Clinton Laboratories

Energy Savings through Capital Improvements and Procedural Changes

2017 Pollution Prevention Conference and Trade Show

Energy Savings through Capital Improvements and Procedural Changes

➢ Site should perform an energy assessment

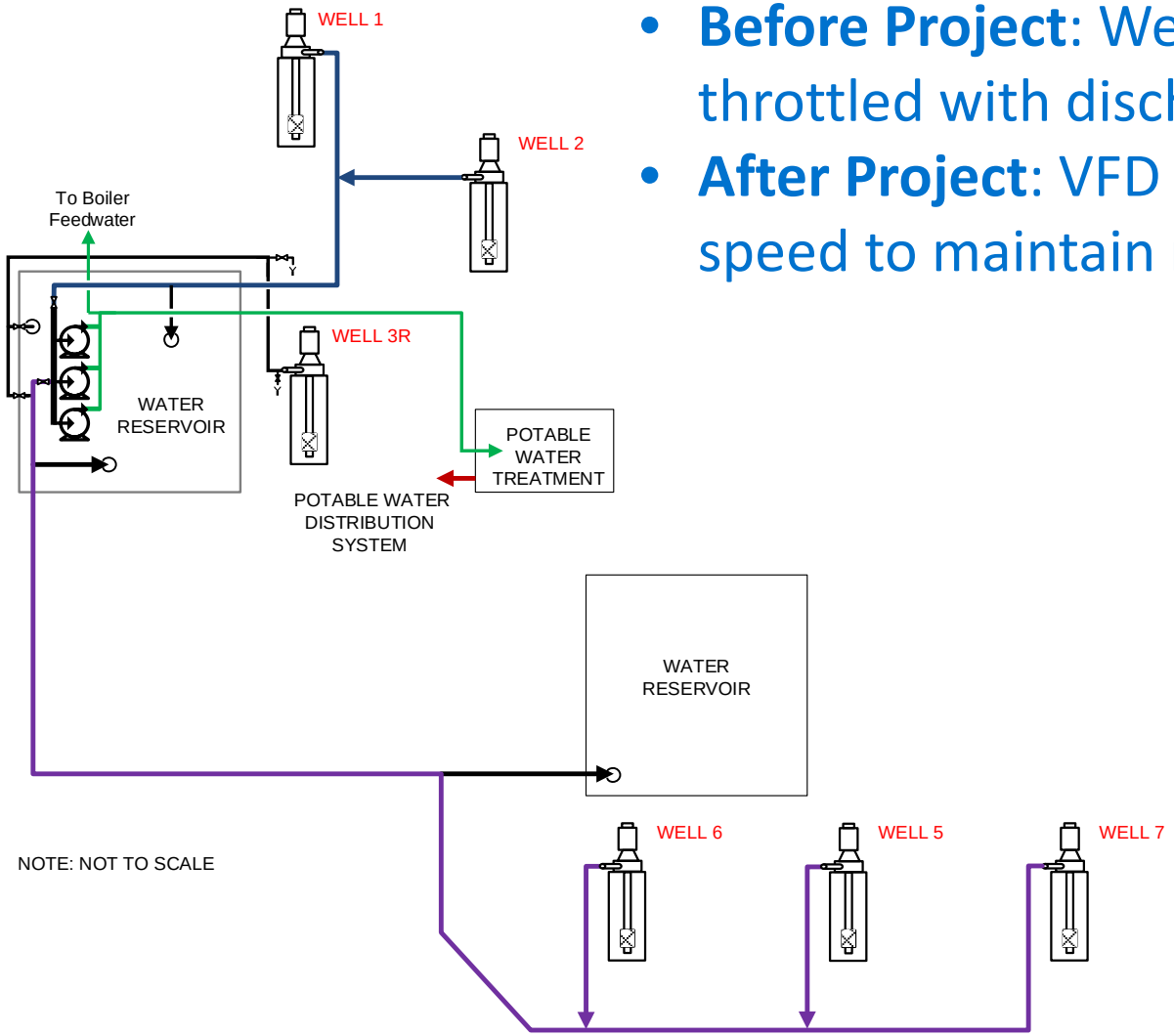
➢ Capital Improvements

- Variable Frequency Drives on Well Pump Motors
- Optimized Operation of Chilled Water Systems in Free Cooling
- Replaced Process Air Compressors and Aftercoolers

➢ Procedural Changes

- Shutting off steam to evaporators when process is off-line greater than eight (8) hours

