Critical Aspects of Designing Controls for a Reliable Microgrid

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Topics of Discussion

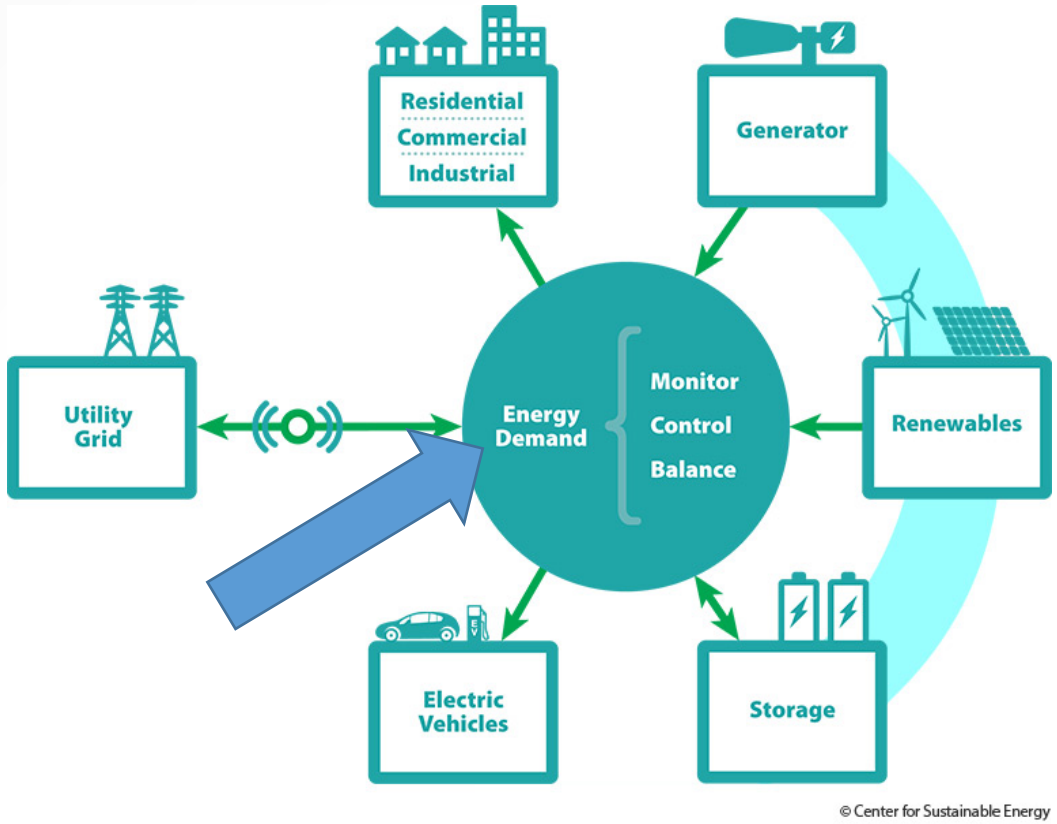
- Overview
- Controls Hardware
- Network Architecture
- I/O Type
- Factory Testing
- Q&A

Overview

Integration and Controls Challenges

- Uptime
- Multiple OEMs
- Each Project is Unique
- Optimization Complexity
- Cybersecurity and Remote Monitoring Requirements
- Limited Opportunity For Real World Testing

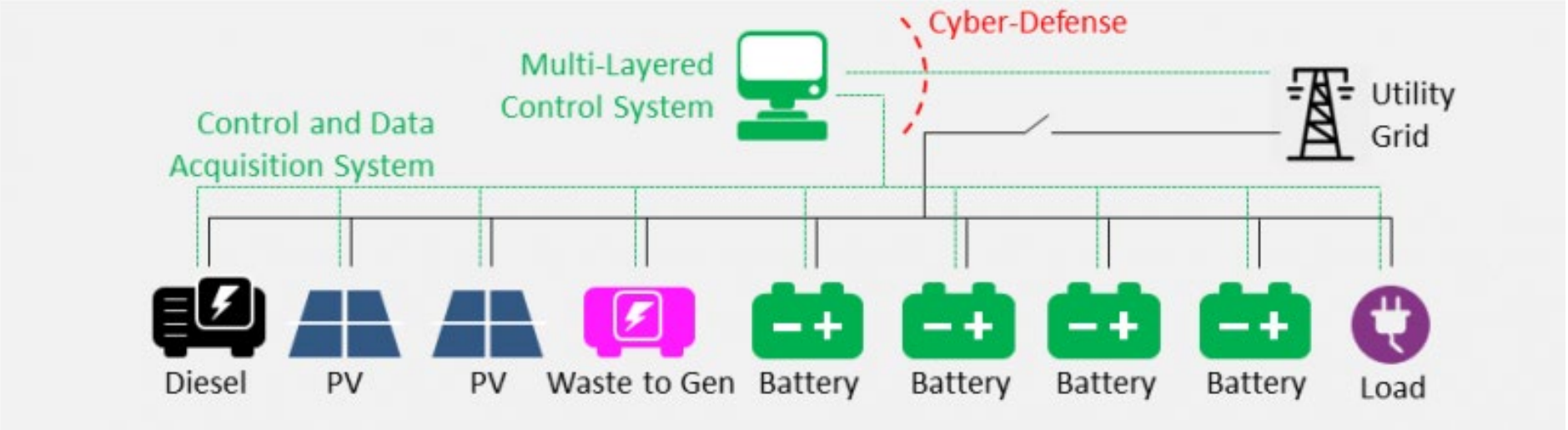
The Microgrid Control System is Key to Project Success



