Distributed Generation Interconnection Seminar

July 20, 2017
National Grid
40 Sylvan Road, Waltham MA 02451
Auditorium
Co-Hosts

nationalgrid

DDER
Massachusetts Department of Energy Resources

MASSACHUSETTS CLEAN ENERGY CENTER

EVERSOURCE ENERGY

Unitil
8:30    Registration
9:00    Welcome, Opening Remarks – Will Kern
9:15    Interconnection Process & Timing – Alex Kuriakose
10:00   Interconnection Developments – Tim Roughan
10:40   Break
10:45   Interconnection Technical Session – Jeff Cahill
11:15   Post ISA Coordination – Hakob Mkrtchyan
11:30   First Bill Walkthrough – Colin Walker
11:50   Questions and Answer Session - National Grid Panel
12:00   Adjourn
Logistics & Introductions

- Facilities
  - Emergency Exits
  - Restrooms
  - Designated smoking areas
  - Mobile Phones
- Introductions
  - DOER / Mass CEC
  - MA Utilities
  - Guests
Rip currents, also known as riptides, are long, narrow bands of water that can pull any objects caught in them away from shore and out to sea. Rip currents are dangerous, and it's best to learn how to identify and stay out of them. Keep your feet on the bottom as much as possible when swimming in surf conditions. Rip currents can occur in any ocean or lake where surf conditions (breaking waves) exist. Keeping your feet firmly on the lake or sea floor will help you to avoid being swept out to sea by a rip current. If, however, you get caught in a rip current, it's relatively easy to escape if you know what to do.

1. **Remain calm if a rip current begins to pull you away from shore.** A rip current will probably not pull you underwater; it will only pull you away from the shore.

2. **Regain your footing if possible.** If the current is relatively weak and you're in shallow water, you will probably be able to touch the bottom again and prevent yourself from being dragged out further. If you can't touch the bottom, do not struggle against the current. Conserve your energy for methodically swimming and staying afloat.

3. **Call for help immediately.** Get the attention of a lifeguard or of other beachgoers by waving your arms and yelling for help.
4. Swim parallel to shore to get out of the current. Rather than swim against the current toward shore, swim parallel to the shore. As you do so, the rip current will carry you further away from shore, but remember, don't panic. Continue swimming parallel to the shore until you are clear of the current. Float on your back or tread water if you can't swim out of the current.

5. Swim toward the shore once you escape the current. When you are out of the current swim diagonally toward shore and away from the current rather than swimming straight back, to avoid swimming back into the rip current. You may be some distance from shore at this point, so stop and float periodically if you need to rest.
DOER’s role in Distributed Generation:

- Assisting with incentives for clean energy
  - Portfolio Standards (RPS/SRECs/APS)
  - Net Metering
- Increasing awareness about policies
  - Interconnection
  - Rates
  - System Planning / Service Quality
- Advising on new policies
  - Streamlining Interconnection
  - Hands-on assistance with challenging projects
Massachusetts Electric Utilities

[Map of Massachusetts showing electric utilities]

- Fitchburg Gas and Electric Light (Until)
- Massachusetts Electric (National Grid)
- Nantucket Electric (National Grid)
- NSTAR
- Western Massachusetts Electric
- Municipal Electric Departments
Received 4,538 interconnection applications representing about 554.6 MW YTD June 2017 compared to 8,577 applications / 203.9 MW same period last year.

Small (<100kW) Interconnection application are triggering large studies because of the aggregate generation on the circuit.
DG Activity Trends - MA

- Received 3,377 applications representing 346.6 MW YTD June 2017
- Received 7,519 applications representing 138.2 MW during the same period CY16

**MA Applications Received Jan - March**

<table>
<thead>
<tr>
<th>Year</th>
<th>Simple Applications</th>
<th>Complex Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>164</td>
<td>110</td>
</tr>
<tr>
<td>2012</td>
<td>653</td>
<td>221</td>
</tr>
<tr>
<td>2013</td>
<td>860</td>
<td>119</td>
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<tr>
<td>2014</td>
<td>2,879</td>
<td>144</td>
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<tr>
<td>2015</td>
<td>6,880</td>
<td>357</td>
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<tr>
<td>2016</td>
<td>7,111</td>
<td>408</td>
</tr>
<tr>
<td>2017</td>
<td>3,073</td>
<td>304</td>
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</table>
DG Activity Trends - MA

- Interconnected 2,981 applications representing 77.5 MW YTD June 2017
- Interconnected 7,499 applications representing 90 MW during the same period CY16

### MA Applications Interconnected Jan - June

<table>
<thead>
<tr>
<th>Year</th>
<th>Simple Applications</th>
<th>Complex Applications</th>
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<tbody>
<tr>
<td>2011</td>
<td>141</td>
<td>65</td>
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<tr>
<td>2012</td>
<td>419</td>
<td>67</td>
</tr>
<tr>
<td>2013</td>
<td>870</td>
<td>93</td>
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<tr>
<td>2014</td>
<td>1,453</td>
<td>61</td>
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<tr>
<td>2015</td>
<td>4,900</td>
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<td>2016</td>
<td>7,286</td>
<td>213</td>
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<tr>
<td>2017</td>
<td>2,799</td>
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DG Interconnection Process

Customer Energy Integration
Alex Kuriakose
Interconnection Discussion Agenda

- The purpose of the Interconnection Process
- Interconnection Process
  - Steps
  - Costs
  - Timetable
- Common Missteps
- Contacts and links for additional information
Importance of the Interconnection Process

- **Safety** of utility workers and general public
- **No adverse impact** to power quality, in terms of:
  - Islanding
  - Transient Voltage Conditions
  - Noise and Harmonics
  - Frequency
  - Voltage Level
  - Machine Reactive Capability
- **Per tariff: customers cannot interconnect without an interconnection agreement and approval.** You proceed at your own risk if you don’t have utility approval.
- Billing implications
Interconnection Process Steps

- Pre-Application
- Simplified Application
- Expedited/Standard Application
- Impact Study and Detailed Study
- Conditional Approval (to construct DG system)
- National Grid Construction
- Witness Test
- Authorization to Interconnect

https://www.nationalgridus.com/masselectric/home/energyeff/4_interconnection-process.asp

http://ngridustest/narragansett/home/energyeff/4_interconnection-process.asp
Customer provides:

- Contact and alternative contact Information
- Facility Location (street address with cross streets, including town, and a Google Map still picture and GPS coordinates):
- Generation type, size (AC kW), single or three phase, service configuration:
- Stand-alone (no on-site load, not including parasitic load)?
- If there is existing service at the Proposed Facility site, provide: Interconnecting Customer Account Number
- Site minimum and maximum (if available) current or proposed electric loads:
- Is new service or service upgrade needed?

Utility provides:

- Circuit voltage, circuit number
- Whether single or three phase is available near site; If single phase – distance from three phase service;
- Aggregate of connected Facilities (kW) on circuit;
- Aggregate of not yet connected (kW) on circuit
- Whether the Interconnecting Customer is served by an area network, a spot network, or radial system;
- Identification of feeders within ¼ mile
- Other potential system constraints or critical items
It Starts With The Application

- **A complete complex application package includes:**
  - **Complete application**, signed and dated, with generator info
  - **Pre-application** (for projects over 500kW)
  - **Application Fee** ($300 minimum; $4.50 / kW – max of $7,500)
  - **PE-Stamped 1-line diagram** showing metering (relay settings if < 500kW)
  - **Site Diagram** showing electric service location, generator location, AC Utility Disconnect, metering, access to metering and disconnect
  - **Documentation problems** “stop the clock” (Reference ESB756 as a guide to avoid customer/contractor holds in the process).
  - **Electronic documents preferred** - however, mail first page of application with application fee
Common Application Mistakes

- Application not signed and dated
- Name on application differs from name on utility account
- Address of facility incorrect
- Ownership of property not identified
- Utility account or meter number not included or incorrect
- Number of inverters not indicated
- Landowner not identified

If new service, call Work Order Service group (800-375-7405): request service and write application “pending” account number and WR#. 
Documentation Mistakes

- Legal Info Document incorrectly represents intent of the parties
  - Third party ownership of generator
  - Legal Info Doc used to prepare Interconnection Service Agreements

- 1-line Diagram Errors:
  - Diagram doesn’t showing all equipment, including all metering
  - Transformer impedance data (% Z, X/R ratio) missing
  - Relay settings and islanding detection needed on larger projects

- Site Plan Errors:
  - Doesn’t show location of metering, or incoming service, or transformer, or access road, or AC Utility Disconnect
Interconnection Costs

- Application Fee
  - Not all projects will require Impact or Detailed Studies, or System Mods
- System Modifications
- Witness Test Fee(s)
- Design, construction and installation of the Interconnection Facilities
Simplified Review Path

- Single phase, UL Listed, inverter based systems **15kW** (was previously 10 kW) or less on a single phase service on a radial feed.

