



# Oklahoma State University's New Central Plant From Master Plan to Completion

March 7, 2018



# Introductions

- **Phil Curley** ([pcurley@okstate.edu](mailto:pcurley@okstate.edu))
  - Project Manager, Oklahoma State University
- **Justin Grissom, PE, CEM, LEED AP** ([jgrissom@burnsmcd.com](mailto:jgrissom@burnsmcd.com))
  - Project Manager, Burns & McDonnell
- **Ron Warner** ([rwarner@flintco.com](mailto:rwarner@flintco.com))
  - Project Director, Flintco
- **Mike Hume** ([mike.hume@flintco.com](mailto:mike.hume@flintco.com))
  - Project Manager, Flintco
- **Vic Alford** ([valford@flintco.com](mailto:valford@flintco.com))
  - Director – Field Operations, Flintco
- **Brian Sauer, PE, LEED AP BD+C, CxA** ([bsauer@fsb-ae.com](mailto:bsauer@fsb-ae.com))
  - Principal, FSB



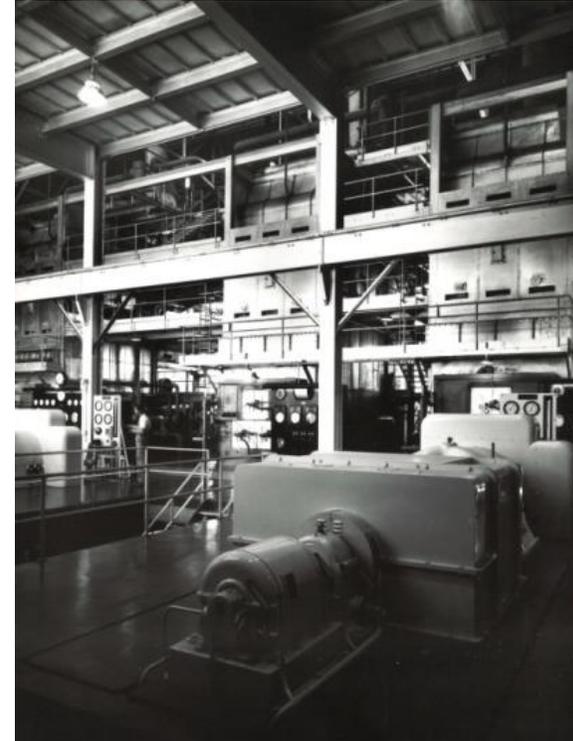
# Overview

- Why a new Central Plant?
- Program Summary
- Design Review
- Commissioning
- Pre Construction Services
- Utility Distribution Construction
- Central Plant Construction
- Successes and Challenges
- Next Steps
- Q&A



# Why a new plant?

- **Central Plant Replacement Necessities**
  - Wind power agreement
  - Utility production capacity
  - Power plant condition
  - Power plant location
- **Central Plant Replacement Opportunities**
  - Tie to education
  - Energy Efficiency
  - Consolidation of Energy Services



