City of Cambridge

PURCHASING DEPARTMENT
795 Massachusetts Ave. • Cambridge, Massachusetts 02139-3219

Amy L. Witts
Purchasing Agent

TO: **All Bidders**

FROM: **City of Cambridge**

DATE: **December 8, 2014**

RE: **File No. 6633 – Solar Energy Photovoltaic System and installation at the Walter J. Sullivan Water Purification Facility - Addendum No. 4**

1. **Please delete and insert the following sections which are attached to this addendum:**
   Revised Section 07009 Maintenance of EPDM Roofing Warranty
   Revised Section 16240 Solar Photovoltaic System

2. **The bid opening has been postponed from Thursday December 11, 2014 @ 2:00PM to Thursday December 18, 2014 @ 2:00PM.**

3. **There will be one last walk through on Wednesday December 10 @ 9:00AM at the Walter J. Sullivan Purification Facility located at 250 Fresh Pond Parkway.**

4. **Questions are now open and will close on Thursday December 11 at 4:00PM.**

All other details remain the same.

Amy L. Witts

Amy L. Witts
Purchasing Agent

Addendum No. 4

© 2014 CDM Smith
All Rights Reserved

SECTION 07009
MAINTENANCE OF EPDM ROOFING WARRANTY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to maintain the existing EPDM roofing warranty for the Project as shown on the Drawings and as specified herein.

B. The work includes the following:

1. All roof penetrations and seam flashing as it relates to maintaining the existing EPDM roof warranty, including conduit, piping, and similar items. Note the following:
   a. Seam flashing is only required along existing field seams that will be concealed by the PV system installation.

C. Notifications

1. Provide five business days written notification to the City before starting any roof penetrations, patches or repairs, for scheduling of work in accordance with the progress schedule.
   a. Failure to provide written notice is at risk to the Contractor solely for contract time and additional fee. No additional contract time or fee will be allowed.
   b. Provide the City and Engineer in writing accurate information and details for all roof penetrations to include, but not be limited to size and exact location of each penetration.

1.02 RELATED WORK

A. Electrical work included in Division 16.

B. EPDM protection membrane under ballast pans included in Division 16.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: For each type of product indicated.

C. Qualification Data: For qualified roofing contractor and roofing materials manufacturer, a letter indicating written acceptance by the original Warranty provider (Versico). Include name, address, telephone number and contact number for the Qualified roofing contractor required by the Quality Assurance article of this section.

D. Field quality-control reports.

E. Warranty Continuance Letter.

© 2014 CDM Smith
All Rights Reserved

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM D 41 -Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

2. ASTM D 312 - Specification for Asphalt Used in Roofing

3. ASTM D 1079 - Terminology Relating to Roofing and Waterproofing

4. ASTM D 4637 -Specification for EPDM Sheet Used in Single-Ply Roof Membrane

B. FM Approvals

1. FM Approvals 4470 - Approval Standard Class 1 Roof Covers (with Supplements)

C. National Roofing Contractors Association (NRCA)

1. The NRCA Roofing and Waterproofing Manual

D. Where reference is made to one of the above or other referenced standards, the revisions in effect at the time of bid opening shall apply.

1.05 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.06 QUALITY ASSURANCE

A. Roofing Contractor Qualifications: A qualified roofing contractor firm that is approved, authorized, or licensed by the original membrane roofing system manufacturer to install manufacturer's product and that is eligible to maintain the manufacturer's warranty for the existing roofing system, inclusive but not limited to performing penetrations and associated patches/repairs.

1. Authorized roofing contractor firm shall be Weather Shield, Inc., of Milford, Massachusetts or equal.

B. Source Limitations: Obtain components for membrane roofing system from same manufacturer of the original membrane roofing or approved by membrane roofing manufacturer.

C. Roofing Conference: Conduct conference at Project site prior to installation of solar PV array and performance of associated roof work.

1. Meet with City, Engineer, City's insurer if applicable, testing and inspecting agency representative, roofing contractor, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

© 2014 CDM Smith
All Rights Reserved

2. Review methods and procedures for roof related installation and repairs, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, roofing contractor's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment ballast, and condition of other construction that will affect roofing system.

5. Review governing regulations and requirements for insurance and certificates if applicable.

6. Review temporary protection requirements for roofing system during and after equipment installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with roof related work only when existing and forecasted weather conditions permit roofing materials to be installed according to manufacturer's written instructions and warranty requirements.

1.09 EXISTING ROOF WARRANTY

A. The roofing system is covered by an existing warranty. The work under this section includes completing the work in a manner to maintain this existing warranty, as conditioned below and throughout this Section.

1. A copy of the current warranty is included at the end of this specification section (Versico Total Roofing System Warranty – one page).

2. The original warranty manufacturer (Versico) provided recommendations to the Engineer for installation of a PV system over a Versico-warranted roofing system, along with conditions that could impact the current Versico warranty. The recommendations made by Versico have been incorporated by the Engineer into the work that is specified in this Section.

