Request for proposal for CAPEX/OPEX business models – Solar grid-connected system • Template

SOLAR Request For PRoposal

TEMPLATE

Design, SUPPLY, DELIVERY, INSTALLATION, TESTING, COMMISSIONING, AND MAINTENANCE OF A SOLAR GRID-CONNECTED SYSTEM

[CAPEX/OPEX MODEL]

[Month, Year]

**Contacts**

|  |
| --- |
| **[Name of the Developer]** |
| [Contact Person's Name]: ……………………………….  [Position]: ………………………………………………….  Phone: ……………………………………………………..  Email: ……………………………………………………... |

# Introduction

A request for proposal (RfP) is often created to outline the bidding process and contract terms and also to provide guidance on how the bid should be formatted and presented. Effective RfPs typically reflect the strategy and short/long-term project objectives, providing detailed insight into which suppliers will be able to offer a matching perspective.

The purpose of this document is to provide an RFP template of a roof-mounted, ground-mounted and carport solar grid-connected system for residential/commercial/industrial users of Nepal. This template contains information on project descriptions, requirements, and submissions. Users may use, and modify the template to suit their projects.

**Instructions**

1. Delete all bracketed text and replace it with work instruction-specific detail.
2. Search and replace “Developer name” with the specific developer's or entity’s name.
3. Delete sections that are not applied to the project. For example; delete roof-related requirements if the RfP is for a ground-mounted system.

# REQUEST FOR PROPOSAL

**[*Developer/Entity name*]** is soliciting proposals from a qualified contractor to design, fabricate, deliver, install, and maintain a **[*select: rooftop, ground-mounted, carport*]** solar grid-connected system.

Statement of Work

Design Build Guidance Criteria

**[*Select: Roof Mounted, Ground Mounted, or Carport*]**

**Solar Grid-Connected System**

## PROJECT IDENTIFICATION

* 1. Project: **[*select: Roof Mounted, Ground Mounted, and Carport Mounted Grid-Connected PV System*]**
  2. Location: **[*include address*]**

## BACKGROUND

**2.1. Objective:** Contractor shall provide a total “turnkey” project including all necessary equipment, materials, design, manufacturing, and installation services for the installation of a **[*enter from 1.1 project type*]** grid-connected photovoltaic system that shall produce a minimum of **[*enter min production*]** kWh AC per year at the point of interconnection, approximately **[*enter capacity*]** kW DC capacity. Larger capacity systems that produce more than the minimum are an alternative and will be evaluated but the proposed system shall not produce more than **[*enter max production*]** kWh per year. The contractor should prepare a system summary detailing each location, applicable equipment/size, and predicted system energy production (kWh). In relation to any building-mounted system, the contractor shall evaluate roof conditions and may remove the existing roof system and replace it with either an integrated roof/PV system or a new roof with PV system installed. See roofing specifications for these requirements. This project shall meet all requirements of this statement of work and other specifications included that apply.

**2.2. Scope:** The contractor shall perform all professional services as necessary to provide **[*Developer/Entity name*]** with a complete design package including the requirements outlined in this statement of work. The contractor shall install the project such that it is operational and compliant with all applicable standards, building codes, UTILITY interconnection requirements, and national requirements. The contractor shall include specifications, calculations, and drawings in the design package, and turn it over to **[*Developer/Entity name*]**. After approval by **[*Developer/Entity name*]** of the final design package, the contractor shall provide all necessary construction to successfully complete the photovoltaic system installation.

* + 1. **Design guidelines for [enter 1.1 project type].**

[*Select guidelines specific to the project type below and delete the ones that are not applicable.]*

**Design guidelines for rooftop PV:** Contractor shall develop a design for a new photovoltaic system at ***[LOCATION]***. See attached drawings indicating available areas for installation and existing roof structure plans. These drawings are meant for informational purposes only and must be field-verified by the contractor.

* The mounting system shall limit roof penetrations and shall be either building integrated roof PV or fully ballasted. The mounting system design needs to meet applicable local building code requirements with respect to snow, wind, and earthquake factors.
* Conduit penetrations shall be minimized.
* If the system is not building integrated or membrane sealed, the system shall be fixed tilt (minimum 5 degrees tilt for flat roof or flush mounted for sloped roof) with an orientation that maximizes annual energy production.
* All roof access points shall be securely locked at the end of each day.
* System layout shall meet local fire department, code, and ordinance requirements for roof access.

**Design guidelines for ground-mounted PV:** The contractor shall develop a design for a new photovoltaic system at **[*LOCATION*]**. See attached drawings indicating available areas for installation. Not all locations need to be utilized. It is the responsibility of the contractor to assess site topography and geotechnical attributes to estimate costs related to project installation.

