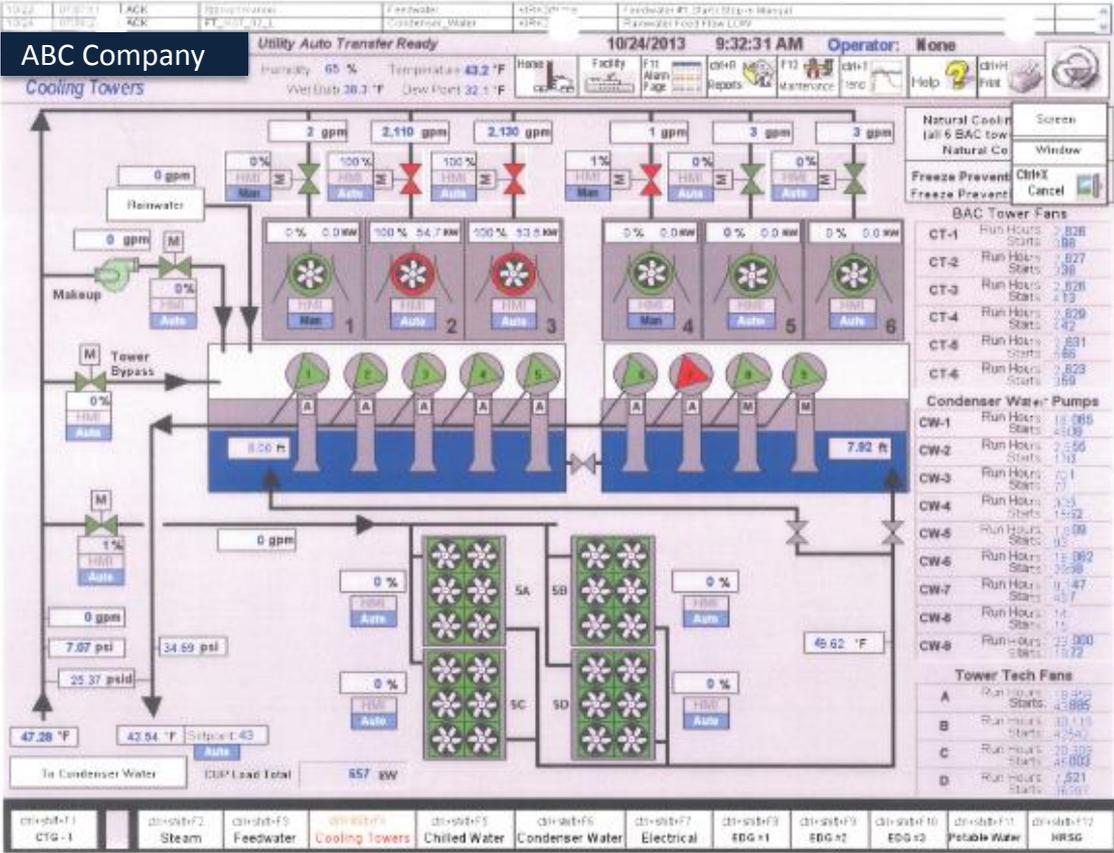
CHW Pump Savings

Shoulder Season with Two Chillers On Line – Revised Case



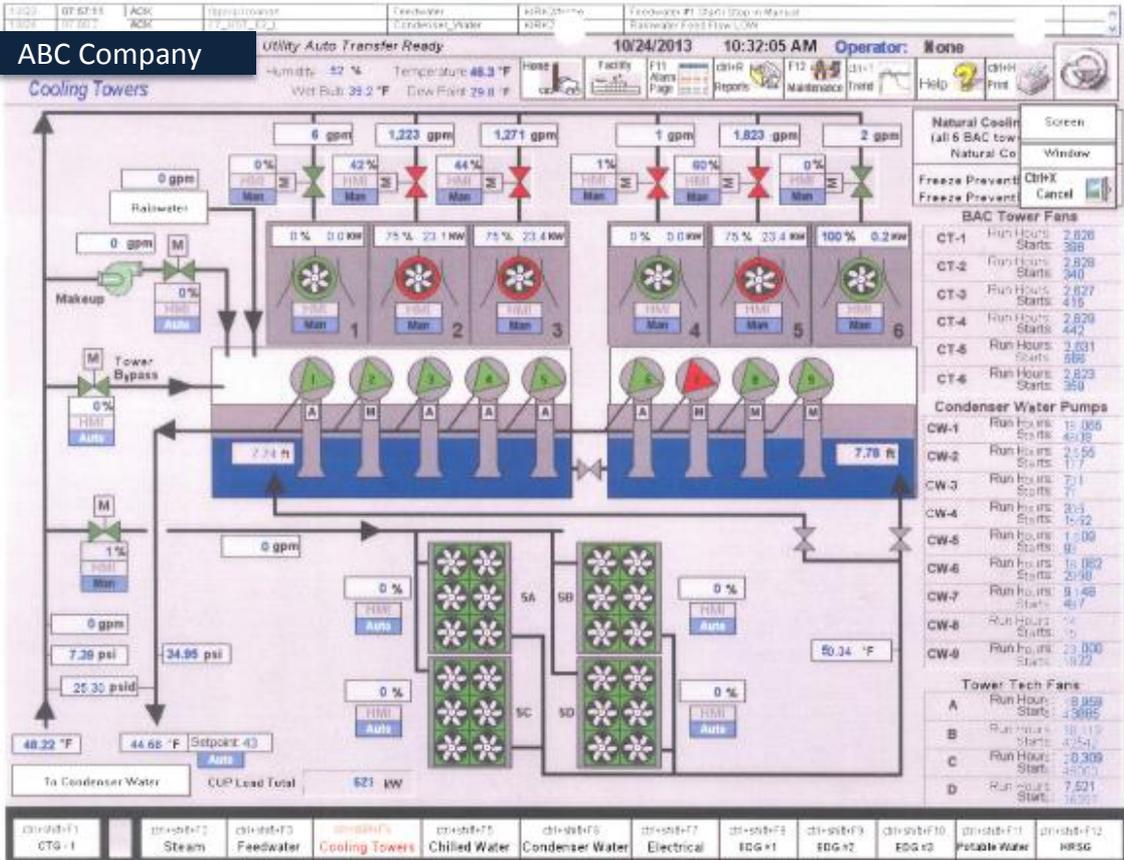
Cooling tower sequence improvements

Shoulder Season – One Chiller On Line – Base Case



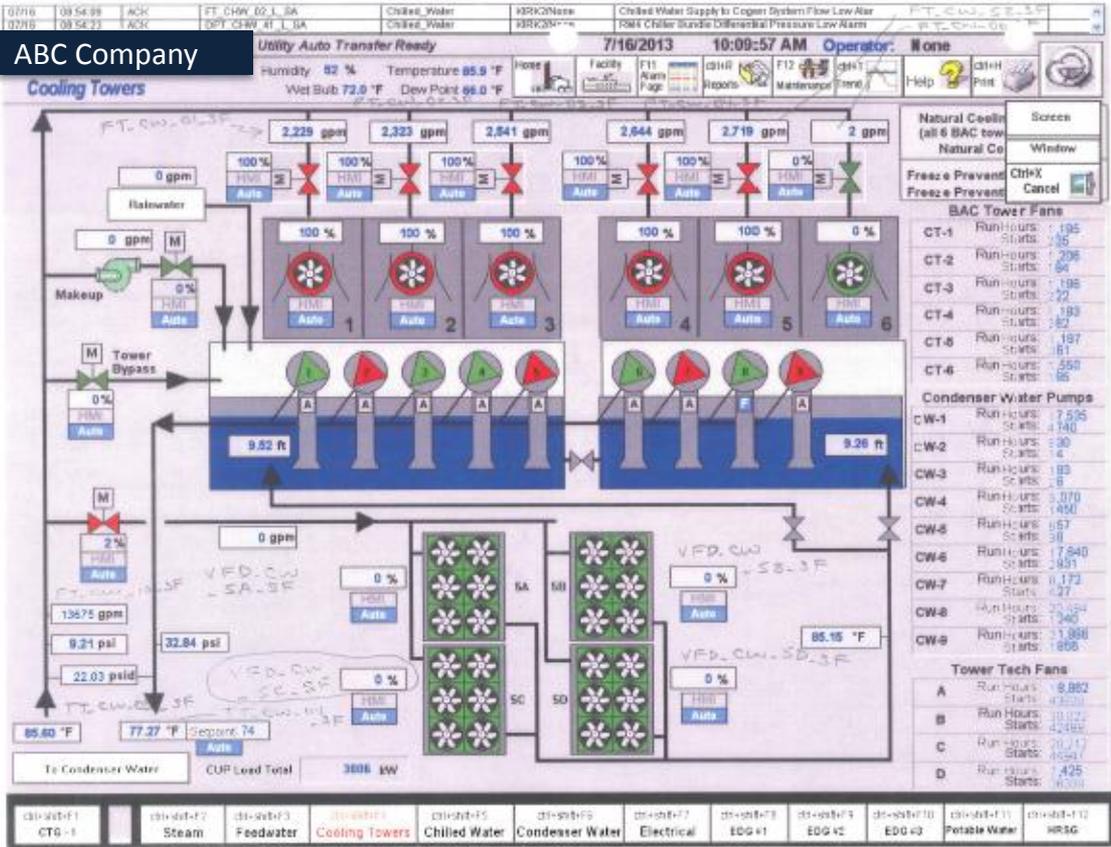
Cooling tower sequence improvements

Shoulder Season – One Chiller On Line – Revised Case



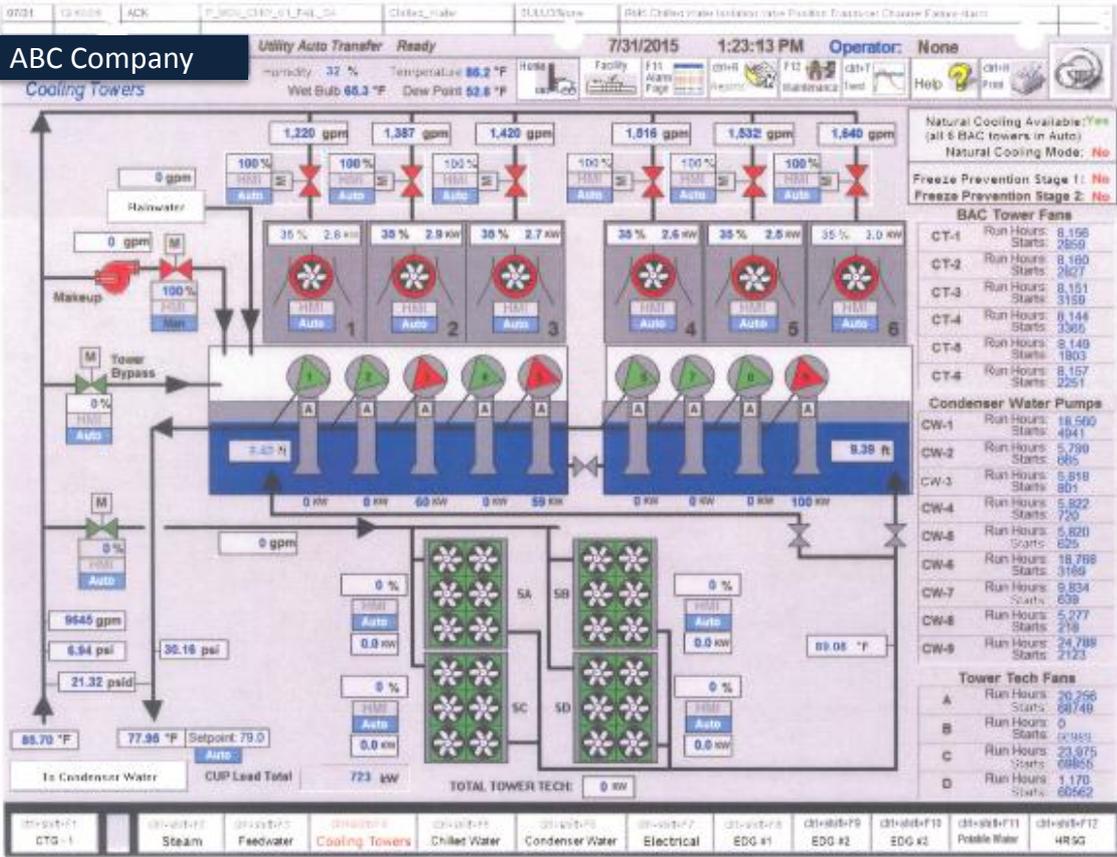
