



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

June 21, 2016



# Introductions



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# Overview

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# Privatization Summary



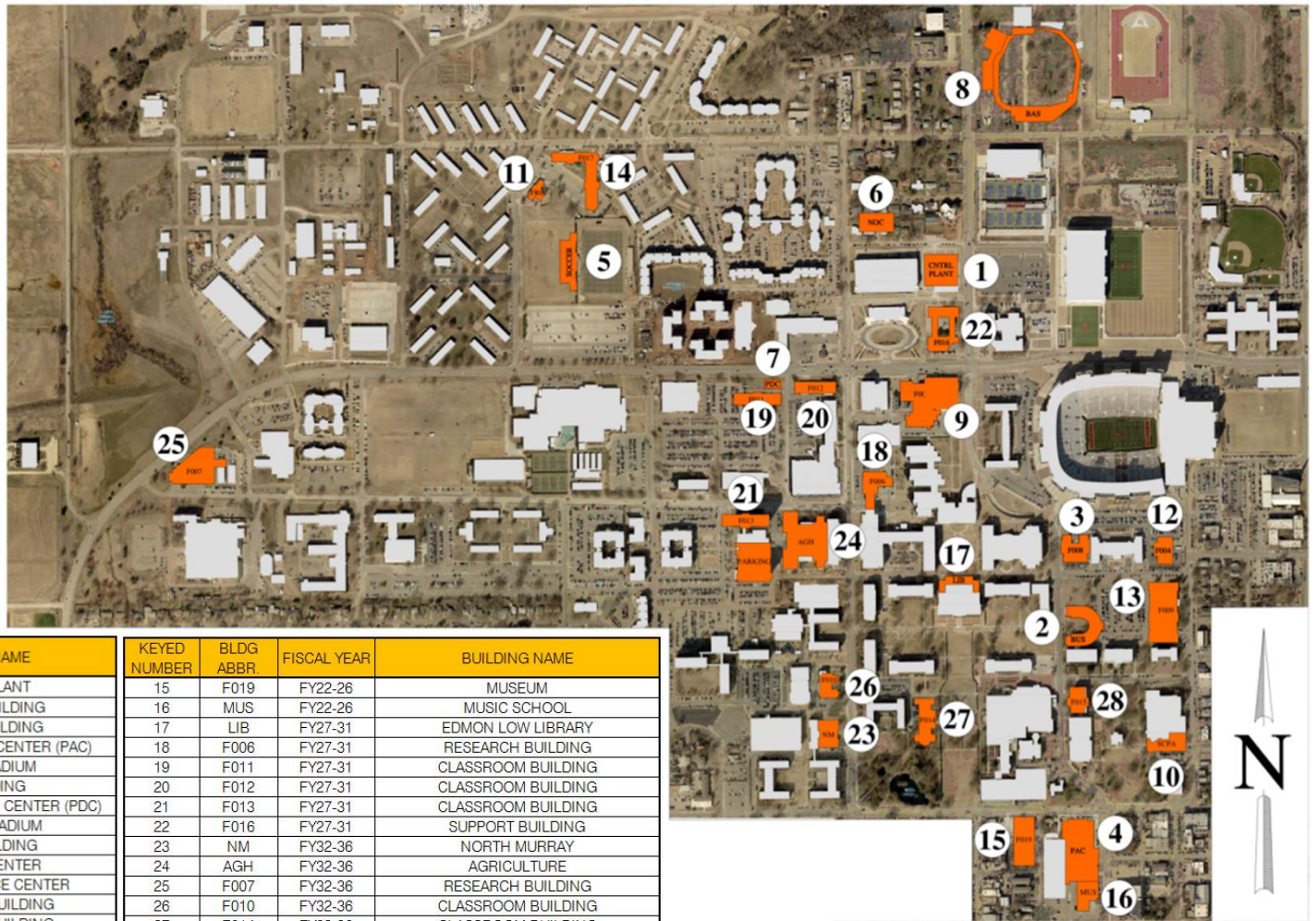
- **January 2012 through September 2013**
- **Privatization Goals**
  - University provided reliable and economical utility services
  - University to realize long-term economic savings
  - Monetization of infrastructure and defeasement of debt
- **Knowledge Gained**
  - Financial Health of the University
  - 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