* The mounting system shall be either directly anchored into the ground (driven piers, concrete footers, etc.) or ballasted on the surface without ground penetration. The mounting system design needs to meet applicable local building code requirements with respect to snow, wind, and earthquake factors.
* Panels’ orientation or azimuth shall be within 20-30 degrees of due south.
* Panels’ tilt shall be based on site latitude and wind conditions.
* Ground cover and vegetation management shall be included in the proposal.
* Stormwater management and erosion control management plan shall be included in the proposal.
* OPTIONAL. Gate shall be included in the proposal.
* All lines interconnecting PV arrays to the point of interconnection shall be underground.

**Design guidelines for carport PV:** The contractor shall develop a design for a new photovoltaic system at **[*LOCATION*]**. See attached drawings indicating available areas for carport installation. Not all locations need to be utilized. It is the responsibility of the contractor to assess site topography and geotechnical attributes to estimate costs related to project installation.

* Use of existing carports to mount PV is preferred but not necessary.
* Carport PV shall be tilted at a minimum of 5 degrees to allow for drainage and reduce soil build-up.
* The carport PV shall be at least 9 feet clear in all locations.
* Lighting shall be provided under each carport. This lighting shall be efficient (e.g., LED) and allow for adjustable times for illumination with photocell controls to turn the lights on at dusk and off in the morning prior to daylight.
* All lines interconnecting PV arrays to the point of interconnection shall be underground.
  + 1. **Performance criteria:** The following performance criteria shall be met for all arrays:
* Power provided shall be either 220V, 400V, or 11 kV three-phase compatible with the onsite distribution system. See drawings for options for connection voltage and location.
* The proposal shall provide estimated energy delivery for each array, for each month of the year, and the total for the year at the delivered voltage (220V, 400V or 11 kV). The estimated annual energy delivery for all arrays shall be a minimum of [enter min production] kWhAC/year at the point of interconnection (POI).
* The STC-rated power value will be entered into [simulation software] using the nearest weather file to determine estimated energy delivery in kWh AC. A default value for the system losses of [percentage] shall be used.
* PV array shall mean one or more PV modules having that same orientation and on the same maximum power point tracking (MPPT) system. Every array with differing orientation shall have a separate MPPT system.
  + 1. All proposed/implemented PV array locations shall be shade-free from 9 AM until 3 PM (solar time). The contractor shall provide documentation of shading calculations for exterior extents for each proposed array. These calculations may be modified for shading obstructions that will be removed and mitigated as part of the project. Suggested documentation would include sun path diagrams for exterior array locations or SunEye measurements.
* All PV hardware components shall be either stainless steel, hot dip galvanized, or aluminium. PV structural components shall be corrosion-resistant (galvanized steel, stainless steel, composites, or aluminium).
* The project, including supports and power conductors, shall not interfere with roof drains, water drainage, expansion joints, air intakes, existing electrical and mechanical equipment, existing antennas, and planned areas for future installation of the equipment shown on drawings.
  + 1. **Production metering:** The project shall have:
* At least one production meter at POI. The contractor shall coordinate with NEA, a utility company for the application of the energy meter. Also, there shall be a separate energy meter other than the NEA energy meter for check and balance.
  + 1. **Construction:** Perform all construction necessary for the successful installation of the system based on the design generated from 2.2.1, 2.2.2, and 2.2.3.
  1. **Technical requirements and reference materials**
     1. **Code compliance:** Installation and equipment shall comply with applicable building, mechanical, fire, seismic, structural, and electrical codes. Only products that are listed, tested, identified, or labelled by IEC, UL, FM, ETL, RETs or another nationally or internationally recognized testing laboratory shall be used as components in the project. Non-listed products are only permitted for use as project components when a comparable useable listed component does not exist. Non-listed products proposed for use as components must be identified as such in all submittals.

The contractor shall use project components that are or are made of materials that are recyclable, contain recycled materials, and are EPA or energy star rated if they are available on the market.

* 1. **Roles and responsibilities**
     1. **Contractor:** The contractor is required to provide:
* Design concepts
* Construction documents and engineering calculations that are signed and sealed by a licensed architect or engineer
* Submittals for materials and products
* Construction materials, equipment and labour
* Design and construction supervision/contract management
* Quality control plan (QCP)
* Safety plan
* Inspections and tests (per QCP)
* Manuals (design calculations, operation/maintenance, shop drawing, etc.)
* Commissioning of project
* Mentoring and training tribal building operating staff for operation and maintenance
* Operation and maintenance during the first year and optional service plan after the first year
* Web-based monitoring system for 20 years
  + 1. **[*Developer/Entity name*]** will:
* Review for approval design submittals and QCP
* Witness inspections and test witnesses to verify attainment of performance requirements
* Make progress payments for design/construction as agreed