Cooling tower sequence improvements

Summer Season – Multiple Chillers On Line – Base Case



Cooling tower sequence improvements

Summer Season – Multiple Chillers On Line – Revised Case



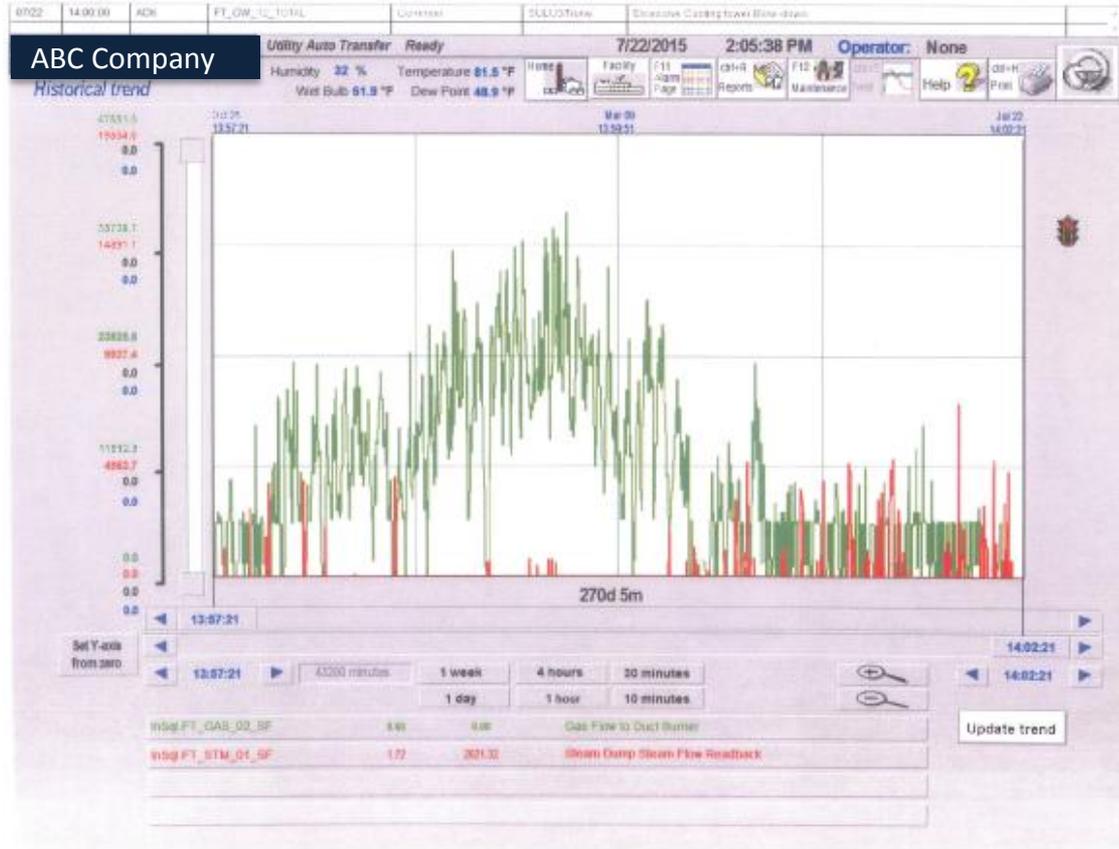
Not chilled water related

Simultaneous operation of the steam dump while duct firing



Not chilled water related

Steam dump and duct burner interlocked



Savings

Cooling tower sequence	\$104,000
Chilled water pumping	\$ 61,000
Reset schedules	\$ 59,000
Free cooling	\$ 39,000
Duct burner control	\$ 23,000
TOTAL	\$286,000

Summary

- ◆ No two situations are alike
- ◆ Client had the tools
- ◆ The ability to adequately manage water
- ◆ Free cooling capability during the winter
- ◆ Single VFD chiller operation for extended periods
- ◆ Minor upgrades were required
 - ❖ Relocation of DP sensors
 - ❖ Addition of three VFDs
 - ❖ Updated programming
 - ❖ Operator training
 - ❖ Ability to track auto versus manual
- ◆ Project ROI of .3 years
- ◆ Avoided capital cost of \$900K

Next steps

- ◆ Monitor and trend system performance
- ◆ Program guidance for chiller staging
- ◆ Evaluate savings associated with additional VFDs

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