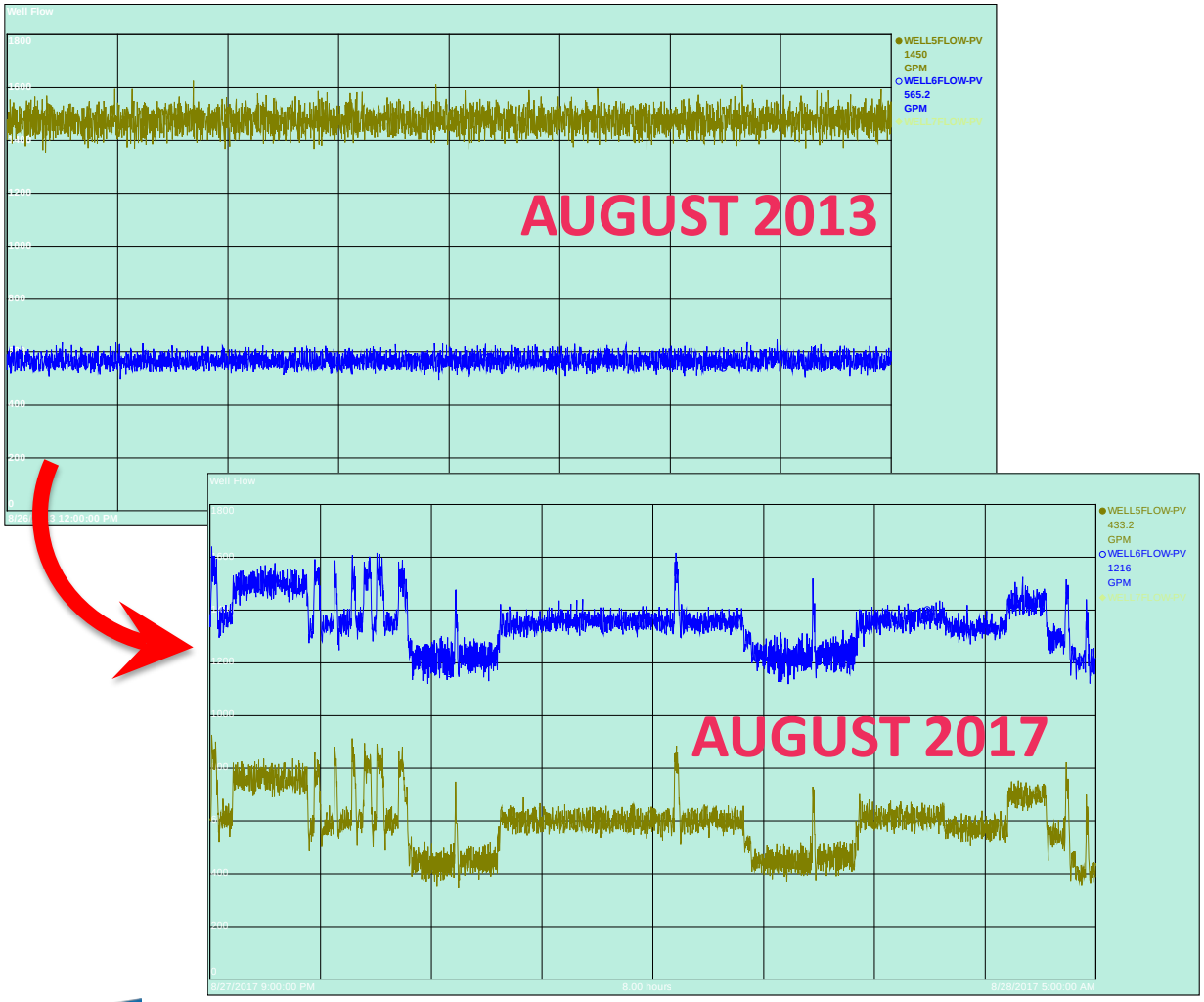
Variable Frequency Drives on Well Pump Motors



- **Before Project**: Well flow manually throttled with discharge valves
- **After Project**: VFD controls pump speed to maintain reservoir levels

