Distributed Energy Resources Interconnection Seminar Expedited Process

Thank you for joining us.
The presentation will begin at 9:00am.
Please mute your phones to avoid any feedback.
Thank you.

August 21, 2024

Co-Hosts

EVERSOURCE ENERGY

EVERSOURCE

MASSACHUSETTS CLEAN ENERGY CENTER

Mass ACA

DOER
Massachusetts Department of Energy Resources

nationalgrid

Unitil

Safety

Safety is the most important thing to consider in designing, connecting and operating a successful DG project.

Live Wires	Regard ALL wires as live. Overhead power lines are not insulated and carry enough energy to cause serious injury or even death.
Keep Away	Keep yourself, your co-workers, tools, ladders and vehicles at least 10 feet away from electric lines and equipment.
Safe Area	Make sure the area is clear of wires before working near trees or shrubs.
Never Attach or Tie	Never attach or tie anything off to power lines or electrical equipment.
Call	If you need to dig, first call Dig Safe at **1-888-dig-safe (1-888-344-7233)** to get underground utilities marked. **(www.digsafe.com)**

Interconnection Contacts

Eversource Energy – Western MA DG

Simplified Projects

- Matthew Secovich, Renata Gamache, & Christina King
- Project inquiries need to be submitted via the portal
- General questions email: wmdg@eversource.com

Expedited Projects

- Matthew Secovich: matthew.secovich@eversource.com
- Anne Morrison: anne.morrison@eversource.com
- Project inquiries need to be submitted via the portal

SMART

- Email: SMART@eversource.com
- Toll Free Number: 844-726-7573

Meter Configuration & Meter Technical Questions

- MEDGAP: medgap1@eversource.com

Eversource Energy Seminars

February 8	**EMA Simplified**
March 20	WMA Expedited / Standard
May 8	EMA Expedited / Standard
June 12	WMA Simplified
August 21	WMA Expedited / Standard
September 18	EMA Simplified
November 20	WMA Simplified
December 11	EMA Expedited / Standard

Power Clerk DG Application

- https://www.eversource.com/content/wma/about/about-us/doing-business-with-us/builders-contractors/interconnections/massachusetts/application-to-interconnect

POWERCLERK

You will use our PowerClerk portal to submit and track your applications. This online tool brings you:

- The ability to easily upload and review documents associated with your projects
- Automatic communications to help you keep track of your projects
- A mobile-friendly user interface that can be used on most devices including your laptop or tablet

You will need an Eversource.com user ID to use PowerClerk. If you don't have an ID, you'll be prompted to sign up.

Continuation Of Power Clerk DG Application

Expedited/Standard Application

Choose this application if you intend to install a:

- System that is greater than **15 kW AC single phase** or greater than **25 kW AC three phase**
- System configuration that does not correspond with the service configuration (such as using single phase inverters on a three-phase service)
- Non-inverter-based generator, co-generator, wind, hydro or other facility
- System on a radial distribution circuit

In addition, your proposed generation equipment must meet IEEE 1547.1 standards.

Expedited/Standard application fee = $4.50 per kW (minimum fee of $300; maximum of $7,500)

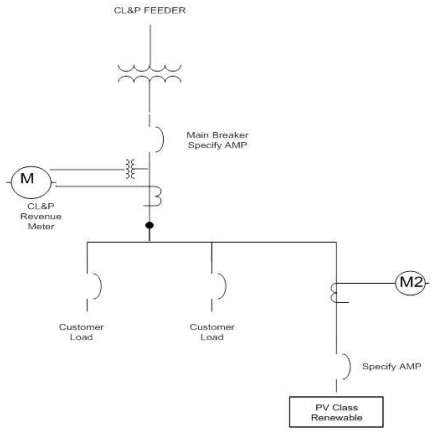
Pre-Application

You no longer need to submit a separate pre-application as it's now part of PowerClerk. You will be prompted to submit a pre-app if you are installing a generation facility of 250 kW AC or greater. View our **hosting capacity map**.

Log into Expedited PowerClerk →

Expedited Requirements

- **One Line**



  - ✓ Required to be stamped by a MA **Electrical** PE.
  - ✓ Well documented electric service
  - ✓ Point of Common Coupling with Interconnecting Device
  - ✓ Size of main breaker
  - ✓ External disconnect switch
  - ✓ Generator breaker & size
  - ✓ Generator connection point
  - ✓ kW rating matches application (name plate)
  - ✓ Interconnecting Customer transformer configuration (if applicable) and impedance must match application.
  - ✓ Location of revenue meter, instrument transformers and protection – Metering Sequence
  - ✓ Title block with Customer name, address, date, drawing number and revision number
  - ✓ Inverter settings in table form
  - ✓ Definitive relay settings in table form, relay(s), PT's and CT's

- **Battery Storage Sheet (BESS)**

  - ✓ Required for any projects with storage

Expedited Requirements

- **Site Plan**
  - ✓ Must show property/lot lines, street names
  - ✓ Interconnecting Pole Numbers
  - ✓ Must show revenue meter location and location of inverter(s) and/or generators
  - ✓ Must show production meter if Net Metered
  - ✓ Does not need to be PE Stamped
  - ✓ Must be a plan form view i.e. vertical
  - ✓ NOT "bird's eye", isometric, 3/4 view, google maps
  - ✓ Title block with Customer name, address, date, drawing number and revision number
- **Cut Sheet**
  - ✓ If inverter based - must be UL1741SB
    - As of October 1, 2023, all inverters must be UL1741SB.
    - https://www.eversource.com/content/docs/default-source/builders-contractors/default-ieee1547-2018-settings-requirements-issued.pdf?sfvrsn=160fb831_2

Expedited Standard Process
(single phase >15kw and three phase >25kw)-All Technologies

INITIATION PHASE

- 250kW and greater Pre-app takes place before submitting application.
- Completed application
- Site plans
- One-line diagram
- Cut sheets
- Energy Storage Narrative
- Application fee
- Application reviewed for completion