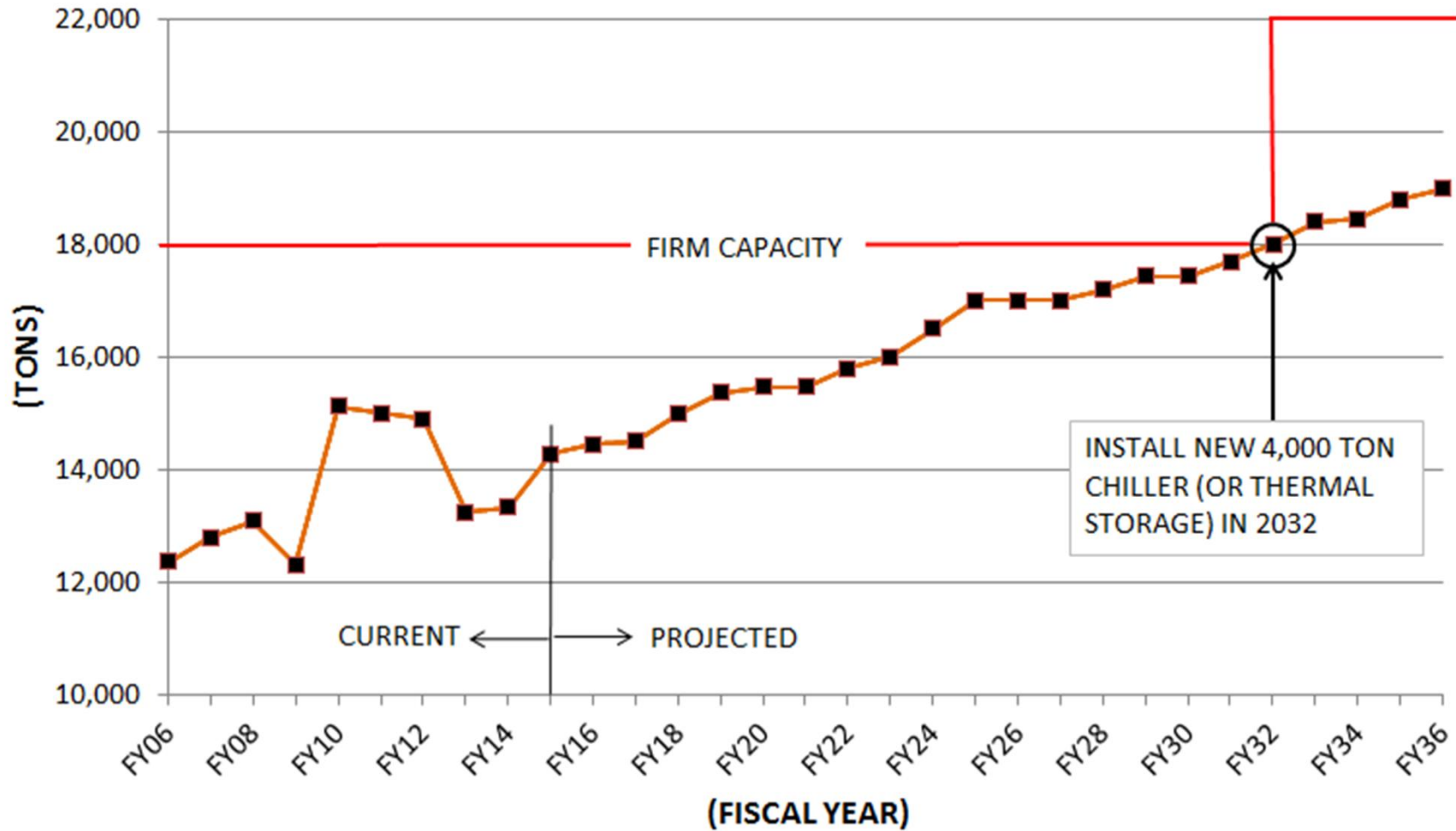
KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME	KEYED NUMBER	BLDG ABBR.	FISCAL YEAR	BUILDING NAME
1	CP	FY16	CENTRAL PLANT	15	F019	FY22-26	MUSEUM
2	BUS	FY17	BUSINESS BUILDING	16	MUS	FY22-26	MUSIC SCHOOL
3	F008	FY17	CEAT LAB BUILDING	17	LIB	FY27-31	EDMON LOW LIBRARY
4	PAC	FY18	PERFORMING ARTS CENTER (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