# Program Summary

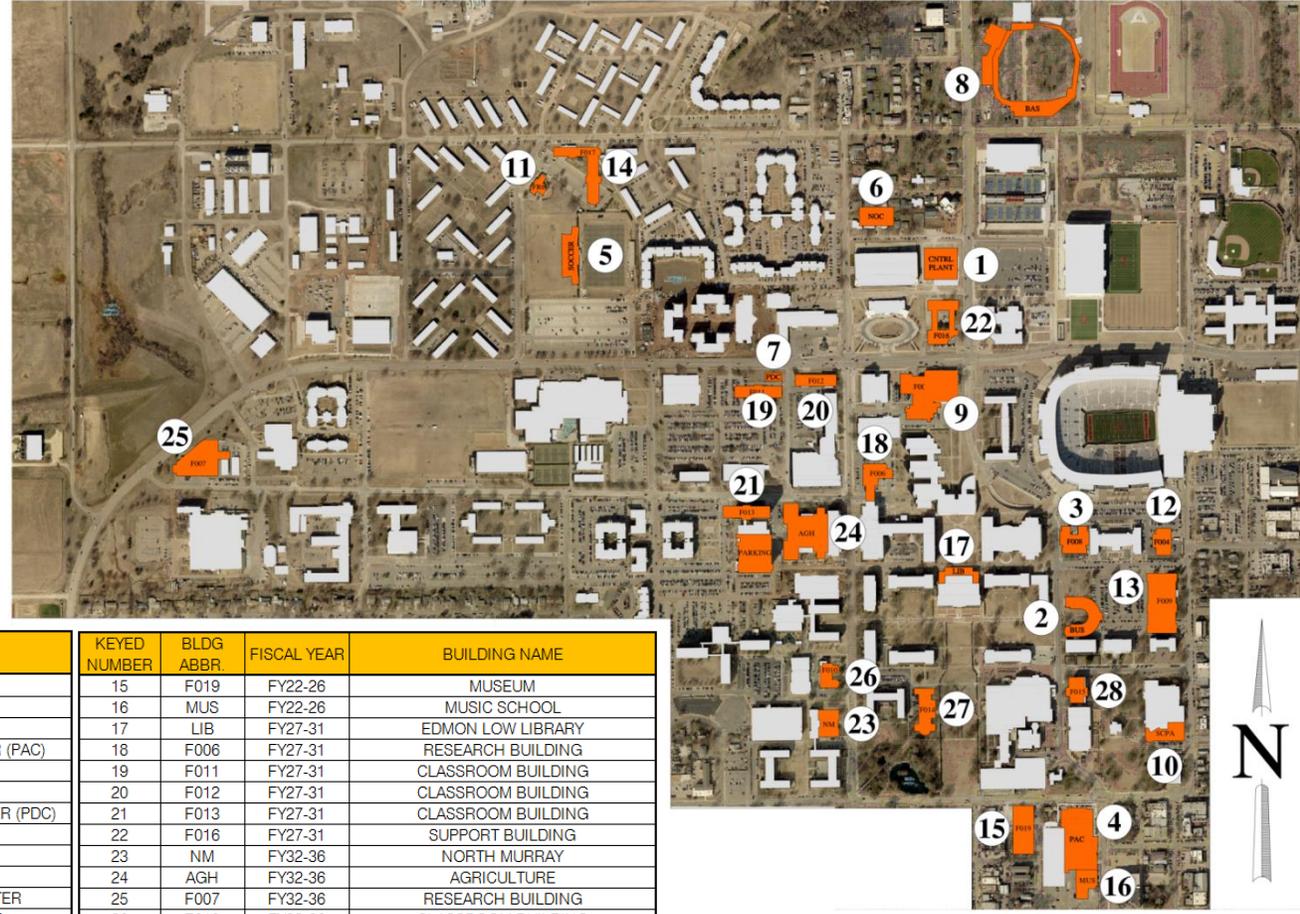


## Utility Master Plan

- 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

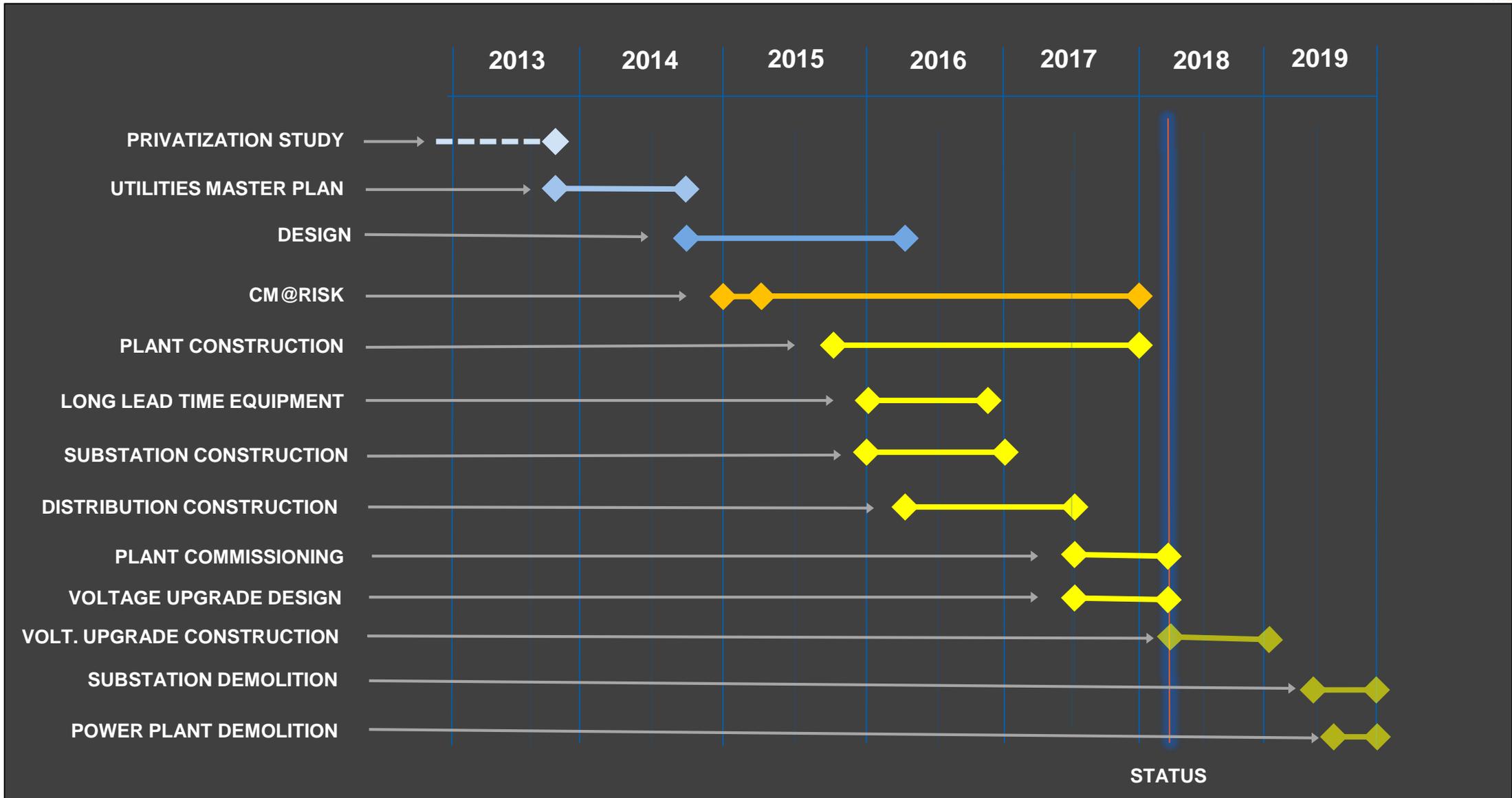
## Electrical Distribution

- New substation
- Voltage upgrade
- Power distribution center

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



# Program Schedule



# Central Plant Design Summary

## ■ Cooling

- 12,000 tons expandable to 16,000 tons
- 3900 HP of pumps with VFDs
- 750 HP of cooling tower fans with VFDs

## ■ Heating

- 220,000 lbs/hr expandable to 280,000 lbs/hr
- Heating water loop to serve buildings near plant
- Stack gas economizers