- Three phase, UL List, inverter based systems **25kW** or less on a three phase service on a radial feed.

- Listed (*UL 1741.1*) inverters, that comply with current *IEEE 1547 standard*, or have nationally recognized test lab results.

- Additional 5 days for review if screen 5 is not met (project isn’t compatible with existing service, e.g. loading on existing service transformer, etc.)
  - Does not apply to non-listed inverters or other generators (induction / synchronous / asynchronous).
  - Does not apply to aggregate generation capacity of listed inverters that exceed the above-mentioned limits.
Submit complete, signed application, $28 fee
Approval usually within 10 business days, unless project not compatible with service
Install system, get Certificate of Completion (COC) signed by local wiring inspector – submit to utility with electrical permit and completion documentations.
Utility will change meter for net metering
Utility inspects within 10 days of receipt of COC – utility can waive inspection
Advantages of Simplified
- Little cost to customer (95% of cases)
- Waived Application and Witness Test Fees
- Rapid approval

<table>
<thead>
<tr>
<th>Simplified Process</th>
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</thead>
<tbody>
<tr>
<td>Eligible Facilities</td>
</tr>
<tr>
<td>Listed Small Inverter DG</td>
</tr>
<tr>
<td>Acknowledge Receipt of Application (Note 2)</td>
</tr>
<tr>
<td>(3 days)</td>
</tr>
<tr>
<td>Review Application for Completeness</td>
</tr>
<tr>
<td>10 days</td>
</tr>
<tr>
<td>Complete Review of All Screens</td>
</tr>
<tr>
<td>15 days - 20 Days (note 3)</td>
</tr>
<tr>
<td>Send Executable Agreement (Note 4)</td>
</tr>
<tr>
<td>Done</td>
</tr>
<tr>
<td>Construction Schedule</td>
</tr>
<tr>
<td>By Mutual Agreement</td>
</tr>
<tr>
<td>Total Maximum Days (Note 5)</td>
</tr>
<tr>
<td>25/30 days (Pg. 44, Note 5)</td>
</tr>
<tr>
<td>Notice/ Witness Test</td>
</tr>
<tr>
<td>&lt; 1 day with 10 day notice or by mutual agreement</td>
</tr>
</tbody>
</table>
Expedited Review Path

- Single phase customers with listed single-phase inverter based systems >15 kW on a radial feed
- Three phase customers with listed three-phase inverter based systems >25kW on a radial feed
- Maximum size is based on review of screens

**Does not Apply to:**
- Non-listed inverters or other generators (induction / synchronous / asynchronous)
- When aggregate generation capacity of listed inverters exceeds the above-mentioned limits
Expedited Review Path

- Often little or no System Modifications required. If meter only – usually no cost
- Application fee plus any Supplemental Review charges up to 30 hours of engineering time @ $150/hr. (if needed)
- Relay control system must be well defined to make supplemental review easier.
- Witness test fee of up to $300 plus travel may be required

<table>
<thead>
<tr>
<th>Eligible Facilities</th>
<th>Expedited</th>
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</thead>
<tbody>
<tr>
<td>Acknowledge Receipt of Application (Note 2)</td>
<td>(3 days)</td>
</tr>
<tr>
<td>Review Application for Completeness</td>
<td>10 days</td>
</tr>
<tr>
<td>Complete Review of All Screens</td>
<td>25 days</td>
</tr>
<tr>
<td>Complete Supplemental Review (if needed) (Note 3)</td>
<td>20 days or Standard Process</td>
</tr>
<tr>
<td>Send Executable Agreement (Note 4)</td>
<td>10 days</td>
</tr>
<tr>
<td>Construction Schedule</td>
<td>By Mutual Agreement</td>
</tr>
<tr>
<td>Total Maximum Days (Note 5)</td>
<td>45/65 days (Note 5)</td>
</tr>
<tr>
<td>Notice/ Witness Test</td>
<td>&lt; 1 day with 10 day notice or by mutual agreement</td>
</tr>
</tbody>
</table>
If any screens are not passed, the Company may provide a **Supplemental Review Agreement** before providing an Interconnection Service Agreement.

Key threshold is whether aggregate generation is less than 67% of minimum load on the feeder. Other screens review voltage quality, reliability and safety to reduce the potential need for impact studies.

Customer signs agreement and pays fee (max $4,500).

Supplemental Review may determine if any System Modifications are required. If no Impact Study is needed an Interconnection Service Agreement will be sent to customer detailing:

- System Modifications, reasoning, and costs
- Specifics on protection requirements

If Supplemental Review cannot determine requirements, an Impact Study Agreement (or equal) will be sent to the customer. Shifts to standard process.
Standard Review Path

- Applies to:
  - Non-listed inverters or other generators:
    - Induction, Synchronous, Asynchronous
  - Large-scale PV (500kW or greater)
  - Most CHP systems
  - *** Any project that requires more than 30 hours of engineering time to identify System Modifications.
Standard Review Path

- After initial review customer may need to enter Standard Process
- Impact Study will determine impact on EPS, other customers, other generators
- Detailed Study will determine System Modifications required and cost (Risk of Islanding)
- ISO notification may be required
- Transmission Study may be required
- Interconnection Service Agreement provided after studies completed
- Witness test fee is actual cost
- There is a “Standard Process Complex Projects” track
- Allows more time for studies (see notes 4 and 5, pg. 48 MDPU 1248)

<table>
<thead>
<tr>
<th>Step</th>
<th>Time</th>
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<tbody>
<tr>
<td>Eligible Facilities</td>
<td>Standard</td>
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<td>Acknowledge Receipt of Application (Note 2)</td>
<td>(3 days)</td>
</tr>
<tr>
<td>Review Application for Completeness</td>
<td>10 days</td>
</tr>
<tr>
<td>Complete Standard Process Initial Review</td>
<td>20 days</td>
</tr>
<tr>
<td>Send Follow-on Studies Cost/Agreement</td>
<td>5 days</td>
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<tr>
<td>Complete Impact Study (if needed)</td>
<td>55 days</td>
</tr>
<tr>
<td>Complete Detailed Study (if needed)</td>
<td>30 days</td>
</tr>
<tr>
<td>Send Executable Agreement (Note 3)</td>
<td>15 days</td>
</tr>
<tr>
<td>Construction Schedule</td>
<td>By Mutual Agreement</td>
</tr>
<tr>
<td>Total Maximum Days (Note 5)</td>
<td>135/200 days (Note 5)</td>
</tr>
<tr>
<td>Notice/ Witness Test</td>
<td>10 days or by mutual agreement</td>
</tr>
</tbody>
</table>
Technical Issues: Limits on Distribution EPS - Radial

- Interconnection Applications on non-dedicated circuits:
  - Largest wind application is 4.5 MVA on 13 kV class circuits
  - Largest Solar application is 6 MVA on 23 kV class circuits

- Interconnection Applications on express(no load) circuits:
  - Largest wind application is 30 MVA on 34.5 kV class circuits
  - Largest Solar application is 14 MVA on 13 kV class circuits
Study “on hold” until company receives the requested info from customer

If an applicant requests additional time at or near a milestone, the Company will get additional time to achieve that milestone

If an applicant requests a significant project change -- as determined by the company - the applicant will be required to submit a new interconnection application

Recent examples – change of inverter could necessitate longer study and be deemed moderate/ significant change (case by case basis)

At any time, an applicant may request a review of time-frame compliance by the company, and the company must respond within ten business days

There is a process to remove customers from the “queue” if they don’t abide by the timelines or extensions

Customer can request refund of application fee if the Company does not comply with timeline(s)
Completion Documentation

- PE-Stamped As-Built 1-line Diagrams – **signed and dated**
- Certificate Of Completion – **signed and dated**
- Commissioning Memo – **signed and dated**
- Schedule Z – **signed and dated** with correct account numbers
- Municipal Inspection – if needed – Inspector MUST call in
- Net Metering Allocation (could be a **Qualifying Facility** instead)
- (5) quality photos needed (with legible labels/plaques)
  - AC Utility Disconnect
  - Inverters / Generator
  - Pad-mount transformer
  - Current Limiting Device
  - Meter Socket
Behind the scenes at the utility…

- Review and replacement of metering, modifications to billing
- Modifications to protection systems as required (e.g. replace or install fusing, install switch, modify breaker/recloser set-points, transfer trip, etc.)
- Larger generators require review by NEPOOL reliability committee and registration with ISO-NE
- Adding generation asset to geographic information systems, maps, system one-lines, dispatch systems, etc.
- Publish internal special operating guidelines for utility field personnel on larger generators.
- Set up future testing for relay protection, meter calibration, insurance tracking, etc.
Many Stakeholders Involved

**Utility**
- Application analyst – processes application, agreements and assists with construction coordination
- Lead Engineer for reviews/studies
- Relay Engineering
- Distribution Planning
- Distribution Dispatch
- Distribution Design Engineering
- Meter Operations
- Meter Engineering
- Meter Data Services
- Relay Telecom Operations
- Inspection team
- Customer Service / Billing
- Legal...

