Autoconfiguration of Microgrid Controls

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Mission: Protection of Assets, Environment, and People
Simple and Dependable

Improve Reliability and Reduce Part Count

60 kW Diesel Genset

32 lb of Electronics

3 lb Relay Replacement
Identical Gateways in Every Genset

- Ethernet Port 1
- Ethernet Port 2
- Serial
- Digital I/O

IEC 61850 or Modbus / TCP
Modbus / RTU

MIL-STD-TMS
Unique Genset
Communications Architecture

- Displays
- Computer
- Data Historian
- IEEE C37.118
- Microgrid Controller
- SDN Switch
- MIL-STD-TMS Network
- DIST
- SRC

- MC
Communications Architecture

Displays

Computer

Data Historian

IEEE C37.118

MC

SDN Switch

MIL-STD-TMS Network

DIST

SRC
Autonomous Learning
No Human Involvement

Hi! I’m a generator.

Great! Send me data.

Generator Automation Controller

Microgrid Controller
Interoperable DERs

30 kW Taylor  
30 kW Gillette

100 kW CAT  

60 kW TQG

Loads

Loads

Loads

Loads
Superior Load Sharing and Frequency Control Performance With Resilience Mode

Engine Manufacturer

State-Space Energy Packet Controls

- No overshoot
- No integral windup
- No oscillations
- No tuning
- Full interoperability
Longer Engine Life With Maintenance Mode
Interoperability With Any Size Genset
Reduce Fuel Usage 15 to 73%
Time-Synchronized Condition Monitoring

- Frequency
- Wet Stacking %
- Cooling Water Temp.
- Measured DER Power
- Phase Angle
- Network Traffic
- Dispatch Set Point

Charts showing data trends over time.
Efficiency Mode

30 kW: 90% Efficient
60 kW: 30% Efficient
100 kW: 30% Efficient

Power Output (%)

Efficiency (%)

0 20 40 60 80 100

SDN Redirects Unexpected Traffic

All Traffic → SDN Ethernet Switch → Allowed Traffic

Heads-up Display

Unexpected Traffic
Migrating Technology to Replace ATS

Conventional

ATS

Emergency Load

Normal Load

Normal Load
Migrating Technology to Replace ATS

After TMS Upgrade

IEC 61850 GOOSE

Relay

ATS Eliminated

High-Priority Load

Relay

Normal Load

Normal Load
## Keep it Simple

<table>
<thead>
<tr>
<th>Emergency Stop</th>
<th>Normal Resiliency</th>
<th>Optimal Fuel Usage</th>
<th>Maximum Resiliency</th>
<th>Maintenance Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GEN</strong></td>
<td><strong>STATUS</strong></td>
<td><strong>CONTROL ENABLE</strong></td>
<td><strong>RATING KVA</strong></td>
<td><strong>KW</strong></td>
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<tr>
<td>Gil1</td>
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</tr>
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<td>CAT2</td>
<td>On</td>
<td></td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>
MIL-STD-TMS Conclusions

- Part count reduction
- Optimal resiliency or optimal fuel usage
- Superior cybersecurity and intrusion detection; and faster network healing
- Simple condition-monitoring system
- Cost reductions
Questions?