

MAY 2019



The University of Texas at Austin
Utilities and Energy Management

AN INTEGRATED SOLUTION FOR UTA MICRO-GRID

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Agenda

- Microgrid Overview
- UTA Microgrid
- SCADA Upgrade

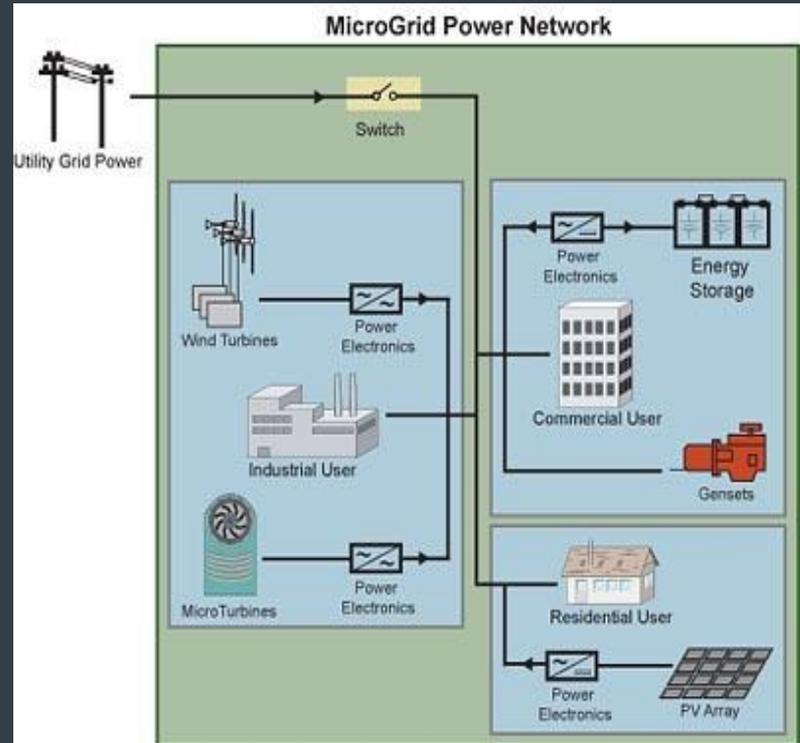
What is a Microgrid?

- Grouping of interconnected loads and distributed energy resources
- Can operate in island mode or grid-connected if desired
- Acts as a single controllable entity to the grid



Microgrid Components

- Distributed Generation(DG)
 - Dispatchable – can be controlled (Generators, Batteries)
 - Non-dispatchable – renewable power
- Loads
 - Critical
 - Non-critical
- Energy Storage System(ESS)
 - Coordinate with DG to guarantee sufficient generation
 - Load shifting – store power when prices are low
- Point of Common Coupling (PCC)
- Microgrid Controller





Why Have Microgrids

- Helps reduce transmission losses
- Provide high quality and reliable energy supply to critical loads
 - During a grid disturbance can separate and run as an island – keep critical loads on
- During peak grid power demands can prevent main grid overloads
- Provides power affordably to remote areas and 3rd world countries
- Microgrid encourages the use of the renewable energy sources
- Reduces the electricity costs to its users by generating some or all of its electricity needs
- Help provide grid security
 - Cyberattack worse than natural disaster – no warning
 - Microgrids can power a community's vital services – law enforcement; fire protection; medical care; distribution of water, food, and fuel; and communications.
 - Distributed assets are more difficult for cyberterrorists to attack than are centralized systems with a single point of failure



Disadvantages of Microgrids

- Voltage and Frequency can be difficult to control without grid connection
- Electrical energy needs to be stored
 - Requires more space and maintenance
- Resynchronization with the main distribution grid can be difficult
- Issues such as standby charges and net metering may pose obstacles for Microgrid
 - Complicated utility contracts
 - Real time pricing
 - Ratcheted demand charges



Microgrid Control Functions

- Point of Common Coupling (PCC) Monitoring
- Point of Common Coupling Control
- Frequency Control
- Load Shedding
- Voltage (Reactive Power) Control
- Remote Breaker Control and Monitoring
- Synchronization
- These functions have been in industrial plants for many years



Microgrid Categories

- Remote and isolated communities
 - No connection to main distribution grid
 - Island communities
 - Offshore oil platforms
- Large self-contained complexes
 - Can run as an island or connected to grid
 - Buy/sell contracts with grid
 - Examples
 - Hospitals
 - Military bases
 - **Universities**
 - Industrial Plants



Integrated Solution for UTA Micro-Grid

- UT Austin micro-grid components
- Control functions that make this system unique in achieving high efficiency and reliability levels
- On-going upgrade of such system, and the non-dependence of the Texas grid.