Graphic Reference:
https://energycenter.org/self-generation-incentive-program/business/technologies/microgrid

Hardware Selection

- Controls hardware needs to be industrial grade
  - Consider redundancy
- Standardize if possible
  - Maximize compatibility across systems
- Microgrid controller must accommodate communication protocols of OEMs



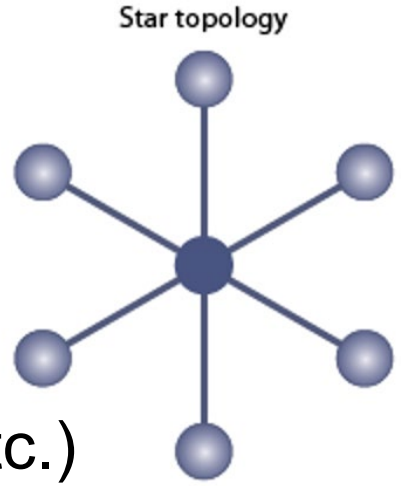
Hardware Selection – Case Studies

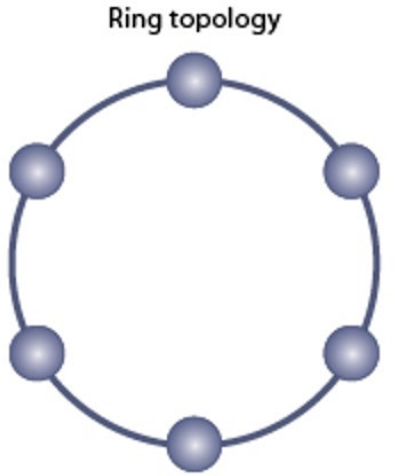
MP Minerals

- 25 MW cogeneration plant
- Generating assets, power management system (PMS), and electrical gear standardized to single industrial grade platform
  - All communications cabling and hardware are fault tolerant
- Systems natively communicate with each other at high speed (~100 ms updates)
  - No need for third party translators
- Reduce spare parts inventory, software licenses, and maintenance personnel training expenses

