MAY 2019

The University of Texas at Austin
Utilities and Energy Management

# AN INTEGRATED SOLUTION FOR UTA MICRO-GRID

**FREDERICK HUFF**
Lead Engineer, Emerson Automation Solutions
**ROBERTO DEL REAL, P.E.**
Associate Director, Utilities and Energy Management

# Agenda

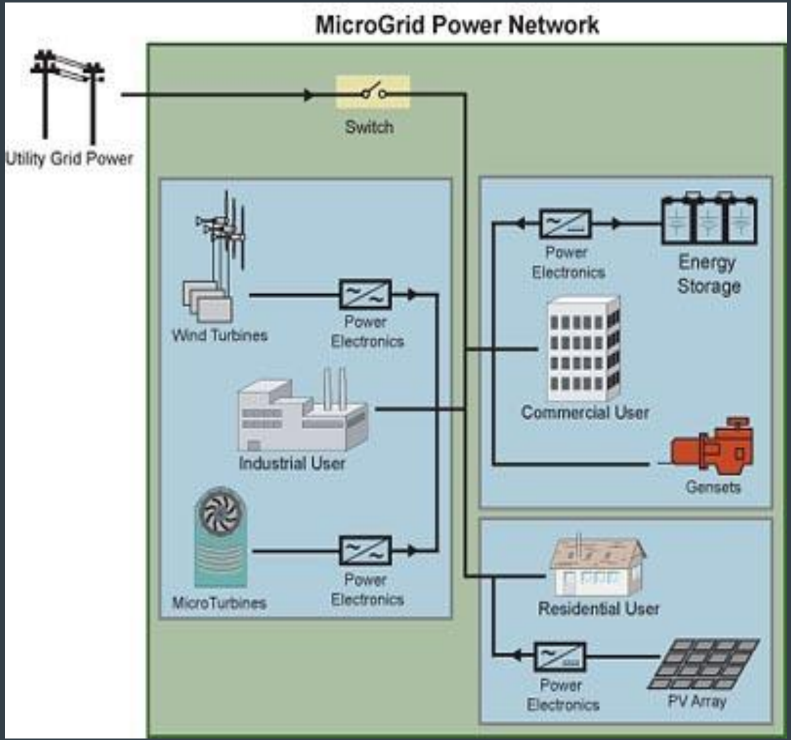
- Microgrid Overview
- UTA Microgrid
- SCADA Upgrade

# 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

**Reliability**
- Load Shedding
- Islanding
- Emergency Backup

+

**Efficiency**
- Megawatt Control
- VAR Control
- MW Shifting with TES/Chiller Dispatching

+

**Cost Controls**
- Generate
- Purchase
- Sell
- Demand Side Energy Reduction

=

**UT Austin’s Smart 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

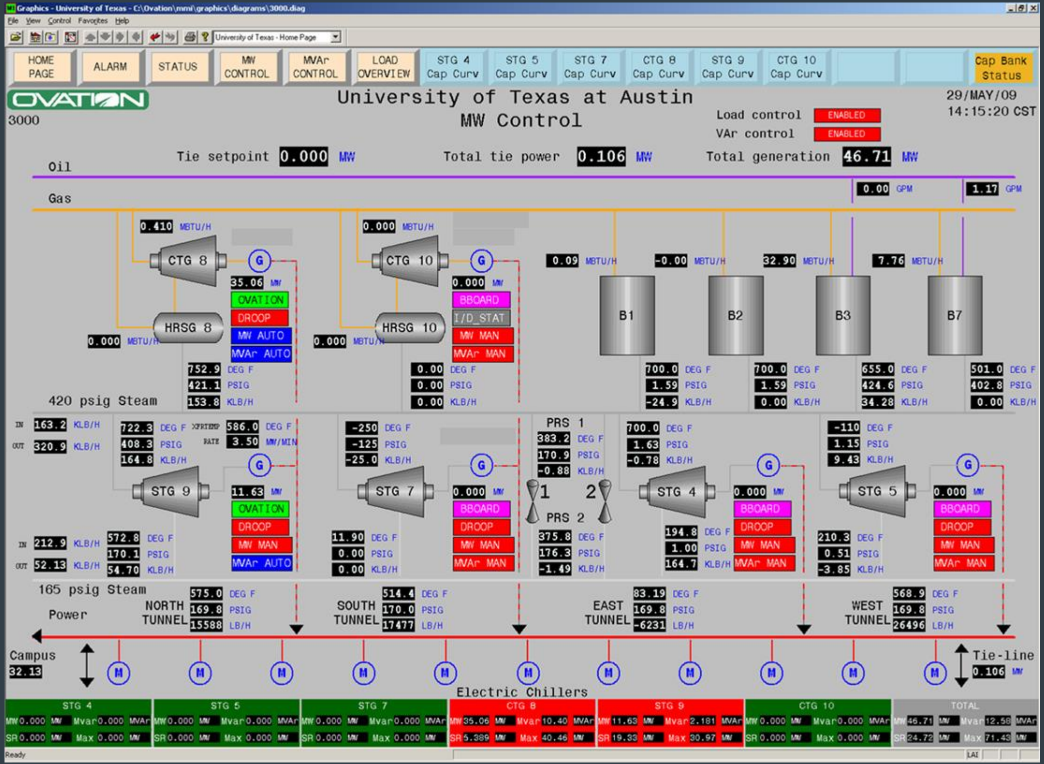
Energy Portal for Campus Buildings energy performance – EUI reduction