Integrated Solution for UTA Micro-Grid





UTA Micro-grid - Reliability Performance Features

Ability to island at will – Generator Isochronous Control

Power Instantaneous Load-Shed built in

25 MW Stand-By power from Grid

N+2 Redundancy for Power via Substation and Stand-By

Buildings - Dual Connections for Electricity, Steam & Chilled Water

Campus Building Outage Instantaneous Notification – email & text

UTA Micro-grid Efficiency Performance Features

Net Zero Power to ERCOT Grid via Master MW Controller

900 + energy meters with first-day-of the-month billing system

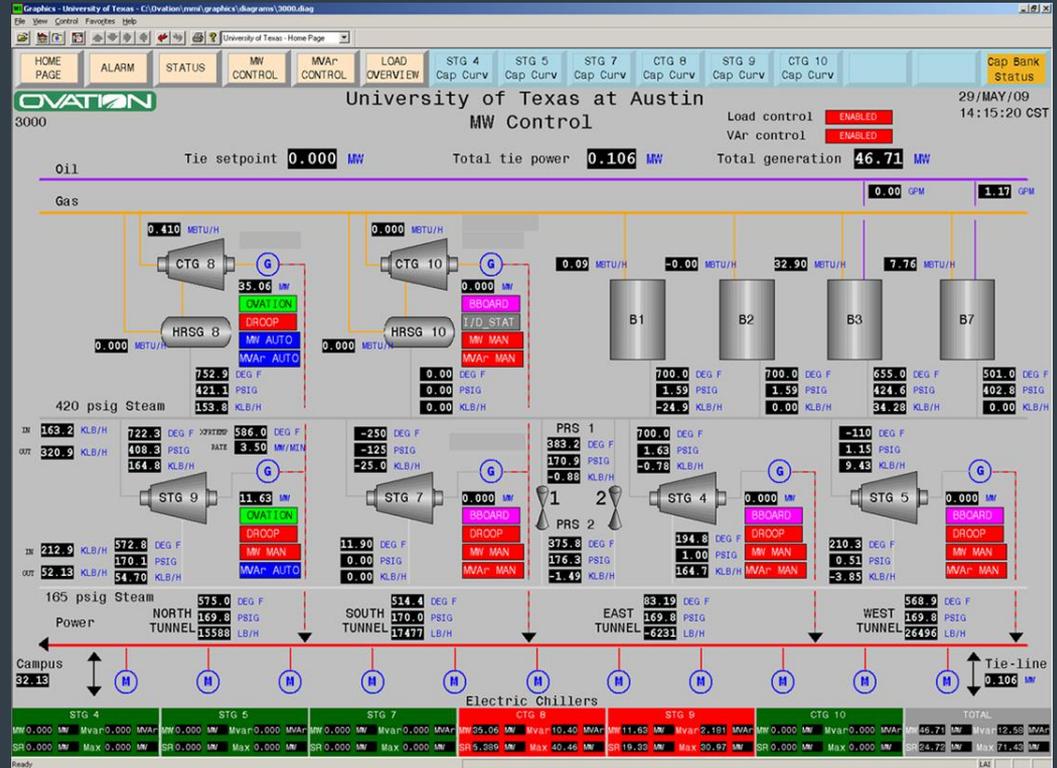
Energy Portal for Campus Buildings energy performance – EUI reduction

Load Shifting via TES technology – flatten MW day/night production by use of TES technology

Optimized Chiller dispatching and chilling station operation – (Avg. 0.65 kW/ton)

