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
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
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
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
## I/O Considerations

<table>
<thead>
<tr>
<th>Hardwired</th>
<th>Communicated</th>
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<tbody>
<tr>
<td><strong>Pros</strong></td>
<td></td>
</tr>
<tr>
<td>• Reliability</td>
<td>• Cost effective</td>
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<tr>
<td>• Speed</td>
<td>• Can have longer update times</td>
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<tr>
<td>• Failsafe</td>
<td>• Less reliable</td>
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<tr>
<td><strong>Cons</strong></td>
<td></td>
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<tr>
<td>• Electrical Installation Cost</td>
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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
• 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
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
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
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.
• 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.
Questions?
THANK YOU!

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