3. To ensure continuation of the Versico warranty, roofing inspections are required during the PV system installation. These inspections must be scheduled and performed by a Versico Field Services Representative. Refer to Paragraph 3.06 for detailed requirements on inspections.

PART 2 PRODUCTS

2.01 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637 uniform, flexible EPDM sheet to match the existing.

1. Manufacturers: Provide products by Versico Incorporated only.

2. Thickness: Match existing.

3. Exposed Face Color: Black.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard.

D. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- wide minimum, butyl splice tape with release film.

E. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, cover strips, and other accessories as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with roofing contractor present.

B. Proceed with roof repairs only after unsatisfactory conditions have been corrected.

© 2014 CDM Smith
All Rights Reserved

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing membrane prior to equipment installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed penetrations of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 INSTALLATION

A. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

B. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

3.04 PENETRATIONS AND PATCH/REPAIRS

A. Manufacturer's approved roofing contractor shall perform all required roof penetrations, associated sleeve insertions, and subsequent permanent roof patch/repairs at all such penetrations, including conduit, piping, etc. Contractor shall be responsible for installation of the conduit into the sleeve and ensuring that the hole/sleeve remains water tight until completion of the permanent patch/repair.

3.05 EXISTING SEAM FLASHING

A. Seams in existing roof membrane under PV array shall be covered with sheet flashing and fully adhered to existing roof membrane. Flashing sheet shall be a minimum of 12-inches wide. Provide lap sealant at edges as recommended by existing roofing system manufacturer.

3.06 FIELD QUALITY CONTROL

A. Progress Inspections: Prior to PV staging, in order to preserve the warranty, the original manufacturer requires an inspection by a Versico Field Services Representative.

B. Final Roof Inspection: Arrange for a Versico Field Services Representative to inspect roofing installation on completion of PV installation.

© 2014 CDM Smith
All Rights Reserved

C. Inspections shall be scheduled such that Engineer and City can be present. At least five business days advance notice shall be provided when establishing the inspection date.

D. Repair or remove and replace components of membrane roofing system including EPDM protection membrane under PC array ballast pans, where inspections indicate that they do not comply with specified requirements.

E. At the Contractor's expense, additional inspections by a Versico Field Services Representative will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer and City.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.08 ROOFING CONTRACTOR'S WARRANTY

A. Provide warranty continuation letter issued by Versico, Inc.

END OF SECTION

VSW-4

VERSICO TOTAL ROOFING SYSTEM WARRANTY

(With Extended Membrane Material Warranty)

Versico Roofing Systems, Inc. (VERSICO) warrants to the Building Owner (OWNER) of the building described below, that subject to the terms, conditions and limitations stated in this warranty, Versico will repair any leak in the Versico Roofing System (VERSICO ROOFING SYSTEM) installed by a Versico Authorized Roofing Contractor for a period of 15 years commencing with the date of Versico's acceptance of the Versico Roofing System installation. However, in no event shall Versico's obligations extend beyond 15 1/2) years subsequent to the date of substantial completion of the Versico Total Roofing System. See below for exact date of warranty expiration.

For an additional 5 years thereafter, in the event of premature deterioration of the Versico membrane material to the point of failure, Versico will provide to the Owner a credit to be applied toward the purchase of new membrane material. The value of the credit shall be determined by Versico and shall be based on the number of remaining months of this warranty and pro-rated at the current prices.

The Versico Roofing System is defined as the following Versico Materials: Membrane, Flashings, Adhesives and Sealants, Fastener Assemblies, Metal Edging, any other Versico brand products utilized in this installation.

TERMS, CONDITIONS, LIMITATIONS

1. Owner shall provide Versico with written notice to the address printed below within thirty (30) days of the discovery of any leaks in the Roofing System. By so notifying Versico, the Owner authorizes Versico to investigate the cause of the leak. Should the investigation reveal the cause of the leak to be outside the scope of this warranty, investigation and repair costs for this service shall be paid by the Owner.

2. If, upon inspection, Versico determines that the leaks in the Roofing System are caused by defects in the Roofing System's material or workmanship of the Versico Authorized Roofing Contractor in installing the same, Owner's remedies and Versico's liability shall be limited to Versico's repair of the leak in the Roofing System.

3. This Warranty shall not be applicable if Versico determines that any of the following has occurred:

(a) The Roofing System is damaged by natural disasters, including, but not limited to, lightning, insects, winds in excess of 72 mph measured at roof level, earthquakes, fire, tornado, and hail; or

(b) The Roofing System is damaged by any acts of negligence, accidents, or misuse, including but not limited to, excessive traffic, recreational activities, storage of materials on the roof, vandalism, or civil disobedience; or

(c) The Roofing System is damaged by infiltration of moisture in, through, or around walls, skylights, vents, copings, HVAC units, building structures, or underlying or surrounding areas; or

(d) The Roofing System is damaged by the building structure failing to have adequate strength to support all live and dead loads, including water and snow loads, or by any other structural defects or failures; or

(e) The Roofing System is damaged by settlement, distortion, cracking, movement or failure of the roof substrate, coping, walls, structural members or components adjacent to the roof or foundation of said building; or

(f) The Roofing System is damaged as a result of attack by roof top contaminants such as solvents, petroleum, oil products, acids, or other harmful chemicals.