## ■ Education

- 80 seat classroom
- Public observation room



# Electrical Distribution



NEW OG&E  
UNIVERSITY  
SUBSTATION

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

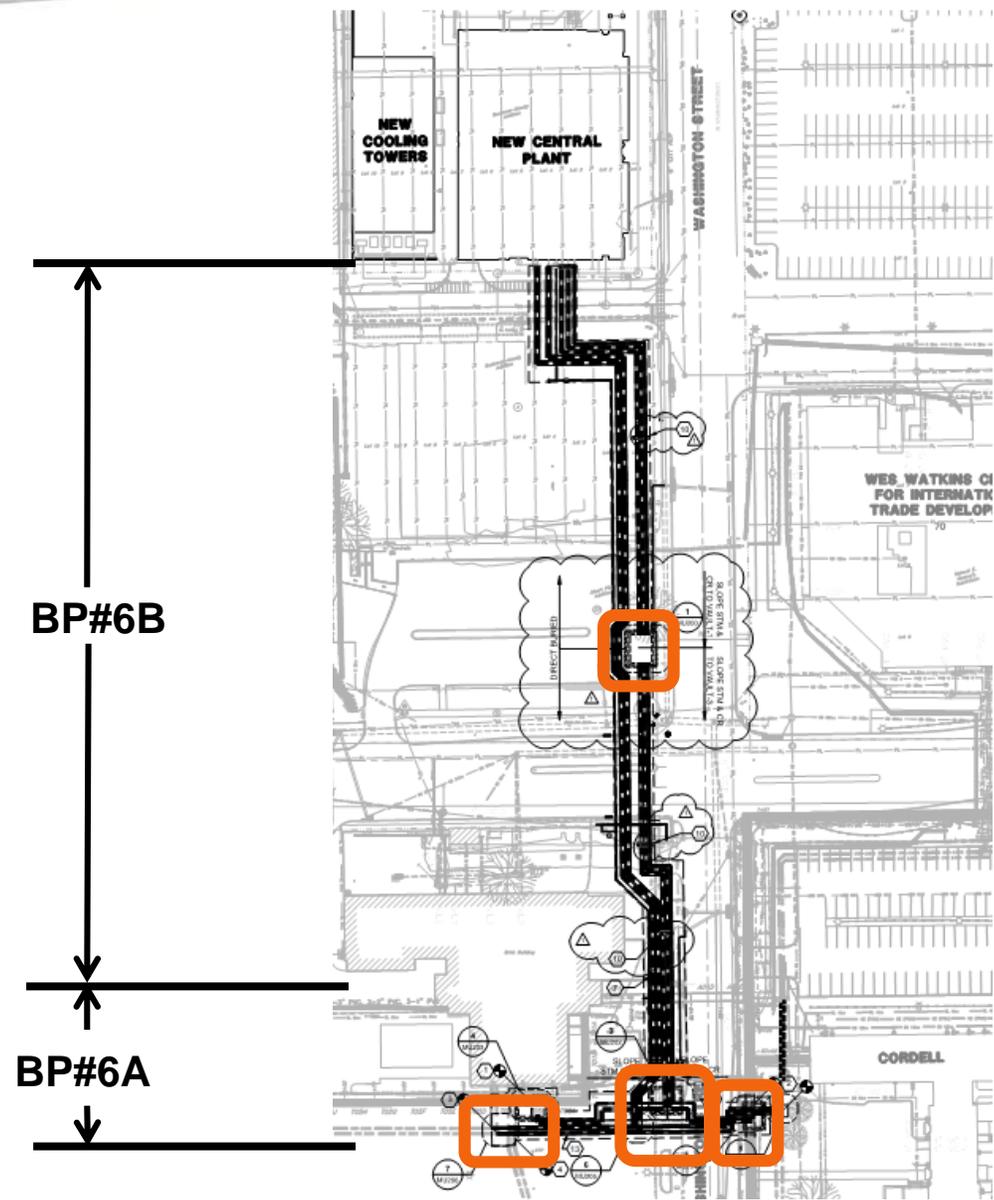
ELECTRICAL  
DISTRIBUTION  
UPGRADES

- 8027 LF DUCTBANK
- 21 VAULTS

NEW CENTRAL  
PLANT

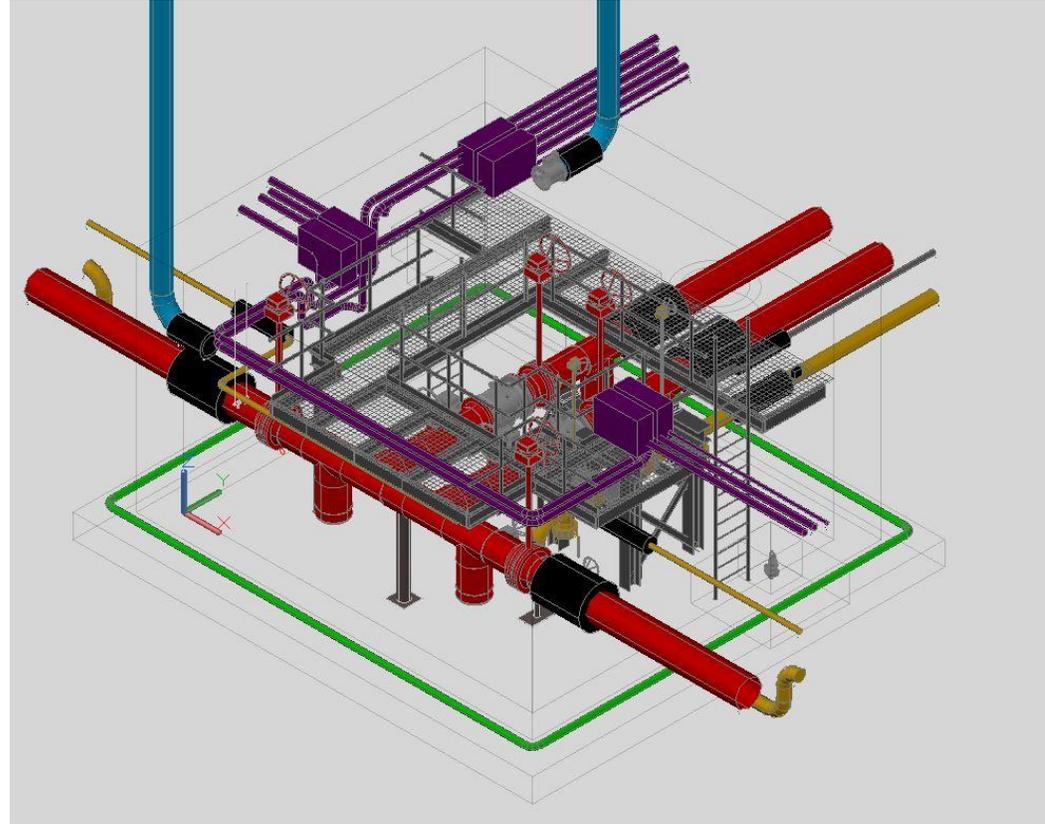


# Steam and Chilled Water Distribution



- 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

# Steam and Chilled Water Distribution



Four vaults for steam traps, valves, and expansion joints

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