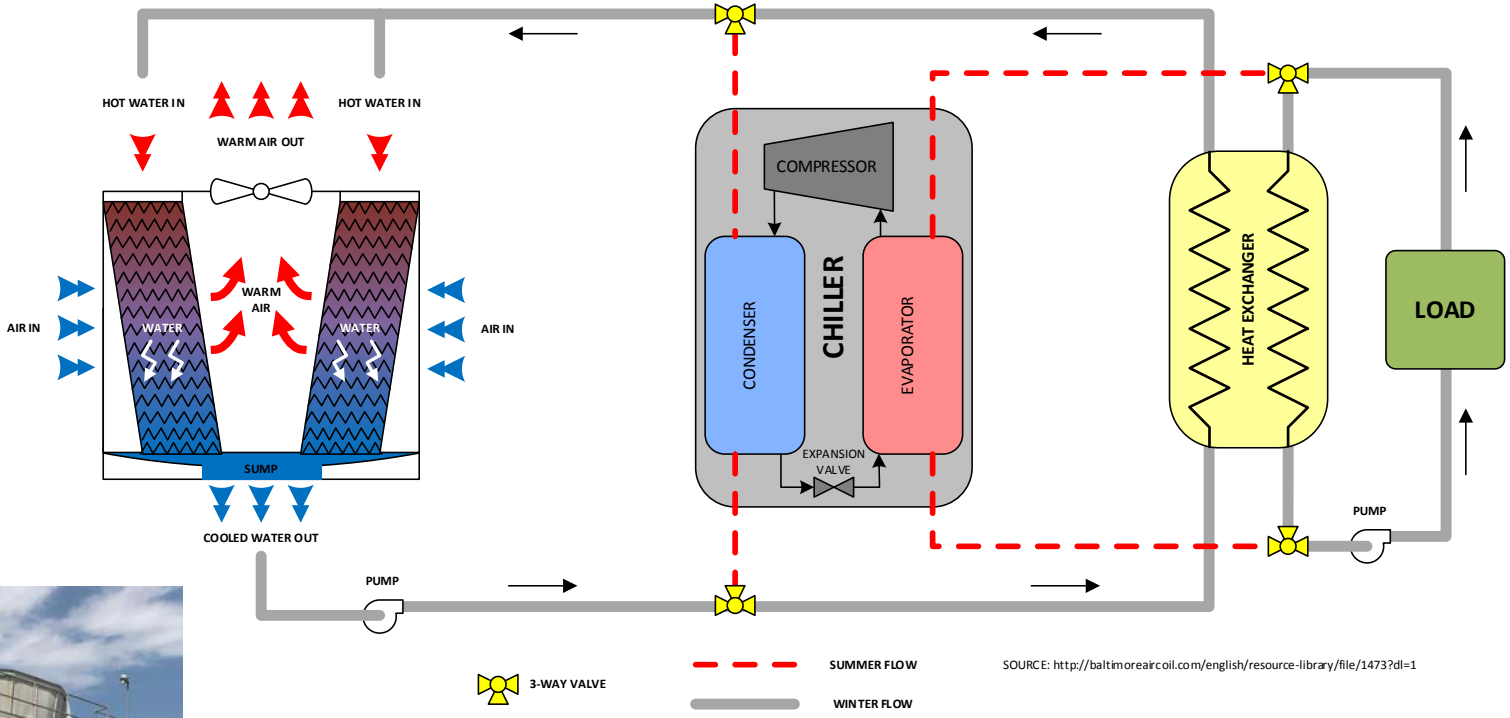
Variable Frequency Drives on Well Pump Motors

- **After Project**: Wells run more efficiently due to Affinity Law
- Reducing speed by **20%** requires only **50%** of the power*



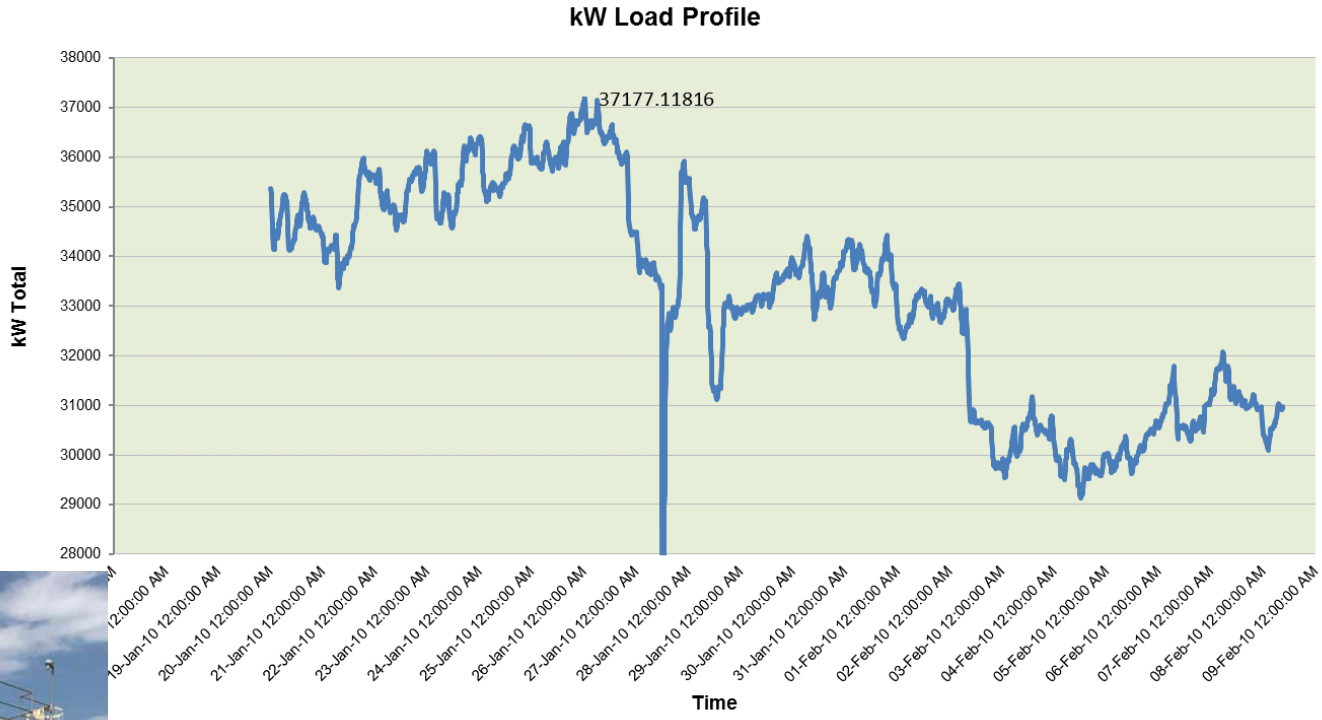
http://literature.rockwellautomation.com/idc/groups/literature/documents/ar/7000-ar002_-en-p.pdf