**Interconnecting Customer**
- Customer
- Equipment vendor
- Lead contractor
- Electrician
- Electrical Engineer (PE)
- Relay Engineer
- Relay testing firm
- Legal

**ISO-NE**
(If necessary)
Summary and Recommendations

- Submit your interconnection application with National Grid early, during conception phase before committing to buy no matter how simple or small the DG might be.

- You can always request general utility information about a specific location from your utility.

- Large interconnection applications take longer to study.

- The Interconnection Tariff is a wealth of information.

- Time frames are standard working days and do not include delays due to missing information or force majeure events.

# National Grid Contacts & Tariff Links

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Director</strong></td>
<td>Kevin Kelly</td>
<td>(978) 725-1325</td>
</tr>
<tr>
<td><strong>Manager - NE</strong></td>
<td>John Kennedy</td>
<td>(401) 784-7221</td>
</tr>
<tr>
<td></td>
<td>William Kern</td>
<td>(781) 907-3023</td>
</tr>
<tr>
<td><strong>Manager – DG Business Support (NE &amp; NY)</strong></td>
<td>Vishal Ahirrao</td>
<td>(781) 907-3002</td>
</tr>
<tr>
<td><strong>MA</strong></td>
<td>Alex Kuriakose</td>
<td>(781) 907-1643</td>
</tr>
<tr>
<td></td>
<td>Hakob Mkrtchyan</td>
<td>(781) 907-1516</td>
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<tr>
<td></td>
<td>Patrick Sullivan</td>
<td>(781) 907-1686</td>
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<tr>
<td></td>
<td>Eric Munzert</td>
<td>(781) 907-3833</td>
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<tr>
<td></td>
<td>Bassey Iro</td>
<td>(781) 907-2522</td>
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<tr>
<td></td>
<td>Melissa Drury</td>
<td>(781) 907-1472</td>
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<td></td>
<td>Thomas Hurley</td>
<td>(781) 907-3145</td>
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<tr>
<td><strong>RI</strong></td>
<td>Harmony Smith</td>
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<td></td>
<td>Patricia Matulaitis</td>
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</tr>
<tr>
<td><strong>Screening Team</strong></td>
<td>Nicholae Gari</td>
<td>(781) 907-2018</td>
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<tr>
<td></td>
<td>Andy Garsils</td>
<td>(516) 545-4682</td>
</tr>
<tr>
<td></td>
<td>Joshua Dibia</td>
<td>(516) 545-4778</td>
</tr>
<tr>
<td><strong>Analysts</strong></td>
<td>Pamela Hill</td>
<td>(508) 860-6673</td>
</tr>
<tr>
<td></td>
<td>Jake Kailey</td>
<td>(781) 907-3729</td>
</tr>
<tr>
<td></td>
<td>Colin Walker</td>
<td>(781) 907-1499</td>
</tr>
</tbody>
</table>

Department Email: [Distributed.Generation@nationalgrid.com](mailto:Distributed.Generation@nationalgrid.com)

RI Website: [https://www.nationalgridus.com/narragansett/home/energyeff/distributed_generation.asp](https://www.nationalgridus.com/narragansett/home/energyeff/distributed_generation.asp)

Customer Contact Center: 1-800-322-3223
Other MA Utility Contacts & Tariff Links

• Eversource ~ NSTAR (Eastern Mass) DG team
  • Pyong Bruce Kim(Simplified) | (781) 441-8285 (Pyong.Kim@eversource.com)
  • Complex | (781) 441-8196
  • Email: emdg@eversource.com
  • https://www.eversource.com/Content/ema-c/residential/programs-services/customer-generation

• Eversource ~ WM DG team (WMECo)
  • Phone: 413-787-1087
  • Email: wmdg@eversource.com
  • https://www.eversource.com/Content/wma/residential/programs-services/customer-generation

• Unitil
  • Phone: 603-773-6480
  • Email: (generator@unitil.com)
  • http://www.unitil.com/energy-for-residents/electric-information/distributed-energy-resources/renewable-energy-generation
Other Information Resources

• MA DG and Interconnection Website: http://sites.google.com/site/massdgic/

• Net Metering Basics: https://sites.google.com/site/massdgic/home/net-metering

Interconnection Developments

Process & Recent Events

Regulatory ~ Tim Roughan
December 2009 Net Metering Tariff, updated July 2012 by DPU.

- DPU has issued clarifying orders in August 2012, and July 2013

- Net Metering means the process of measuring the difference between electricity delivered by a Distribution Company and the electricity generated by a Class 1, Class II, or Class III Net Metering Facility and fed back to the Distribution Company.

- Three Classes of Net Metering Facilities in Net Metering Tariff:
  - **Class 1**: Any generator up to 60 KW is eligible
  - **Class 2**: Agricultural, anaerobic digester, solar, or wind net metering facility over 60 KW but less than or equal to 1 MW (for municipal or government it’s “per unit”)
  - **Class 3**: Agricultural, anaerobic digester, solar, or wind net metering facility over 1 MW but less than or equal to 2 MW (for municipal or government it’s “per unit”)
Energy use is “netted” over the billing period, typically a month
- If there is net energy usage, Host Customer is billed for net purchases.
- If there is net energy sales, credit is export kWh times the following
- Credit is calculated on host customer’s rate

<table>
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<tr>
<th>Class</th>
<th>min</th>
<th>max</th>
<th>Type</th>
<th>Default Service kWh **</th>
<th>Distribution kWh</th>
<th>Transmission kWh</th>
<th>Transition kWh</th>
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</thead>
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<tr>
<td>I</td>
<td>0</td>
<td>60 KW</td>
<td>Agricultural, Anaerobic Digestion, Solar, Wind</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>I*</td>
<td>0</td>
<td>60 KW</td>
<td>All Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>II</td>
<td>&gt;60 KW</td>
<td>1 MW</td>
<td>Agricultural, Anaerobic Digestion, Solar, Wind</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>III</td>
<td>&gt;1 MW</td>
<td>2 MW</td>
<td>Agricultural, Anaerobic Digestion, Solar, Wind</td>
<td>X</td>
<td></td>
<td>Gov’t only</td>
<td>X</td>
</tr>
</tbody>
</table>

- Customer still responsible for customer charges and demand charges, even if net export
- Tariff allows credits to be allocated (with limitations)

**Notes:**
1.) Class I* All Other (Non-Renewable) = Credited at average monthly clearing price set by ISO-NE.
2.) Default Service kWh ** = Fixed default service rate.
Net Metering

- Class 2 and Class 3 projects will need a production meter on generation.
- Net Metering is limited to 7% of each utility’s peak MW for private and 8% of peak for public projects.
- Contribution towards total is posted on each utility’s web site and updated monthly; also MASSACA website updated daily [www.massaca.org](http://www.massaca.org)

### Private: Available, Interconnected, Reserved and Pending Capacity (Values in kW)

<table>
<thead>
<tr>
<th>Company</th>
<th>Net Metering Cap</th>
<th>Interconnected (a)</th>
<th>Reserved Cap Allocations (b)</th>
<th>Pending Cap Allocations (c)</th>
<th>Capacity Available Under Cap (e)</th>
<th>Waiting List (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGrid</td>
<td>359,170</td>
<td>225,017</td>
<td>132,915</td>
<td>23</td>
<td>1,215</td>
<td>3,242</td>
</tr>
<tr>
<td>NGrid-Nantucket</td>
<td>3,500</td>
<td>398</td>
<td>463</td>
<td>0</td>
<td>2,639</td>
<td>0</td>
</tr>
</tbody>
</table>

### Public: Available, Interconnected, Reserved and Pending Capacity (Values in kW)

<table>
<thead>
<tr>
<th>Company</th>
<th>Net Metering Cap</th>
<th>Interconnected (a)</th>
<th>Reserved Cap Allocations (b)</th>
<th>Pending Cap Allocations (c)</th>
<th>Capacity Available Under Cap (e)</th>
<th>Waiting List (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGrid</td>
<td>410,480</td>
<td>282,614</td>
<td>127,623</td>
<td>0</td>
<td>243</td>
<td>3,555</td>
</tr>
<tr>
<td>NGrid-Nantucket</td>
<td>4,000</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>3,900</td>
<td>0</td>
</tr>
</tbody>
</table>

