The University of Texas at Austin

WHAT STARTS HERE CHANGES THE WORLD

BURNS McDONNELL

Lessons Learned and a Creative District Energy Approach to serve a new Medical District

Campus Energy 2016:
The Changing Landscape

February 8-12, 2016

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Utilities & Energy Management

OVERVIEW

- Introduction
- Approach
- Lessons Applied
- Summary
- Current Status
- Next Steps

Utilities & Energy Management

BURNS McDONNELL

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

Image Courtesy: The University of Texas

Image Courtesy: The University of Texas

INTRODUCTION

UTILITIES & ENERGY MANAGEMENT

- Main Campus
  - 45,000 cooling tons
  - 1,089,000 pph steam
  - 137 MW CHP
  - 3.9 million gallon TES
  - USGBC PEER certified campus
- Pickle Research
  - 8,000 cooling tons
  - 3,750 ton plant and 1 million gallon TES tank serving super computer
- New Medical District
  - 15,600 cooling tons
  - 87,000 MBH heating water
  - 5.5 million gallon TES
  - ~2 miles of new distribution piping

PEER

Image Courtesy: The University of Texas

Note: Installed capacity values indicated

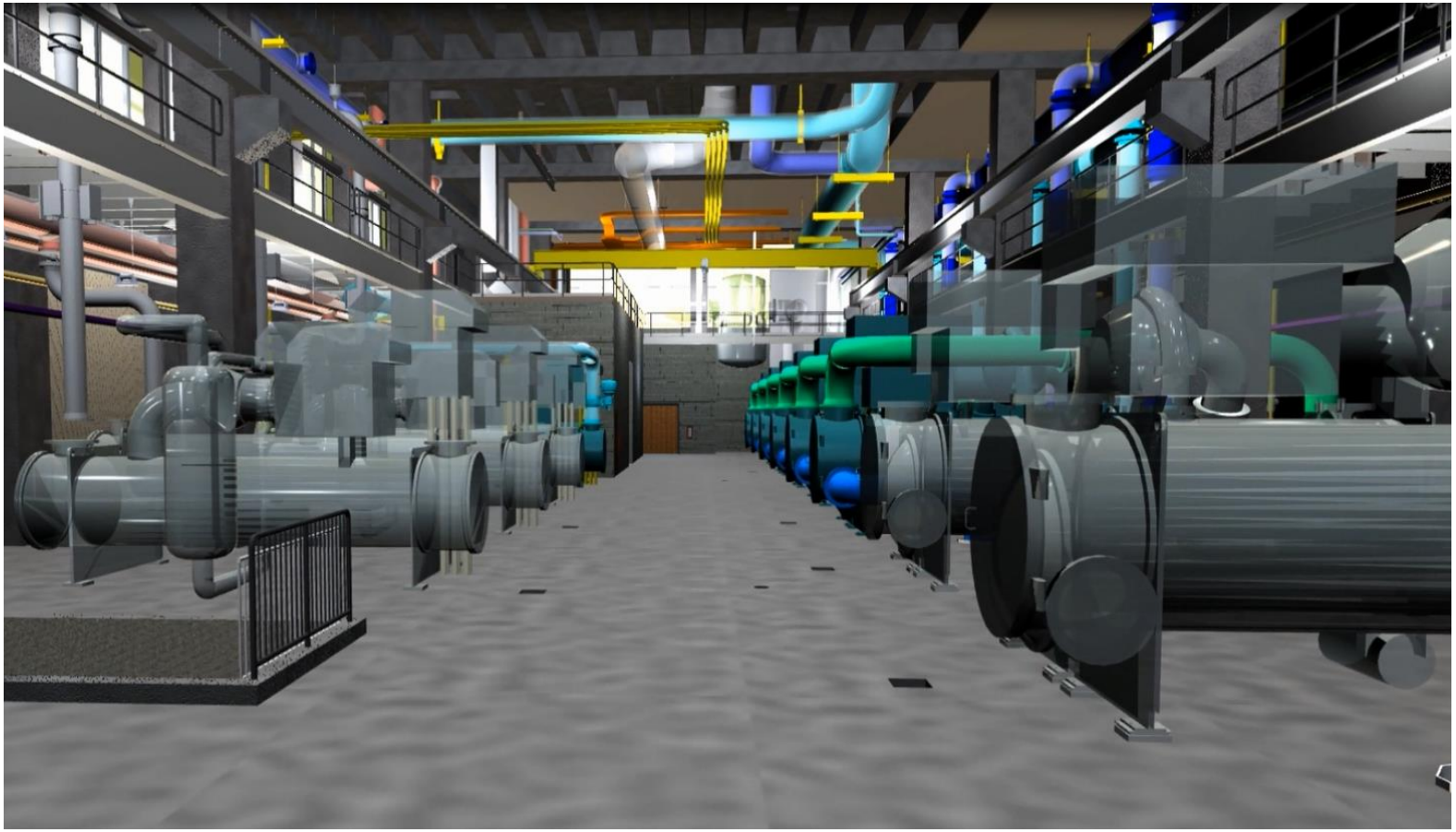