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)

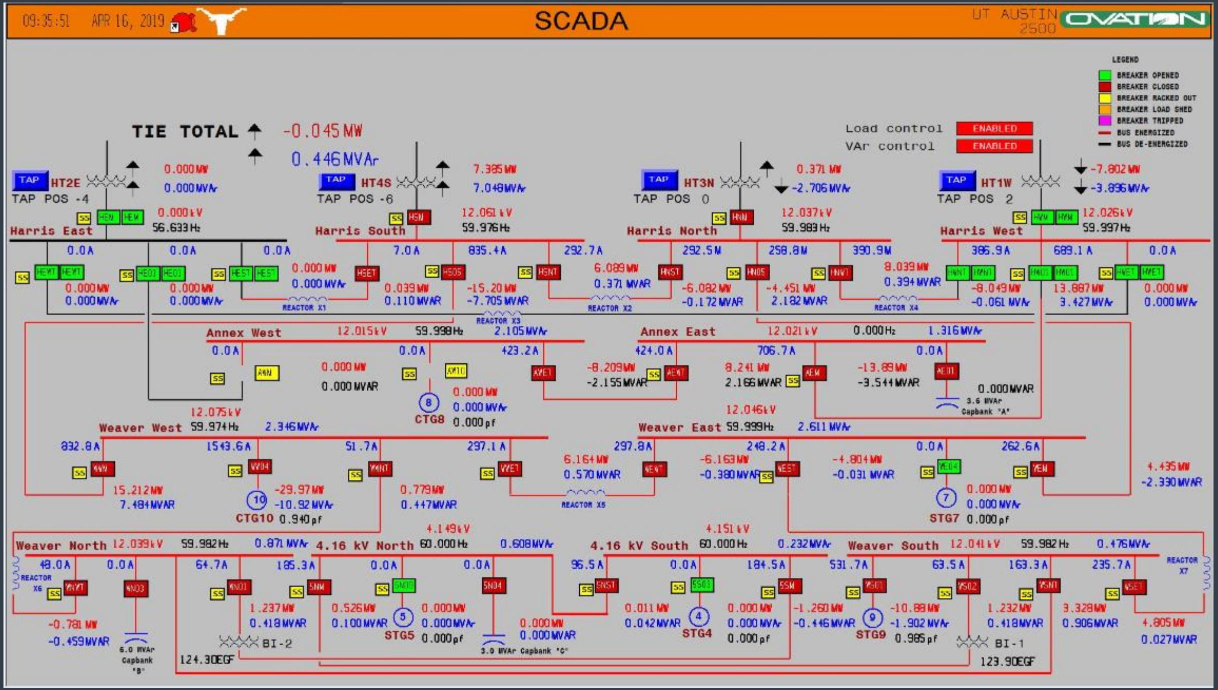
# Reliability in Generation – Meeting Campus Demand