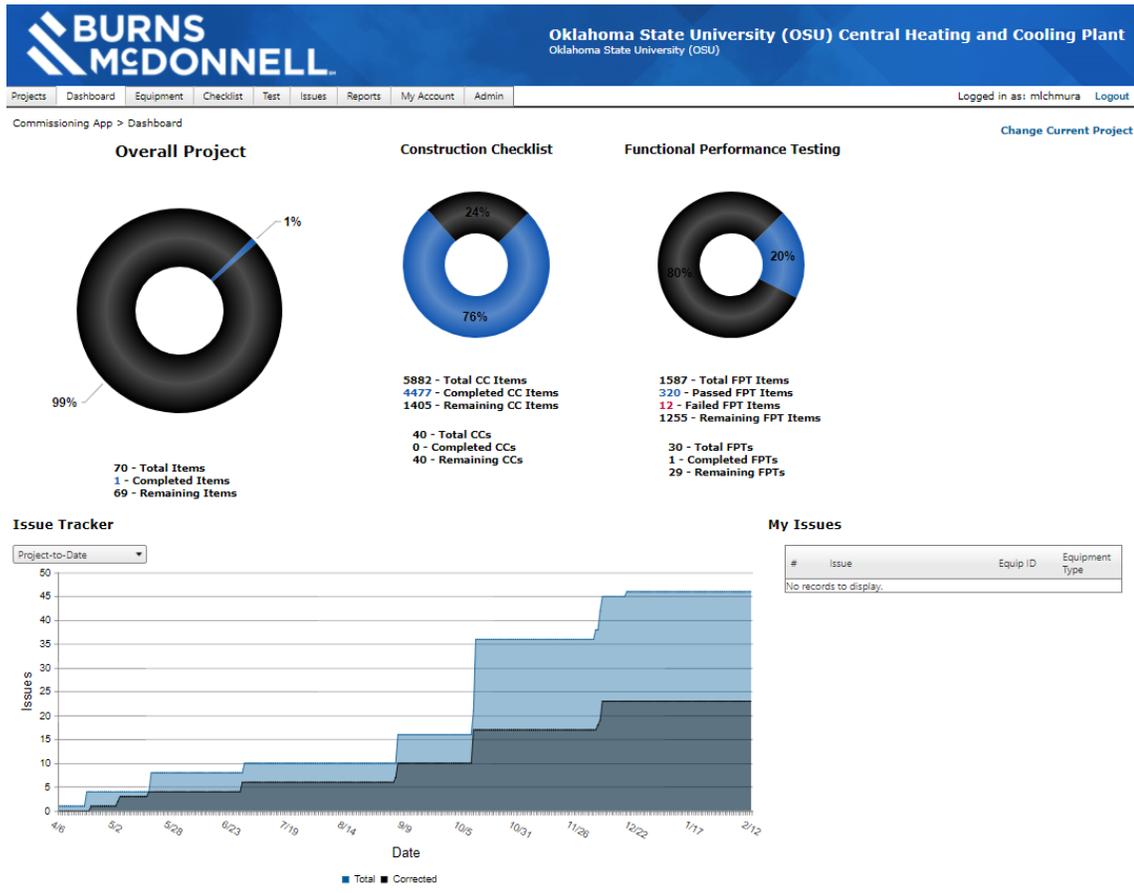
# Commissioning

## Pre-Functional Checklists

- PFCs for major mechanical and electrical equipment reviewed prior to startup
- Incomplete tasks were identified and corrected prior to scheduling startup activities

## Functional Tests

- Spurred great conversations on the controls sequences and resolved some issues early



## Regular site visits

- Adequate budget to perform regular site visits
- Visits coupled with weekly Cx and startup meetings helped keep the team on track, coordinated, and gave visibility to project issues.

