CAMPUS MASTER PLANNING

FROM DESIGN TO IMPLEMENTATION

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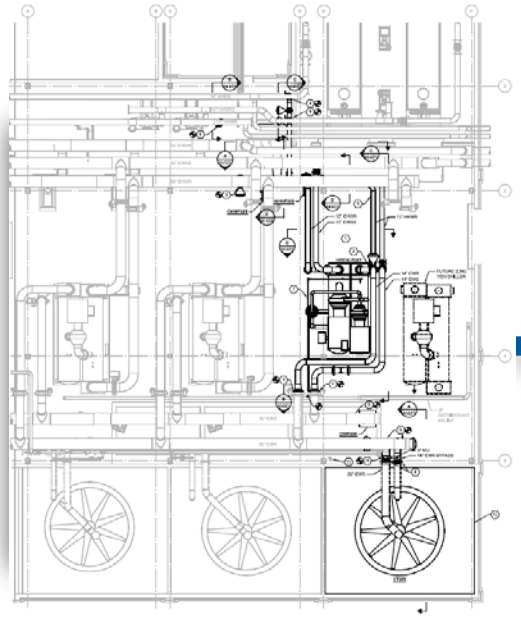
Burns & McDonnell SINCE 1898

TEXAS A&M UNIVERSITY UTILITIES & ENERGY SERVICES

Association of Texas College & University Facilities Professionals 2014 Conference

Campus Master Planning

From Design to Implementation



David Payne, Texas A&M University

Associate Director for Utilities & Energy Services

Justin Grissom, PE

Project Manager

BMcD *On*Site Energy & Power

Campus Master Planning

From Design to Implementation

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Agenda

- Texas A&M Overview
- Initiating the Plan
- Utilities & Energy Master Plan Results
- Implementing the Plan/Case Studies
- Making Sure the Plan Works
- Key Takeaways

Campus Master Planning

Overview of Texas A&M University

- State's first public institution of higher education, was opened on Oct. 4, 1876 as the Agricultural and Mechanical College of Texas
- Total undergraduate/graduate enrollment is over 56,000
- Holds a rare federal land, sea, space grant university designation
- TAMU is a Tier 1 research university with total research expenditures exceeding $820 million
- Campus size is over 5,500 acres, more than 500 acres for the main campus in College Station, TX

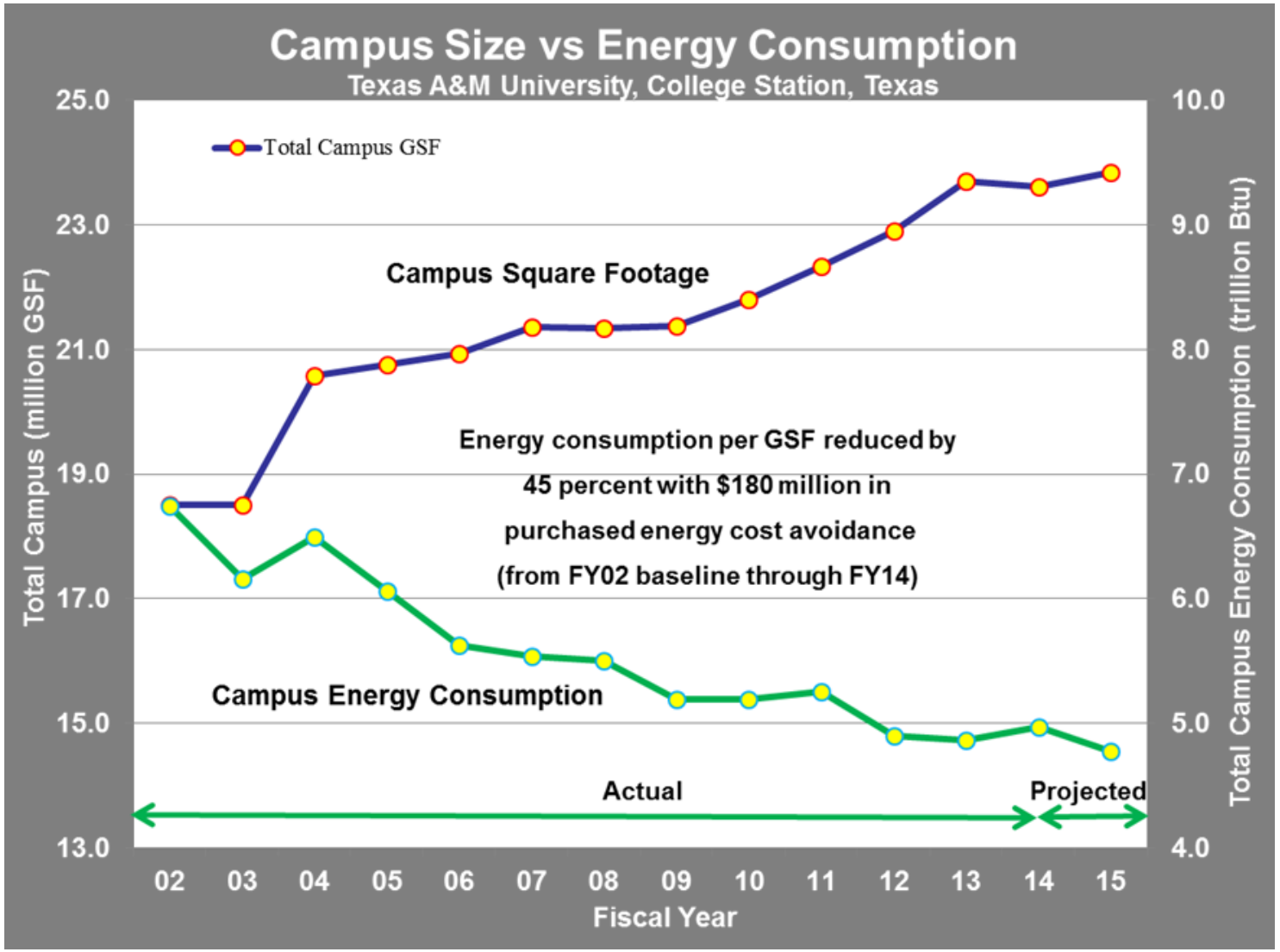
Overview of Utilities and Energy Services (UES)