ENGINEERING REVIEW

- Depending on project type and size various levels of engineering groups are involved
- System Planning Engineering determines if Impact Study is required or not

IMPACT STUDY

- Impact Study Agreement or supplemental agreement or both and Payment
- Impact Study Completed with a +/-25% Interconnection Cost Estimate
- ISA Executed
- Group Study (if applicable. See link below)

NO IMPACT STUDY

- A determination is made if any local upgrades are needed to the existing service or system.
- ISA Executed

DETAILED ENGINEERING

- Scheduled to begin after Customer pays 100% payment after ISA
- Final Sketch complete, Final Costs compiled, Easements by Property Owner Paperwork compiled, Town Hearings Scheduled, etc…

CONSTRUCTION PHASE

- ES construction
- Install meter and meter communications
- Relay settings confirmed
- Close out documents
- Schedule witness test

FINAL PHASE

- Test Energization
- Witness Test
- PTO
- Verify set up bill

Group Study website link: https://www.eversource.com/content/ct-c/about/about-us/doing-business-with-us/builders-contractors/interconnections/massachusetts-application-to-connect/distribution-group-studies

Questions?

WMA Expedited DG Interconnection Studies

August 21, 2024

Spencer Hutchins

Associate Engineer

Overview

- DER applications in WMA continue to increase and bring more saturation to existing stations. Eversource continues to work closely with ISO-NE on DER projects to assess and verify the correct path forward for each project.
  - Eversource substations are now seeing approximately 300MW of DER connected generation in just WMA alone.

- Eversource in coordination with ISO-NE assess each DER application and perform an Impact Screen to determine if the facility may result in adverse impact to the system and the correct path of study.

- Eversource continues to work to improve and streamline the process of receiving applications, reviewing project information and improving information transparency to DER interconnection customers relative to studies.

Agenda:

- Process & Resources for understanding the ASO Impact Screen
- Level 0 & Level 3 Studies
- Timing and Communication
- Summary of Resources Available

*See definition of Significant Adverse Impact in ISO-NE's *Transmission Planning Technical Guide*: https://www.iso-ne.com/static-assets/documents/2017/03/transmission_planning_techincal_guide_rev6.pdf

Process Overview

Developers can self-screen projects for likely anticipated path of study. Final determination can vary from below in some circumstances; important to review all points of the document.

If your project is between 1MW & 5MW **AND** the interconnecting substation generation total is below 5MW:
Level 0 with no analysis

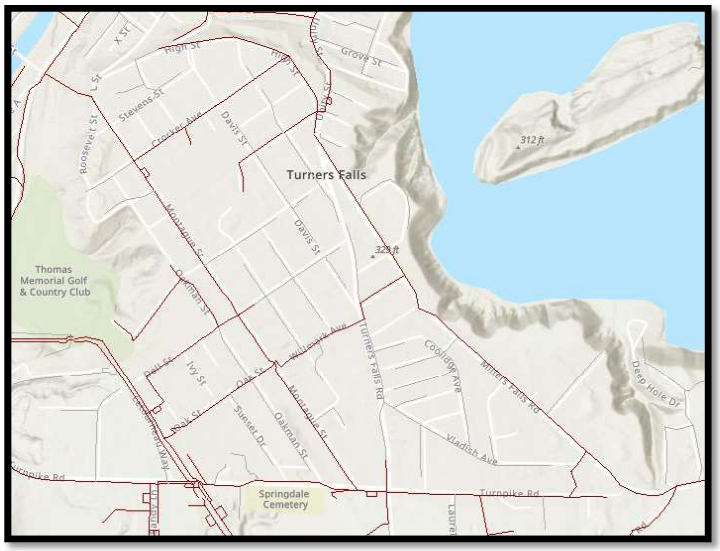
If your project is between 1MW & 5MW **AND** the substation total is between 5MW & 20MW:
Level 0 with Transfer Limit Analysis (testing for no adverse impact)

If your project is 5MW or above **OR** if the substation total is above 20MW:
Level III ASO Study

Electrically-close stations can be summed in certain instances to invoke a Level III ASO study even in the case that it appears the station has less than 20MW interconnected. ISO-NE makes this final determination.

https://www.eversource.com/content/docs/default-source/builders-contractors/aso-impact-screen-diagram.pdf?sfvrsn=551cdd62_2

Hosting Capacity Maps



DG Hosting WMA Final: 21C8	
Location Hosting Capacity(MW)	0.20
Section ID	8475956
Operating Voltage (kV)	13.8
Circuit Name	21C8
Bulk Circuit Name	21C8
Distribution Substation Name	N/A
Distribution Substation Voltage(kV)	N/A
Distribution Substation Rating (MVA)	
Bulk Substation Name	21C MONTAGUE
Bulk Substation Voltage(kV)	115/13.8
Bulk Substation Rating (MVA)	40.00
Bulk Sub Hosting Capacity(MW)	0.00
Circuit DER Online(kW)	9496.00
Circuit DER In Queue(kW)	68.00
Ferc Jurisdiction	Y
Current ASO Studies	None ; Lvl 3 In Study:4
Circuit Feeds Secondary Network Customers	N
Circuit Rating (Amp)	300.00
3V0 Status	
Date Last Updated	07/18/2023, 06:20 AM

Hosting Capacity Maps publicly available – provides insight into level of saturation and queued generation pending. Maps are general guides and subject to change.

https://www.eversource.com/content/ema-c/about/about-us/doing-business-with-us/builders-contractors/interconnections/massachusetts/hosting-capacity-map

DER Projects & Market Participation

Reminder:

- On August 28th, 2022, FERC approved ISO-NE's proposal to have all distribution connected projects follow the state interconnection process regardless of if the project is interconnecting on a market facing feeder.
- DER projects that receive PPA approval can participate in ISO-NE markets without the need for an ISO-NE queue position or a 3 party FERC IA.

What did not change?

