



Moving Toward Greater Sustainability: Oklahoma State University Builds a New Central Plant

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Introductions



- **James Rosner, PE, CEM** (james.rosner@okstate.edu)
 - Director of Energy Services, Oklahoma State University
- **Brian Sauer, PE, LEED AP BD+C, CxA** (bsauer@fsb-ae.com)
 - Utility Master Plan Project Manager, Frankfurt Short Bruza
- **Mike Isch, RA** (misch@fsb-ae.com)
 - Central Plant Project Manager, Frankfurt Short Bruza
- **Justin Grissom, PE, CEM, LEED AP** (jgrissom@burnsmcd.com)
 - Utility Distribution Project Manager, Burns & McDonnell

Overview

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Privatization Summary



■ January 2012 through September 2013

■ Privatization Goals

- University provided reliable and economical utility services
- University to realize long-term economic savings
- Monetization of infrastructure and defeasement of debt

■ Knowledge Gained

- Financial Health of the University
- Entire utility system cataloged and analyzed
- System deficiencies identified

■ Evaluation Results

- OSU did not privatize and retained all Utilities Functions
- Began implementation of University's Most Efficient Organization
- Began A/E selection process for a Utilities Master Plan

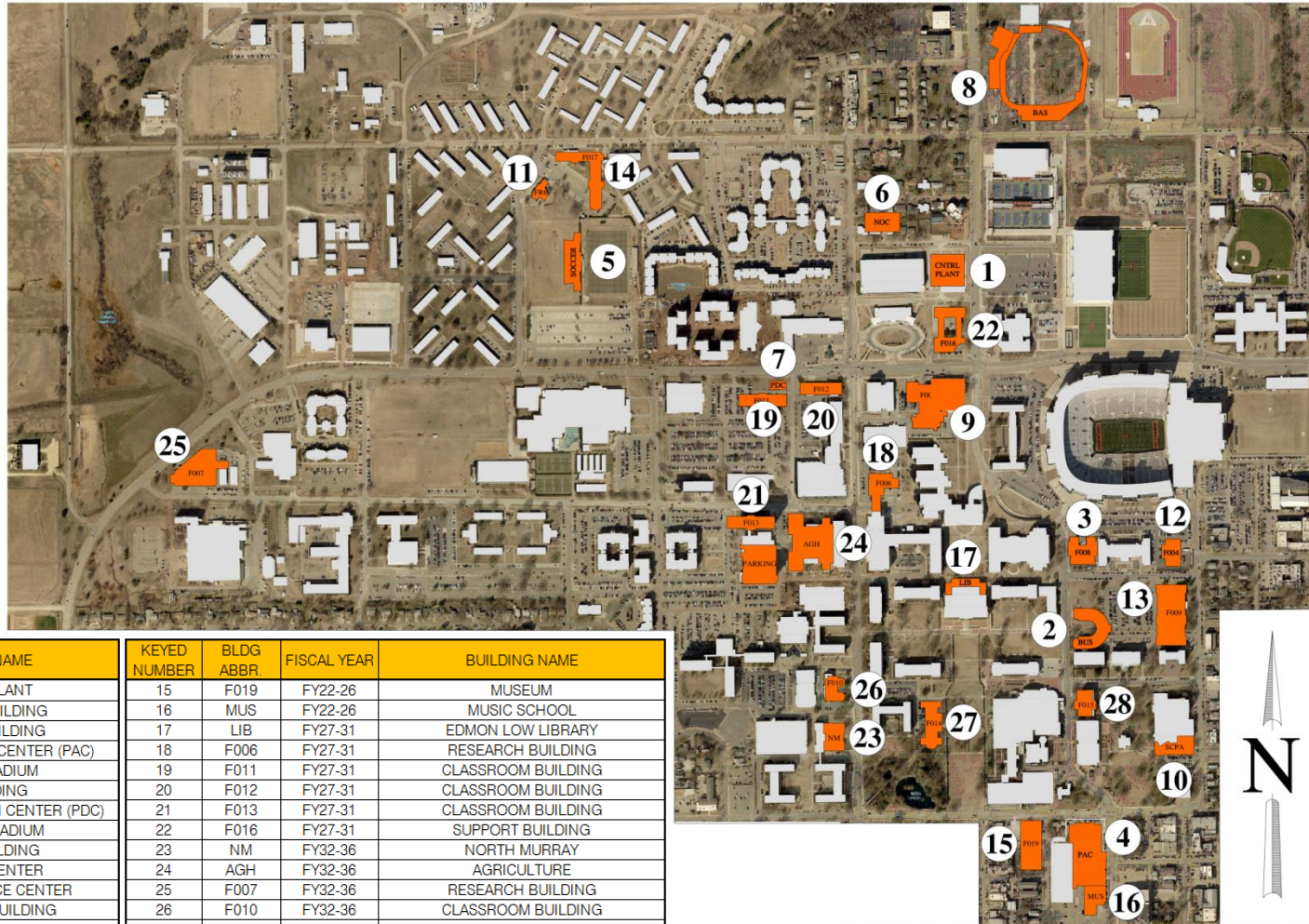


Utility Master Plan Purpose

- **Respond to privatization study**
 - Plan for correcting existing deficiencies
 - 5-year plans for steam, chilled water, and electrical
 - 20-year plans for steam, chilled water, and electrical
- **Develop tools for future campus planning**
 - KY Pipe thermodynamic steam model
 - KY Pipe hydraulic chilled water model
 - SKM Power Tools electrical model
 - Utility Geographic Information System (GIS)
- **Determine new Central Plant location and size**



