Solar*Rewards Community Subgroup Meeting

9/16/2019

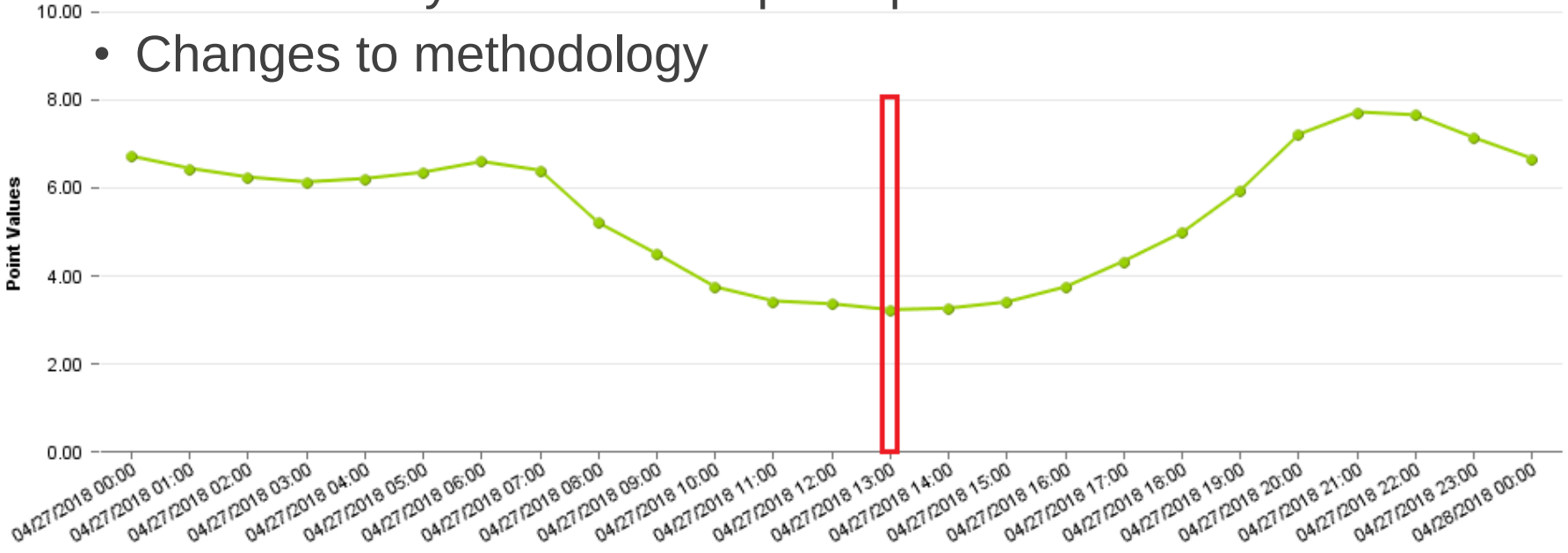
Meeting Agenda

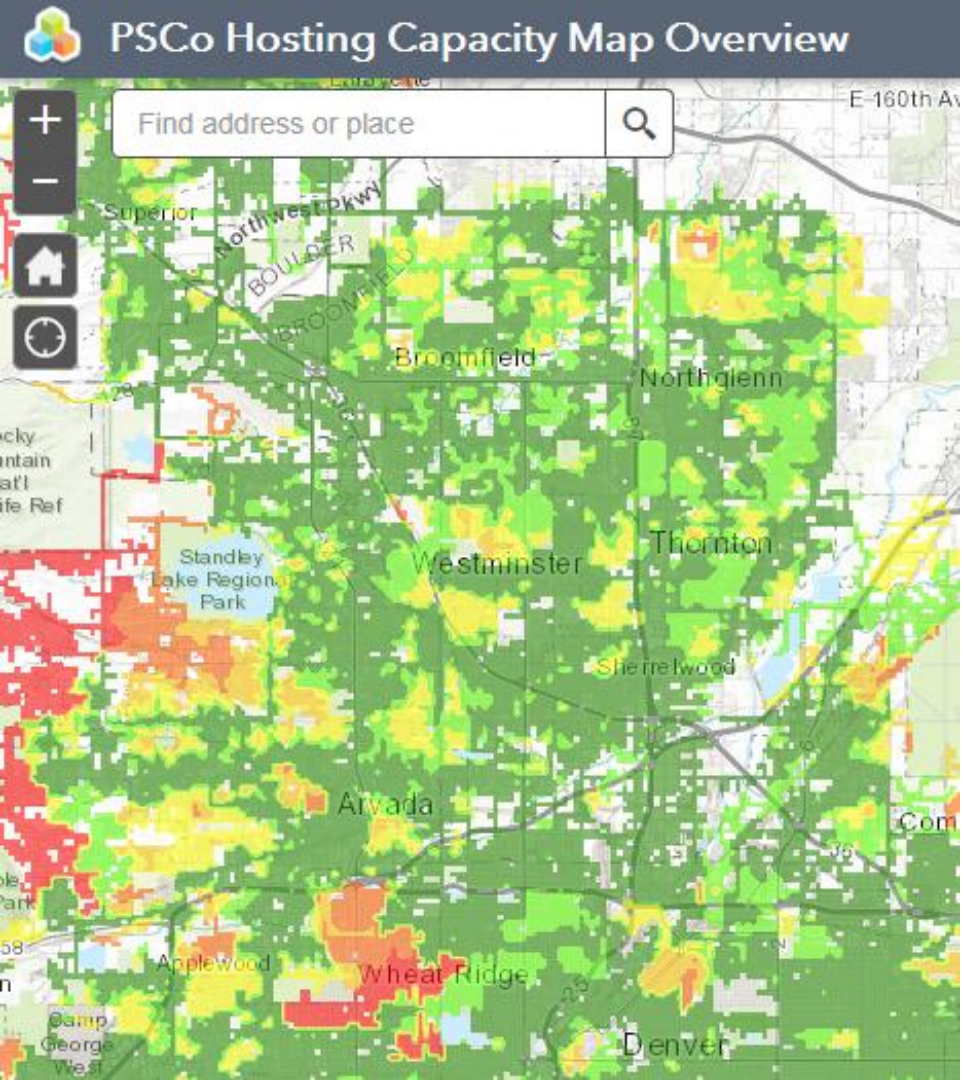
1:00 – 1:10	**Welcome & Introductions**	Kevin Cray
1:10 – 1:30	**Hosting Capacity Resources**	Matt Hagan
1:30 – 2:00	**Tips & Tricks for Field Identification/Pre-App Data Report Evaulation**	Jacob Whitaker
2:00 – 2:30	**Substation Overview**	Patrick Kuretich
2:30 – 3:00	**SRC Metering Requirements**	Dave Wynkoop
3:00 – 3:30	**Open Phase Testing and Ground Referancing**	Alan Urban
3:30 – 3:45	**Overall Program Timeline and General Program Changes/Updates**	Shawn Queenan
3:45 – 4:00	**Wrap – Review Action Items, Future Agenda Items & Schedule Next Meeting**	Kevin Cray

