Control System Solutions for Hybrid CHP Implementation for Isolated Micro-Grid
Topics of Discussion

• Introductions
• TWA Flight Center Hotel microgrid development project
• What is a microgrid & what is a hybrid CHP/microgrid?
• TWA Flight Center Hotel microgrid case study
• Q&A
Introduction

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Thermo Systems is a national, full-service control systems integration partner with a focus on serving Energy and Consumer markets.

Waldron has extensive experience in the engineering and design of energy generation and distribution systems.
TWA Hybrid CHP/Microgrid System
TWA Engine Enclosure
What is a Traditional Microgrid?

A group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid.

- Able to disconnect from grid (*island mode*)
- Able to parallel with the grid (*parallel mode*)

Graphic Reference:
https://energycenter.org/self-generation-incentive-program/business/technologies/microgrid
What is a Hybrid CHP/Microgrid?

A group of interconnected loads and distributed energy resources that acts as a single controllable entity, BUT with no connection to the electrical grid.

- Fully standalone and self-sustaining
  
  *(no grid interface – ever)*
Challenges

• No grid connection

• Prime mover asset staging/selection priority

• Meeting the Varying hotel energy/thermal loads

• Hotel and convention center customers

• Load balancing of Reciprocating Engine Generators (REG)

Solutions

• Maintain high storage level in batteries to ride out plant or engine trips

• Based on equipment availability, current load conditions,

• Three engine driven and one electric chiller & multiple thermal modes SOO, REG

• Build resilient MG system based on industrial grade PLC technology

• Utilize the Energy Management System functionality within the BOP PLC to drive speed setpoints to REG
  • Changes based on charging or discharging battery modes
Case Study: TWA Flight Center Hotel

TWA Flight Center Hotel’s Microgrid Details:

- Three natural gas reciprocating engine generators 353kW each
- Energy consumers – Lobby/terminal building, hotel towers, convention center
- Engines part of Combined Heat and Power Plant
- Exhaust gas used to create hot water – increased overall efficiency
- Balance of Plant (BOP) controller - chilled water, hot water, condenser water, fuel gas, battery storage, etc..
- Energy Management System controls – staging of prime mover assets based on kW, load, battery charge. System integrates with DI.AN.E controls, Areos and Teco-chil to form a cohesive system.
Microgrid Control System Overview:
• One redundant ControlLogix PLC panel
• Two remote IO panels
• Fiber optic device level ring
• ~650 hardwired IO (includes PCS and vendor skids)
• Wonderware SCADA with Historian
• Two operator workstations (OWS) and one engineering workstation (EWS)
• Two wall-mounted industrial PC OIT’s
• Managed Network Switches
Case Study: TWA Flight Center Hotel
Energy Management System Functions:

• Power usage setpoint control
  • Limits power consumption and draw of major building loads
    (ie. Elevators, Electric Chiller, etc)

• Modes of operation
  • ESS in grid forming mode, NG Engine gensets operate in parallel
  • Diesel Generator in ISOCH, ESS and NG engines operate in parallel
  • NG engines operate in parallel with each other
  • Grid formed by two roll-up Diesel generators
Energy Management System Functions:

• Selects what operating configuration/mode the facility is in for electric generation
• Balances the base load commands to the Engine gensets based on the ESS State-of-charge (SOC)
• Manages the electrical load to create temporary lower loads to transition modes
• Watches cross-system impacts of electric load management to the thermal plant
• Continually uses rate-of-change of residual SOC of ESS to time out the transition to alternate configuration (the “Gas tank” equation)
EMS Ten Year Peak Operating Scenario

P-Bess Control Strategy

Battery discharges to maintain load profile

ESS Discharges to peak
E1+E2+E3
E1+E2
ESS State of Charge
Load
• Why Hybrid CHP/Microgrid with Energy Management System
  ➢ Flexible, resilient technology to maximize system uptime
  ➢ Highly efficient, economical, sustainable, resilient source for power and thermal loads

• Why Battery storage
  ➢ Provides the ability to smooth out load peaks
  ➢ Breaking the link between load demand from generation
    (GENERATE → STORE → DELIVER LATER)

• Why Industrial PLC Plant Control and Energy Management
  ➢ When your system includes critical/complex assets and there is no utility
Questions?