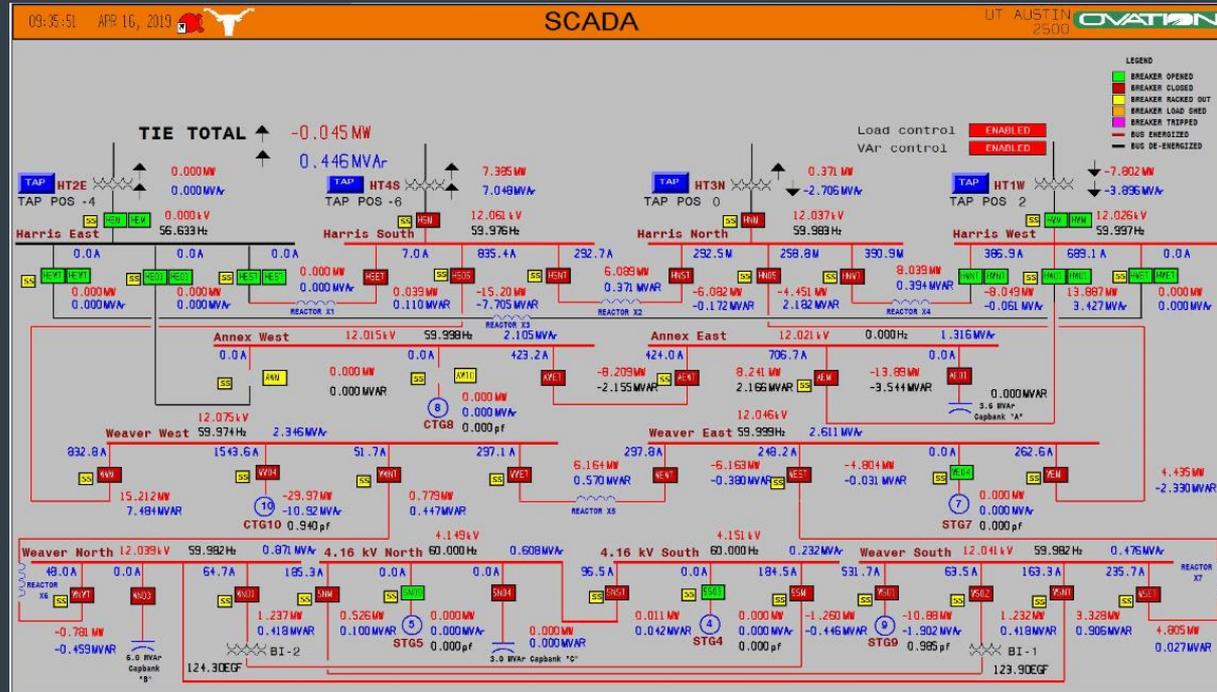
Reliability in Generation – Meeting Campus Demand

- Two combustion gas turbine generators
- Two heat recovery steam generators (HRSG)
- Four steam turbine generators
- Four natural gas-fired boilers
- Two TES + Five Chilling Stations (17 Electric Chillers)



Reliability in Distribution – Meeting Campus Demand

- Two 69 kV transmission feeds forming a loop
- Four City-Tie connections
- Six pairs distribution load centers



Reliability in Generation – Load Shed & Islanding

- 13 Possible Contingency Cases:
 - Loss of a main generator (6 cases)
 - Loss of grid connection
 - Under-frequency of generation buses

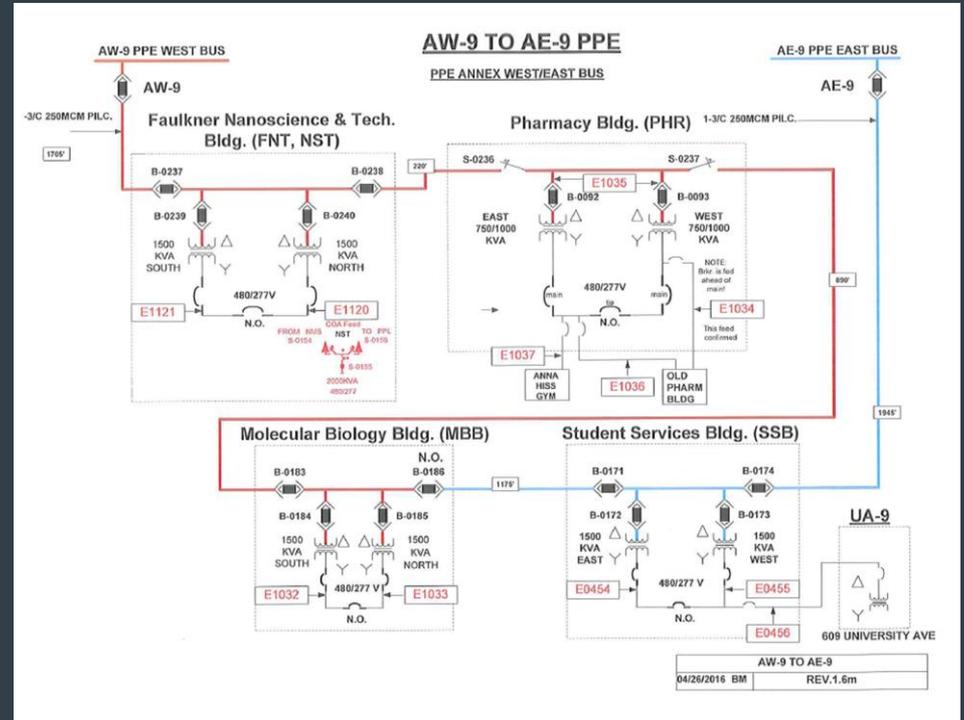
University of Texas at Austin
 Loadshed Priority Table

