Software controls for storage interconnection

NY ITWG

February 2019

stem

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

GE · RWE · MITHRIL · Constellation. An Exelon Company · ANGELENO GROUP · MITSUI & CO., LTD. · IBERDROLA · ACTIVATE capital · TOTAL · ONTARIO TEACHERS' PENSION PLAN

Distinguished Honors & Awards

SEPA Power Player 2017: Innovative Partner of the Year

WORLD ECONOMIC FORUM · ENERGY EXCELERATOR · GRIDEDGE 20 · 100 · Bloomberg WINNER · SEPA POWER PLAYERS

Objectives

NEW YORK STATE OF OPPORTUNITY. | Reforming the Energy Vision

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

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Non-export for reliability

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

All of Stem's hundreds of CA installations are BTM non-export

- 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)

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

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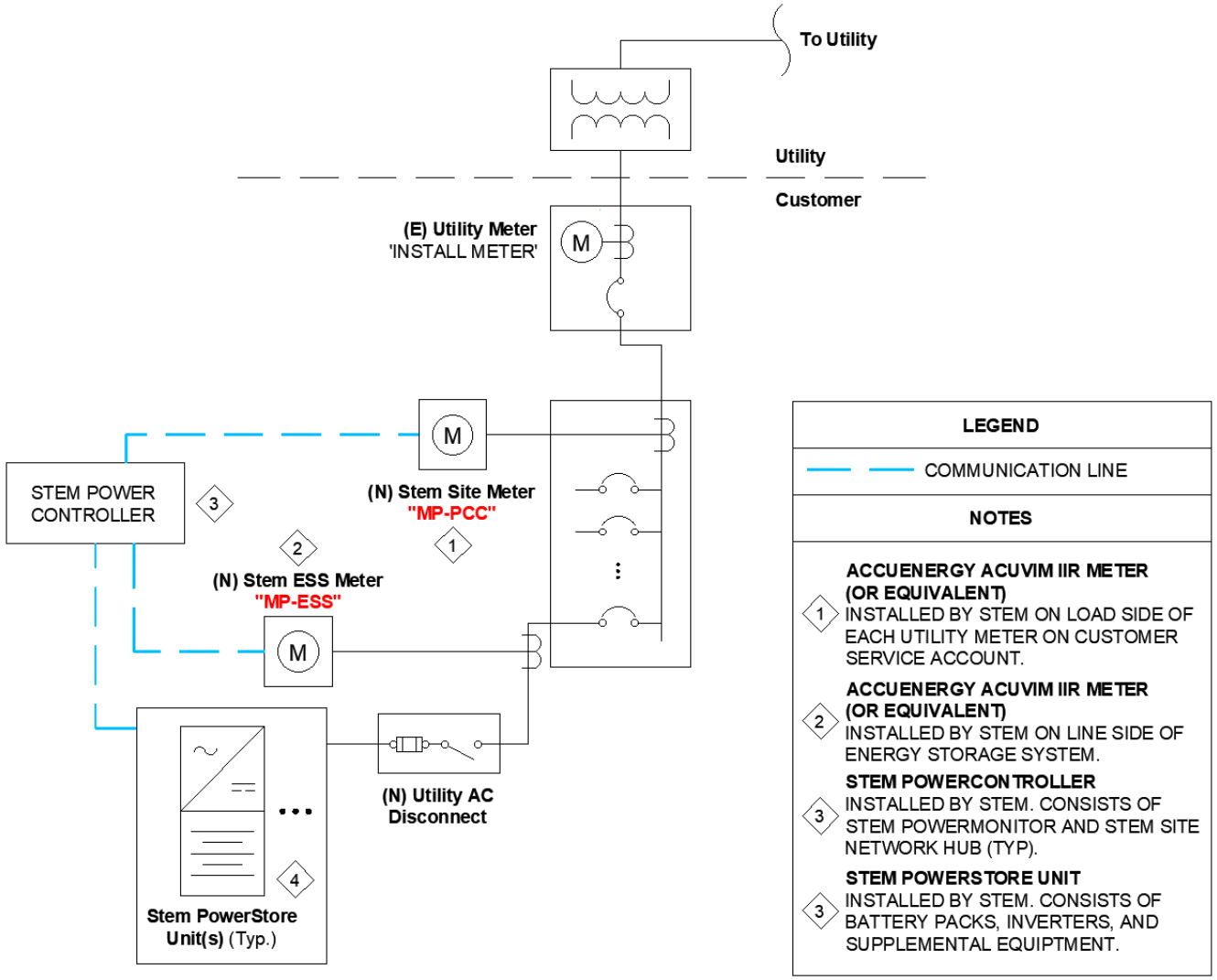
Basic software controls: non-export



- 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

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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

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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