INTRODUCTION

Chilling Station #7 and Hot Water Plant #1

	Chilling Station #7	Hot Water Plant #1
Startup Year	2016	2016
Number of Buildings Served	160	5 (Phase 1)
Square Footage Served	17 million sqft (campus area served)	1.1 million sqft (medical district)
Distribution Network length	> 9 miles (campus total)	2,850 Trench Feet (medical district)
Heating		
Heating Capacity	47 MMBtu	40 MMBtu
Equipment	3 gas-fired boilers + 1 HPC	3 steam-HW heat exchangers
Piping Diameters	16 inches	16 inches
System Pressure	80 psig	80 psig
System Temperatures	176 F supply / 104 F return	176 F Supply / 104 F Return
Chilling		
Chilling Capacity	15,600 tons	
Equipment	6 chillers + 1 HPC	
Piping Diameters	36 inches	
System Pressure	120 psig	
System Temperatures	39 F supply / 55 F return	
Thermal Energy Storage		
Volume	5,500,000 gallons	
Capacity	52,000 ton-Hours	
Electrical Demand Offset	6 MW	

INTRODUCTION

Chilling Station #7 and Hot Water Plant #1



APPROACH

OWNER PROJECT DEVELOPMENT

- Upstream utility master plan
- Gathered internal lessons learned
  - Recent projects
  - Industry experience
- Refined owner's specifications
- Procure sole-source key scopes

