UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
Energy Management and Sustainability on the Road to 10G

Ensuring HFC Network Resiliency During Extended Utility Outages

Toby Peck
Sr. Director of Broadband Product Management
EnerSys
Background

HFC is the primary source of vital High-Speed Data for millions of users.
Ensuring HFC Network Resiliency During Extended Utility Outages

Background

HFC is the primary source of vital High-Speed Data for millions of users

Increase in Significant Outages
Ensuring HFC Network Resiliency During Extended Utility Outages

Background

HFC is the primary source of vital High-Speed Data for millions of users

Increase in Significant Outages

HFC can meet future bandwidth needs with the 10G initiative, but how can we ensure power availability for this critical HFC service?
Extended Outages: Key Challenges

Definition of Extended Outage:
"An outage that goes beyond the typical site backup time (4 hrs.) plus typical portable generator run time (8 hrs.) = 12 hrs."

Typical HFC powering site:
• Designed for 3-4 hrs of backup
• 3 or 6 batteries
• Space for additional cabinets limited
• High cost of permits for additions or service changes
## Extended Backup Options: Generators

<table>
<thead>
<tr>
<th>PORTABLE GENERATOR</th>
<th>STATIONARY GENERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Flexible option for backup</td>
<td>• Ideal for centralized power</td>
</tr>
<tr>
<td>• Operational strategy</td>
<td>• Large footprint, higher TCO</td>
</tr>
<tr>
<td>• Size ↑, runtime ↑, ease of deployment ↓</td>
<td>• LNG provides extreme runtime</td>
</tr>
</tbody>
</table>
Ensuring HFC Network Resiliency During Extended Utility Outages

Extended Backup Options: VRLA Batteries

- Valve-Regulated Lead-Acid
- Longer life than flooded
- Non-liquid electrolyte (Gel vs. AGM)
- Standard Case size 27 or 31 for HFC
- AGM most resistant to extreme temps
- AGM is rated non-spillable
Ensuring HFC Network Resiliency During Extended Utility Outages

Extended Backup Options: TPPL Batteries

High-Capacity Lead-Acid Batteries

Thin Plate Pure Lead

- Thinner plates =
  - Higher energy density
  - Higher current capacity
  - Faster charging
- Pure lead
  - Reduces positive grid corrosion
  - Longer service life
- Maximum runtime:
  - Case size 31 → 114 Ah
  - High capacity TPPL – 210 Ah

Thin Plate Pure Lead plates are ~1mm

Traditional Lead Acid plates are ~3-4mm

Thin plates allow a greater number of plates to fit in a given case size

Thicker plates allow fewer plates to fit into the same size case
Ensuring HFC Network Resiliency
During Extended Utility Outages

Extended Backup Options: Lithium Ion Batteries

- Accelerating R&D driven by EV market
- Store and release energy by shuttling Lithium Ions between electrodes
- Variance in electrode chemistry defines cell voltage and energy density
- Nickel-Manganese-Cobalt (NMC) and Iron Phosphate (LFP) most common
- Significant increase in energy density over Lead-Acid

Li-Ion: Negative Electrode Voltage by Chemistry

- FeP/Ti
- Mn/Ti
- FeP/C
- NCA/C
- NMC & Mn/C
- Co/C

Voltage:
- 1.9V
- 2.4V
- 3.2V
- 3.6V
- 3.7V
- 3.8V
Figure 3- Spider chart showing key attributes of LFP & NMC Lithium Ion batteries
Layered Safety Design for Lithium Ion Batteries

Layer 1: The tray is designed to physically protect the battery from mechanical abuse

Layer 2: Monitoring of the whole system behavior and controls charge / discharge

Layer 3: Monitoring of each individual cell in the module to check for events that could cause harm

Layer 4: Would rely on this only in an “everything goes wrong” situation—cell construction is designed and built with a high level of safety
Ensuring HFC Network Resiliency During Extended Utility Outages

Lithium System Value

- Enclosure
- BMS
- Lithium Ion Batteries
- Charger / Power Supply
- Remote Monitoring
Ensuring HFC Network Resiliency During Extended Utility Outages

TPPL vs. Lithium Ion Attributes

### Physical Attributes:

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Energy Density</th>
<th>Form Factors</th>
<th>Weight</th>
<th>Physical Orientations</th>
<th>Include BMS Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPPL</td>
<td>High</td>
<td>Many</td>
<td>Heavier</td>
<td>Most</td>
<td>Not required</td>
</tr>
<tr>
<td>Lithium Ion</td>
<td>Higher</td>
<td>Limited</td>
<td>Lighter</td>
<td>All</td>
<td>Yes, required</td>
</tr>
</tbody>
</table>

### Operational Attributes:

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Ventilation</th>
<th>Cut Off Voltage</th>
<th>Cycling Capable</th>
<th>Partial SoC Operation</th>
<th>Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPPL</td>
<td>Limited</td>
<td>Variable</td>
<td>Limited</td>
<td>Limited</td>
<td>98%</td>
</tr>
<tr>
<td>Lithium Ion</td>
<td>None</td>
<td>Fixed</td>
<td>Significant</td>
<td>Excellent</td>
<td>Limited</td>
</tr>
</tbody>
</table>
Scenario 1

Power Supply Load: 4A

Available Space: 1 Pole Mount Enclosure

Fuel Availability: No LNG

Security Concerns: Low Risk

Lead-Acid

Lithium Ion

Portable Generation?

Run Time Range with Best TCO

<21 hours

21–79 hours

>79 hours
Scenario 2

Power Supply Load: 8A

Available Space: 2 Enclosures

Fuel Availability: Natural Gas

Security Concerns: Low Risk

Lead-Acid: <38 hours
Lithium Ion: 38-109 hours
Curbside Generator: >109 hours

Run Time Range with Best TCO
Scenario 3

Power Supply Load: 12A

- 0 Amps
- 12 Amps

Available Space: 2 Enclosures

- None
- Acres

Fuel Availability: Natural Gas

- No
- Yes

Security Concerns: High Risk

- Low-Risk
- High-Risk

Run Time Range with Best TCO:

- Lead-Acid: <25 hours
- Lithium Ion: 25–73 hours
- Curbside Generator: >73 hours

Ensuring HFC Network Resiliency During Extended Utility Outages
Conclusion

You need a suite of solutions

- Lithium Ion Batteries
- Standard TPPL Batteries
- Portable Generators
- High Capacity TPPL
- Curbside Generators
- New Technology R&D
Thank You!

Toby Peck
Sr. Director of Broadband Product Management
EnerSys
Toby.Peck@enersys.com