Utility Master Plan Analysis

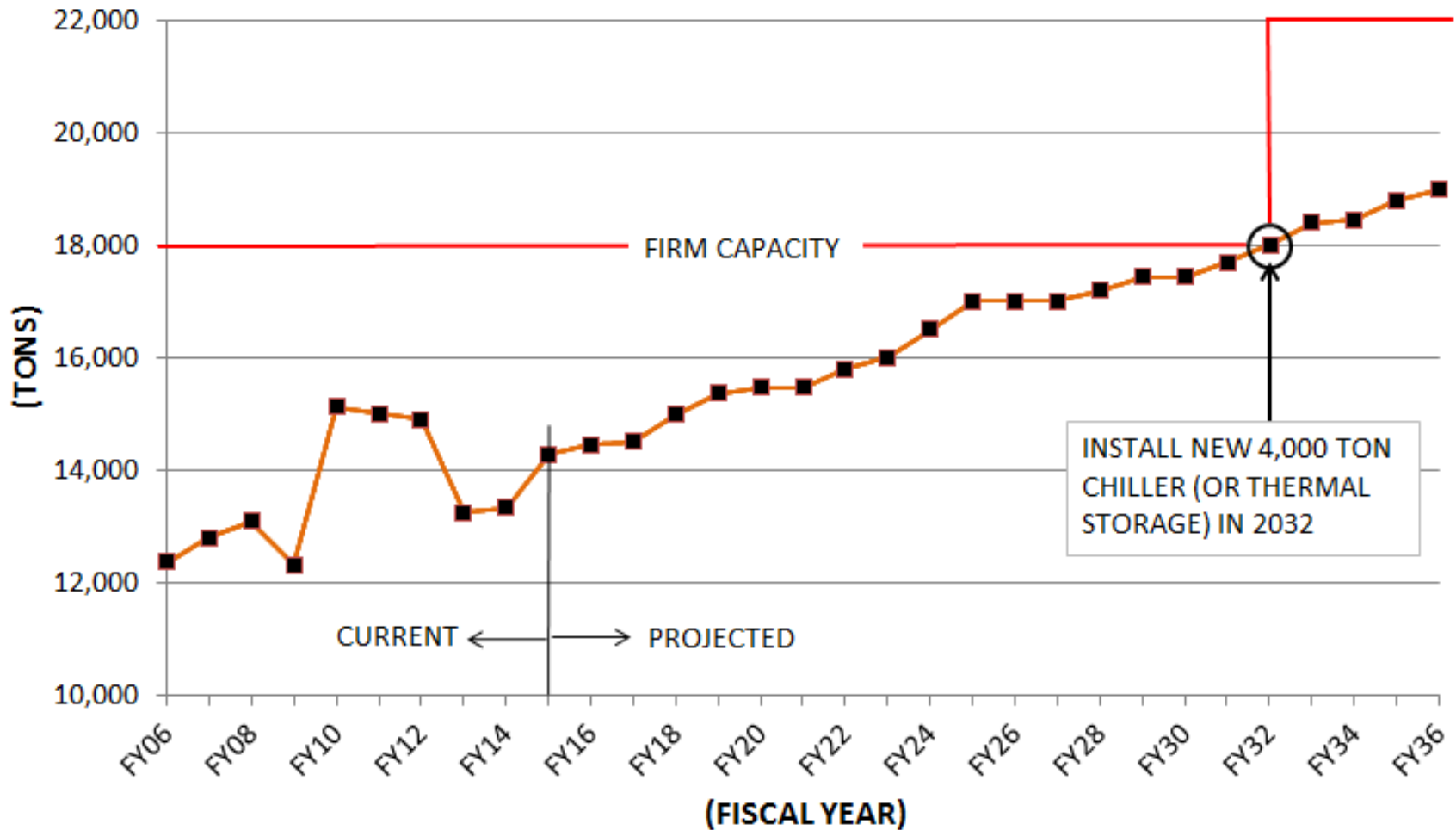


KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME	KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME
1	CP	FY16	CENTRAL PLANT	15	F019	FY22-26	MUSEUM
2	BUS	FY17	BUSINESS BUILDING	16	MUS	FY22-26	MUSIC SCHOOL
3	F008	FY17	CEAT LAB BUILDING	17	LIB	FY27-31	EDMON LOW LIBRARY
4	PAC	FY18	PERFORMING ARTS CENTER (PAC)	18	F006	FY27-31	RESEARCH BUILDING
5	SOC	FY18	SOCCER STADIUM	19	F011	FY27-31	CLASSROOM BUILDING
6	NOC	FY18	NOC BUILDING	20	F012	FY27-31	CLASSROOM BUILDING
7	PDC	FY18	POWER DISTRIBUTION CENTER (PDC)	21	F013	FY27-31	CLASSROOM BUILDING
8	BAS	FY19	BASEBALL STADIUM	22	F016	FY27-31	SUPPORT BUILDING
9	F005	FY21	FUTURE BUILDING	23	NM	FY32-36	NORTH MURRAY
10	SCPA	FY22-26	SERETEAN CENTER	24	AGH	FY32-36	AGRICULTURE
11	FRC	FY22-26	FAMILY RESOURCE CENTER	25	F007	FY32-36	RESEARCH BUILDING
12	F004	FY22-26	CLASSROOM BUILDING	26	F010	FY32-36	CLASSROOM BUILDING
13	F009	FY22-26	CLASSROOM BUILDING	27	F014	FY32-36	CLASSROOM BUILDING
14	F017	FY22-26	RESIDENCE HALL	28	F015	FY32-36	CLASSROOM BUILDING