- Projects are still subject to the same requirements for ISO-NE PPA approval and screening for potential adverse impact to the transmission system.

https://www.iso-ne.com/static-assets/documents/2022/08/er22-2226-000.pdf

Overview of T Studies

- **Level 0 Studies**
  - At a minimum, generally consist of a transfer limit analysis to ensure no degradation of ISO-NE Interface Limits. If adverse impacts found, a Level 3 study will be required.
  - Some Level 0 projects may require more detailed analysis while others may require less analysis.
- **Level 3 Studies**
  - Conduct thermal and voltage steady state, short circuit, stability analysis
  - PSCAD analysis will be required as per ISO-NE PP5-6 requirements
  - Technical data will be requested from projects and is required to start studies.
  - Highly saturated substations generally now all fall into a group study.

https://www.eversource.com/content/docs/default-source/builders-contractors/aso-impact-screen-diagram.pdf?sfvrsn=551cdd62_2

Technical Data Required - Level 3 ASO

- Conductor types and distance
  - Between Project and inverters/GSUs
  - Project's tie line to the point of interconnection (POI)
- Generator step-up (GSU) transformer size (MVA), impedance (%Z), and X/R ratio
- GSU transformer number of taps and per unit size of each (typical is +/-2 steps, each at 2.5% or, 0.95, 0.975, 1.0,1.025, 1.05 per unit)
- Stamped project one line (must include inverters)
- Project inverter modeling information (>1MW and <5MW)
  - Eversource to use DER_A inverter stability models
  - Developers to provide parameters
- Project inverter modeling information (>=5MW)
  - Datasheet and manual
  - Reactive capability curve and/or data tables necessary to create the capability curve when the project output is a maximum (Pmax)
  - Stability model in PSS/E standard library format. **Note ISO-NE does not accept user developed models.**
- All projects' inverter modeling information
  - Protective voltage and frequency trip set points
    - Ride through capabilities need to meet ISO-NE SRD requirements.
  - PSCAD models for a potential frequency response study

Link below provides a comprehensive list of all Technical Data required for Level 3 ASO Study

https://www.eversource.com/content/docs/default-source/builders-contractors/aso-technical-data-request.pdf?sfvrsn=2d53d562_0

Timing and Communication

- Within 20 days of application deemed complete: Eversource will conduct the ASO Impact Screen.
- Within 5 days, developer will be provided a Standard Process Initial Review Report – Identifying Results of the Impact Screen.
- If potential for adverse impact is found: Eversource will request determination by ISO-NE confirming if a study is required.
- If the potential need for a study is determined, developers are notified with an explanation of why it may be required.
    - Developers will then be provided a bimonthly report indicating what further information is required and when certainty will be known that a study is required.
- Once a study has commenced: Monthly written updates will be provided to all affected developers included in the study.
- If a group study is required, developers will have an opt in deadline which will be publicly available on Eversource's Website.

DG Guidelines
https://www.eversource.com/content/docs/default-source/builders-contractors/distributed-generation-guidelines-interconnection.pdf?sfvrsn=5432d062_2

Summary of Resource Available

Mass Distributed Generation, Interconnections & Net Metering
https://www.eversource.com/content/ema-c/about/about-us/doing-business-with-us/builders-contractors/interconnections/massachusetts

ASO Impact Screening Flow Diagram
https://www.eversource.com/content/docs/default-source/builders-contractors/aso-impact-screen-diagram.pdf?sfvrsn=551cdd62_2

Technical Data Request List for Level 3 ASO Transmission Studies
https://www.eversource.com/content/docs/default-source/builders-contractors/aso-technical-data-request.pdf?sfvrsn=2d53d562_0

Hosting Capacity Maps
https://www.eversource.com/content/ema-c/about/about-us/doing-business-with-us/builders-contractors/interconnections/massachusetts/hosting-capacity-map

DG Guidelines
https://www.eversource.com/content/docs/default-source/builders-contractors/distributed-generation-guidelines-interconnection.pdf?sfvrsn=5432d062_2

Questions?

Solar MA Renewable Target Program (SMART)

Program Information

Ask Questions and Get Clarification

Coming Soon -

FAQ page, which will appear at this link: https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/solar-energy/net-metering-defined/renewable-credits-portal

- CLEAResult (SMART Program Administrator)
  - MA.SMART@CLEAResult.com
  - 888-989-7752
- Eversource SMART Team
  - SMART@eversource.com
  - 844-726-7573

Questions?

MA SMART Program
Metering Review

Manager, Meter Services - Chris Kellogg
Supervisors, Meter & Service
Andrew Netherwood

