Software controls for storage interconnection

NY ITWG
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Stem Overview

Stem operates the world’s smartest and largest digital energy storage network

Founded: 2009
Headquarters: Millbrae, CA
Employees: 150+
Operations In: CA, HI, NY, TX, MA, Japan, ONT
Installed: 500+ sites, 3.5M+ device hours
Project Finance: >$500 MM

High Caliber Global Investors

ANGELENO GROUP

Distinguished Honors & Awards

SEPA Power Player 2017: Innovative Partner of the Year
Objectives

New York Energy Storage Roadmap

• Ambitious storage targets
• Expanding market opportunities for distributed storage
• Already launched NY Sun storage incentive
• Market Acceleration Bridge Incentive coming soon

Can software controls reduce costs and timelines of storage interconnection?

Two objectives within this question

• Safety and Reliability – primary purpose of interconnection processes
• Accounting – configuration and metering to meet program requirements
Non-export for reliability

- Traditional interconnection, for PV, assumed potential export up to nameplate capacity
- Modern tariffs distinguish non-export with several options to qualify
- Simplest method is hardware relay: non-export or min import
- Hardware relays can get very expensive (e.g. $20K for one project in CA)

Qualified BTM non-export systems should be faster and cheaper to interconnect

Non-export qualification matters for power flow analysis but not for protection, like fault current

All of Stem’s hundreds of CA installations are BTM non-export
• Stem system qualifies for Rule 21 Option 2: minimum import

• Minimum import determined by size of customer service

• Utility tests configuration at customer site

• Once approved, configuration can be reused without re-testing

• Approval did not involve industry standards or certifications
Max Export: Solar+Storage

Power flow studies should use max export, not combined nameplate

- Traditional interconnection studies combined nameplate of all inverters
- Storage has fine-grained control over export timing and amount
- NY SIR 2018 Update included max export concept
- AZ rules revised 2019 approves ”max capacity”
- MA utilities say “site limiting schemes are considered”
- HI rules say “maximum amount of export as permitted by the existence of an on-site limiting element that caps the amount of the...export at the PCC”

If controls can limit to zero (non-export), then limiting to a max export number works just the same
Key Considerations

I. Can software controls respond quickly enough?
   I. Anti-islanding standards are sub 2 seconds
   II. Protective devices can be hundreds of milliseconds
   III. Networked Secondaries have tighter requirements (much of ConEd territory?)
   IV. Potential to adjust network protection devices (reclosers)

II. How to ensure software is installed and configured properly?
   I. Installer limited to small set of options
   II. Design allows inspectors to review configuration profiles

III. How to ensure software changes don’t break controls?
   I. Retesting / re-certification regimes
   II. Software change security measures limit changes to manufacturer
   III. Ultimately, need to trust interconnection agreement
Metering for Hybrid Tariff:
Option A – Renewable Charging

<table>
<thead>
<tr>
<th>Compensation methodology</th>
<th>Option A Renewable Charging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Storage charges exclusively from renewable generator</td>
</tr>
<tr>
<td>E value</td>
<td>✔ Net hourly injections at PCC</td>
</tr>
</tbody>
</table>
| MTC                       | 1 or 2 or 3
| Capacity Value            | Alternative 1 or 2 |
| # of utility revenue grade meter | 1 or 2 or 3 |

Only one (1) meter is needed in certain cases:
- DC-coupled system, unidirectional inverter
  - Only 1 meter is needed since Storage can only charge from renewable generator
- AC-coupled system, bidirectional inverter on Storage
  - Only 1 meter is needed if controls are in place

Control method:
- Max export
- Max import
- Time of day export
### Metering for Hybrid Tariff: Option B – Renewable Charging

Only one (1) meter is needed in certain cases:
- DC or AC-coupled system, bidirectional inverter
  - Only 1 meter is needed if controls are in place
- Control method:
  - Max export
  - Max import
  - Time of day export

<table>
<thead>
<tr>
<th>Compensation methodology</th>
<th>Option B Controls Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Only renewable generator injects into grid</td>
</tr>
<tr>
<td>E value</td>
<td>Net hourly injections at PCC</td>
</tr>
<tr>
<td>MTC</td>
<td>✔</td>
</tr>
<tr>
<td>Capacity Value Alternative 1 or 2</td>
<td>1 or 2 or 3</td>
</tr>
<tr>
<td># of utility revenue grade meter</td>
<td>1 or 2 or 3</td>
</tr>
</tbody>
</table>

![Diagram of hybrid system with metering options](image)
## Program Comparisons

<table>
<thead>
<tr>
<th></th>
<th>NY Hybrid</th>
<th>CA NEM</th>
<th>MA NEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Charged</td>
<td>Option A</td>
<td>“No Grid Charging”</td>
<td>Config 2</td>
</tr>
<tr>
<td>Storage non-export</td>
<td>Option B</td>
<td>“No Storage Export”</td>
<td>Config 3</td>
</tr>
<tr>
<td>Flexible</td>
<td>Option C</td>
<td>NGOM</td>
<td>Config 4 (not approved)</td>
</tr>
<tr>
<td>Net Export</td>
<td>Option D</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

CA Decision, Jan 2019, authorized software controls for Solar Charged and Storage non-export options

Important! Software controls approval can be based on national standards *or* testing regime approved by utility
UL 1741 – Power Control Systems

- Certification Requirements Decision (CRD) published X date
- UL does not distinguish between firmware and software
- Originally designed for accounting/metering but general enough for safety & reliability
- UL will test against the specs given to them
- Software changes – still open question
Recommendations

All states should define how software controls can be used in place of hardware controls or meters

- NY Utilities clarify how max export is verified and used in practice
- NY SIR specifies situations where software can replace hardware relays
- VDER Hybrid Tariff specifies where software can replace meters

New York should formally allow use of UL standard *and* develop more "lightweight" testing regime