Utility Master Plan Analysis



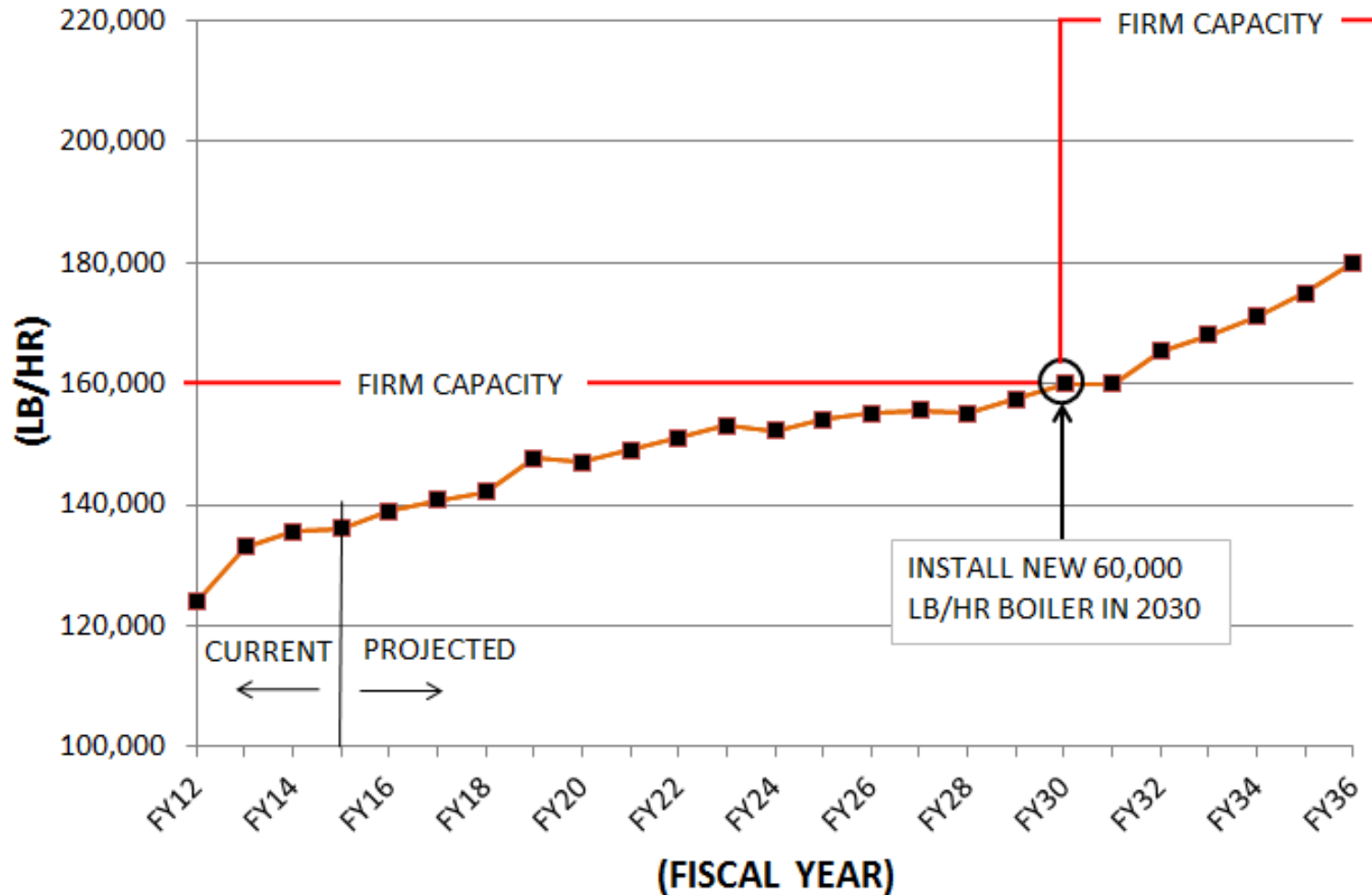
COOLING LOAD GROWTH



Utility Master Plan Analysis



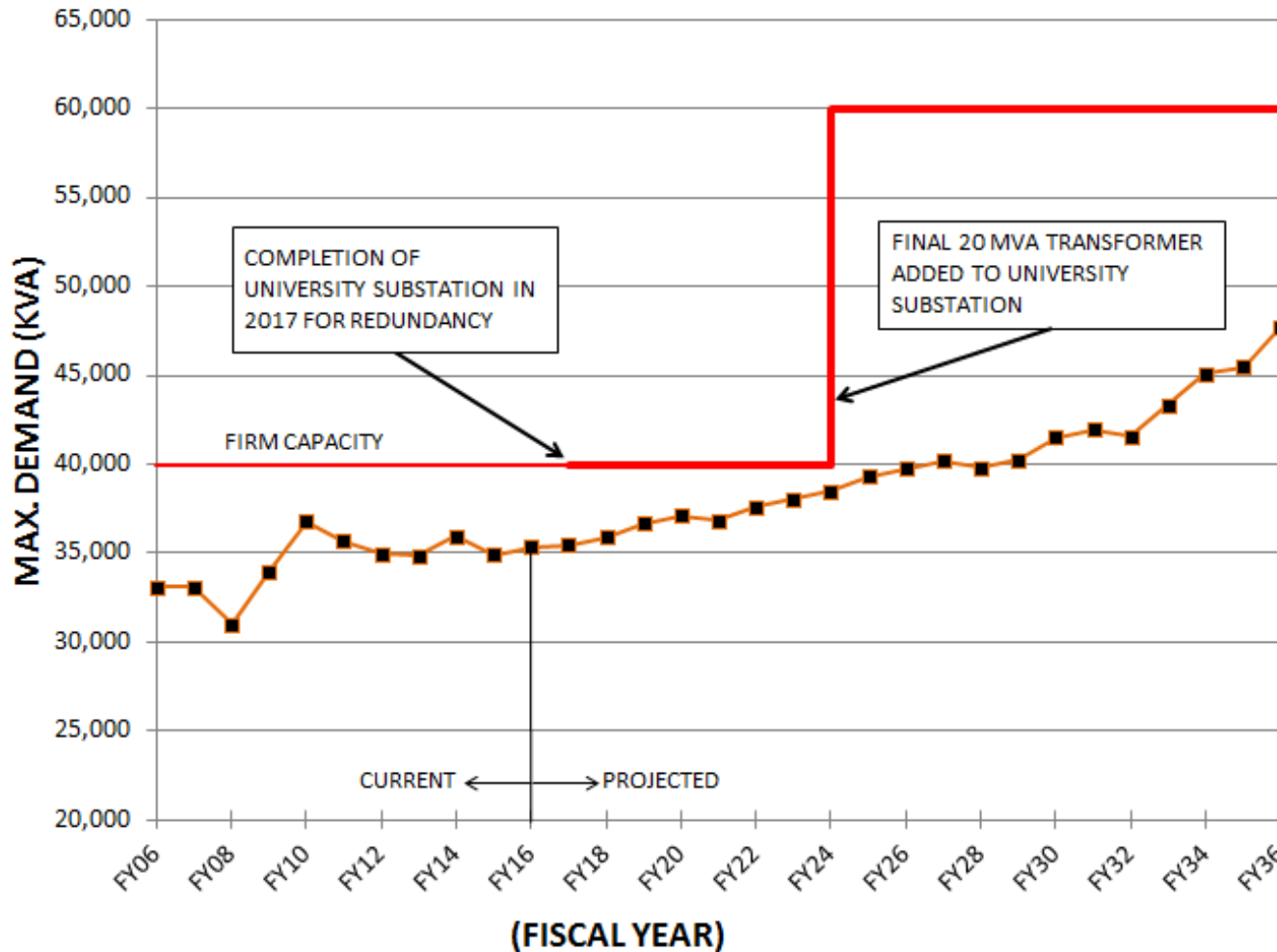
HEATING LOAD GROWTH



Utility Master Plan Analysis



ELECTRICAL LOAD GROWTH



Why a new plant?



- **CENTRAL PLANT REPLACEMENT NECESSITIES**

1. Adherence to wind power agreement requires completion by December 2017
2. Utility production capacity