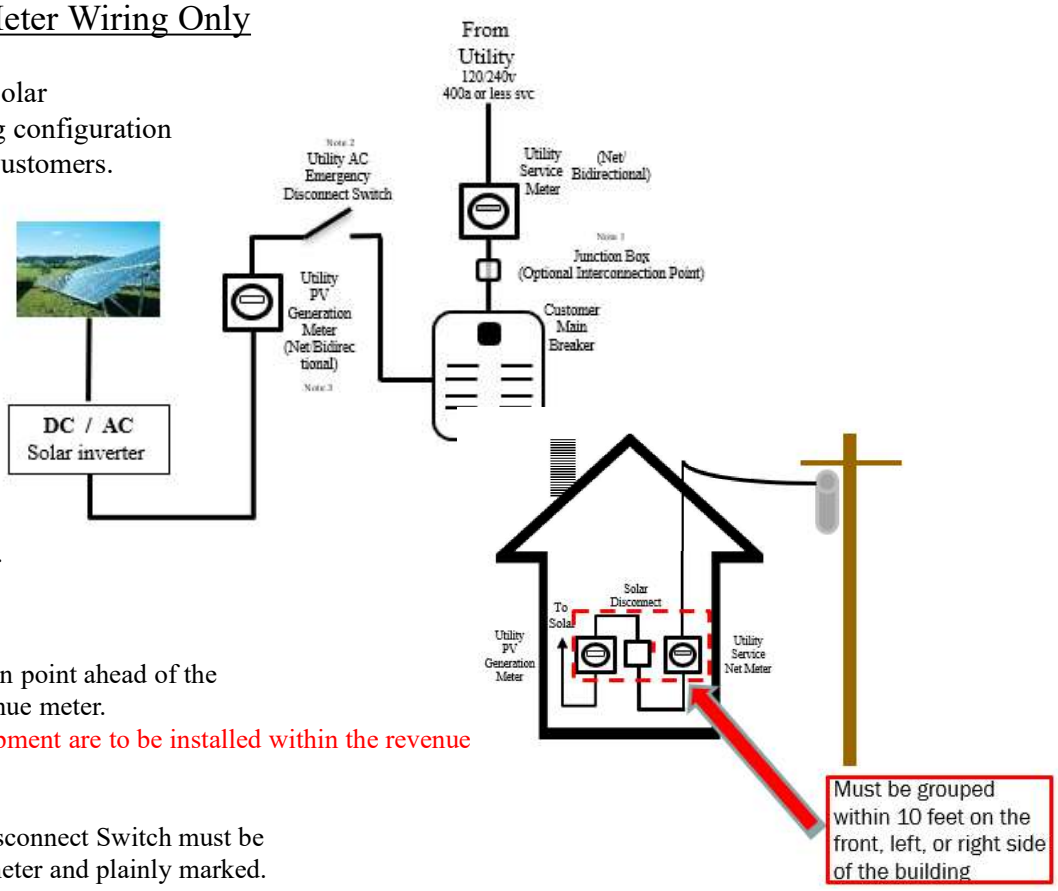
MA SMART Program Topics

- Meter Socket wiring
- Emergency disconnect position
- Information on meter socket use
- IT (instrumented transformer) Rates Services
    - What the contractor provides
    - What Eversource provides
    - Labeling

Meter Wiring

Solar and Production Socket Meter Wiring Only

Scenario – Behind the Meter (BTM) Solar
Description: typical solar meter wiring configuration for residential and small commercial customers.



Solar Prod Meter
(Utility PV Generation Meter)
< 60KW = Scalar meter
(Monthly consumption)
> 60KW = Interval Recording meter

Note 1: Optional acceptable interconnection point ahead of the main breaker, but behind the revenue meter.
No connections, splices or measuring equipment are to be installed within the revenue meter socket.

Note 2: Customer provided Emergency Disconnect Switch must be Located next to the Eversource Revenue meter and plainly marked.

Note 3: Utility PV Generation and the Utility Storage meters must be wired with Utility feed to the top of the Meter socket; Solar panels to the bottom of the meter socket

Meter Wiring

Solar Meter Wiring Only

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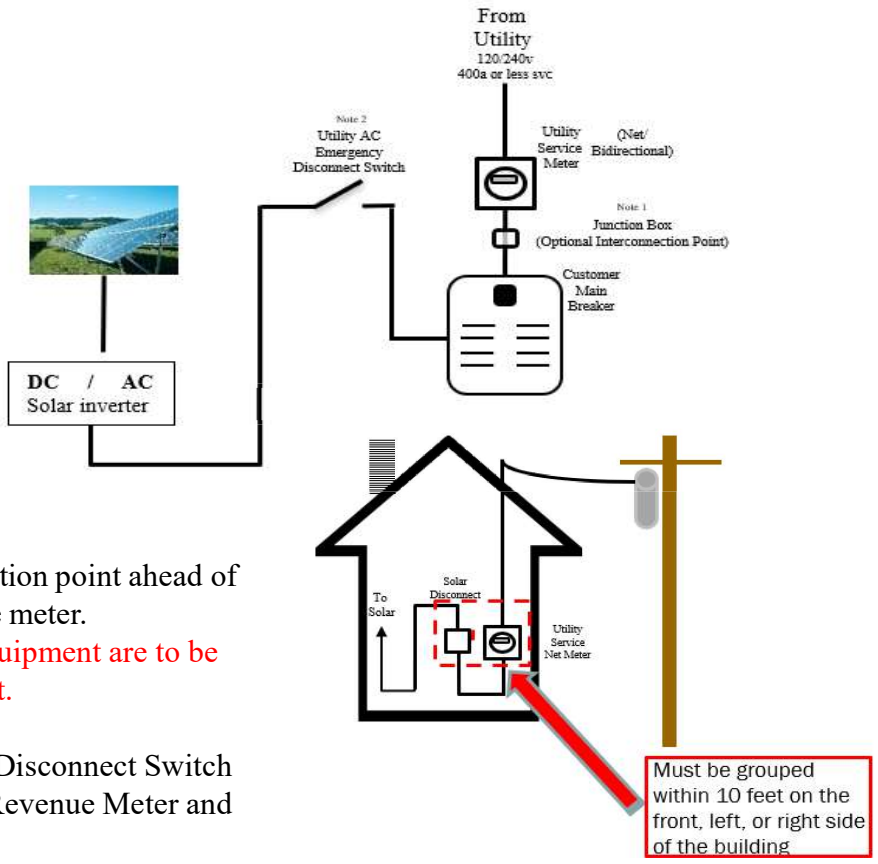

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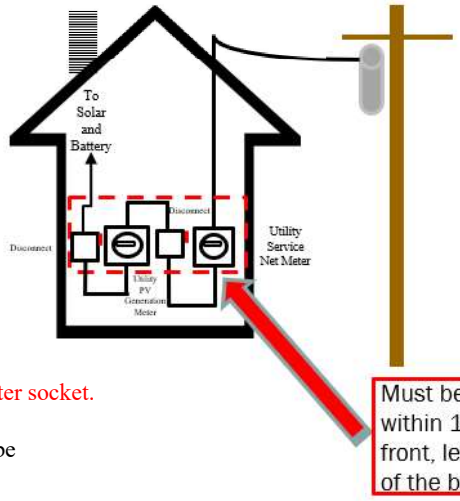
Note 2: Customer provided Emergency Disconnect Switch must be located next to the Eversource Revenue Meter and plainly marked.

Meter Wiring

Solar with Battery and Production Socket Meter Wiring Only

Scenario – Behind the Meter (BTM) Solar and Battery

Description: typical solar and battery meter wiring configuration for residential and small commercial customers.



