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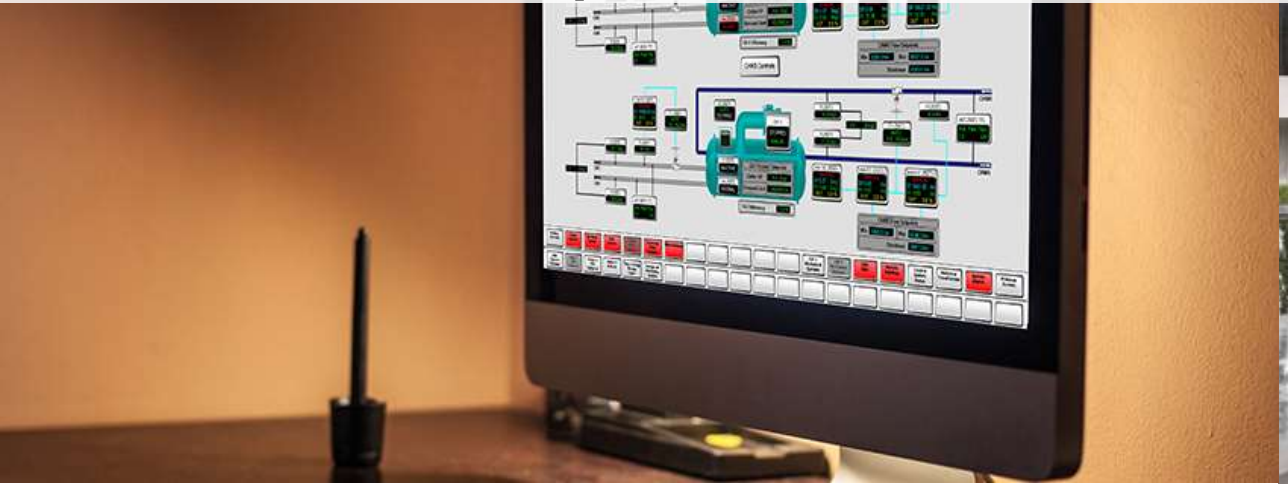
Control System Solutions for Hybrid CHP Implementation for Isolated Micro-Grid



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

Presenters:

Serge Zinger

Account Executive, Thermo Systems

Jeremy Smith, P.E.

Project Manager, Waldron Engineering

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.

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TWA Construction Site (April 2018)