Goal: Set expectations for high quality solution

APPROACH

OWNER PROJECT DEVELOPMENT

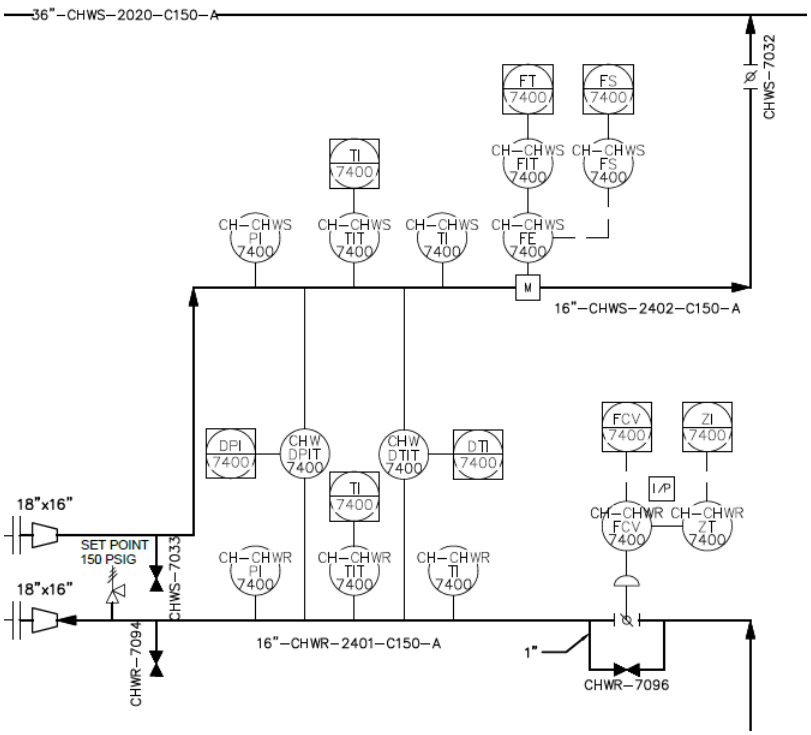
- Developed strong RFP
  - Defined overall scope/schedule
  - System design criteria
  - Preliminary equipment criteria
  - Identified potential design studies
  - Encompassed operational/design philosophy
  - Required some “pre-design”
    - Consider getting help
- Design-Build approach selected
  - Schedule advantages
  - Open book flexibility
  - Early pricing
  - Team mentality

Goal: Pick the right team

APPROACH

DESIGN-BUILD

- Strategic team
  - Engineer led
  - Controls integrator on the design team
  - Optimization consultant
- Extensive tours of existing facilities
  - The good and the not so good
- Design charrettes
  - Focus on early P&ID development
- Line-by-line review of sequence of ops
  - Involve UT leadership AND operations staff
- Inclusive design reviews with UT discipline reps
- BIM walkthroughs at major design milestones



Goal: Incorporate best practices, hone the solution

APPROACH
DESIGN-**BUILD**

- More BIM walkthroughs
- Early subcontractor engagement
  - Pricing and constructability feedback
  - Accountability
- Open book finances
  - Flexibility enabled smart decisions
- Early Procurement
  - Minimized financial risk
  - Helped define schedule / staging
  - Coordination with actual equipment
- BMcD Mech/Elec field superintendents