4. This Warranty shall be null and void if Versico determines that any of the following has occurred:

(a) If, after installation of the Roofing System by a Versico Authorized Roofing Contractor, there are any alterations, test cuts, or repairs made on or through the roof, or objects such as, but not limited to, structures, fixtures, or utilities are placed upon or attached to the roof without first obtaining written authorization from Versico, or

(b) Failure by the Owner to use reasonable care in maintaining the roof, including, but not limited to, periodic cleaning of drains and removal of harmful debris from the roof, or

(c) Owner fails to comply with every term and/or condition stated herein.

5. During the term of this Warranty, Versico shall have free access to the roof during regular business hours.

6. Versico shall have no obligation under this Warranty while any bills for installation, supplies, services, and warranty charges have not been paid in full to the Versico Authorized Roofing Contractor, Versico, or material suppliers.

7. Versico's failure at any time to enforce any of the terms or conditions stated herein shall not be construed to be a waiver of such provision.

8. This warranty is not assignable by operation of law or otherwise. Application may be made by a new building owner for reissuance of the warranty during the original warranty period. Certain procedures, including an inspection of the Roofing System by a Versico representative, and fees will apply to any reissuance. Versico reserves the right, in its sole discretion, to refuse to reissue this warranty.

9. Only Versico brand insulations are covered by this warranty. Versico specifically disclaims liability, under any theory of law, for damages sustained by or caused by non-Versico brand insulation products.

10. Versico shall not be responsible for the cleanliness or discoloration of the Versico Roofing System caused by environmental conditions including, but not limited to, dirt pollutants or biological agents.

VERSICO DOES NOT WARRANT PRODUCTS UTILIZED IN THIS INSTALLATION WHICH IT HAS NOT FURNISHED; AND SPECIFICALLY DISCLAIMS LIABILITY, UNDER ANY THEORY OF LAW, ARISING OUT OF THE INSTALLATION AND PERFORMANCE OF, OR DAMAGES SUSTAINED BY OR CAUSED BY, PRODUCTS NOT FURNISHED BY VERSICO.

THE REMEDIES STATED HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES FOR FAILURE OF THE ROOFING SYSTEM OR ITS COMPONENTS. THERE ARE NO WARRANTIES EITHER EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, WHICH EXTEND BEYOND THE FACE HEREOF. VERSICO SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED, TO, LOSS OF PROFITS OR DAMAGE TO THE BUILDING OR ITS CONTENTS UNDER ANY THEORY OF LAW.

OWNER: CITY OF CAMBRIDGE

BUILDING: FRESH POND WATER PUR PLT & VEH STOR
250 FRESH POND PKY
CAMBRIDGE, MA

DATE INSTALLATION COMPLETED: 05/20/01

WARRANTY EXPIRATION DATE: 05/20/16

LENGTH OF WARRANTY: 15 YEARS

ROOF AREA COVERED: 66,200 SQ FT

ROOFER: GILBERT & BECKER CO, INC
16-24 CLAPP ST
P O BOX 255066
DORCHESTER, MA 021255066
PHONE: 617-265-4342

SERIAL NUMBER: 059898

VERSICO INCORPORATED
A subsidiary of Collins Syntec Incorporated

3485 Fortuna Drive
Akron, Ohio 44312
(800) 992-7663
(330) 644-2613 FAX

VERSICO INCORPORATED

By _____

© 2014 CDM Smith
All Rights Reserved

SECTION 16240
SOLAR PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor equipment, materials and incidentals required and install and test a complete solar photovoltaic system, as shown on the Drawings and specified herein.

B. The installed photovoltaic (PV) systems shall meet the following performance requirements:

1. The Solar PV system shall be roof mounted and have a minimum DC rating of 17 kW at the Vehicle Storage Building (VSB).

2. The Solar PV system shall be roof mounted and have a minimum DC rating of 152.5 kW at the Water Purification Facility (WPF).

3. The PV system shall be utility interactive with interconnection to the plants electrical distribution system.

C. All electricity produced by the Solar PV array will be consumed onsite behind the meter.

D. Contractor shall employ the services of a photovoltaic systems company with at least five years of demonstrable relevant experience to complete the installation of the photovoltaic system and prepare detailed installation drawings and material specifications for shop drawing review. The installer shall be certified by North American Board of Certified Energy Practitioners (NABCEP) PV Installer and shall be a licensed electrician in the Commonwealth of Massachusetts.