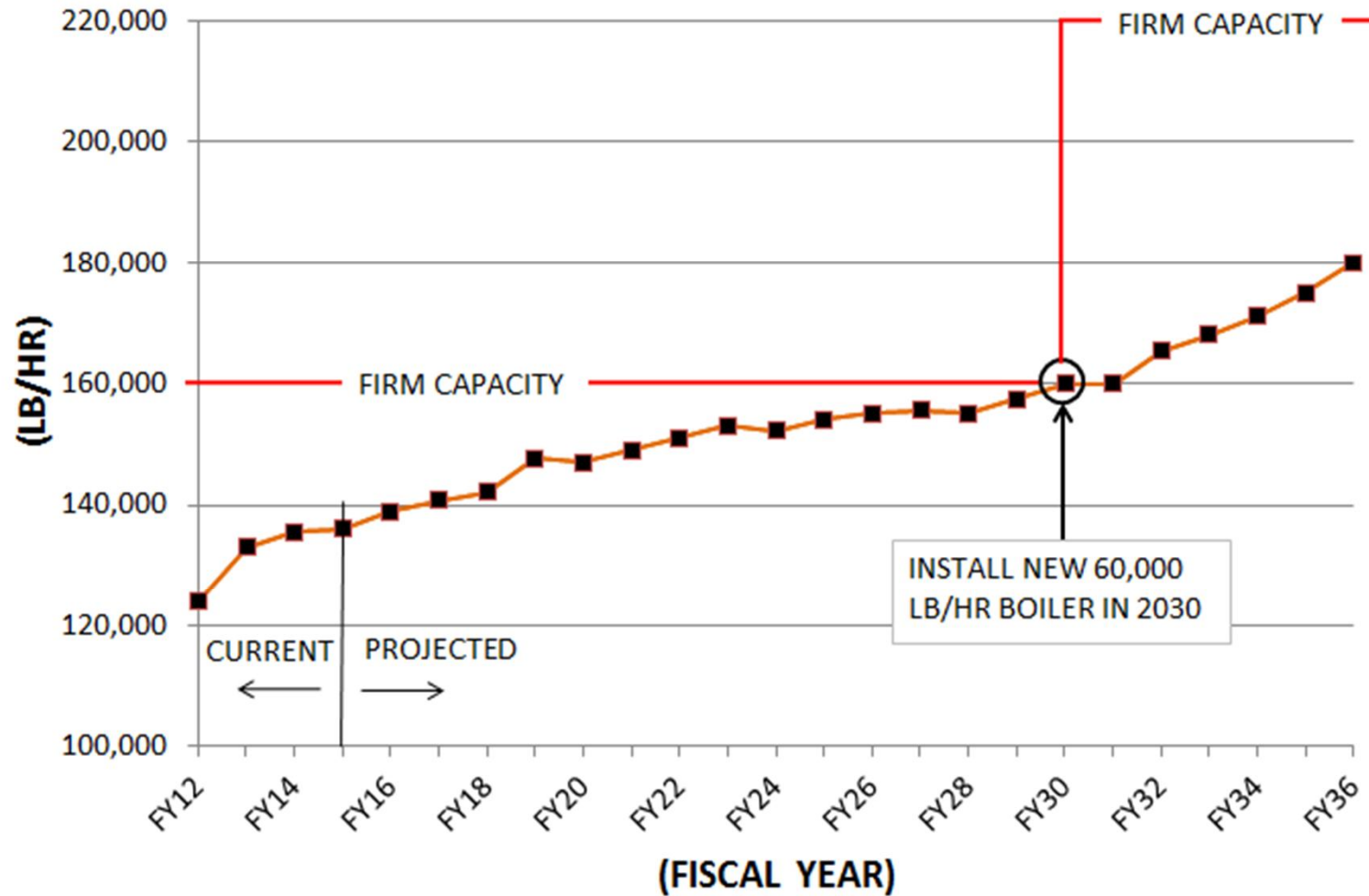
## COOLING LOAD GROWTH



# Utility Master Plan Analysis



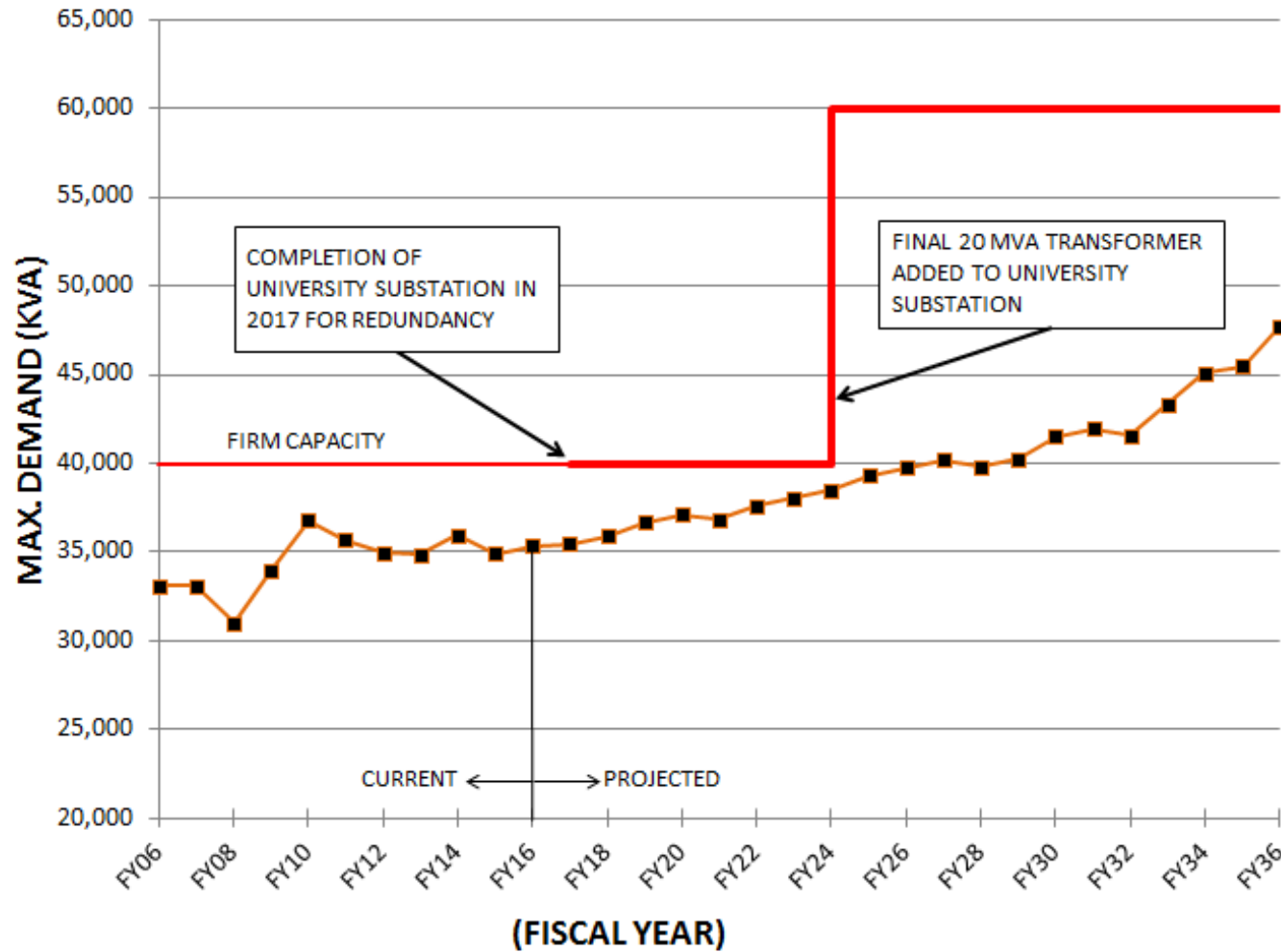
## HEATING LOAD GROWTH



# 