Feeder Name	Open/Closed Status	Load Shed Priority	Default MW	Load Shed/Inhibit Status
Electric Chillers				
Chilling Stn 3.1 Main	CLOSED	7	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 3.2 Main	CLOSED	1	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 3.3 Main	OPEN	2	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 4.2 Main	OPEN	3	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 4.3 Main	OPEN	4	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 5.1 Main	OPEN	5	0.500 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 5.2 Main	OPEN	8	0.500 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 5.3 Main	CLOSED	6	0.000 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 6.1 Main	BAD I/O	9	10.00 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 6.2 Main	BAD I/O	10	11.10 MW	LOAD SHED Inhibit Load Shed
Chilling Stn 6.3 Main	BAD I/O	11	11.20 MW	LOAD SHED Inhibit Load Shed

STG 4	STG 5	STG 7	CTG 8	STG 9	CTG 10	TOTAL
MW 0.000 MW MVar 0.000 MVar 1.591 MW MVar 0.417 MVar	MW 0.000 MW MVar 0.000 MVar 29.00 MW MVar 0.107 MVar	MW 0.000 MW MVar 0.000 MVar 16.28 MW MVar 44.42 MVar	MW 0.000 MW MVar 0.000 MVar 16.28 MW MVar 44.42 MVar	MW 0.000 MW MVar 0.000 MVar 16.28 MW MVar 44.42 MVar	MW 0.000 MW MVar 0.000 MVar 16.28 MW MVar 44.42 MVar	MW 39.76 MW MVar 10.80 MVar
SR 0.000 MW Max 0.000 MW	SR 5.600 MW Max 7.000 MW	SR 0.000 MW Max 0.000 MW	SR 16.28 MW Max 44.42 MW	SR 22.15 MW Max 21.60 MW	SR 0.000 MW Max 0.000 MW	SR 44.10 MW Max 27.40 MW

Reliability at Building Level – Meeting Campus Demand

- Internal campus distribution grid
- Loop distribution scheme
- Double-ended substations on each building



Reliability at Building Level – Building Outage Instantaneous Notifications

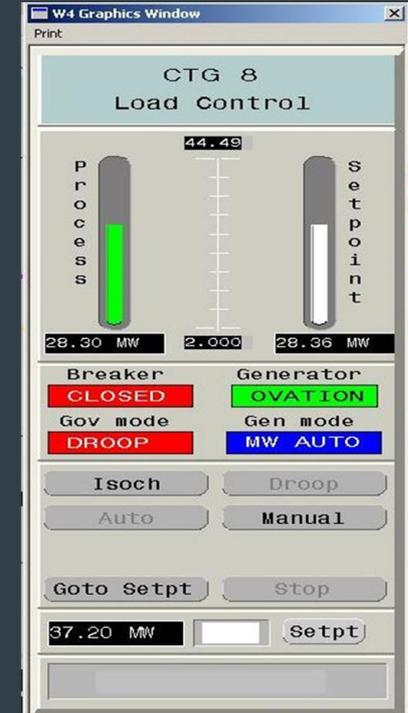
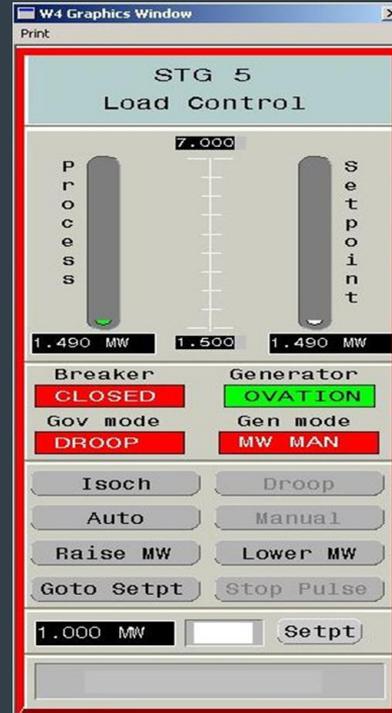
The screenshot displays a web interface for monitoring building power conditions. At the top, it shows the university's logo and name. Below that, the title 'Building Power Conditions' is followed by a summary '3 power outages'. A note states: 'A typical building power outage duration is about one hour. But outage causes can be varied. We are working hard to restore power. See below for actual outage conditions.' Below this is a table of outages, and at the bottom is a map of the campus with markers for each building.