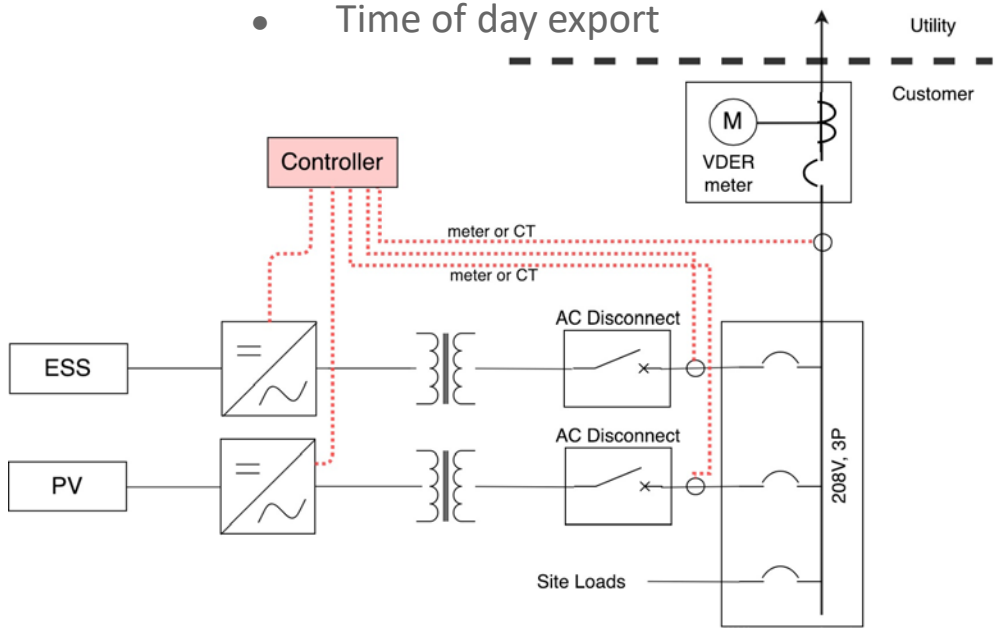
III. **How to ensure software changes don't break controls?**
   I. Retesting / re-certification regimes
   II. Software change security measures limit changes to manufacturer
   III. Ultimately, need to trust interconnection agreement

Metering for Hybrid Tariff:
Option A – Renewable Charging

Compensation methodology	Option A Renewable Charging
Description	Storage charges exclusively from renewable generator
E value	✔ Net hourly injections at PCC
MTC	
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

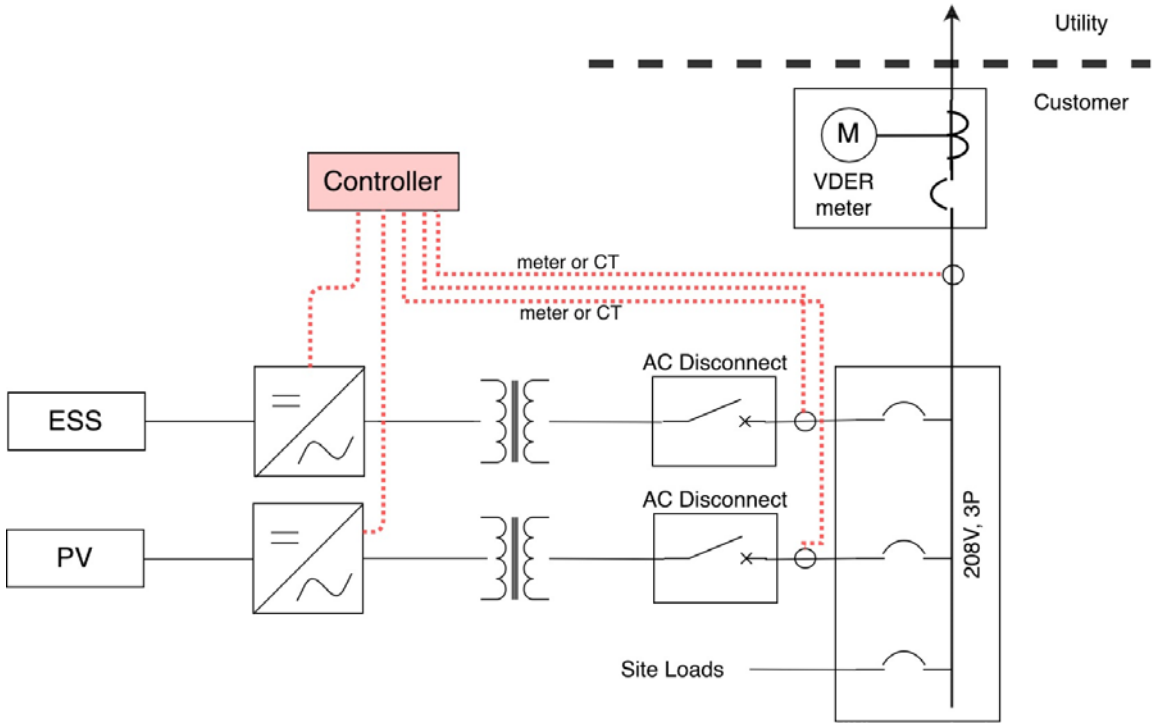


Metering for Hybrid Tariff:
Option B – Renewable Charging

Compensation methodology	Option B Controls Configuration
Description	Only renewable generator injects into grid
E value	✔ Net hourly injections at PCC
MTC	
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 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



