



BURNS & McDONNELL



Trials and Victories: Designing and Operating a Second TES tank for UT's CHW system

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A Sustainable Future
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Utilities & Energy Management



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- ▶ Current Status
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Utilities & Energy Management

INTRODUCTION

UNIVERSITY OF TEXAS AT AUSTIN

- ▶ Main Campus
 - Founded 1883
 - 70,000 students and faculty
 - 431 acres, 20 million square feet, 150+ buildings
 - 50 states, 126 countries represented
- ▶ Pickle Research Campus
 - Applied Research Labs
 - Nuclear Engineering
 - Advanced Computing Center



Image Courtesy: The University of Texas

INTRODUCTION

DELL MEDICAL SCHOOL

► Phase 1

- \$800 million new construction
- 1.1 million square feet
- Level 1 trauma hospital

► Fast-tracked

- Bond passed - November 2012
- First students - Fall 2016

► Long-term

- 2 million additional square feet



The University of Texas at Austin
Dell Medical School



Health Learning Building, Image Courtesy: The University of Texas



INTRODUCTION

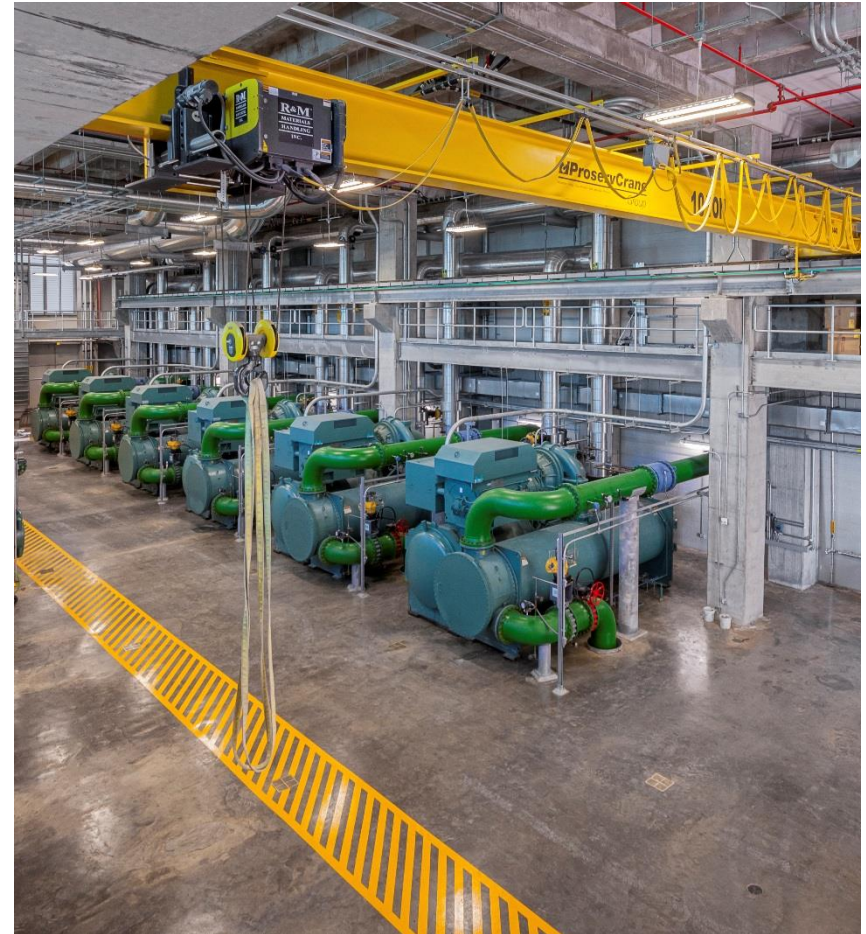
CS7 & HWP1 PROJECTS

► Chilling Station #7

- Cooling
 - 15,000 tons VFD chiller, 5,000 tons future
 - 600 tons Heat Pump Chiller, 1,800 tons future
 - TES 5.5 million gallon
- Heating
 - 37 MMBtu HW Boiler, 12 MMBtu future
 - 10 MMBtu Heat Pump Chiller, 30 MMBtu future