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

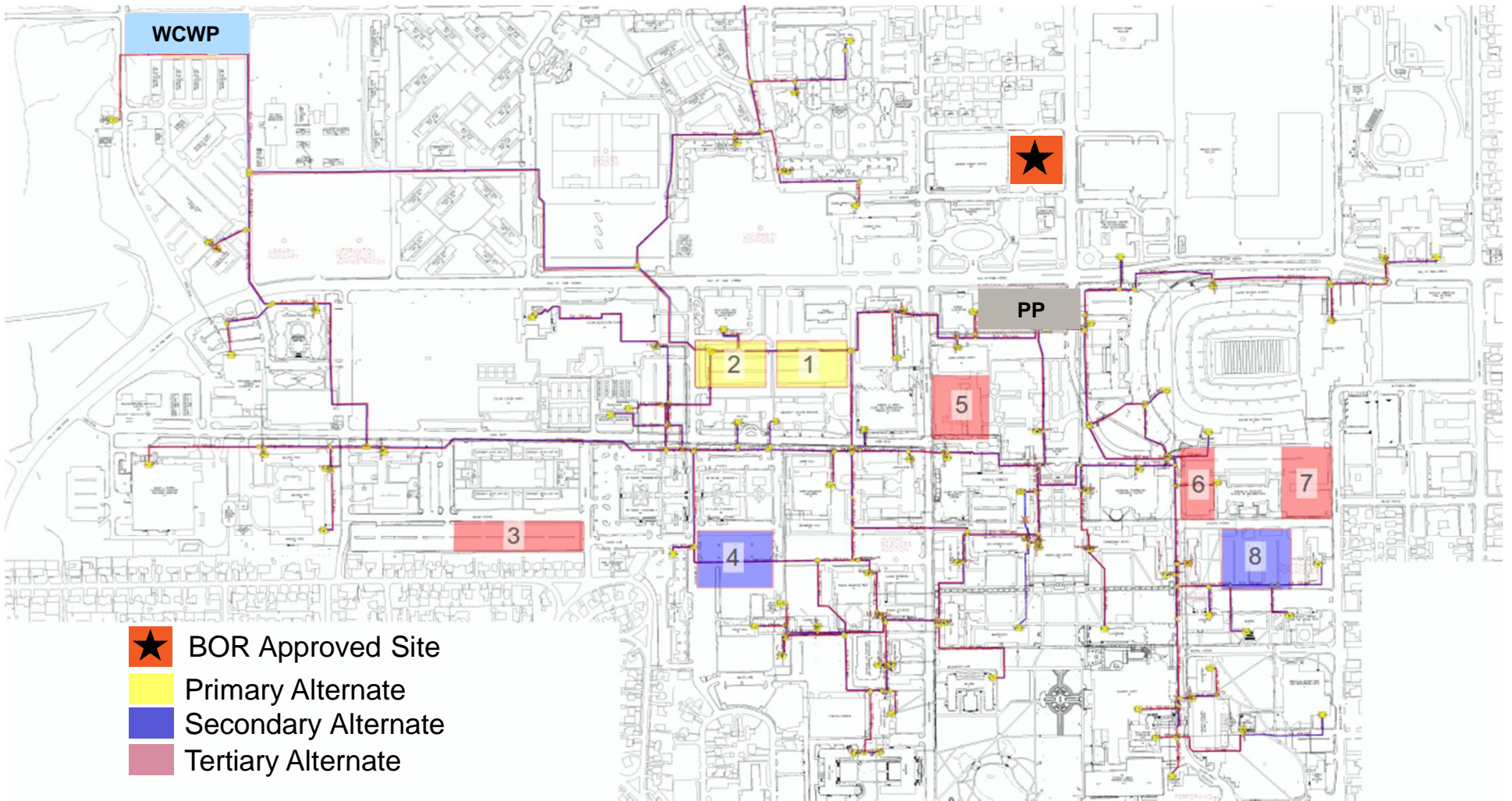
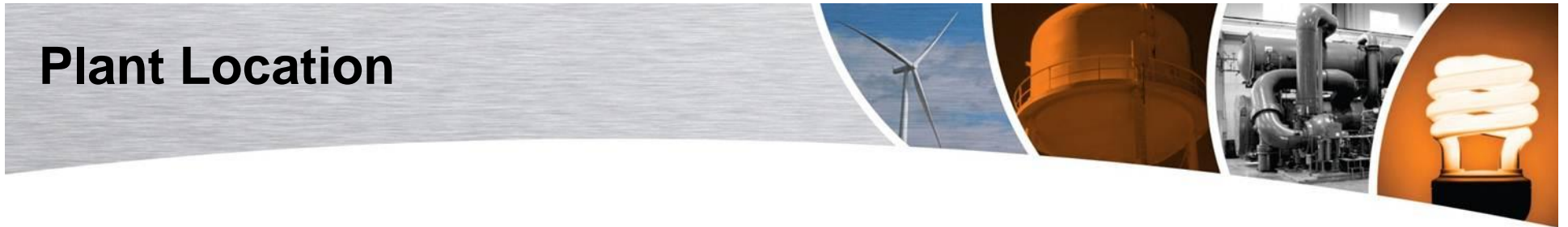
Most equipment has exceeded its life expectancy:

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



# Architecture



# Architecture



# Architecture



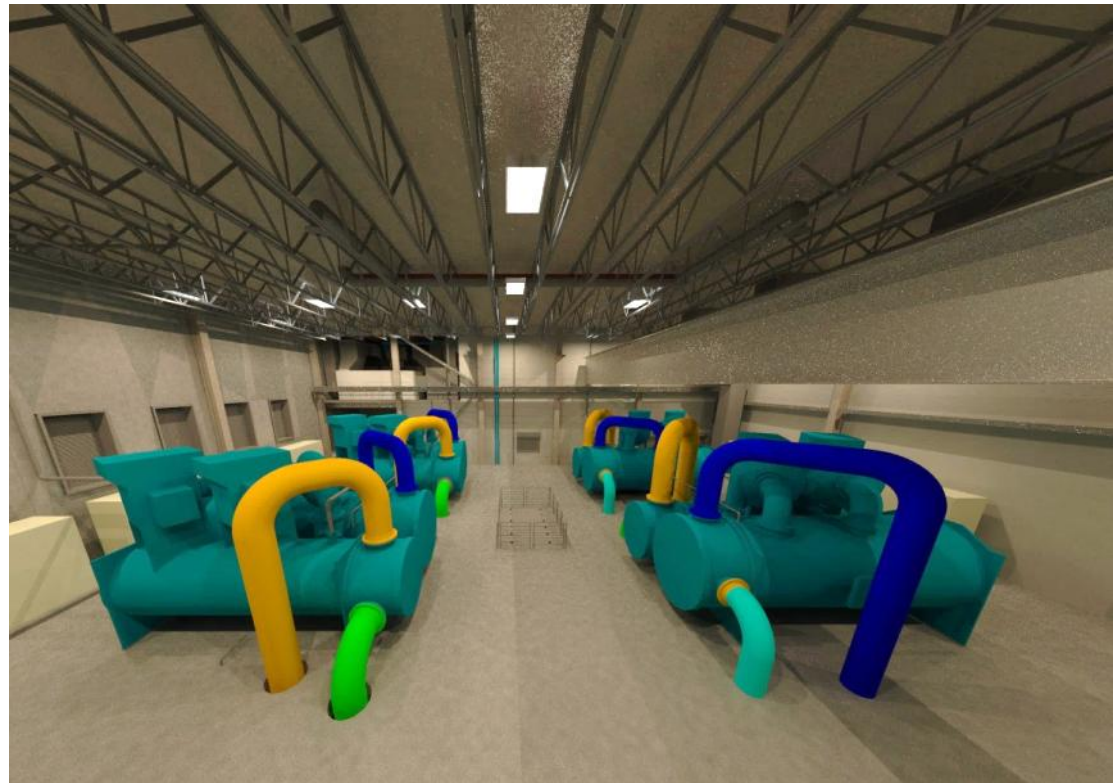
# Architecture



# 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

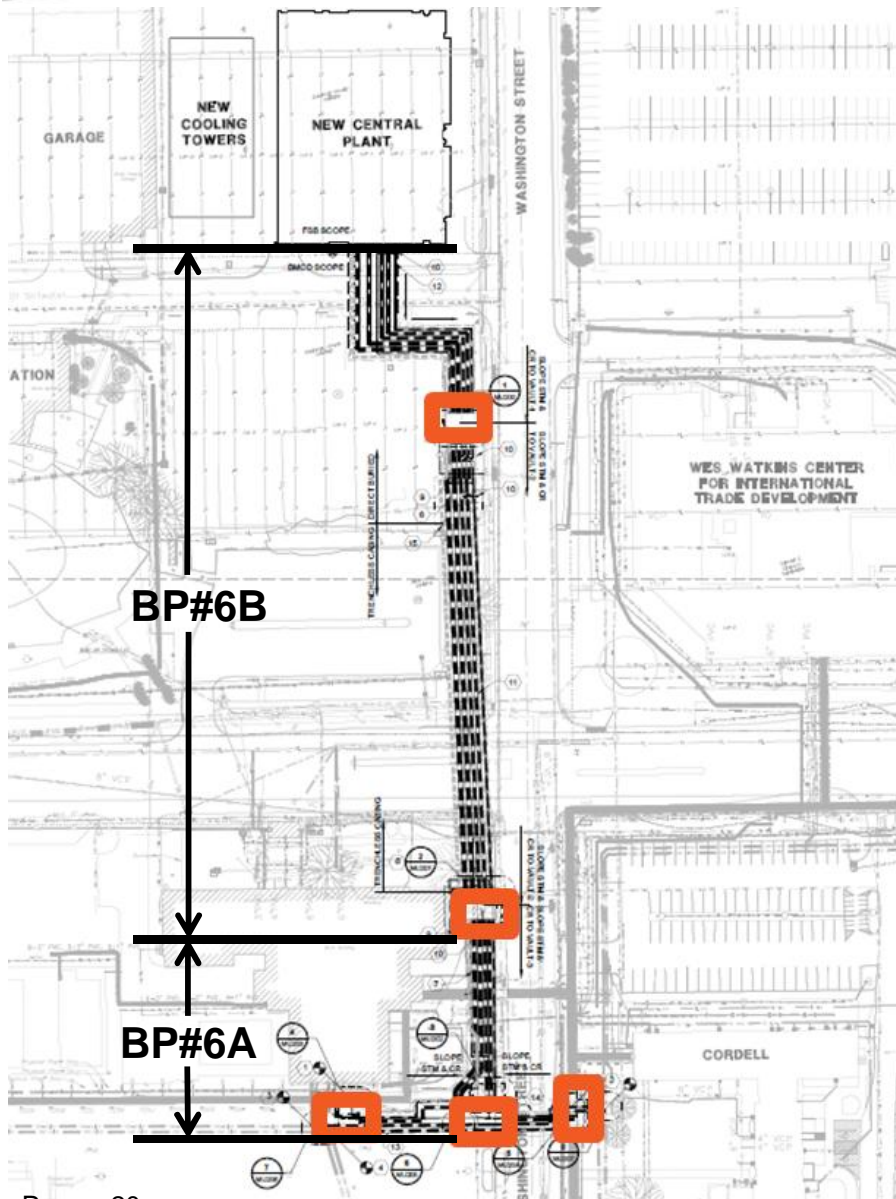