Image Courtesy: Flintco

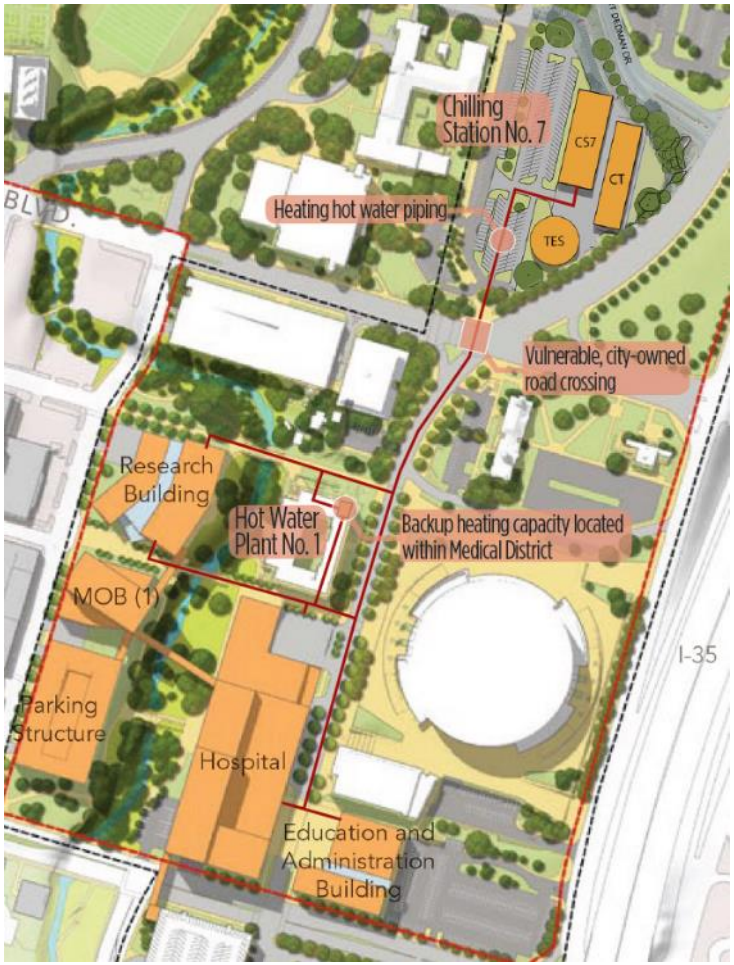
FLINTCO Constructive Solutions

Goal: Expedited delivery without sacrificing quality

LESSONS APPLIED
OPERATIONS

- Avoid single points of failure
  - N+1 pumping
  - 4 independent water services
  - Multiple distribution paths
  - Bypass lines
- Geographic diversity
- Smaller equipment, higher quantity
  - Reliability
  - Operational flexibility

Goal: Resiliency!



Graphic Courtesy: The University of Texas

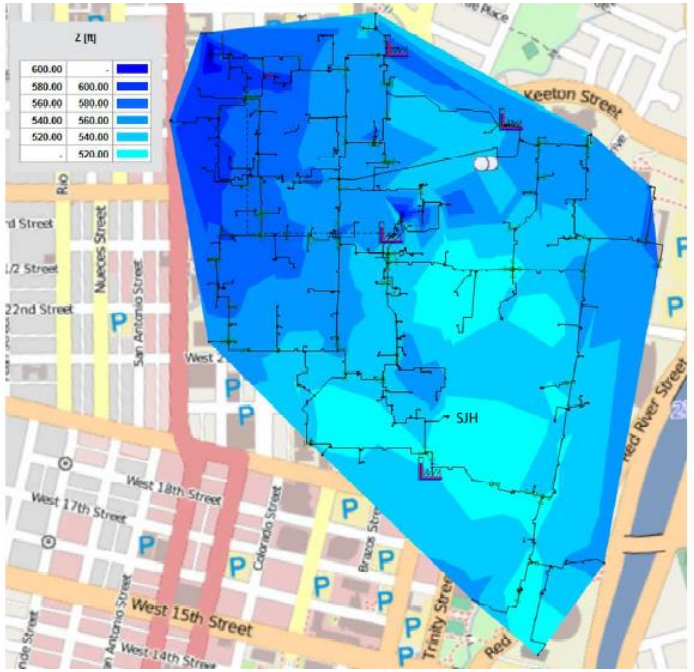
LESSONS APPLIED
OPERATIONS

- Attention to dead legs and idle operation
  - Bypass for the bypass
- Material Selections
  - Valve components
  - Gaskets and pump seals
  - Considerations at cooling tower!
- Comprehensive Cx
  - Owner executed

Goal: Attention to Details – EVERYTHING MATTERS!

LESSONS APPLIED
OPERATIONS

- TES-1 start-up experience
  - Extreme focus on TES-2 design and control
- Predictive operational models
  - Campus-wide flow modeling
  - Optimization across CS6/CS7
  - Focus design on the “sweet spot”



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Goal: Optimized Operations

LESSONS APPLIED
DESIGN

- HDPE distribution piping
  - Sizing for surge
  - To insulate or not to insulate…
  - Transition joint design
    - Torque calculation & procedure
    - Custom flange adapter at valves
    - Gasket selection
    - Belleville washers
- Corrosion protection
  - “Exercise” sequences
  - Avoided dead legs
  - Material upgrades