Hosting Capacity Resources

2019 MDL Data

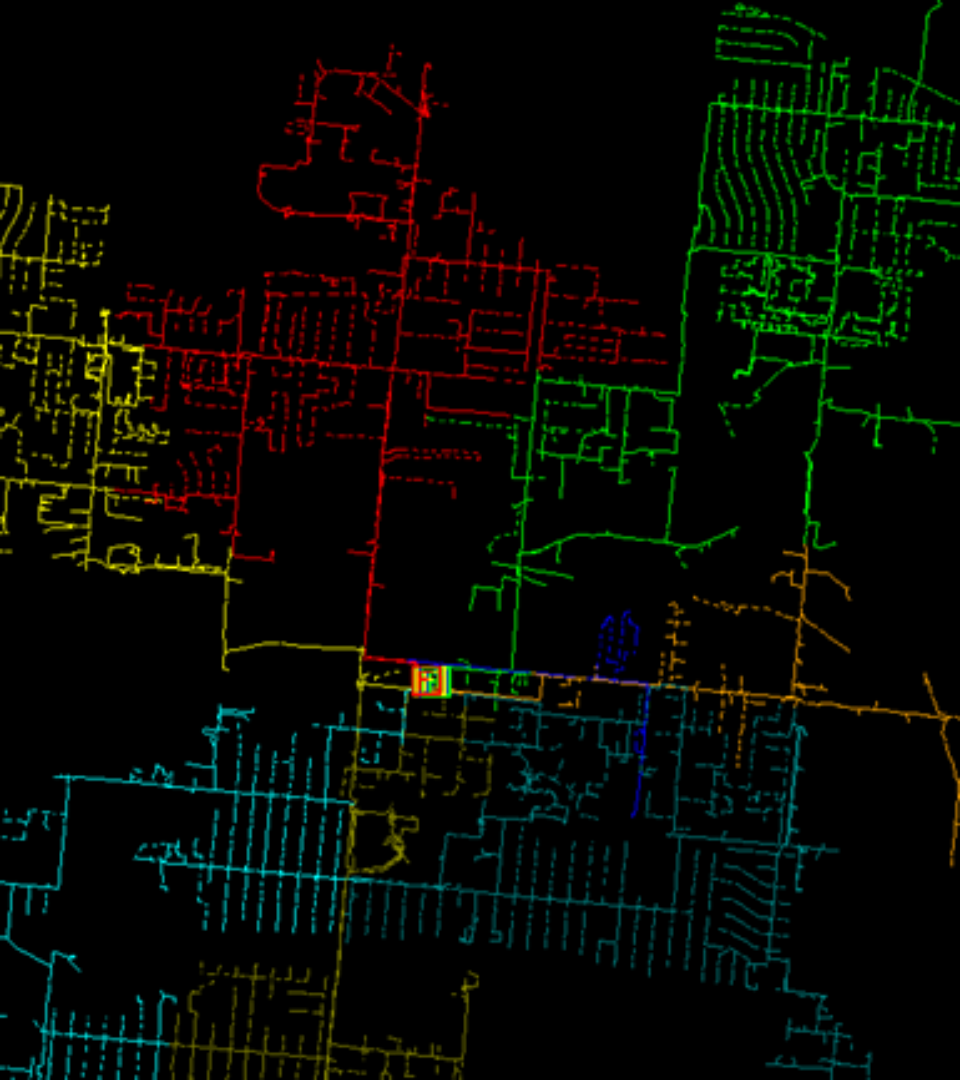
- Minimum Daytime Load Report updated for 2019 data
- Changes to methodology