## Involvement from the plant operations staff

- Plant ops spent a good deal of time onsite
- Witnessed portions of the functional testing
- Provide early look at plant operations
- Time for questions and input in the process

### Commissioning Site Observation Report



Entry #: 001  
Category: Witness Startup  
Equipment/Systems: CDPs

Photos:

Observations and notes from CDP (Secondary CHW distribution pumps):

- CDPs were filled and purged of air 6.28.17
- Coupling guards were installed 6.28.17
- BMcD witnessed startup of the CHPs (notes on next page)
- CHPs were previously aligned and bumped for rotation
- At approximately 4pm, isolation valves were open to the main distribution system to run the CDPs (BMcD did not witness)



Picture to the left: The CHW pipe stanchions with vibration isolation springs are not yet installed. A temporary pipe has been welded. This installation must be completed prior to running the pumps consistently

Pictured above: The motor shaft to driven pump shaft connection is pictured. The alignment was completed to within .005" accuracy for each angle/offset. The manufacturer's representative performed the alignment. OSU Utilities took their own baseline alignment and was present during the initial run of the pumps

# Pre-Construction Services

- Budgets for each phase
- Bid Package breakdown for best value
- Allowances
- Fast track – get started building while design finishes

DESCRIPTION	Total Project Base Bid	NOC Utility Extension	Bid Package #4	Bid Package #5C	Bid Package #5	Bid Package #6A and Basement	Bid Package #3	Bid Package #2
Division 2 - Existing Conditions	220,000	0	0	0	0	0	220,000	0
Division 3 - Concrete	6,843,000	0	100,000	0	0	529,170	3,376,440	2,738,000
Division 4 - Masonry	1,537,000	0	0	0	0	0	1,537,000	0
Division 5 - Metals	2,481,000	0	0	0	0	0	2,481,000	2,034,000
Division 6 - Wood & Plastics	249,340	0	0	0	0	0	249,340	0
Division 7 - Painting & Moisture Protection	1,072,000	0	0	0	0	0	1,072,000	380,400
Division 8 - Doors & Windows	49,800	0	0	0	0	0	49,800	0
Division 9 - Finishes	1,672,000	0	0	0	0	0	1,672,000	0
Division 10 - Specialties	116,270	0	0	0	0	0	116,270	0
Division 11 - Equipment	10,000	0	0	0	0	0	10,000	0
Division 12 - Furnishings	40,000	0	0	0	0	0	40,000	0
Division 13 - Special Construction	0	0	0	0	0	0	0	0
Division 14 - Electrical	249,500	0	0	0	0	0	249,500	256,400
Division 21 - Fire Suppression	349,500	0	0	0	0	0	349,500	0
Division 22 & 23 - Mechanical	14,318,000	0	3,895,210	292,720	0	0	9,320,450	259,440
Division 26 - Electrical	7,818,820	0	589,250	0	4,840,370	10,600	2,285,200	1,433,500
Division 27 - Communications	49,800	0	0	0	0	0	49,800	0
Division 28 - Electronic Safety & Security	107,410	0	0	0	0	0	107,410	0
Division 31 - Earthwork	3,025,000	0	3,100,200	0	0	2,018,000	200,000	42,000
Division 32 - Exterior Improvements	120,000	0	0	0	0	0	120,000	0
Division 33 - Utilities	1,172,510	970,510	203,000	0	0	3,450,000	0	0
Division 41 - Material Handling Equipment	277,750	0	0	27,760	0	0	250,000	0
Site Requirements	11,145,000	23,000	0	0	0	0	0	0
<b>Subtotal</b>	<b>59,396,971</b>	<b>995,510</b>	<b>8,300,660</b>	<b>320,500</b>	<b>4,840,370</b>	<b>6,007,470</b>	<b>22,441,365</b>	<b>5,777,453</b>
Contractor's Contingency	1,000,000	0	0	0	0	0	1,000,000	0
Owner/Architect's Contingency	800,170	49,770	419,430	14,310	0	0	710,100	119,540
Performance & Payment Bond	200,000	0	0	0	0	0	200,000	0
Subcontractor Default Insurance	28,000	0	0	0	0	0	28,000	0
Builders Risk	162,000	0	0	0	0	0	162,000	0
General Liability	200,000	0	0	0	0	0	200,000	0
<b>Direct Construction Cost</b>	<b>\$60,033,538</b>	<b>\$1,108,557</b>	<b>\$9,159,863</b>	<b>\$344,867</b>	<b>\$5,135,746</b>	<b>\$5,755,720</b>	<b>\$24,553,720</b>	<b>\$6,123,740</b>
Professional Services								
General Conditions	3,998,154	178,336	-	-	-	-	293,986	-
Utility GC Reduction	(178,000)	(178,000)	-	-	-	-	-	-
Fee	4,202,210	80,943	640,910	23,804	369,502	402,005	1,739,339	428,662
Professional Services Total	\$8,022,464	\$80,279	\$640,910	\$23,804	\$369,502	\$402,005	\$1,739,339	\$428,662
MEP Allowance	1,000,000	0	0	0	100,000	0	1,000,000	0
BP #6 Allowance	1,000,000	0	0	0	0	0	0	0
<b>Project Subtotal</b>	<b>\$69,156,003</b>	<b>\$1,192,928</b>	<b>\$9,799,774</b>	<b>\$368,671</b>	<b>\$5,595,248</b>	<b>\$6,158,664</b>	<b>\$27,587,045</b>	<b>\$6,552,402</b>

**OSU Central Plant**

**BID PACKAGE 26C: ELECTRICAL DUCTBANK**

Specification Section	Description
DIVISION 0	Procurement and Contracting Requirements
DIVISION 1	General Requirements
261013	Medium Voltage Cable, complete
262540	Underground Ducts and Raceways for Electrical Systems, complete
311000	Site Clearing, pertinent portions thereof applicable to the work of this bid package
312000	Earth Moving, pertinent portions thereof applicable to the work of this bid package

(In addition to the Specification Sections listed, Bidders will include but not be limited to specific or any other items that may be associated with this trade whether indicated or not.)