Goal: Long-term Reliability

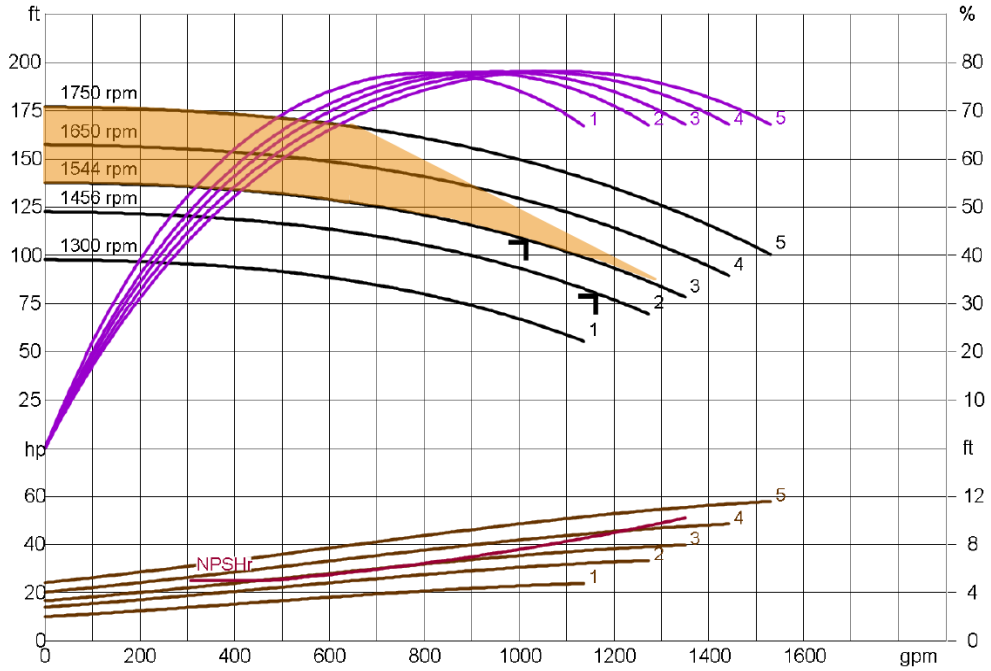
Image Courtesy: Flintco

Image Courtesy: Flintco

LESSONS APPLIED

DESIGN

- Pump adventures
  - VS operation: 0-60 Hz and beyond
  - Max impellers, max flexibility
  - VFD overloading protection
  - Terminal box envy
- Valve selection
  - Gear box torque capability
  - High performance vs. resilient seat



