



CITY OF MEMPHIS

REQUEST FOR PROPOSAL

#27483

Solar Photovoltaic Installation

At Lichterman Nature Center

Date Issued: September 1, 2015

Proposal Submission Deadline: October 16, 2015

CONTENTS

1. OVERVIEW	5
1.1 PROJECT BACKGROUND	5
1.2 GENERAL CONDITIONS.....	5
2. SCOPE OF SERVICE	6
2.1 SOLAR PV SYSTEM	7
2.2 GENERAL TECHNICAL STANDARDS.....	9
3. PROPOSAL RESPONSE	16
3.1 COVER LETTER	17
3.2 EXECUTIVE SUMMARY	17
3.3 SCOPE	18
3.4 SOLUTION/IMPLEMENTATION DESIGN	18
3.5 PRICING MODEL.....	18
3.6 REFERENCES.....	18
3.7 PROPOSER'S ALTERNATIVE PROPOSALS	18
3.8 PROPOSER'S DUE DILIGENCE REQUIREMENTS	18
3.9 INSURANCE AND RISK OF LOSS.....	19
3.10 EQUAL BUSINESS OPPORTUNITY (EBO) PROGRAM	21
3.11 ANNUAL REPORT	25

4.	INSTRUCTIONS ON RFP PROCESS	25
4.1	USE OF INFORMATION	25
4.2	PRINCIPAL CONTACT AND INFORMATION REQUESTS	25
4.3	SCHEDULE OF ACTIVITIES.....	25
4.4	PRE-SUBMITTAL CONFERENCE	26
4.5	INITIAL QUESTIONS SUBMISSION, FINAL QUESTIONS SUBMISSION	26
4.6	PROPOSAL SUBMISSIONS	27
4.7	FINALIST SELECTIONS (OPTIONAL).....	29
4.8	RECIPIENT PRESENTATIONS (OPTIONAL).....	29
4.9	CONTRACT AWARD.....	30
4.10	PROTESTS.....	30
4.11	MODIFICATION OR TERMINATION OF RFP PROCESS	30
4.12	SUPPLEMENTAL INFORMATION	30
4.13	NO REPRESENTATIONS OR WARRANTIES	31
4.14	PROPOSAL PREPARATION COSTS.....	31
4.15	OWNERSHIP AND INTELLECTUAL PROPERTY.....	31
5.	EVALUATION MODEL	31
5.1	QUALIFYING PROPOSALS.....	31
5.2	EVALUATION OF QUALIFYING PROPOSALS.....	31
6.	RFP TERMS AND CONDITIONS.....	33
	EXHIBITS	36
	EXHIBIT 1 – PROPOSER QUESTIONS TEMPLATE	36
	EXHIBIT 2 – PRICE FORM	37
	EXHIBIT 3 – SITE PHOTOGRAPHS.....	41

EXHIBIT 4 – UTILITY BILL.....	42
EXHIBIT 5 – CITY OF MEMPHIS SERVICE AGREEMENT GENERAL TERMS AND CONDITIONS (PROCUREMENT ATTACHMENT).....	43
EXHIBIT 6 - FM GLOBAL PROPERTY LOSS PREVENTION DATA SHEETS.....	53

1. OVERVIEW

The City of Memphis invites proposals from responsible firms or teams to provide a “turnkey” design and installation of a solar PV array. The intent of this project is to deploy a roof-mounted solar PV system at Lichterman Nature Center (hereafter referred to as LNC), 5992 Quince Rd, Memphis, Tennessee 38119. Proposers to this RFP shall indicate optimal location for the solar PV array in order to achieve goals of energy generation and design quality. The City intends to execute this contract utilizing grant funding and CIP funding.

Term of the agreement shall be determined by negotiation, based upon proposed business model.

1.1 PROJECT BACKGROUND

The City of Memphis wishes to enter into a contract with a single vendor to provide a “turnkey” design, installation, and labor for a 50 kW rooftop solar PV array at the LNC. In October 2012, the City of Memphis developed the Clean & Green Initiative, a series of strategic recommendations aimed at improving sustainability across city government. Key initiative areas include energy efficiency, energy generation, recycling, waste to energy, waste remediation, and wastewater management. One of the primary initiatives related to energy generation is solar development using government owned buildings and properties.

In order to facilitate the greater use of city property for solar development, the City of Memphis seeks to take a pilot approach by making the LNC the first solar installation on City of Memphis property. The LNC is an ideal location for the first installation because it is centrally located, has a uniquely environmental focus, and is visited by thousands of residents and school children each year. Due to the visibility of the site to so many in the community, the City of Memphis is seeking proposals for “turnkey” design & installation with high emphasis on energy generation, design quality, and quality of workmanship and materials. The selected vendor will also be expected to assist financing through enrollment in the TVA Green Power Providers program.

1.2 GENERAL CONDITIONS

The following data is intended to form the basis for submission of proposals to provide a “turnkey” design & installation of a solar PV array for the City of Memphis. This material contains general conditions for the procurement process, the scope of service requested, contract requirements, instructions for submissions of proposals, and submission forms that must be included in the proposal. The RFP should be read in its entirety before preparing the proposal. All materials submitted pursuant to this RFP shall become the property of the City of Memphis.

To the extent permitted by law, all documents pertaining to this Request for Proposals shall be kept confidential until the proposal evaluation is complete and a recommendation is submitted to the

Memphis City Council, to the extent necessary for review. No information about any submission of proposals shall be released until the process is complete, except to the members of the Evaluation Committee established by the City and other appropriate designated City staff. All information provided shall be considered by the Evaluation Committee in making a recommendation to enter into an agreement with the selected consultant.

Any inquiries, suggestions or requests concerning interpretation, clarification or additional information pertaining to the RFP shall be made **in writing and be in the hands of the Purchasing Agent by the close of the business day on September 30, 2015**. Questions must be submitted by email to Eric.Mayse@memphistn.gov. Subject line must read "Questions – Solar Photovoltaic Installation." The City of Memphis is not responsible for oral interpretations given by any City employee, representative, or others. The issuance of written addenda is the only official method whereby interpretation, clarification, or additional information can be given.

If any addenda are issued to this Request for Proposals, the Purchasing Division will post them to the City's website at <http://www.memphistn.gov/Business.aspx/RFPsRFQs.aspx>. Submitting organizations are strongly encouraged to view this website often to see if addenda are posted. Failure of any proposer to receive such addendum or interpretation shall not relieve such Proposer from any obligation under his proposal as submitted. All addenda so issued shall become part of the Contract Documents.

The City of Memphis reserves the right to (a) accept or reject any and/or all submissions of proposals; (b) to waive irregularities, informalities, and technicalities; and (c) to accept any alternative submission of proposals presented which, in its opinion, would best serve the interests of the City. The City shall be the sole judge of the proposals, and the resulting negotiated agreement that is in its best interest, and its decision shall be final. The City also reserves the right to make such investigation as it deems necessary to determine the ability of any submitting entity to perform the work or service requested. Information the City deems necessary to make this determination shall be provided by the submitting entity. Such information may include, but is not limited to, current financial statements by an independent CPA, verification of availability of equipment and personnel, and past performance records.

2. SCOPE OF SERVICE

The City invites interested firms to provide a "turnkey" design & installation of a Solar PV array. Proposals should demonstrate a firm's experience and qualifications with regard to the design, installation, and third party financing of solar photovoltaic systems, their financial stability, and their proposed strategy for the design, installation, and financing of the solar array. Term of the agreement shall be determined by negotiation, based upon proposed business model.

The selected firm's engineering services may be subcontracted, but the subcontracted engineer must be licensed to conduct business in the State of Tennessee. The proposal of any firm that intends to subcontract engineering services must include the license information and resume of the proposed engineer.

The City's project management will be administered by the City of Memphis Division of General Services.

2.1 SOLAR PV SYSTEM

Preliminary due diligence has been conducted for a solar PV array installation on the LNC Visitor Center. However, the City requests proposers indicate the optimal location on the site for the rooftop array providing maximum achievement of energy generation and aesthetic design quality. Proposers should be aware that the roof of the Visitor Center was installed in 2000. The roof is a Berridge MFG / 12-3/4" Tee panel standing seam. The roof has a 20 year MFG warranty on the material. The warranty has ended for the contractor.

Proposals should include performance of due diligence to ensure that the structural integrity and waterproofing of the Visitor Center roof or other proposed roof can accommodate the solar arrays proposed for installation by the Proposer. A map of LNC campus noting the location of the Visitor Center is attached in Exhibit 3. Utility bill information for connected to the Visitor Center is attached as Exhibit 4. Proposers may request a site visit before submitting a proposal. The City will work to accommodate these requests before the RFP deadline. Initial design schemes may be required from the selected firm in order to secure eligibility for programs such as TVA's Green Power Providers, which the City anticipates would be necessary for a viable financing model.

The proposal should identify and schedule the project components necessary to perform due diligence, financially structure, obtain site clearances, design, build, commission, own, operate, and maintain a complete roof-mounted PV system.

Prior to the City's issuing a notice to proceed with system installation, the selected Contractor will provide any information, documentation, and prerequisites to enable solar PV installation on the chosen site, including but not limited to zoning approval, electric and building permits, and other technical and special requirements listed in Section 2.2. To the extent applicable, the following includes what will be done to ensure necessary involvement within each task description.

a. The project goals for this initiative are:

- i. Benefit financially from revenue and/or electricity cost savings generated by a renewable energy system
- ii. Support deployment of renewable energy at city facilities
- iii. The use of solar energy in the city of Memphis provides an excellent means to educate the Mid-South community about how energy choices impact the environment, as well as how the choice of solar in this region can lead to a more secure energy future for our community. This is in keeping with the City of Memphis' Clean & Green Initiative.

b. Knowledge and Familiarity with Work Site: The selected firm should expect to perform due-diligence to ensure the viability of a solar array at the Visitor Center or other selected structure on the LNC campus. Due diligence includes, but is not limited to, verification of sufficient structural integrity, solar

resource, and all necessary approvals for an installation on the proposed host site. Installations should be designed and executed such that they do not negatively impact the roof at the Visitor Center or other proposed roof. The final contract scope will clearly show that identified risks have been addressed.

Proposers should make all necessary investigations to inform themselves thoroughly as to all difficulties involved in the completion of all work required pursuant to the mandates and requirements of this proposal. No plea of ignorance of conditions or difficulties that may hereafter exist, or of conditions or difficulties that may be encountered in the execution of the work pursuant to this proposal as a result of failure to make the necessary examinations and investigations will be accepted as an excuse for a failure or omission on the part of the Contractor to fulfill, in every detail, all of the requirements of the Contract Documents, nor will they be accepted as a basis for any claims whatsoever for extra compensation or for an extension of time.

If the Visitor Center or other proposed site on the LNC campus proves to be an unsuitable location for the installation of a solar array, the City will consider negotiating a change order allowing the contractor to review other locations in an effort to find a suitable project site.

c. System Design: The system design should be as transferable as possible to prevent wasted effort if due diligence requires site change. The system design shall comply with all Technical Standards as described in Section 2.2 below. Note: MLGW's interconnection procedures require MLGW review and approval prior to the purchase of equipment.

The City anticipates the system to be approximately 50 kW; however firms may propose a system with smaller capacity. The PV system may utilize either fixed or tracking arrays, and may be installed at any azimuth and orientation that provides the highest quantity of electricity at the lowest price. If participating in TVA's Green Power Providers Program, the City anticipates that the PV system must be designed, constructed, and fully functional no later than 180 days following acceptance into TVA's Green Power Providers Program.

Aesthetics: Aesthetics are a priority and the vendor will be required to present a visual preference survey for approval of design. It should be uniform in appearance and show quality workmanship.

Preliminary due diligence has been conducted for an installation of a solar PV array at the LNC Visitor Center. However, proposals may consider other buildings on site in order to maximize energy generation and aesthetic design quality.

d. System Installation and Connection to Grid: Pending zoning, permitting and other applicable clearance, the selected firm or contractor will proceed with well-coordinated installation and grid connections, consulting with TVA, MLGW, and LNC throughout the installation process. The installation and connection shall comply with all Technical Standards as described in Section V below.

e. **Financial Structure:** A financing model that allows the City to benefit monetarily from the system is required. It is the responsibility of the firm to ensure that the financing model used adheres to all legal requirements.

The City anticipates that the system will be connected to the electrical grid through TVA's Green Power Providers Program. This program and the structure and regulations of the TVA prevent some third-party financing models from being used in the Tennessee Valley. The Green Power Providers agreement acts, effectively, as a 20-year power purchase agreement. For the first 10 year life of the agreement, TVA will purchase all electricity produced by the system at a premium rate above retail electricity rates. For the last ten years, TVA will purchase all produced electricity at the applicable retail rate. It is the responsibility of the proposing firm to understand the terms and conditions of the Green Power Providers program, if applicable.

f. **Communication:** Outcomes of this Task include increasing environmental awareness and building trust. Deliverables include the effective transfer of information through written documents and face-to-face communication with the City, TVA, MLGW, and LNC, as well as any other interested stakeholders. Firms should expect to share relevant information regarding the financing model system design with the public in a process that will be facilitated through the City.

g. The selected firm or contractor may be required to publicly share the financial model and structure used for this project.

h. **Service Guarantee & System Monitoring:** The Contractor shall guarantee PV system performance for at least the first ten years of operation. For the life of the agreement, the actual kWh produced will be compared to the potential kWh given metered solar radiation and the expected degradation of the PV system over time.

As applicable, the proposing team should plan to monitor and report information required by TVA / MLGW for participation in the Green Power Providers Program in compliance with such that program. TVA requires an interval generation meter, which must record at least clock-hour interval data, preferably in 15 minute increments. Systems larger than 10kW or systems of any size where the billing meter is demand-metered and the distributor has chosen load-side tie require interval meter.

The City of Memphis requires tracking data, including but not limited to renewable power generation, energy savings (kWh equivalents), among financial and other factors for the life of the agreement. It is expected that the Contractor track and submit to the City on a monthly basis any such data not already submitted to the City by TVA or MLGW. If the actual monthly kWh production falls more than 10 percent below the guaranteed level given the conditions above, Contractor shall within 30 days notify the City of the deficiency, make any necessary modifications to the system to meet the service level guarantee, and compensate the City accordingly. The Contractor shall provide to the City a real-time reading of the output system to allow for energy savings tracking to meet City requirements.

2.2 GENERAL TECHNICAL STANDARDS

- a. OSHA: Consultants and Contractors must comply with all OSHA health and safety (H&S) requirements during construction and start-up of the PV system. The City of Memphis may, at its discretion, impose additional H&S requirements which exceed OSHA standards. Any special requirements will be agreed upon between the Contractor and the City before construction begins.
- b. Waste Stream: The Contractor shall provide a waste stream document for City approval prior to the notice to proceed for system installation that includes type of wastes generated and addresses of where those wastes will be disposed of. Throughout the term of the contract, the Contractor shall keep site free from accumulations of waste material, debris or rubbish. The Contractor shall remove all waste, rubbish, tools, and surplus materials from the work site and keep the area clean. Clean up shall be performed in accordance with established safety and proper disposal procedures and in accordance with all applicable federal, state and local laws, rules, and ordinances.
- c. Licenses and Insurance: Consultants and Contractors, and any subcontractors used for this contract, shall be licensed and insured in the State of Tennessee and possess any and all applicable licenses and certifications to perform services under this contract. Note that the State of Tennessee does not grant temporary license and states that entities must be registered "prior to the offering" or rendering of professional engineering services.
- d. Permits: The Contractor shall be responsible for obtaining all required permits. No exemptions for permits have been confirmed or should be assumed. The Contractor shall design to code, apply for the necessary permits and secure all required permits before proceeding.
- e. NABCEP (North American Board of Certified Energy Practitioners): The City requires that the contractors and subcontractors designing the system and performing the installation are NABCEP Installer-certified or supervised by NABCEP Installer-certified individuals.

If applicable, the Green Power Providers program requires that installers have completed one of the following requirements:

- Completed participation in the NABCEP Entry Level Program and passed the entry-level installer examination as certified by an Achievement Award distributed by NABCEP once a passing score has been achieved, or
 - Completed the requirements of the NABCEP PV installer certification as certified by a Certificate distributed by NABCEP once an individual has satisfied the requirements and standards for the Certified Solar PV Installer credentials established by the NABCEP Board of Directors.
- f. Design and Installation: The Contractor shall design the system and install all equipment in accordance with manufacturer's recommendations. All aspects of the installation shall comply with appropriate national and local codes and ordinances; electrical components of the installation shall comply with the 2008 National Electrical Code and other current applicable local codes. Current applicable local codes can be found at:
<https://shelbycountyttn.gov/index.aspx?nid=390>

- g. **Subcontractors:** Consultants and Contractors shall utilize only fully qualified, trained employees or subcontractors to perform the work specified in this contract. The Contractor and all subcontractors shall be appropriately licensed and insured to perform services under this contract. It is preferred that subcontractors involved with the design or installation of the PV system be NABCEP Installer-certified or supervised by NABCEP Installer-certified individuals.
- h. **Maintenance:** The Contractor shall provide five (5) copies of the complete operation and maintenance (O&M) manuals for all components of the system on compact discs to the City upon system commissioning. The O&M manuals shall include, but not be limited to, all information required to allow client operation, should the client decide to self-operate in the future, including equipment specification, maintenance schedules, suppliers information, warranty information, etc. In the event that the City opts to purchase the equipment, the Contractor shall train City staff on equipment use, function, operation, maintenance and repair.

Photovoltaic Module Technical Standards

- a. All PV modules and electrical components shall be UL-listed or approved equivalent and installed to meet the requirements set forth in this specification.
- b. The PV modules shall be designed to have minimum maintenance requirements and high reliability, have a minimum 25 year warranted, and be designed for normal unattended operation in the Memphis-area local climate.
- c. The power warranty for modules shall be a minimum of 90% of the initial power rating for the first 10 years and 80% of the initial power rating for years 11 through 25.
- d. If PV modules using hazardous materials (e.g., cadmium or other hazardous materials) are in use, the environmental impact of the hazardous material usage must be discussed and documented in writing during the due diligence process, including any special maintenance requirements and proper disposal/recycling of the modules at the end of their useful life. Modules containing hazardous materials must comply with the EPA Landfill Disposal Requirements. Any additional costs related to PV modules containing hazardous materials and responsibility for those costs must be clearly identified.
- e. Framed PV modules shall be anodized aluminum with pre-drilled holes or mounting channels. For unframed modules, acceptable mounting methods shall be provided by the manufacturer.
- f. Bolted and similar connections shall be non-corrosive and include locking devices designed to prevent twisting over the 25 year design life of the PV system.
- g. The modules and system should be designed for outdoor installation in Memphis, TN. The area is subject to long-term humidity and temperature conditions. The system shall be designed to handle expected ambient temperatures that range from regional winter lows to regional summer roof top highs. Supplied equipment must be rated and warranted to withstand and operate under these conditions. The PV system and its associated structures shall be certified by a Tennessee-registered Professional Engineer to meet the local wind loading requirements. The modules should

not adversely impact the roof's ability to contain and control rainfall. The system should not create leaks or decrease the life span of the roof. Removing panels should not cause any damage to the integrity of the roof.