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No connections, splices or measuring equipment are to be installed within the revenue meter socket.

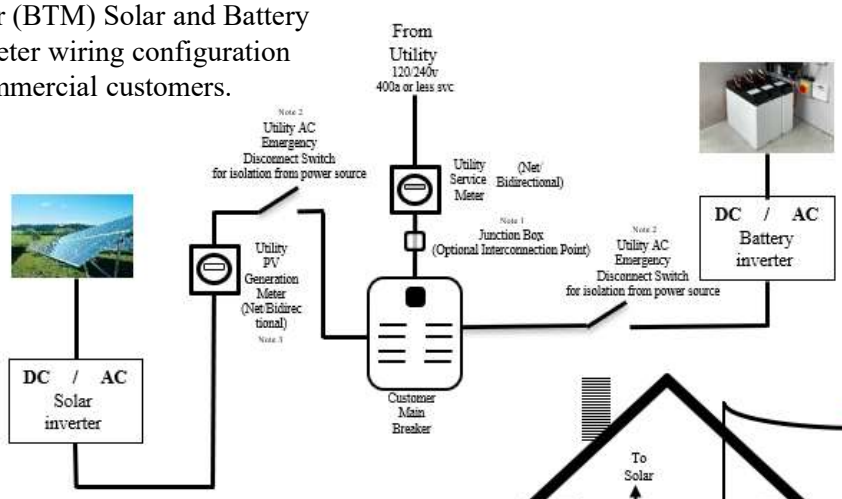
Note 2: Customer provided Emergency Disconnect Switches and Production Meter must be located next to the Eversource Revenue Meter and plainly marked.

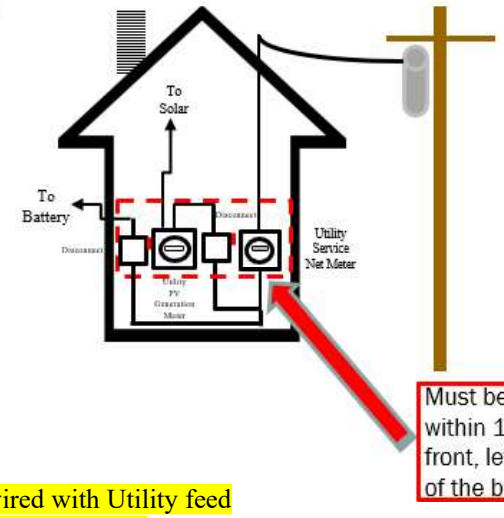
Note 3: Utility PV Generation and the Utility Storage meters must be wired with Utility feed to the top of the Meter socket; Solar panels to the bottom of the meter socket

Meter Wiring

Solar Production Socket and Battery Meter Wiring Only

Scenario – Behind the Meter (BTM) Solar and Battery
Description: typical solar meter wiring configuration for residential and small commercial customers.





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Note 1: Customer provided Emergency Disconnect Switch must be Located next to the Eversource Revenue meter and plainly marked.

Note 2: Utility PV Generation and the Utility Storage meters must be wired with Utility feed to the top of the Meter socket; Solar panels to the bottom of the meter socket

Meter Wiring

Solar and Battery Meter Wiring Only

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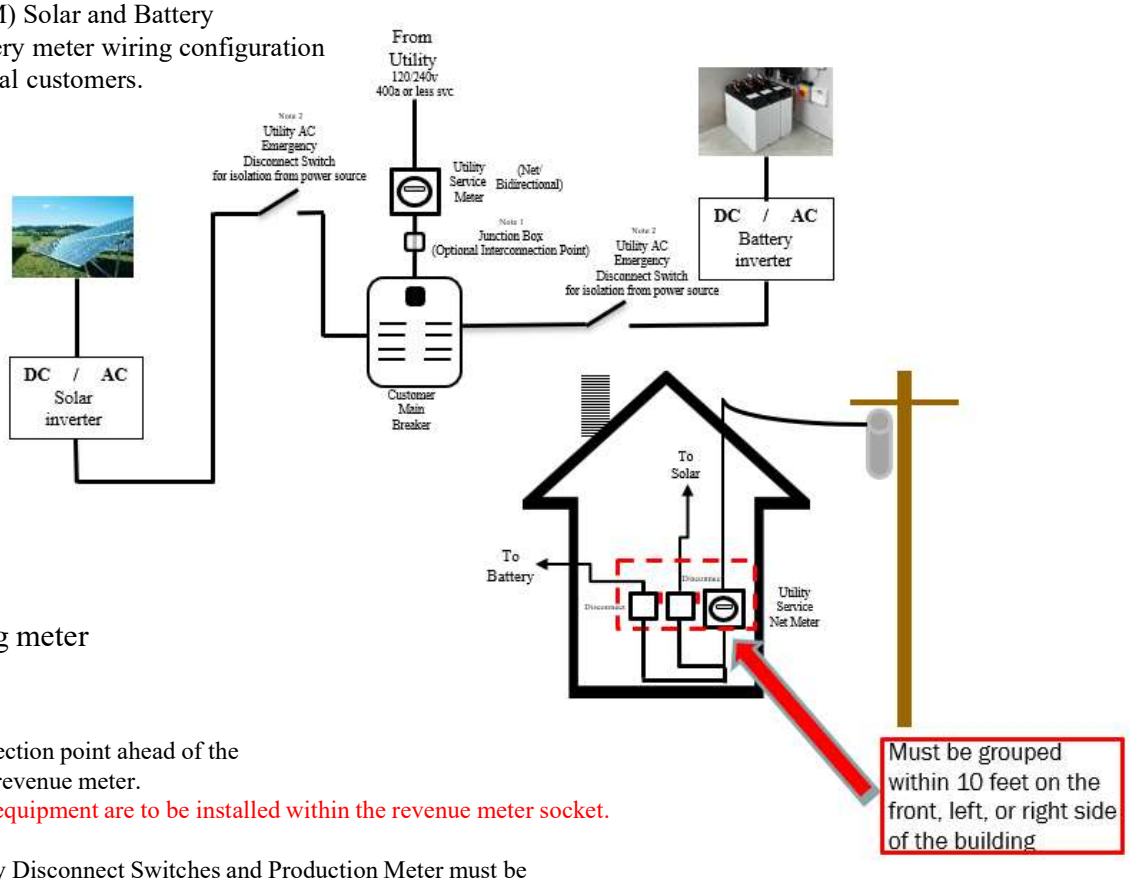
Description: typical solar and battery meter wiring configuration for residential and small commercial customers.