- The university utility systems have operated with on-site power generation since 1893
- Extensive network of electrical distribution and central thermal energy production and distribution for cooling and heating to meet university requirements for over 800 buildings totaling over 24M GSF (19M conditioned)
- UES offers a highly reliable and cost-effective range of mission-critical services for over 60,000 customers consisting of students, faculty, staff, and visitors on campus

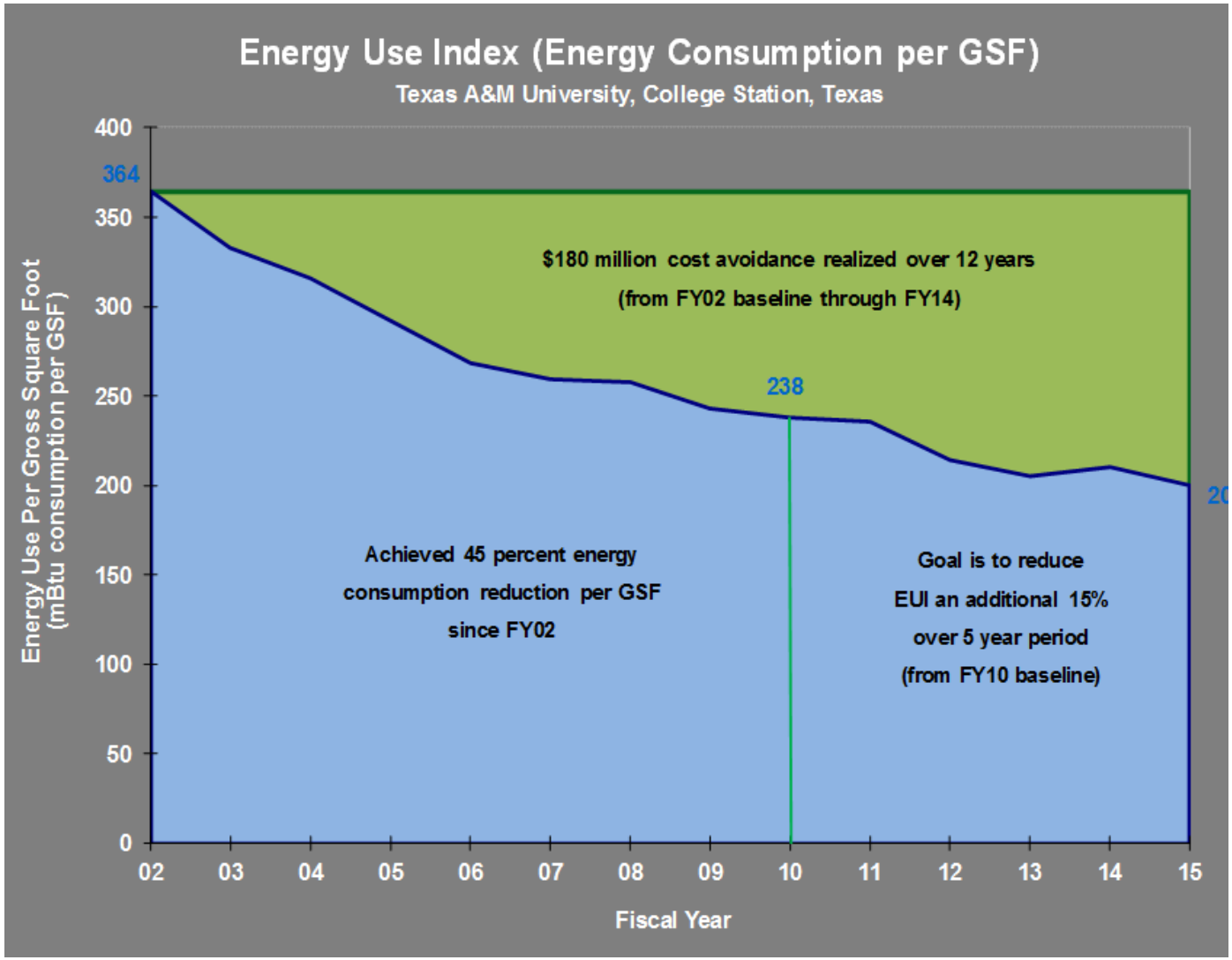
Texas A&M University Energy Services Continuum

PROCUREMENT	TRANSMISSION	PRODUCTION	DISTRIBUTION	METERING & BILLING	DEMAND-SIDE MANAGEMENT
Calculate and nominate campus energy requirements Specify annual and monthly consumption of electricity and natural gas Review and recommend payment of energy invoices Serve on TAMU energy risk management committee	<u>TAMU owns:</u> • Domestic water transmission system <u>Atmos owns:</u> • HP (600 psi) NG delivery system <u>ERCOT/BTU owns:</u> • 138kV electrical transmission system UES coordinates closely with Atmos and ERCOT/BTU	<u>Management of:</u> • Four campus utility plants • System Building utility plant • Solid Waste & Recycling • 2 wastewater treatment facilities <u>Production of:</u> • Electricity • Chilled water for cooling • Hot water for heating • Domestic cold & hot water • Steam	<u>TAMU owns campus delivery systems:</u> • 12.5kV electrical • Domestic water (hot & cold) • Chilled Water • Heating Hot Water • Steam • Sanitary Sewer • Storm Drainage <u>Atmos owns:</u> • LP & IP natural gas delivery system	Over 2,000 revenue-quality meters in over 500 buildings Manage utility rate model and rate setting Cost recovery for all utilities and energy – both operating budget and purchased energy Direct customer Invoicing through FAMIS Energy efficiency improvement services	First response to ensure customer comfort Building automation and HVAC regulation Energy stewardship & building system optimization Design review and capital project coordination Customer requests thru AggieWorks Center Key performance indicators and resource management