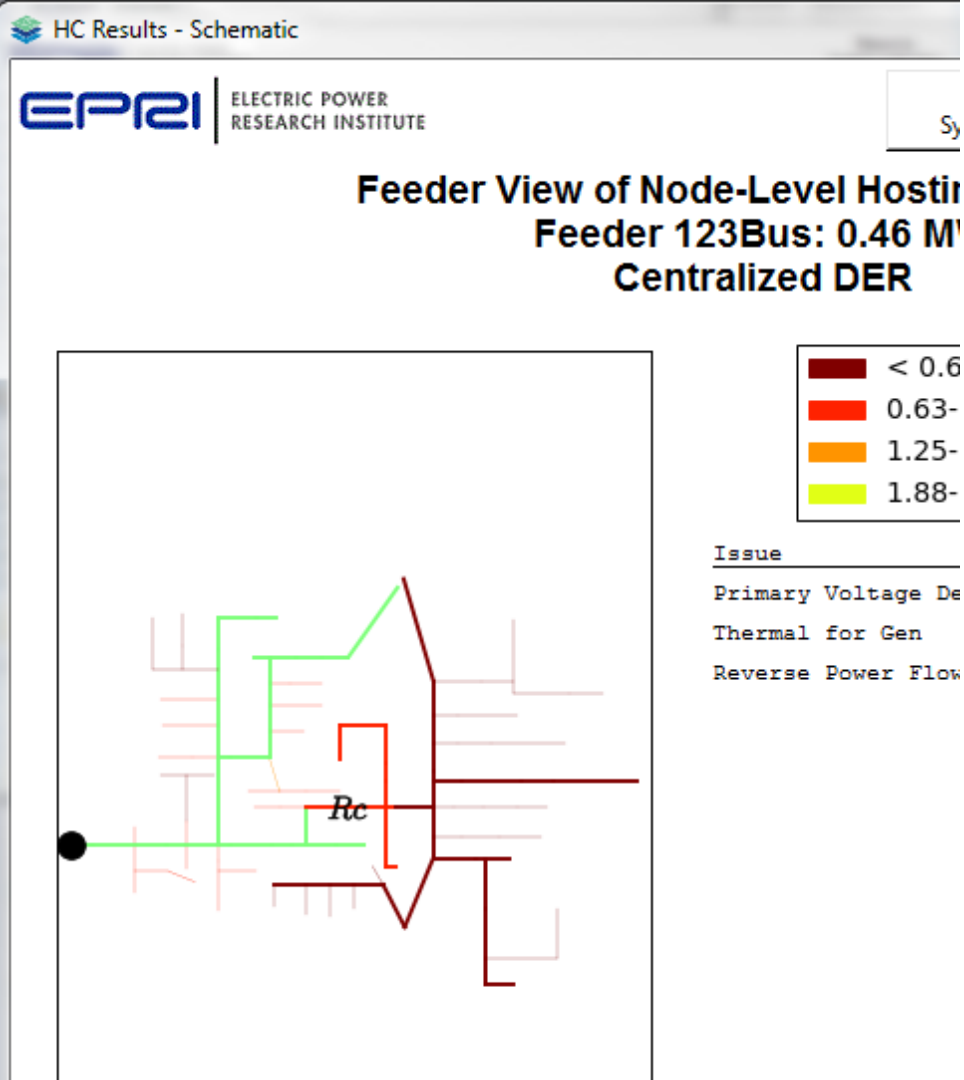
Hosting Capacity Map Updates

- Fixed bugs related to the map scale
- Changed the scale from 4MW to 2MW
- Added threshold for reverse power flow at feeder breaker
- Still no single phase representation
- Still based on 2017 MDL data
- Pop-ups are coming



Power Flow Model Updates

- More accurate MDL data means more accurate of power flow model and maps
- Using measured voltage data (where available)
- 75% of models will be completely rebuilt from scratch to include new GIS data
- Better representation of large customers
- Connected DER updated in GIS data
- Better representation of connected DER