E. All required permits, approvals and licenses required by Laws for the installation, use and operation of the Equipment, including without limitation, all federal, state and local building, and electrical permits and NSTAR Utility Interconnection Agreements, shall be applied for, secured and paid for by Contractor. The city will use its reasonable efforts to assist Contractor in obtaining such necessary permits and approvals for installation of the equipment. In no event shall the City, however, be responsible for payment of any permit or license fees. The equipment and the operation of the equipment by Contractor shall, upon acceptance, conform to all federal, state and local code requirements. The Contractor shall furnish copies of each permit or license which is required to perform the work to customer before contractor commences the portion of the work requiring such permit or license.

F. Provide the services of a structural engineer registered in the Commonwealth of Massachusetts to be the registered design professional and fulfill all requirements of the Massachusetts State Building Code for the registered design professional, for the structural work of this Section.

1.02 RELATED WORK

A. Electrical raceways, boxes, fittings and supports not specified herein is included in Section 16020.

B. Electrical wire and cable work not specified herein is included in Section 16020.

© 2014 CDM Smith
All Rights Reserved

C. Roof penetrations shall be sealed by roofing contractor in accordance with 01170.

D. Roof membrane shall be furnished and installed by roofing contractor in accordance with 01170.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, shop drawings and product data, for the following:

1. Manufacturer equipment data sheets including sufficient data to indicate compliance with the specifications including physical dimensions, weight, performance data, and ratings for all associated PV System equipment. Clearly indicate which model is being selected. Indicate all options, special features, ratings and deviations from this Section. Indicate total weight of installed system.

2. Submit PV calculations that demonstrate the selected system meets the performance requirements as stated herein. Calculations should include all assumptions, derating factors, peak power output in dc and ac and monthly/annual kWh production.

3. Submit point-to-point wiring diagrams for the entire system showing all devices and interconnecting wiring.

4. Bill of material listing all components by quantity and part number.

5. Itemized breakdown of pricing for components and services.

6. Submit system mounting details.

7. Provide, in accordance with Section 01300, the following submittals:
   a. Test reports.
   b. O&M manuals.
   c. Training materials.
   d. Separate list of spare parts to be provided.
   e. List of recommended spare parts.
   f. Record documents.

8. The installer shall submit documentation verifying certification by NABCEP as a PV Installer.

9. For record purposes only, submit calculations and drawings of the structural supports (including but not limited to steel frames/legs) for the photovoltaic array to be attached to the roof of the Water Purification Facility and Vehicle Storage Building and for support of the PV modules. Structural calculations and drawings shall be sealed by a Professional Structural Engineer registered in Massachusetts. Submittal shall be for record purposes only and will not be reviewed by the engineer.

10. Submit P.E. certification form as appended to Section 01300 to indicate compliance with the requirements of this Section.

11. Any associated electrical or mechanical work that is required due to the Contractor's use of an alternate item, arrangement of equipment, and/or layout other than specified herein,

shall be at the Contractor's expense. If said use and/or arrangement/layout results in changes to the Engineer's design, the Contractor shall be responsible for preparing a revised design and detailed plans with professional engineering stamp for submittal to the Engineer for approval. No additional compensation will be provided for such changes in either the Contractor's work or the work by others.

12. Submit documentation demonstrating five years of solar PV design and installation experience.

1.04 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)

1. UL 1703 – UL Standard for Flat-Plate Photovoltaic Modules and Panels

2. UL 1741 – UL Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems

B. National Fire Protection Association (NFPA) 70 – National Electrical Code

C. IEEE 929 - Recommended Practice for Utility Interface of Photovoltaic (PV) Systems

D. Weathering

1. ASTM E1038-Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls

2. ASTM E1171- Standard Test Method for Photovoltaic Modules in Cyclic Temperature and Humidity Environments

3. ASTM E1596- Standard Test Methods for Solar Radiation Weathering of Photovoltaic Modules

4. ASTM E1597- Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments

5. ASTM E1802-Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules

6. ASTM E2047- Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays

7. ASTM E1830- Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules

8. ASTM E781- Standard Practice for Evaluating Absorptive Solar Receiver Materials When Exposed to Conditions Simulating Stagnation in Solar Collectors With Cover Plates

9. ASTM E782- Standard Practice for Exposure of Cover Materials for Solar Collectors to Natural Weathering Under Conditions Simulating Operational Mode

10. ASTM E823- Standard Practice for Nonoperational Exposure and Inspection of a Solar Collector

11. ASTM E881- Standard Practice for Exposure of Solar Collector Cover Materials to Natural Weathering Under Conditions Simulating Stagnation Mode

E. Calibration:

1. ASTM E1039- Standard Test Method for Calibration of Silicon Non-Concentrator Photovoltaic Primary Reference Cells Under Global Irradiation

2. ASTM E1362- Standard Test Method for Calibration of Non-Concentrator Photovoltaic Secondary Reference Cells

F. Energy Performance:

1. ASTM E948- Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight

2. ASTM E1021- Standard Test Methods for Measuring Spectral Response of Photovoltaic Cells

3. ASTM E903- Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres

4. ASTM E1040- Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells

5. ASTM E1462- Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules

G. North American Board of Certified Energy Practitioners (NABCEP)

H. Massachusetts Electric Code (MEC) 2008

I. Massachusetts Building Code (780 CMR) 7th Edition, 2008

J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 WARRANTY

A. Installer Warranty: PV system shall have a minimum 5 year labor warranty (from completion of the project) provided by the PV system company to protect the City 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 shall 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.