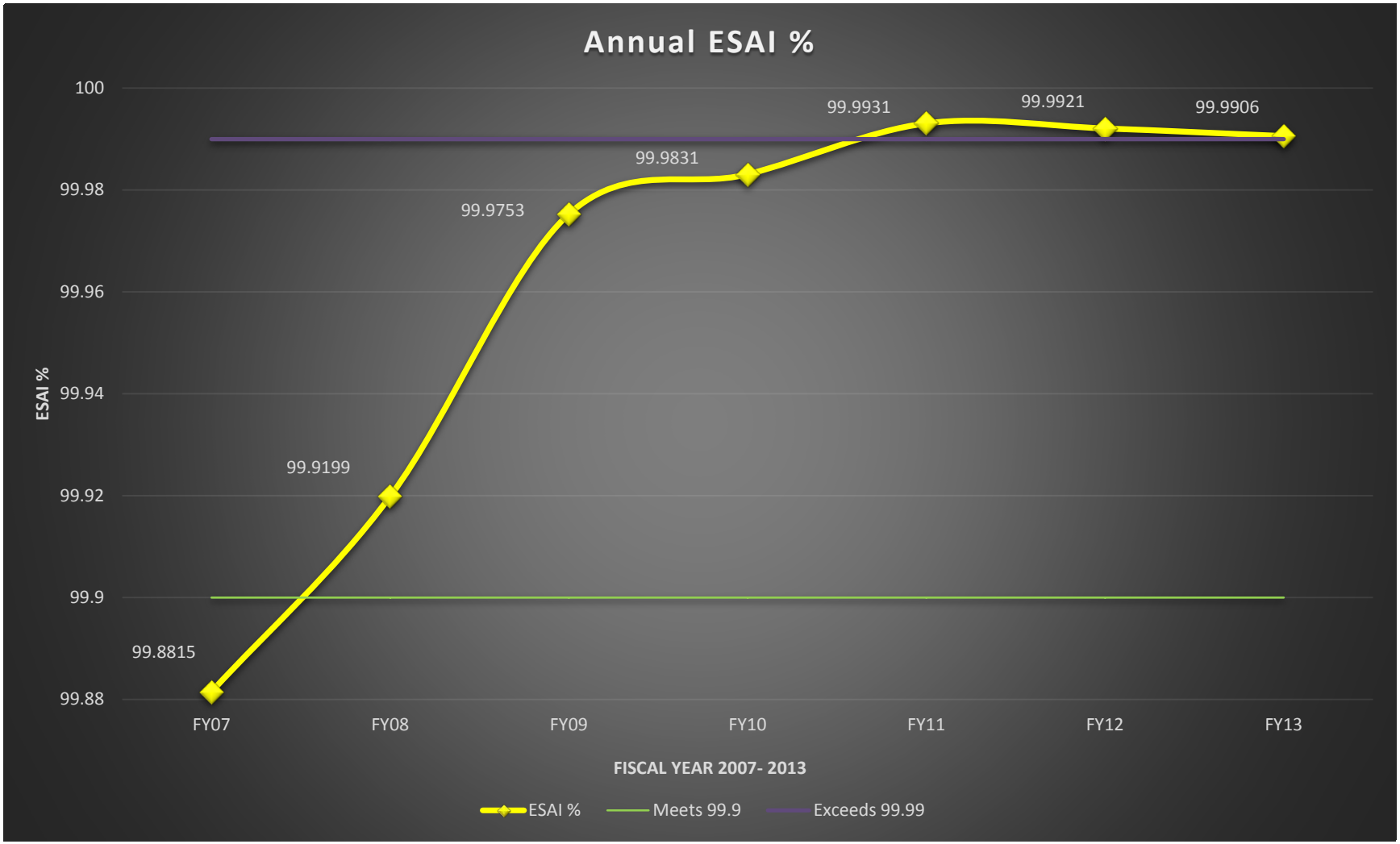
Texas A&M University Divergent Energy w/GSF