3. Power plant condition
4. Power plant location

- **CENTRAL PLANT REPLACEMENT OPPORTUNITIES**

1. Tie to education
2. Energy efficiency
3. Consolidation of Energy Services

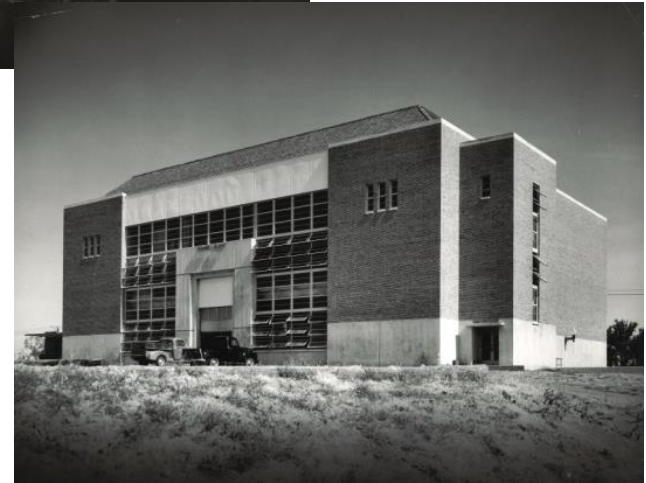
Power Plant Condition

- 67 year old steam plant
- 38 year old chilled water plant

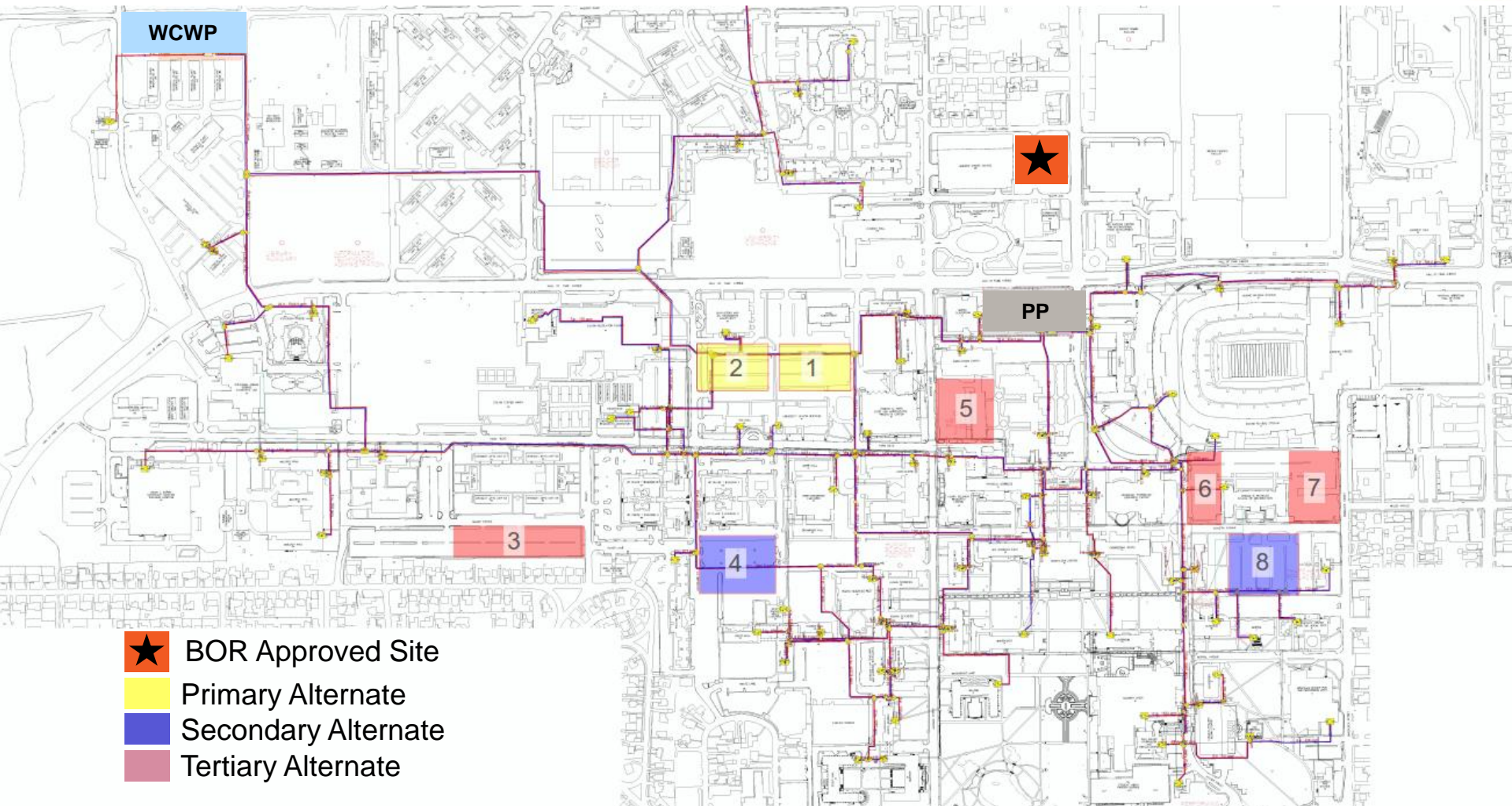
Most equipment has exceeded its life expectancy:

Boiler #1 – 1947	Chiller #1 – 1975
Boiler #2 – 1947	Chiller #2 – 1976
Boiler #3 – 1947	Chiller #3 – 1986
Boiler #4 – 1956	Chiller #4 – 1987
Boiler #5 – 1962	Switchgear – 1947

Revitalization of Power Plant
unviable due to cost and schedule



Plant Location



- ★ BOR Approved Site
- Primary Alternate
- Secondary Alternate
- Tertiary Alternate

Architecture



Architecture



Architecture

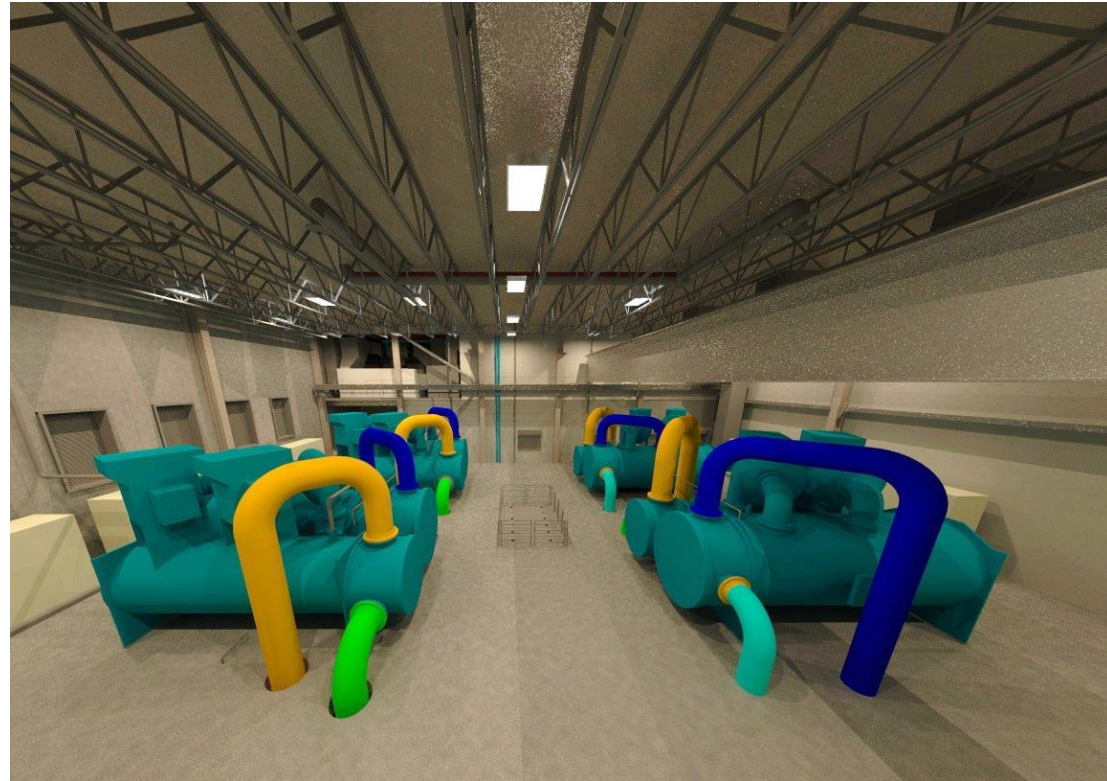


Architecture



Chilled Water System

- Three 4,000 ton chillers
- Three 300 hp primary chilled water pumps
- Three 500 hp chilled water distribution pumps
- Three 500 hp vertical turbine condenser water pumps
- Three 5250 ton cooling tower cells with 250 hp fans
- Space for fourth chiller, associated pumps and cooling tower cell



Steam System

- Three 60,000 lb/hr boilers
- One 40,000 lb/hr boiler
- Low-NOx dual fuel burners (natural gas & #2 fuel oil)
- PLC based Burner & Combustion Management System
- Stack gas economizers
- 200,000 lb/hr deaerator
- Reverse osmosis makeup water
- Space for future 60,000 lb/hr boiler and heating hot water heat exchangers