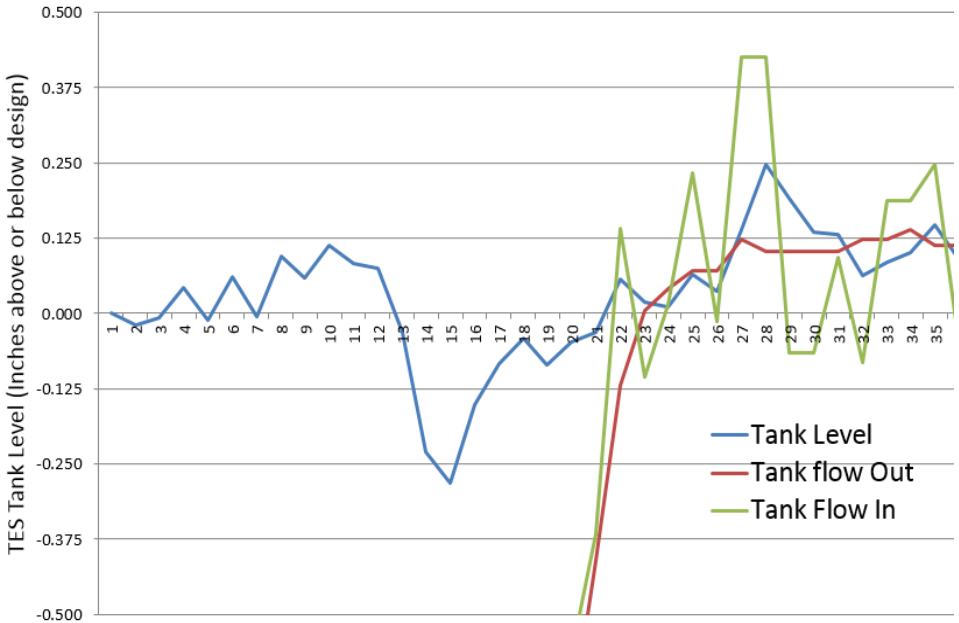
Graphic Courtesy: ITT Goulds

Goal: Find the best balance between cost and performance

LESSONS APPLIED

DESIGN

- 5°F approach cooling tower
  - Lowest cost of ownership
- TES-2 control
  - 6,000 gallons/inch!
  - Dynamic return pressure
  - Concurrent operation with TES-1
  - Level response simulation
  - Tight CV selection
- Designed for optimization
  - Custom sequences
  - HW temp flexibility
  - Strategic equipment selections
  - 600 ton Heat pump chiller



Graphic Courtesy: The Hartman Company

Goal: Design with optimization in mind

SUMMARY

CS7 / TES-2 BENEFITS

- Lower campus annual kW/ton
  - 0.547 kw/ton annual projected
- Offset 6 MW of peak demand
  - Avoids additional CHP capacity
- Improves campus hydraulics
- Off-load plants in need of renewal
- Room for expansion
  - 5,000 tons more chiller
  - 1,800 tons / 30 MMBtu more HPC
  - 12 MMBtu more boiler

CURRENT STATUS
DELL MEDICAL SCHOOL

- Phase 1 Under Construction
  - Dell Seton Medical Center Teaching Hospital
  - Research
  - Education and Administration
  - Medical Office
- Scheduled to open fall 2016

Image Courtesy: Flintco

CURRENT STATUS

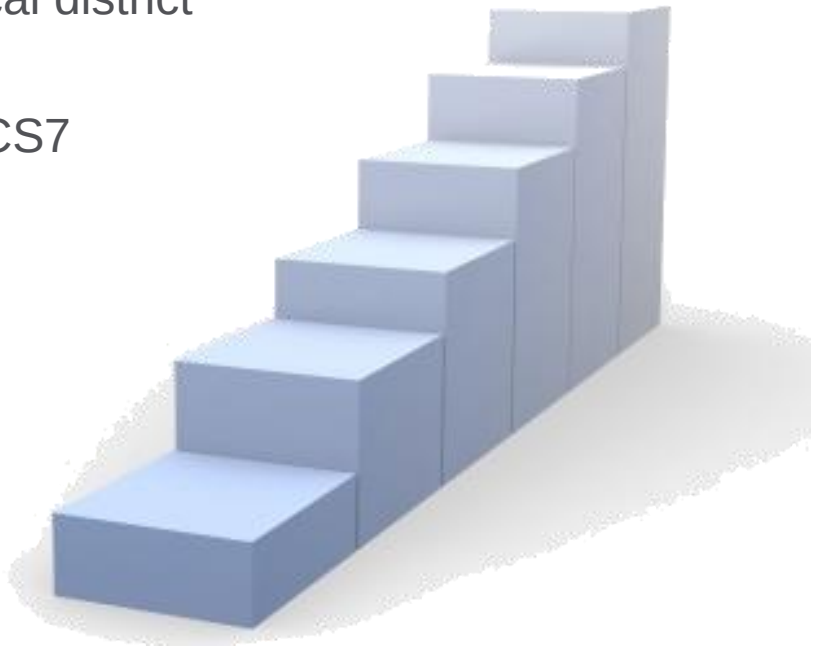
CHILLING STATION #7

- Substantial completion late June 2016
- Pre-functional testing underway

Image Courtesy: Flintco

NEXT STEPS

- Study to optimally balance CHP and TES (x2) dispatch
- Optimization implementation
- Offset peak power increase from medical district
- Phase 2 build-out of medical district
- Distribution upgrades to further utilize CS7



QUESTIONS??

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