EPRI DRIVE Tool Updates

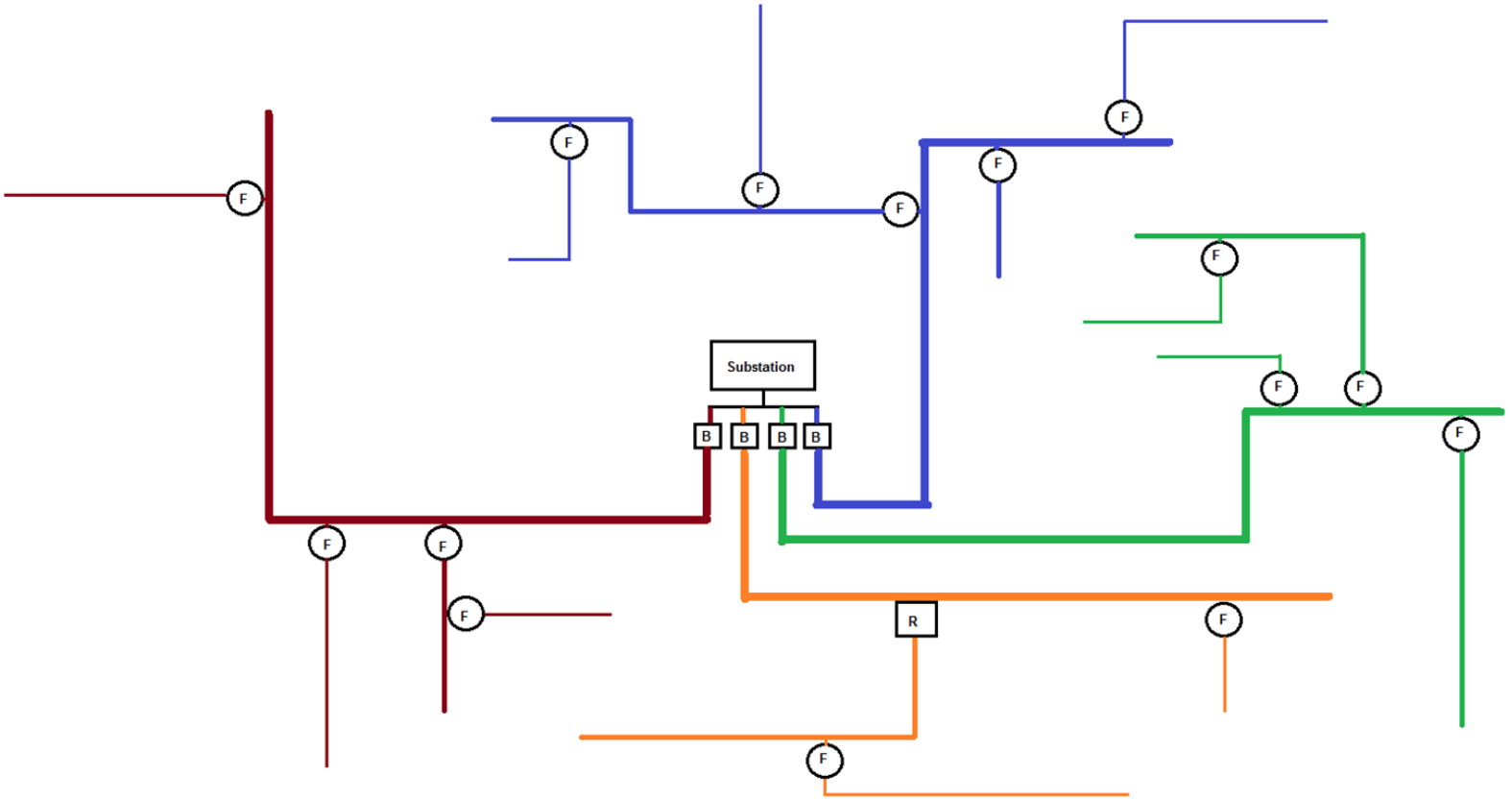
- Received V2.0 in June
- Reverse Power Flow and Unintentional Islanding thresholds are more dynamic
- Results reflect 1, 2, & 3 phase data
- Thermal limits now account for fuses too
- New Thresholds: Operational Flexibility and 3V0 Transient Overvoltage
- Change with Breaker Relay Reduction of Reach threshold

Looking to the Future

- Advanced Distribution Management System (ADMS)
- 2MW → 5MW maximum interconnection size
- Looking into more dynamic & interactive map
- Layer Package not available yet

Tips and Tricks for Field Identification of Distribution System Conductor Size and Capacity/Pre-App Data Report Evaluation

Distribution System



Substation

Substation (Transmission Lines)

Mainline Feeder (Terminal Pole)

Overhead Fuse (Tap)

Fuses

Reclosers

Reclosers

Recloser

Recloser Control (Says Recloser)

Normally Open Switches

Substation Overview

The Radial System

- Distribution System Connected to Transmission System Through Substations.
- Traditionally Built to Operate Radially – Transmission System is the Source and Distribution System is the Load.
  - This is changing as the distribution system is installing sources
- Upgrades are Needed as More Distribution Sources are Added

Source: Waukesha

General Substation Overview

- There Are Many Different Substation Designs and Vintages.
- While Differences Exist, There is Equipment that is Found in Most Substations
  - Step-Down Transformer
  - Circuit Breakers
  - Instrument Transformers
  - Protective Relays