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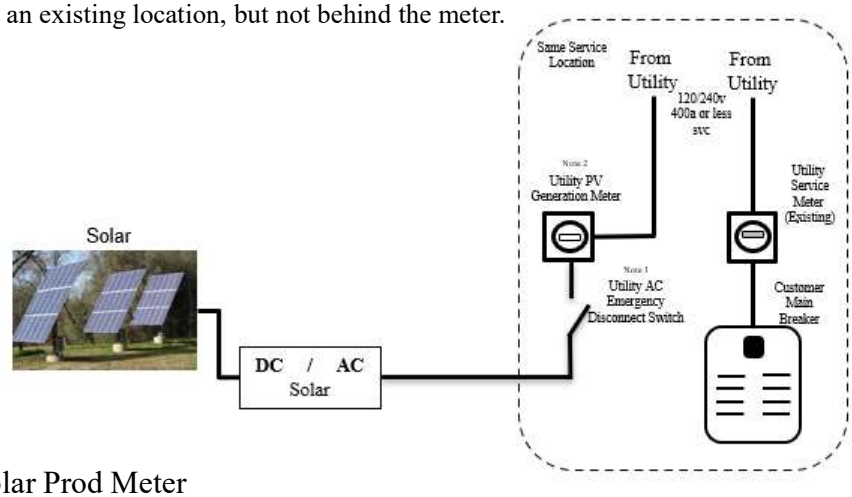
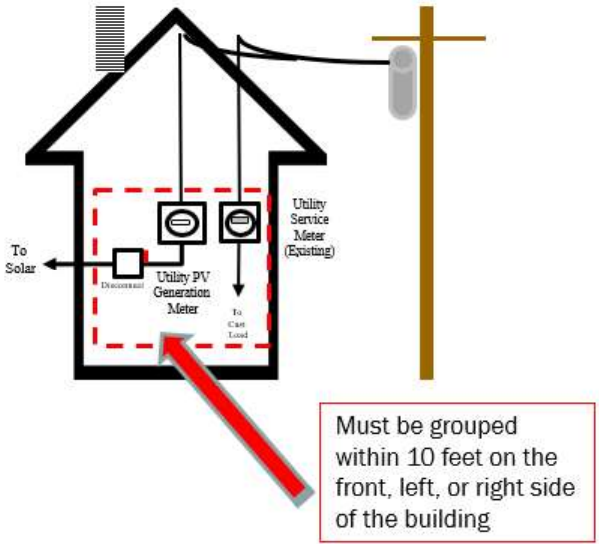
Note 1: Optional acceptable interconnection point ahead of the main breaker, but behind the revenue meter.
No connections, splices or measuring equipment are to be installed within the revenue meter socket.

Note 2: Customer provided Emergency Disconnect Switches and Production Meter must be located next to the Eversource Revenue Meter and plainly marked.

Meter Wiring

Scenario – Standalone Meter at Existing Service location
Description: typical meter wiring configuration for residential and small commercial customers where the solar is installed at an existing location, but not behind the meter.





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Note 1: Customer provided Emergency Disconnect Switch must be Located next to the Eversource Revenue meter and plainly marked.

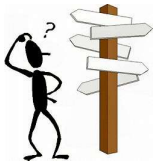
Note 2: Utility PV Generation and the Utility Storage meters must be wired with Utility feed to the top of the Meter socket; Solar panels to the bottom of the meter socket

Meter Wiring

Scenario – Standalone Meter at Existing Service location
Description: typical meter wiring configuration for residential and small commercial customers where the solar is installed at an existing location, but not behind the meter.

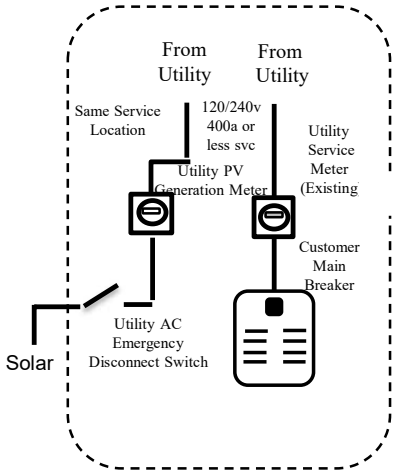
WHY ??