► Hot Water Plant #1

- Back-up steam-fired capacity
- Embedded in med district
- 40 MMBtu HX's



MOTIVATIONS

THERMAL ENERGY STORAGE

- ▶ Med District impact on CHP system
 - Generating Capacity/Redundancy
 - Best Efficiency
- ▶ Independent Operation from CS7
 - Charge from System
- ▶ Maintenance Flexibility
- ▶ Improved Reliability
- ▶ TES-1 experience
 - Design improvements
 - Focus on start-up and CX



OPERATIONAL NOTES

FOOD FOR THOUGHT

► General

- Talking about lessons-learned...not enough
- Doing anything at 3pm on Friday is a bad idea
- Trust...but verify
- Ensure new buildings are FULLY full and bled before opening them into system
- Challenges starting CX while still under construction
- High quality valves / materials
- Hydrolazing
 - Piping, yes
 - Valves, no



DESIGN CONSIDERATIONS

EXISTING SYSTEM CHALLENGES

- ▶ Dynamic System Pressure Gradient
 - Lower water elevation than TES-1
 - Geographically remote from make-up
- ▶ Operational Independence
 - Dedicated PLC, pumping
- ▶ Dual Tank Operation Capability
- ▶ Limited Expansion – stiff system
- ▶ “Downhill” loads = offset supply pressure limit



DESIGN CONSIDERATIONS

HARDWARE

- ▶ Thermal Storage Tank
 - Types Considered
 - Siting Factors
 - ▶ Aesthetic, Safety, Height
 - View Corridor
- ▶ Pumping / Piping
 - Arrangements
 - Wide range of operation
 - HDPE Surge Considerations
- ▶ Instrumentation
 - Inline mag meters on inlet/outlet
 - N+1 level sensors
 - Staggered temp strings



DESIGN CONSIDERATIONS

SOFTWARE

- ▶ Tank Level Simulations
- ▶ Dedicated TES PLC
- ▶ Relational Control Approach
- ▶ Specific Control Valve Sequence
 - Ratchet/control approach
 - Controlling to CV directly
- ▶ Multiple interlocks and safeties
- ▶ Control Valves
 - Valve CV as control variable
 - Catalog CV curves versus reality

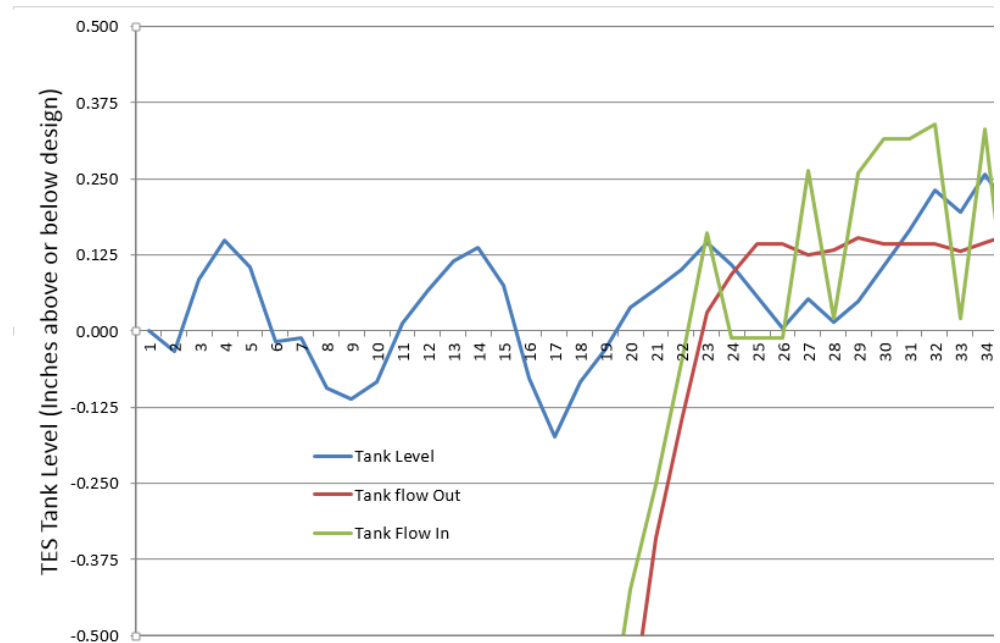


Image Courtesy: The Hartman Company

START-UP / CX

IT'S ALIVE!