**Definition of Terms**  
 Contractor = Bidder  
 Construction Manager = Fintec, LLC  
 Owner = Oklahoma State University  
 Architect = FSB Architects

The scope of work of this bid package shall also include the following items, but without limiting the scope of work as provided above:

- Coordinate location of existing and proposed ductbanks in relation to existing and proposed structures.
- Coordinate to install an excavation permit per the OSU Facilities Management Emergency Services Excavation Permit Procedure Handbook prior to beginning any excavation work and before any other work.
- Provide and install all underground electrical ductbanks as shown on the Construction Documents, including coordination of concrete, trenching, bedding, gravel, and backfill, electrical conduit, concrete cover, and ductbank bedding, including all trench, excavation, and backfill as well as access to all required trench and bedding in accordance with the Construction Documents and State Requirements.
- Provide and install all medium voltage cables as shown on the Construction Documents, including cables, cable splices, terminations and accessories as required.
- Perform all excavation, trenching, and bedding and final grading as required. Backfilling will be done in accordance with the Construction Documents and the OSU Facilities Management Emergency Services Excavation Permit Procedure Handbook.
- This contractor is responsible for all items to complete this bid package not in contract documents ES 0100 through ES 0105 (per the Construction Documents) including, but not limited to, cut-and-pipe removal, asphalt and concrete paving removal, surface grading, trenching, sidewalk removal, concrete slabs and pads, stone, stone, aggregate, curbs, bollards, light poles and bases, conduits, poles, concrete utility, concrete walls and foundations, interior walls, concrete, casting bumpers, guardrails, rebar, utility, site, or other items, including utility, curbs, bollards, light poles, and foundation, and all other items as shown on the Construction Documents.
- Before any work is started in a construction site, the contractor is to submit a site plan to the Construction Manager for review and approval before starting work.
- Final and final inspection and testing shall be completed and approved by the Construction Manager before the Construction Manager concrete contractor, steel erector and electrical contractor before the foundation is poured. The Construction Manager personnel will notify the contractor of all items, including rebar, etc., and the Construction Manager's approval.
- After all necessary testing is complete, the contractor is to submit a site plan to the Construction Manager for review and approval before starting work.
- Upon completion of the Contractor's design and work, the Contractor shall be responsible for providing the site plan to the Construction Manager, including all drawings and specifications, and the Construction Manager shall be responsible for the review of the site plan.

Construction Manager's Bid Book  
 OSU Central Plant  
 004700 26C 1  
 REVISED per CM #2



# Utility Distribution Construction – BP# 6



- Over 12,000 total LF of steam, condensate return, and chilled water
- Two Construction Phases
  - 6a
  - 6b
- Non-Closable Roads
- Campus Schedule Critical Completion Dates
- Washington Street Stadium Access
- Hall of Fame

# Utility Distribution BP#6a

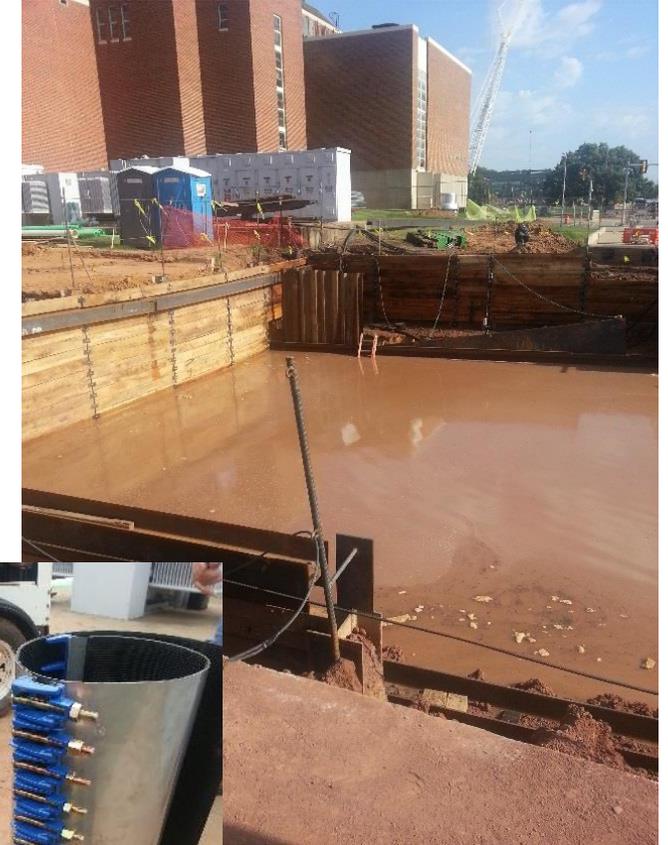


- Campus Schedule Critical
  - Football Gameday
- Innovative Construction Methods