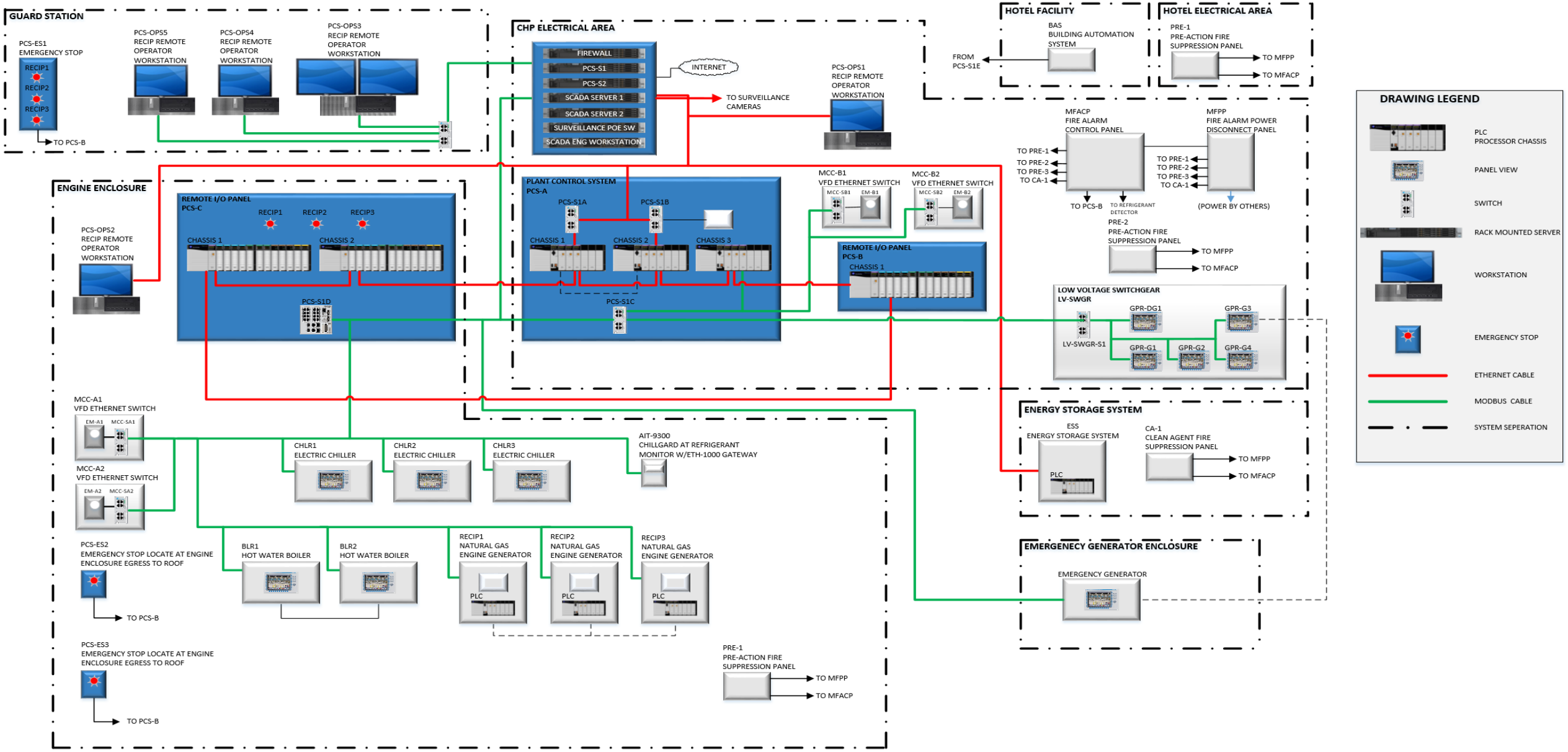
Network Architecture

- Segregate Networks
  - Layers (corporate, SCADA, controllers, I/O)
  - DMZs
  - Separate communication protocols (ethernet, Modbus, DNP3, etc.)
- Managed Ethernet Switches/Routers
  - Limit collisions
  - Fault recovery
- Redundant topology
  - Ring over star
- Cybersecurity
  - Designated Network Administrator





Network Architecture Example



I/O Considerations

Hardwired

Use For Information required For Control Decisions

Pros

- Reliability
- Speed
- Failsafe

Cons

- Electrical Installation Cost
- Additional Hardware

Communicated

Use For Monitoring Information (Trending)

Pros

- Cost effective

Cons

- Can have longer update times
- Less reliable

I/O Considerations – Examples

Citibank Financial Services HQ Microgrid

- Hardwired
  - -Switchgear open/close commands and position feedback
  - -E-Stop circuits
  - -Voltage/Frequency Raise/Lower commands
- Communicated
  - -Electrical data (kw, kvar, PF, etc..)
  - -Fault and trip descriptions, non-critical alarm status

Sequence of Operations (SOO)

- The coordination and optimization of generating assets and loads should be well defined during the design phase
- Equipment vendors need to be aware of their role in the larger SOO scheme
- Schedule regular coordination meetings between the microgrid controller and equipment vendors

SOO - Example

TWA Hotel

- Off grid JFK airport hotel facility with onsite CHP plant
- Reciprocating engines with battery storage and emergency diesel generator
- SOO was well defined in design phase allowing customer to select vendors with proper capabilities.
    - Unique requirements due to the nature of the load and the off-grid status of the microgrid

Factory Testing

Extensive, Coordinated Factory Testing is Critical

- Include OEMs, utility interface, and microgrid controller
- Working out issues in the field leads to quick fixes and band aids
- Decrease startup and commissioning time spent in the field
- Uncover and eliminate showstoppers
- Some test scenarios may be difficult or impossible to schedule
- Every project is unique

Factory Testing - Example

Hudson Yards Cogen

- New mixed-use development on east side of Manhattan
- Interconnect agreement and plant size required extensive interface (< 100 points) with local utility (Con Ed)
- Single day between Thermo Systems and Con Ed allowed for communication between systems and I/O mapping to be verified.
- Reduced startup and commissioning time onsite to less than 1 week.
- Onsite commissioning required commissioning agent, owner, electrical installer, Con Ed, and TS personnel. Reduced commissioning time = savings.

Key Takeaways

- Proper MG controller hardware selection required for smooth integration and resilient microgrid.
- Control system network architectures are complex and cannot be overlooked. Require ongoing maintenance.
- Coordinated factory testing of the control systems minimizes delays during commissioning and increases project success

Key Takeaways

- Upfront planning leads to a more tightly coordinated, optimized microgrid solution.
- Investing in a strong, well thought out microgrid control scheme and sequence of operations during the design phase is key to a successful project.

Q&A

Questions?

THANK YOU!

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