B. PV Modules - PV modules shall have a 25 year power warranty and a 5 year workmanship warranty, guaranteeing power rating at Standard Test Conditions will remain at 90% or greater than Minimum Specified Power Rating for the first ten years and for the next fifteen years guaranteeing a power rating at Standard Test Conditions will remain at 80% or greater than the Minimum Specified Power Rating.

C. Mounting System – Manufacturer shall warrant the Mounting System to be free from defects in the material and workmanship for a period of ten years.

D. Inverter -Manufacturer shall warrant the Inverter to be free from defects in material and workmanship for a period of twenty 20 years.

1.06 SPARE PARTS

A. Furnish 10 percent of each fuse size and type.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials shall be new.

B. Photovoltaic Modules:

1. Photovoltaic modules shall consist of series-connected multi-crystalline silicon solar cells and shall have polarized, weatherproof, DC-rated plug-and-socket connectors. The cells shall be laminated between sheets of ethylene vinyl acetate and high-transmissivity tempered glass. The modules shall have a minimum power rating of 305 W DC at STC. The modules shall be UL listed and shall have a UL Class C fire rating.

2. Panels shall have a Performance Guarantee of 90% or greater than Minimum Specified Power Rating for the first ten years and for the next fifteen years a guaranteed power rating at Standard Test Conditions of 80% or greater than the Minimum Specified Power Rating.

3. Solar system PV module is based on the Suniva 305 W product. Alternative manufacturer products of equivalent performance will be acceptable provided the submittal requirements specified above are met.

C. Combiner Boxes

1. Combiner boxes shall be steel, NEMA 3R with an integrated DC disconnect.

2. Combiner boxes shall contain the number of poles, fuses and fuse sizes as indicated on the drawings. Each string shall be fused separately.

3. Combiner boxes shall include compact load-break rated switches with lockout capability.

4. Solar system combiner box is based on the Solectria DISCOM 4. Alternative manufacturer products of equivalent performance will be acceptable provided the submittal requirements specified above are met.

© 2014 CDM Smith
All Rights Reserved

D. Power Inverter

1. VSB - Power inverter for the Solar PV array shall be able to accept a nominal input voltage of 600 VDC and shall produce an output voltage of 480 VAC, 60 Hz, 3 Phase; be able to deliver 18 kW AC of continuous power; have a minimum CEC efficiency of 95.8 percent or greater; and be rated for -4 °F to 122 °F.

2. WPF - Power inverter for the Solar PV array shall be able to accept a nominal input voltage of 600 VDC and shall produce an output voltage of 480 VAC, 60 Hz, 3 Phase; be able to deliver 153 kW AC of continuous power; have a minimum CEC efficiency of 95.8 percent or greater; and be rated for -4 °F to 122 °F.

3. Inverter shall be UL1741 compliant and have a fully integrated design includingtransformer, filters, AC&DC disconnects, DC Combiner Fuses.

4. NEMA 3R disconnects shall be provided with inverter.

5. Inverter shall include precision DSP-controlled Maximum Power Tracking algorithm, have no night-time standby losses.

6. Communications: RS232 port and software for diagnostics and data capture with PC.

7. Data logging communications shall be CAT6 compatible for monitoring and recording data.

8. Safety: Electronics temperature protection, intelligent cooling, DC ground-fault detection and interrupt, current and voltage limit protections.

9. Solar system at the VSB is based on the Solectria PVI 20TL 20kW inverter. Alternative manufacturer products of equivalent performance will be accepted.

10. Solar system at the WPF is based on the Solectria 225kW SGI Commercial inverter. Alternative manufacturer products of equivalent performance will be accepted.

E. Data Logging and Control

1. Data Logging and Control device shall be able to provide complete system monitoring, remote diagnosis, data storage, and display. Power supply shall be 120VAC/60Hz (from the inverter),1 phase, and operating ambient temperature shall be within the range of -4 °F to 131 °F. Integral UPS shall be provided

2. Provide a vendor-Supplied Data Acquisition Service (DAS) that offers remote monitoring and automatic Renewable Energy Credit (REC) reporting and has Massachusetts Clean Energy Center (MassCEC) PTS-incorporated Automated Reporting features. Refer to the MassCEC minimum technical requirements.

3. Device shall have an integrated HTTP web interface that allows the CITY to access information on the PV system via a personal computer, regardless of operating system or browser type using an internet connection. At a minimum, the following shall be provided on the web interface:

a) Real time, daily, monthly and annual energy data Energy Production (kWh)
b) Temperature with historical data

4. Data Logging and Control device shall meet Revenue Grade Energy Production, and support Ethernet CAT6 compatibility protocols for data transfer to and from the PV inverter control panel and from the revenue grade meter. Data transfer shall be automatic and communications protocols and interconnection shall be coordinated with furnished meter and monitoring box.