# Utility Distribution BP#6a

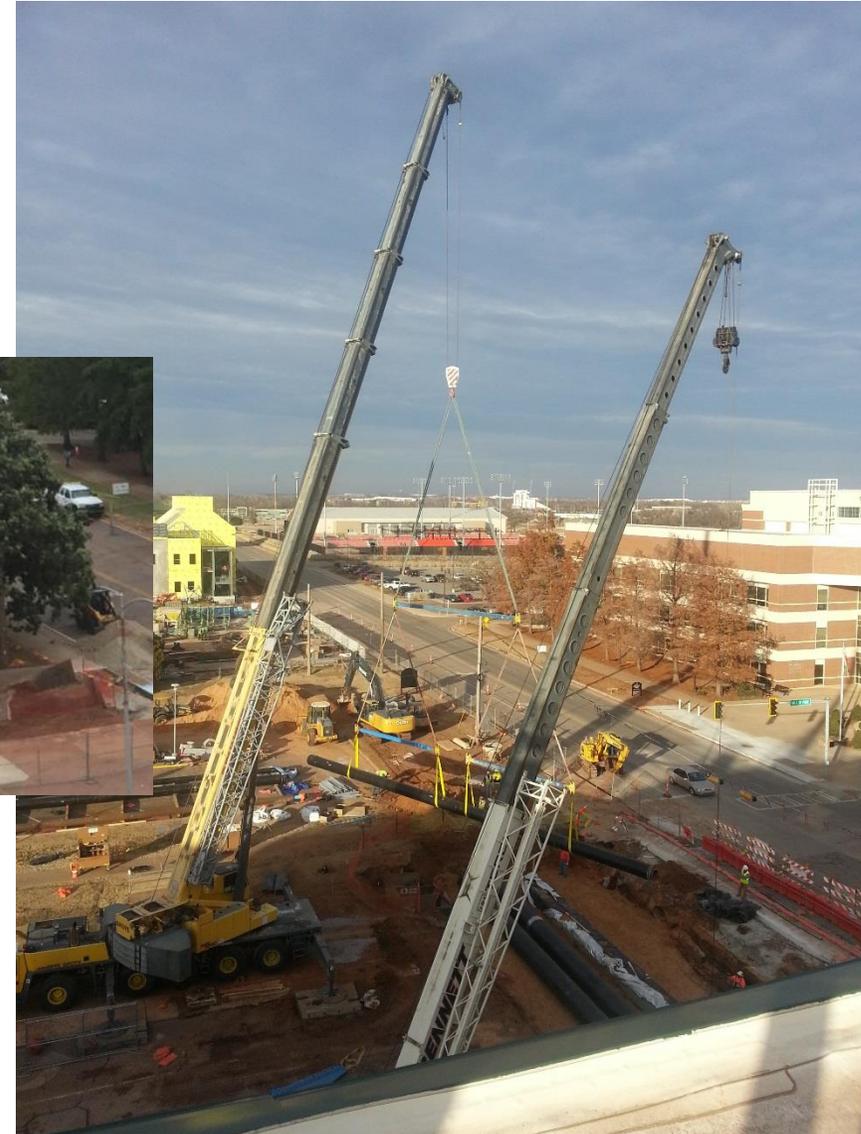
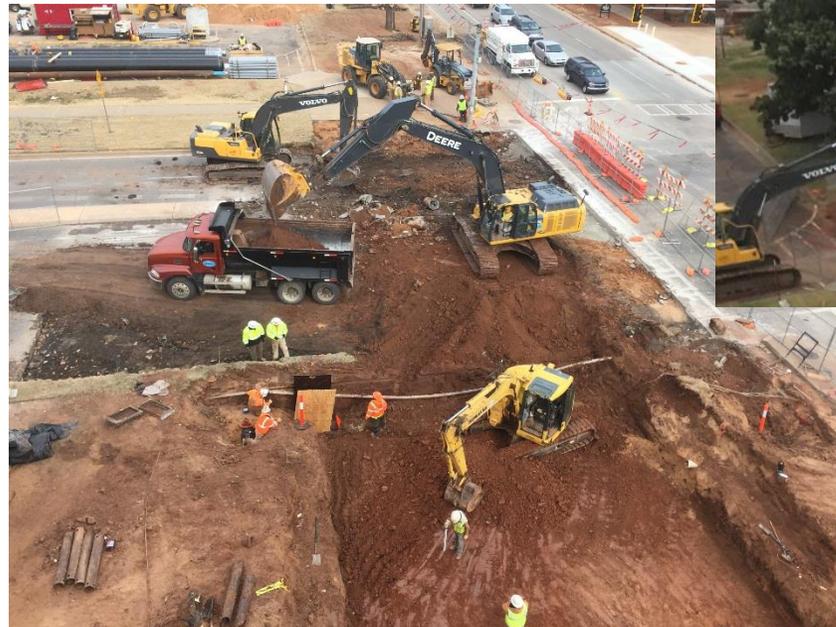
- Existing Utilities in Close Proximity
  - ATT duct bank
  - Campus Chilled Water





## You Can't Close Hall of Fame!

- Considerations
  - Direct buried vs. walkable tunnel
  - Open cut vs. trenchless installation
  - There is a **TREE** there



# Electrical Distribution – BP#5

- Understanding Existing Utilities
  - Hydro-Excavation
- Communication
  - Campus updates
  - Direct Communication with Major Stakeholders
- Western and Hall of Fame Intersection
  - 48" RCP
  - Coordination with Paving Contractor



# OSU Central Plant– BP#1



- Excavation
  - 75,500 cu yds
- Shoring
- Dewatering



# OSU Central Plant– BP#2

- Concrete
- Structural Steel
  - 40 Ton Bridge Crane



# OSU Central Plant– BP#3 & 4



- Cooling Tower Structure
- MEP
- Architectural
- Underground Utilities



# OSU Central Plant– BP#3 & 4



## Mechanical, Electrical, Plumbing



# OSU Central Plant– BP#3 & 4



## Architectural



# Successes and Challenges

## Successes

- Aggressive timeline
  - Master plan start to plant completion in less than 5 years
- Tie to educational mission of University
- Involvement of plant operators in design, construction, and Cx
- Team approach of University, CMAR, A&Es, and CxA
- BIM coordination
- 50-year vision
- Integration into campus Architecture