Cap data as of 7/11/2017

Guidance on submitting an Application for Cap Allocation is available at:
- [http://www.massaca.org/help.asp](http://www.massaca.org/help.asp),
- via the [Help@MassACA.org](mailto:Help@MassACA.org) email,
- or the MassACA Helpline (877) 357-9030

Need to determine whether project is a “Public” or a “Private” Facility
- **Public**: Host Customer is certified as a Municipality or Other Governmental Entity by the DPU and has Class II or Class III Facility. Host Customer allocates to only customers who are certified Public. Ten MW limit per entity in Massachusetts.
- **Must apply to DPU to be certified as a Public Facility**
- **Host Customer and all allocated customers must get this certification as a Public Facility**
- **Need to send copy of certificate(s) to utility**
- **Private**: All other Host Customers.
Net Metering ‘Eligibility’

- Three Factor Approach (order 11-11C, issued 8/24/12)
  - Single parcel / single interconnection point / single meter
    - Enacted to limit gaming and limits one meter per parcel of land with a limit of 2 MWs on the parcel for private entities
      - A governmental entity can have a total of 10 MWs of net-metered accounts throughout the state or on a parcel
      - No more 6 – 1 MW projects on a parcel
      - We can not provide more than one interconnection point (POI)
    - Otherwise separate metered project could earn higher credits than if it was behind an existing meter
Net Metering ‘Eligibility’

- 11-11E issued 7/1/13
  - Allows for ‘an exception for optimal interconnection’.
    - Utility can have more than one interconnection point and meter for technical and/or operational reasons
  - Still only allows one net-metering facility per parcel
    - Customers can petition DPU for exceptions
    - Can have a separate meter for net metering facility along with other non-net meter meters on the single parcel

- Company will determine if customer’s proposed configuration is technically ‘eligible’ for net metering as soon as it can
  - Could be upon application, or not until the project has been through screening or initial review
  - Customer must be ‘qualified’ for net metering by applying to the SoA.
  - Company can not provide net metering without proof of this ‘qualification’. If on waiting list we could set up customer as a QF (Qualifying Facility) and pay for excess at the hourly clearing price at the ISO-NE for the load zone where project is located.
Net Metering Production Reporting

- Net Metering Tariff requires reporting of generator’s kWh output.
- Class 1 Facilities to provide in writing by January 31 and September 30
- Class 2 and Class 3 Facilities may participate in production tracking system (PTS).
  - Mass CEC provided PTS data to the utilities, still working through implementation issues
  - Utility can request data from Class 2 and 3 Facilities
Net Metering Summary

- If planning to Net Meter, submit Schedule Z with interconnection application or as soon as is practical.

- Correctly fill out Schedule Z.
  - Host Customer is primary account holder on the electric account.
  - Must be signed by Host Customer.

- If allocating, verify name/address/account info of electric customer(s) or will need to submit corrected form.

- Host Customer must apply to DPU for certification as a Municipality or Other Governmental Entity and submit confirmation to Distribution Company.
  - If allocating credits to customers, those customers must also obtain certification.

- Must obtain a qualified cap allocation from Mass ACA. (If on waiting list and still looking to interconnect became a Qualifying Facility.)

- Production reporting is required.

- Class II and III Facilities - ISO registration required and associated ISO-NE OP 18 metering.
Solar SMART Status

- New feed-in-tariff program

- Draft tariff development is underway
  - Program is expected to be available to projects interconnected on or after April 1, 2018 or when approved by the MA DPU

- Initial 100 MW procurement process – to set initial prices
  - RFP to be issued in October
  - RFP results announced end of 2017
When is ISO-NE Notification or Study Required?

- **Proposed Plan Applications (PPA):**
  - *0 - 0.999 MW cumulative increase* - no form required
  - *1.000 - 4.999 MW cumulative increase* - notification form required to go to Reliability Committee.
    - Submitted after Impact Study is completed.
    - Transmission Owner submits PPA if generator is not a NEPOOL participate.
    - If generator is NEPOOL participant, Transmission Owner must review PPA first.
  - *> 4.999 MW cumulative increase* - PPA and studies required to go to Stability and Transmission Task Forces and Reliability Committee
    - After Impact Study completed, determine if any Substation / Transmission upgrades required.
    - Transmission Owner and Task Forces need to agree if transmission study will/will not be required.
    - Transmission Owner submits PPA if generator is not a NEPOOL participate.
    - If generator is NEPOOL participant, Transmission Owner must review PPA first.
    - A stability model will likely be required.

- **Refer to Planning Procedure 5-1**

* NOTE = cumulative increase from last approved PPA
Compensation if not Net Metered

- If the customer will never export power – no concern.

- If customer will export power – they can sell their exported power to the market through a registered market participant.
  - Customer becomes or works with a registered market participant to sell power.
  - Customer must pay for all power they use.

- Customer with a **Qualifying Facility** (QF) certificate (≥1MW) from FERC for the generator, can receive compensation under the local utility’s Power Purchase Schedule (PPS) rate.
  (The PPS Short Run Energy rate is the ISO-NE locational marginal price (LMP).)

• This presentation will review the interconnection standard (Interconnection Tariff) applicable to generators that will connect (grid tied) to the Distribution System (either to a 69 kV line or lower).

• Generally, generation systems are considered DG if they are going to connect to the distribution system. In this case, the owner must follow the local utility’s interconnection process.

• If you would like to apply to the transmission system (generally larger systems), you need to apply to the New England Independent System Operator (ISO-NE), and are not considered DG.

• If you will be selling your power to a third party, you may have to apply through ISO-NE even for a distribution system interconnection

• If circuit is already “FERC Jurisdictional” you may need to apply to ISO-NE.
When is an Interconnection Request Submitted to ISO-NE?

- Interconnecting generation to a distribution circuit which already has a wholesale transaction (FERC Jurisdictional), and, the project plans to sell power to a third party
- Increasing capacity of an existing generating facility*
- Materially modify an existing generating facility*
- Changing from energy only (NR) to energy and capacity unit (CNR)
- There is no minimum size

* NOTE = Generation facility with wholesale sales of electricity in interstate commerce (i.e. not Net Metered or compensated under Power Purchase Schedule as a QF).
Break: 5 Minutes, then Follow up Questions
Distribution Planning & Asset Management

Jeff Cahill
Technical Discussion

- Potential Impacts of DG on Distribution EPS
- System Modeling Studies
- Transformer Limits
- Radial Systems versus Secondary Network Systems
- Anti-Islanding
What are industry standards and codes that apply to DG interconnections to the EPS?

- IEEE standards applicable to DG installations:
  - **IEEE 1547** “Standard for Distributed Resources Interconnected with Electric Power Systems”
  - IEEE 1547 references several other standards, such as but not limited to the C37.90 series.
Interconnection Standards – Industry Standards, Codes, Regulatory Rules, Local Rules, Product Standards

- Federal Government
  - FERC SGIP “Small Generator Interconnection Procedure”

- Regional
  - NERC Standard FAC-001-0 - Facility Connection Requirements
  - Standard PRC-002-NPCC-01 - Disturbance Monitoring

- State Government
  - New York Department of Public Service (NY DPS)
    - PSC NY Standardized Interconnection Requirements for Distributed Generation Connected to the Distribution EPS (NY SIR)
    - Niagara Mohawk d/b/a National Grid tariff, P.S.C. 220
  - Massachusetts Department of Public Utilities (MA DPU)
    - Massachusetts Electric d/b/a National Grid tariff, M.D.P.U. 1320
  - Rhode Island Public Utilities Commission (RI PUC)
    - Narragansett Electric d/b/a National Grid tariff, R.I.P.U.C. 2078
      https://www.nationalgridus.com/non_html/shared_interconnectStds_RI.pdf
Interconnection Standards – Industry Standards, Codes, Regulatory Rules, Local Rules, Product Standards

Each utility has their requirements pursuant to the regulations that govern them as varying from state-to-state based on the NESC.

ESB 750 Specifications for Electrical Installations

ESB 756 General Requirements for Parallel Generation Connected to a National Grid Owned EPS

- Appendix A Requirements for Parallel Generation Connected to National Grid Facilities in NY

- Appendix B Distributed Generation Connected To National Grid Distribution Facilities per the NYS SIR

- Appendix C Distributed Generation Connected To National Grid Distribution Facilities per the MA SIDG (September 2015, Version 3.0)

- Appendix D Distributed Generation Connected To National Grid Distribution Facilities per the RI SCDG (R.I.P.U.C. 2078, November 2011 tariff.)