Yes the meter WILL SPIN BACKWARDS When generating



Load

Excess Generation



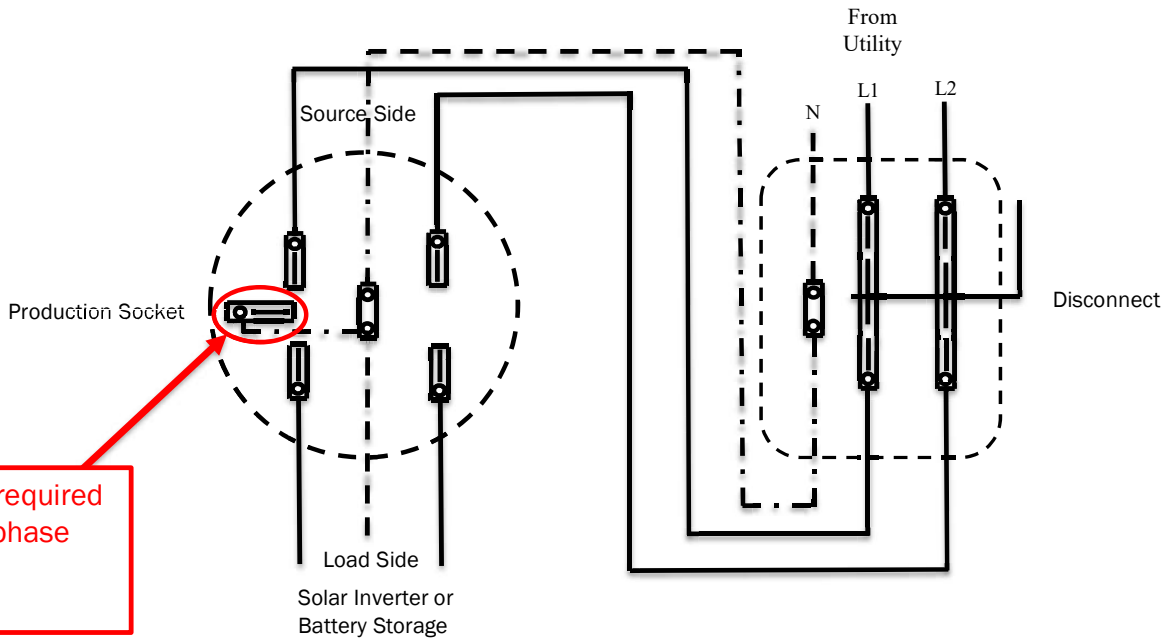
Load

Excess Generation

Trying to maintain consistency in the direction of load and generation for both the Revenue and Production Meters

Production Socket Wiring

Utility PV Generation and the Utility Storage meters must be wired with Utility feed to the top of the Meter socket; Solar panels and Battery storage to the bottom of the meter socket

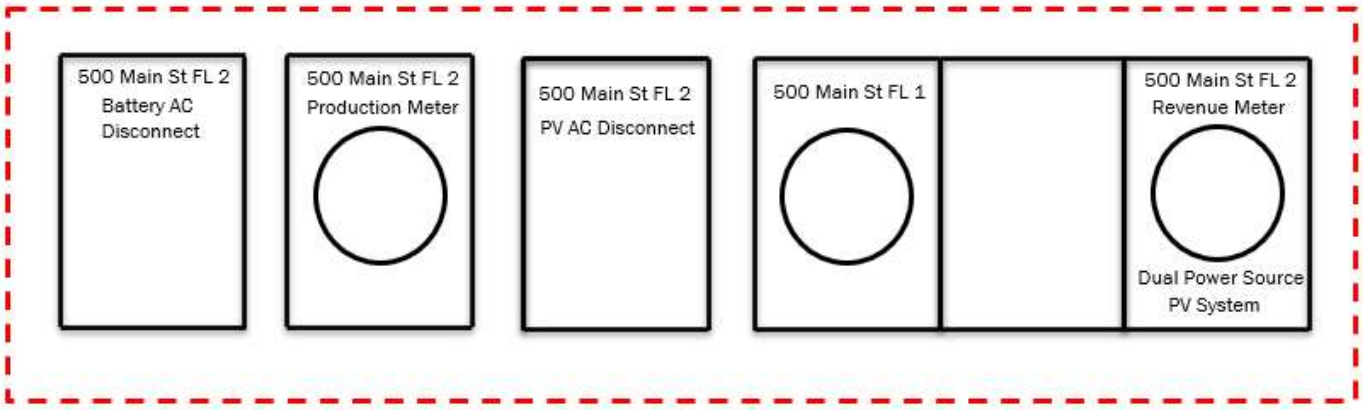


This 5th jaw is required for any single-phase service that is 120/208

Note: If you are installing battery storage behind a production socket you will need a second disconnect on the load side of the production socket

Meter Socket and Disconnect Labeling

- The Revenue Meter Socket needs to be labeled as **Revenue Meter** with the address (Number, Street name & Unit number) that has the solar system.
- The Production Meter Socket needs to be labeled **Production meter** with the address (Number, Street name & Unit number) that has the solar system.
- The Disconnect on the Source Side of the Production Socket needs to be labeled **PV Disconnect** (Number, Street name & Unit number) The Disconnect on the Load Side of the Production Socket if needed must be labeled with the address (Number, Street name & Unit number) . Also needs to be **labeled Battery Disconnect**
- If the battery system is not on the load side of the Production Socket, a Disconnect is still required and that will have to be labeled with the address (Number, Street name & Unit number). Also, to be **labeled Battery Disconnect**.



Note: All the Revenue Meters, Disconnects and Production Meters are grouped together on the exterior either on the front, or sides of the buildings.

Information about metering socket use

- Consult the WMA I&R book for approved meter sockets.
- Link to WMA I&R book:
  - https://www.eversource.com/content/docs/default-source/wma---pdfs/info-requirements-wma.pdf
- Using a meter socket listed in the I&R book will AVOID DELAYS
- All Stand-alone scenarios are considered as new services and MUST follow all I&R requirements.
- A new service request must be submitted for any revenue meter upgrades that are needed to proceed with solar installation. The new service request needs to be completed first before the DG request can moved forward.
- No meter socket can be used as raceway or a splice box. The only wires allowed in a meter socket are the line side, load side and a bonding wire. No grounding wire is allowed. (Grounding wire is a wire the goes out of the meter socket directly to a ground rod)

Instrument Transformer (IT) Rated Services

EVERSOURCE ENERGY

What does the Installation Contractor Provide?

- ✓ Diagrams – 1-line and 3-line diagrams
- ✓ Approved IT cabinet
- ✓ Approved Meter Socket w/Test Switch
- ✓ Emergency disconnect

Provide all diagrams and equipment spec sheets to Eversource for review.

What does the Eversource Provide?

- ✓ Necessary Current Transformers
- ✓ Any necessary Voltage Transformers
- ✓ Meter

All service voltages at or above 277/480v will require voltage transformers.

Secondary CTs will be either 600:5 bar types or 2000:5 window types.

Any services above 3000 A will be primary metered.

Eversource will install all CTs and VTs and wire the secondary side to the test switch.

IT Rated Services:
What type of equipment do I use?

- Consult the WMA I&R book for approved meter sockets AND IT rated transformer enclosures.
- All IT metering must be Cold Sequenced.
- Label Label Label.
  Clearly mark the Emergency Breaker, all IT cabinets and Meter sockets. The more we know when we go out to wiring the equipment, the fewer delays you will encounter.