- 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

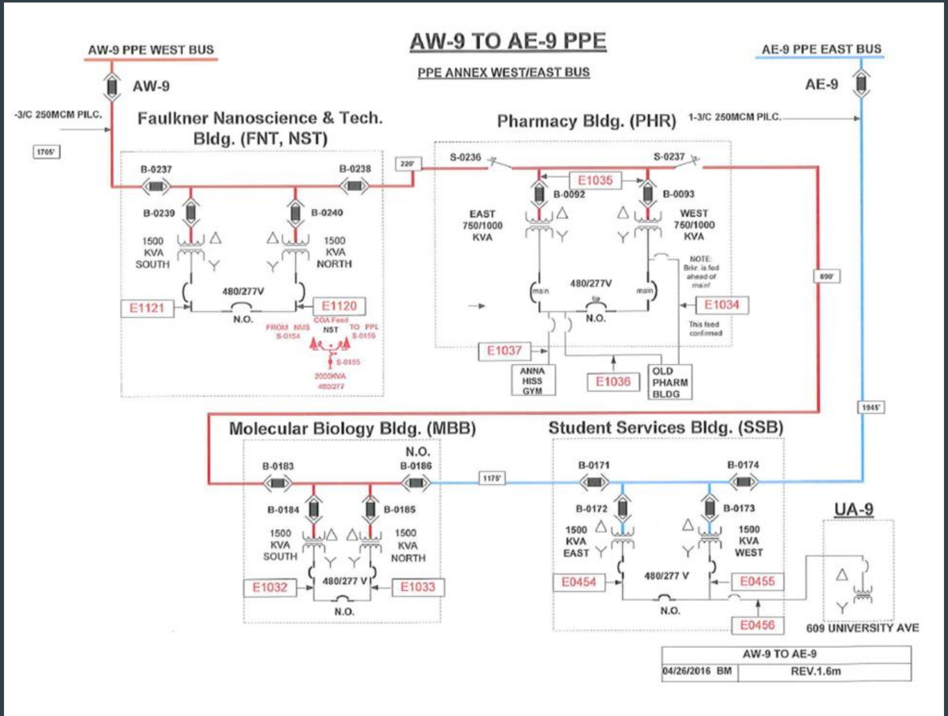


# Reliability in Generation – Load Shed & Islanding

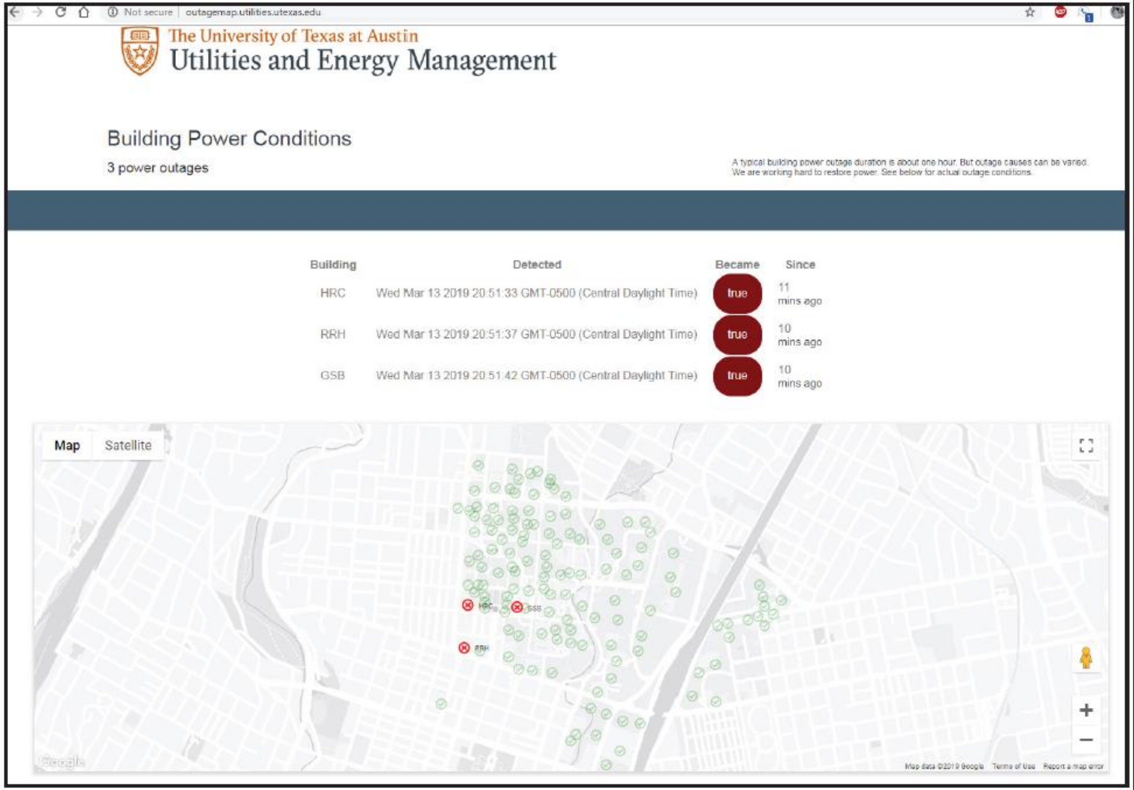
- 13 Possible Contingency Cases:
  - Loss of a main generator (6 cases)
  - Loss of grid connection
  - Under-frequency of generation buses