# Sustainability

- 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

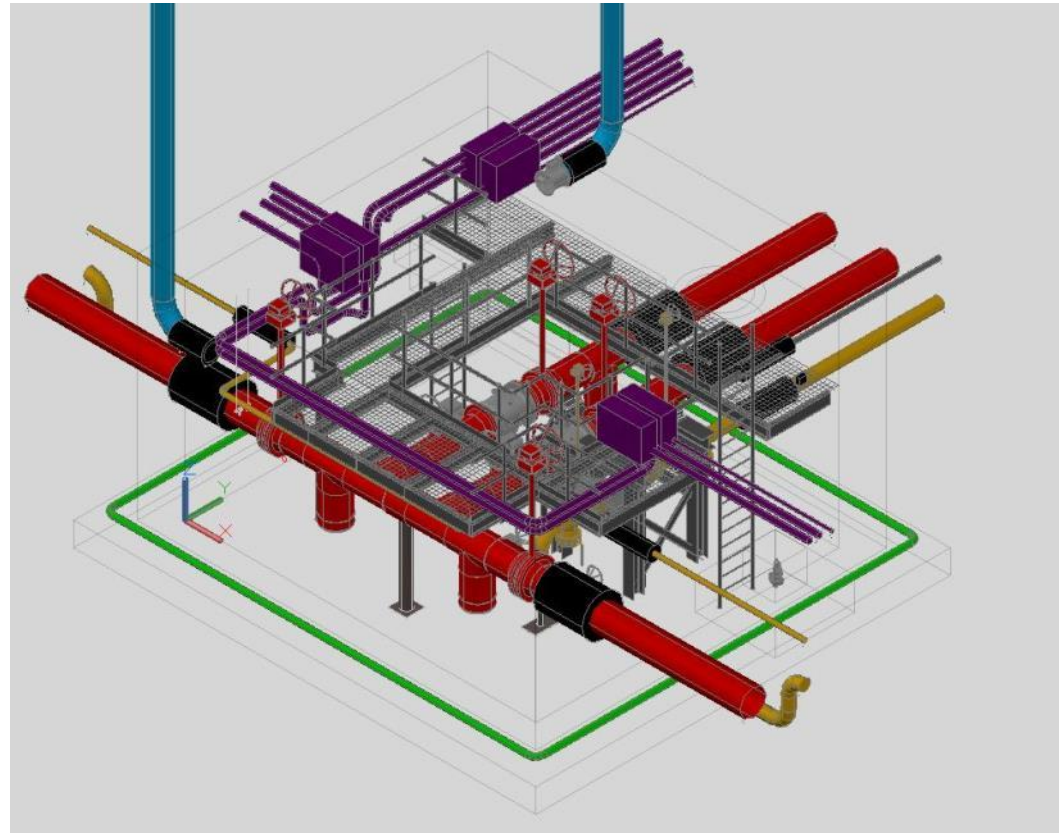


- Over 12,000 total LF of steam, condensate return, and chilled water
- Design considerations
  - Direct buried vs. walkable tunnel
  - Open cut vs. trenchless installation