5. Records real time, daily, monthly and annual energy data, including, but not limited to ac voltage, current and power, frequency and total/daily/monthly/annual energy production.

6. SD Card shall be capable of storing up to 32GB of data storage.

7. Third party shall provide remote alarming to cell phone, pager or email based on PV inverter manufacturer recommendations and set points, associated coordination and programming shall be provided.

8. Data Acquisition Server shall have the ability to communicate via CAT 6 Ethernet for data transfer.

9. All programming integration shall be provided.

10. Contractor shall be responsible for coordinating the revenue grade meter with the data logging server to ensure compatibility.

11. A minimum of two years of service shall be provided with the service contract specified herein and corresponding price list and terms shall be provided for future renewal.

12. Data Logging Service Vendor shall be on the MassCEC approved vendor list.

F. Mounting

1. Furnish and install a ballasted, non-penetrative type building mounted PV support system for the solar panels as shown on the plan. Panels shall be mounted at zero degrees south facing.

2. Structural calculations and fabrication drawings shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

3. Mounting system shall be designed specifically for the solar module chosen and shall be capable of holding the quantity of modules as shown on the plans and specified herein.

4. PV mounting system shall not penetrate the roof.

5. Fasteners shall be stainless steel.

6. Frames and brackets shall be aluminum.

© 2014 CDM Smith
All Rights Reserved

7. It shall be the responsibility of the Contractor to furnish and install all necessary mounting hardware and to coordinate and comply with manufacturer installation requirements.

8. Aluminum frames and brackets for the support of the PV modules and shall be designed to withstand the environmental loads such as the wind, seismic, snow and ice loads in accordance with the requirements stipulated in the current edition of the Massachusetts Building Code 780 CMR.

9. Factory installed nonporous, heavy-duty, slip-resisting, surface-textured EPDM material of approximately 3/8" thick on all mounting structure material in contact with roof, to protect roof membrane.

10. Design Criteria
    a. Mounting system and footings shall be designed for all applicable loads and combinations of these loads as required by the Building code and local regulations.

    b. Roof top PV panel array shall be installed on the existing roof with a zero-penetration ballast-mount. The ballast-mounting shall be compatible with the existing roofing system and shall utilize frictional forces between ballast and roofing materials to resist sliding of the PV panel array. The overall system weight shall not exceed 7 psf.

    c. The system shall resist design loads in accordance with the Massachusetts State Building Code:

        a) Snow Load:
            a) Ground Snow Load = pg = 45 psf
            b) Snow Exposure Factor = Ce = 1.0 (partially exposed)
            c) Snow Load Importance Factor = Is = 1.10
        b) Wind Load:
            a) Basic Wind Speed = 105 mph (3-second gust)
            b) Wind Importance Factor = Iw = 1.15
            c) Wind Exposure = C
            d) Mean Roof Height = 30-feet
        c) Seismic Load:
            a) Spectral Response Acceleration at Short Periods = Ss = 0.279
            b) Spectral Response Acceleration at a Period of 1 sec. = S1 = 0.068
            c) Occupancy Importance Factor = IE = 1.25
            d) Seismic Site Class = D

11. System shall utilize DPW Solar "Ballasted Power Rail" mounting system or equivalent. Alternative manufacturer products of equivalent performance will be accepted.

PART 3 EXECUTION

3.01 INSTALLATION

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

© 2014 CDM Smith
All Rights Reserved

1. Local, state, and/or federal building and electrical laws, codes and practices. The provisions of the appropriate version of the Massachusetts Electric Code (MEC) 2008 as specified by state code.

2. Interconnection Agreement. A separate application shall be submitted to the electric utility to start the formal interconnection process, and sufficient lead time shall be allowed, based on time frames listed in the interconnection Tariff, PV projects shall have an appropriate electric utility interconnection agreement in place at the time of interconnection to the utility grid.

3. All pertinent permits and inspections shall be obtained and copies kept on file as may be required by local codes and/or state law.

B. Provide all equipment, wiring, conduit and outlet boxes required for the installation of a complete and operating system in accordance with applicable Federal and State codes, the manufacturer's recommendations and these Contract Documents. All wiring shall be in a completely separate conduit system. Color coded wires shall be used throughout and wiring shall conform to the NEC.

C. The photovoltaic system shall be installed per approved shop drawings.

D. Manufacturers shall provide engineering guidance during installation and/or after installation is completed to perform a checkout of the system. At such time, the manufacturer shall make all necessary adjustments and instruct the operating and maintenance personnel on the proper use and care of the system.

E. All electrical connections and terminations shall be fully tightened, secured, and strain relieved as appropriate.

F. All mounting equipment shall be installed to the manufacturer's specifications.

G. Installation should be organized and neat. Module connections and wiring should be neatly prepared and easily accessed by service persons.