- Appendix E Requirements for Parallel Generation Connected to National Grid Facilities in New Hampshire

✓ The Appendices to ESB 756 are intended for jurisdictional-specific requirements.

Key Points for Electric Service Requirements:

- Require some means of disconnect and main overcurrent protection, i.e., service equipment.
- Billing meters secure.
- Interface points clear to avoid potential operating and safety problems.

Key Points for Parallel Generation Requirements:

- Company determines the interconnect voltage and method of interconnection.
- Prior notification to and approval by the Company is required for any generation to be installed or operated in parallel with the Company EPS.

www.nationalgridus.com/electricalspecifications
ESB 756 references all requirements for parallel generation connected to National Grid facilities located in Upstate New York, Massachusetts, and Rhode Island.

The purpose of this National Grid Electric System Bulletin (ESB) is to:

1. **Provide general requirements and recommendations for all generators connected in parallel with the electric power system (EPS) operated by National Grid (Company).** Stand alone generators serving isolated load, which can never be connected in parallel with the Company EPS, are not subject to these requirements.

2. **Ensure compliance with NERC Standard FAC-001-0 – Facility Connection Requirements**, effective April 1, 2005. Along with all of the Company’s Electric System Bulletins, the most current version of ESB 756 is available electronically on its National Grid USA web page at: [www.nationalgridus.com/electricalspecifications](http://www.nationalgridus.com/electricalspecifications).

3. **Ensure that the electrical reliability and security of the Company EPS and the larger power system grid** is maintained following connection of the parallel generator to the utility supply.

4. **Refer Generator-owners to the applicable FERC or state-specific tariff regulations** pertaining to parallel generators.
Technical Issues
Integrating Distributed Generation with the Utility Distribution EPS

- Potential Impacts of DG on Distribution EPS

Customer generation connected to the distribution system can cause a variety of system impacts including **steady state and transient voltage changes**, **harmonic distortion**, and **increased fault current levels**.
System Modeling Studies

The purpose of impact studies is to identify the severity of system impacts of the Customer’s generators and the upgrades needed to avoid problems on the Company’s distribution electric power system (EPS).

Careful engineering can effectively eliminate the potentially adverse impacts that DG or distributed resource (DR) penetration could impress on the electric delivery system, such as exposing system and customer equipment to potential damage, decrease in power quality, decrease in reliability, extended time to restoration after outage, and potential risks to public and worker safety.
The IEEE supports the following system issues that the utility industry faces with DG penetration on the local EPS, but not limited to:

- Voltage
- Capacitor operations
- Flicker and voltage regulator and LTC operations
- Protection coordination
- Feeding faults after utility protection opens
- Interrupting rating of devices
- Faults on adjacent feeders
- Fault detection
- Ground source impacts and ground fault overvoltages
- Single phase interruption on three phase line
- Recloser coordination

- Thermal overload and conductor burndown
- Risk-of-islanding:
  - Loss of power grid and sensitivity under light load
  - Vulnerability and overvoltages
- System restoration and network issues
- Harmonic distortion contributions
- Power system stability and impact to bulk power network
- System reinforcement
- Metering
- Telemetering
Technical Issues
Integrating Distributed Generation with the Utility Distribution EPS

- **Transformer Limits- DG Installations less than 600V**
  - The utility distribution transformers **continuous duty nameplate rating** is applied to sizing for DG Customer installations to ensure reliability of the supply.
  - Exceeding transformer nameplate rating from DG sources affects the transformer normal loading capability and transformer life cycle becomes shortened.
  - Replacement later due to overload by DG causes burden on other customers on same feed!

---
Radial Systems versus Secondary Network Systems

Area Networks consist of one or more primary circuits from one or more substations or transmission supply points arranged such that they collectively feed secondary circuits serving one (a spot network) or more (an area network) Interconnecting Customers.
DG saturation refers to the point at which large amounts of parallel generation are installed, whether by a single large facility or multiple facilities in aggregate, such that it becomes technically infeasible to operate on a single distribution feeder.

- A resulting example is excessive voltage regulation issues associated with intermittent resources like solar and wind. IEEE 1547 is recognized by the applicable Company tariff, P.S.C. 220 Rule 53 providing technical guidance whereby voltage regulation impacted by DG is a limiting factor.

It is expected due to the DG market that distribution feeders in many areas will reach the saturation point based on the application growth rate in those areas.

- Stability issues due to generation exceeding the feeder load causing back feed to the transmission system will need to be addressed where DG saturation occurs.
Technical Issues:
Limits on Distribution EPS - Radial

- DG reduces load on the system
- Multiple systems on a line can pose unique challenges

**Potential impact of PV on Load Profile**

*12 kV Distribution Feeder - June 28 - July 4, 2009*
Technical Issues: Limits on Distribution EPS - Radial

**Example: Intermittent Resources - Large PV Inverter-based DG:**

- Ramp rates of large PV inverter-based generators can affect EPS operations and power quality.
- Geographic diversity effects not yet fully understood.

✓ First check – “How is EPS affected and how much is acceptable on it (other customers on the feeder)?”
Electric Service Bulletin (ESB) requirements have changed as of Nov. 15, 2016.

- In most cases, certified inverter projects would no longer require direct transfer trip (DTT).

- For generation projects without customer load, a utility owned point of common coupling (PCC) recloser may be required. This may allow the customer to provide simpler service installations.

- Where PCC reclosers are required, in most cases, a remote terminal unit (RTU) would not be required.

This policy will be included in the next revision of ESB 756C, which will be published later this year.
Zero Sequence Overvoltage (3V0)

- For single-line-to-ground faults on the delta side of substation delta-wye-ground transformers, over-voltages may occur where significant amounts of DG are connected on the wye side of the transformer.

- Impact studies evaluate total DG on the substation versus total minimum load.

- If risk of overvoltage condition is present, additional substation protection required:
  - CCVT’s
  - 59N relaying
  - Control wiring to trip all wye-ground (low) side breakers
The M.D.P.U. No. 1248, Section 4.2.3.2.1b: Interconnection system response to abnormal frequency clearing times. Clearing time is considered as the time that it takes the relay to initiate a trip plus the breaker operating time.

- The adjustable under frequency set point shall comply with the NPCC Directory 12 curve for setting under frequency trip protection on DR1 larger than 30kW. Per the NPCC A-03 curve, if the setting falls above the curve, there must be an equivalent amount of load shed when tripped, which in this case cannot be done and therefore the 81 under frequency must be set below the curve.

- Per NPCC Directory 12 Curve: Document A-03 Exhibit 4.9 page 5: “Generators should not be tripped for under-frequency conditions in the area above the curve in Figure 1.”

[Link to NPCC A-03 curve](https://www.npcc.org/Standards/Directories/Directory12%20Full%20Member%20clean%202020150330%20GJD.pdf)
The M.D.P.U. No. 1320, Section 4.2.3.2.1b: Interconnection system response to abnormal frequency clearing times. Clearing time is considered as the time that it takes the relay to initiate a trip plus the breaker operating time.

<table>
<thead>
<tr>
<th>DR size</th>
<th>Frequency range (Hz)</th>
<th>Clearing time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 30 kW</td>
<td>&gt; 60.5</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>&lt; 59.3</td>
<td>0.16</td>
</tr>
<tr>
<td>&gt; 30 kW</td>
<td>&gt; 60.5</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>&lt; {59.8 - 57.0} (adjustable setpoint)</td>
<td>Adjustable 0.16 to 300</td>
</tr>
<tr>
<td></td>
<td>&lt; 57.0</td>
<td>0.16</td>
</tr>
</tbody>
</table>

*DR ≤ 30 kW, maximum clearing times; DR > 30 kW, default clearing times*

- Clarifying points to avoid potential Issues causing non-compliance to the NPCC and IEEE 1547 standard
- Aggregate generation under 30kW is acceptable if documentation is provided showing UL1741 “listed” inverters
- Aggregate generation greater than 30kW: UL1741 “listed” inverters are required to provide confirmation of settings from above table. This means if multiple string inverters less than 30kW are used for a site that aggregates greater than 30 kW, the appropriate settings from the table should be loaded in the inverters for UL 1741 testing.
Technical Issues
NPCC Requirements for Generator Tripping
Examples:

<table>
<thead>
<tr>
<th>Example 1:</th>
<th>81U</th>
<th>UNDER-FREQUENCY RELAY</th>
<th>STEP 1: PICKUP 57 HERTZ, TIME DELAY 10 CYCLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>81O</td>
<td>OVER-FREQUENCY RELAY</td>
<td>PICKUP 60.5 HERTZ, TIME DELAY 10 CYCLES</td>
<td></td>
</tr>
</tbody>
</table>

*Times listed are total clear (should include breaker/interrupter time, detection time, etc.)*