Source: Trench

Effects of Distribution Energy

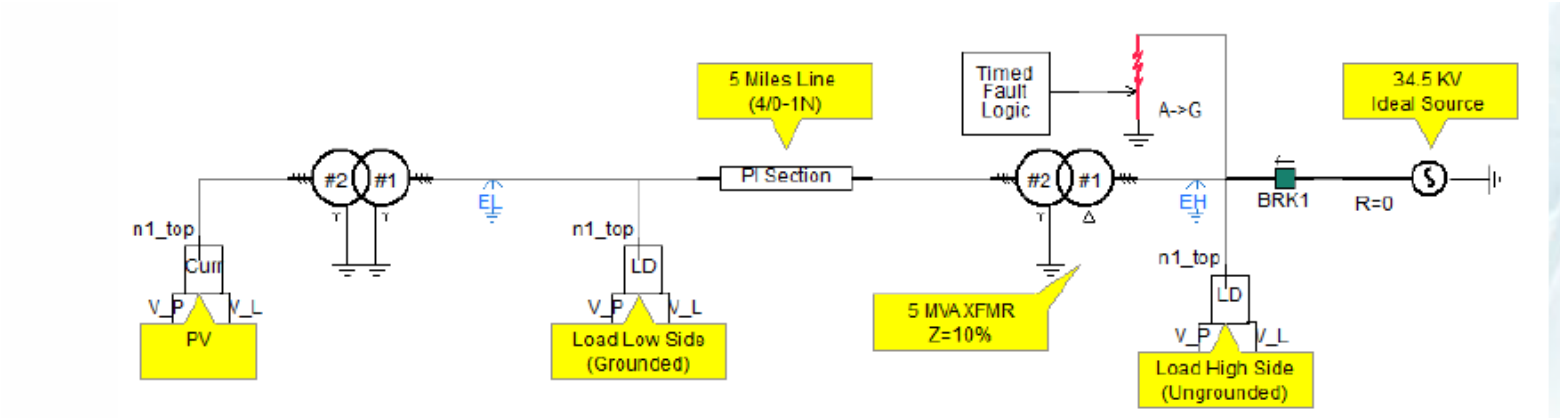
- Once the Distribution Ceases to be Radial, Modifications may be required to Support that Shift.
- These Modifications will Depend on many factors including:
  - Magnitude of the Distribution Sources
  - Substation Configuration
  - Existing Substation Protection and Controls

Common Modifications

- Voltage Supervised Reclosing (VSR)
  - Related to distribution sources on a feeder level.
  - Requires modern protective relaying and voltage transformer
- Transfer-Trip
  - Related to generation to load ratio and types of distribution sources
  - Requires modern protective relaying and communication/pilot channel between substation and generation source

Common Modifications

- Ground Fault Over Voltage Protection (GFOV) or 3V0
  - Related to distribution sources at an aggregated substation level
  - Requires modern protective relaying and high-side voltage transformers



Source: Pterra and NY State

SOLAR REWARDS COMMUNITY – METERING

Secondary Service

- PV system size – 2.25 MW AC or less.
- Xcel Energy Standard for Electric Installation and Use manual.
  - Current revision – November 15, 2018
  - Web Link for notification sign up and PDF
  - https://www.xcelenergy.com/working_with_us/builders/installation_standards
- PSCo service voltages – Section 3.1.1
  - Largest secondary transformer – 2500KVA 277/480V, 3Ø, 4W

Secondary Service – Cont.

- Key requirements for one-lines:
  - Identify conductor size and number of runs to transformer.
  - Requires metering for both main billing and PV production.
    - Transformer rated metering – Section 4.10.7 & 4.12
      - CT orientation for main billing – utility transformer as source.
      - CT orientation for production metering – inverter(s) as source.
    - Self-contained metering – Section 4.11
      - Cold sequenced metering – Section 4.17.3
  - Meter socket identification – Section 4.14.4

Primary Service

- PV system size – 2.25 MW AC and above (5 MW DC Max)
- Requires metering for both main billing and PV production at primary voltage.
  - No secondary voltage production metering allowed.
- Typical voltages – 12.47KV, 13.2KV, 13.8KV, and 24.9KV
- Customer owned/maintained secondary distribution system.
  - Allows for non-standard service voltages.

