Chilled Water Distribution Upgrade at Oklahoma State University

Lessons Learned – The Good, The Bad, and The Ugly

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Introductions

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  - Project Manager – Burns & McDonnell
Overview

- Master Planning
- Distribution Design Constraints
- From paper to reality
- Construction Challenges
  - 4 Speed Bumps
- Lessons Learned
Basis of Existing Utilities

Existing Power Plant

Oklahoma Agricultural and Mechanical College Campus Development Plan From 1945 Redskin Yearbook
Program Summary

- Utility Master Plan
  - Plan for correcting existing deficiencies
  - 5-year plans for steam, chilled water, and electrical
  - 20-year plans for steam, chilled water, and electrical

- Campus Planning Tools
  - KY Pipe steam and chilled water models
  - SKM Power Tools electrical model
  - Utility Geographic Information System (GIS)

- New Central Plant
Utilities Load Analysis

Chilled Water
- Current campus peak demand as of 2016: 15,300 tons
- Estimated 5-year campus peak demand: 15,469 tons
- Estimated 20-year campus peak demand: 18,992 tons

Heating
- Current campus peak demand as of 2016: 136,000 LB/HR
- Estimated 5-year campus peak demand: 150,000 LB/HR
- Estimated 20-year campus peak demand: 190,000 LB/HR

Electrical
- Current campus peak demand as of 2016: 31,995 kW
- Estimated 5-year campus peak demand: 32,647 kW
- Estimated 20-year campus peak demand: 38,291 kW
New Central Plant Locations

- Nine sites analyzed resulting in Washington & Scott location
Location Analysis

- Steam, chilled water, electrical models revealed impacts of Central Plant location when compared to Campus Master Plan growth
- Determines amount of campus disruption for distribution connection

### Distribution Costs for New Central Plant

<table>
<thead>
<tr>
<th>Option</th>
<th>Today</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>$14.5M</td>
<td>$0</td>
</tr>
<tr>
<td>Option 2</td>
<td>$19.1M</td>
<td>$800K</td>
</tr>
<tr>
<td>Option 3</td>
<td>$26.1M</td>
<td>$3.6M</td>
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</tbody>
</table>

- Future upgrades needed to main lines based on plant location for campus growth
- Extension of lines will still be required to support specific projects
- Route 12,000+ total LF of:
  - 36” chilled water supply and return
  - 2x20” steam supply
  - 8” pumped condensate return
  - 3” flash steam
  - Two (2) 8” domestic water feeds
  - 3x3 6” electrical ductbank
  - 10” natural gas (from the north)

- From New Plant to “Hub” at Power Plant
- Campus Schedule Critical Completion Dates
- Must be Open for 1st Home Football Game
  - Washington Street Stadium Access
- Zero Outages to Campus
- Oh, and for Hall of Fame Avenue….
Initial Direction to Design Team:

YOU SHALL NOT PASS!

HALL OF FAME AVENUE!
Five vaults for steam traps, valves, and expansion joints

- Replace/interface with existing tunnel
- Robust design
- Access, safety, and maintainability is critical
Initial Distribution Design

- Design considerations
  - Direct buried vs. walkable tunnel
  - Open cut vs. trenchless installation
  - Pre-insulated Class A piping system
  - Separate steam mains leaving plant
  - Variety of complex construction methods required

UTILITY TRANSMISSION LINE TRENCHING
UTILITY TRANSMISSION LINE BORING BENEATH HALL OF FAME AVENUE
Speed Bump #1: 9 million reasons

- Why get permission to close Hall of Fame?
  - $9 million bust for Distribution Bid Package (#6)
- Keep Design south of Hall of Fame
  - Vaults 3, 4, and 5
- Redesign from Plant to Vault 3
- Request Permission and Plan for a Closure of Hall of Fame Avenue
- Begin Construction on Bid Package #6A
- Re-design Bid Package #6B
- Drivers for Re-design
  - Reduced Costs (within budget)
  - Maintainability and Accessibility
  - Reduced Number of Vaults
Utility Transmission
CONSTRUCTION SCHEDULE – JUNE 2016 to JUNE 2017

1c. TUNNEL TO VAULT #3, & VAULT #3: 6-1-2016 to 9-1-2016

2a. VAULT #3 TO VAULT #4: 9-1-2016 to 11-21-2016

2b. VAULT #4: 9-1-2016 to 11-21-2016

1a. VAULT #3 TO VAULT #5: 6-1-2016 to 9-1-2016

1b. VAULT #5: 6-1-2016 to 8-30-2016


4. OPEN TRENCH HoF & VAULT 2: 5-15-2017 to 8-30-2017 (est)
Updated Distribution Design
Speed Bump #2: What AT&T Ductbank?

- AT&T Ductbank
- Never Located or marked after 811 calls
- Running parallel to existing steam tunnel
- Not discovered until excavation for installation of Vault #4
- Primary infrastructure serving North East Oklahoma!
Speed Bump #2: What AT&T Ductbank?
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Is there anything that looks odd in this picture?
Speed Bump #3: Vault 3 Swimming Pool

- Pulled Shoring
- 18” Transite Pipe
- Lost all chilled water to campus for multiple hours (over 95 buildings affected)
- 5 buildings had no chilled water for three days
- Over 131,000 Gallons of chilled water were released into excavation area
Speed Bump #3: Vault 3 Swimming Pool
Placeholder for video
CW line break gets a “thumbs down” from James
Pouring concrete on August 30, 2016, just 4 days before first home football game. Like it never happened…
Speed Bump #4: Crossing over Christmas

- Request Permission and Plan for a Closure of Hall of Fame Avenue
- Granted for Start and Finish over OSU Winter Break
- HoF to be open on January 9, 2017 with start date of December 11, 2016
- Crossing over winter break had a roughly $200k price adder, but reduced Hall of Fame construction crossing timeline from 3 months to 3 weeks.
Utility Distribution BP#6b
Utility Distribution BP#6a
Distribution at Central Plant.
Excavation south leaving New Plant
The Good, the Bad, and the Ugly

CLINT EASTWOOD

50th ANNIVERSARY EDITION

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