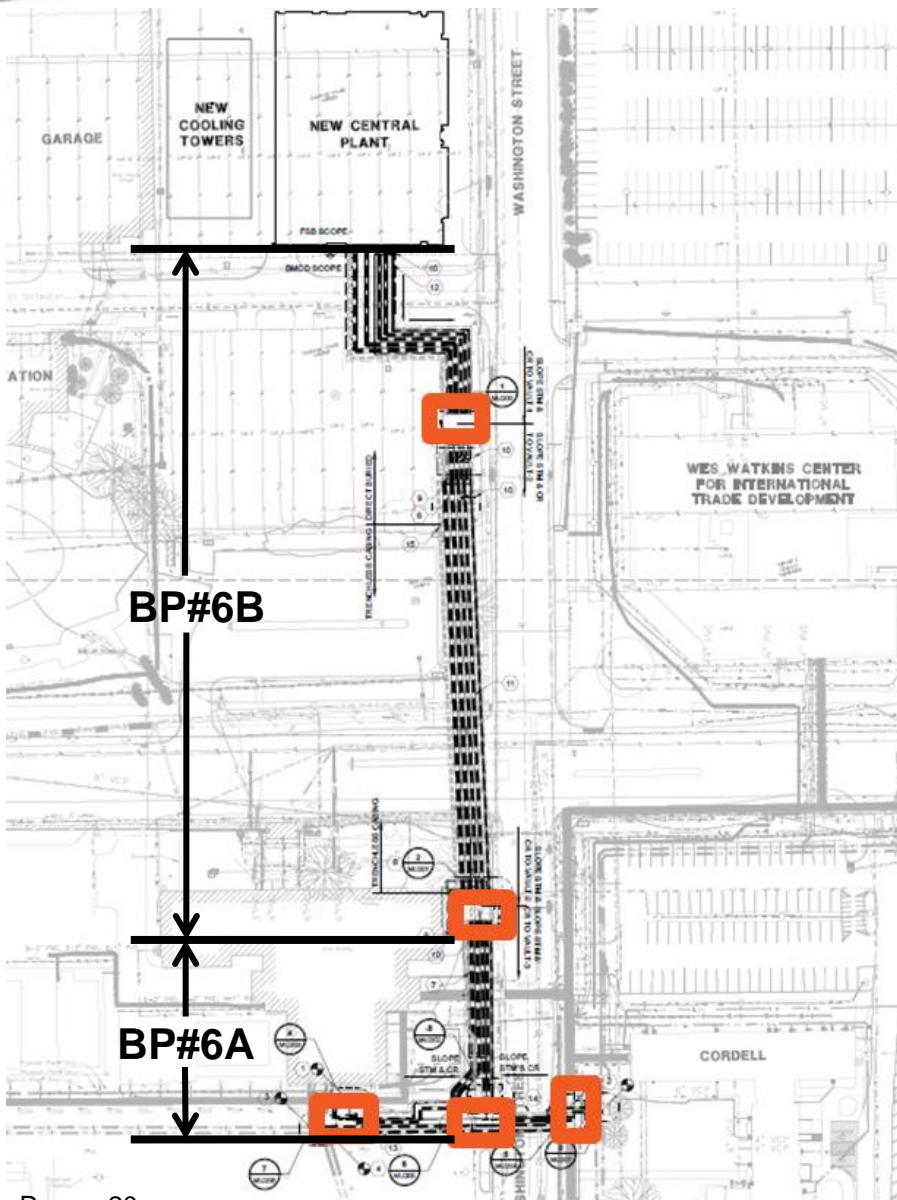


Sustainability

- 42% reduction in Energy Services campus footprint
- 21% more efficient boilers
- 31% more efficient chillers
- 30 variable frequency drives
- Exhaust air energy recovery
- Ultra-low flow plumbing fixtures with sensor operation
- LED lighting
- Occupancy sensors
- Daylighting
- Enhanced commissioning



