

Attachment D

Minimum Technical Requirements

All Commonwealth Solar Rebate Program PV projects must demonstrate compliance with the Minimum Technical Requirements set forth in this attachment. These requirements are not intended to be all-encompassing, nor is this attachment intended to be a substitute for engineering specifications or for safety requirements. Site-specific conditions and/or local regulations may require additional requirements not contained in this attachment. MRET reserves the right to withhold payment to any project that does not satisfy the Minimum Technical Requirements.

Minimum Design and Estimated Production Requirements

The PV project must be designed so that the estimated annual energy output for the PV project, based on actual site specific shading, azimuth, and inclination is at least 80% of the default optimal output for a fixed PV project of the same capacity, as estimated by PVWATTS or a similar tool.

Optimal parameters for purposes of a PVWATTS estimate are: 1) 0.77 dc to ac derate factor, 2) 42 degree array tilt, and 3) 180 degree (True South) azimuth. Please see the Application and Instructions (Attachment A) Part 3: PV Project Technical and Cost Worksheet for related information.

PVWATTS is available at the following website: http://rredc.nrel.gov/solar/codes_algs/PVWATTS/.

Exception for Commercial Only:

- Commonwealth Solar will provide partial rebates to PV projects that meet or exceed 65% of optimal output but do not meet the 80% production requirement based on the following schedule:

Percent of Optimal Production	Percent of Rebate
80%	100%
79%	98%
78%	96%
77%	94%
76%	92%
75%	90%
74%	88%
73%	86%
72%	84%
71%	82%
70%	80%
69%	78%
68%	76%
67%	74%
66%	72%
65%	70%

Exception:

Fixed off-grid PV applications that are permanently located on the same contiguous property of an eligible non-residential, grid-connected applicant and facility must include energy balance calculations that ensure that the PV project will provide sufficient power and energy storage to run loads for periods of time with the lowest average daily insolation and longest periods of inclement weather, taking into account the load, losses, deratings (e.g., battery temperature) and shading. This translates to array-to-load ratios greater than 1.05 and no/low sun energy storage of at least 7 days.

Additional Design Requirements for Projects of 50 kW or Larger

Stamped affidavits or drawings are required for the electrical and structural components of the installation.

- The electrical design must be stamped by a Professional Engineer (PE) licensed in the Commonwealth of Massachusetts.
- The structural design requires a stamped affidavit from a Massachusetts-registered engineer or architect confirming that the roof structure is adequate to withstand the static and dynamic loads of the PV project under the design conditions specified for the project location in the current edition of the Massachusetts Building Code. The analysis must include all roof-mounted portions of the PV project, including modules, racks, ballast, and other related components.

Installation Requirements

The **PV project electrical work must be performed by a Massachusetts licensed electrician**. For more information: <http://www.mass.gov/?pageID=ocaconstituent&L=2&L0=Home&L1=Licensee&sid=Eoca>

The PV project must be installed according to the manufacturer's instructions and in compliance with all applicable codes and standards including:

- Local, state, and /or federal building and electrical¹ laws, codes and practices. The provisions of the appropriate version of the Massachusetts Electric Code (MEC) 2008 as specified by state code.
- Interconnection Agreement. A separate application must be submitted to the electric utility to start the formal interconnection process, and sufficient lead time should be allowed, based on time frames listed in the Interconnection Tariff (see link below). All PV projects must have an appropriate electric utility interconnection agreement in place at the time of interconnection to the utility grid. For more information: www.masstech.org/cleanenergy/howto/interconnection/index.htm
- All pertinent permits and inspections must be obtained and copies kept on file as may be required by local codes and/or state law.

Additional general installation practices to be followed include:

- All installations must follow the most current edition of the Massachusetts Electrical Code with the following changes as noted below. In all cases where manufacturer instructions, third-party guides/handbooks, or other materials contradict the most current edition of any local, state, or federal code, the applicable code shall take precedence over such materials.
- The following additional MRET requirement is taken from MEC 2005, 690.47 (C), but is also compliant with MEC 2008, 690.47 (C), Systems with Alternating-Current and Direct-Current Grounding. The intent is to enhance the safety of the PV system being installed over and above that offered under some alternatives available under MEC 2008, 690.47 (C).

(C) Systems with Alternating-Current and Direct-Current Grounding Requirements Photovoltaic power systems with both alternating-current and direct-current (dc) grounding requirements shall be permitted to be grounded as described in (1) or (2):

(1) A grounding-electrode conductor shall be connected between the identified dc grounding point to a separate dc grounding electrode. The dc grounding-electrode conductor shall be sized according to 250.166. The dc grounding electrode shall be bonded to the ac grounding electrode to make a grounding electrode system according to 250.52 and 250.53. The bonding conductor shall be no smaller than the largest grounding electrode conductor, either ac or dc. The grounding electrode conductor shall be installed in accordance with 250.64.

(2)The dc grounding electrode conductor and ac grounding electrode conductor shall be connected to a single grounding electrode. The separate grounding electrode conductors shall be sized as required by 250.66 (ac) and 250.166 (dc). The grounding electrode conductor shall be installed in accordance with 250.64.

- All interconnecting wires must be copper and all wiring connections must be properly made, insulated, and weather-protected. Aluminum wiring may be used only under the following circumstances:
 - Use of aluminum conductors requires a design stamped by a professional engineer licensed in the Commonwealth of Massachusetts, and
 - All interconnecting wires smaller than #1 AWG (American Wire Gage) must be copper.
- Areas where wiring passes through ceilings, walls, or other areas of the building must be properly

¹ Massachusetts Building Code (780 CMR) and Electrical Code (527 CMR) are available from the Executive Office of Public Safety and the Board of Fire Prevention Regulations, respectively.

restored, booted, and sealed.