- h. The Contractor shall create a uniform appearance of the array and spacing between individual modules and panel-groups should be uniform. As much as possible, all mechanical hardware, conduit, junction boxes, and other equipment should be concealed beneath and/or behind the array.

Electric Power Requirements

- a. Power produced by the PV system must be compatible with the onsite and/or MLGW electric distribution system.
- b. The PV system must be installed in accordance with all applicable requirements of local electrical and national electric codes. The PV system electrical design shall also comply with IEC, IEEE, ANSI or other standards as determined by the local jurisdiction. Local utility codes shall dictate the interconnection of the PV system to the MLGW's electric utility distribution system, through TVA's Green Power Switch Green Power Providers Program:
<http://www.tva.com/greenpowerswitch/partners/>
- c. All electrical components, including over-current protection, disconnect, surge suppression devices, conduit, wiring, and terminals must be commercial- or utility-grade and have appropriate voltage, current, and temperature ratings for this application.
- d. Voltage drop in the PV array DC circuits should be within the 2008 National Electric Code (NEC) guidelines, including losses in conductors and through all fuses, blocking diodes, and termination points. All installation and connection must apply to 2008 NEC standards. A voltage drop of 3% or better is preferred.
- e. The Contractor shall supply a step-up transformer, if necessary, to match the voltage of MLGW's distribution system. The step-up transformer shall be compatible with MLGW's standards for voltage, phasing and grounding. This transformer shall be housed in the dust-tight and rain-tight enclosure. It may be dry type or liquid-filled type. For oil filled transformers, the PV Developer shall provide an adequate oil containment system. PCBs shall not be permitted.
- f. The step-up transformer shall include an automatic positive load-breaking means of disconnect (e.g., switch, circuit breaker, etc.) on the high side. The disconnect means shall be provided to disconnect all phases simultaneously. This disconnect means shall be capable of remote operation. The utility shall connect to the disconnect. The Contractor will be responsible for all equipment including the disconnect, and shall coordinate the details (equipment, placement, etc. with MLGW in advance.

Inverters

- a. All inverters shall comply with UL 1741 – “Standard for Static Inverters and Charge Controllers for use in Photovoltaic Systems.”

- b. The inverters shall be UL-listed or approved equivalent and installed to meet the requirements set forth in this specification.
- c. The inverters shall be designed for a fully-functional utility-interactive system.
- d. The inverters shall be designed to produce high-efficiency energy, have minimum maintenance requirements and high reliability, and be designed for normal unattended operation.
- e. The inverters must be of a proven design which has been demonstrated in other solar power systems for a minimum period of at least one year.
- f. The design should plan for maximum power availability at all times.
- g. The inverters shall be housed in an appropriately waterproof and dust proof enclosure, or in a building. The inverters shall have provisions to prevent moisture condensation and entrance of rodents into air intake or exhaust ports. The inverter enclosure shall take into consideration the effects of direct sunlight and extreme weather such that the inverters are appropriately shielded from the elements. The inverter enclosure should be well ventilated or be air conditioned so that the inverters operate safely at or near their maximum power point (MPP).
- h. Inverters shall be installed in accordance with Federal Emergency Management Agency (FEMA) Flood Control District regulations. Inverter pre-approval and location shall be coordinated with MLGW staff. This approval process is outlined in TVA's Green Power Agreement.
- i. The inverters shall be capable of completely automatic unattended operation, including wake up, synchronization, and disconnect. The inverters shall also be capable of operation by local (front panel) controls.
- j. The inverters shall be capable of operating in parallel with other inverters meeting the specifications delineated herein, the electrical collection system, and connected loads.
- k. The Contractor's system shall be capable of interrupting line-to-line fault currents and line-to-ground fault currents. It is preferred that the inverter design include turning off the inverter before AC or DC contactors are opened, as applicable.
- l. The inverters shall include all necessary self-protective features and self-diagnostic features to protect the inverter from damage in the event of component failure or from parameters beyond normal operating range due to internal or external causes. The self-protective features shall not allow the inverters to be operated in a manner which may be unsafe or damaging. Faults due to malfunctions within the inverter or solar conversion system equipment shall be cleared by the inverter over-current protection device and not by protection devices.
- m. An inverter grounding system shall be designed and installed with the system. The grounding system shall provide personnel protection for step and touch potential in accordance with utility standards. The system shall also be adequate for the detection and clearing of ground faults.

Monitoring Requirements

- a. The Contractor shall provide a metering system that records and stores the following data on an hourly basis:
 - AC-kWh output from each individual inverter
 - AC-kWh output from the entire solar plant
 - Incident solar radiation in the plane of the array (a pyranometer shall be used), tailored to provide only data necessary to meet any TVA / MLGW monitoring requirements.
- b. Other points may be metered as specified by the Contractor to monitor and maintain the system with a high degree of reliability. The kWh meters shall be utility-grade and shall meet ANSI utility testing standards. The inverter output meters may be an integral part of the inverter. The meter shall be used to provide data to the City in real time.

Additional Technical Requirements

- a. All structures and structural elements, including array structures, shall be designed in accordance with all applicable local codes and standards pertaining to the erection of such structures.
- b. All outdoor enclosures shall be at minimum rated NEMA 3R.
- c. All structural components, including array structures, shall be designed in a manner commensurate with attaining a minimum 25 year design life. Particular attention shall be given to the prevention of corrosion at the connections between dissimilar metals.
- d. Compression type connectors at the PV module output terminals shall be provided in a watertight connection terminal box with knockouts for watertight conduit mountings. Twist-on wire splices, crimped, soldered, or taped connections are not permitted for required field-installed wiring.
- e. All of the exposed non-current carrying metal parts shall be solidly grounded. Particular attention shall be given to prevention of corrosion at the connection of dissimilar metals such as aluminum and steel.
- f. Other technical codes that may apply include ASME PTC 50 (solar PV performance) and ANSI Z21.83 (solar PV performance and safety).
- g. All modules shall be installed in accordance with any applicable FEMA regulations.
- h. The Contractor shall provide (as needed) its own construction office or trailer on the site during construction and shall include temporary electricity if needed. The City shall not provide office or storage space for the Contractor's use.

- i. *Use of Premises: The Contractor shall have use of the areas within the facilities where the solar panels will be installed. Upon request, the LNC Manager will designate space to be used needed for temporary storage. Storage in undesignated spaces is not permitted. The Contractor shall coordinate with the LNC Manager to schedule the work at a time convenient for the facility and with least disruption of service to the public. The Contractor will be responsible for all materials and tools used/stored at the job site. Any damage to existing facilities occurring during the construction process will be the responsibility of the Contractor to repair.*
- j. The Contractor shall be responsible for all maintenance and operation associated with the PV plant.

Additional Special Requirements

- a. The solar company chosen through this RFP would provide the project management who will be the on-ground coordinator.
- b. The solar company will determine if the roof has load bearing capacity.
- c. The solar company will respect the peak event times of the Visitor Center or other selected building and stay clear of areas needed for rental space. Construction must be completed during the winter months of December thru February.
- d. Consideration will be given in putting the inverter in a mutually agreed upon location that is both secure and unobtrusive.
- e. The solar company will provide the fire department, as required, the location and information about the panels and how to remotely disconnect the power source.
- f. The solar company will provide specifications on the hail rating of the panels.
- g. The solar company will be accountable for maintenance and management of the solar panels for the life of the project.

Interconnection to the Utility Grid

The City anticipates that the PV system shall be interconnected to the utility grid through TVA's Green Power Providers Program via MLGW's electric system per their requirements and standards; e x a m p l e s of these requirements are outlined on MLGW's website: <http://www.mlgw.com/about/mlgwgreenpowerswitch>. Information on the 2015 Green Power Providers Program may be found at: <http://www.tva.com/greenpowerswitch/providers/>. Expected Standards and Certification Criteria are listed as follows (final criteria will depend on 2015 Green Power Providers Program):

The DG equipment must comply with the latest revision of the following standards and the customer must provide evidence of certification with the DG Equipment Application or with the Certificate of Completion:

1.8.1. IEEE1547 Standard for Interconnecting Distributed Resources with Electric Power Systems (including use of IEEE 1547.2 testing protocols to establish conformity)

1.8.2. IEEE1547.2 Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

1.8.3. UL 1741 Inverters, Converters, and Controllers for Use in Independent Power Systems

1.8.4. NFPA 70 National Electrical Code

1.8.5. The DG Equipment shall be considered certified for interconnected operation if the generation equipment and all related interconnection components have been tested and listed by a Nationally Recognized Testing Laboratory (NRTL certification by Department of Labor) for continuous interactive operation with an electric distribution system in compliance with the codes and standards outlined in 1.8.1 - 1.8.4 above.

1.8.6. The customer must provide evidence that the installation has been inspected and approved by state or local code officials, as applicable, prior to its operation in parallel. This information will be submitted with the Certification of Completion. The Contractor shall provide all the equipment including the step-up transformer (s) and automatic disconnect to connect to MLGW's 3 phase, 13200 volts (phase to phase) system.

If expecting participation in the Green Power Providers Program, the Contractor shall negotiate a custom interconnection agreement between the TVA and MLGW. A sample template of the Green Power Providers agreement information can be found here

<http://www.mlgw.com/images/content/files/pdf/2015MLGWGreenPowerProvidersprogramoverview.pdf>; please note the participant must agree to the indemnification clause in the participation agreement. Unless an alternative can be negotiated with TVA/MLGW, the Green Power Providers agreement will need to be between the City and TVA/MLGW. In this case, the City will commit to re-issuing a portion of the Green Power Providers credit/value back to the contractor, or whatever entity needs to capture the value of the system output. The interconnection agreement shall be with TVA / MLGW and shall be separate and independent from the contract between the City and the Contractor. Please note that there is a cost associated to MLGW for the box and transformers, so the Consultant will need to budget for that, as well as the interconnection study. MLGW will work with the Contractor to insure proper interconnection based on system design.

3. PROPOSAL RESPONSE

This Section describes the contents of Proposer's Proposal and provides an outline of how the Proposer should organize it. Proposer's Proposal will not be considered responsive unless it fully complies with the requirements in this Section, as well as, the additional instructions provided in Section 4.6 regarding the required Proposal formats and submission process.

Specifically, Proposer’s Proposal shall include each of the sections referenced in the table below. The requirements for each of these Proposal sections are described in more detail in this Section.

PROPOSER'S PROPOSAL WILL BE DISQUALIFIED FROM THIS RFP PROCESS IF THE PROPOSER FAILS TO CONFORM TO THE PROPOSAL INSTRUCTIONS IN THIS SECTION.

Sections and Topics
Section 1 – Cover Letter
Section 2 – Executive Summary
Section 3 – Scope
Section 4 – Solution/Implementation Design
Section 5 – Pricing Model
Section 6 – References
Section 7 – Proposer’s Alternative Proposals
Section 8 – Proposer’s Due Diligence Requirements
Section 9 – Insurance and Indemnification
Section 10 – Equal Business Opportunity (EBO) Program
Section 11 – Annual Report: May be included in separate cover from bound copies, but must be included with response.

3.1 COVER LETTER

Proposer’s Proposal shall contain a cover letter acknowledging Proposer's understanding of the RFP process and requirements set forth in this RFP, including its commitment to its Proposal. The cover letter shall be signed by an authorized representative of Proposer’s company.

3.2 EXECUTIVE SUMMARY

Proposer’s Proposal shall begin with an executive summary providing an overview of Proposer’s solution/implementation, with a focus on any new technologies, innovations, processes, and transformation that Proposer will bring to help the City meet its objectives. The Executive Summary should include a description of the following:

- A description of Proposer’s solution/implementation
- A description of Proposer’s pricing approach.
- A description of Proposer’s relevant experience to the proposed solution/implementation, including customer’s previous municipal and local government clients.

- A list of key interactions between Proposer and the other involved parties (e.g., the City, City contractors, etc.), as well as, a description of Proposer’s approach for managing and communicating between and among those.
- A summary of any key differentiators that make Proposer uniquely positioned to provide a solar photovoltaic system to the City.

3.3 SCOPE

In Section 3 of its Proposal, Proposer shall explicitly confirm its agreement with the full scope of Services described in this section. If, however, Proposer believes that it can provide a solution/implementation that better fits the City’s requirements/objectives/ constraints by not providing all of the Services, Proposer may propose alternatives under the Alternative Proposals section, described below.

3.4 SOLUTION/IMPLEMENTATION DESIGN

Section 4 of Proposer’s Proposal shall describe Proposer’s “Solution/Implementation Design”.

3.5 PRICING MODEL

In Section 5 of Proposer’s Proposal, Proposer shall provide a detailed breakdown of costs. For example, what is the cost for equipment, service, training and implementation? Detailed cost sheets are included in Exhibit 2: Price Forms

3.6 REFERENCES

In Section 6 of the Proposer’s Proposal, proposers shall provide a list of completed PV projects with the following information.

- Owner’s name and contact information.
- Physical address of installation.
- Scope of work.
- Date started.
- Date completed.

Proposer shall provide physical address of local office or facility of designated service provider for the installation and maintenance of the project and state how long at said address, and if not the proposer, how long under contract with the proposer.

3.7 PROPOSER’S ALTERNATIVE PROPOSALS

In Section 7 of the Proposer’s Proposal, Proposer may (at its option) include an alternative solution/implementation ("Alternative Proposal") for consideration by the City. Alternative proposals shall be accompanied by appropriately adjusted solution/implementation descriptions and pricing models. For clarity, alternative proposals are intended to be supplements to Proposer’s core proposal, and should not be used as a substitute to addressing City’s stated requirements.

3.8 PROPOSER’S DUE DILIGENCE REQUIREMENTS

In Section 8 of its Proposal, Proposer should submit a detailed list of any additional due diligence – such as review of specific information and interviews of particular City personnel – that Proposer would

need to perform following down-selection, if Proposer were chosen as a down-selected provider, in order to develop and submit a detailed and unqualified best and final offer.

3.9 INSURANCE AND RISK OF LOSS

In Section 9 of its Proposal, Proposer should submit a statement of compliance to all listed insurance in the reply to this RFP or note any exceptions. The following insurance requirements must be submitted by the successful vendor upon award of contract.

The Company shall not commence any work under this contract until it has obtained and caused its subcontractors to procure and keep in force all insurance required. The Company shall furnish the Risk Manager a Certificate of Insurance and/or policies attested by a duly authorized representative of the insurance carrier evidencing that the insurance required hereunder is in effect. All insurance companies must be acceptable to the City of Memphis and licensed in the state of Tennessee.

If any of the Insurance Requirements are non-renewed at the expiration dates, payment to the company may be withheld until those requirements have been met, or at the option of the City. The City may pay the renewal premiums and withhold such payments from any monies due the Company.

The Company shall indemnify, defend, save and hold harmless the City, its officers, employees, and agents, from and against any and all claims, demands, suits, actions, penalties, damages, settlements, costs, expenses, or other liabilities of any kind and character arising out of or in connection with the breach of this Agreement by Company, its employees, subcontractors, or agents, or any negligent act or omission of Company, its employees, subcontractors, or agents, which occurs pursuant to the performance of this Agreement, and this indemnification shall survive the expiration or earlier termination of this Agreement. The provisions of this paragraph shall not apply to any loss or damage caused solely by the acts, errors, or omissions of the City, its officers, employees and agents. Contracts for third party service providers should include indemnity provisions that protect the City from any liability arising out of the Company's loss of City's sensitive information.

Each certificate or policy shall require and state in writing the following clauses:

Company shall provide notice to the City within three (3) business days following receipt of any notice of cancellation or material change in Company's insurance policy from Company's insurer. Such notice shall be provided to City by registered mail, to the following addresses:

City of Memphis
Attn: Risk Management
2714 Union Extended, Suite 200
Memphis, TN 38112

City of Memphis
Attn: Purchasing Agent
125 North Main, Room 354
Memphis, TN 38103

The Certificate of Insurance shall state the following: "The City of Memphis, its officials, agents, employees and representatives shall be named as additional insured on all liability policies." The additional insured endorsements shall be attached to the Certificate of Insurance and the Certificate of Insurance shall also state: "The additional insured endorsement is attached to the Certificate of Insurance."

WORKERS COMPENSATION:

The Company shall maintain in force Workers' Compensation coverage in accordance with the Statutory Requirements and Minimum Limits of the State of Tennessee and shall require all subcontractors to do likewise.

Employers Liability	\$100,000	Each Accident
	\$500,000	Disease – Policy Limit
	\$100,000	Disease – Each Employee

AUTOMOBILE LIABILITY:

Covering owned, non-owned and hired vehicles with MINIMUM LIMITS OF:
 \$1,000,000 Each Occurrence – Combined Single Limits

COMMERCIAL GENERAL LIABILITY:

Comprehensive General Liability Insurance, including Premises and Operations, Contractual Liability, Independent Contractor's Liability, and Broad Form Property Damage Liability coverage with Minimum Limits Of:

\$4,000,000	General Aggregate (Per Project / Per Location)
\$4,000,000	Products & Completed Operations
\$4,000,000	Personal & Advertising
\$4,000,000	Each Occurrence (Bodily Injury & Property Damage)
\$ 50,000	Fire Damage any One Fire
\$ 5,000	Medical Expense any One Person

ERRORS AND OMISSIONS LIABILITY with Minimum Limits Of:

\$2,000,000	General Aggregate
\$2,000,000	Each Claim

The company shall maintain such coverage for at least three (3) years from the termination or expiration of this agreement.

PROPERTY INSURANCE:

The Company shall be responsible for maintaining any and all property insurance on their own equipment and shall require all subcontractors to do likewise. The Company shall require all subcontractors to carry insurance as outlined above, in case they are not protected by the policies carried by the Company.

The Company is required to provide copies of the insurance policies upon request.

SOLAR PANEL:

Plans for the Solar Photovoltaic Panel Installation should be forwarded to FM Global for review and acceptance by FM Global before installation begins. The completed installation is also subject to a field acceptance by FM Global.

3.10 EQUAL BUSINESS OPPORTUNITY (EBO) PROGRAM

In Section 10 of the Proposer's Proposal, Proposer shall provide a complete participation plan or well documented good faith efforts. See the following pages for descriptions and forms.

Equal Business Opportunity Program

This contract will be subject to the requirements of the City of Memphis Ordinance #5384 which establishes the Equal Business Opportunity ("EBO") Program. It is up to the Respondent to ensure that all requirements of this ordinance are met. The Ordinance may be accessed on the City's website at www.memphistn.gov under "Doing Business". The intent of the EBO Program is to increase the participation of locally owned minority and women owned business enterprises ("M/WBE") in the City's purchasing activities. Toward achieving this objective, the M/WBE participation goal for this solicitation is 20%. The percentage of M/WBE participation is defined as the dollar value of subcontracts awarded to certified minority and/or women business enterprises divided by the total proposed base bid amount.