Texas A&M University Energy Use Index Chart



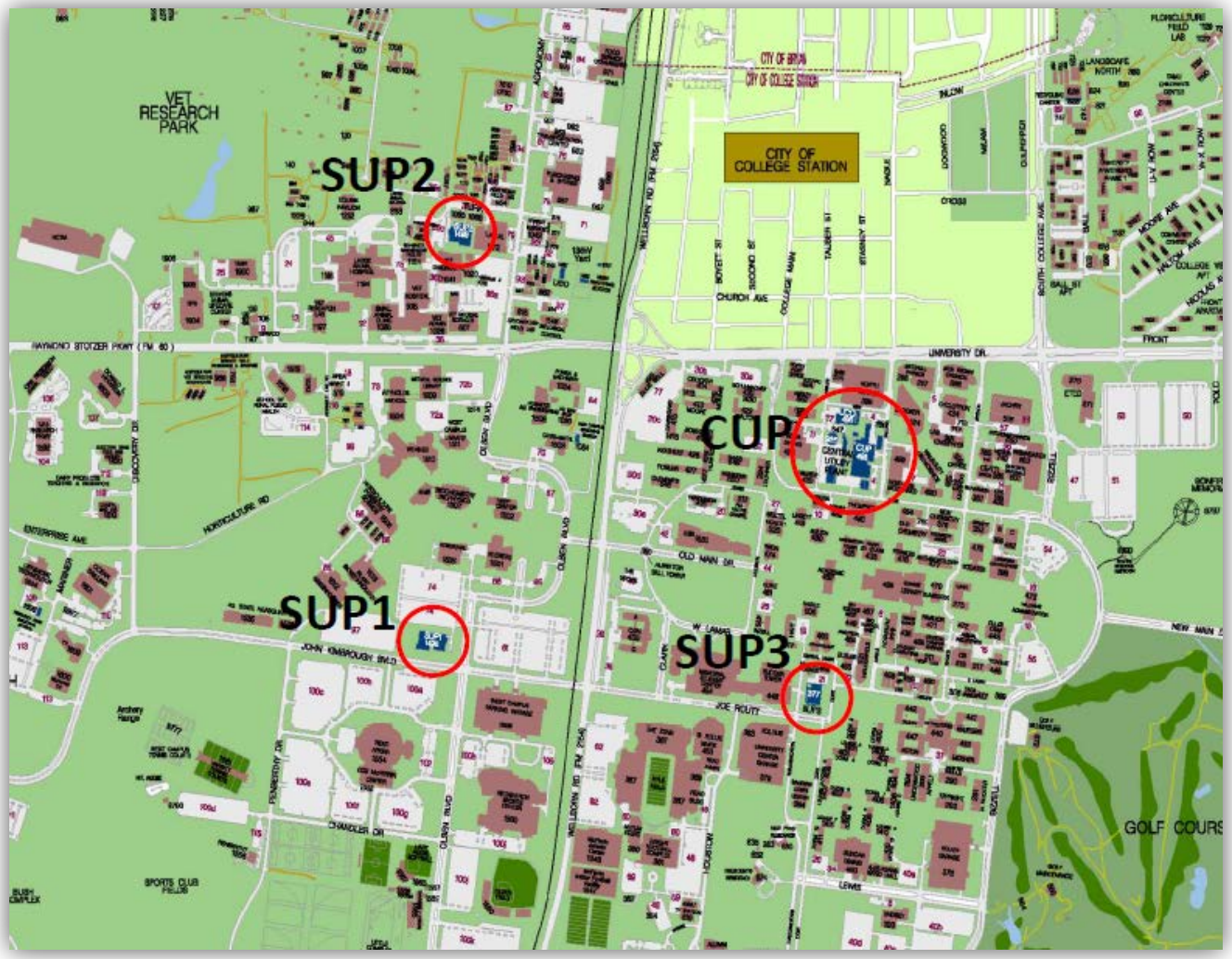
Annual Electrical Service Availability (ESAI)



Texas A&M University Overview

- **Utilities Divided – Main and West Campuses**
  - (4) Utility Plants
  - 54,000 ton cooling (steam & elec)
  - 440,000 pph steam
  - 451,000 Mbtu/h heating hot water
  - 50 MW – power gen capacity
    - 34 MW – gas turbine
    - 16 MW – two steam turbines

Texas A&M University Overview



Initiating The Plan Getting Buy-In

- Internal Challenges
  - "Didn't we just do this?"
  - Tight Budgets
  - Agreement between departments
- Secrets to Success
  - Show changes driven by others
    - Updated architectural master plan / vision
    - Utility market changes
    - New environmental targets
  - Show value – focus on $$
    - Previous master plan contributed in saving $140 million, improved reliability, etc.
      - TAMU – 40% energy reduction per GSF, $140 MM saved
      - Time is now to be *proactive*
    - Being *reactive* later wastes capital and operations $
    - Delayed savings are LOST savings

Texas A&M University Growth

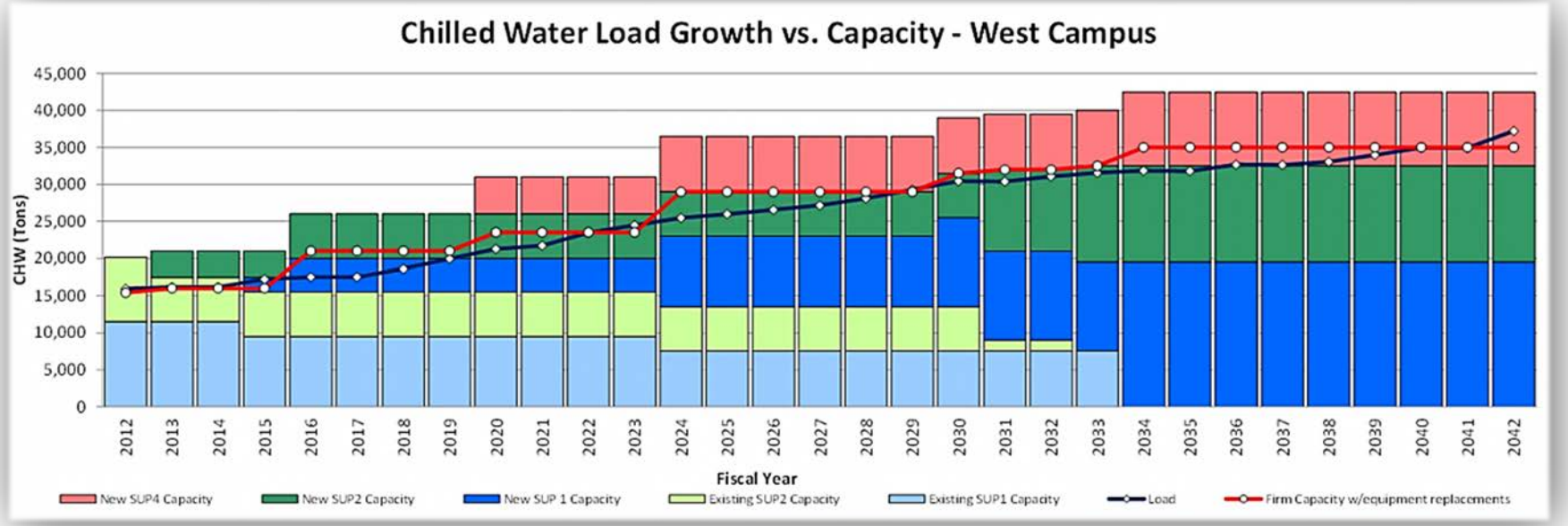
	2012	Year 5	Year 30	Avg Growth/Yr
Area	22,500,000 SF	24,600,000 (9%)	35,200,000 (56%)	1.5%
CHW Peak	37,600 tons	41,500 (10%)	64,000 (70%)	1.7%
Heating HW	222 MMBtuh	242 (9%)	372 (68%)	1.6%
Dom HW	295 gpm	324 (10%)	581 (97%)	2.2%
Electricity	70 MW	80 (14.3%)	100 (43%)	1.4%