- Pre-insulated Class A piping system
- Separate steam mains leaving plant
- Variety of complex construction methods required

# 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

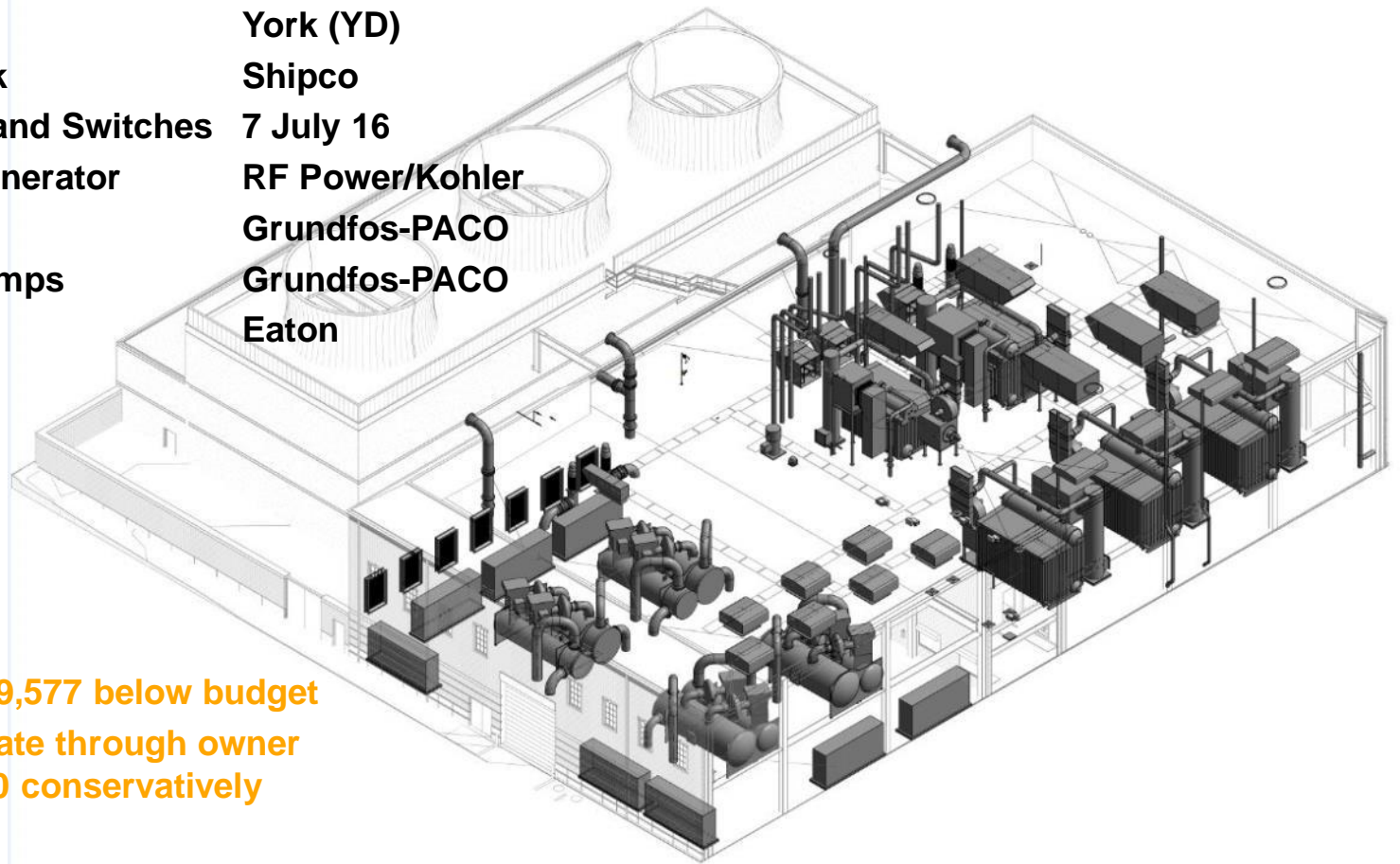
Owner Furnished, Contractor Installed: \$11,556,827 Total