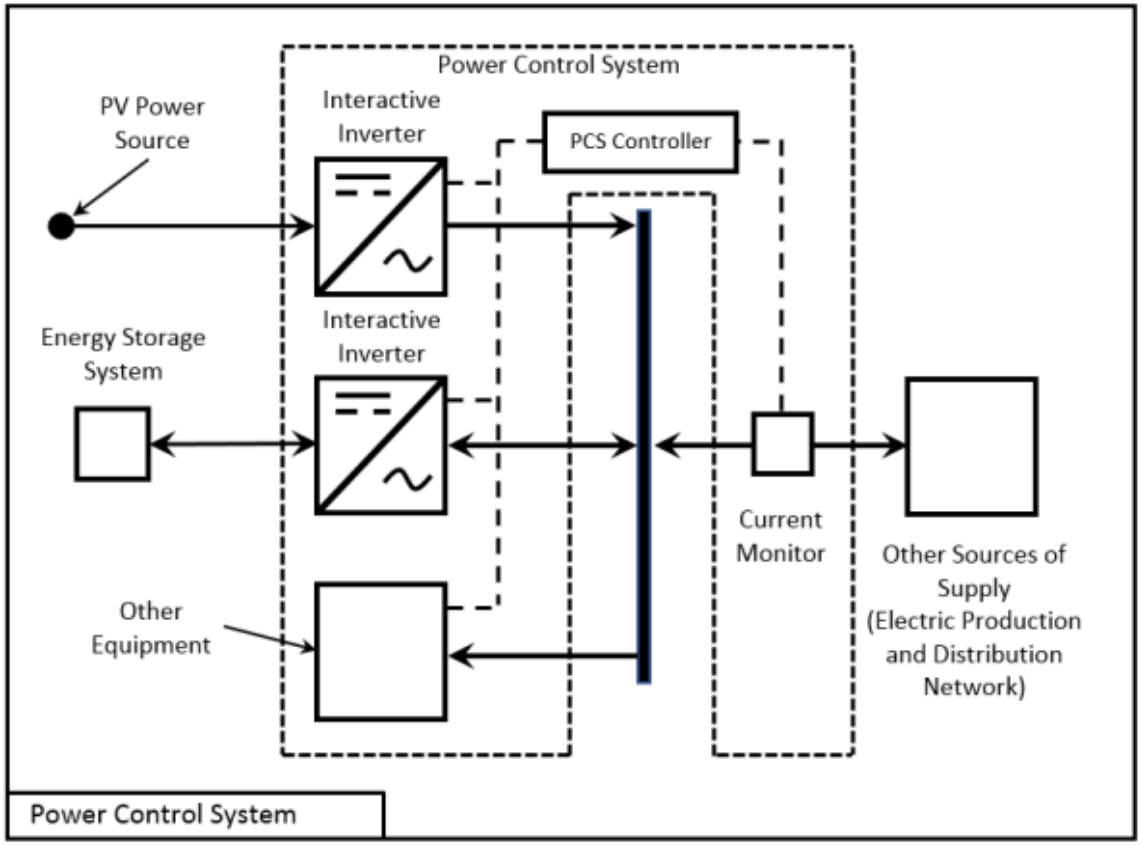
Program Comparisons

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

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

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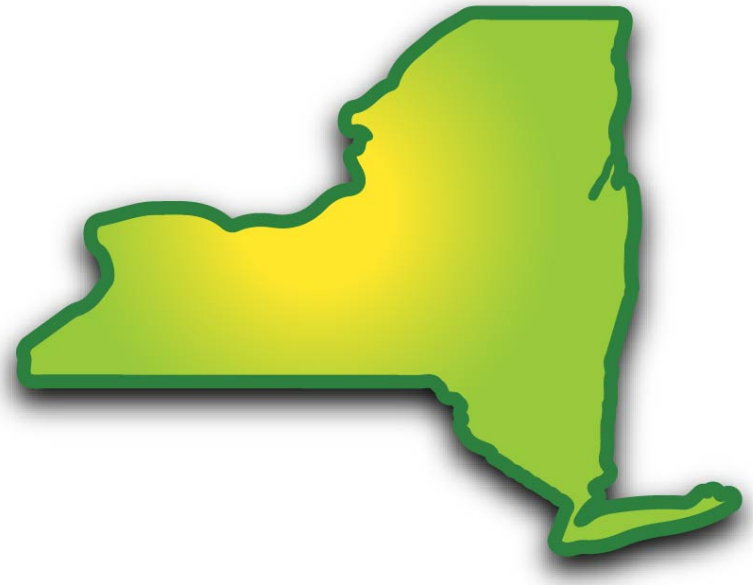
Recommendations

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

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