# Reliability at Building Level – Meeting Campus Demand

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

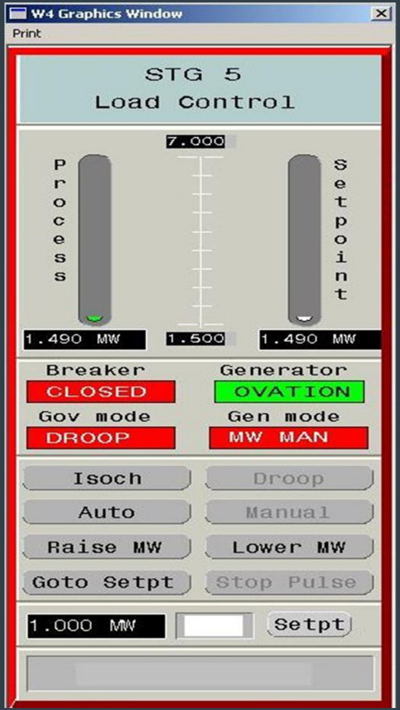


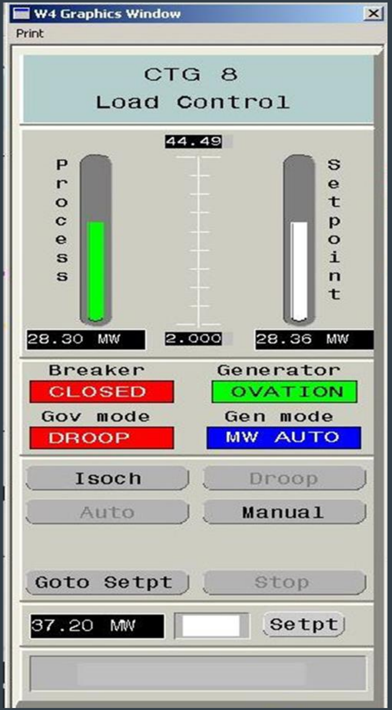
# Reliability at Building Level – Building Outage Instantaneous Notifications



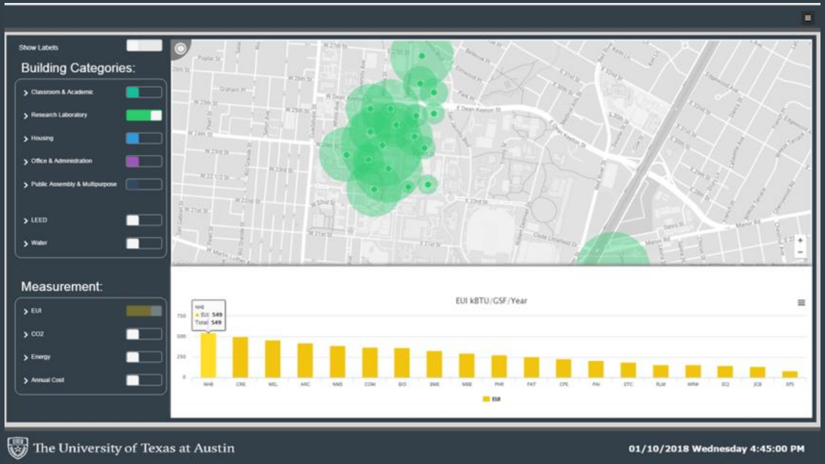
# Efficiency in Generation

- 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



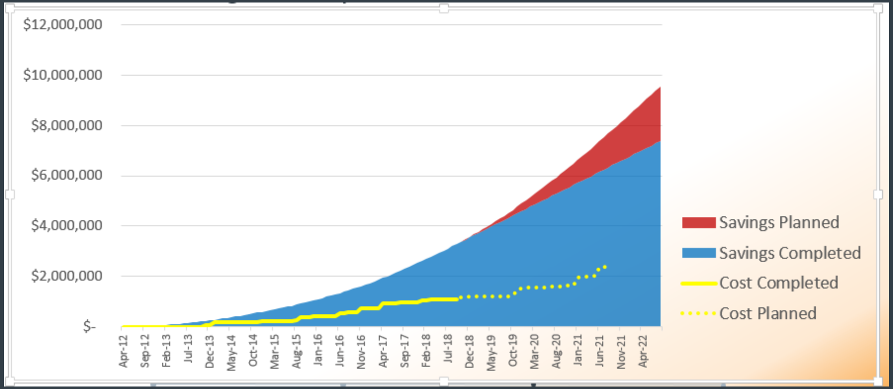
# Efficiency in Demand Side – Energy Portal