## Equipment:

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

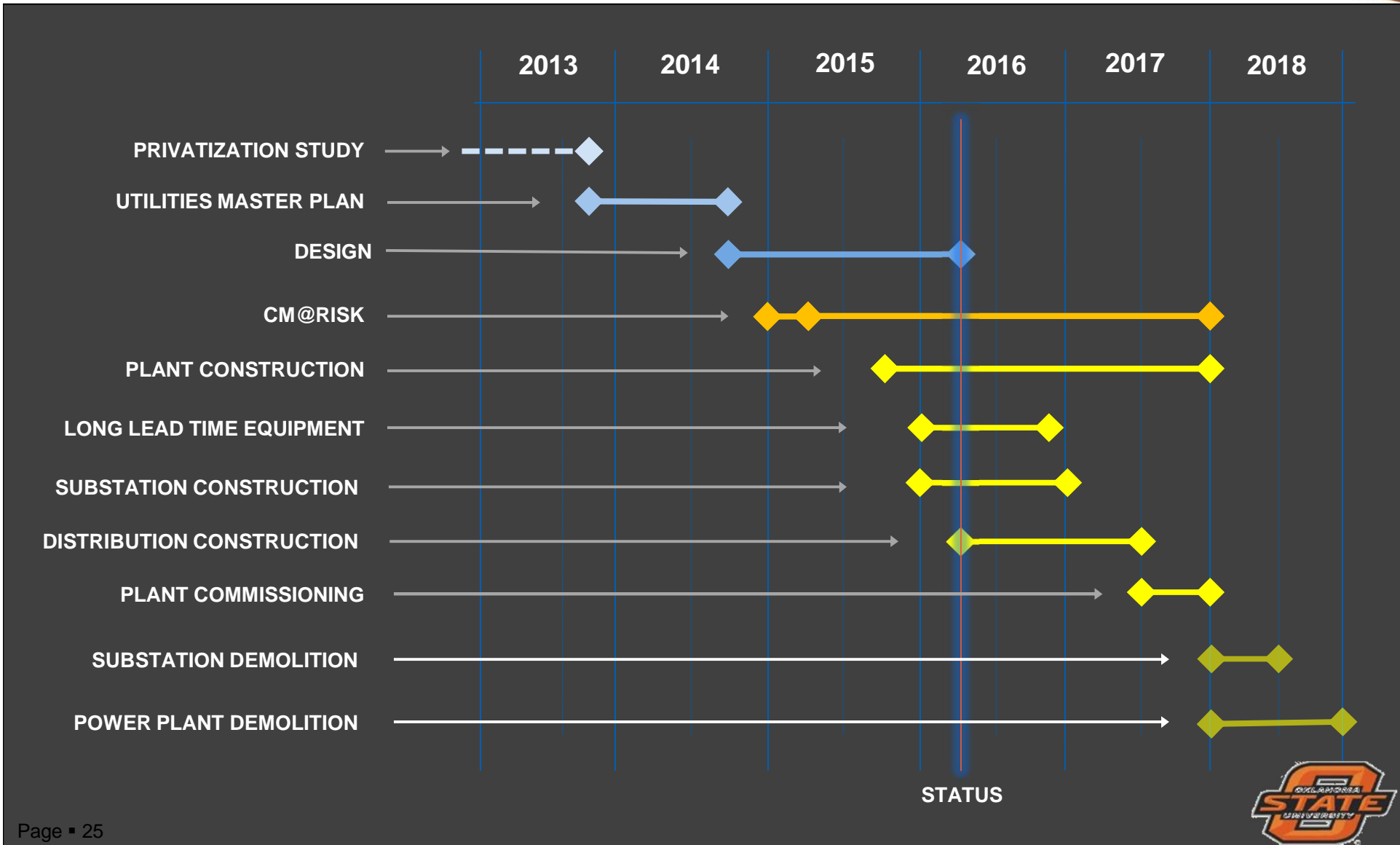
## Awarded to:

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>