Optimized Operation of Chilled Water Systems in Free Cooling



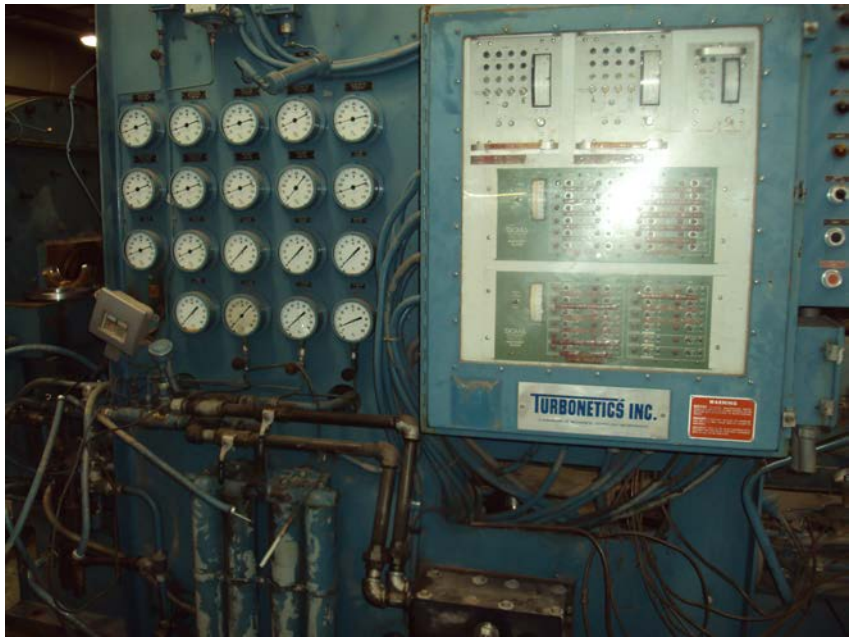
- **Before Project**: 4+ hours to manually position valves for free cooling
- **After Project**: <20 minutes with automated valves & updated tower process control

Optimized Operation of Chilled Water Systems in Free Cooling (continued)



- **After Project**: Typical drop in site load, from approximately 36,000 kW to 31,000 kW

Replaced Process Air Compressors and Aftercoolers



- **Before Project**: Operated 4 of 5 installed Turbonetic Air Compressors (2000HP motors) to meet the desired airflow rate to fermentation tanks
- **After Project**: Now operate 3 of 5 new HSI Centrifugal Blowers to meet system requirements (http://www.hsiblowers.com/products.html)

Replaced Process Air Compressors and Aftercoolers

- Capital Project Cost:
  $2.5 million
- Former power requirement:
  57,000 MW-hr/year
  ($3.5 million/year)
- Current power requirement:
  50,000 MW-hr/year
  ($3.0 million/year)
- $0.5 million/year savings, plus an additional $0.13 million/year savings in cooling (chilled water), since the air being discharged from the new blowers is cooler

Shutting off steam to evaporators when process is off-line greater than eight (8) hours

- **Before SOP Revision**: Steam on Evaporator Jets 24x7x365
- **After SOP Revision**: Steam shut off when process is expected to be down >8 hours (with freeze protection taken into account).

- **40.9 MM lbs steam** saved
  - ✓ 4.9 million gallons water saved
  - ✓ Treatment of waste water avoided
- **58,000 MMBTU/Year** savings
- **Total Emissions Reduction**: 6,000 US Tons CO2e/Year

Energy Savings through Capital Improvements and Procedural Changes

➢ Summary:

- Energy assessment will provide opportunities
- Engineering First Principles and modeling can provide insights to potential savings
- Consider both capital improvements and procedure/methods changes

➢ Final Point:

- **Not just about saving energy and the environment – this is good business!**