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

- 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

- Previous Multi-platform Components
- Load Centers
- Payment Plan
- Execution Plan
- Existing Ovation Infrastructure
- Additional Ovation Infrastructure
SCADA UPGRADE
SCADA UPGRADE

Execution Plan

Controller and Network Setup - 4th Q. 2017

Phase 1 - Common and Weaver N/S - 1st Q. 2018

Phase 2 - Annex E/W - 2nd Q. 2018

Phase 6 - Weaver 5kV - 3rd Q. 2018

Phase 3 - Weaver E/W - 3rd Q. 2018

Harris Tap Changers - 4th Q. 2018

Phase 4 - Harris N/S - 1st Q. 2019

Phase 5 - Harris E/W - 2nd Q. 2019

Grid Synchronization & Campus Metering - 3rd Q. 2019

Phase 7 - DCS Evergreen Upgrade - 1st Q. 2020
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
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
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