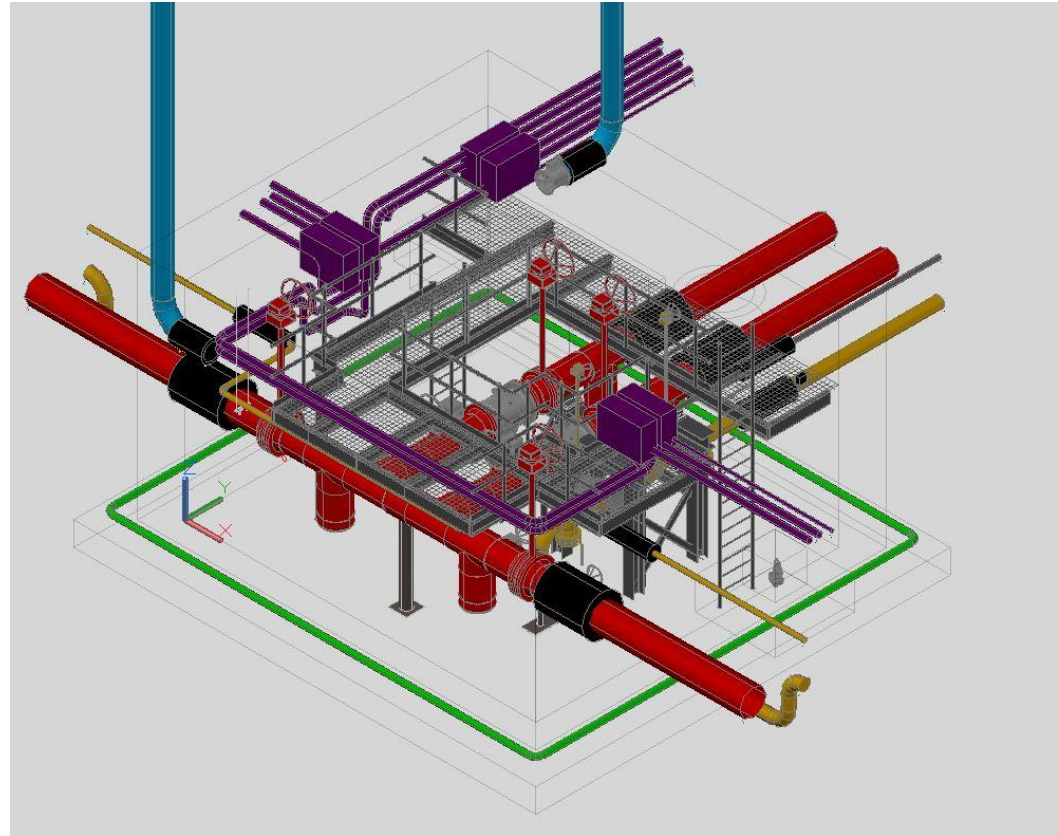
Utility Distribution



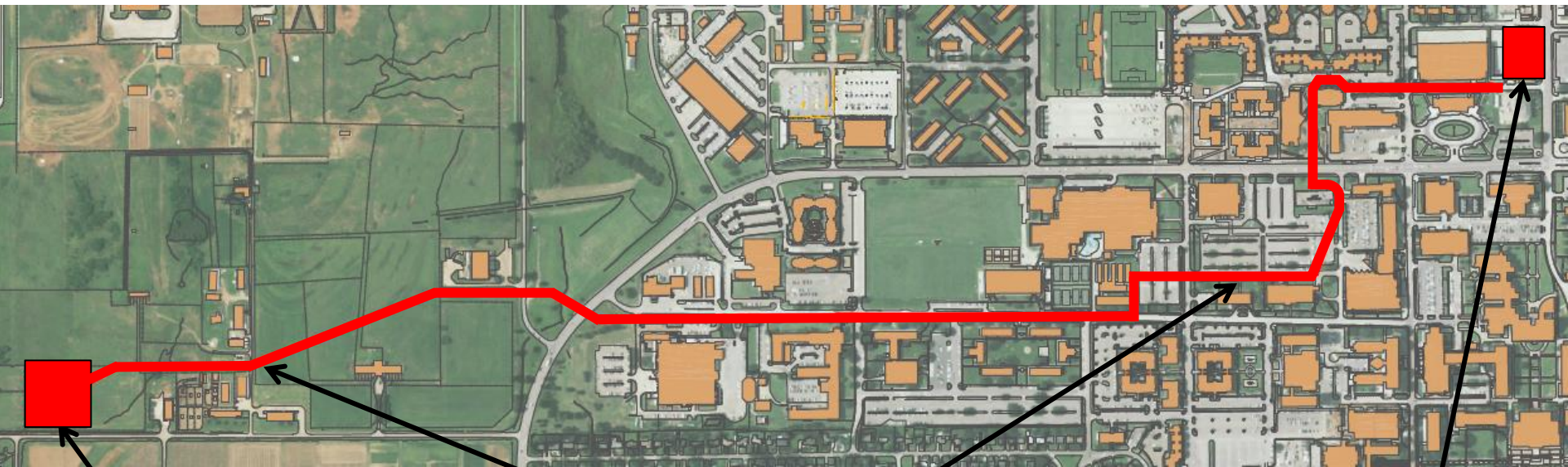
- Over 12,000 total LF of steam, condensate return, and chilled water
- Design considerations
 - Direct buried vs. walkable tunnel
 - Open cut vs. trenchless installation
- Pre-insulated Class A piping system
- Separate steam mains leaving plant
- Variety of complex construction methods required

Utility Distribution

- Five vaults for steam traps, valves, and expansion joints
 - Replace/interface with existing tunnel
 - Robust design
 - Access, safety, and maintainability is critical



Utility Distribution



NEW OG&E
UNIVERSITY
SUBSTATION

- 2 X 20MVA TRANSFORMERS
- 1 X 20 MVA FUTURE

ELECTRICAL
DISTRIBUTION
UPGRADES

- 8027 LF DUCTBANK
- 21 VAULTS

NEW CENTRAL
PLANT



Construction Progress

- Flintco/Alberici selected as CM@R
- Package 1: Mass excavation, site demolition, utility relocation (\$3.6M)
- Package 2: Underfloor utilities, foundations & basement walls, steel frame, elevators, bridge cranes (\$5.7M)
- Package 3: Building completion (\$24.4M)
- Package 4: Storm water detention (in progress)
- Package 5: Exterior electrical distribution (\$5.6M)
- Package 6: Exterior utilities distribution
 - Package 6A: \$6.2M
 - Package 6B: In Progress



Central Plant Equipment



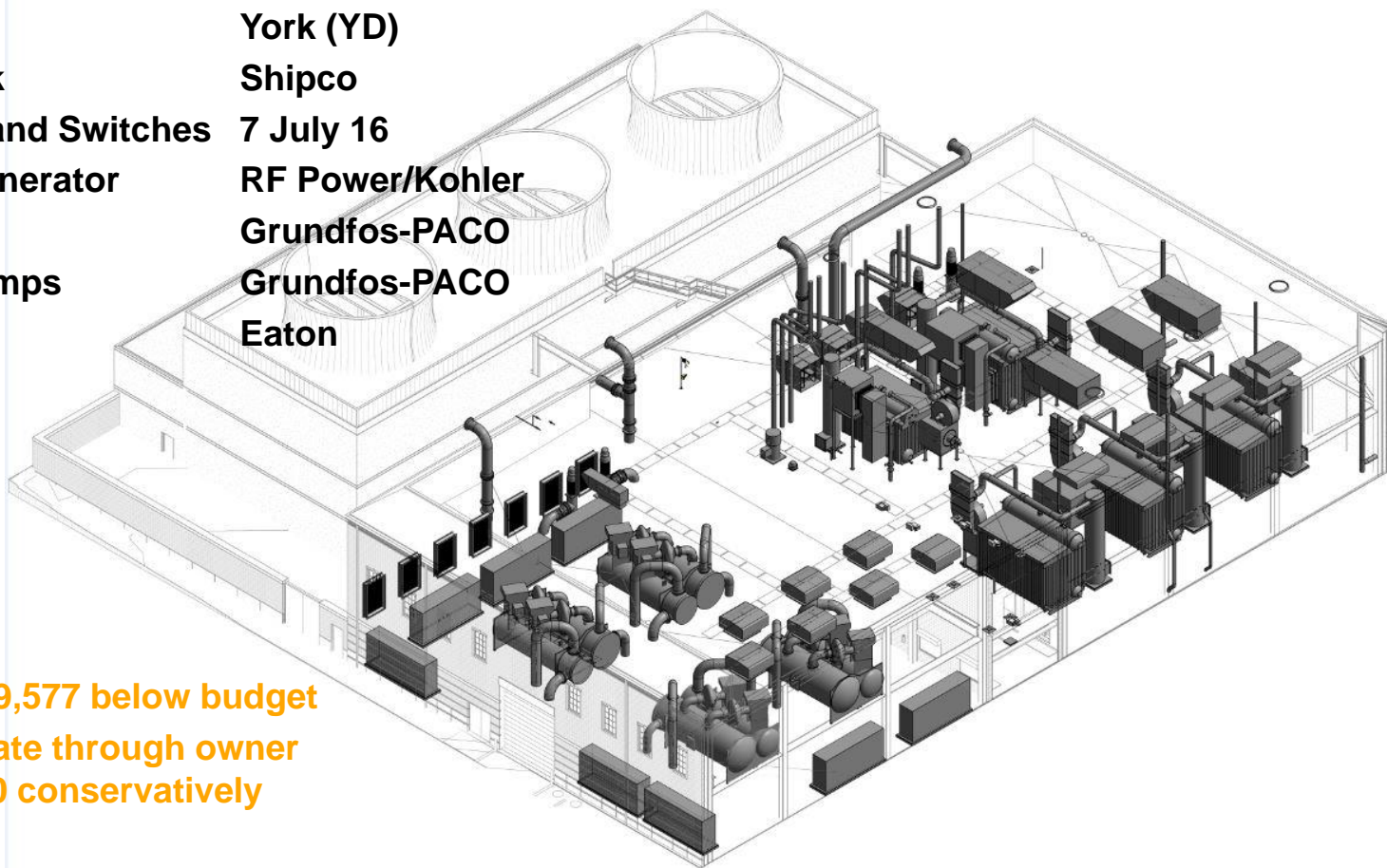
Owner Furnished, Contractor Installed: \$11,556,827 Total