For Adjustable Under Frequency Setpoint required by IEEE 1547-2003
Acceptable setting range to comply with the NPCC Directory 12 Curve “Standards for Setting Underfrequency Trip Protection for Generators” for the Eastern Interconnection

Example 2:

<table>
<thead>
<tr>
<th>81U</th>
<th>57.0 Hz</th>
<th>0.16 SEC (10 CYCLE) DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>59.0 Hz</td>
<td>300 SEC (18,000 CYCLE) DELAY</td>
<td></td>
</tr>
<tr>
<td>81O</td>
<td>60.5 Hz</td>
<td>0.16 SEC (10 CYCLE) DELAY</td>
</tr>
</tbody>
</table>

Any Project Above 30kW
Post ISA Coordination

Customer Energy Integration
Hakob Mkrtchyan
**Post ISA Coordination**

**Engineering, Procurement & Construction Process (Overview)**

<table>
<thead>
<tr>
<th>ISA Execution</th>
<th>Design</th>
<th>Procurement/Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Payment Plan</td>
<td>• Field Investigation</td>
<td>• Procuring Long Lead items</td>
</tr>
<tr>
<td>• Kick-off Meeting</td>
<td>• Detailed Design Sketches and Specifications</td>
<td>• Securing Easements, Right of Way access and/or Environmental permits/licenses</td>
</tr>
<tr>
<td>• Preliminary Engineering</td>
<td>• Construction grade estimates</td>
<td></td>
</tr>
<tr>
<td>• Milestone Plan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Engineering**

- Recloser and Primary Meter
- Company System Updates
- Compliance Verification

**Construction**

- Advanced notice for scheduling
- Field Check
- Outage coordination
- Construction

**Energization, Testing & Commissioning**

- Field Commissioning and Energization
- Relay Test
- RTU Test
- Customer Commissioning

Customer Interface: TSES, Customer Service, and Customer Solutions
Post ISA Coordination (cont’d)

Witness Testing Process Overview

**Witness Test Documents**
- IC submits WT Documents
- Company reviews & approves WT documents
- IC Submits Pre-testing results
- Call to discuss test results and sequence of events

**Scheduling Witness Test**
- IC requests WT date
- Company confirms WT date & sequence of events
- Company coordinates WT with internal groups

**Day of Witness Test**
- Relay test
- Functional Trip test
- In-service checks
- Generator/Inverter relay test

**Authority To Interconnect**
- Company reviews & approves test results
- Company confirms receipts of all compliance documentation
- Company to issue AI letter

- In case of IPP, the site will ONLY be energized first time on the day of the witness test after successful completion of relay test and functional trip test.
- Customer shall perform pre-testing using their own generator source.
- The Company needs at least 10 day advance notice to schedule a witness test.
- It is recommended to submit witness test documents at least 30 days prior to the witness test.
Post ISA Coordination

Key Items

- Developing Project Schedule including Interconnection Tasks
- Procuring communication lines for Interconnection – MPLS circuit and Telephone line
  - Verizon High Voltage Protection Requirements
  - Other Utility Costs
- Design/ Equipment Changes
- Municipal Inspection
- Verizon Pole Installation and Payment
- Testing and Commissioning Plan
  - Test Procedure
  - Energization Plan
  - Long term O&M Arrangement

**Note:** Please plan ahead for all close-out activities, like witness testing, as they can be time consuming to coordinate and complete. Please keep all critical milestone date or deadline of commercial operation of the system in mind while planning for witness test.
First Bill Walkthrough

Customer Energy Integration
Colin Walker
Basics of Net Metering

- When you are using more power than you are generating, your meter registers positive. You are importing power from your electric company.

- When you are generating more power than you are using, your meter registers negative. You are exporting power to your electric company.

- In any billing period where exported energy exceeds imported, your electric bill will show negative use. You are a net exporter for the billing period, and are entitled to a Net Metering Credit.

*Important: Standard utility meters cannot differentiate between import and export. A bi-directional meter is needed to properly record directional flow.*
Net Metering – Simple Example

- Our Host Customer uses 700 kWh and has a 12kW PV system, which is expected to generate ~ 1200 kWh / mo
  - Host Customer uses: 700 kWh (import)
  - Host Customer generates: 1200 kWh (export)
  - Use – Generation = Export: - 500 kWh (net export)
- The electric bill will show only the net, (-) 500 kWh
- Credit will be calculated based on 500 kWh

Note: Host needs separate (customer-owned) production metering to know exactly how much was generated
How much is the Net Metering Credit worth?

Did the account net export during the billing period? (Did I generate more energy than I used?)

- If yes, then the credit will depend on the rate of your Net Metered Account (determined by the demand (kW) of your facility)
  - Residential and Small Commercial are energy-only rates
  - Medium and Large Commercial rates include demand charges and time-of-use components, and may include other charges
- Each rate includes several charges. The Net Metering credit per kWh is a combination of the distribution, transmission, transition, and standard offer service charges.
What will this look like on my bill?

- Net Export is the basis for Net Metering Credit, and appears in “Metered Usage” section
- Net Metering Credits appear in “Delivery Services” section
- Net Metering Credits are calculated using the retail rate, which may include several types of charges (block rates, time-of-use, demand charges, etc.)
- Calculation depends on rate, class, and load zone
- With different rate structures and use patterns, credit may not appear the same on every net metered account.
Net Metering Calculations

• Calculation 1
  Class I - Not solar, wind, farm, or anaerobic digester < 60 kWs – credits based on average (wholesale) clearing price at ISO-NE for load zone during the month credits were earned

• Calculation 2
  Class I and Class II - Solar, wind, farm, or anaerobic digester < 1 MW – credits based on rate class, load zone and month apply to distribution, transmission, transition, and fixed basic service. Also includes Class III governmental entities

• Calculation 3
  Class III - < 2 MW (not including governmental entities) credits based on rate class, load zone and month apply to transmission, transition, and fixed basic service
Qualifying Facilities under 60 kW are reimbursed based on ISO-NE monthly average clearing price X net exported kWh

**DETAIL OF CURRENT CHARGES**

*Delivery Services*

<table>
<thead>
<tr>
<th>Description</th>
<th>Energy-kWh</th>
<th>Demand-kW</th>
<th>Demand-kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metered Usage</td>
<td>-74775 kWh</td>
<td>28.0 kW</td>
<td>28.0 kVA</td>
</tr>
<tr>
<td>Billed Usage</td>
<td>0 kWh</td>
<td>28.0 kW</td>
<td>28.0 kVA</td>
</tr>
</tbody>
</table>

**Meter Number**: [Redacted]

**Next Scheduled Read Date**: Apr 23

**Service Period**: Jan 23 - Feb 20

**Number of Days in Period**: 29

**Rate**: General Service - Demand G-2

**Voltage Delivery Level**: 0 - 2.2 kv

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>16.56</td>
</tr>
<tr>
<td>Distribution Demand Chg</td>
<td>168.00</td>
</tr>
<tr>
<td>ISO Clearing Price</td>
<td>-7,523.40</td>
</tr>
<tr>
<td><strong>Total Delivery Services</strong></td>
<td><strong>-$ 7,338.84</strong></td>
</tr>
</tbody>
</table>
Some rate structures do not contain blocked or time of use rates, which allows us to display the Net Metering Credit on one line on the bill.

Net Metering Credit includes: transmission, transition, distribution, and basic service credits

**DETAIL OF CURRENT CHARGES**

**Delivery Services**

<table>
<thead>
<tr>
<th></th>
<th>Energy-kWh</th>
<th>Demand-kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metered Usage</td>
<td>-17642 kWh</td>
<td>104.0 kW</td>
</tr>
<tr>
<td>Billed Usage</td>
<td>0 kWh</td>
<td>104.0 kW</td>
</tr>
</tbody>
</table>

**Meter Number**: [Redacted]  
**Next Scheduled Read Date**: May 22  
**Service Period**: Mar 20 - Apr 18  
**Number of Days in Period**: 30  
**Rate**: General Service - Demand G-2  
**Voltage Delivery Level**: 0 - 2.2 kv

**Customer Charge**: 16.56

**Net Metering Credit**: $0.092804 x -17642 kWh = -1,637.24

**Distribution Demand Chg**: 6 x 104 kW = 624.00

**Total Delivery Services**: -$996.68
Block rate formats require Distribution Charges be displayed in the manner below.

- Net Met Cr Other is a combination of transmission, transition, and basic service credits.
- Net Met Cr First is the distribution credit for the first 600 kWh.
- Net Met Cr Next is the distribution credit for usage beyond first 600 kWh.