Participation Plan

The Participation Plan must include: (1) level and dollar amount of participation your firm anticipates to achieve in the performance of contract resulting from this RFP; (2) the type of work to be performed by the M/WBE participation; and (3) the names of the M/WBEs the Respondent plans to utilize in the performance of the contract resulting from this RFP.

Good Faith Efforts Documentation

If a Respondent proposes an M/WBE percentage less than the established goal, the Respondent must, at the time of the response, submit a Good Faith Efforts statement accompanied by the appropriate documentation justifying its submitted M/WBE percentage. The ability of the Respondent to perform the work with its own work force will not in itself excuse the Respondent from making good faith efforts to meet participation goals. The determination of whether a Respondent has made a good faith effort will be made by the City's Contract Compliance Officer, Director of Finance and the Purchasing Agent, prior to the award of the project.

Eligible M/WBE Firms

To qualify as an M/WBE firm, per the requirements of City of Memphis Ordinance #5384, a firm must be included on the City's list of certified M/WBE firms. One or a combination of several M/WBEs may be utilized to meet the established goal of 20%.

Requests for verification must be submitted to the City's Contract Compliance Office listed below:

Mary L. Bright
City of Memphis
Contract Compliance Officer
Mary.Bright@memphistn.gov
125 North Main Street, Suite 546
Memphis, TN 38103
Phone: (901) 576-6210
Fax: (901) 576-6560

CITY OF MEMPHIS

EQUAL BUSINESS OPPORTUNITY PROGRAM COMPLIANCE FORM

PROJECT TITLE Solar Photovoltaic Installation

Project M/WBE GOAL: 20%

The following sections must be completed by bidder. A certified subcontractor or supplier is defined as a firm from the list of certified firms provided with this specification.

Bidder's Name

Section A - If the bidder is a certified firm, so indicate here with a check mark.

_____ MBE _____ WBE

Section B - Identify below those certified firms that will be employed as subcontractors or suppliers on this project. By submitting this bid, the bidder commits to the use of the firms listed below.

\$ = Show the dollar value of the subcontract to be awarded to this firm

% = Show the percentage this subcontract is of your base bid

M/WBE = Show by inserting an M or W whether the subcontractor is an MBE or WBE

\$ / %	M/WBE	SERVICE	CERTIFIED SUBCONTR. NAME, ADDRESS, TEL. #

Total	\$	%
MBE		
WBE		

THIS FORM and SUPPORTING DOCUMENTATION MUST BE SUBMITTED WITH THE BID OR THE BID WILL BE CONSIDERED NON-CONFORMING.

**CITY OF MEMPHIS
GOOD FAITH EFFORT DOCUMENTATION FORM**

To The Honorable Mayor City of Memphis, Tennessee
From:

PROPOSER NAME _____

PROJECT TITLE: **Solar Photovoltaic Installation**

Enclosed please find the required documents:

Said Bidder ____ did / or ____ did not attend the project pre-bid meeting.

***Copies of all written notification to City of Memphis M/WBE listed firms. (Please attach list of all firms notified, detail how they were notified and when).**

Said Bidder _____ did / or ____ did not select economically feasible portions of the work to be performed by M/WBE firms.

***List all M/WBE firms with which negotiations took place. (Attach list. If no negotiations were held, please state so.) Provide names, addresses, and dates of negotiations.**

***Statement of efforts to assist M/WBE firms, with bonding, insurance, financing, or with document review. (Attach list. If no assistance was provided, please state so.)**

The Bidder ____ did / or ____ did not use all M/WBE quotations received. If the Bidder did not use all M/WBE quotations received, list on attached sheets, as required as to the reasons those quotes were not used.

***List (on attached sheets as required) all M/WBE firms contacted that the bidder considered not to be qualified, and a statement of the reasons for the bidder's conclusions. If no firms were found to be non-qualified, please state so.**

THIS SIGNED FORM AND REQUESTED DOCUMENTATION (noted by an asterisk '*') MUST BE SUBMITTED WITH THE BID IF THE BIDDER DOES NOT MEET THE REQUIRED M/WBE PROJECT GOAL. IF REQUESTED DOCUMENTATION IS NOT SUBMITTED THE BID WILL BE CONSIDERED NON-CONFORMING.

Contractor's Name

Signature

Printed or Typed Name and Title

3.11 ANNUAL REPORT

The Proposer shall submit their most recent annual report or current audited financial statements. The financial stability of the Proposer and the Proposer's length of time in business will be closely evaluated. Financial information may be included in separate cover from bound copies, but must be included with response.

4. INSTRUCTIONS ON RFP PROCESS

4.1 USE OF INFORMATION

All correspondence about this RFP and the Initiative should be limited to the Principal Contact described in Section 4.2 or other designated City personnel or agents.

4.2 PRINCIPAL CONTACT AND INFORMATION REQUESTS

Eric Mayse is the single point of contact (the "Principal Contact") for all matters relating to this RFP. Proposer should direct all inquiries to the Principal Contact at:

eric.mayse@memphistn.gov

Proposer should not, under any circumstances, contact any City personnel (including senior City management or City employees with whom Proposer has an existing business or personal relationship) to discuss this RFP without the Principal Contact's prior written consent. Utmost discretion is expected of Proposer and all other RFP recipients. Any recipient attempting to circumvent this process will risk elimination from further participation in the bidding process.

4.3 SCHEDULE OF ACTIVITIES

- In order to accelerate the business transformation, service improvements and cost savings the City anticipates, the City has developed an estimated timeline for this Initiative. The City will move as quickly and efficiently as possible to determine the feasibility of each Proposer's Proposal and to move forward with term sheet discussions and ultimately conclude an agreement accordingly.
- As a result, the City requests that Proposer make a dedicated team available to participate in the proposal development and evaluation processes as necessary to participate in the activities and meet the deadlines provided in the table below.
- It is the City's option to conduct interviews with finalists. However, in no way is the City obligated to interview finalists.
- The City reserves the right to modify or update this schedule at any point in time.

In no event shall the deadline for submission of the proposal be changed except by written modification by the City of Memphis Purchasing Department.

Activity	Date
Publish RFP	September 1, 2015
Pre-submittal meeting	September 15, 2015
Proposer Questions Deadline	September 30, 2015
City Response to Questions	October 7, 2015
Proposal Submission Deadline	October 16, 2015
Finalist Selections – Optional	Week of October 26, 2015
Finalist Presentations – Optional (City’s Discretion)	Week of November 2, 2015
Negotiations	November, 2015
Agreement Finalization	November, 2015

Several of the activities identified in the above table are described in more detail in the remainder of this Section 4.

4.4 PRE-SUBMITTAL CONFERENCE

A pre-submittal conference is scheduled for this RFP at 10:00 a.m. on September 15, 2015 at the Division of Planning and Development Conference Room, 125 North Main Street, Room 477, Memphis, TN 38103. Although attendance is not mandatory, all interested proposers are encouraged to attend. Proposers wishing to attend should communicate their intentions, via e-mail, by September 10, 2015, to the individual listed in Section 4.2. Communication shall include the subject heading “(your company’s name) – pre-submittal conference”. In addition to the sender’s e-mail address, the e-mail should include the number of attendees. Attendees may also e-mail advance questions to the City, which may be addressed during the meeting.

4.5 INITIAL QUESTIONS SUBMISSION, FINAL QUESTIONS SUBMISSION

Proposer may submit an initial set of questions based on its review of this RFP, by completing the template provided at Exhibit 1 (Proposer Questions Template) and sending it via email by September 30, 2015 by 5:00 pm CDT. Questions received after 5:00 will not be answered. This email should be sent to the individual(s) described in Section 4.2, with the subject heading: “[Your company’s name] – Initial City of Memphis Solar Photovoltaic Installation RFP Questions.” The City will post the responses to the questions on the City’s web site October 7, 2015 by 5:00 pm CDT. To ensure the fair and consistent distribution of information, no individual answers will be given. The only official answer or position of the City will be the one posted via the City’s website.

4.6 PROPOSAL SUBMISSIONS

PROPOSAL SUBMISSION AND DUE DATE

Proposer shall submit (A) one (1) original and five (5) complete printed copies of its Proposal (including the signed Cover Letters); and (B) 2 CDs or DVDs containing softcopies of its entire Proposal (including PDFs of the Signed Cover Letters) on or before **October 16, 2015, at 2:00 pm CDT**, to the addressee provided below:

**City of Memphis Purchasing Department
125 N. Main Street, Room 354
Memphis, TN 38103**

The label should identify the contents as: **City of Memphis Lichterman Solar Project RFP #27483**

PROPOSALS SUBMITTED AFTER THE DEADLINE OR WHICH STATE THAT INFORMATION WILL BE PROVIDED 'AT A LATER DATE', OR WHICH ARE OTHERWISE INCOMPLETE OR FAIL TO COMPLY WITH THE REQUIREMENTS SET FORTH IN THIS RFP WILL BE DISQUALIFIED FROM PARTICIPATION IN THIS RFP PROCESS.

Proposals may not be amended after the submission deadline.

Notwithstanding any legends on the proposal or any other statements to the contrary, all materials submitted in connection with proposer's response to this RFP will become the property of the city and may be returned only at the City's option.

With respect to the information contained on proposer's CDs or DVDs:

The folders and/or files should be organized in such a way as to preserve the order and labeling of how such information is presented in proposer's printed copy of its proposal;

Each document (and file name) should clearly show the name of proposer;

Each file should be pre-formatted by proposer to facilitate on-line viewing and printing in a form consistent with proposer's printed copy of its proposal;

All documents should be presented in a native Microsoft office format (e.g., word, excel, PowerPoint, project) or PDF.

Documents should not include embedded files.

PROPOSAL FORMAT

The City expects the Proposal to be a compilation of various documents, in particular because Proposer's Proposal must utilize the RFP response templates set forth in the Exhibits in this RFP. The Proposal should be structured so that there is a primary, "core" document (organized in accordance with Section 3) that incorporates by reference, as applicable, the other documents.

Proposer shall use Microsoft Office 2010 file formats in preparing its Proposal to the maximum extent possible. All pages should be formatted to print on 8 ½" x 11" paper, unless another format is provided by the response template. Proposer responses should be specific, factual, brief and to the point, and should avoid pure sales and marketing content to the extent possible.

PROPOSAL EXPIRATION DATE

Proposals in response to this RFP shall remain valid for nine (9) months from the Proposal due date. The City may request an extension of time if needed.

PROPOSER DATA

The confidentiality of information and data contained in the firm of contractor's Proposal shall be subject to and governed by the Open Records Act and any other Public Records laws with which the City is legally obligated to comply (including a Freedom of Information Act Request under "FOIA").

Deadline Extension

The City reserves the right to extend the submission deadline, if such action is considered necessary by the City.

Ambiguity, Conflict, or other Errors in the RFP

If a Proposer discovers any ambiguity, conflict, discrepancy, omission or other error in the RFP, it shall immediately notify, in writing e-mail, the City of such error request modification or clarification of the document. The Proposer shall include the RFP number, page number and the applicable paragraph title. The City will issue/post any revisions to the RFP on the City's website (www.memphistn.gov). The Proposer is responsible for clarifying any ambiguity, conflict, discrepancy, omission, or other error in the Request for Proposals prior to submitting the proposal or any ambiguity, conflict, discrepancy, etc. shall be waived.

Failed Competition

The City reserves the right to reject any or all proposals which are not responsive to the specifications of this Request for Proposal (RFP). Competitive negotiation requires that at least two responsive proposals for the same scope of work and service area be received in response to the RFP. A competition is considered failed if only one responsive proposal is received. If a competition has been declared failed, the City then has the option to reopen the procurement or enter into a non-competitive procurement.

Withdrawing or Amending a Proposal

At any time prior to the scheduled deadline for receipt of proposals, the Proposer may withdraw or amend its proposal by submitting a written request from the authorized representative whose name and signature appears on the proposal. A written request to withdraw or amend the proposal must be submitted to the individual and address to whom/which the proposal was submitted in accordance with the section above titled "PROPOSAL SUBMISSION AND DUE DATE."

Acceptance/Rejection of Proposals

The City reserves the right to accept or reject, in whole or in part, any or all proposals submitted. The City shall reject the proposal of any Proposer that is determined to be non-responsive.

Informalities/Minor Irregularities

The City reserves the right to waive minor irregularities or informalities in a Proposer's proposal when the City determines that it will be in City's best interest to do so. Any such waiver shall not modify any remaining RFP specifications or excuse the Proposer from full compliance with the RFP specifications and other contract requirements if the Proposer is awarded the contract.

Proposer indebted to the City

No contract will be knowingly awarded to any organization which, in the City's sole discretion, is in arrears to the City of Memphis upon any debt or contract, or which is a defaulter as surety or otherwise under any obligations to the City of Memphis, or which has failed to perform faithfully on any previous contract with the City of Memphis.

Tax Payments

The City of Memphis is exempt from federal excise, state and local taxes on all purchases and will issue tax exemption certificates, upon request.

4.7 FINALIST SELECTIONS (OPTIONAL)

The City may or may not select a number of the RFP respondents who will be asked to give an oral presentation of its proposal to the City. However the City is not obligated to interview any finalist. If interviews are conducted, these providers will be selected based on an evaluation of their Proposals against the criteria described in Section 5 of this RFP. RFP recipients that are not selected to progress to the oral presentations likely will be excluded from further consideration.

For this reason, Proposer is strongly encouraged to make as complete and compelling a Proposal as possible. The RFP recipient who fails to comply risks being dropped from further consideration without having an opportunity to improve its offer.

4.8 RECIPIENT PRESENTATIONS (OPTIONAL)

Details pertaining to the oral presentation phase of the RFP process will be confirmed after Proposal submission, however the presentations are tentatively scheduled to begin the week of November 2, 2015.

If Proposer is one of the RFP recipients asked to give an oral presentation, Proposer should prepare a comprehensive presentation that concentrates on the business and technical aspects of the Proposal, and should not be marketing discussions. **PROPOSER'S PROPOSAL WILL NOT BE ALTERED OR ENHANCED DURING THE ORAL PRESENTATION.**

Appropriate visual and written materials are expected, but the format will be left to the discretion of the Proposer. A soft copy of all presentation materials must be delivered to the Principal Contact at least one business day before the beginning of the presentation. Proposer should also bring a sufficient number of printed copies of the materials for the City attendees at the presentation.

The City may provide a last minute agenda or other direction for the Proposer's presentation based on the City's initial review of the Proposals.

4.9 CONTRACT AWARD

The award of contract will be made on the basis of the best proposal, as solely determined by the City, which meets the requirements and criteria set forth in the solicitation. The City will only accept proposals for the services requested. The proposal submitted in response to this solicitation is not a legally binding document; however, the contract, which will be based on information provided in the proposal, becomes legally binding once all parties have signed it. Any contract resulting from this RFP shall be subject to the City of Memphis General Terms and Conditions set forth in this solicitation and any additional terms imposed by City. The successful Contractor shall be required to execute the contract originated by the City of Memphis and satisfy all contract requirements as specified by the City. One or more contracts may be awarded under this RFP, and any contract awards and amounts are subject to the availability and appropriation of funds. Unless changed by the City, the anticipated contract will commence upon contract execution and end June 30, 2017. The City reserves the option to extend the contract term for an additional 12-month period.

4.10 PROTESTS

Any protest of award must be filed in writing with the Purchasing Agent within five (5) calendar days of the award announcement at the following address:

City of Memphis Purchasing Agent:
125 North Main, Room 354, Memphis, Tennessee 38103.

4.11 MODIFICATION OR TERMINATION OF RFP PROCESS

Subject to the rules and regulations of the City's Procurement Office, including with respect to providing notification and, where applicable, providing the opportunity to revise proposals, the City reserves the right to, in its sole discretion, discontinue, amend, supplement, or otherwise change this RFP, the Initiative, the process used for evaluation, and the expected timeline at any time and for any reason, and makes no commitments, implied or otherwise, that this process will result in a business transaction with any provider.

4.12 SUPPLEMENTAL INFORMATION

If, subsequent to issuance of this RFP, additional relevant material is produced by or becomes available to the City, such material will (where appropriate) be transmitted to all RFP participants for their consideration. The City will make modifications by issuing a written addendum, which will be posted on the City's website. Any revisions to the solicitation will be made only by an addendum issued by the City. It is the responsibility of the Proposer to check the website for possible addenda

and should consider such information in its Proposal. The City will assume that all changes or additional requirements transmitted have been taken into account in Proposer's Proposal (including with respect to pricing), unless otherwise specified.

4.13 NO REPRESENTATIONS OR WARRANTIES

The City makes no representations or warranties regarding the accuracy or completeness of the information contained in this RFP or otherwise provided by the City through the RFP process. Proposer is responsible for making its own evaluation of information and data contained in this RFP or otherwise provided by the City, and for preparing and submitting responses to the RFP. The City has attempted to validate the information provided in this RFP, but it is possible that Proposer may detect inconsistencies or potential errors. While Proposer should identify these potential issues in its questions or in an appendix to its Proposal, Proposer should use the information provided on an "as-is" basis for its initial Proposal. Information regarding the City and the Initiative may be revised or updated, and republished for inclusion in a final response.

4.14 PROPOSAL PREPARATION COSTS

Proposer will be responsible for all costs it incurs in connection with this RFP process (including but not limited to Proposal preparation, personnel time, travel-related costs, and other expenses) and any subsequent agreement negotiations.

4.15 OWNERSHIP AND INTELLECTUAL PROPERTY

The City will own all of the data collected by and contained within the Solar PV System.

5. EVALUATION MODEL

5.1 QUALIFYING PROPOSALS

City will review each submitted Proposal to determine whether it is a Qualifying Proposal. A Qualifying Proposal is one that meets all of the criteria set forth below. All Proposals that ARE NOT a Qualifying Proposal will be disqualified from this RFP process. A Qualifying Proposal is a Proposal that:

- Was submitted (in the form and format required) by the due date as specified in Section 4.6.
- Conforms to the requirements of the RFP (e.g. includes the requisite number of copies, customer references, etc.).

5.2 EVALUATION OF QUALIFYING PROPOSALS

An evaluation team composed of representatives of the City will evaluate proposals on a variety of quantitative and qualitative criteria. Upon receipt of proposals, the City will review to determine whether the proposal is acceptable or non-acceptable based on the criteria outlined below.