Primary Service – PSCo Owned

- Main billing metering:
  - Shall be located on the customer's property within a distance of 5 - 25 feet from the access point.
  - OH installations to comply with drawing PM-10.
  - UG installations to comply with drawing PM-40.
    - Cabinet ratings - 15KV 200A & 600A, 25KV 200A & 600A
    - Two line and two load terminations per phase.
    - Load side conductor to match PSCo conductor sizes.

Primary Service – PSCo Owned

- PV production metering:
  - Will only be offered for OH services.
  - Allowed to be located within SRC property, no limitation on distance.
  - PSCo will provide cluster rack with metering transformers.
  - Customer to install rack in accordance with drawing PM-10.

Primary Service – Customer Owned

- Main billing metering:
  - Cabinet shall meet PSCo specifications – No exceptions.
  - Switchgear shall be designed to meet the PSCo specifications for the required utility metering bay.
    - Manufacture drawings and wiring diagrams require Meter Engineering approval prior to equipment purchase and construction.
    - PSCo will ship metering transformers for installation in the gear while it is at the manufacturers factory.
    - Additional metering site work will be required prior to the equipment being authorized for energization once it is set on its pad.

Primary Service – Customer Owned

- PV production metering:
  - Cabinet may be designed to meet PSCo primary metering cabinet specifications to simplify the approval process.
  - Other cabinet manufactures permitted. Drawings require written approval in advance of equipment purchase and construction.
  - Switchgear is same approval process as main billing meter
    - Gear will have two associated metering bays.
    - Station service transformer to be tapped between the two meter bays.

Primary Metering - Key Points

- Key requirements for one-lines:
  - Identify equipment ownership.
  - Primary meter installations - Section 4.13
  - Meter socket identification – Section 4.14.4
- Meter Engineering approval of equipment is mandatory.
  - Metering transformers will not be ordered until equipment is approved.
  - Lead times can exceed 10-12 weeks.
- Equipment cannot be energized without metering approval.
- Coordination is key to avoid delays or costly changes!

Metering Questions?

Open Phase Testing and Ground Referencing

Agenda

- Open Phase Testing
  - Background
  - Requirements
  - Creating an Open Phase
- Ground Referencing

Open Phase Testing

Background

- Open phase conditions not uncommon
- Increased risk to customer equipment
- Exposure to live downed conductors

Background

- Interconnection standards require open-phase response
  - IEEE 1547
  - NEC
- Non-Compliance commonly observed
  - Customer equipment damage