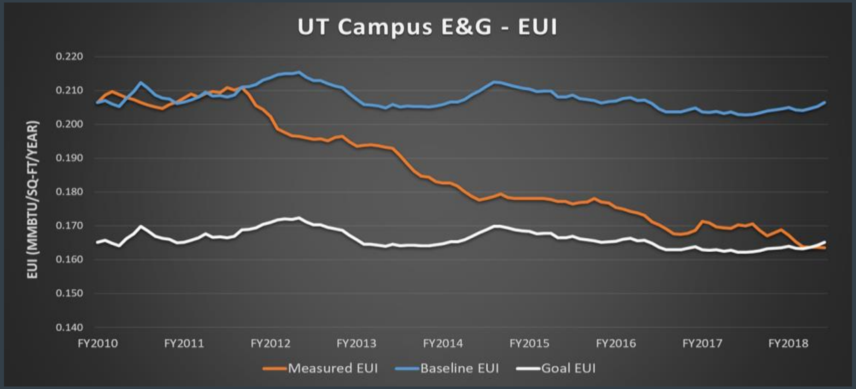



EUI Comparison for Campus Laboratories


Historical and real-time CHW use in buildings

# Efficiency in Demand Side – Energy Savings

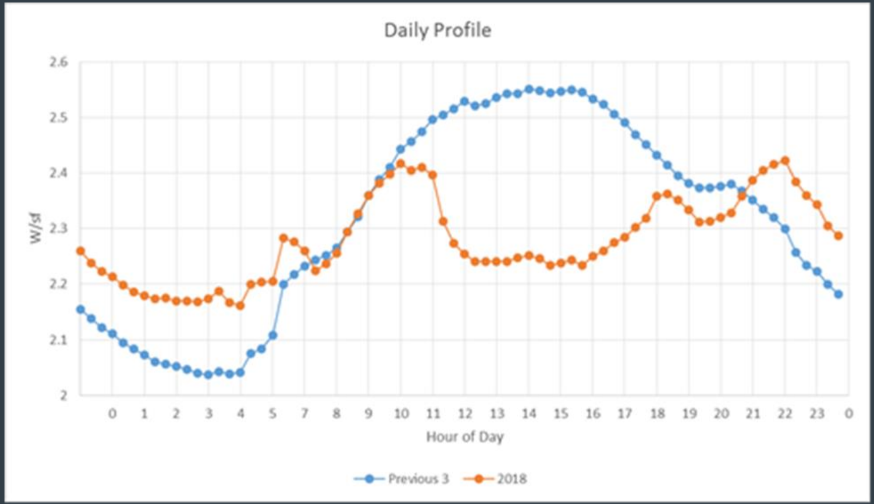