The criteria, and their associated weights, upon which the evaluation of the proposals will be based on the following:

- a. Relevant project experience and references: Principal and Team (25 points)** Provide prior PV experience with systems of similar size; references are required. Clearly identify the principal-in-charge and include in that person's qualifications a description of expertise. Also clearly identify a project manager and their experience. Include the dedication of time (as a percentage of available weekly work hours) to be spent on the project by the principal-in-charge and the project manager, particularly as that time relates to interaction with the City. If subbing or partnering, identify partners and their qualifications. Cite projects of similar scope and size that have been successfully completed, and that have involved team members identified in the submittal. Demonstrate success in coordinating similar PV projects from cradle to grave. Include the names of persons, their respective titles/roles, résumés/vitae, and dedication of time for any team member playing a significant role in the project; of particular interest are those that will lead the finance design, and installation portions of the project. Preferences will be given to firms that enlist NABCEP- certified individuals, particularly in the design and installation process.
- b. [In Section 6 of the Proposal] Ability to execute financial contracts (10 points)** Demonstrate success in executing financial contracts for renewable energy systems and meeting applicable performance or savings guarantees. Include evidence of good communication with all involved parties, a record of working successfully with property owners and regulatory agencies, use of creative problem solving, and the ability to manage staff and budgets to minimize the necessity for project change orders.
- c. Financial Stability (20 points)** Describe your organization's financial stability by providing the following:
 - Balance Sheet for the years of 2012, 2013, & 2014
 - Profit & Loss statement for the years of 2012, 2013, & 2014. State the amount of working capital you had on hand for the years of 2012, 2013, & 2014.
 - Show all necessary bonds are in place.
- d. Compliance with Technical Requirements / Technical approach and adaptability (25 points)** Demonstrate that there is a strong and consistent approach to execution of similar PV projects from start to finish, and that the team follows financial and industry best practices. Demonstrate that personnel can adapt to unknown circumstances and that they are capable of problem solving and making good decisions. Showcase knowledge of financing arrangements, understanding of utility programs and requirements, as well as general solar PV systems. Describe any experience with solar and structural site assessments.
- e. Ability to deliver high quality reports and documentation (10 points)** Demonstrate that design documentation, finished product deliverables, and data collection and reporting are a consistently high quality, without errors, and that they are well coordinated with both applicable regulatory

agencies and the client. Demonstrate ability to communicate with the public and convey project progress in multiple settings.

f. Price (10 points) Demonstrate a competitive price for services rendered (See Price Form in Exhibits)

6. RFP TERMS AND CONDITIONS

The City of Memphis seeks proposals from firms who have the expertise to provide a solar photovoltaic installation in accordance with this RFP document. This is a Request for Proposal that may be modified by the City in the selection process.

THE CITY OF MEMPHIS ENCOURAGES THE PARTICIPATION OF SMALL, MINORITY AND WOMEN-OWNED BUSINESSES IN THE PURCHASING PROCESS.

The City of Memphis is an Equal Opportunity Employer and does not discriminate on the basis of race, color, national origin, sex, religion, age, or handicap status in employment or in the provision of services.

This procurement may be subject to the requirements of Ordinance No. 5114 which establishes a local preference for local businesses located within the City of Memphis. A copy of your current Memphis and Shelby County Tennessee Business Tax Receipt must accompany the proposal for consideration of this ordinance.

Any protest of award must be filed in writing with the Purchasing Agent within five (5) calendar days of the intent to award announcement at the following address: City of Memphis Purchasing Agent; 125 North Main, Room 354; Memphis, Tennessee 38103. Notice will be posted on the City's website and outside Council Chambers, located on the lobby floor of City Hall. The intent to award notification shall be deemed publicly announced on the date specified on the notice.

Only proposals submitted on the provided form(s) with no changes, additions or deletions to the terms and conditions will be considered. Proposals containing terms and conditions other than those contained herein may be considered nonconforming.

No objections with regard to the application, meaning, or interpretation of the specifications will be considered after the opening of the subject proposals. If there are questions or concerns regarding any part of plans, terms, specifications or other proposed documents, a written request for interpretation thereof may be submitted to the City Purchasing Agent prior to the deadline date. The organization submitting the request shall be responsible for the prompt delivery of the request. Any interpretation in response to the written request will be made only by addendum duly issued, and a copy of such addendum will be mailed or delivered to each organization receiving a set of such documents and/or posted on the City's website. The City of Memphis will not be responsible for any other explanation or interpretation of the proposed documents. By submission of its proposal, a proposer shall be deemed to have understood fully the contents and meaning of the RFP.

All proposals must be signed by an authorized representative of your organization. Unsigned proposals will be considered nonconforming.

Any contract resulting from the proposals received in response to this solicitation shall be construed in accordance with and governed by the laws of the State of Tennessee. All actions, whether sounding in contract or in tort, relating to the validity, construction, interpretation and enforcement of this Agreement shall be instituted and litigated in the courts of the State of Tennessee, located in Shelby County, Tennessee without regard to conflicts of laws principles.

By order of the Mayor of the City of Memphis, Tennessee.

A C WHARTON, JR., MAYOR

Eric Mayse, City Purchasing Agent

Published in The Daily News on _____ 2 Copies

INSTRUCTIONS TO PROPOSERS

Proposers shall submit their signed proposal in a sealed envelope INDICATING ON THE OUTSIDE: THE COMPANY NAME and THE REQUEST FOR PROPOSAL NUMBER.

Proposers must comply with all applicable licensing requirements. Pursuant to the City of Memphis Charter, Article 71, Section 777 et seq., it is unlawful to operate a business within the limits of the city of Memphis without possessing a Memphis and Shelby County business license, excepting non-profit organizations that qualify as tax exempt under Sec. 501(c)(3) of the Internal Revenue Code. Upon award notification and prior to the City issuing a properly executed purchase order or entering into a contract with the proposer, the successful proposer, whose principal business address is located within the limits of the city of Memphis, will be required to submit, along with the required insurance and other required documentation, a copy of (1) the tax-exempt ruling or determination letter from the Internal Revenue Services; or (2) its current Memphis and Shelby County Business Tax Receipt/License.

Issuance of this RFP does not obligate the City to contract, in whole or in part, for services specified herein. The City of Memphis reserves the right to cancel this solicitation, in whole or in part, or to reject, in whole or in part, any and all proposals. Cancellation of this RFP or any subsequent award will be posted on the City's website: www.memphistn.gov under the section titled "Government News."

Any firm receiving a mailed solicitation on the above subject and not bidding will be electronically removed from the City's mailing list used for the above-referenced subject after 3 consecutive non-responses or no bids.

For additional information concerning this solicitation, please contact: Eric Mayse via e-mail at Eric.Mayse@memphistn.gov. Subject line must read "Questions – Solar Photovoltaic Installation."

This solicitation shall be in accordance with the City of Memphis Ordinances and Purchasing Policies and Procedures, which may be amended from time to time.

All materials submitted pursuant to this RFP shall become the property of the City of Memphis.

To the extent permitted by law, all proposals submitted in response to this RFP shall be kept confidential until the proposals have been evaluated and the intent to award is announced. Until the intent to award is announced, no information regarding any proposal will be released to anyone, except members of the Evaluation Committee who are responsible for evaluating the proposals and other appropriate City staff. All information provided by the Proposer in response to this RFP will be considered by the Evaluation Committee in evaluating the proposal and making an award recommendation to the City.

The Mayor of the City of Memphis is the only individual who can legally sign contracts on behalf of the City. Costs chargeable to the proposed contract shall not be incurred before receipt of a fully executed contract.

EXHIBIT 2 – PRICE FORM

The total turnkey price for this work is \$ _____

The undersigned PROPOSER proposes and agrees, if this Proposal is accepted, to enter into an Agreement with CITY to complete all Work as specified or indicated in Contract Documents for Contract Price and within Contract Time indicated in this Proposal and in accordance with Contract Documents.

In submitting this Proposal, PROPOSER represents, as more fully set forth in Agreement, that:

PROPOSER has examined copies of all Contract Documents and of the following addenda (receipt of all of which is hereby acknowledged):

Addenda # _____ Date _____ Signature _____

Addenda # _____ Date _____ Signature _____

Addenda # _____ Date _____ Signature _____

PROPOSER has examined site and locality where Work is to be performed, legal requirements (federal, state and local laws, ordinances, rules and regulations) and conditions affecting cost, progress or performance of Work and has made such independent investigations as PROPOSER deems necessary.

This Proposal is genuine and not made in interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; PROPOSER has not directly induced or solicited any other Proposer to submit false or sham Proposal; PROPOSER has not solicited or induced any person, firm or corporation to refrain from proposing; and PROPOSER has not sought by collusion to obtain for itself any advantage over any other Proposer or over CITY; and

CITY reserves right to delete any section of Work.

Communications concerning this Proposal shall be addressed to: (PROPOSER to provide Proposer's name, address, telephone number and name of individual familiar with this Proposal and able and authorized to answer questions regarding this Proposal.)

Non-collusion affidavit

The Proposer, by its officers and its agents or representatives present at the time of filing this Proposal, being duly sworn on their oaths say, that neither they nor any of them have in any way, directly or indirectly, entered into any arrangement or agreement with any other Proposer, or with any officer of the Owner or Owner's representative whereby such affiant or affiants or either of them has paid or is to pay such other Proposer or officer any sum of money, or has given or is to give to such other Proposer or officer anything of value whatever, or such affiant or affiants or either of them has not directly or indirectly, entered into any arrangement or agreement with any other free competition into the letting of the contract sought for by the attached prices that no inducement of any form or character other than that which appears on the face of the Proposal will be suggested, offered, paid or delivered to any person whomsoever to influence the acceptance of the Proposal or awarding of the Contract, nor has this Proposer any agreement or understanding of any kind whatsoever, with any person whomsoever to pay, deliver to, or share with any other person in any way or manner, any of the proceeds of the Contractor sought by this Proposal.

Submitted By:

Firm Name _____

Authorized Signature _____

Date _____

SIGNATURES

If PROPOSER is:

A. An Individual

By

(SEAL)

(Individual's Name)

Doing business as

Business Address:

Phone Number: _____

B. A Partnership

By

(SEAL) (Firm Name)

(General Partner)

Business Address:

Phone Number: _____

C. A Corporation

By

(SEAL) (Corporation Name)

(State of Incorporation)

By

(Name of Person Authorized to Sign)

Title

Attest

(Secretary)

Business Address:

Phone Number: _____

D. A Joint Venture

By

(Name)

Business Address:

By

(Name)

Business Address:

Each joint venture member must sign. The manner of signing for each individual partnership and corporation that is party to joint venture should be in manner indicated above.

EXHIBIT 3 – SITE PHOTOGRAPHS



Current Conditions (Visitor Center)

Please note: Proposer may recommend a more optimal building for installation other than Visitor Center meeting conditions set forth in Section 2.

Proposed Installation (Visitor Center)



Map of Lichterman Nature Center Campus

EXHIBIT 4 – UTILITY BILL

Meter Name	Meter Type	Start Date	End Date	Usage/Quantity	Usage Units	Cost (\$)
65252	Electric - Grid	11/1/2013	11/30/2013	30300	kWh (thousand Watt-hours)	2874.18
65252	Electric - Grid	12/1/2013	12/31/2013	28650	kWh (thousand Watt-hours)	2689.86
65252	Electric - Grid	1/1/2014	1/31/2014	23700	kWh (thousand Watt-hours)	2372.84
65252	Electric - Grid	2/1/2014	2/28/2014	23100	kWh (thousand Watt-hours)	2460.89
65252	Electric - Grid	3/1/2014	3/31/2014	30900	kWh (thousand Watt-hours)	3244.84
65252	Electric - Grid	4/1/2014	4/30/2014	36000	kWh (thousand Watt-hours)	3368.93
65252	Electric - Grid	5/1/2014	5/31/2014	38850	kWh (thousand Watt-hours)	4017.15
65252	Electric - Grid	6/1/2014	6/30/2014	34800	kWh (thousand Watt-hours)	3495.7
65252	Electric - Grid	7/1/2014	7/31/2014	33000	kWh (thousand Watt-hours)	3440.3
65252	Electric - Grid	8/1/2014	8/31/2014	37050	kWh (thousand Watt-hours)	3465.67
65252	Electric - Grid	9/1/2014	9/30/2014	29100	kWh (thousand Watt-hours)	2811.46
65252	Electric - Grid	10/1/2014	10/31/2014	43500	kWh (thousand Watt-hours)	3822.1
65252	Electric - Grid	11/1/2014	11/30/2014	28350	kWh (thousand Watt-hours)	2329
394765	Natural Gas	11/1/2013	11/30/2013	1799.16	ccf (hundred cubic feet)	1102.13
394765	Natural Gas	12/1/2013	12/31/2013	2036.76	ccf (hundred cubic feet)	1511.48
394765	Natural Gas	1/1/2014	1/31/2014	2232.12	ccf (hundred cubic feet)	1758.47
394765	Natural Gas	2/1/2014	2/28/2014	955.68	ccf (hundred cubic feet)	859.77
394765	Natural Gas	3/1/2014	3/31/2014	548	ccf (hundred cubic feet)	413.29
394765	Natural Gas	4/1/2014	4/30/2014	91	ccf (hundred cubic feet)	295.36
394765	Natural Gas	5/1/2014	5/31/2014	34.32	ccf (hundred cubic feet)	126.01
394765	Natural Gas	6/1/2014	6/30/2014	42.24	ccf (hundred cubic feet)	133.2
394765	Natural Gas	7/1/2014	7/31/2014	35.64	ccf (hundred cubic feet)	119.99
394765	Natural Gas	8/1/2014	8/31/2014	51.48	ccf (hundred cubic feet)	131.2
394765	Natural Gas	9/1/2014	9/30/2014	73.92	ccf (hundred cubic feet)	149.97
394765	Natural Gas	10/1/2014	10/31/2014	528	ccf (hundred cubic feet)	431.59
394765	Natural Gas	11/1/2014	11/30/2014	1438.8	ccf (hundred cubic feet)	872.63

**EXHIBIT 5 – CITY OF MEMPHIS SERVICE AGREEMENT GENERAL TERMS AND CONDITIONS
(PROCUREMENT ATTACHMENT)**

The successful Contractor will be required to comply with and execute an agreement specifying the following general terms and conditions, as may be modified and/or supplemented at the City's sole discretion:

REPORTS. Upon request, the Contractor shall prepare and submit reports of its activities, funded under this agreement, to the originating department of the City. The reports shall include an itemization of the use of the City's funds, inclusive of specific services delivered by the Contractor. Any such reports provided to the City shall be prepared with the understanding that the City may make such reports available to the public.

In addition, Contractor shall submit and, as necessary, update subcontractor information (including but not limited to payments thereto), for **any and all subcontractors** used on City project(s), in the City's compliance tracking software, B2GNow. The City shall have the right to withhold future disbursement of funds under this Agreement and any future Agreements until the requirements of this provision have been met.

ENTIRE AGREEMENT. This Agreement constitutes the full and final understanding of the parties with respect to the subject matter hereof and supersedes and replaces any and all prior or contemporaneous agreements or understandings, whether written or oral, express or implied, between the parties with respect to the subject matter of the Agreement.

STANDARD OF PERFORMANCE. All services by the Contractor shall be performed in compliance with the specified requirements, in a manner satisfactory to the City, and in accordance with the generally accepted business practices and procedures of the City and pursuant to the governing rules, practices and regulations of the industry, based on the type of services performed hereunder.

HEADINGS. Titles and headings used herein are for the convenience of reference only and shall be disregarded completely in the interpretation and validity of this Agreement or any of its terms.

MODIFICATION AND AMENDMENT. This Agreement shall be amended or modified only by a written document signed by the parties hereto, in accordance with applicable laws and regulations.

CONFIDENTIALITY. While performing work under this Agreement, the Contractor may gain access to proprietary and/or confidential information that, if disclosed to third parties, may be damaging to the City or its officials or employees. Such information shall include materials considered to be confidential information as a matter of law (e.g., personnel records), and shall also include (i) all materials in any form developed or created by the City related to funding and financial and business information; (ii) all information owned, possessed or used by the Contractor, which is communicated to, learned, developed or otherwise acquired by the Contractor in the performance of the Services for the City; (iii) the terms, conditions and pricing contained herein; and (iv) any other information that the Contractor has been advised by the City is confidential, privileged or proprietary. Confidential information, as used

in this Agreement, shall not include (i) information in the Contractor's possession prior to disclosure by the City; (ii) information generally available to the public or that becomes available to the public through a source other than the City, or (iii) information that was rightfully obtained by the Contractor from a third party who is under no obligation of confidentiality to the City with respect to such information. The Contractor agrees that it will accept and hold confidential information obtained from the City in confidence at all times during and after termination of this Agreement. The Contractor shall neither use nor disclose such information, except as provided in this Agreement or as required by law, without the prior written permission of the City.

The Contractor acknowledges and agrees that a breach of this section by the Contractor will cause the City irreparable injury and damage; therefore, the Contractor expressly agrees that the City shall be entitled to injunctive or other equitable relief in any court of competent jurisdiction to prevent or otherwise restrain a breach of this Agreement. The Contractor agrees that it will disclose confidential information only to those employees who have a right to know, and shall require its employees, agents, and subcontractors to comply with the requirements of this provision and the requirements of the provisions herein titled "Public Statements" and "Rights in Data."

PUBLIC STATEMENTS. The Contractor shall not make any announcement, release any information, or authorize or participate in any interview concerning this Agreement and goods and/or services required herein, without obtaining prior written consent from the City. The Contractor shall require its employees, agents, and subcontractors to comply with the requirements of this provision. This provision shall survive the expiration or termination of this Agreement.

RIGHTS IN DATA. The Contractor agrees that all reports, studies, plans, models, drawings, specifications, and any other information or data of any type produced under this Agreement, whether or not the same is accepted or rejected by the City, shall remain the property of the City and shall not be published by the Contractor or any other party without the express prior written consent of the City. In implementing the foregoing, the Contractor hereby grants and assigns to the City all rights and claims of whatever nature, whether now or hereafter, arising in and to any and all of such reports, studies, plans, models, drawings, specifications, and other information or data and shall cooperate fully with the City in any steps the City may take to obtain copyrights, trademark or like protections with respect thereto. The signing of this Agreement shall constitute a complete transfer of ownership, intellectual property and copyright of all documents from the Contractor to the City upon the Contractor's delivery of such documents and/or information to the City or upon completion of the Project, whichever occurs first. The Contractor shall not construe such transfer as a grant for usage nor can the Contractor revoke it.

EMPLOYMENT OF CITY WORKERS. The Contractor shall not engage, on a full, part-time or any other basis during the term of this Agreement, any professional or technical personnel who are or have been at any time during the term of this Agreement in the employ of the City.

CONTRACTOR'S PERSONNEL. The Contractor certifies that it presently has adequate qualified personnel to perform all services required under this Agreement and that all work performed under this Agreement shall be supervised by the Contractor. Contractor will make its personnel aware of and cause

them to comply with the City's policies that have been made known to Contractor while performing pursuant to this Agreement. The Contractor further certifies that all of its employees assigned to perform any work hereunder shall have such knowledge and experience as required to perform the duties assigned to them. Any employee of the Contractor who, in the opinion of the City, is incompetent, whose conduct becomes detrimental to the work, or whom the City deems to be unsatisfactory for any reason, shall immediately be removed from association with the services hereunder per the City's request. Upon such request, the Contractor shall use all reasonable efforts to promptly replace such employee(s) with substitute employee(s) having appropriate skills and training. Contractor is responsible for the acts or omissions of its personnel under or relating to this Agreement.