Building	Detected	Became	Since
HRC	Wed Mar 13 2019 20:51:33 GMT-0500 (Central Daylight Time)	true	11 mins ago
RRH	Wed Mar 13 2019 20:51:37 GMT-0500 (Central Daylight Time)	true	10 mins ago
GSB	Wed Mar 13 2019 20:51:42 GMT-0500 (Central Daylight Time)	true	10 mins ago

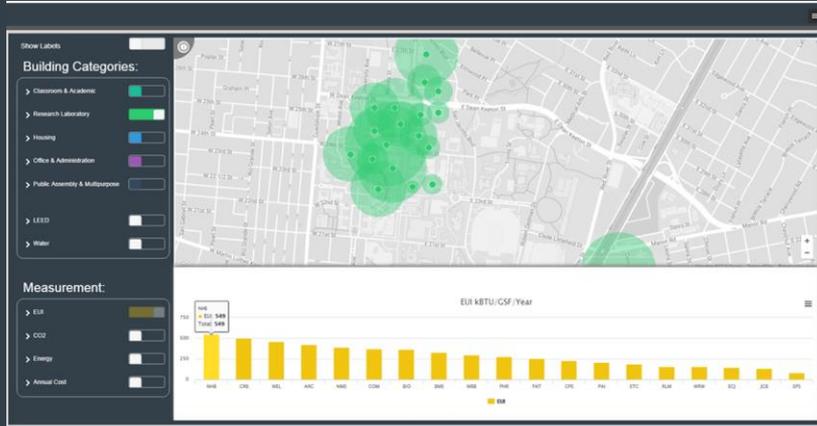
The map below the table shows a street grid of the campus. Most buildings are marked with green circles containing a checkmark, indicating they are powered on. Three buildings are marked with red circles containing an 'X', corresponding to the outages listed in the table above. The map includes standard navigation controls like zoom in (+) and zoom out (-) buttons.

Efficiency in Generation

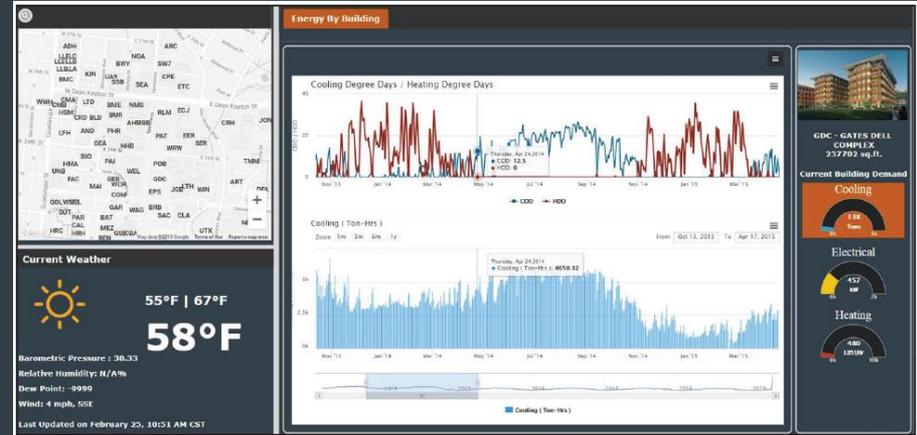
- Performs Campus MW Demand Control
- Keeps Texas Grid Tie at Net Zero
 - Negative Import
 - Positive Export
- Keeps Unity PF at Tie
- Provides Cost savings through tight control