H. All cables, conduit, exposed conductors, and electrical boxes should be secured and supported according to code requirements.

I. All exposed conduit shall be rigid aluminum.

J. All national and local electric and building code requirements shall be met.

K. All excess PV module vendor cable shall be tie-wrapped beneath modules; tie wraps shall be UV resistant.

L. Contractor shall follow manufacturer's guidelines for the installation of all array components.

M. All PV modules shall be properly grounded in accordance with the NEC.

N. Data Monitor/Controller shall be programmed and configured for client.

O. Inverter shall be configured to optimize efficiency with PV array.

© 2014 CDM Smith
All Rights Reserved

P. All PV power conductors shall be type RHW-2.

3.02 DELIVERY, STORAGE AND HANDLING

A. PV modules and system components shall be delivered to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and will prevent damage from construction operations. Protection will be removed only after equipment is safe from such hazards.

B. Contractor shall maintain the integrity of the ground (lawn) surface during delivery, handling, and installation.

C. Each module shall be visually inspected for defects by the Contractor upon receipt.

3.03 LABELING AND IDENTIFICATION

A. For diagnostic and troubleshooting purposes, array strings shall be uniquely tagged and identified.

B. The photovoltaic system shall be labeled in accordance with NEC article 690 VI. Marking.

C. Plaques shall be installed in accordance with NEC 705.10.

D. All disconnecting means including switches and circuit breakers shall be provided with signage in accordance with NEC article 690.17.

3.04 CLEANING

A. PV modules shall be free of dirt and construction debris prior to system start up procedures. All PV surface cleaning shall be in accordance with the manufacturer's recommendations.

3.05 PHYSICAL CHECKOUT

A. PV Modules

1. Check for cracked or broken glass on the modules

2. Check for signs of delaminating or water infiltration on modules

3. Check for broken damaged or discolored module cells

B. PV Array

1. Physically inspect proper markings and labeling of all wire terminations, enclosures and equipment.

2. Layout of modules is as depicted on the Array Plan. If not Drawings shall be marked up to reflect as built conditions.

3. Total number of modules in array is as shown on Drawings

4. Racking components are tight and secure

© 2014 CDM Smith
All Rights Reserved

5. Modules are attached securely to the racking system

6. Module and string homerun wiring is connected and securely fastened to racking structure

7. Measure the angle of the mounted PV modules to confirm compliance with the specification.

8. All modules and racking system is grounded

C. DC Wiring

1. DC conduits are properly installed and supported

2. Physically inspect and verify that PV array quick connectors are fully mated and wires neatly secured.

3. Wiring and conduit sizes are as depicted in the schematic diagram. If not drawings shall be marked up to reflect as-built conditions

D. DC Combiner Boxes

1. Combiner boxes are properly installed and supported

2. Combiner boxes are labeled as indicated on the Drawings

3. PV source wiring is labeled within the combiner box

4. Fuses are sized as indicated on the schematic diagram

5. All wiring is secure within the terminals

E. DC Disconnect Switches

1. Disconnects are properly installed and supported

2. Disconnects are labeled as indicated on the Drawings

3. Wiring within the disconnect switch is as depicted on the schematic diagram

4. All wiring is secure within the terminals

F. PV Inverter(s)

1. Inverter(s) are securely mounted to wall, floor or equipment pad

2. There is manufacturers and NEC required clearances around the inverter

3. Wiring (AC, DC and ground) within the inverter is secure and sized as depicted in the schematic diagram

4. Inverter is properly labeled as indicated on the Drawings

© 2014 CDM Smith
All Rights Reserved

G. AC Wiring

1. AC conduits are properly installed and supported

2. Wiring and conduit sizes are as depicted in the schematic diagram. If not Drawings shall be marked up to reflect as built conditions

H. AC Combiner Panel (if used)

1. Panel(s) are securely mounted to wall, floor or equipment pad

2. There is required NEC clearance around panel

3. Panel type and size are as depicted on drawings

4. Wiring within the panel is secure and sized as depicted in the schematic diagram

5. All wiring is secure within terminals

6. Panel and all breakers are properly labeled as indicated on the Drawings

I. Utility Disconnect Switch

1. Disconnect is properly installed and supported

2. Wiring within the disconnect switch is as depicted on the schematic diagram

3. All wiring is secure within terminals

4. Disconnect is labeled as indicated on the Drawings and NEC

J. PV Interconnect Breaker/Fused Switch

1. Physically verify the circuit breaker(s) are back-feed compliant in accordance with the NEC.

2. Breaker switch is properly installed and supported

3. Wiring within the breaker/switch is as depicted on the schematic diagram

4. All wiring is secure within terminals

5. Breaker/switch is labeled as indicated on the Drawings

6. Confirm all fuses are installed correctly with the appropriate type and size.

K. Metering and Monitoring

1. Metering equipment is properly installed and supported

2. Wiring with metering equipment is as depicted on drawings

© 2014 CDM Smith
All Rights Reserved

3. There is an active internet/communications port for connection of the metering system

L. Physically inspect the site. All tools, materials and waste required for construction shall be removed.

3.06 TESTING PROCEDURES

A. System inspection and safety checks: Contractor shall run through a checklist of start-up requirements and conduct a series of safety tests to ensure proper installation, safe operation and performance up to specification. All results shall be recorded and submitted to the engineer.