The Contractor shall be solely liable and responsible for providing to, or on behalf of, all persons performing work pursuant to this Agreement, all employee compensation and benefits. The City shall have no liability or responsibility for the payment of any salaries, wages, unemployment benefits, health, welfare and disability benefits, Federal and local taxes, or other compensation, benefits or taxes for any personnel provided on behalf of the Contractor. In addition, the Contractor shall be solely liable and responsible for any and all workers' compensation benefits to any person as a result of injuries arising from or connected with any work performed by or on behalf of the Contractor pursuant to this Agreement.

INDEPENDENT CONTRACTORS. Nothing in this Agreement shall be deemed or construed to represent that the Contractor, or any of the Contractor's employees or agents, are the agents, representatives, or employees of the City. The Contractor acknowledges that it is an independent contractor over the details and means for performing the services hereunder. Anything in this Agreement which may appear to give the City the right to direct the Contractor as to the details of the performance of its obligations hereunder or to exercise a measure of control over the Contractor is solely for purposes of compliance with local, state and federal regulations and means the Contractor will follow the desires of the City only as to the intended results of the scope of this Agreement.

It is further expressly agreed and understood by the Contractor that neither it nor its employees or agents shall hold itself out contrary to the terms of this paragraph, and the City shall not be liable for any representation, act or omission of the Contractor contrary to the provisions hereof..

TERMINATION

1. It shall be cause for the immediate termination of this Agreement if, after its execution, the City determines that either:
 - a. the Contractor or any of its principals, partners or corporate officers, if a corporation, including the corporation itself, has plead nolo contendere, or has plead or been found guilty of a criminal violation, whether state or federal, involving, but not limited to, governmental sales or purchases, including but not limited to the rigging of bids, price fixing, misappropriation of government funds, or any other collusive and illegal activity pertaining to bidding and governmental contracting; or

b. the Contractor subcontracted, assigned, delegated, or transferred its rights, obligations or interests, voluntarily or involuntarily, under this Agreement without the City's consent or approval; or

c. the Contractor has filed bankruptcy, has been adjudicated bankrupt, become insolvent or made an assignment for the benefit of creditors, or a receiver, or similar officer is appointed to take charge of all or part of the Contractor's assets.

2. The City may cancel/terminate this Agreement, in whole or in part, upon providing written notice to the Contractor of the City's intention to terminate the Agreement as a result of Contractor's failure to provide the goods/services specified under this Agreement or in violation(s) of any of the terms herein, and the Contractor has failed to cure such breach within (TBD) business days of such notice. The City may reject the goods/services and cancel this Agreement for any goods/services rendered or to be rendered hereunder. At its option, the City may return the rejected portion of such products to Contractor at its expense or hold the same for such disposal as Contractor shall indicate. In the event of any such rejection/termination, the City shall, at the City's option, have the right to obtain like goods/services elsewhere or to take over the work and prosecute the same to completion, both at the Contractor's expense; and in such event, the City may take possession of and utilize in completing the work, such materials, appliances, etc. as may be on the site of the work and necessary therefore. The Contractor shall be liable to the City for any loss, damage, or additional cost incurred thereby, including but not limited to any difference between the cost for procuring such like services and the price specified herein, attorneys' fees and court costs.

3. Notwithstanding the foregoing or any section herein to the contrary, the Contractor shall not be relieved of liability to the City for damages sustained by the City by virtue of any breach of the Agreement by the Contractor, and the City may withhold any payments to the Contractor, for the purpose of setoff, until such time as the exact amount of damages due the City from the Contractor is determined.

4. The City may, in its sole discretion, suspend and/or terminate this Agreement for convenience upon giving (TBD) business days prior written notice to the Contractor. In the event a purported termination for cause by the City is in error, then such termination may, at the City's sole discretion, be deemed to be a termination for convenience under this section. In the event of such termination, the Contractor shall be entitled to receive just and equitable compensation, as determined by the City, for any goods accepted and/or satisfactory authorized work performed in accordance with the Agreement up to the termination date; but in no event shall the City be liable to the Contractor for expenses incurred after the termination date. All goods accepted by the City/services completed by the Contractor prior to the Termination Date shall be documented and all tangible work documents shall be transferred to the City prior to payment for services rendered, and shall become the sole property of the City. Such termination by the City shall not be deemed a Breach of Contract by the City, and the Contractor shall not be compensated for any anticipatory profits, or other damages of any description, that have not been earned as of the date of termination.

5. The Contractor shall deliver to the City all hard copy and electronic files maintained on behalf of the City within thirty (30) calendar days of termination of this Agreement. Upon reasonable request, the City reserves the right to obtain such information prior to the termination of this Agreement.

COMPENSATION FOR CORRECTIONS. No compensation shall be due or payable to the Contractor pursuant to this Agreement for any of the services performed by the Contractor to correct services, when such corrections are required as a direct result of negligence by the Contractor to properly fulfill any of its obligations herein.

CITY'S RIGHT TO WITHHOLD CERTAIN AMOUNTS AND MAKE APPLICATION THEREOF. If evidence is produced before the final settlement of all or any balances that the Contractor has failed to pay laborers employed on his work or failed to pay for materials used therein, or if the City has reason to suspect the same, the City may withhold such balances and upon evidence satisfactory to the City as to the amount due for such labor and materials, the City, acting as the agent of the Contractor, may settle and pay for the same and charge the amounts to the Contractor and deduct the same from the said balance or balances.

REMEDIES CUMULATIVE. All remedies available to the City herein are cumulative and shall be in addition to all other rights and remedies provided by law. The termination, expiration, or suspension of this Agreement shall not limit the City from pursuing other remedies available at law or in equity.

SUBCONTRACTING, ASSIGNMENT or TRANSFER. The Contractor shall not subcontract, assign, delegate or transfer all or part of its rights, responsibilities, or interest under this Agreement without the prior written consent of the City. Any purported assignment, transfer, or delegation in violation of this Section shall be voidable by the City. No subcontracting, assignment, delegation or transfer shall relieve the Contractor from performance of its duties hereunder; neither shall the City be responsible for the fulfillment of the Contractor's obligations to its transferors or subcontractors. Upon request of the City, the subcontracting, assigning, delegating or transferring party shall provide all documents evidencing the transfer. At any time, City may, in its sole discretion, revoke its prior approval of a subcontractor and direct Contractor to replace such subcontractor or perform the services that were being performed by such contractor itself if the City finds in its reasonable judgment that (i) such subcontractor's performance is materially deficient or otherwise unacceptable to City; (ii) good faith doubts exist concerning the subcontractor's ability to render future performance because of changes in the subcontractor's ownership, management, financial condition, or otherwise; or (iii) there have been one (1) or more material misrepresentations by or concerning the subcontractor. The City reserves the right to terminate the Agreement if Contractor, in whole or in part, is acquired by another entity during the term of this Agreement.

In the event the Contractor is allowed to sublet any part of the Agreement, the Contractor shall be as fully responsible to the City for the acts and omissions of the subcontractor and of the persons employed or directly or indirectly employed by the subcontractor as he is for the acts and omissions of

persons employed by Contractor. The Contractor shall not be allowed to subcontract more than (TBD)% of the work on this project. The computation for percentages shall be based on monetary values.

CONFLICT OF INTEREST. Neither party shall engage in any conduct or activity in the performance of this Agreement that constitutes a conflict of interest under applicable federal, state or local laws, rules and regulations.

The Contractor covenants that it has no public or private interest, and shall not acquire, any interest, directly or indirectly, which would conflict in any manner with the performance required under this Agreement, and the Contractor covenants that no gratuities, in the form of entertainment, gifts, or otherwise, were offered or given by the Contractor or any agent or representative of the Contractor, to any officer, official, agent or employee of the City, in an effort to secure the Agreement or favorable treatment with respect to any determinations concerning the performance of the Agreement. The Contractor warrants that no part of the total contract amount provided herein shall be paid directly or indirectly to any officer or employee of the City as wages, compensation, or gifts in exchange for acting as officer, agent, employee, subcontractor or consultant to the Contractor in connection with any work contemplated or performed relative to this Agreement. For breach or violation of this provision, the City shall have the right to recover or withhold the full amount of such gratuities.

COVENANT AGAINST CONTINGENT FEES. The Contractor warrants that it has not employed or retained any company or person other than a bona fide employee working solely for the Contractor, to solicit or secure this Agreement, and that it has not paid or agreed to pay any company or person, other than a bona fide employee working solely for the Contractor any fee, commission, percentage, brokerage fee, gift, or any other consideration contingent upon or resulting from the award or making of this Agreement. For breach or violation of this provision, the City shall have the right to recover the full amount of such fee, commission, percentage, brokerage fee, gift, or other consideration.

GENERAL COMPLIANCE WITH LAWS. The Contractor certifies that it is qualified or will take steps necessary to qualify to do business in the State of Tennessee and that it shall take such action as, from time to time, may be necessary to remain so qualified and shall obtain and maintain, at its own expense, all licenses, permits, insurance, and governmental approvals, if any, necessary to the performance of its obligations under this Agreement. Such permits and licenses shall be made available to the City, upon request.

The Contractor is assumed to be familiar with and shall comply with all applicable federal, state, and local laws, ordinances, and regulations in performing any of its obligations under this Agreement, including but not limited to the City of Memphis Living Wage Ordinance, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA), and the Americans with Disabilities Act (ADA). The Contractor shall promptly notify the City of any conflict discovered between this Agreement and any applicable laws, rules, regulations, and/or permits and licenses, and await resolution of the conflict.

NON-DISCRIMINATION. The Contractor hereby agrees to comply with Title VI and Title VII of the Civil Rights Act of 1964 and all other federal, state or local laws prohibiting discrimination, which provide in

whole or in part, that no person shall be excluded from participation in, or be denied benefits of, or be otherwise subjected to discrimination in the performance of this Agreement or in the Contractor's employment practices on the grounds of handicap and/or disability, age, race, color, religion, sex, national origin, or any other classification protected by Federal, State or statutory law. The Contractor shall, upon request, show proof of such nondiscrimination, and shall post in conspicuous places available to all employees and applicants notices of nondiscrimination. In the event the Contractor fails to comply with the City's non-discrimination policy and any and all other laws prohibiting discrimination, this Agreement may be canceled, terminated or suspended in whole or in part by the City.

The City reserves the right to investigate any claims of illegal discrimination by the Contractor and in the event a finding of discrimination is made and upon written notification thereof, the Contractor shall take all necessary steps to cure and rectify such action to the reasonable satisfaction of the City. The Contractor's failure or refusal to do so shall be cause for termination of this Agreement in accordance with the terms of this Agreement.

EMPLOYMENT OF ILLEGAL IMMIGRANTS. The Contractor hereby certifies to comply with all applicable federal and state laws prohibiting the employment of individuals not legally authorized to work in the United States. Contractor shall not knowingly (i) utilize the services of illegal immigrants; or (ii) utilize the services of any subcontractor who will utilize the services of illegal immigrants in the performance of the contract. In the event the Contractor fails to comply with any and all local, state and federal laws prohibiting the employment of individuals not legally authorized to work in the United States, this agreement may be canceled, terminated or suspended in whole or in part by the City, and the Contractor may be prohibited from contracting to supply goods and/or services to the City for a period of one (1) year from the date of discovery of the usage of illegal immigrant services in the performance of a contract with the City.

SEVERABILITY. If any terms or provisions of this Agreement are held to be illegal, invalid or unenforceable as a matter of law, such provision shall be fully severable, and the remaining provisions of this Agreement shall remain in full force and effect and continue to be binding and shall not be affected by such provision or by its severance herefrom. Furthermore, in lieu of such unlawful, invalid, or unenforceable provision, the parties may negotiate in good faith to replace such provision with a valid, legal and enforceable provision that most closely approximates the parties' original intent.

NO WAIVER OF CONTRACTUAL RIGHT. No term or provision of this Agreement, or of any document executed pursuant hereto, shall be held to be waived, modified or deleted unless in writing and executed by the parties hereto and specifically identified as a waiver of any succeeding breach thereto or of any other provision herein contained. No delay or failure of the City to enforce any right or provision of this Agreement or in any document executed pursuant hereto shall operate as a waiver or relinquishment of the City's right to subsequently enforce and compel strict compliance with such provision or any other provision herein or in any document related hereto.

SUBJECT TO FUNDING. This Agreement is subject to availability and annual appropriation of funds by the Memphis City Council. In the event sufficient funds for this Agreement are not available or

appropriated by the Memphis City Council for any of its fiscal period during the term hereof, then the City shall immediately terminate this Agreement upon written notice to the Contractor. In the event of such termination, the Contractor shall be entitled to receive just and equitable compensation for any satisfactory work performed up to the termination date. Such termination by the City shall not be deemed a Breach of Contract by the City, and the Contractor shall have no right to any actual, general, specific, incidental, consequential, or any other damages whatsoever of any description or amount that have not been earned as of the date of termination.

CONTRACTING WITH SMALL AND MINORITY FIRMS AND WOMEN'S BUSINESS ENTERPRISE. The Contractor shall take affirmative action to ensure that small, minority-owned and women-owned businesses, which have been certified by the City, are utilized when possible as sources of supplies, equipment, construction and services.

PUBLIC RECORDS. Notwithstanding anything to the contrary contained herein or within any other document supplied to the City by the Contractor, the Contractor understands and acknowledges that the City is a governmental entity subject to the State of Tennessee Public Records Act, and any reports, data or other information supplied to the City regarding services performed hereunder may be subject to disclosure as a public record in accordance with the laws of the State of Tennessee.

ORGANIZATION STATUS AND AUTHORITY. The Contractor represents and warrants that it is a corporation, limited liability company, partnership, or other entity duly organized, validly existing and in good standing under the laws of the state of Tennessee; it has the power and authority to own its properties and assets and is duly qualified to carry on its business in every jurisdiction wherein such qualification is necessary.

The execution, delivery and performance of this Agreement by the Contractor has been duly authorized by all requisite action and will not violate any provision of law, any order of any court or other agency of government, the organizational documents of the Contractor, any provision of any indenture, agreement or other instrument to which the Contractor is a party, or by which the Contractor's respective properties or assets are bound, in conflict with, result in a breach of, or constitute (with due notice or lapse of time or both) a default under any such indenture, agreement or other instrument, or result in the creation or imposition of any lien, charge or encumbrance of any nature whatsoever upon any of the properties or assets.

Each person executing this Agreement represents that: he/she is lawfully authorized to sign the Agreement on behalf of the party he/she represents and execution of the Agreement was duly and regularly authorized by the party's governing body.

WARRANTY. The Contractor warrants to the City that all goods/work shall be free from defects in design and faulty or improper workmanship and shall be in strict compliance with the terms of this Agreement. This warranty shall be effective for a period of not less than one year from the date of acceptance by the City of such goods and/or services as satisfactorily complete, and shall be in addition to all other

warranties, express, implied or statutory. The warranty shall survive the termination or expiration of this Agreement.

RECORDS AND AUDITS. The Contractor shall make and keep as the same accrue, full and complete books, documents, accounting records and other evidence, that specifically relate to this Agreement, in accordance with generally accepted accounting principles. The Contractor shall retain such records, and shall make same available to the City, upon reasonable request, during the term of this Agreement, and for a minimum period of three (3) full years after completion of the contract obligations or from the date of final payment under this Agreement, whichever is later. In the event any litigation, claim or audit is instituted prior to the expiration of the required three-year retention period, such records shall be retained until such litigation, claim or audit finding has been resolved. Copies of said records shall be furnished to the City upon request.

Upon reasonable notice, the Contractor shall permit the City, any other governmental entity, any agency participating in the funding of this Agreement, or any of their duly authorized representatives, to enter the Contractor's offices, during regular business hours, to interview employees and to inspect and/or copy said records and books of accounts together with any and all documents pertaining hereto that may be kept, maintained or possessed by the Contractor. Reviews may also be accomplished at meetings that are arranged at mutually agreeable times and places.

DISPUTE RESOLUTION. In the event of any dispute(s), controversy, or claim arising out of or relating to this Agreement or the breach thereof, the parties agree that they shall first use their best efforts in an attempt to settle the dispute through negotiations involving themselves or their representatives as they each deem appropriate.

Any dispute concerning a question of fact in connection with this Agreement between the Contractor and the City shall be referred in successive order for resolution, first to the City Purchasing Agent, second to the City Attorney, and thirdly, to the Mayor of the City of Memphis, whose decision regarding same shall be final.

FORCE MAJEURE. The City shall not be deemed in default hereunder, nor shall the City be responsible for any delay, interruption, or cessation in the performance of its obligations under this Agreement where such failure of performance is the result of any force majeure event, including, but not limited to, acts of God, riots, wars, strikes, epidemics, acts, governmental authorities or acts of nature or other similar cause beyond its control.

SUCCESSORS AND ASSIGNS. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective heirs, legal representatives, successors and assigns.

NOTICES. All notices and other communications required or permitted to be given hereunder shall be written and hand delivered with signed receipt; delivered by facsimile; delivered by a nationally recognized overnight courier; or mailed via certified U.S. mail, postage prepaid and return receipt requested. All notices shall be deemed received and effectively given as follows: (i) if by hand delivery, on the date of delivery; (ii) if by fax, on the day the fax transmission is received at the receiving location

and receipt is telephonically confirmed by the sender; (iii) if by delivery via U.S. mail, on the date of receipt appearing on a return receipt card; or (iv) if by overnight courier, on the date receipt is confirmed by such courier service. All notices must be addressed to the respective party at the following addresses or to such other person or address as either party may designate in writing and deliver as provided herein.

NO THIRD PARTY BENEFICIARY. This Agreement is entered into solely between, and may be enforced only by, City and Contractor. Unless otherwise specified herein, this Agreement shall not be deemed to create any rights in third parties, including suppliers or customers of either party.

SERVICE MARKS. The Contractor agrees that it shall not, without City's prior written consent, use the name, service mark or trademarks of the City.

NUMBER AND GENDER. Unless the context requires otherwise, (i) use of a specific gender imports the other gender(s); and (ii) use of the singular imports the plural and vice versa.

SURVIVAL. The parties hereto acknowledge that provisions that require or contemplate performance or observance after expiration or termination of this Agreement shall survive the expiration or termination of this Agreement and continue in full force and effect.

CITY LIABILITY. The City shall have no liability except as specifically provided in this Agreement. The City, by execution of this Agreement, assumes no liability for damages caused to persons or property by reason of Contractor providing services herein or for injury to any employee, agent or subcontractor of the Contractor performing under this Agreement.

