PEÑA STATION/PANASONIC PILOT

- 1MW/2MWh Younicos Lithium-Ion Battery
  - 4 x Y-cubes at 250 kW
- 1.3MW Carport PV @ 13.2 kV
- 200kW Panasonic rooftop PV
- Microgrid Switchgear and Relays
  - SEL-751 Relay
  - S&C 13.8 kV Islanding Switch
USE CASES

- Microgrid/Islanding of Panasonic building
- Peak Demand Reduction
  - System Peak Demand Reduction (AutoGrid)
  - Feeder Peak Demand Reduction
- Voltage Regulation
- PV smoothing/Ramp Rate Limiting
- Energy Arbitrage
- Frequency Response
Eclipse 08/21/2017 Panasonic Project

PV Max Ramp
Rate ~ 48 kW/s

PV Max Ramp
Rate ~ 4 kW/s
08/21/2017 "Smoothed" Ramp Rate

- **Power (kW)**
- **Time of Day**

- **PV Output**
- **PV+BESS Output**
STAPLETON NEIGHBOURHOOD

- Stapleton feeder has ~18.5% PV penetration
- Utility-Sited Systems:
  - System Provider: Northern Reliability
  - Six Li-Ion battery energy storage systems
  - Sited along the feeder at two different phases
- Behind-the-Meter Systems:
  - System Provider: Sunverge
  - Six Li-Ion battery energy storage systems
  - Sited in a customer’s home
STAPLETON UTILITY SITED
OVERVIEW

• Northern Reliability Modular Units:
  – 2 x 18 kW/69 kWh
  – 2 x 36 kW/138 kWh
  – 2 x 54 kW/207 kWh

• Use Cases:
  – Peak Demand Reduction
  – Voltage Regulation
  – Solar Time Shifting
  – Energy Arbitrage
STAPLETON BEHIND-THE-METER OVERVIEW

- Sunverge SIS units
  - 6 x 6 kW/15.5 kWh

- Use Cases:
  - Providing Residential Backup Power
  - Peak Demand Reduction
  - Solar Time Shifting
  - Volt-Watt Operation
• A charge/discharge test with a fixed duty cycle test can be used to find:
  
  - Efficiency of the system
    \[ \eta = \frac{E_{\text{discharge}} - E_{\text{aux--discharge}}}{E_{\text{charge}} - E_{\text{aux--charge}}} \]
  
  - Charge/discharge capacity compared to the rated energy of system
  
  - Rated continuous charge and discharge power compared to the rated power of the system
TENTATIVE RESULTS
EFFICIENCY (SEPT – OCT TESTING)

Efficiency of SIS Units with Different Operations

Operations

<table>
<thead>
<tr>
<th>STS &amp; SPDR</th>
<th>Net Zero</th>
<th>VRO &amp; SPDR</th>
<th>Bill Management</th>
</tr>
</thead>
</table>
| Efficiency (%)

STS – Solar Time Shifting, SPDR – System Peak Demand Reduction, VRO – Voltage Regulation, Net Zero – Set the Home to have Net Zero
BESS POWER OUTPUT WITH DIFFERING EFFICIENCY

BESS Power Output

High efficiency since the BESS is not performing any operation

Lower efficiency since BESS is performing an intensive operation
SAMPLE TEST
SOLAR TIME SHIFTING

Power (W) vs. Time of Day

- Solar PV Production
- Battery-PV

Charge battery
Discharge battery
PRELIMINARY TEST RESULT
TIME-OF-USE BILL MANAGEMENT

-8,000
-6,000
-4,000
-2,000
0
2,000
4,000
6,000
0:00 3:00 6:00 9:00 12:00 15:00 18:00 21:00 0:00

Peak period

Charge battery

Begin discharging battery

Site meter demand with battery (load convention)
Site meter demand without battery (load convention)
Battery discharges to maintain load at net zero demand
Test Results for BTM Unit

- Set Site Meter to 500 W
- PV Charging
- Charge from Grid

Power (W) vs. Time of Day

Site
PV
Questions
## YOUNICOS ENERGY STORAGE PARAMETERS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Apparent Power</td>
<td>1,000 kVA</td>
</tr>
<tr>
<td>Rated Real Power</td>
<td>1,000 kW</td>
</tr>
<tr>
<td>Rated Energy</td>
<td>2,100 kWh</td>
</tr>
<tr>
<td>Available Energy</td>
<td>1,690 kWh</td>
</tr>
<tr>
<td>Round-Trip Efficiency</td>
<td>85.5 %</td>
</tr>
<tr>
<td>Voltage Range</td>
<td>432-528 V</td>
</tr>
<tr>
<td>Rated Continuous AC Current</td>
<td>1,200 A</td>
</tr>
<tr>
<td>Operating Temp. Range</td>
<td>-10°C - 45°C</td>
</tr>
<tr>
<td>Physical Dimension</td>
<td>42’ x 10’</td>
</tr>
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</table>
## NRI ENERGY STORAGE PARAMETERS

<table>
<thead>
<tr>
<th>Description</th>
<th>18 kW System</th>
<th>36 kW System</th>
<th>54 kW System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Apparent Power</td>
<td>18 kVA</td>
<td>36 kVA</td>
<td>54 kVA</td>
</tr>
<tr>
<td>Rated Real Power</td>
<td>18 kW</td>
<td>36 kW</td>
<td>54 kW</td>
</tr>
<tr>
<td>Rated Energy</td>
<td>69 kWh</td>
<td>138 kWh</td>
<td>207 kWh</td>
</tr>
<tr>
<td>Round-Trip Efficiency</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage Range</td>
<td></td>
<td>172 – 264 V</td>
<td></td>
</tr>
<tr>
<td>Rated Continuous AC Current</td>
<td>94 A</td>
<td>187 A</td>
<td>281 A</td>
</tr>
<tr>
<td>Operating Temp. Range</td>
<td>-30°C -50°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Dimension</td>
<td>56” x 52.75” x 53”</td>
<td>112” x 52.75” x 53”</td>
<td>159” x 52.75” x 53”</td>
</tr>
</tbody>
</table>
**SUNVERGE SIS UNIT**

- Hybrid Inverter (4.5kW or 6kW rated)
- IO Board
- Solar Charge Controller (150V or 600V MPPT)
- Distribution Panel
- Application Gateway
- Outdoor rated cabinet
- Lithium-ion Battery (Scaleable to 19.4 kWh)
- Polycrrete pad
## SUNVERGE ENERGY STORAGE PARAMETERS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Apparent Power</td>
<td>6 kVA</td>
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<tr>
<td>Rated Real Power</td>
<td>6 kW</td>
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<td>Rated Energy</td>
<td>15.5 kWh</td>
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<tr>
<td>Available Energy</td>
<td>11.64 kWh</td>
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<tr>
<td>Round-Trip Efficiency</td>
<td>92.5 %</td>
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<td>Voltage Range</td>
<td>233 – 247 V</td>
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<tr>
<td>Rated Continuous AC Current</td>
<td>25 A</td>
</tr>
<tr>
<td>Operating Temp. Range</td>
<td>-20°C - 50°C</td>
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<tr>
<td>Physical Dimension</td>
<td>76” x 34” x 14 “</td>
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