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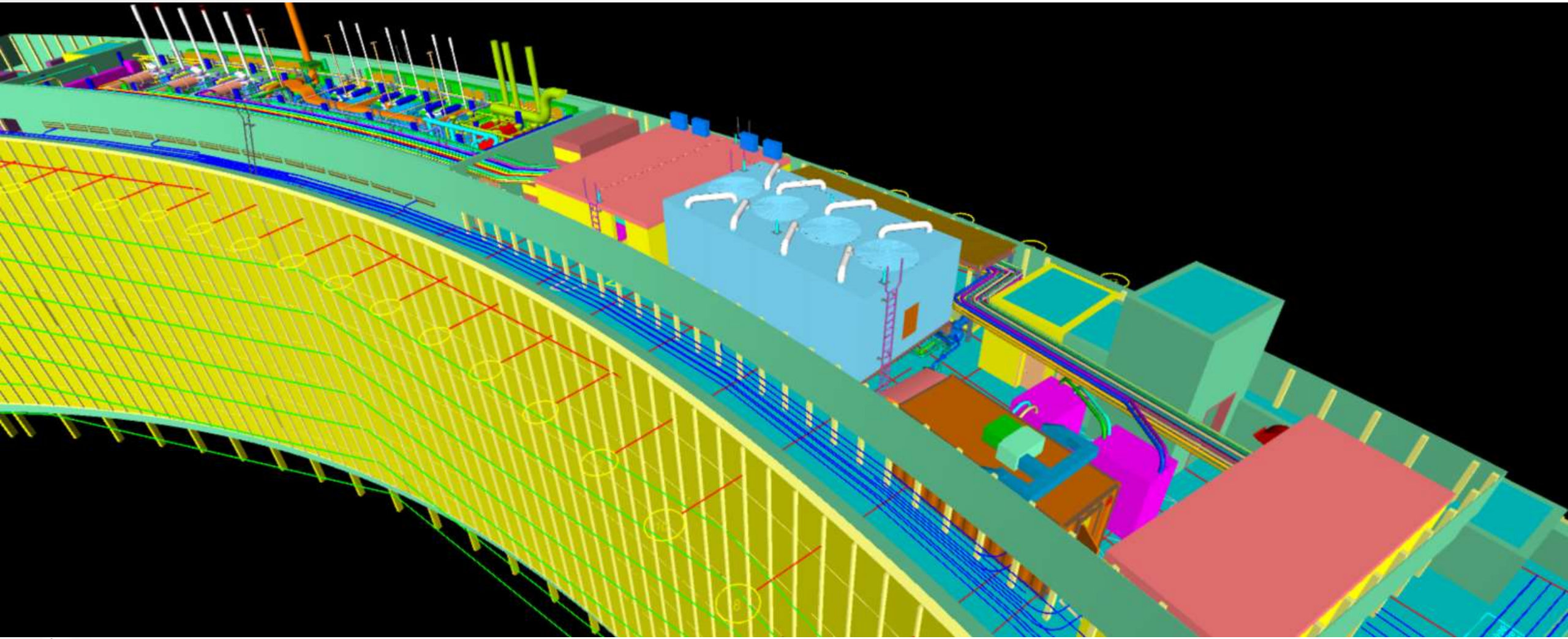
TWA Hybrid CHP/Microgrid System



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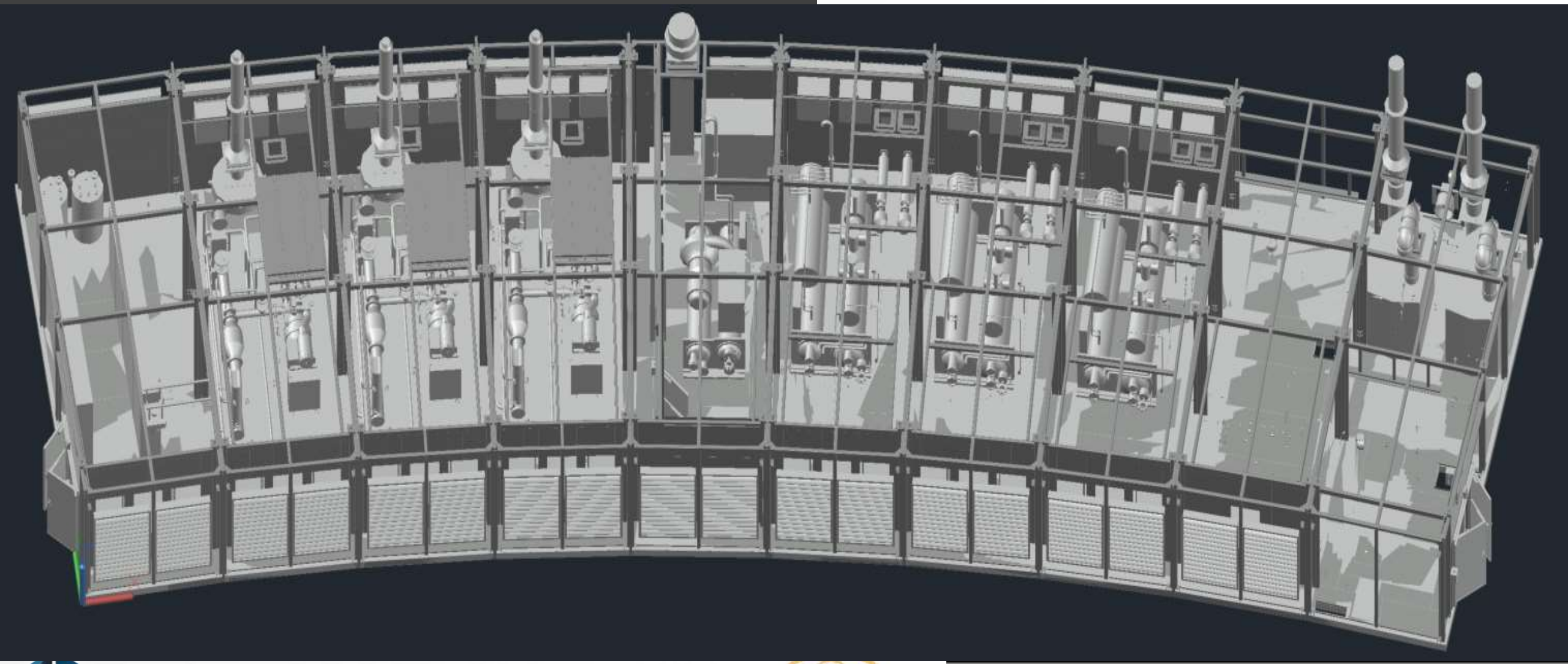
TWA Engine Enclosure