- ▶ Building side load materialization
 - Dependent on weather & timing
 - Load estimates during construction - unreliable
 - Building engineers can be over conservative
- ▶ TES System Considerations
 - Opportunity to test chillers while TES charging
 - Discharge requires testing against campus
 - ▶ Detailed Planning with Operations
 - Calibrate level instruments while filling!
 - Despite safeties and careful planning...
 - ▶ Overpressure event



START-UP / CX

TAKE-AWAYS

- ▶ TES System
 - Tank Insulation
 - Tight Level Margin
 - ▶ Low Pressure Event
- ▶ BOP System
 - ▶ FRP Basin
 - ▶ Software Simulations
 - ▶ Trend data during start-up
 - ▶ Custom Chiller Controllers

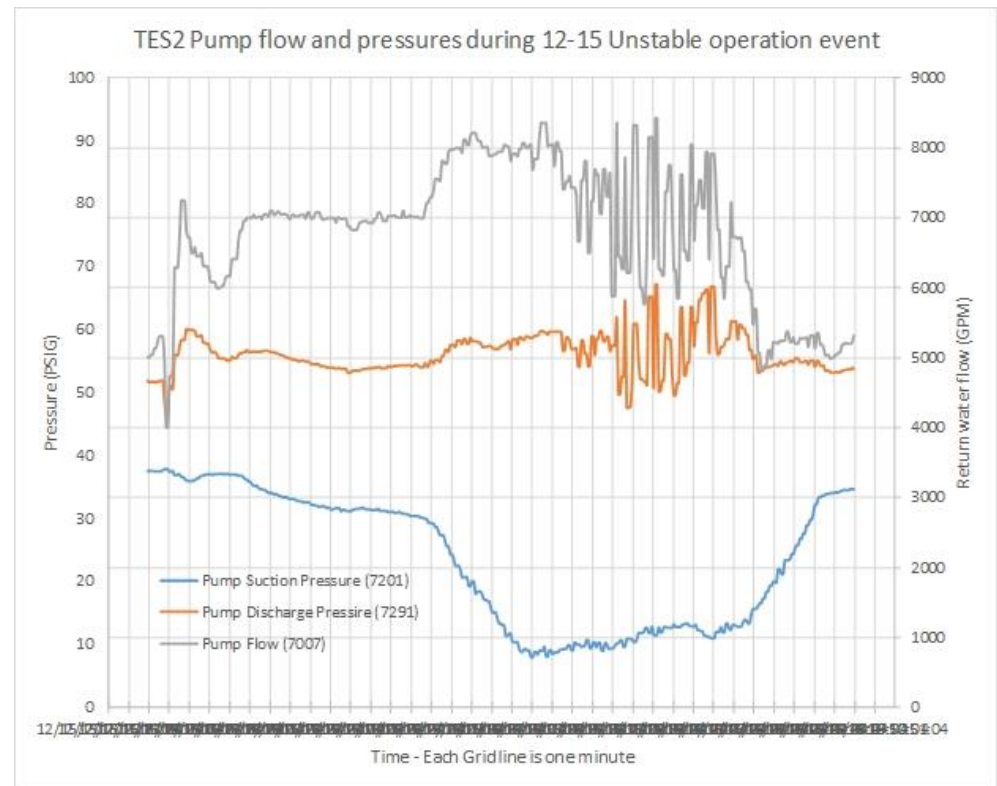


Image Courtesy: The Hartman Company

CURRENT STATUS

READY TO SERVE

- ▶ Dell Medical School
 - 3 initial buildings occupied
- ▶ CHW Plant – Operational
- ▶ Boiler & Heat Pump Chiller
 - Pending CX
 - Load size and stability issues
 - Competing with building-side HPC
- ▶ TES System Testing
 - Control valve CV issues resolved
 - Level issues resolved
 - Dual Tank Operation Achieved



NEXT STEPS

MAKE IT BETTER

- ▶ Complete Functional CX
- ▶ Improve dual tank discharge control
- ▶ Utility Master Plan update
 - Distribution Improvements
 - Increase CS7 utilization
- ▶ Optimize CHW
- ▶ Fully Optimize Entire System
 - Power
 - Steam
 - CHW
 - TES-1, 2





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