INDEMNIFICATION. Contractor shall indemnify, defend, save and hold harmless the City and its officers, agents and employees from and against any and all claims, demands, suits, actions, penalties, damages, settlements, costs, expenses, or other liabilities of any kind and character, including without limitation attorney fees and litigation expenses, arising out of or in connection with the breach of this Agreement by Contractor, its employees, subcontractors, or agents, or any negligent acts or omission of Contractor, its employees, subcontractors, or agents, which occurs pursuant to the performance of this Agreement, excepting those losses or damages directly caused solely by the acts, errors, or omissions of the City or any of its officers, agents or employees. This indemnification shall survive the expiration or termination of this Agreement.

The Contractor expressly understands and agrees that any insurance protection required by this Agreement or otherwise provided by the Contractor shall in no way limit the Contractor's responsibility to indemnify, defend, save and hold harmless the City or its elected or appointed officials, officers, employees, agents, assigns, and instrumentalities as herein required.

The City reserves the right to appoint its own counsel regarding any matter defended hereunder. The Contractor acknowledges that the City has no obligation to provide legal counsel or defense to the Contractor, its employees or subcontractors in the event that a suit, claim or action of any character is brought by any person not a party to this agreement against the Contractor as a result of or relating to

obligations under this agreement. The City shall have no obligation for the payment of any judgments or the settlement of any claims asserted against the Contractor or its subcontractors or employees as a result of or relating to the Contractor's obligations hereunder.

The Contractor shall immediately notify the City c/o City Attorney; 125 North Main, Suite 336; Memphis, TN 38103, of any claim or suit made or filed against the Contractor or its subcontractors regarding any matter resulting from or relating to the Contractor's obligations under this Agreement and agrees to cooperate, assist and consult with the City in the defense or investigation thereof.

PATENT INDEMNIFICATION. The Contractor warrants that any goods/services furnished hereunder do not infringe or violate any United States or Canadian patent, trademark, copyright, trade secret, or any other proprietary right of any third party; that it shall defend all suits that may arise with respect thereto; and that it shall indemnify, defend, save and hold harmless the City, its officials, employees, agents, successors and assigns, from and against all liabilities, suits, claims, damages, costs or expenses, including without limitation attorney and expert witness fees, for or by reason of any actual or alleged claim the goods/services purchased by City hereunder infringe any patent, copyright, or is a violation of trade secret disclosure laws, whether by reason of the Contractor's purchase or otherwise. This indemnification shall survive the expiration or termination of this Agreement.

CITY LIABILITY. The City shall have no liability except as specifically provided in this Agreement. The City, by execution of this Agreement, assumes no liability for damages caused to persons or property by reason of Contractor providing services herein or for injury to any employee, agent or subcontractor of the Contractor performing under this Agreement.

GOVERNING LAW, JURISDICTION AND VENUE. The terms and conditions of this Agreement shall be construed in accordance with and governed by the laws of the State of Tennessee. All actions, whether sounding in contract or in tort, relating to the validity, construction, interpretation and enforcement of this Agreement shall be instituted and litigated in the state or federal courts of the State of Tennessee, located in Shelby County, Tennessee, without regard to conflicts of laws principles. In accordance herewith, the parties to this Agreement submit to the jurisdiction of the courts of the State of Tennessee located in Shelby County, Tennessee.

EXHIBIT 6 - FM GLOBAL PROPERTY LOSS PREVENTION DATA SHEETS

[Exhibit content on following pages]

ROOF MOUNTED SOLAR PHOTOVOLTAIC PANELS

Table of Contents

	Page
1.0 SCOPE	3
1.1 Changes	3
2.0 RECOMMENDATIONS	3
2.1 Construction and Location	3
2.1.1 Wind	3
2.1.2. Fire Exposure and Classification	5
2.1.3 Gravity Loads and Roof Drainage	5
2.1.4 Hail	6
2.1.5 Earthquake	6
2.2 Operation and Maintenance	6
2.3 Electrical	7
3.0 SUPPORT FOR RECOMMENDATIONS	9
3.1 Basic Operation of PV Systems	9
3.2 Wind Resistance	10
3.2.1 Boundary Layer Wind Tunnel (BLWT) Testing and Ballasted PV Systems	10
3.2.2 PV Systems Fastened to Standing Seam Roofs (SSR)	13
3.3 Fires and Electrical Ignition Sources	14
3.3.1 Ground Fault Protection	14
3.3.2 Preventing Fires from DC Ground Fault in PV Arrays	14
3.4 Exterior Fire Spread in Roof-Mounted PV Arrays	15
3.5 Gravity Loads and Roof Drainage	16
3.6 Hail Resistance	17
3.7 Flexible PV Installations	17
4.0 REFERENCES	17
4.1 FM Global	17
4.2 Other	17
4.3 Bibliography	18
APPENDIX A GLOSSARY OF TERMS	18
APPENDIX B DOCUMENT REVISION HISTORY	19

List of Figures

Fig. 1. Wind deflectors provided on the high sides of panels in each row (closed array)	4
Figs. 2A and 2B. Examples of mechanical anchors used to secure equipment to the roof deck or roof framing	5
Fig. 3. Residual current measurements with auxiliary trip (CB = combiner box, RCD = residual current disconnect, GFDI = ground fault detection and interruption)	7
Fig. 4. Electronic current sensing relay in ground circuit	8
Fig. 5. One-line example diagram of remote-operated DC disconnect for grounded PV system (the negative pole is grounded at the inverter in this example)	8
Fig. 6. One-line example diagram of remote-operated DC disconnect for ungrounded PV system	9
Fig. 7. Mechanically fastened roof cover billowing when subjected to wind pressure	11
Fig. 8. Solar panels with steeper slopes or lacking wind deflectors will experience greater wind effects	12
Fig. 9. Equipment lacking anchorage to roof framing	12
Fig. 10. Solar panels secured to standing seam roofs using external seam clamps	13
Fig. 11. Unacceptable arrangement: clamp missing from SSR rib below middle of outer panel edge	14

Fig. 12A. One-line example diagram to a PV system with ground faults 15
Fig. 12B. One-line example diagram to a PV system with ground faults 16
Fig. 12C. One-line example diagram to a PV system with ground faults 16

List of Tables

Table 1. Minimum Values of Insulation Resistance 6

1.0 SCOPE

This data sheet provides property loss prevention guidance related to fire and natural hazards for the design, installation, and maintenance of all roof mounted photovoltaic (PV) solar panels used to generate electrical power. This document does not address solar towers, roof-mounted solar-powered water heaters, or ground-mounted solar farms. For guidance on ground-mounted solar farms, see Data Sheet 7-106, *Ground-Mounted Photovoltaic Solar Power*.

1.1 Changes

October 2014. Interim revision. Added additional diagram (Fig. 12B, *One-line example diagram io a PV system with ground faults*).

2.0 RECOMMENDATIONS

Use FM Approved equipment, materials, and services whenever they are applicable and available. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1 Construction and Location

2.1.1 Wind

2.1.1.1 Design all roof-mounted, rigid PV solar panels and their securement for wind speeds and surface roughness exposures in accordance with DS 1-28, *Wind Design*. An importance factor of 1.0 may be used if acceptable by local codes. Use Exposure C in non-coastal areas, unless all conditions for Exposure B are met. Use the topographic factor (K_{zT}) as determined using ASCE 7, except for locations with relatively flat terrain ($<10^\circ$ ground slope), where K_{zT} can be assumed to be 1.0. Use a minimum safety factor (SF) of 2.0 for wind loads on panel anchors. A minimum safety factor of 1.6 may be used for other wind loads. Use rigid PV solar panels that are FM Approved in accordance with Approval Standard 4478, where available.

2.1.1.2 Design wind pressure resistance for ballasted or anchored roof-mounted PV panels using one of the following options:

A. Provide wind resistance based on prescriptive calculation methods provided in SEAOC PV2 (see Section 4.2).

B. Provide wind resistance based on boundary layer wind tunnel (BLWT) data per ASCE 49 (or equivalent international standard). SEAOC PV2 lists organizations that are qualified to conduct BLWT tests.

Have the design for each specific installation reviewed and accepted by a third party that is qualified in the interpretation and application of BLWT data. Computational fluid dynamics (CFD) modeling should not be used as the primary substantiation for the design of wind resistance. It should only be used to interpolate (not extrapolate) BLWT test data. The design should consider, among other things, whether the arrays are closed (wind deflectors, see Figure 1) or open.

2.1.1.3 Install rigid PV solar panels over metal standing seam roofs (SSR) using external seam clamps that are FM Approved and properly fit the specific standing seam rib type at each seam. Torque clamps and intermittently inspect for continued tightness in accordance with the manufacturer's instructions.

Installing clamps only at every other seam is not acceptable and does not follow the wind load path as designed by the SSR manufacturer. For new buildings, use SSRs that are FM Approved in accordance with Approval Standard 4471, as specified in *RoofNav*, and installed in accordance with Data Sheet 1-31, *Metal Roof Systems*. When installed over existing SSRs, the adequacy of the roof should first be determined to be adequate. Secure clamps as close as practical to the internal seam clips securing the standing seam roof panels to purlins. A less desirable alternative for rigid PV solar panels is to fasten them through the deck and directly into the purlins. However, this option is more prone to leakage and suitable sealing of the deck must be provided.

Ensure design wind loads are in accordance with the recommendations in Section 2.1.1.1 and 2.1.1.2.



Fig. 1. Wind deflectors provided on the high sides of panels in each row (closed array)

2.1.1.4 Install ballasted rigid PV roof-mounted solar panels roofs with a maximum roof slope of 1/2 in. per ft (2.4°). A higher slope is not recommended for ballasted PV panels as it will decrease frictional resistance to wind forces and increase sliding forces from gravity loads, weakening wind resistance. Use a combined weight of solar panels, associated hardware, and additional concrete paver blocks as needed to meet wind loads per Sections 2.1.1.1 and 2.1.1.2.

Install materials on the underside of the ballasted solar panel pedestals and paver trays, which in combination with the type of roof cover below will provide the minimum coefficient of static friction (μ , the lesser of the wet or dry value) needed for the array size and ballast weight proposed. Conduct tests for μ in accordance with ASTM D1894 (or equivalent standard outside the United States). If separator sheets are proposed between the pedestals and the roof covers, friction tests should reflect their presence.

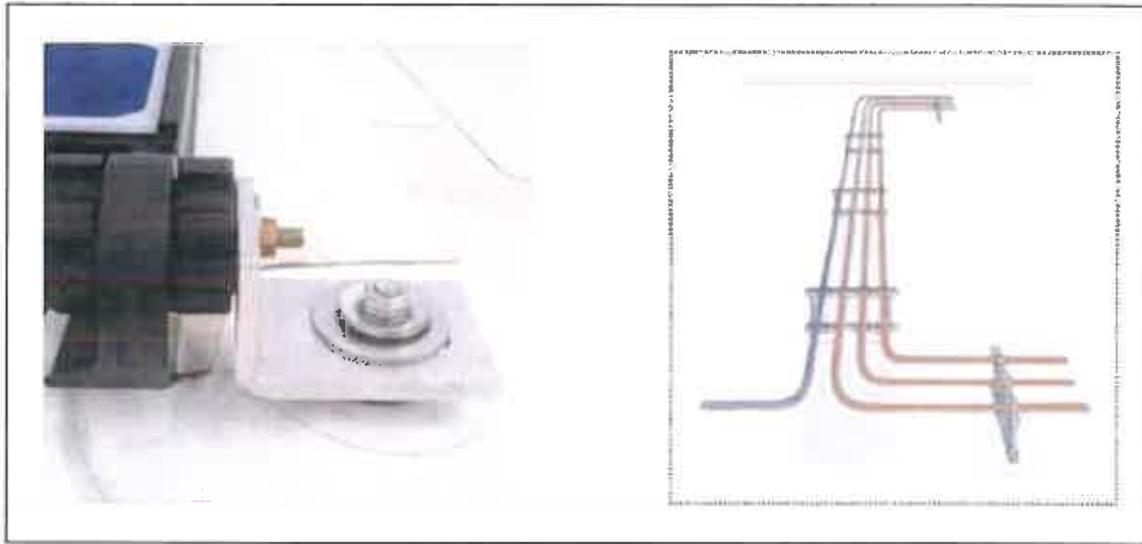
2.1.1.5 Install ballasted, rigid PV roof-mounted solar panels over fully adhered roof covers. Mechanically fasten solar panels when the roof cover is mechanically fastened.

2.1.1.6 Use concrete paver blocks for ballasted PV panels that meet specifications in ASTM C1491 and are satisfactorily tested in accordance with ASTM C1262 for exposure to freeze-thaw cycles. (Use comparable standards outside the United States.)

2.1.1.7 Keep the roof surface free from all forms of roof aggregate, including pea gravel or larger stone ballast, which could result in windborne debris damage to the PV panels. Also, if ballasted PV pedestals or paver trays are installed directly on top of roofing aggregate, it can adversely affect the arrays' resistance to sliding. Roof cover ballast that is continuous over the entire roof cover and consists of concrete paver blocks designed in accordance with DS 1-29, *Roof Deck Securement and Above-Deck Roof Components*, are acceptable if a sufficient weight of concrete paver blocks is provided above the solar panel pedestals or paver trays to provide the needed wind resistance for the solar panels.

2.1.1.8 Anchor all related equipment, such as combiner/junction boxes and conduits, to the roof deck or roof structural members (or inverters to concrete foundations) as required to provide proper anchorage against expected loads (see Figures 2A, 2B, and 9). Use mechanical anchors that can be connected to the equipment and to the roof deck or roof framing. The dead weight and resulting frictional resistance for most equipment is not sufficient to resist wind uplift and lateral wind loads.

2.1.1.9 During installation, complete all required steps for the securement of PV panels before the end of each shift. This includes the connection to previously installed panels and any needed additional ballast.



Figs. 2A and 2B. Examples of mechanical anchors used to secure equipment to the roof deck or roof framing

2.1.2. Fire Exposure and Classification

2.1.2.1 Provide noncombustible, compressible insulation (such as mineral wool) within roof expansion joints when new PV installations are to be installed on new or existing roof covers.

2.1.2.2 Install roof assemblies that are FM Approved per Approval Standard 4478 with the specific roof-mounted PV panel used when new roofs are to be installed before the installation of new roof-mounted solar panels. Use insulation or cover boards directly below the roof cover that are noncombustible. This includes gypsum cover boards and mineral wool or expanded glass insulation.

2.1.2.3 Do not use PV panel systems that contain foam plastic, such as extruded foam polystyrene, unless specifically FM Approved as part of the assembly (consider both interior or Class 1 rating and exterior fire exposure). The assembly should maintain a Class 1 or noncombustible fire rating for underside fire exposure. Do not install PV arrays within 50 ft (15 m) of maximum foreseeable loss (MFL) subdivisions (see DS 1-22, *Maximum Foreseeable Loss*).

2.1.2.4 Provide sufficient aisle spaces (4 ft, 1.2 m) between other adjacent PV arrays, other adjacent rooftop equipment or penetrations, and between PV panels and expansion or control joints on each side. Submit the proposed layout to the public fire service for review and acceptance. Minimum 4 ft (1.2 m) wide aisles at a maximum of 150 ft (46 m) in each direction is recommended and may be required by some local public fire services.

2.1.3 Gravity Loads and Roof Drainage

2.1.3.1 Install PV systems on roofs with minimum slopes of $\frac{1}{4}$ in. per ft (1° ; 20 mm/m), but not greater than noted in Section 2.1.1.4. For existing roofs with less slope, evaluate for potential roof collapse (see DS 1-54, *Roof Loads for New Construction*.) and vegetation growth resulting from ponding and water accumulations. Wind exposure will increase in some areas of the roof when the slope exceeds 7° .

2.1.3.2 Design the roof for snow drifting potentially caused by the PV arrays in accordance with DS 1-54. The greater the slope of the PV panels and the height of their high end, the greater snow drifting is likely to be.

2.1.3.3 Analyze existing roofs to ensure the dead weight of the proposed PV system, including any additional recommended ballast weight, does not reduce the roof resistance to snow, rain, and other live loads below acceptable levels.

2.1.3.4 Provide proper drainage for PV panel systems that contain curbs around the perimeter of an array, or continuous beams resting directly on the roof cover and supporting panels within an array. Analyze in

accordance with DS 1-54, *Roof Loads for New Construction*. The volume of the rainfall displaced by the PV system within the curbed area may be deducted when determining the added weight of the rainfall within the curbed area.

2.1.3.5 Design the PV panels to resist design roof snow loads, including potential drifting, in accordance with DS 1-54.

2.1.4 Hail

2.1.4.1 For the following hail-prone areas (see Appendix A and DS 1-34 for definitions), use PV panels that have the shown hail ratings (established in accordance with FM Approval Standard 4478, 4476 or 4473):

- Very Severe Hail Area: Class 4 (2 in.; 50 mm diameter ice ball)
- Severe Hail Area: Class 3 (1.75 in.; 44 mm diameter ice ball) or Class 4 (2 in.; 50 mm diameter ice ball)
- Moderate Hail Area: Class 2 (1.5 in.; 38 mm diameter ice ball), Class 3 (1.75 in.; 44 mm diameter ice ball) or Class 4 (2 in.; 50 mm diameter ice ball)

2.1.5 Earthquake

2.1.5.1 Attach rigid PV solar panels to the roof deck or framing for installations located in seismic zones 50 through 500 years, as defined in DS 1-2. Use welded, bolted, or other positive fastening methods as required by Chapter 13 of ASCE 7. Do not consider frictional resistance dependent on gravity. Test PV panels in accordance with Approval Standard 4478. Otherwise, the design may be in accordance with SEAOC PV1.

2.2 Operation and Maintenance

2.2.1 Check all equipment for damage or required maintenance after severe wind or snow storms.

2.2.2 Perform PV array insulation resistance tests every three years. The resistance measured with test voltage specified should not be less than the minimum resistance per Table 1 (refer to IEC 62446).

2.2.3 Perform a thermo-graphic survey for all electrical components (e.g., inverters, wire connections, and modules) annually.

2.2.4 Visually inspect inverters on a daily basis.

2.2.5 Test inverters annually to ensure correct operation in accordance with the manufacturer's specifications.

2.2.6 Inspect wiring connections and terminations annually for corrosion and tightness, and repair or replace as needed.

2.2.7 Inspect the sealing of roof penetrations for water-tightness annually, and repair or replace as needed.

2.2.8 Adjust the inspection and testing frequencies depending on the particular type of equipment and its duty, failure history, criticality, and condition using guidance specified in DS 5-20, *Electrical Testing*. Inspection and testing frequencies noted are a general guide.

Table 1. Minimum Values of Insulation Resistance

Test Method	Array voltage (V)	Test Voltage (V)	Minimum Insulation Resistance (M Ω)
Test Method 1: Separate tests to array positive and array negative.	<120	250	0.5
	120-500	500	1
	>500	1000	1
Test Method 2: Array positive and negative shorted together.	<120	250	0.5
	120-500	500	1
	>500	1000	1

2.2.9 Inspect solar panel assemblies at least annually to ensure mechanical connections between panels and supports have not loosened or become corroded, and that concrete paver blocks have not deteriorated. Tighten connections and replace corroded or deteriorated materials as needed.