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TWA Engine Enclosure (cont'd)

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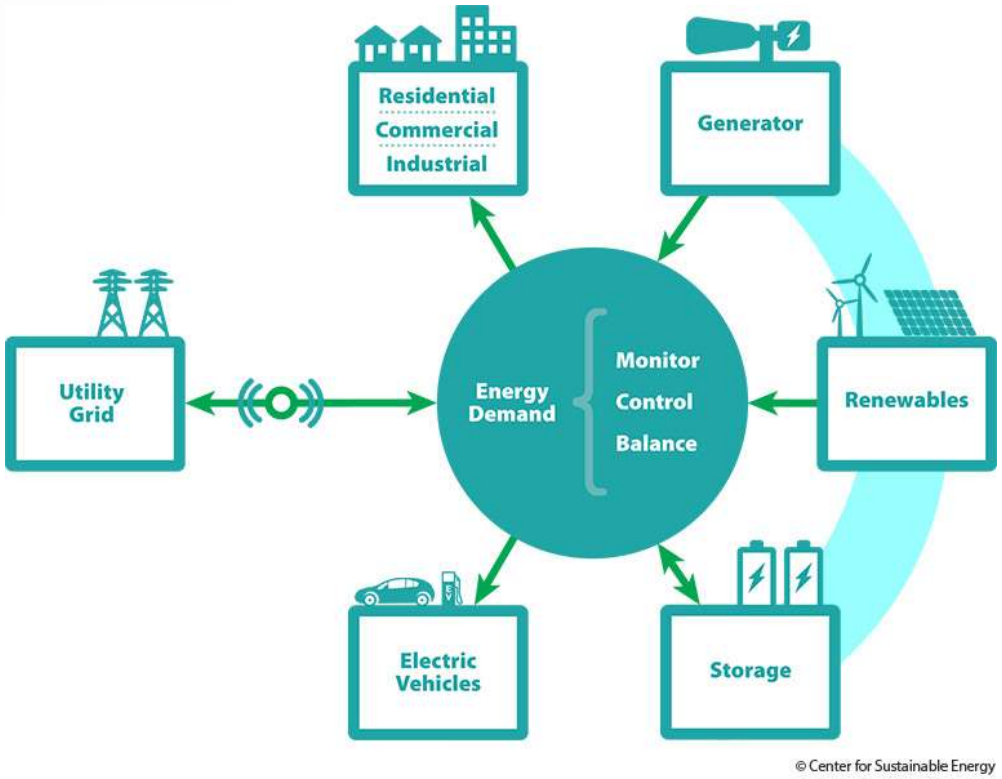
What is a Traditional Microgrid?