- **Long Term Growth is Huge**
  - **But moderate year over year**
- **Mix of Building Types has Dramatic Impact**
- **Need Architectural Master Plan to Be Most Effective**
- **Focus on Energy Efficiency to Reduce Demand**
  - **Today ≠ Tomorrow**

Utilities & Energy MP Results

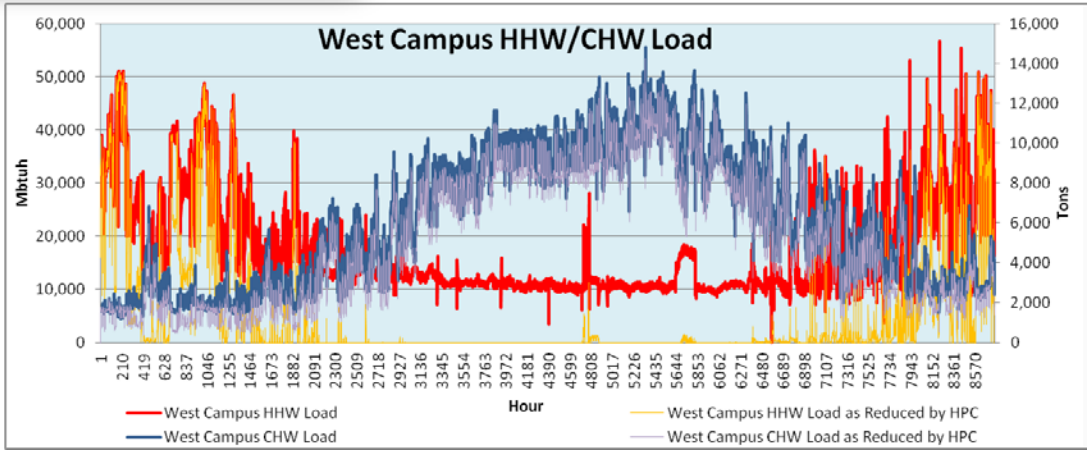
- $45M in capital projects – through 2016
  - $31M in replacement & capacity projects
  - $1.9M in annual savings
- $135M - through 2042
  - $32.9M in Life Cycle Savings
- Expansions and Replacements Planned
- New Thermal Plant – Planned for 2020

Utilities & Energy MP Results



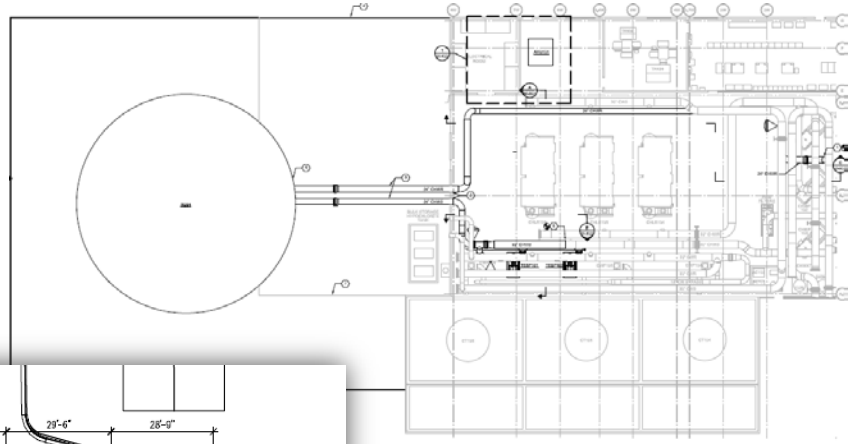
Utilities & Energy MP System Enhancements

