SMUD’s Experience with Interconnection of PV

David Brown P.E.
May 8th 2019

Powering forward. Together.
About Sacramento Municipal Utility District (SMUD)

- 626,000 meters
- 1.5 million population
- $1.5 billion in revenues
- 900 mi², 2304 km² service territory
- 7 member, elected Board of Directors
- Not-for-Profit Utility

- 2nd largest muni in California, 6th largest in the US
- 2219 employees
- 3299 MW peak load (2006)
- 460 MW of PV under contract
Process Improvement

Old Process - Highlights
• Paper Applications
• Solar Specialist reviewed application and did data entry
• Distribution System Planner did each single-line review
• Solar Specialist inspects installation, and coordinates with City Building Inspector
• Paper notification sent to update Billing

New Process - Highlights
• On-line Applications
• New Business Designer reviewed
• Distribution System Planners review only complex designs
• Meter Tech inspects
• E-mail to City inspector to release
• Billing updated directly
PowerClerk 2 – Application Tool
from Clean Power Research

- On-line Interconnection Application
  - Customer and Site information
  - Input proposed system information – Smart Inverters
- Calculates
  - Estimates system annual output for Net-Energy Metering (NEM) program compliance
- Scan in documents
  - Recent billing
  - Layout Drawing
  - Electrical Single-line drawing
- Communicates
  - Auto generates status e-mails to applicant and their contractor
2016 CEC705.12D(2)(3)b Connection

- \((7600W / 240V) \times 1.25 = 39.58\) Amps is less than 40 Amps
- Production meter is shown on single line
- Disconnect switch shown in approved location
- Main panel \((200 \times 1.2) = 240\) max PV breaker is 40 amps (Main can be derated to 175 allowing a max PV breaker of 65 amps)
Voltage Rise

Situation

Additional residential solar installations can result in a local high voltage on the shared secondaries and services. Solutions:

1. Install a dedicated transformer(s)
2. Increase the size of the secondary conductors
3. Install a voltage regulating transformer(s)
4. Enable Smart Inverter Features (Volt/VAr, Volt/Watt)
5. Employ battery storage during minimum load
Smart Inverter Volt-VAR
Smart Inverter Volt-Watt
Increasing Hosting Capacity with Smart Inverters

**Without Volt/var Control**

- Maximum Feeder Voltages vs. Increasing penetration (kW)
- ANSI voltage limit
- 5000 cases shown, each point = highest primary voltage

**Volt/var Control**

- Maximum Feeder Voltages vs. Increasing penetration (kW)
- ANSI voltage limit

### PV Hosting Capacity (kW)

<table>
<thead>
<tr>
<th>Primary Voltage Deviation</th>
<th>Without Volt/var</th>
<th>With Volt/var</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st violation</td>
<td>938</td>
<td>&gt;2500</td>
</tr>
<tr>
<td>50% scenarios with violation</td>
<td>1323</td>
<td>&gt;2500</td>
</tr>
<tr>
<td>All scenarios with violation</td>
<td>1673</td>
<td>&gt;2500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Over Voltage</th>
<th>Without Volt/var</th>
<th>With Volt/var</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st violation</td>
<td>540</td>
<td>880</td>
</tr>
<tr>
<td>50% scenarios with violation</td>
<td>871</td>
<td>1464</td>
</tr>
<tr>
<td>All scenarios with violation</td>
<td>1173</td>
<td>2418</td>
</tr>
</tbody>
</table>

**160% increase in hosting capacity**

**60% increase in hosting capacity**
Thank You

David Brown P.E.
May 8th 2019

Powering forward. Together.