Microgrid Controls to Operate a CHP/Steam Plant

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CampusEnergy2020
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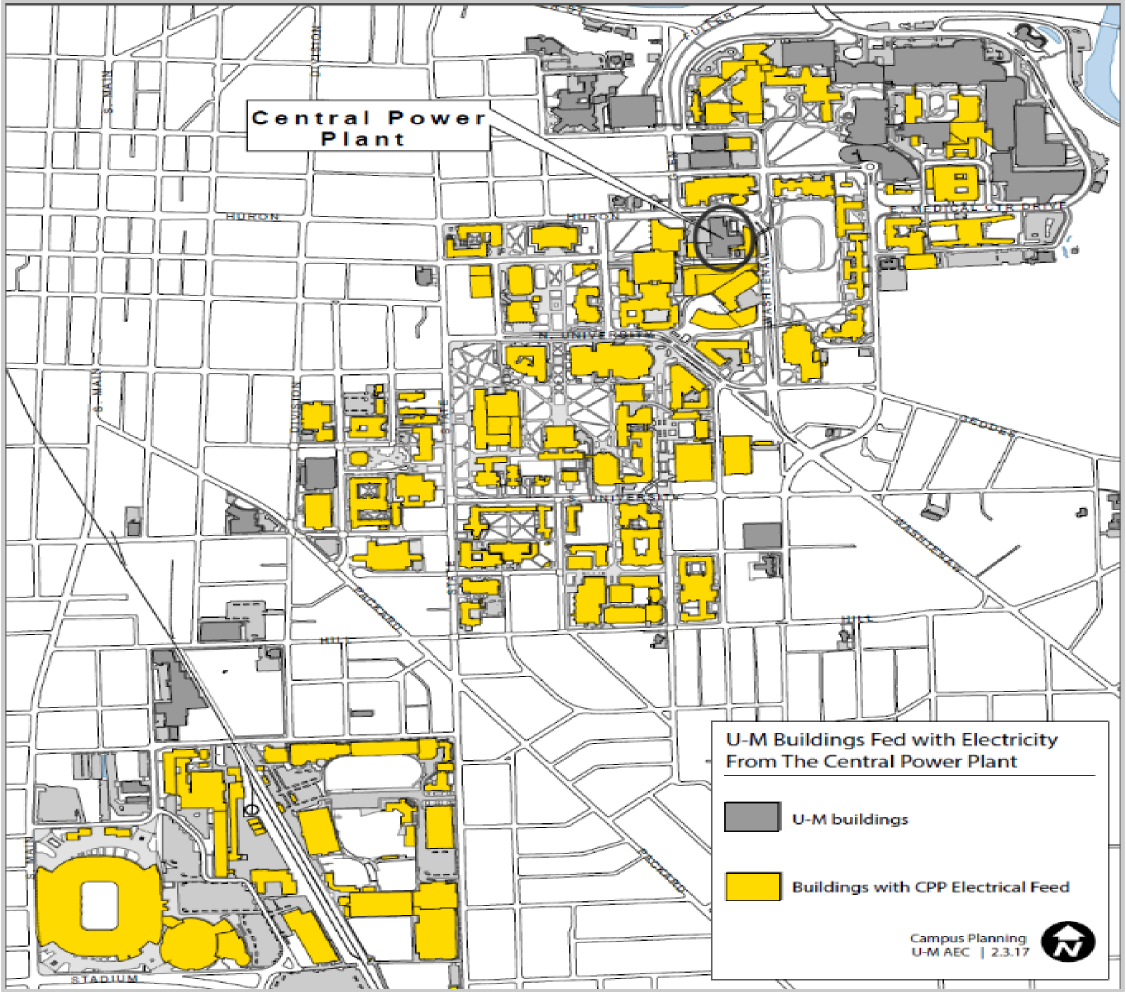
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