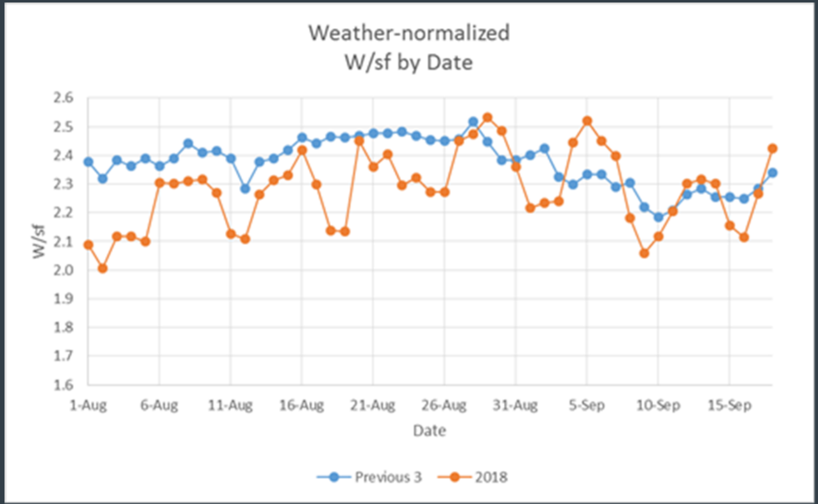




Fuel Cost Savings Vs. Implementation Cost

EUI – 20 % Goal Savings

# Efficiency in Generation thru CHW Production

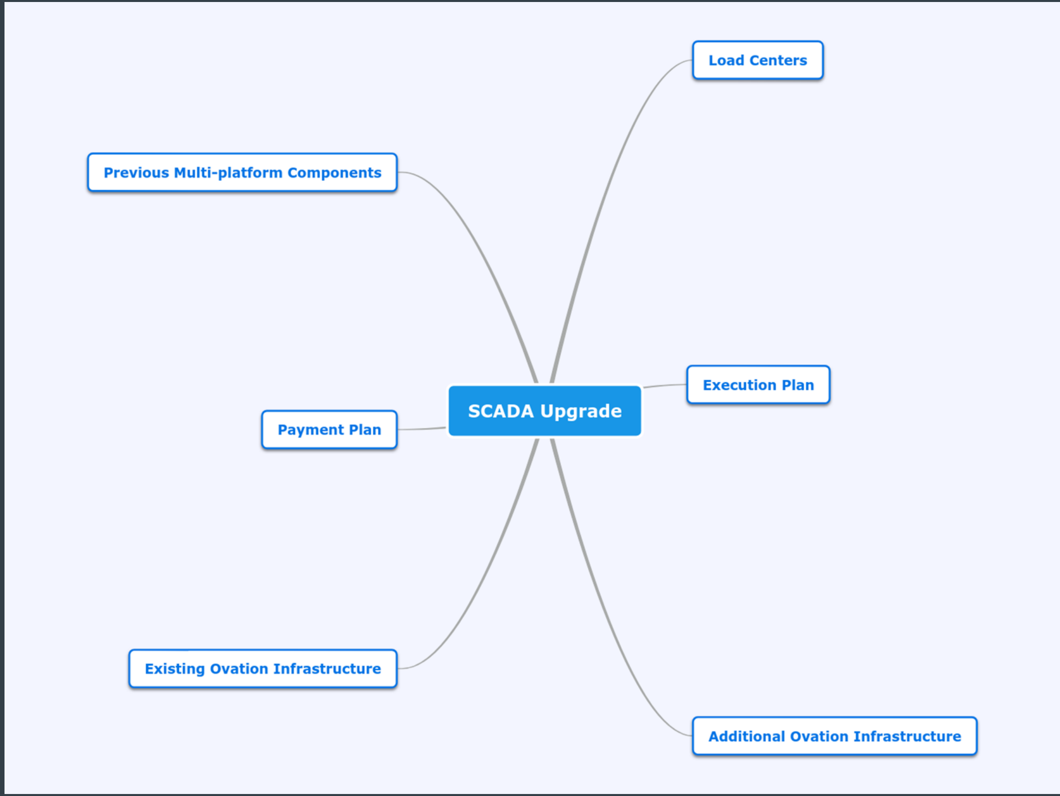


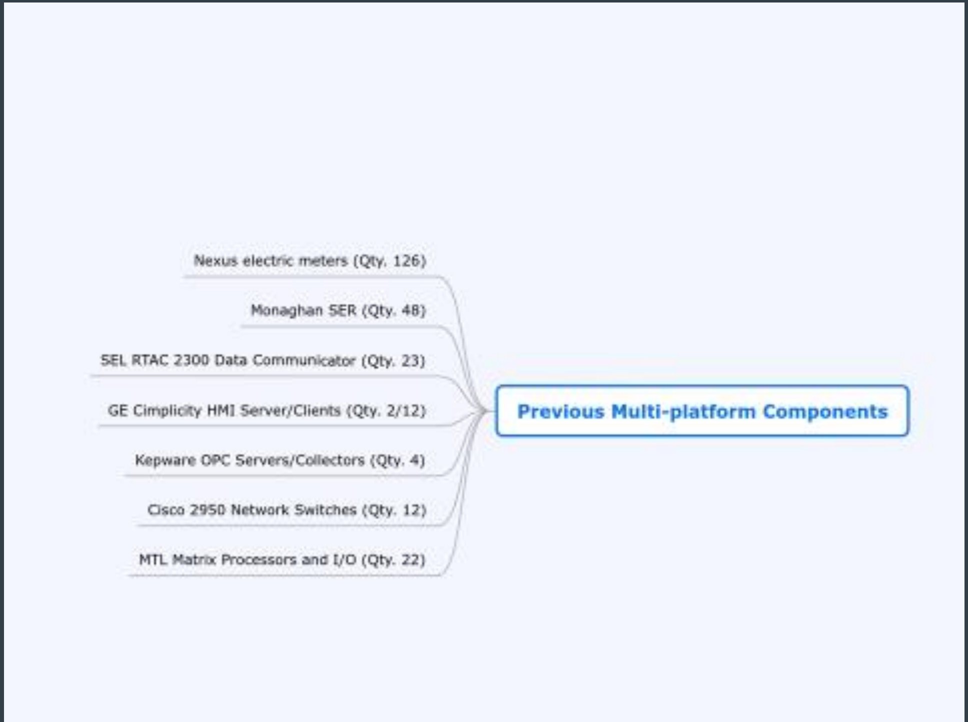