Efficiency in Demand Side – Energy Portal

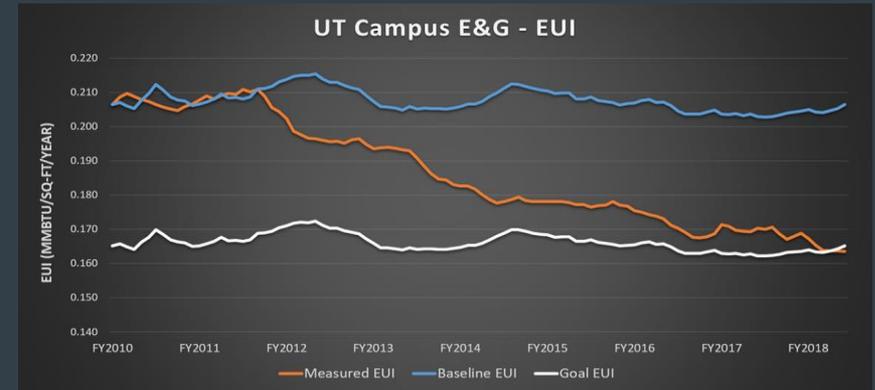
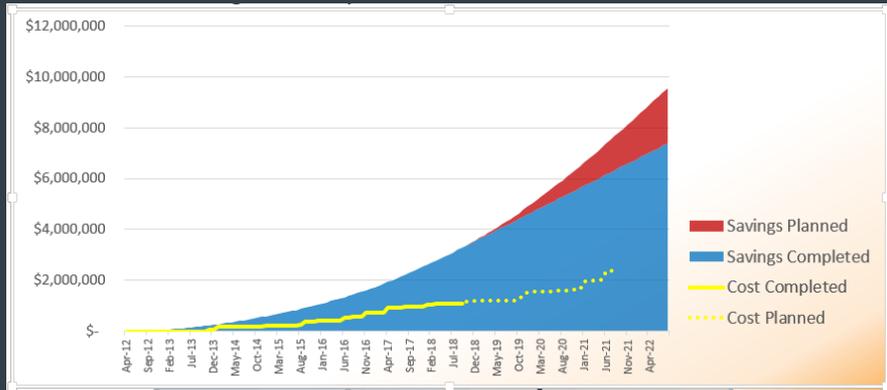


EUI Comparison for Campus Laboratories



Historical and real-time CHW use in buildings

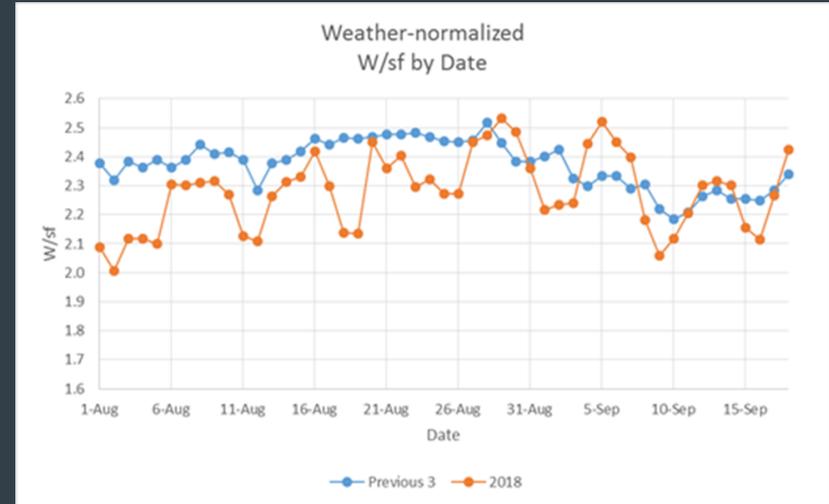
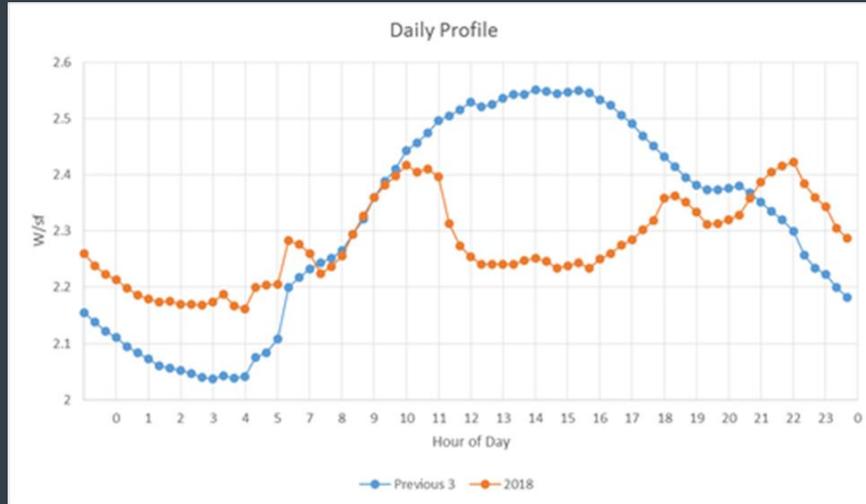
Efficiency in Demand Side – Energy Savings