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

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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)*






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Case Study: TWA Flight Center Hotel

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

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Case Study: TWA Flight Center Hotel

TWA Flight Center Hotel's Microgrid Details:

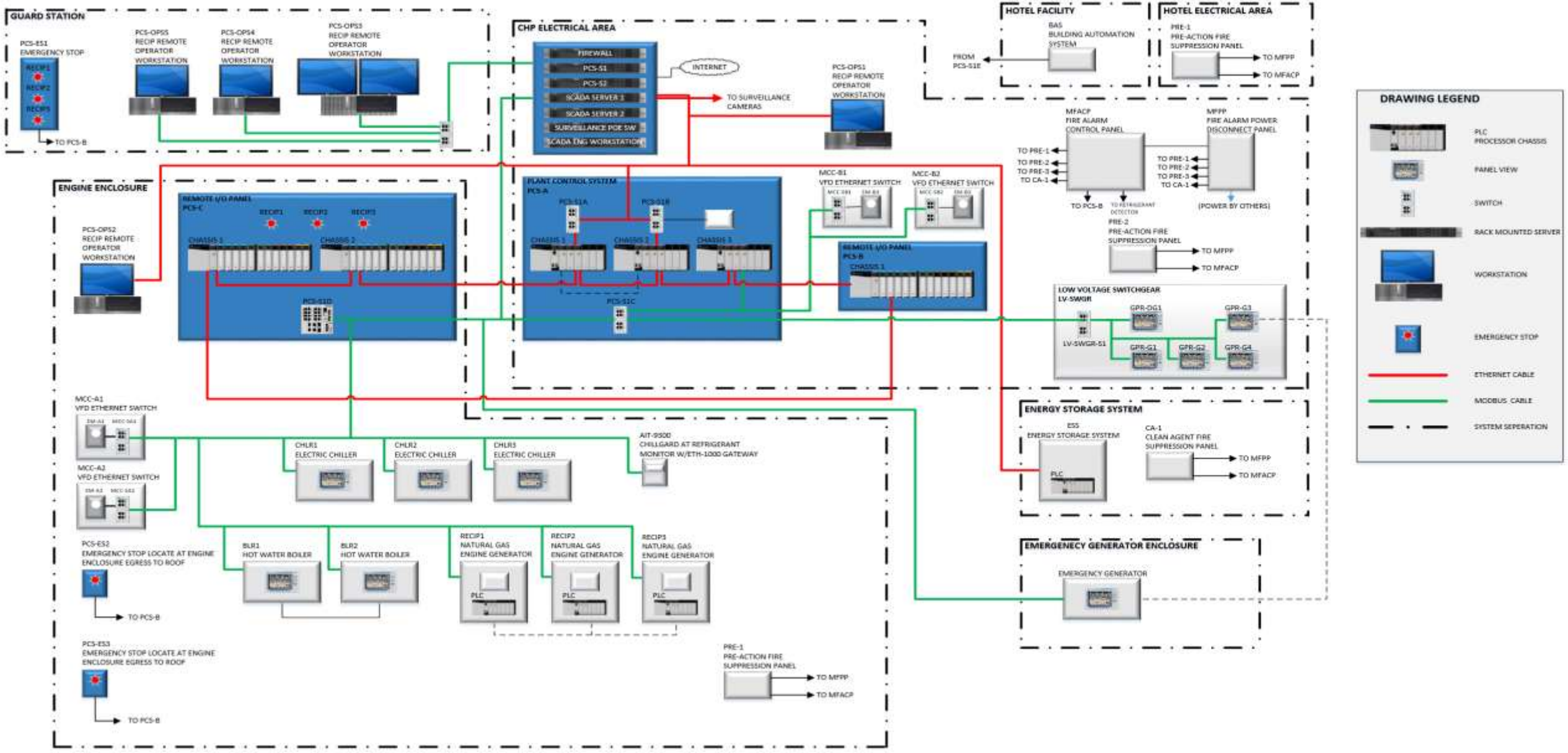
- Three natural gas reciprocating engine generators 353kW each
- Energy consumers – Lobby/terminal building, hotel towers, convention center
- Engines part of Combined Heat and Power Plant
- Exhaust gas used to create hot water – increased overall efficiency
- Balance of Plant (BOP) controller - chilled 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.