Chilled Water TES for Load Shifting Strategy

# SCADA CONTROL NETWORK UPGRADE

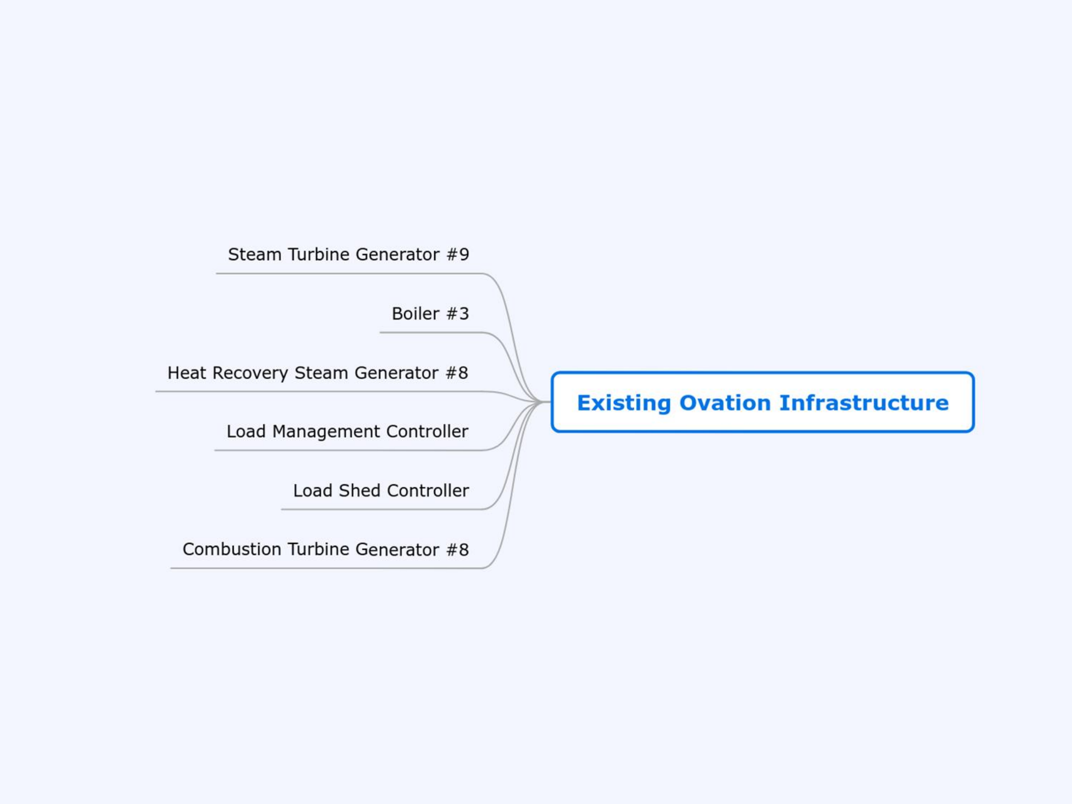
# SCADA UPGRADE



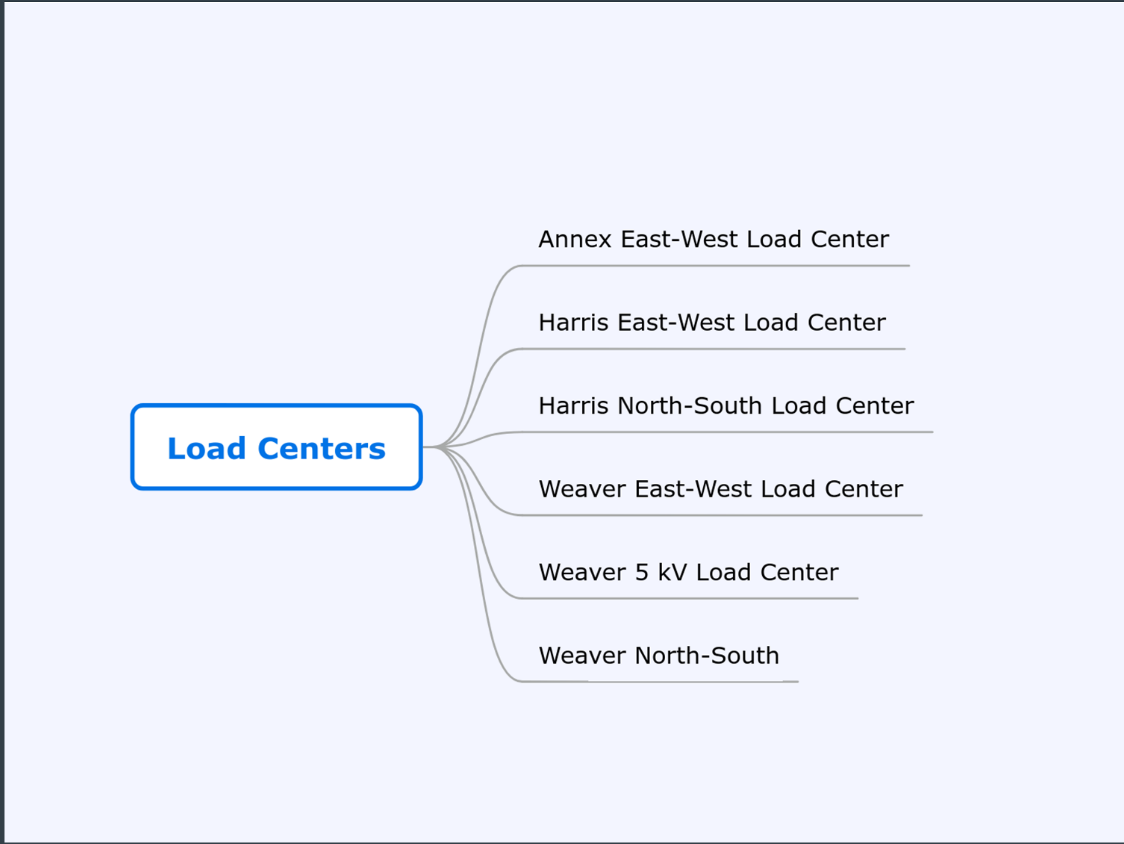
