Microgrid Controls to Operate a CHP/Steam Plant

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University of Michigan – Central Power Plant

**We safely produce reliable energy that provides critical support to our hospital, our research and to our students, faculty and staff**

- Operating at the current site since 1914
- Central Power Plant (CPP) produces electricity, steam (400, 60 & 9lb), compressed air and domestic hot water (LTHW)
- Central campus; approximately 22 million sq ft, 118 buildings
Central Power Plant – Electricity Service Area
Central Power Plant – Heat Service Area
Central Power Plant – Current Assets

• 4 Gas Boilers
• 2 Heat Recovery Steam Generators
• 2 Combustion Turbines
• 2 Steam Back Pressure Turbines

Current Demand Profile:

Heat: 120,000klbs/hr – 600,000klbs/hr
Electricity: 30MW – 60MW
Central Power Plant – Expansion Project

• Expansion Project approval was in January 2017

• Expansion Project schedule – 2019 to 2021

• Install new building that includes a 140,000klbs/hr HRSG and 16.5 MW Combustion Turbine

• Install new 13.2kV switchgear with Microgrid Controls
Central Power Plant – Why install a Microgrid?

• To ensure a resilient supply of energy to our customers

• The Campus experiences electrical outages due to extreme weather events – this trips the CPP and heat production is lost

• The CPP cannot produce enough electricity to cover the summer peak loads, therefore load shedding is required
Central Power Plant – Selecting an Integrator

• Developing the technical specification was challenging

• The complex nature of integrating multiple energy production sources

• Resulted in a 1000+ page document and RoviSys was selected as the preferred vendor
Microgrid Controller (MC)

• SEL-based Microgrid Control System
  • Redundant Controllers
  • Redundant Network
  • Encrypted Traffic
  • High-Speed Communications
MC HMI

• Utilizes the University’s existing DeltaV DCS
  • Continuity in graphics
  • Minimizes training effort
  • Minimizes additional cost for licensing and new equipment

• Backup SEL-based web HMI
MC Network

• Redundant managed switches at every location
• Encrypted traffic between CPP and remote locations
• Utilizes IEC-61850 protocol to determine connections to utility/generation and provide metering data
• Redundant GPS clocks for time synchronization of all PPS control equipment and field relays
MC Controls

• Provides real-time status of all MV switchgear
• Dispatches generators into Isochronous/Droop mode on loss of utility connection
• Provides priority-based load shedding per bus with sub-cycle reaction time on loss of utility
• Provides priority-based load shedding per bus on under/over voltage and frequency
CPP Drawing “As-Builts”

Numerous unknowns with current systems

Nearly 20 enclosures

Various control systems

200+ man-hours onsite
Steam Model

• Simulate the current CPP control system

• Determine shortfalls in current operations

• Analyze effects of adding new steam equipment
Steam Model Implementation

• Merge CPP’s DCS controls with AspenTech HYSYS software

• Steam Production
  • 4 Existing Boilers
  • 2 Existing HRSGs and 1 New

• Steam Handling/Conversion
  • 2 Steam Turbine Generators
  • Several PRVs
Steam Model Outcome

• Analysis of system disturbances (boiler trips, turbine trips, islanding scenarios, etc.)
• Minor DCS logic tweaks
• Load shed on loss of utility will not cause a major steam system disruption
• Operations will be capable of stabilizing during islanded conditions
• Valuable training tool in a controlled environment
Preliminary Results

MINIMAL PERSONNEL INTERACTION, WHICH REDUCES DISTRACTIONS

SUB-CYCLE LOAD SHEDDING

ELECTRICAL LOAD SHEDDING WILL NOT CAUSE STEAM OUTAGE
Design Considerations

• Load shed priority table is critical for each season
• Accuracy of existing equipment drawings is critical
• Use of technology based on existing
• Fit the network to your installation
• Operator interaction vs. automated sequences
• Access prevention for critical controls equipment
Implementation Considerations

• Open communications with customer

• Detailed documentation and test plans

• Thorough factory acceptance testing

• Operations Training is vital
Questions?
Thank You

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