

## Attachment D

### Commonwealth Solar II Minimum Technical Requirements

All Commonwealth Solar II 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. MassCEC 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://www.nrel.gov/rredc/pvwatts/>.

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.

#### 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=Licenses&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 electrical<sup>1</sup> laws, codes and practices. The provisions of the 2011 Massachusetts Electric Code (MEC) 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.
- 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 MassCEC requirement is intended to enhance the safety of the PV system being installed over and above that offered under some alternatives available under the 2011 edition of the MEC, 690.47(C) Systems with Alternating-Current and Direct-Current Grounding Requirements.
  - All installations must utilize either 690.47(C)(1) *Separate Direct-Current Grounding Electrode System Bonded to the Alternating-Current Grounding Electrode System*, or 690.47(C)(2) *Common*

<sup>1</sup> 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.

*Direct-Current and Alternating-Current Grounding Electrode.*

- An installation following 690.47(C)(3) *Combined Direct-Current Grounding Electrode Conductor and Alternating-Current Equipment Grounding Electrode* does **not** meet Commonwealth Solar Minimum Technical Requirements.
- All interconnecting wires must be copper and all wiring connections must be properly made, insulated, and suitable for the environment where they are installed. 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 DC interconnecting wires smaller than #1 AWG (American Wire Gage) must be copper.
- Installations on flat commercial rooftops that have Photovoltaic Output Circuits running through the building must contain a DC disconnect installed on the roof that will isolate the building from all ungrounded circuit conductors.
- Installations of ground- and pole-mounted arrays must have a DC disconnect installed at each structure that will isolate all ungrounded circuit conductors.
- Disconnecting devices must be installed to allow isolation of all PV project components for service and inspection
- Areas where wiring passes through ceilings, walls, or other areas of the building must be properly restored, booted, and sealed.
- Thermal insulation in areas where wiring is installed must be returned to “as found or better” condition.
- Warning labels, as specified in the 2011 MEC must be posted on disconnects, panel enclosures, raceways, and accessible junction boxes.
- 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 Solar Renewable Energy Certificates (RECs).
- MassCEC recommends, but does not require, that all PV projects installed under the Commonwealth Solar II 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 MassCEC 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 PowerClerk's equipment dropdown list. This list is established by the California Energy Commission's list of eligible renewable energy equipment: [http://www.gosolarcalifornia.ca.gov/equipment/pv\\_modules.php](http://www.gosolarcalifornia.ca.gov/equipment/pv_modules.php). If you are a Non-Expedited Installer and want to confirm that the equipment you plan to use is listed in PowerClerk, please contact the Commonwealth Solar Team at [cs@masscec.com](mailto:cs@masscec.com). Note: If the equipment you want to use is not listed in PowerClerk, it must meet the above mentioned requirements and be added to the California Energy Commissions list of eligible renewable energy equipment to be eligible in the program.
- 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 be available for periodic testing and/or re-calibration, if necessary.
- For systems with an installed capacity over 10 kW, meters, and current transformers (CT) must meet the accuracy standards listed in NEPOOL Operating Procedure 18. See APPENDIX C - MINIMUM ACCURACY STANDARDS FOR NEW AND UPGRADED METERING, RECORDING AND TELEMETERING INSTALLATIONS AND FOR CALIBRATION OF EXISTING EQUIPMENT. See [http://www.iso-ne.com/rules\\_proceeds/operating/isone/op18/op18c\\_rto\\_final.pdf](http://www.iso-ne.com/rules_proceeds/operating/isone/op18/op18c_rto_final.pdf).

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.