Equipment:

- 4 Boilers
- Cooling Towers
- 3 Chillers
- Deaerator Tank
- Transformers and Switches
- Emergency Generator
- CW Pumps
- Condenser Pumps
- VFDs

Awarded to:

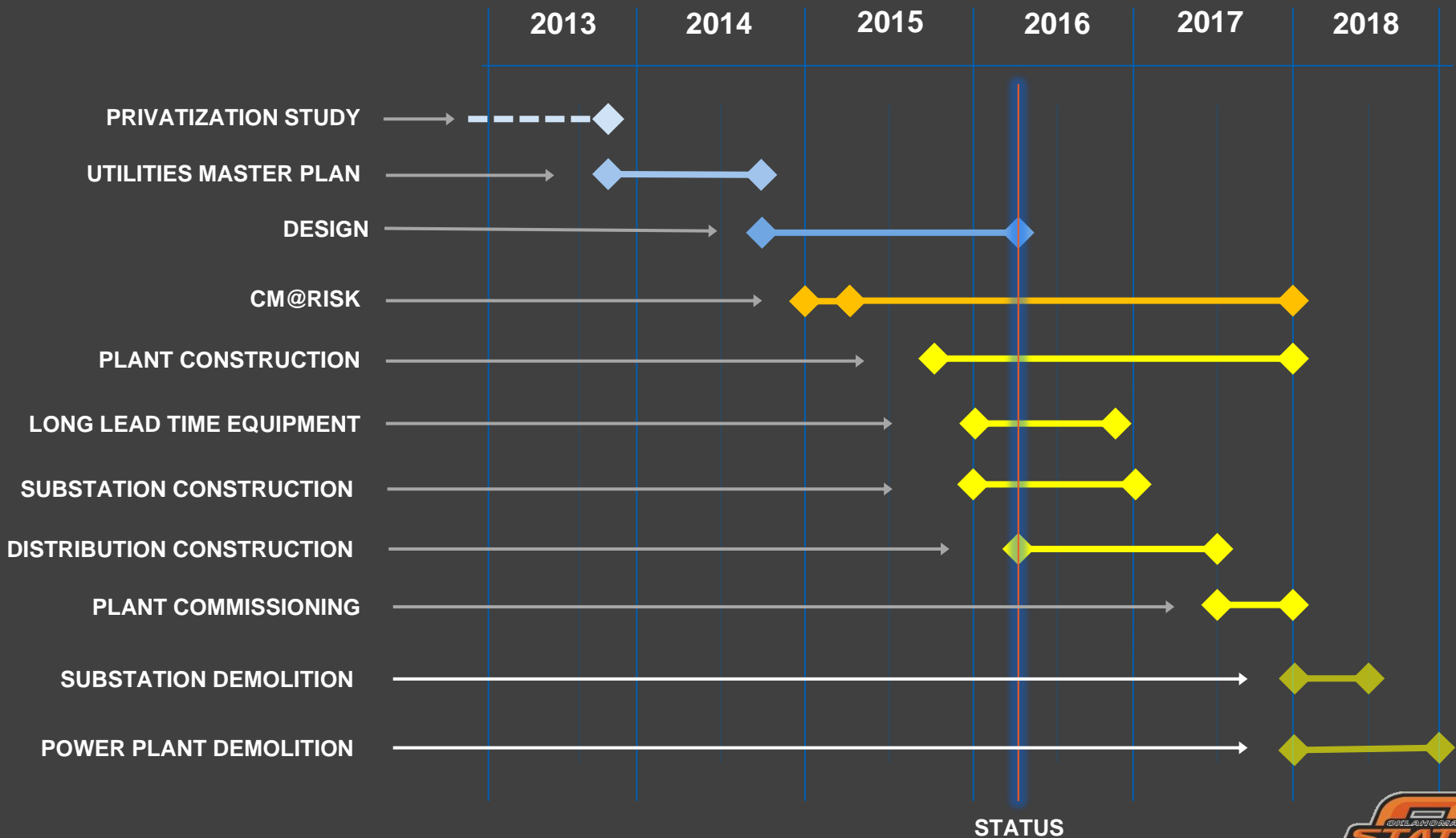
English Boiler & Tube
SPX/Marley
York (YD)
Shipco
7 July 16
RF Power/Kohler
Grundfos-PACO
Grundfos-PACO
Eaton



* Awards total \$1,589,577 below budget

** Avoided cost to date through owner
purchased: \$780,240 conservatively

Program Timeline



Successes and Challenges



Successes:

- Aggressive timeline
 - Master plan start to plant construction in 18 months
- Owner furnished equipment
- 50-year vision
- Integration into campus Architecture
- Tie to educational mission of University

Challenges:

- Utility distribution required redesign
- Zero outages to campus
- Impact on the campus
 - Road and Parking Closures
 - Special Events Coordination
 - Trees



Q & A

Thank You!

Please follow our progress at <http://utilities.okstate.edu>