B. Minimum Functional Field Testing Requirements:

1. Perform all inverter startup tests, as specified by the inverter manufacturer

2. Contractor shall correct any deficiencies uncovered by the testing prior to commissioning of the system.

C. DC String Wiring Tests Procedures

1. Open the string fuses within combiner boxes

2. Check the polarity of all string circuits

3. Measure and record the open circuit voltage for each string

4. When the system is operating, measure the operating current for each string

D. DC Wiring Tests Procedures

1. With all of the string combiner box fuses closed, check and measure the following at each DC disconnect:
   a. Disconnect Number
   b. Polarity
   c. Open Circuit Voltage (Disconnect in open position)
   d. Open Circuit Voltage (Disconnect in closed position)

2. With all of the DC disconnects closed, check and measure the following at each array combiner :
   a. Array Combiner Number
   b. Polarity
   c. Open Circuit Voltage (Fuses in open position)
   d. Open Circuit Voltage (Fuses in closed position)

3. With all of the array combiner boxes closed, check and measure the following at each inverter:
   a. Array Combiner Number
   b. Polarity
   c. Open Circuit Voltage (Inverter DC disconnect in open position)
   d. Open Circuit Voltage (Inverter DC disconnect in closed position)

© 2014 CDM Smith
All Rights Reserved

E. AC Wiring Tests Procedures

1. Open the DC disconnect on the inverter(s)
2. Open the AC disconnect/breaker on the inverter(s)
3. Close the AC interconnect breaker/switch
4. Measure and record the AC voltage and frequency at the terminals of the inverter(s)

F. System Start-Up Procedures (in addition to inverter manufactures start-up procedures)

1. Close the DC disconnect on the inverter(s)
2. Close the AC disconnect/breaker on the inverter(s)
3. Follow the inverter manufacturers installation manual to initiate and inverter start
4. Verify successful start of the inverter(s)
5. Verify the measured values match the displayed values on the inverter (if inverter equipped with display)

G. Verification of Utility Interconnect Requirements Procedures

1. Verify inverter operating and generating power
2. Open the utility disconnect switch
3. Verify inverter immediately stops generating power
4. Verify inverter shutdown and utility disconnect switch open
5. Close the utility disconnect switch
6. Verify inverter starts up automatically after 5 minutes

H. System Metering & Monitoring

1. Verify that the monitoring system host are active and receiving data
2. Verify that the values received by the monitoring host match the measured values at the site. Values should be within 5% of each other.

3.07 PERFORMANCE TESTING

A. Every PV module shall be individually tested and verified for proper voltage and current characteristics by the manufacturer.

B. The complete and functional photovoltaic system shall be demonstrated to the City and Engineer upon installation completion. The time and day of demonstration shall be coordinated with the City and Engineer prior to completion.

© 2014 CDM Smith
All Rights Reserved

C. System Performance Procedure:

1. Measure or calculate and record the below values

2. Calculate and record the inverter output using the formula below

3. Verify that the system output is within 5% of calculated
   a. Array Power (DC, STC)
   b. Irradiance (watts/square meter)
   c. Mismatch and dust factor
   d. Array Temperature (degrees C, measure on back of module)
   e. Wiring efficiency factor
   f. Inverter efficiency
   g. Invert output power, using the following equations:
      a) Inverter Output Power = Array power*(irradiance/1000)*mismatch factor*Array temp factor*wiring eff. Factor * (Inverter eff/1000)]
      b) Array Temp Factor = 1+ (((Measured array temp-25)*Peak power temp coefficient for module)/100)

D. Measure AC power and compare to predicted power based upon estimated irradiance level. The test shall be performed over a four hour period and must start and end within three hours of solar noon. Test results shall be adjusted if and to the extent that solar irradiance and module temperature measured during the test period are different than the values that were assumed in the submittal calculation. Correction curves shall be furnished by the Contractor in advance of the performance test.

3.08 DOCUMENTATION

A. Contractor shall prepare Operating and Maintenance Manual per Section 01730. As a minimum the manual shall include:

1. A complete set of all approved submittals including shop drawings and product literature.

2. As-built plans showing the final placement of all panels, connections and conduit.

3. As-built electrical plans, including single line diagrams.

4. Troubleshooting guidelines.

5. System maintenance schedule and procedures.

6. Contact information for technical assistance and parts ordering.

7. Copies of pertinent permits and inspections

3.09 TRAINING

A. The PV system installer will train necessary building staff for operation and maintenance of PV system. One day of training shall be provided.

© 2014 CDM Smith
All Rights Reserved

END OF SECTION