# Successes and Challenges

## Challenges

- Timing of OFCI equipment purchases
- Closing non-closable streets
- Transition of steam service from existing plant to new plant
- What to do with 70,000 gallons of fuel oil

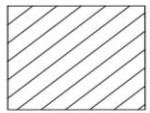


# Next Steps

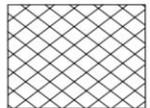
## Next Steps

- Completion of Heating Water Loop Phase I
- Completion of Voltage Upgrade and Power Distribution Center
- Steam & Chilled Water Distribution Upgrades
- SCADA System

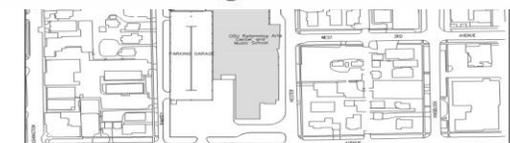
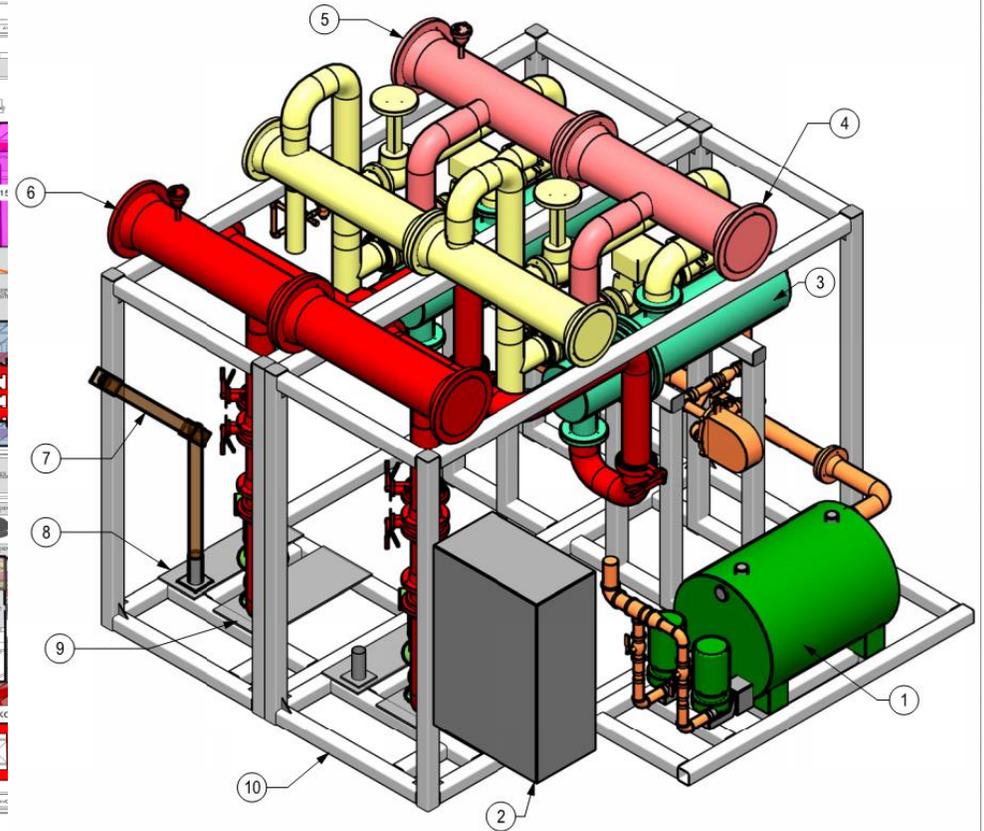
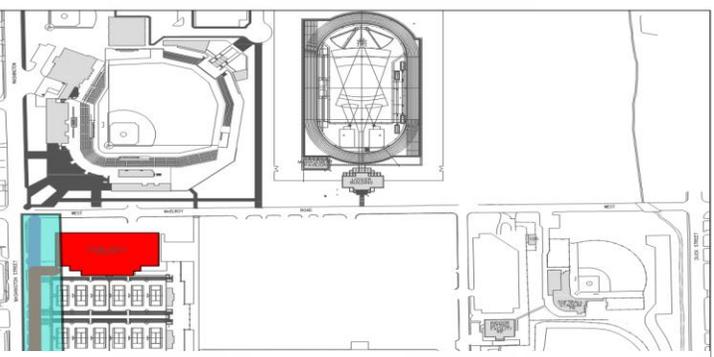
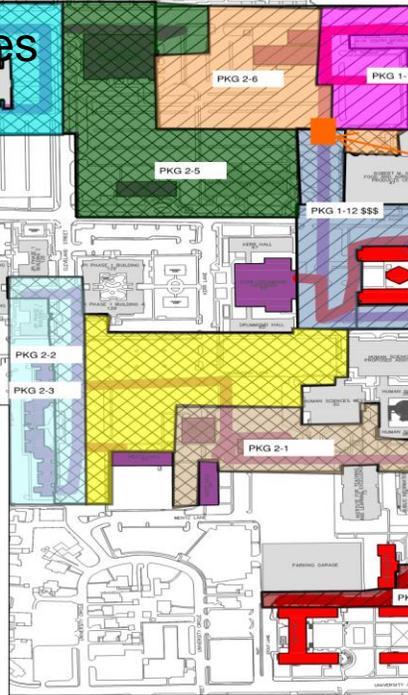
## Low Voltage Upgrades:



Phase 1



Phase 2



# Q&A Period