**DETAIL OF CURRENT CHARGES**

**Delivery Services**

<table>
<thead>
<tr>
<th>Service Period</th>
<th>No. of days</th>
<th>Current Reading</th>
<th>Previous Reading</th>
<th>Total Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 22 - Apr 24</td>
<td>33</td>
<td>42381 Actual</td>
<td>50928 Actual</td>
<td>-8547 kWh</td>
</tr>
</tbody>
</table>

**RATE** Residential Regular R-1

<table>
<thead>
<tr>
<th>Customer Charge</th>
<th>4.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Met Cr Other</td>
<td>0.09606 x -8547 kWh</td>
</tr>
<tr>
<td>Net Met Cr First -600 KWH</td>
<td>0.03356 x -600 kWh</td>
</tr>
<tr>
<td>Net Met Cr Next -7947 KWH</td>
<td>0.04018 x -7947 kWh</td>
</tr>
</tbody>
</table>

**Total Delivery Services** -$ 1,156.46
Rate G-3 (Time-of-Use)

Example

- Net Met Credit Other is a combination of transmission, transition, and basic service credits
- Net Metering Credits are calculated on both the Peak and Off Peak schedule
- Net Metering Credit is the sum of Peak, Off Peak and basic service credits.

<table>
<thead>
<tr>
<th>DETAIL OF CURRENT CHARGES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delivery Services</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Energy-kWh</strong></td>
</tr>
<tr>
<td>Peak</td>
</tr>
<tr>
<td>Off Peak</td>
</tr>
<tr>
<td>Billed Usage</td>
</tr>
</tbody>
</table>

**Meter Number**

- METER NUMBER:
- NEXT SCHEDULED READ DATE: Jun 6
- SERVICE PERIOD: Apr 4 - May 3
- NUMBER OF DAYS IN PERIOD: 30
- RATE: Time-of-Use G-3
- VOLTAGE DELIVERY LEVEL: 0 - 2.2 kV

- Customer Charge: 200.00
- Distribution Demand Chg: 3.92 x 372 kW/kVA = 1,458.24
- Net Metering Credit Onpk: 0.01247 x -13510 kWh = -168.46
- Net Metering Credit Offpk: 0.00494 x -12480 kWh = -61.65
- Net Metering Credit Other: 0.081607 x -25990 kWh = -2,120.96

**Total Delivery Services**:

- $692.83
This calculation does not include Distribution Charges, so there are no issues related to blocked or TOU rates; therefore, we can display the Net Metering Credit on one line on the bill.

### DETAIL OF CURRENT CHARGES

**Delivery Services**

<table>
<thead>
<tr>
<th></th>
<th>Energy-kWh</th>
<th>Demand-kW</th>
<th>Demand-kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>-128012 kWh</td>
<td>252.0 kW</td>
<td>268.0 kVA</td>
</tr>
<tr>
<td>Off Peak</td>
<td>-219815 kWh</td>
<td>784.0 kW</td>
<td></td>
</tr>
<tr>
<td>Billed Usage</td>
<td>0 kWh</td>
<td>252.0 kW</td>
<td>268.0 kVA</td>
</tr>
</tbody>
</table>

- **Meter Number**: [Redacted]
- **Next Scheduled Read Date**: May 30
- **Service Period**: Mar 27 - Apr 28
- **Number of Days in Period**: 33
- **Rate**: Time-of-Use G-3
- **Voltage Delivery Level**: 22 - 50 kV

<table>
<thead>
<tr>
<th>Charge</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>200.00</td>
</tr>
<tr>
<td>Distribution Demand Chg</td>
<td>3.92 x 252 kW/kVA</td>
</tr>
<tr>
<td>High Voltage Discount</td>
<td>-0.45 x 252 kW</td>
</tr>
<tr>
<td><strong>Net Metering Credit Other</strong></td>
<td>0.08375149 x -347827 kWh</td>
</tr>
<tr>
<td>High Voltage Metering</td>
<td>-1.0 % x $1187.84</td>
</tr>
<tr>
<td><strong>Total Delivery Services</strong></td>
<td>-$28,068.48</td>
</tr>
</tbody>
</table>
Schedule Z

- Schedule Z is used to allocate Net Metering Credits from a Host Account to “target” account(s)

- Net Metering Credits are calculated using certain components of the retail rate of the Host Account

- The value of the Net Metering Credit depends on the rate of the Host and the class of the Net Metering Facility

- National Grid transfers credits, on a percentage basis, to accounts listed on your Schedule Z

*Important: There is no mechanism for transferring specific dollar amounts, only percentages of Net Metering Credits*
When can I expect to see the first transfer of credits?

- The first Net Metering Credit may not appear until the month following the first bill after you received formal Authorization to Interconnect.
- Each month the Host Account meter is read and net export is used to calculate Net Metering Credits for that month.
- Our Accounts Processing group transfers credits, as directed on Schedule Z.
- Typically, Net Metering Credits are transferred to “target” accounts about 1-2 weeks after Host Account has billed.
- Net Metering Credits will be displayed on both the Host Account and “target” accounts on the next month’s bill.
- As Host Customers and “target” customers may not be in the same billing cycle, transfers from one month may not show up until the following month, and may not always occur on the same date.
FAQ’s

- How often can I change my Schedule Z allocation(s)?
  - Customers are allowed to change Schedule Z twice a year.
- When will my new Schedule Z allocation(s) take effect?
  - When we receive a revised Schedule Z, the account(s) are updated. Changes should take effect the following billing cycle.
- Will the bill show credits transferred from Host Account to “target” accounts?
  - Host Account will show “Transfer Credit”, and $ amount
  - “Target” account will show “Transfer Credit” and $ amount
  - Host Account will not show “target” account numbers
  - “Target” account will not show Host Account number.
Host to Target Customer Credit Transfer

- The Host Customer bill with the transferred credit on the subsequent bill

**Other Charges/Adjustments**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer Credit/Charges</td>
<td>432.02</td>
</tr>
<tr>
<td><strong>Total Other Charges/Adjustments</strong></td>
<td>$ 432.02</td>
</tr>
</tbody>
</table>

- The Target Customer bill with the transferred credit on the subsequent bill

**Other Charges/Adjustments**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer Credit/Charges</td>
<td>-432.02</td>
</tr>
<tr>
<td><strong>Total Other Charges/Adjustments</strong></td>
<td>-$ 432.02</td>
</tr>
</tbody>
</table>
For Example Only – Your Answers May Vary

Schedule Z – Additional Information Required for Net Metering Service

Please fill out the form completely.

Primary Account Holder

Host Customer Name: John Doe

Telephone: 413-123-4567

Address of Facility: 123 Main Street, Town, MA 01000

Billing Account Number: 541234567891

Meter Number: 112234455

Application ID Number: 2A100-2000

Is the Host Customer a Municipality Other Governmental Entity

If so, submit certification provided by the DPU when obtained.

A) Is the Host Customer applying for net metering service an electric company, generation company, aggregator, supplier, energy marketer, or energy broker, as those terms are used in M.G.L. c. 164, §§ 1 and 1F and 220 C.M.R. §11.00? [ ] No (you are not eligible for net metering service)

[ ] Yes

NOTE: Definitions are:

“Electric company” means a corporation organized under the laws of the commonwealth for the purpose of making by means of water power, steam power or otherwise and for selling, transmitting, distributing, transmitting and selling, or distributing and selling, electricity within the commonwealth, or authorized by special act so to do, even though subsequently authorized to make or sell gas; provided, however, that electric company shall not mean an alternative energy producer; provided further, that a distribution company shall not include an entity which owns or operates a plant or equipment used to produce electricity, steam and chilled water, or an affiliate engaged solely in the provision of such electricity, steam and chilled water, where the electricity produced by such entity or its affiliate is primarily for the benefit of hospitals and nonprofit educational institutions, and where such plant or equipment was in operation before January 1, 1986; and provided further, that electric company shall not mean a corporation only transmitting and selling, or only transmitting, electricity unless such corporation is affiliated with an electric company organized under the laws of the commonwealth for the purpose of distributing and selling, or distributing only, electricity within the commonwealth. G.L. c. 164, § 1.

“Generation company” means a company engaged in the business of producing, manufacturing or generating electricity or related services or products, including but not limited to, renewable energy generation attributes for retail sale to the public. G.L. c. 164, § 1.

“Aggregator” means an entity which groups together electricity Customers for retail sale purposes, except for public entities, quasi-public entities or authorities, or subsidiary organizations thereof, established under the laws of the commonwealth. G.L. c. 164, § 1.

“Supplier” means any supplier of generation service to Retail Customers, including power marketers, brokers and marketing affiliates of distribution companies, except that no power company shall be considered a supplier. G.L. c. 164, § 1.