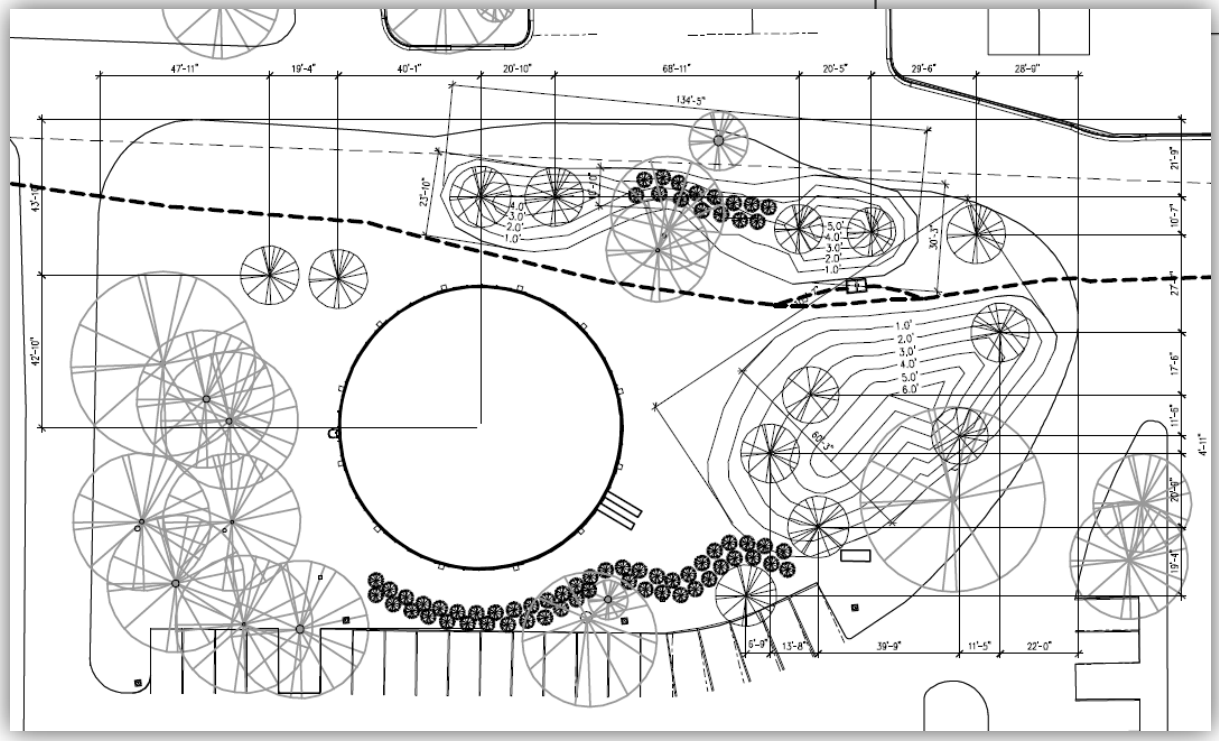
- Thermal Energy Storage
- Heat Recovery Chiller
- Chilled Water Plant Optimization
- **Provide Significant Utility Cost Flexibility**
  - Texas Grid Cap - $4.5/kWh in 2012
  - $5/kWh in 2014
  - $9/kWh in 2015
- Hold Up to Sensitivity Analysis



Utilities & Energy MP Case Study- TES

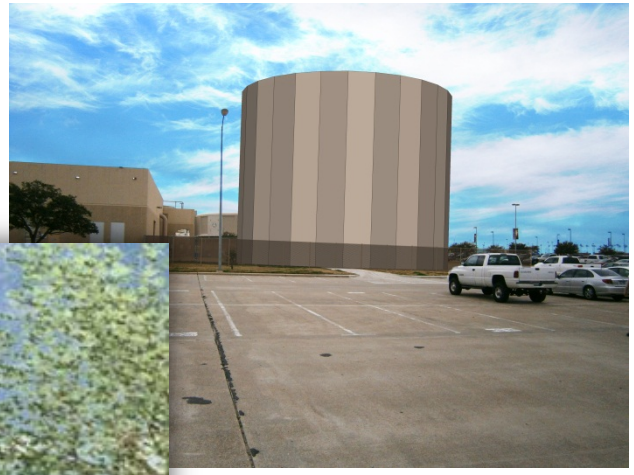
- Changes from MP to Design
  - Size
  - Location



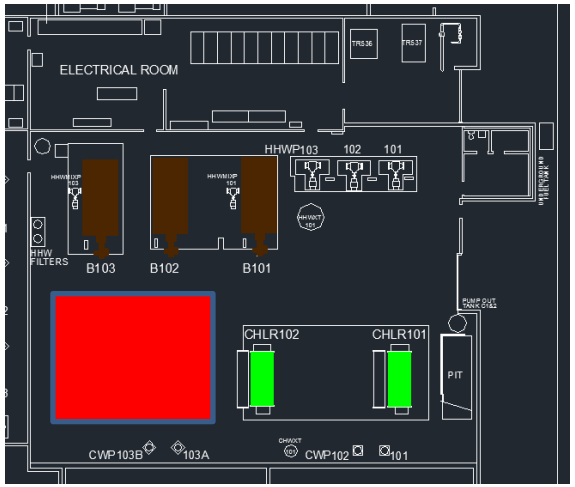


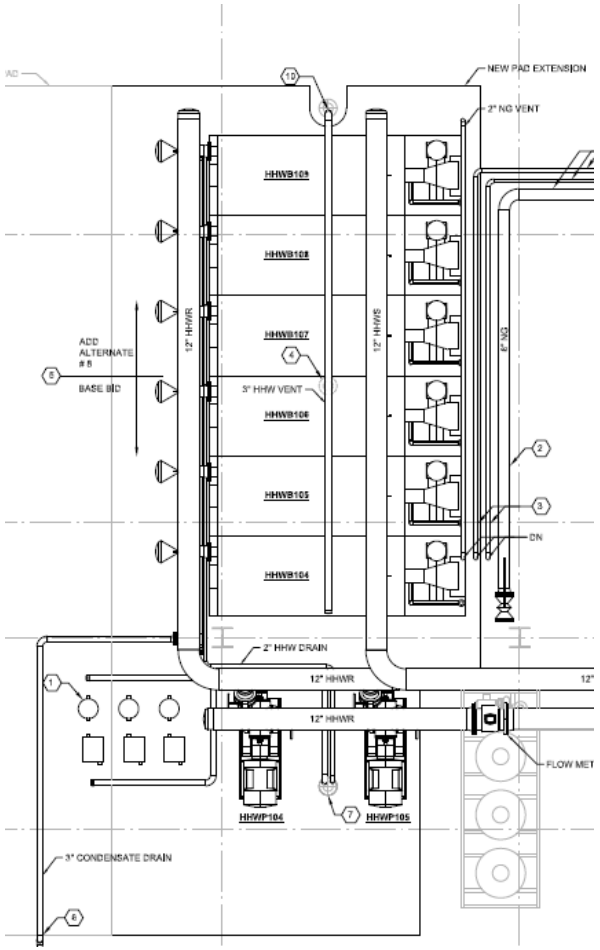
Utilities & Energy MP Case Study - TES

- Changes from MP to Design
  - Aesthetics



Utilities & Energy MP Case Study – Boiler Upgrade





- **Changes from MP to Design**
  - Three boilers planned at ultimate build out
  - Six boilers installed due to changing loads