2.2.10 Perform maintenance inspections and testing for all the relevant equipment on the alternating current (AC) side of solar electrical system in accordance with DS 5-10, DS 5-20, and DS 5-31. This includes transformers, switchgears, circuit breakers, fuses, and cables. Follow guidelines in DS 5-20 for electrical equipment with voltages of 600 V or less, and DS 5-19 for electrical equipment with voltages higher than 600 V. See DS 5-32 for cables and bus-bars.

2.2.11 Arrange pre-fire planning with the local public fire service. Ensure they are familiar with ground access, stairs to the roof, PV array aisles, the location of combiner boxes and inverters, and all related fuses and disconnects.

2.3 Electrical

2.3.1 Install new PV electrical energy systems, including the array circuit(s), inverter(s) and controller(s) for these systems, in accordance with Article 690 of the 2014 version of NFPA 70, *National Electric Code* (or equivalent international standard).

2.3.2 Install (new installations) or retrofit (existing installations) PV systems as follows.

A. Provide one of the following:

1. Residual current DC monitoring (RCD) on +/- feeder circuits, or
2. Electronic DC current sensing relay in ground circuit in series with ground fault fuses

B. Provide interlocks to trip the DC feed to the inverter and initiate an on-site building alarm. Emergency procedures should state that a prompt response to this alarm should include an investigation of the ground fault.

The goal of the above recommendations (parts A and B) is to resolve the initial problem prior to the second ground fault. Recent losses have shown that traditional ground fault protection (GFP) using fuses per Article 690 of the NEC is not sufficiently sensitive and allows "blind spots" with an undetected initial ground fault. Given a second ground fault, this can result in enough energy to start a roof-top fire. For more information, see Figures 3 and 4 and Section 3.3.

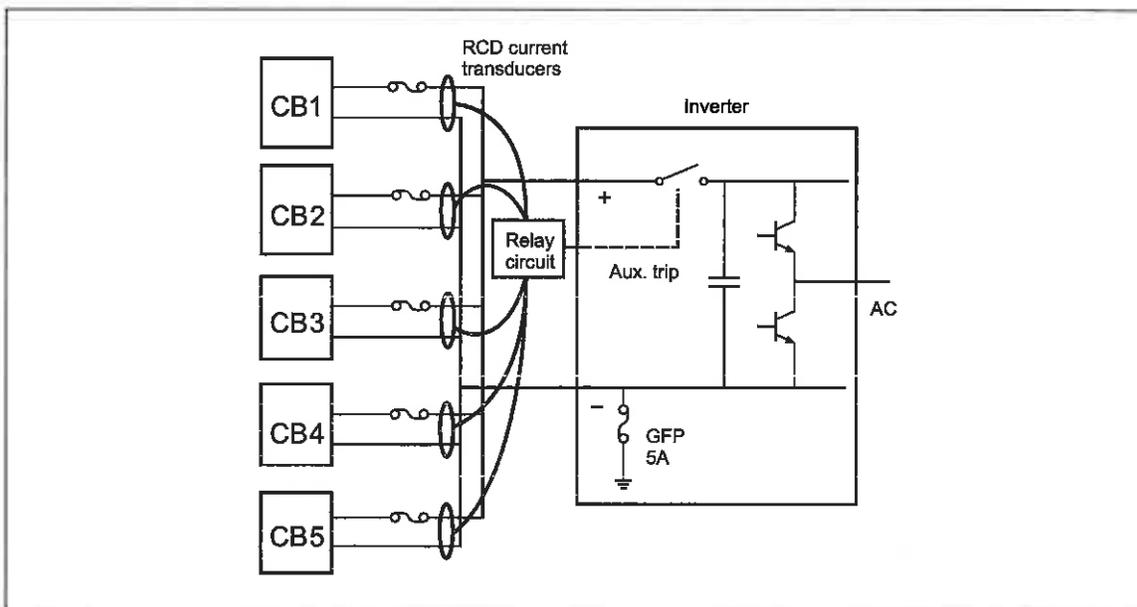


Fig. 3. Residual current measurements with auxiliary trip (CB = combiner box, RCD = residual current disconnect, GFPDI = ground fault detection and interruption)

2.3.2.1 Provide ground fault detection systems with an alarm function for ungrounded systems.

2.3.3 Provide a remote DC disconnect for each combiner box as close as possible to the output side of the box for all new installations. See Figures 5 and 6.

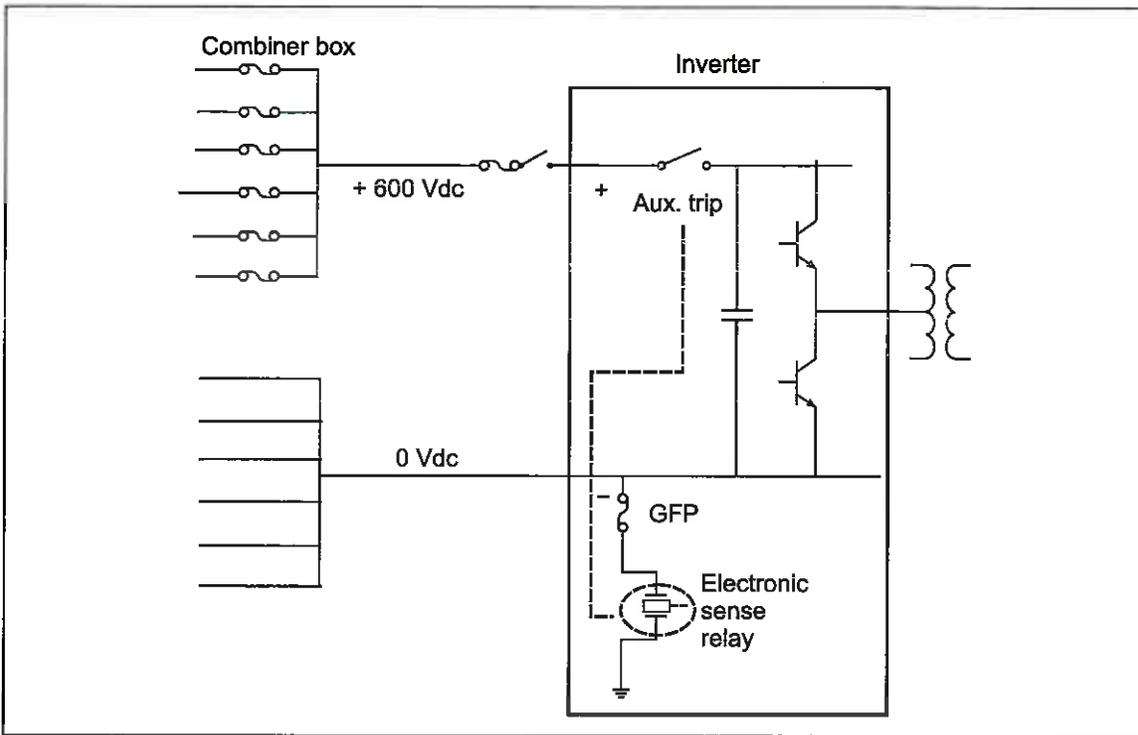


Fig. 4. Electronic current sensing relay in ground circuit

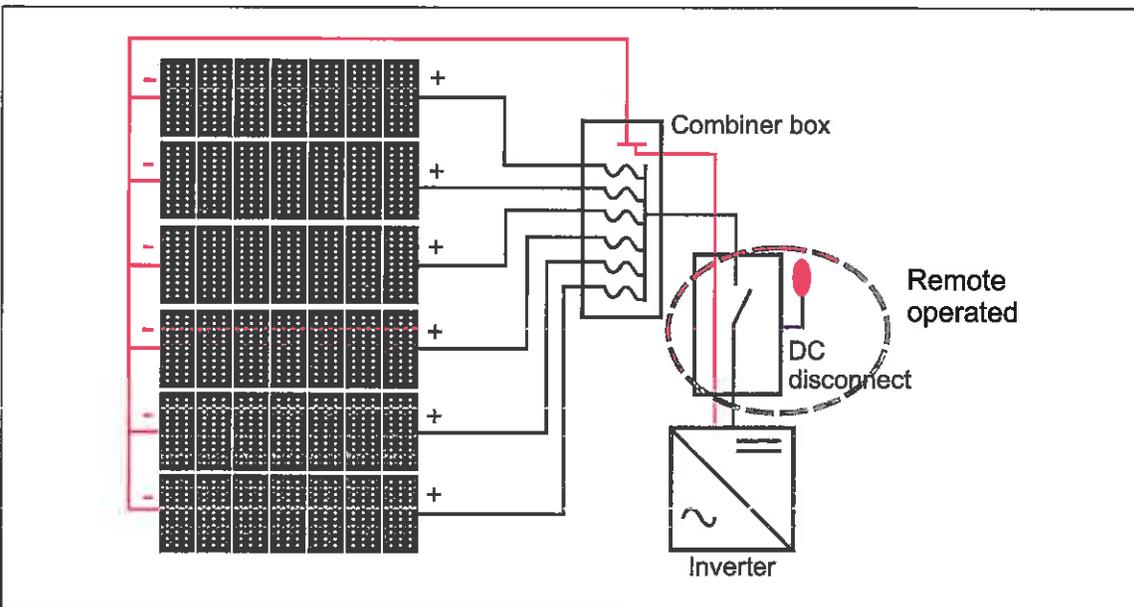


Fig. 5. One-line example diagram of remote-operated DC disconnect for grounded PV system (the negative pole is grounded at the inverter in this example)

2.3.4 Do not install electrical wiring within the rib opening of steel decking or otherwise within the plane of the above-deck components. Besides serving as a possible ignition source, it would also inhibit access for maintenance and repair and be subject to damage from mechanical fasteners used to secure above-deck roof components.

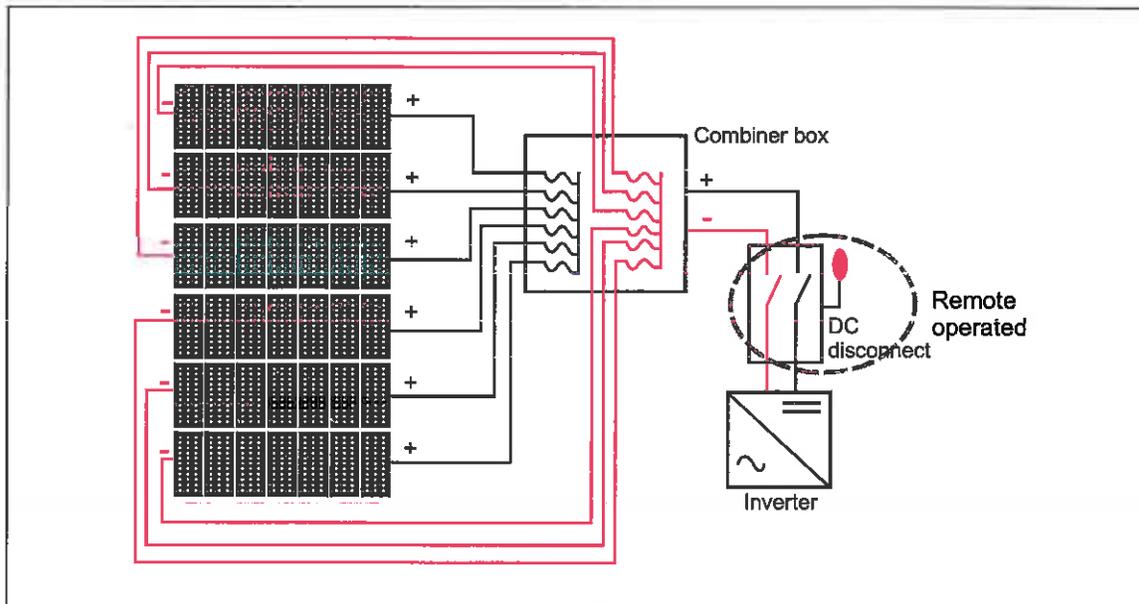


Fig. 6. One-line example diagram of remote-operated DC disconnect for ungrounded PV system

2.3.5 Ensure adequate provision is made for expansion and contraction due to extreme temperature fluctuations during the year. This includes wiring, as well as the interface between the PV panels and the roof cover.

2.3.6 Provide surge protection for the inverters on the DC and AC sides.

2.3.7 Provide reverse current overload fuses (RCOL) for each string of panels to prevent reverse current from undamaged parallel panel circuits being exerted on damaged panels.

2.3.8 Design and install cables and bus-bars in accordance with DS 5-31.

2.3.9 Use DC wires that are moisture and sunlight resistant and have a minimum temperature rating of 194°F (90°C).

2.3.10 Use rigid PV panels that meet electrical performance criteria per IEC/EN 61215, *Crystalline Silicon Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval*.

Use rigid PV panels that comply with criteria for electrical safety per IEC/EN 61730-2, *Photovoltaic (PV) Module Safety Qualifications, Part 2: Requirements for Testing*, or ANSI/UL 1703, *Flat Plate Photovoltaic Modules and Panels*.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Basic Operation of PV Systems

Rigid PV solar panels are made up of semiconductors in the form of individual silicon cells wired in series, and usually protected above by tempered glass and on the bottom by a polymeric encapsulant (back-sheet). Back-sheets are laminated in up to 3 layers and can consist of almost any combination of ethylene vinyl acetate (EVA), polyethylene terephthalate (PET), Kynar, or Tedlar. An anti-reflective coating is provided on the top surface. Modules are linked together in series to form strings, and then individual strings are connected within a combiner box to form an array. The modules within the array convert energy from sunlight into direct current (DC) electrical power. This power can be stored as DC, but more commonly it is converted to AC using an inverter, and then fed into a large electrical grid, or in some cases used directly on-site. Usually one or more arrays/combiner boxes are connected to an inverter when the electric power is converted from DC to AC.

Common sites for PV panels are roofs of warehouses and other facilities that do not require extensive rooftop equipment that would shadow the PV panels. Aisles are often provided within or between arrays to allow

access for maintenance of rooftop equipment and manual firefighting, as well as to prevent the panels being shadowed by other equipment, higher roofs, or other obstructions to sunlight. For additional information on rigid PV panels, see DS 7-106.

3.2 Wind Resistance

3.2.1 Boundary Layer Wind Tunnel (BLWT) Testing and Ballasted PV Systems

Testing in a boundary layer wind tunnel (BLWT) is conducted to determine wind loads and resistance for roof-mounted PV panels. It is important that the scaled models used to replicate the proposed roof-mounted panels be as representative as possible, particularly with ballasted arrays. This includes the sizes of individual panels, the weights of the panels and ballast, the PV panel slope (see Figure 8), the coefficient of friction (μ) between the roof surface and the underside of the panel pedestals or paver trays, and the size of the array. Tests should replicate the minimum array size to be used, with regard to the number of interconnected panels within a given array and the minimum number of panels within a row or column.

To allow the test data to be used for a variety of combinations of roof cover types and pedestal pads/paver trays, separate testing may be needed to quantify the coefficient of friction between the two surfaces. Testing should reflect any slip sheets that may be used. Since movement of any panel defines failure, the use of the static coefficient of friction may be used in lieu of the dynamic value. While often the wet coefficient of friction yields a lower value, test data reflects that in some cases the dry value is lower.

Testing needs to be conducted in a boundary layer wind tunnel (BLWT) rather than an aerospace wind tunnel (AWT). While there are some similarities between the two types, the BLWT simulates wind flow toward a building by providing obstructions between the entrance of the wind into the tunnel and the scaled building model. Typically, but not always, an open terrain or Exposure C is simulated. The simulated building is often a flat rigid object. This allows the wind to hit the wall of the model, flow over it, and create turbulence and vortices that cause higher uplift pressures above the roof, particularly at the perimeter and corner areas. Such a realistic effect is not provided when using an AWT. Even in a BLWT, internal building pressure effects and vertical movement of the roof cover are not simulated. Such movement of the roof cover can increase the drag and lift coefficients for the PV panels, and the presence of a mechanically fastened roof cover (MFRC, see Figure 7) can make the results of the BLWT invalid. This is not a concern with fully adhered roof covers. PV panels used over MFRC should be mechanically fastened.

While there are numerous AWTs, a limited number of BLWTs exist. The following locations have BLWTs:

- Colorado State University (CSU)
- Western University (formerly the University of Western Ontario or UWO), Ontario, Canada
- Cermak, Peterka and Peterson (CPP) in Colorado and Australia
- Rowan, Williams, Davies and Irwin, Inc. (RWDI), Canada
- I.F.I. Institute, Germany
- Force Technology, Europe
- University of California, Davis
- University of Maryland
- University of Minnesota
- Concordia University, Montreal, Quebec, Canada

A. Experimental wind load estimates on roof-mounted solar panels can be inaccurate for the following reasons:

1. The experiments were conducted without considering the effect of the building on the solar panels. This includes experiments that were conducted in an AWT, which is used for testing cars and aircraft. These types of wind tunnels produce smooth wind at a constant speed, and at very low turbulence intensity (< 0.5%). In order to study the wind load on roof-mounted solar panels, experiment have to be conducted in a BLWT, where the wind is turbulent and gusty with high turbulence intensity (>10%). The wind tunnel

experiments also have to be conducted in accordance with the ASCE's *Wind Tunnel Studies of Buildings and Other Structures*.

2. The experiments were conducted only for a single wind direction. Just like the roof itself, the tilted solar panels can experience substantial wind loads from cornering winds.

B. Wind load estimates obtained using only CFD simulations on roof-mounted solar panels are not recommended by ASCE and may be inaccurate for the following reasons:

1. The simulations were performed without considering the effect of the building on the solar panels.
2. Validation of the CFD simulations with existing literature or with BLWT experiments were not performed.

3.2.1.1 Increased Ballast Around Openings

Often there will be aisle spaces around other roof-mounted equipment that break the continuity of the interconnection between panels. This reduces the wind load distribution, as well as the shielding affect against wind that the outer panels in the array provide for those panels farther in from the edges. In order to account for this, additional ballast should be provided for the panels immediately around the openings.



Fig. 7. Mechanically fastened roof cover billowing when subjected to wind pressure



Fig. 8. Solar panels with steeper slopes or lacking wind deflectors will experience greater wind effects



Fig. 9. Equipment lacking anchorage to roof framing

3.2.2 PV Systems Fastened to Standing Seam Roofs (SSR)

Rigid PV panels can be mechanically fastened to SSRs and can be FM Approved in accordance with Approval Standard 4478. For more information on SSRs, see DS 1-31. SSR panels are seamed to the internal clips, which are pre-fastened at each deck rib to each steel purlin or a continuous substrate. The wind design for SSR assumes the wind load is distributed evenly to each internal clip. An external seam clamp, similar to those used to enhance the wind resistance of SSRs, is used to connect PV panels to the SSR deck ribs (see Figures 10 and 11). These clamps do not penetrate the seam. One clamp should be provided at each standing seam rib at the down-slope and up-slope edges of the PV panels. The spacing between clamps may vary from about 3 to 10 ft² (0.3 to 1.0 m²) per clamp, depending on the SSR rib spacing and the distance between internal clips along the deck seams. It is important that the individual clamp be designed to fit the specific seam of the SSR.