Questions?

Western Massachusetts Expedited Interconnection Seminar

Wednesday August 21, 2024

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Lead Engineer – Protection and Control

Information and Technical Requirements for the Interconnection of Distribution Energy Resources (DER)

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for the

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Effective Grounding

If effective grounding is required, the customer's site must meet the effective grounding requirement of X0/X1 at the PCC between 2 and 3 when disconnected from the Eversource system. Eversource will review a customer's site effective grounding by modeling the site in ASPEN and evaluating the X0/X1 at the PCC.

For customers with separate PCCs for their PV and BESS systems, they will need to achieve effective grounding in the following three scenarios 1) PV only, 2) BESS only, 3) PV and BESS.

Effective grounding shall be required for all DER interconnections where any of the following is true:

- The fault current at the point of common coupling (PCC) is caused to increase by at least 10 percent of the existing value.
- Areas where fault current may already be deemed excessive.
- DER interconnections equal to or larger than 1MW.
- Anywhere there may exist a potential islanding concern regarding generation to load ratio.

DER that require effecting grounding shall use one of the following methods:

- A GSU with a reactively grounded neutral on the high (utility) wye-connected side and a delta configuration on the low (generator) side.
- A GSU with a grounded-wye / grounded-wye configuration and a grounding transformer on either side of the GSU.
- A delta high (utility) side GSU configuration and a grounding transformer on the high (utility) side.

DER that do NOT require effecting grounding shall use:

- A GSU with delta windings on the high (utility) side of the GSU in conjunction with a customer provided 59N (3V0) scheme fed by PTs on the high (utility) side of the GSU.

Please see Section 2.8 in the Information and Technical Requirements for more information.

P&C Common Comments on SLD

- One-line diagrams must have the IEEE1547 protective settings, and the Ride-Thru capability of the inverter included. See Tables I-IV from ISO New England outlining the IEEE1547 standard.
- The voltage pickup values need to be listed in volts (primary and/or secondary) in addition to p.u. values.
- The PCC disconnect switch should not be a fused disconnect. If a fuse were to blow, an open phase condition would exist, and the site may export unbalanced generation and experience possible ferro resonance.
- For inverter-based sites over 500kW, the site must have one additional utility grade relay with 27, 59, **59N**, 81U and 81O relay functionality.
- The customer's dedicated utility grade relay/protection shall be located at the PCC.

Table I: Inverters' Voltage Trip Settings

Shall Trip – IEEE Std 1547-2018 (2nd ed.) Category II					
Shall Trip Function	Required Settings		Comparison to IEEE Std 1547-2018 (2nd ed.) default settings and ranges of allowable settings for Category II		
	Voltage (p.u. of nominal voltage)	Clearing Time(s)	Voltage	Clearing Time(s)	Within ranges of allowable settings?
OV2	1.20	0.16	Identical	Identical	Yes
OV1	1.10	2.0	Identical	Identical	Yes
UV1	0.88	2.0	Higher (default is 0.70 p.u.)	Much shorter (default is 10 s)	Yes
UV2	0.50	1.1	Slightly higher (default is 0.45 p.u.)	Much longer (default is 0.16 s)	Yes

Table II: Inverters' Frequency Trip Settings

Shall Trip Function	Required Settings		Comparison to IEEE Std 1547-2018 (2nd ed.) default settings and ranges of allowable settings for Category I, Category II, and Category III		
	Frequency (Hz)	Clearing Time(s)	Frequency	Clearing Time(s)	Within ranges of allowable settings?
OF2	62.0	0.16	Identical	Identical	Yes
OF1	61.2	300.0	Identical	Identical	Yes
UF1	58.5	300.0	Identical	Identical	Yes
UF2	56.5	0.16	Identical	Identical	Yes

Table III: Inverters' Voltage Ride-through Capability and Operational Requirements

Voltage Range (p.u.)	Operating Mode/ Response	Minimum Ride-through Time(s) (design criteria)	Maximum Response Time(s) (design criteria)	Comparison to IEEE Std 1547-2018 (2nd ed.) for Category II
V > 1.20	Cease to Energize	N/A	0.16	Identical
1.175 < V ≤ 1.20	Permissive Operation	0.2	N/A	Identical
1.15 < V ≤ 1.175	Permissive Operation	0.5	N/A	Identical
1.10 < V ≤ 1.15	Permissive Operation	1	N/A	Identical
0.88 ≤ V ≤ 1.10	Continuous Operation	infinite	N/A	Identical
0.65 ≤ V < 0.88	Mandatory Operation	Linear slope of 8.7 s/1 p.u. voltage starting at 3 s @ 0.65 p.u.: $T_{VRT} = 3\,s + \frac{8.7\,s}{1\,p.u.}(V - 0.65\,p.u.)$	N/A	Identical
0.45 ≤ V < 0.65	Permissive Operation [a,b]	0.32	N/A	See footnotes a & b
0.30 ≤ V < 0.45	Permissive Operation [b]	0.16	N/A	See footnote b
V < 0.30	Cease to Energize	N/A	0.16	Identical

The following additional operational requirements shall apply for all inverters:

a. In the Permissive Operation region above 0.5 p.u., inverters shall ride-through in Mandatory Operation mode, and

b. In the Permissive Operation region below 0.5 p.u., inverters shall ride-through in Momentary Cessation mode with a maximum response time of 0.083 seconds.

Table IV: Inverters' Frequency Ride-through Capability

Frequency Range (Hz)	Operating Mode	Minimum Time(s) (design criteria)	Comparison to IEEE Std 1547-2018 (2nd ed.) for Category II
f > 62.0	No ride-through requirements apply to this range		Identical
61.2 < f ≤ 61.8	Mandatory Operation	299	Identical
58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite	Identical
57.0 ≤ f < 58.8	Mandatory Operation	299	Identical
f < 57.0	No ride-through requirements apply to this range		Identical

Any Questions?