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



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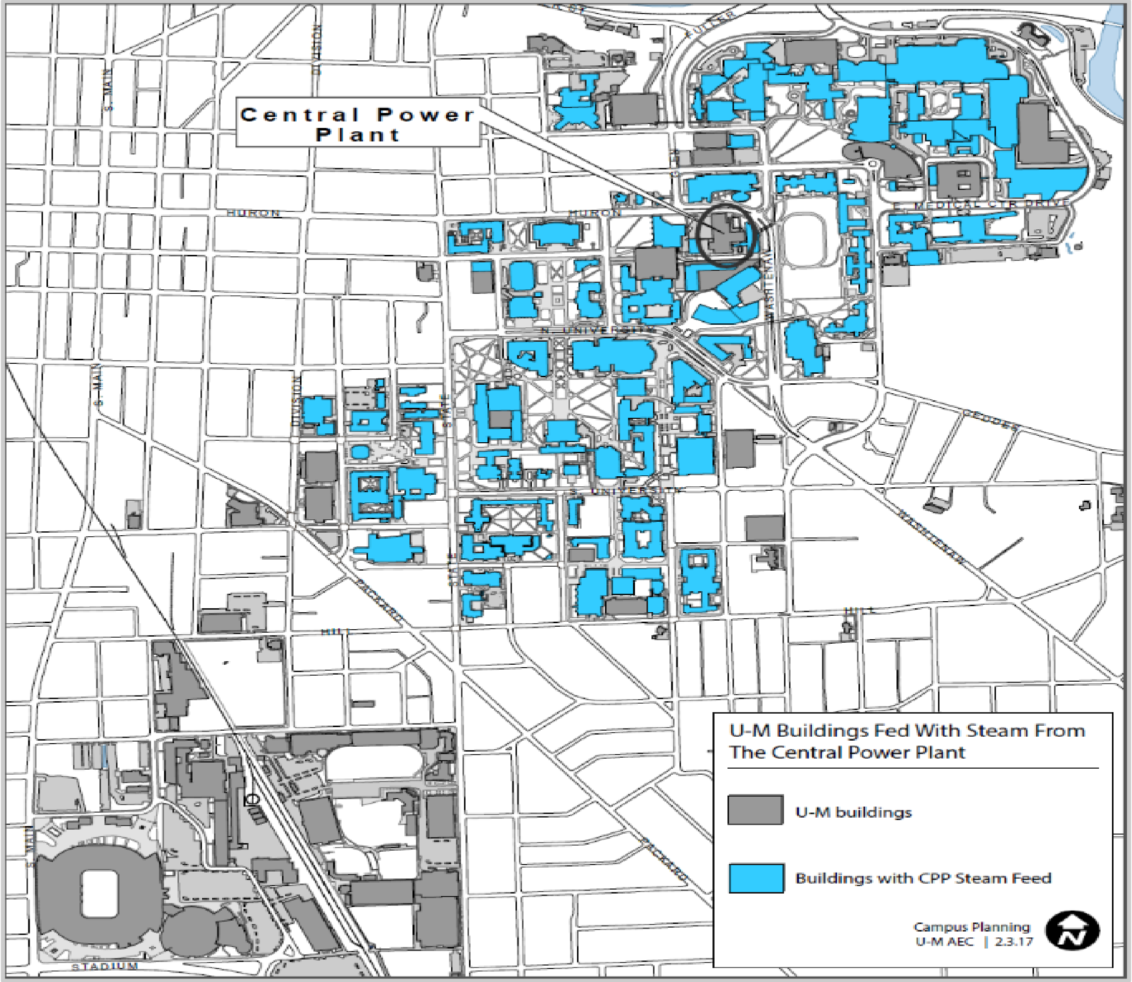
Central Power Plant – Heat Service Area