# SCADA UPGRADE



# SCADA UPGRADE

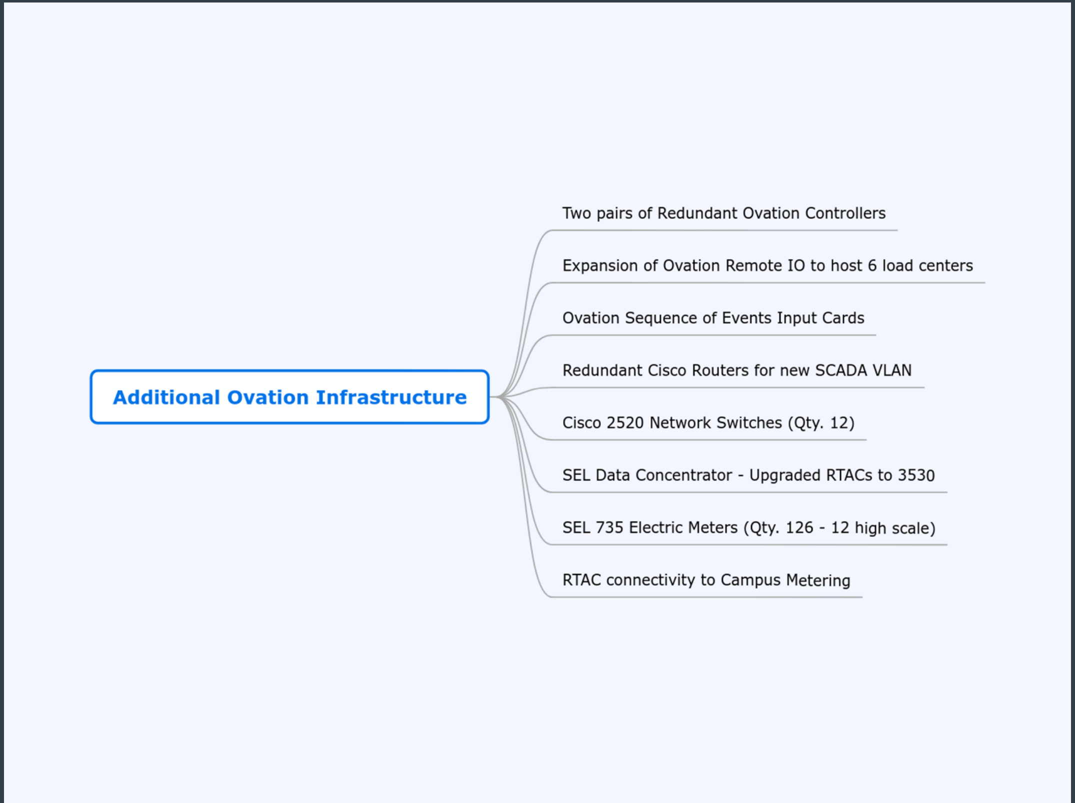


# SCADA UPGRADE

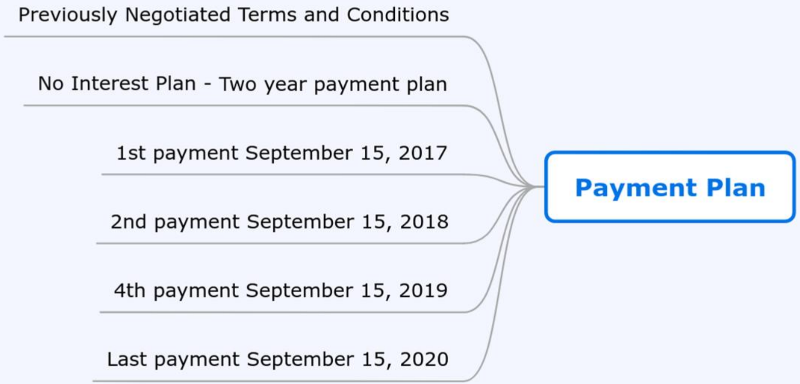


# SCADA UPGRADE

# SCADA UPGRADE



# SCADA UPGRADE



# 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