Long Term Plan Impact Key Interests

- **Distribution Planning**
  - Biggest disruption on campus
  - Plan to do it once
  - Be conservative with sizing
- **Future Plant Locations**
  - Improves distribution
  - Try to “save” the space for utilities
- **New or Enhanced Technologies will be Available**
  - Don’t focus too much on analyzing new efficiency projects 20 to 30 years out
  - Too many variables in play

Utilities & Energy MP Additional Initiatives

- 2021 EUI Target – 140 mBtu / GSF – entire campus

- Building Prioritization Categories
  - Energy Reduction Capital Projects
  - Retro-Commissioning
  - Planned Renovation Projects
  - Energy Efficient Building

- EUI Target Establishment for New Buildings
  - By Building Category
  - Stretch Goals – not impossible goals
  - Dramatic Impact - $$$ and GHG Emissions
  - Hold Building Designers Accountable

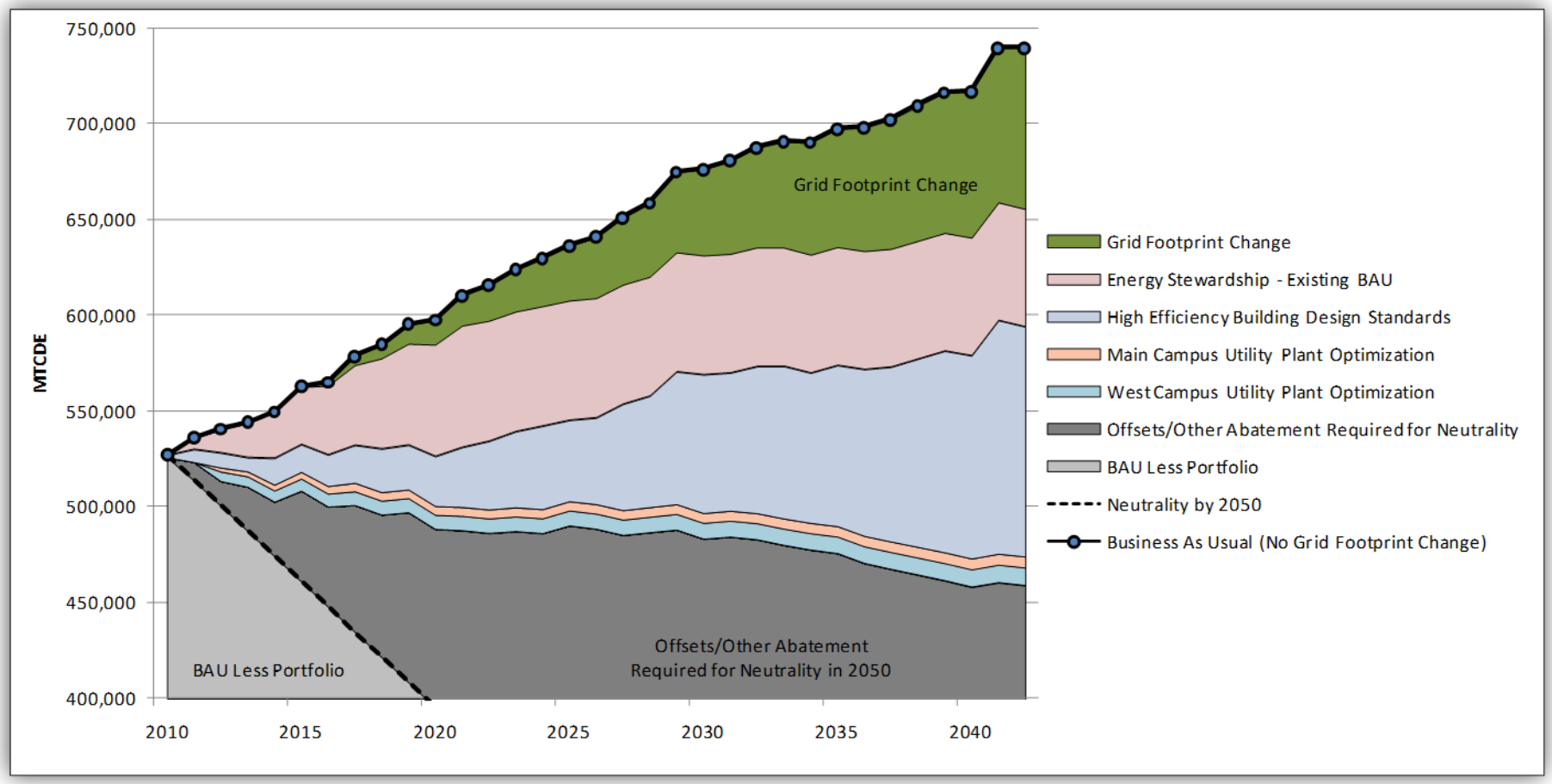
OPPORTUNITY FOR ENERGY REDUCTION	
0972[1]	LABORATORY ANIMAL CARE BUILDING
1041[2]	TEXAS VET MED DIAGNOSTIC LAB
1184[1]	BIO WASTE MANAGEMENT FACILITY
1513[1]	BORLAUG CENTER
1810[1]	OFFICE OF THE STATE CHEMIST
RETROCOMISSIONING	
0516[1]	COMPUTING SERVICES CENTER
0434[1]	LUEDECKE BUILDING (CYCLOTRON)
1507[1]	BIOCHEMISTRY/BIOPHYSICS BUILDNG
0386[1,2]	JACK E. BROWN CHEM ENGINEER
0513[1]	DOHERTY BUILDING
NEAR TERM CAPITAL PROJECTS PLANNED	
0376[1,2]	CHEMISTRY BUILDING ADDITION
0484[1,2]	CHEMISTRY BUILDING
1194[1]	VETERINARY LARGE ANIMAL HOSPITAL
0740[1]	MCNEW LABORATORY
0456	MILITARY SCIENCES BUILDING
ENERGY EFFICIENT BUILDINGS	
0404	GAINER HALL - DORM 5
0407	HARRELL HALL - DORM 8
0414	CROCKER RESIDENCE HALL
0411	UTAY HALL - DORM 12
0401	KIEST HALL - DORM 2