For the terms “energy marketer” and “energy broker,” please use the definition for “Electricity Broker,” which means an entity, including but not limited to an Aggregator, which facilitates or otherwise arranges for the purchase and sale of electricity and related services to Retail Customers, but does not sell electricity. Public Aggregators shall not be considered Electricity Brokers. 220 C.M.R. 11.02.

B) If applying for Net Metering as an Agricultural Net Metering Facility, please answer the following questions:

1) Is the Agricultural Net Metering Facility operated as part of an agricultural business? [ ] Yes [ ] No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

2) Has the Commissioner of the Department of Agriculture recognized the business as an agricultural business? [ ] Yes [ ] No

3) Is the Agricultural Net Metering Facility located on land owned or controlled by the agricultural business mentioned in Item B.1 above? [ ] Yes [ ] No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

4) Is the energy from the Agricultural Net Metering Facility used to provide electricity to metered accounts of the agricultural business mentioned in Item B.1 above? [ ] Yes [ ] No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

5) If applying for neighborhood net metering, please answer the following questions:

C) 1) Are all participants served by the same distribution company? [ ] Yes [ ] No

2) Are all participants served by the same ISO-NE load zone? [ ] Yes [ ] No

3) Do all participants reside in the same municipality? [ ] Yes [ ] No

NOTE: If any of the answers to the questions in Item C are no, then the facility is ineligible for neighborhood net metering unless granted an exception by the Department of Public Utilities under 220 C.M.R. §18.00(6).

D) Please indicate how the Host Customer will report to the Company the amount of electricity generated by the net metering facility. The information is due twice each year: (1) by January 31 for the prior year’s generation; (2) by September 30 for the year-to-date generation:

[ ] Provide the Company access to their ISO-NE GIS account

[ ] Provide the Company access to their metering or inverter data

Select One

[ ] X Provide the Company with a report in writing of the generation by January 31 and again on September 30 each year

E) For any Billing Period in which the Host Customer earns Net Metering Credits, please indicate how the Distribution Company will apply them:

[ ] X Allocate all of the Net Metering Credits to the account of the Host Customer (Skip Items F and G)

[ ] Allocate all the Net Metering Credits to the accounts of eligible Customers (Classes I and II Net Metering Facilities)

Both apply a portion of the Net Metering Credits to the Host Customer’s account and allocate a portion to the accounts of eligible Customers (Classes I and II Net Metering Facilities)
B) If applying for Net Metering as an Agricultural Net Metering Facility, please answer the following questions:

1) Is the Agricultural Net Metering Facility operated as part of an agricultural business?
   Yes  No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

2) Has the Commissioner of the Department of Agriculture recognized the business as an agricultural business?
   Yes  No

3) Is the Agricultural Net Metering Facility located on land owned or controlled by the agricultural business mentioned in Item B.1 above?
   Yes  No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

4) Is the energy from the Agricultural Net Metering Facility used to provide electricity to metered accounts of the agricultural business mentioned in Item B.1 above?
   Yes  No (the facility is not eligible for Net Metering as an Agricultural Net Metering Facility)

C) If applying for neighborhood net metering, please answer the following questions:

1) Are all participants served by the same distribution company?  Yes  No
2) Are all participants served by the same ISO-NE load zone?  Yes  No
3) Do all participants reside in the same municipality?  Yes  No

NOTE: If any of the answers to the questions in Item C are no, then the facility is ineligible for neighborhood net metering unless granted an exception by the Department of Public Utilities under 220 C.M.R. §18.09(6).

D) Please indicate how the Host Customer will report to the Company the amount of electricity generated by the net metering facility. The information is due twice each year: (1) by January 31 for the prior year’s generation; (2) by September 30 for the year-to-date generation:

- Provide the Company with their ISO-NE GIS account
- Provide the Company with their metering or inverter data
- Provide the Company with a report in writing of the generation by January 31 and again on September 30 each year

E) For any Billing Period in which the Host Customer earns Net Metering Credits, please indicate how the Distribution Company will apply them:

- Apply all of the Net Metering Credits to the account of the Host Customer (Skip Items F and G)
- Allocate all the Net Metering Credits to the accounts of eligible Customers (Class I and II Net Metering Facilities) (skip Item F)
- Both apply a portion of the Net Metering Credits to the Host Customer’s account and allocate a portion to the accounts of eligible Customers (Class I and II Net Metering Facilities) (skip Item F)

F) If the Host Customer has a Class III Net Metering Facility, please indicate below the range that best represents the number of eligible Customer accounts to which Net Metering Credits would be allocated. Alternatively, please complete Item G. This information will allow the Company to exercise its option to purchase Net Metering Credits from the Host Customer rather than allocating such credits.

The Company will notify the Host Customer within 30 days of the filing of Schedule Z whether it will allocate or purchase Net Metering Credits. If the Company elects to purchase Net Metering Credits, the Company will render payment by issuing a check to the Host Customer each Billing Period, unless otherwise agreed in writing by the Host Customer and Company. If the Company elects to allocate Net Metering Credits, the Host Customer must complete Item G and submit the revised Schedule Z to the Company.

- Allocate Net Metering Credits to fewer than 50 eligible Customer accounts (Skip Item G)
- Allocate Net Metering Credits to 50 or fewer eligible Customer accounts (Skip Item G)
- Allocate Net Metering Credits to more than 50 eligible Customer accounts (Skip Item G)

G) Please state the total percentage of Net Metering Credits to be allocated.
   % Amount of the Net Metering Credit being allocated. The total amount of Net Metering Credits being allocated shall not exceed 100%. Any remaining percentage will be applied to the Host Customer’s account.

Please identify each eligible Customer account to which the Host Customer is allocating Net Metering Credits by providing the following information (attach additional pages as needed):

- Customer Name: (Customer Name as listed on Electric Bill)
- Service Address: (Service Address as listed on Electric Bill. This is NOT the Mailing Address)
- Billing Account Number: (Billing Account number as listed on Electric Bill)
- If public entity, DPU Public Classification ID: (Complete if applicable, otherwise leave blank)
- Amount of Net Metering Credit Allocated: (Amount being allocated to this account) %

Customer Name: 
Service Address: 
Billing Account Number: 
If public entity, DPU Public Classification ID: 
Amount of Net Metering Credit Allocated: %

Customer Name: 
Service Address: 
Billing Account Number: 
If public entity, DPU Public Classification ID: 
Amount of Net Metering Credit Allocated: %

Customer Name: 
Service Address: 
Billing Account Number: 
If public entity, DPU Public Classification ID: 
Amount of Net Metering Credit Allocated: %
Net Metering – filling out Schedule Z, last page

Customer Name: __________________________________________
Service Address: _________________________________________
Billing Account Number: ________________________________
If public entity, DPU Public Classification ID: __________________%
Amount of Net Metering Credit Allocated: __________________%

Customer Name: __________________________________________
Service Address: _________________________________________
Billing Account Number: ________________________________
If public entity, DPU Public Classification ID: __________________%
Amount of Net Metering Credit Allocated: __________________%

H) The Company may elect to seek to obtain capacity payments from ISO-NE for the electricity generated by Class II and III Net Metering Facilities. The Company will notify the Host Customer within 30 days of the filing of Schedule Z whether it will assert title to the right to seek those capacity payments. If the Company elects to assert title to those capacity payments, the Company will include any capacity payments received from ISO-NE in the Company’s annual Net Metering Recovery Surcharge reconciliation.

I) The terms of this Schedule Z shall remain in effect unless and until the Host Customer executes a revised Schedule Z and submits it to the Company. Unless otherwise required herein or mutually agreed to in writing by the Host Customer and the Company, a revised Schedule Z shall not be submitted more than twice in any given calendar year.

J) A signature on the application shall constitute certification that (1) the Host Customer has read the application and knows its contents; (2) the contents are true as stated, to the best knowledge and belief of the Host Customer; and (3) the Host Customer possesses full power and authority to sign the application.

Host Customer (Signature) ______________________________________

Host Customer (Print) ______________________________________

Date ______________________________________

Please return Schedule Z to:
Western Massachusetts Electric Company
Attention: WMECO DG
55 Russell Street
Hadley, MA 01035-9455
Email: wmecodg@me.com
Fax: 413-585-1709

Primary Account Holder
2017 DG Seminars – MA

• **Today** (National Grid – Waltham)
• August 23, 2017 (Eversource -- formerly WMCo) -- Hadley
• September 13, 2017 (Eversource East – formerly NSTAR)
• **October 19, 2017** (National Grid -- North Andover/Brockton)
• November 2, 2017 (Eversource -- formerly WMCo) -- Hadley
• December 13, 2017 (Eversource East – formerly NSTAR)
Thank you for Participating!

Contact for Follow-Up Questions:

Email: Distributed.Generation@nationalgrid.com