Case Study: TWA Flight Center Hotel

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



Case Study: TWA Flight Center Hotel

Energy Management System Functions:

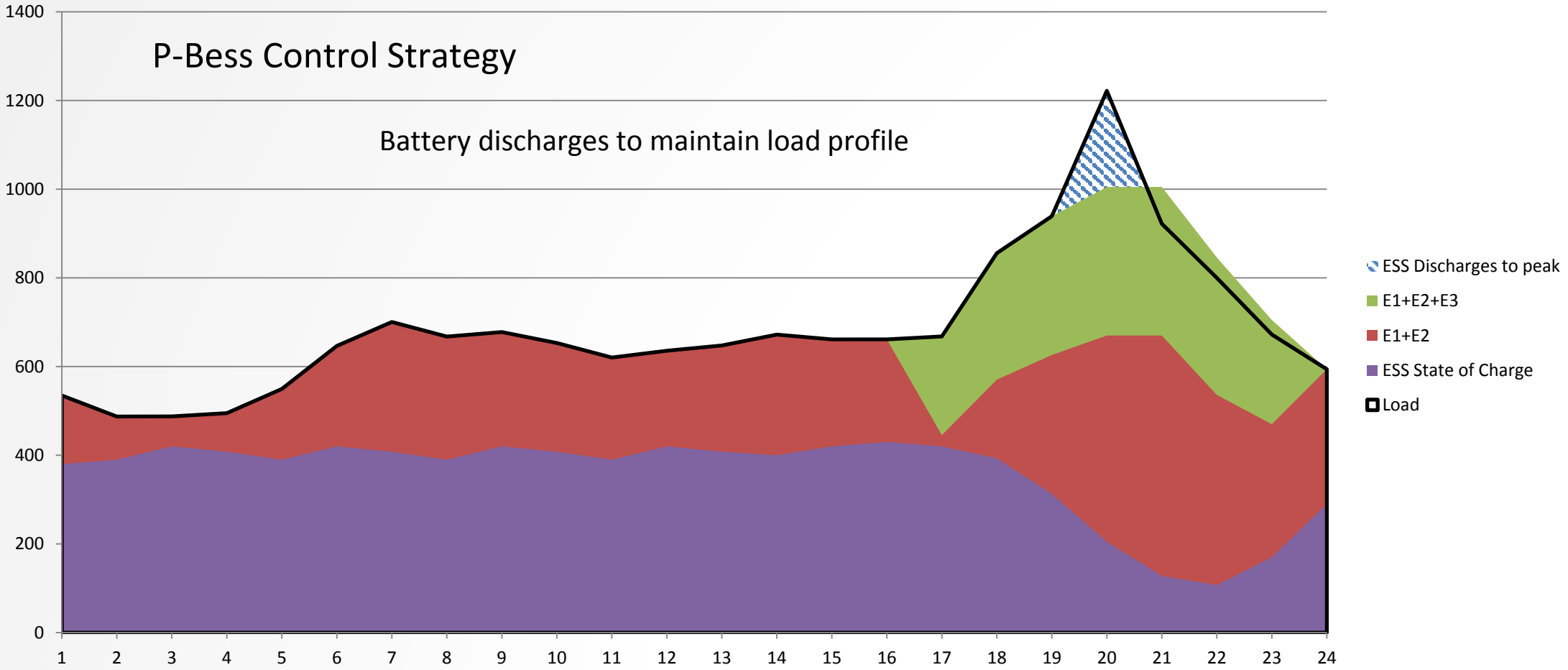
- Power usage setpoint control
  - Limits power consumption and draw of major building loads
    (ie. Elevators, Electric Chiller, etc)
- Modes of operation
  - ESS in grid forming mode, NG Engine gensets operate in parallel
  - Diesel Generator in ISOCH, ESS and NG engines operate in parallel
  - NG engines operate in parallel with each other
  - Grid formed by two roll-up Diesel generators

Case Study: TWA Flight Center Hotel

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)

Hybrid Microgrid Energy Management System (EMS)



EMS Ten Year Peak Operating Scenario

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Closing Message

- 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

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Q&A

Questions?