Fig. 10. Solar panels secured to standing seam roofs using external seam clamps



Fig. 11. Unacceptable arrangement: clamp missing from SSR rib below middle of outer panel edge

3.3 Fires and Electrical Ignition Sources

3.3.1 Ground Fault Protection

Numerous fires have started in U.S. installations of roof-mounted PV arrays due to inadequate ground fault protection. Such installations in the United States typically include conductors that are intentionally grounded, but have ground fault detection designed for ungrounded conductor faults. This design is based on conservative assumptions of leakage current to avoid nuisance trips. However, the present ground fault detection uses fuses that are not sensitive enough, resulting in undetected ground faults. Such systems have become more prevalent in recent years and, as they continue to age, the frequency of such fires could increase.

Fires of electrical origin are fairly common in roof-mounted solar arrays. There are sufficient combustibles present in the form of roof coverings and insulation, which are more likely to become ignited with the PV system there. Also, the redirection of flames and reradiation of heat by the PV panels from a roof fire tend to create more fire spread than if the panels were not there. Following the electrical guidance in this document will reduce, but not eliminate, the potential for a fire.

3.3.2 Preventing Fires from DC Ground Fault in PV Arrays

A ground fault in a PV array is an accidental electrical short circuit involving ground and one or more normally designated current-carrying conductors. Ground faults in PV arrays are safety concerns because they may generate DC arcs at the fault point on the ground fault path, damage surrounding insulation, and create fire hazards. The risk of fire is escalated substantially if a second ground fault is developed. A DC ground fault is common in PV systems and result from the following causes:

- A. Insulation failure of cables (e.g., an animal chewing through cable insulation and causing a ground fault)
- B. Incidental short-circuit between the normal conductor and ground (e.g., a cable in a PV junction box incidentally contacting a grounded conductor)
- C. Ground faults within PV modules (e.g., a solar cell short-circuiting to grounded module frames due to deteriorating encapsulation, impact damage, or water corrosion in the PV panel)
- D. Abraded wire insulation caused during installation or from thermal movement of the components

To properly protect PV arrays from ground fault damage and ensuing fire, NFPA 70, National Electrical Code, Article 690.5(A), specifies that ground fault protection device (GFPD) or system must be capable of detecting a ground-fault current, interrupting the flow of fault current, and providing an indication of the fault. According to recent industry experience, there are some cases where the first ground fault could not be detected by the currently design GFPD (such as applying a fuse in the grounding electrode). A second ground fault made the fault current flow in the array, leading to fire. Figure 12 (A, B and C) illustrates the unnoticed first ground fault and the danger of a second ground fault in a PV system. Sophisticated techniques, such as residual current monitoring, to measure the imbalance of current flow in the positive and negative feeders from the inverter to each combiner box are being developed to improve ground fault protection.

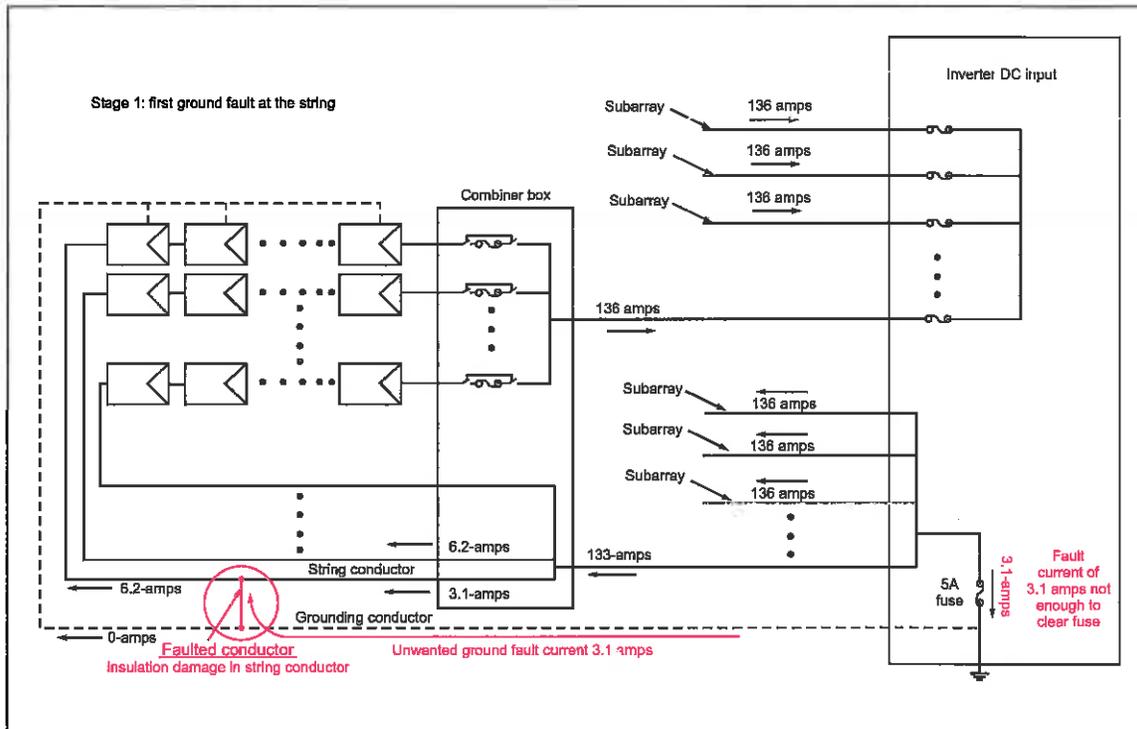


Fig. 12A. One-line example diagram to a PV system with ground faults

In Figure 12, note the following:

1. The PV system shown has eight combiner boxes with a normal DC output of about 136 A.
2. The DC string conductor as the input of the combiner box has a normal DC current of 6.2 A.
3. The first ground fault at the string conductor only generates about 3.1 A ground fault current, which is not sufficient to melt the fuse as the ground fault protection in this system (Part A)
4. When the 2nd ground fault develops at the array conductor, a return path is established (internal short circuit developed). The ground fault protection fuse operates (Part B), however, is no longer able to interrupt the fault current because of the internal return path established by these two ground faults. In the example shown, the string conductor, which normally carries 6.2 A current, has about 1082 A fault current. This high level of fault current can potentially cause a fire (Part C).

3.4 Exterior Fire Spread in Roof-Mounted PV Arrays

Where roof-mounted PV arrays are present, the risk of exterior fire spread is much greater than it would be for the roof assembly alone. This would be the case even if the solar panels had no combustible components. A typical fire scenario is the electrical wiring associated with the solar PV array causing ignition of the roof assembly. The potential flame height is largely a function of the type of roof cover and insulation immediately below the array. While the presence of solar panels may affect combustion air being drawn to the fire, it otherwise does not reduce, but redirects the flames from the roof fire.

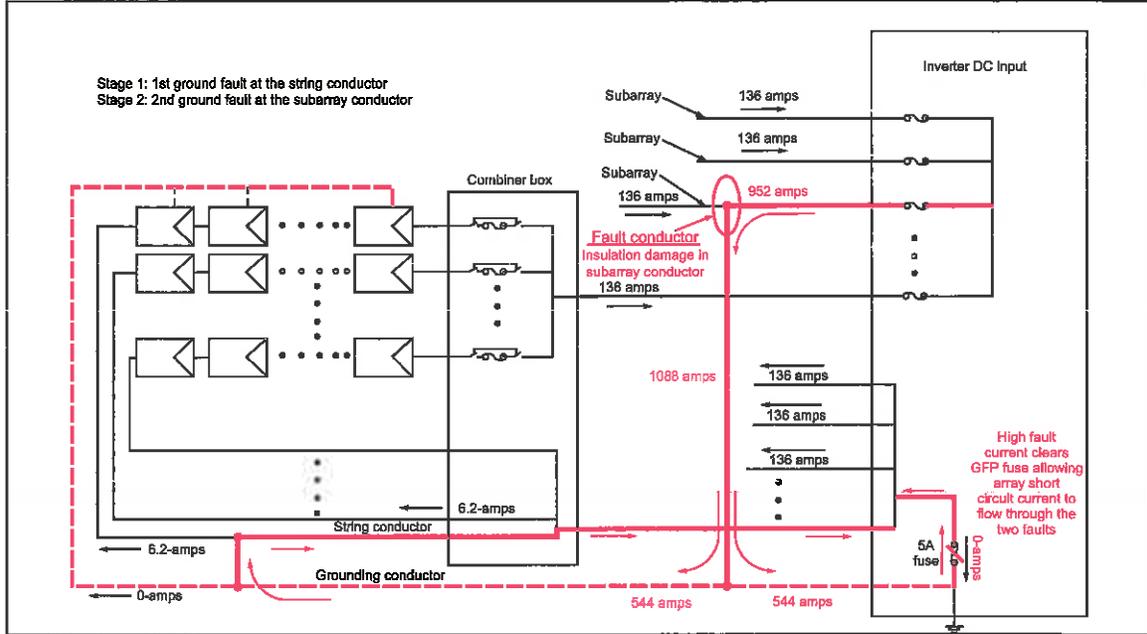


Fig. 12B. One-line example diagram to a PV system with ground faults

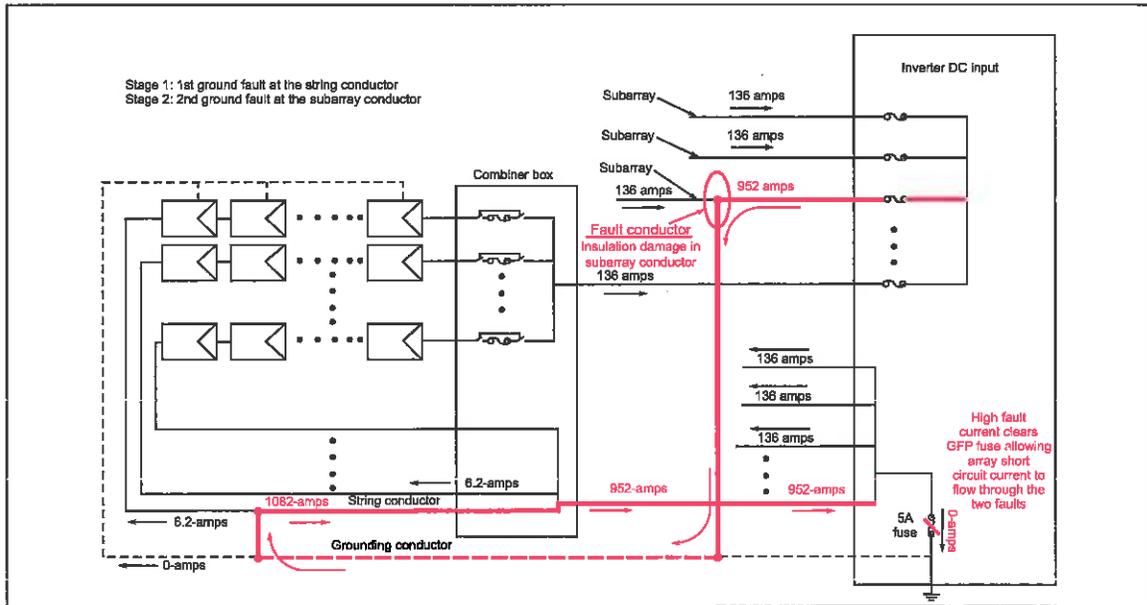


Fig. 12C. One-line example diagram to a PV system with ground faults

3.5 Gravity Loads and Roof Drainage

For systems that use curbs or continuous support beams, ensure these components do not adversely affect roof drainage (rain water weighs 5.2 psf per in. of depth, or 1 kg/m² per mm). Consider the design rainfall intensity on the roof, paths to the roof drains, how much water will have to flow through the curbs or beams, and whether the drainage holes or spaces are large enough to accommodate that flow. The height of the curb should be limited to act as a secondary drainage method from within the curbed area in case drain holes are clogged by leaves or debris. For additional information on roof drainage, see DS 1-54.

3.6 Hail Resistance

Hail resistance of rigid PV panels should be determined by ice ball testing in accordance with Approval Standard 4478. Hail resistance of flexible PV panels should be determined by steel ball testing in accordance with Approval Standard 4476.

Impact from hail larger than that for which the panels were successfully tested could cause severe damage to the PV panels.

3.7 Flexible PV Installations

Adhered, flexible solar panels are FM Approved in accordance with Approval Standard 4476, as specified in RoofNav and are required to be adhered across their entire underside. Flexible solar panels that are only secured around their edges will not uniformly distribute the wind load to the roof cover they are adhered to.

4.0 REFERENCES

4.1 FM Global

Data Sheet 1-2, *Earthquakes*

Data Sheet 1-22, *Maximum Foreseeable Loss*

Data Sheet 1-28, *Wind Design*

Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components*

Data Sheet 1-31, *Metal Roof Systems*

Data Sheet 1-54, *Design Loads for New Construction*

Data Sheet 5-11, *Lightning Protection*

Data Sheet 5-19, *Switchgear and Circuit Breakers*

Data Sheet 5-20, *Electrical Testing*

Data Sheet 5-23, *Emergency and Standby Power Generating Systems*

Data Sheet 7-106, *Ground-Mounted Photovoltaic Solar Power*

FM 4476, *Approval Standard for Flexible Photovoltaic Modules*

FM 4478, *Approval Standard for Rigid Photovoltaic Modules*

ANSI/FM 4473, *Test Standard for Impact Testing of Rigid Roofing Material by Impact Testing with Freezer Ice Balls*

Approval Guide, Building Materials section, an online resource of FM Approvals

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4.2 Other

American Society of Civil Engineers (ASCE). *Minimum Design Loads for Buildings and Other Structures*. ASCE 7.

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Los Angeles City Fire Department Requirement. *Solar Photovoltaic System*. FPB Requirement No. 96, 2-03-09.

Pagnamenta, R. "BP Solar Panel Blaze Raises Concerns Over Alternative Energy." The Times, Monday June 29, 2009.

APPENDIX A GLOSSARY OF TERMS

Aerospace wind tunnel: A wind tunnel that simulates horizontal wind forces acting directly on an object. It does not simulate conditions between the fans and the object within the lower portion of the boundary layer, which is required to replicate the surface roughness exposure related to wind design of the building and rooftop equipment. Neither does it replicate wind flow over a wall of a modeled structure below the rooftop equipment that would be required to simulate actual suction effects in addition to the horizontal forces.

Array size: The number of interconnected PV panels (the minimum number of panels within each row and each column) and the gross plan area occupied within a given array. There is usually a slight (fraction of an inch) separation between panels in the east-west direction and sufficient separation (depending on panel slope) between rows to prevent shadowing. Wind tunnel or field model tests should replicate the minimum array size required. Data for a larger array does not justify the design for a smaller array.

Ballasted: Not adhered to the roof cover below, nor fastened to the roof deck or structure. Resistance to wind loads is provided by the weight of the panels, mounting equipment, and any additional ballast. (Same as "loose laid.")

Boundary layer wind tunnel: A wind tunnel with a long transition between the fans and the object, and that has obstructions to replicate the lower portion of the boundary layer and the surface roughness exposure related to wind design of the building and rooftop equipment. Testing is done with scaled models of rooftop equipment and the building upon which it is installed.

Closed mounting system: A PV mounting system that has a wind deflector on the high side (north side in northern hemisphere and south side in southern hemisphere) of each row of panels, but may or may not have one on the east and west ends of each row.

Coefficient of friction (μ): A dimensionless coefficient used to quantify resistance to lateral movement (in this case, between the undersides of the panel mounts and the top surface of the roof cover). It is equal to the lateral load resistance divided by the force normal to the two mating surfaces. This will vary depending on the construction of the underside of the panel mount and the type of roof cover. Such construction includes, but is not limited to, stainless steel, aluminum, coated metal, or metal with a pad (such as a piece of single-ply roof cover material or rubber) adhered to its underside.

Computational fluid dynamics (CFD): A form of computer modeling that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of fluids with surfaces defined by boundary conditions. Validation of such software is performed using a wind tunnel.

FM Approved: Products or services that have satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete list of products and services that are FM Approved.

Hail day: A day in which minimum 3/4 in. (19 mm) diameter hail occurred within 25 mi (40 km) of a location.

Inverter: An electrical device used to convert direct current (DC) electrical power to alternating current (AC) electrical power.

Loose Laid: not adhered to the roof cover below, nor fastened to the roof deck or structure. Resistance to wind loads is provided by the weight of the panels, mounting equipment, and any additional ballast. (Same as "ballasted.")

Moderate hail hazard area: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34, and areas outside the United States that have experienced, on average, fewer than three hail days per year.

Non-sheltered PV panels: PV panels located on the exterior side of an array in the perimeter row(s) of PV panels, and that are not sheltered from the wind load from other panels, and for which the wind load may be greater than that of the interior, sheltered panels.

Open mounting system: A PV-mounting system that does not have a wind deflector on the high side (north side in northern hemisphere and south side in southern hemisphere) of each row of panels.

Photovoltaic (PV) system: A system that uses solar panels to convert sunlight into electricity. It consists of PV panels, support framework, and electrical connections and equipment to allow regulating and converting the electrical output from DC to AC.

PV panel: An individual unit consisting of numerous cells, usually 60 or 72. It is usually about 39.4 in. (1 m) in the north-south direction and 65 to 77 in. (1.65 to 2.0 m) in the east-west direction. In most cases it is bounded by edge framing. In some cases panels are also referred to as modules, particularly for ballasted situations. For anchored installations, three or four modules connected together may be considered a panel.

Roof control joint: A construction joint that provides a break in the continuity of above-deck roof components to prevent damage to the roof cover from thermal movement. This joint does not provide a break in the roof deck.

Roof expansion joint: A construction joint that provides a break in the continuity of the building framing, roof deck, and above-deck roof components to prevent damage to the building components from thermal movement.

Setback: The distance between the outside edge of a roof supporting solar panels and the outer edge of the solar array.

Severe hail hazard area: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34, and areas outside the United States that have experienced, on average, at least three hail days per year.

Shadowing: Shade created by neighboring objects that necessitate relocation of solar panels and sometimes openings within the array. This can create wind forces on solar panels immediately adjacent to the opening that are higher than the forces on the interior of the array.

Sheltered PV panels: PV panels located on the interior side of the perimeter row(s) of PV panels that are somewhat sheltered by the perimeter panels and for which the wind load is somewhat less than for the perimeter panels.

Very severe hail hazard areas: Areas in the United States designated as such on the Hailstorm Hazard Map in DS 1-34.

APPENDIX B DOCUMENT REVISION HISTORY

October 2014. Interim revision. Added additional diagram (Fig. 12B, *One-line example diagram to a PV system with ground faults*).

July 2014. This is the first publication of this document.