Utilities & Energy MP Design Guidelines

- Design Guidelines Formally Capture Campus Goals
  - New Construction and Major Building Renovations
- Guidelines are a Communication Tool
- Quality Guidelines Provide:
  - Lower Energy Consumption and Cost
  - Lower Maintenance Cost
  - Consistency, Reliability
- Set Modeling Approach for New Building Design
- **Define What You Want or There's No Way You'll Get It!**

Utilities & Energy MP Master Plan Results

Greenhouse Gas Reduction – "Wedge Analysis"

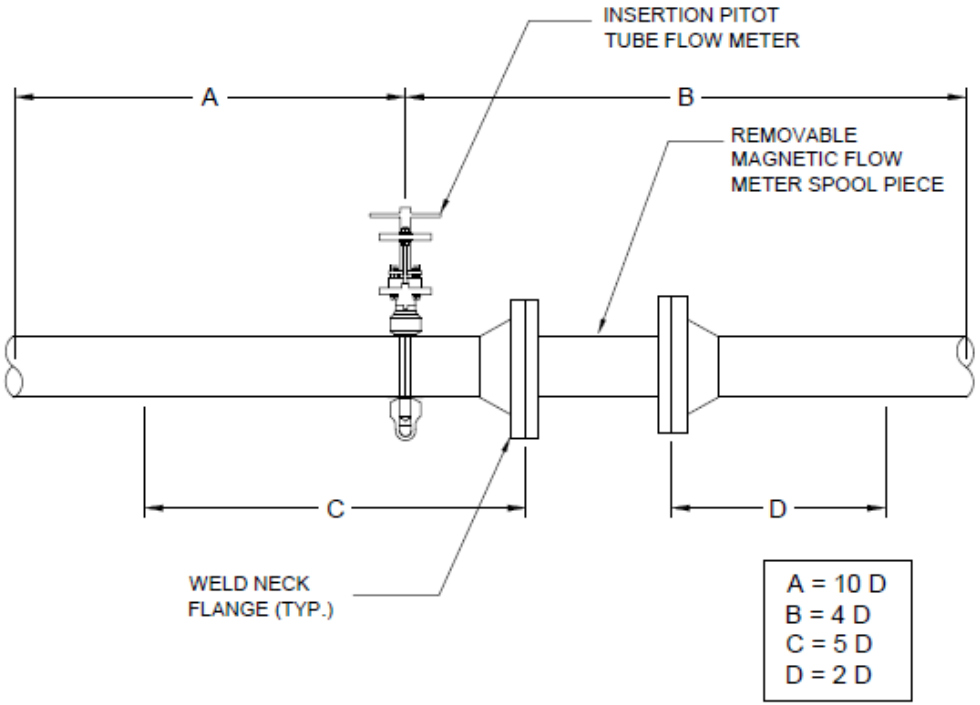


Utilities & Energy MP On To Design/Construction

- Maximize capital project scope against budgets
  - Appropriately Conservative Estimates
  - Consider bid alts to improve economics/flexibility
- Early Discussion of Operational Nuances
  - Flow meter needs and locations
  - VFD (with or without bypasses)
  - Manufacturer (standardized or variety of equipment)
- Minor Capital Project Wish List
  - Relocation of items
  - Clean up of previous issues
  - Part of bid alts

Utilities & Energy MP Case Study – Flow Metering

- Changes from MP to Design
  - Magnetic vs. Insertion Pitot Tube
  - Piping modifications for future installation



Implementing The Plan So Now What Do I Do?

- **Pre-Sell**
  - Stay in front of the key people
  - Provide updates
  - Continually remind them of the “Whys” and “Benefits”

- **Understand What Each Individual Cares About**
  - Yes, you are trying to make everyone happy
  - Capital, Energy, or O&M Savings
  - Reliability
  - Emissions
  - Aesthetics
  - **This is SALES! Make Others Feel and Look Good**

Implementing The Plan So Now What Do I Do?

"Architectural master plan is changing"

It always will! We plan as best we can and adjust as needed. Doing nothing and hoping is not an option.

"What about other new technologies coming out?"

Our plan is flexible. We do what we need to do now and allow for review and enhancements as technologies become tried and true. Reliability is key. We want leading edge, not bleeding edge.

"We don't have the money"

Our plan is the most cost effective approach. Any other way costs more both short and long term. We're an institution – we're not going anywhere.

Implementing The Plan So Now What Do I Do?

- Emphasize Impact of "Business as Usual"

- Utility system not ready for new loads
  - Reactive vs. proactive implementation
  - Undersized piping (dig it up and replace later)
  - Local building chillers and boilers
  - Lack of redundancy / reliability
  - Etc, etc, etc.
  - **Doing Nothing is 'Doomsday Scenario'**

Additional Efforts

- Energy Management Program
  - Texas A&M System-wide Program
- Sharing Experiences, Lessons Learned, & Successes
- Helping Create Focus and Targets
  - Can't just be business as usual
- "You Can't Handle the Truth"
  - 'Twilight Tours' of buildings
  - Documentation and reporting
  - Establish EUIs and ECIs
  - Multi-phase approach

Key Takeaways

- Be Proactive – Growth will Happen; Be Ready
- Plan for Future Efficiency Improvement
- Know Your Goals – LCC, Energy, Emissions, Reliability
- Design Guidelines, Metering, Specific Targets
- Sell, Sell, Sell – If you don't, no one will
- Be Ready for the No's – Have a 'Plan B'

What You Are Doing is Important and Impacts
Your Campus, Your Region, Our World

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