Fuel Cost Savings Vs. Implementation Cost

EUI – 20 % Goal Savings

Efficiency in Generation thru CHW Production



Chilled Water TES for Load Shifting Strategy

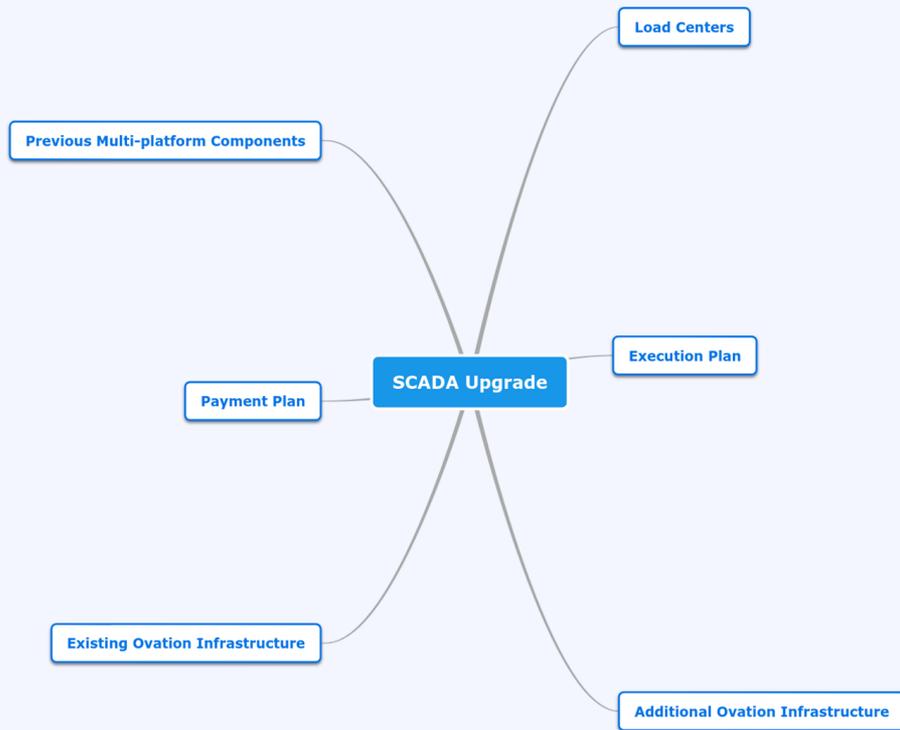


SCADA CONTROL NETWORK UPGRADE





SCADA UPGRADE





SCADA UPGRADE

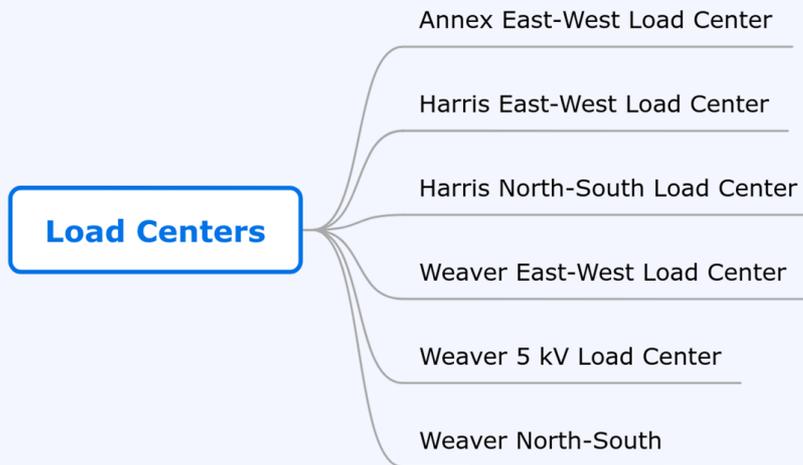


SCADA UPGRADE



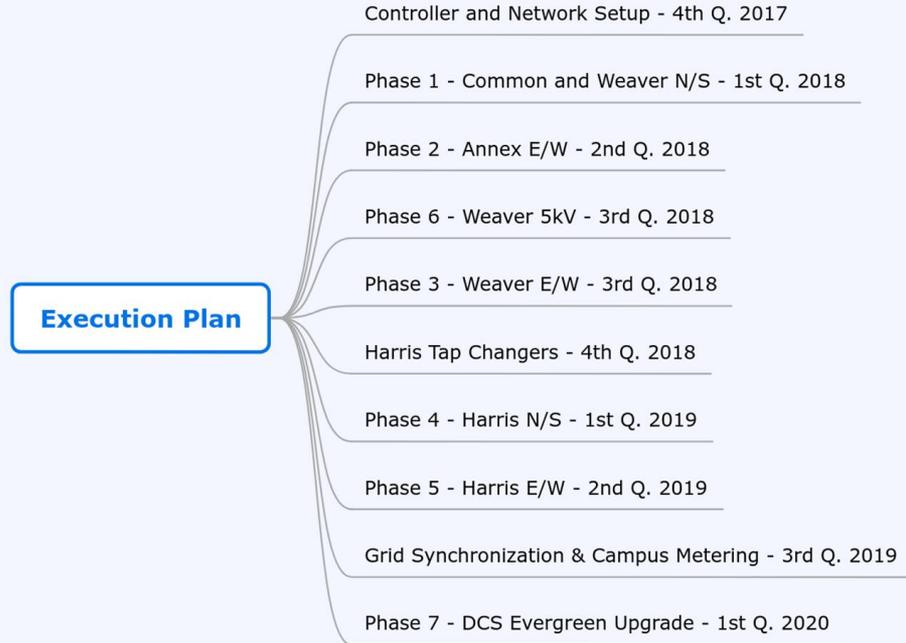


SCADA UPGRADE





SCADA UPGRADE





SCADA UPGRADE

Additional Ovation Infrastructure

Two pairs of Redundant Ovation Controllers

Expansion of Ovation Remote IO to host 6 load centers

Ovation Sequence of Events Input Cards

Redundant Cisco Routers for new SCADA VLAN

Cisco 2520 Network Switches (Qty. 12)

SEL Data Concentrator - Upgraded RTACs to 3530

SEL 735 Electric Meters (Qty. 126 - 12 high scale)

RTAC connectivity to Campus Metering



SCADA UPGRADE

Previously Negotiated Terms and Conditions

No Interest Plan - Two year payment plan

1st payment September 15, 2017

2nd payment September 15, 2018

4th payment September 15, 2019

Last payment September 15, 2020

Payment Plan



SCADA UPGRADE – UT BENEFITS

- **Common platform for electrical processes and applications**
- **Information from the Load Centers integrated in the existing Ovation Point Historian**
- **Automatic Tap Changers**
- **Grid auto-resynchronization**
- **12 years extension of equipment life after 2020**
- **Increased Cyber Security**
- **Ability to monitor Campus Bldgs. Loops**



SCADA UPGRADE

- **In house installation**
 - 6000 electrical man-hours
 - 9000 programmer man-hours
- **1800 I/O points connections**
- **Near zero disruptions**
- **Collaborative Commissioning efforts**
Ops/Controls/Emerson

Conclusion

- The term Microgrid is relatively new but they have existed for a long time
 - UT Austin is an example
- The grid is becoming distributed
- Cybersecurity becoming more important and Microgrids help provide this security