Non-Compliance Observations

Number of Failures

	Tested	Passed	Failed
# of Sites	90	66	24
Total	100%	73%	26%

Types of Failures

	5 Min Delay for Restart	Cease Gen in 2 Sec	High Voltage
# of sites	3	16	3
%	12.5%	75%	12.5%

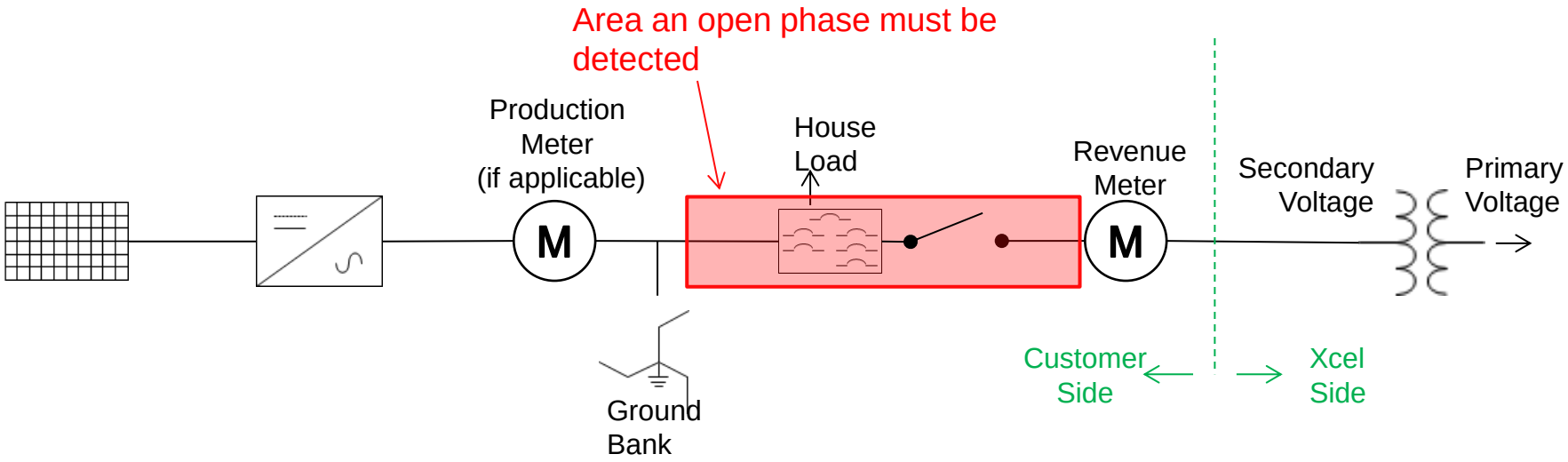
Data last updated January 2019

Testing Requirements

- Must Cease Output on all 3-phases within 2 seconds
- DER must not exceed 110% voltage on any phase during test
- Must delay 5 minutes when source restored

Testing Requirements

- DER must be able to sense and respond to an open phase upstream of the ground bank



Creating an Open-Phase

- Methods are proposed by developers/installers
- Operator is responsible to ensure procedure is designed to NEC/OSHA/other safety considerations
- Xcel reviews and approves for technical feasibility
  - Regardless, onsite, if unsafe, Xcel will use stop-work authority

Ground Referencing

Ground Referencing

- Ground referencing equipment required on all DER ≥100 kW
- Refer to Xcel Energy Interconnection Guidelines for specific requirements

Ground Referencing

- Ongoing evaluation of new industry research
- Notable issues:
  - Line to line connected loads
  - Frequently dynamic system configurations
  - High generation to load ratios

Overall Program Timeline and General Program Changes/Updates

SRC Process Timeline

	Developer Action Item	Xcel Energy Action Item	Shared Action Item
Pre-Interconnection Agreement	Submit post award requirements (90 calendar days)		
		Perform initial engineering review (15 business days)	
		Prepare good faith estimate (15 business days)	
	Pay good faith estimate (30 business days)		
		Conduct formal study and prepare IA (60 business days)	
	Execute and pay IA (30 business days)		
Construction			Schedule pre-con meeting (10 business days)
		Complete required system upgrades (associated timeframes on the right)	
		Deliver CTs and meter housings (3 weeks)	
Final Documentation/Testing	Submit final documentation		
		Review final documentation (5 business days)	
		Set meters on site (2-3 weeks)	
			Schedule witness test (5 business days)
		Provide PTO letter (3 business days)	

For more information visit **xcelenergy.com/SRCResources**
or email **solarrewardscommunity@xcelenergy.com**

Typical timeframes for Xcel Energy to engineer/procure/construct/deliver various types of system upgrades and/or equipment (note timeframes begin when an IA is executed/paid)

- **Distribution system work** (typically 8-12 weeks for routine work. Projects that require significant utility system rebuilds, DTT, remote disconnect schemes or other project complexities along with long lead time materials could extend these dates significantly)
- **Substation work** (9-12 months, note there could be a need for complex distribution/transmission studies which may impact this timeframe)
- **Metering equipment** (3 weeks for standard secondary metering equipment; up to 20 weeks for primary metering equipment, also please expect the need for additional coordination with the metering department for any primary metered projects)

Program Subscriber Operations Updates

- Dynamic Reporting Coming
- Future RFP subscriber rules
- New Customer requirements (3,199kWh or less)
- Data Request Form Updates
- Telemetry cost update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