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

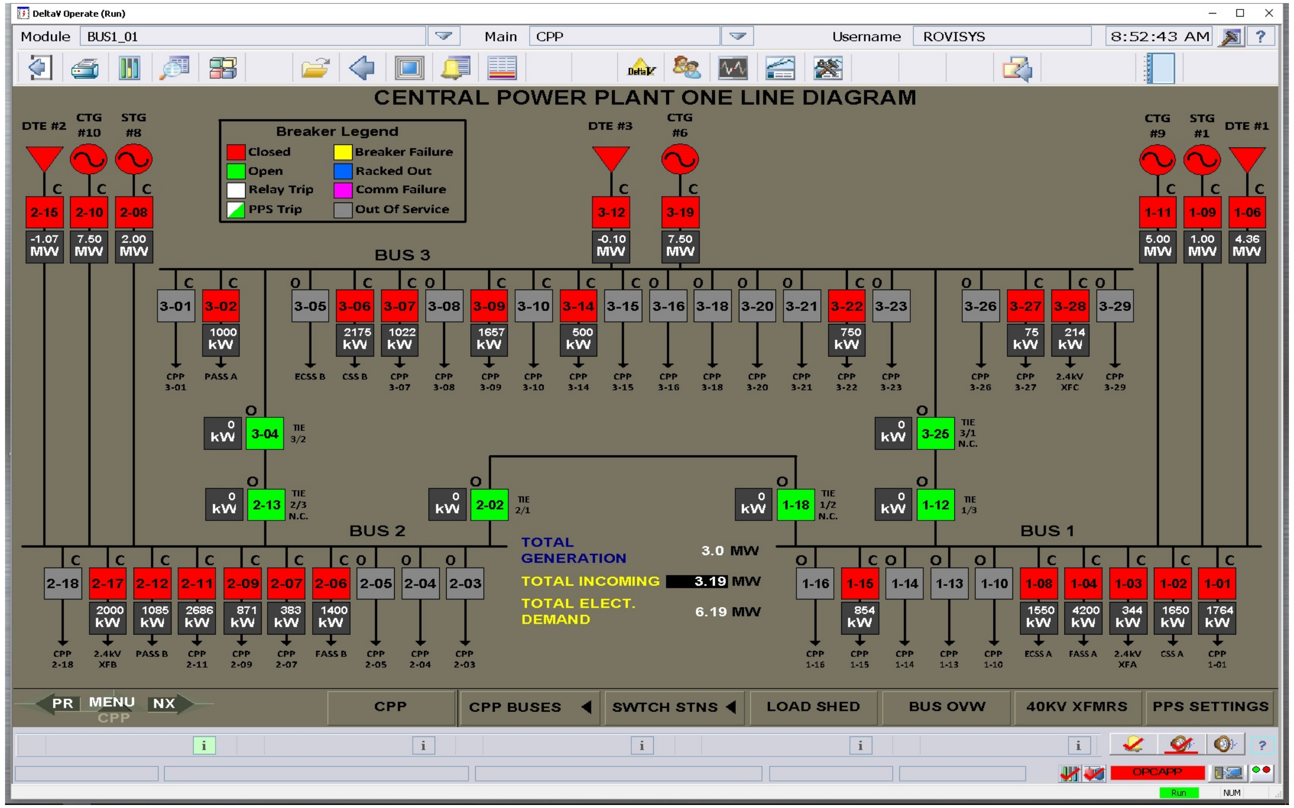
- Developing the technical specification was challenging
- The complex nature of integrating multiple energy production sources
- Resulted in a 1000+ page document and RoviSys was selected as the preferred vendor

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

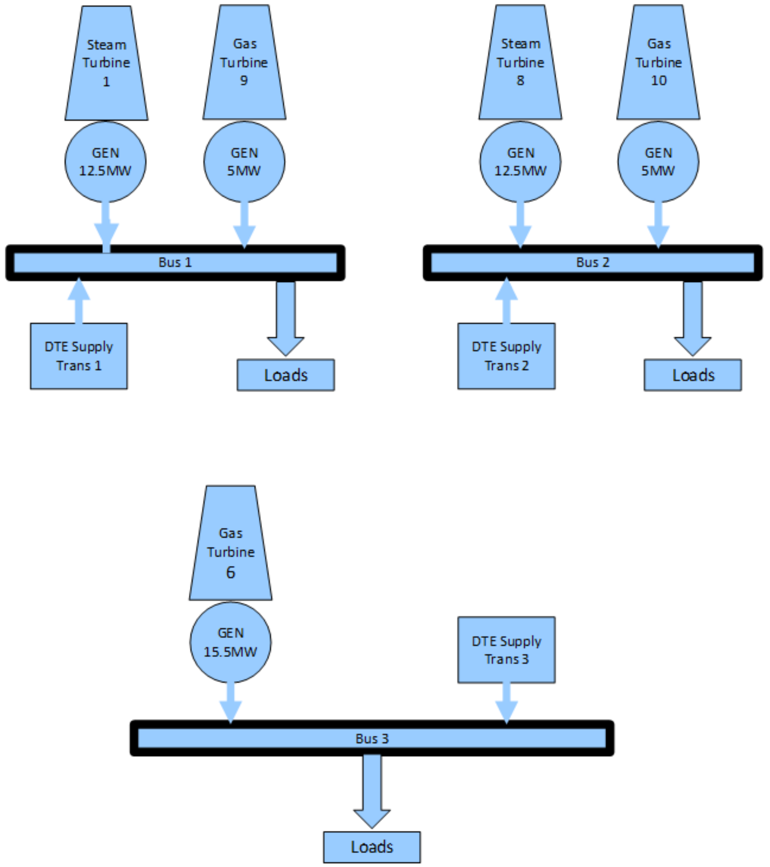
200+ MAN-HOURS ONSITE

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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