- Disconnecting devices must be installed to allow isolation of all PV project components for service and inspection.
- Thermal insulation in areas where wiring is installed must be returned to “as found or better” condition.
- Warning labels, as specified in the Massachusetts Electrical Code (MEC) 2008 version, must be posted on disconnects, panel enclosures, and accessible junction boxes indicating that the circuits are energized by an alternate power source independent of utility-provided power.
- All installed electrical components must be listed by a nationally recognized testing laboratory such as Underwriters Laboratory (UL), and/or be compliant with Institute of Electrical and Electronics Engineers (IEEE) standards, or the American National Standards Institute (ANSI), or other nationally recognized testing laboratory standards (e.g., UL, CSA, ETL, TUV, etc.), unless otherwise noted in this document, and installed in a manner consistent with the relevant listing and labeling.
- All work must be completed in a neat and professional manner.
- An owner’s manual of operating and maintenance instructions must be provided to the PV project owner and preferably also posted on or near the PV project. The owner’s manual should include manufacturer’s specifications, serial numbers, warranty policies, etc.
- Owners must be provided with, at minimum, a basic training orientation that includes maintenance instructions, troubleshooting, meter reading, and electric production reporting instructions. Owners should also be informed of any opportunities to sell Renewable Energy Certificates (REC).
- MRET recommends, but does not require, that all PV projects installed under the Commonwealth Solar program include appropriate surge arresters or other means to protect PV project components from lightning and other surge events. However, it is the responsibility of the installer to ensure that the installation meets any local, state or federal building and electrical laws that address lightning and surge protection.

PV Project and Equipment Warranty Requirements

- **Installer Warranty.** All PV projects must have a minimum 5 year labor warranty provided by the installer to protect the purchaser against defective workmanship, PV project or component breakdown (exceptions noted below), or degradation in electrical output of more than fifteen percent from their originally rated electrical output during the warranty period. The warranty must cover the PV project, including PV modules (panels) and inverters, and provide for no-cost repair or replacement of the PV project or system components, including any associated labor during the warranty period.
- **Manufacturer Warranty.** All major equipment must meet the following minimum manufacturer warranties:
 - Photovoltaic Module: Minimum of one year product warranty from date of sale to first consumer purchaser for product workmanship and materials, plus a minimum performance warranty of 20 years within which time the module will produce, under standard test conditions, a minimum of 80% of the product’s minimum rated power at time of sale;
 - Inverters: Minimum of 10 years product warranty from date of sale to first consumer purchaser for product workmanship and materials;
 - Revenue grade production meters: 2 year product warranty
 - Mounting equipment: 5 year product warranty.
- Exception:
 - Aforementioned warranty requirements do not apply to the components of a Data Acquisition System with exception of the revenue grade meter. However, equivalent warranties, if available, or equivalent service contracts are strongly recommended for such equipment.

Additional Solar PV Equipment Requirements

The equipment and components that comprise the PV project must have the following characteristics:

- All electrical equipment funded in part or in whole by MRET must be new.
- Underwriters Laboratory (UL) listed and compliant with Institute of Electrical and Electronics Engineers (IEEE) standards, or other nationally recognized testing laboratory standards (e.g., UL, CSA, ETL, TUV, etc.).
 - All photovoltaic modules must be certified by a nationally recognized testing laboratory as meeting the requirements of the UL Standard 1703.
 - Inverters must be certified as meeting the requirements of IEEE 1547 and UL Standard 1741.
- All modules, inverters, and production meters must be on the California Energy Commissions list of

eligible renewable energy equipment: www.consumerenergycenter.org/erprebate/equipment.html

- Exceptions:
 - A Data Acquisition System does not need to be UL listed.
 - UL is not required, but is recommended, for PV projects operating at less than 30 volts.

Electricity Production Meter Requirements

All PV projects must have a dedicated production meter that:

- Is readily accessible and easily understood by the PV project owner;
- Records the PV project's AC output as measured on the AC side of the PV project's isolation transformer; in the case of DC-only PV projects the meter should record the PV project output provided to the facility load; if a storage device is integral to the PV project, the meter should record the output from the storage device;
- Shall be separate from the utility billing meter and shall not interfere with utility billing or net-metering;
- Must be a standard utility "revenue quality" meter that conforms to applicable American National Standards Institute (ANSI) C-12 standards and shall be installed on the AC output side of the PV projects inverter or isolation transformer; and
- Shall have a visible display of cumulative energy produced by the PV project and be available for periodic testing and/or re-calibration, if necessary.

More information about meter requirements can be found at: <http://ar.masstech-pts.org/downloads/>

Exception:

- Fixed off-grid PV applications that are permanently located on the same contiguous property of an eligible non-residential, grid-connected applicant and facility are exempt from production metering requirements.

Automated Reporting to MRET's Production Tracking System (PTS)

All Commercial PV projects receiving a Commonwealth Solar rebate calculated using a PV project size of over 10 kW (dc) must include an automated reporting system, which meets the requirements described below, and must report to the MRET Production Tracking System (PTS) for a minimum of five years. (*Note: Residential projects are not required to automatically report production, regardless of size.)

There are three options for automated reporting to the PTS:

- 1) Vendor-Supplied System: A Data Acquisition System (DAS) that has local PTS-incorporated Automated Reporting features.
- 2) Vendor-Supplied Service: A DAS with a service that offers remote monitoring that has PTS-incorporated Automated Reporting features.
- 3) Sample Source Code Integration: A DAS vendor or service provider can customize the software of their system to incorporate this data transfer functionality.

Contact your Installer, Vendor or MRET for a list of products that have incorporated automated reporting capabilities.

For more information about Automated Reporting requirements, access: <http://ar.masstech-pts.org/downloads/>