## PROPOSAL CONCEPT DRAWINGS AND SPECIFICATIONS SUBMISSIONS

* 1. **Concept drawings:** The contractor shall provide ***[Developer/Entity name]*** with concept drawings with the proposal. The drawings must indicate the proposed location of the PV array(s) and access points along with a one-line electrical diagram showing inverters, transformers, meters, and interconnection locations. All drawings shall be submitted with dimensions shown in English units.
  2. **Concept information:** The proposal shall include major equipment information, proposed installation/interconnection information, applicable incentive information, and performance characteristics of the system. Identify an appropriate location for the solar PV inverter equipment and its related components and environmental control systems that will meet the following criteria:
* Ease of maintenance and monitoring
* Efficient operation
* Low operating losses
* Secured location and hardware
* Compatibility with existing facilities
* Avoidance of flood-prone areas
* Visual harmony

All products shall comply with the technical requirements shown under section 8, “Solar electric module array”. At a minimum, the proposed concept information shall include:

Equipment Information:

* System description
* Layout of installation
* Selection of key equipment and layout of equipment
* Performance of equipment components, and subsystems
* Specifications for equipment procurement and installation
* All engineering associated with structural and mounting details
* Controls, monitors, and instrumentation
* Operation and maintenance service plan

Installation Interconnection Information:

* Solar electric array orientation (degrees)
* Solar electric module tilt (degrees)
* Electrical grid interconnection requirements
* Integration of solar PV system with other power sources
* System type and mode of operation (utility-interactive)

Performance Characteristics

* Shading calculation documentation
* Total system output
* Estimated kWh/month per array (shown over a 12-month period)
* Warranties and guarantees

Applicable Incentives

* Identify all applicable incentives

Interconnection Agreement

* Provide confirmation that the PV systems will be designed to comply with applicable UTILITY interconnection requirements

Cost

* Total bid price of project including operation and maintenance for the first year, and optional service plan after the first year

## DESIGN SERVICES

Solar PV systems shall be designed and engineered to maximize the solar energy resources, taking into consideration the customer’s electrical demand and load patterns, proposed installation site, available solar resources, existing site conditions, proposed future site improvements, and other relevant factors.

Design services for this project shall require a schematic design submission, a design development submission; a check set submission, and a construction document submission. A final set of as-built drawings shall also be provided to **[*Developer/Entity name*]**. These submissions shall be delivered to **[*Developer/Entity name*]** based on the project schedule submitted and approved by **[*Developer/Entity name*]**. The design package shall include the following details (4.1-4.6).

* 1. **Timeline/Project schedule:** The contractor is required to provide an estimate on the project timeline and schedule.
  2. **Post-award conference:** Within 21 calendar days after receipt of the contract award. The meeting will be attended by ***[Developer/Entity name]*** team members and the contractor’s personnel. At a minimum, the prime contractor’s project manager and foreman, the primary designer, and a representative of any subcontractor performing over 25% of the work must attend. The meeting will be held at the project location. The purpose of the meeting will be to discuss the contractor’s plan for completing the design and construction, including a construction schedule. A walk-through of the site will occur at the end of the meeting.
  3. **Specifications:** A full set of specifications shall be required for this project. Specifications that express all information and demonstrate sufficient detail so as to direct the construction work outlined in this statement of work shall be required. The specifications package shall be coherent enough that any contractor not familiar with the project would be able to construct the project design. The specifications shall include all equipment information, proposed installation and interconnection information, and performance characteristics of the system.
     1. All drawings, estimates, calculations, and specifications shall be in English units.
     2. The contract shall take into account a construction plan producing a minimum disruption of day-to-day activities, utilities, services, etc.
  4. **Construction drawings**
     1. Provide drawings for each discipline required (architectural, structural, electrical, etc.), with separate plans for new work and demolition as well as special types of drawings where necessary, such as enlarged plans, equipment curbing and flashing details, roof penetration details, etc. Drawings shall clearly distinguish between new and existing work.
     2. Each drawing shall indicate project title, project number; array identification and location, A/E firm, A/E's address and/or phone number, contract number, drawing title, drawing type, drawing number, and key plan. A cover sheet shall be provided and shall include a list of the drawings, legend, vicinity map, and location map in addition to all items required for each drawing. Each A/E submission shall be clearly dated and labelled (e.g. 75% Design development submission, 100% Check set submission, Construction document submission, as-built drawings, etc.). Each drawing sheet submitted shall include a graphic scale in the lower right-hand portion of the sheet. The final set shall be stamped by a registered engineer and/or registered architect for the state in which the building/carport is located. At a minimum, the following drawings are required:
* Site plan including utility locations and connections – shall show staging and phasing requirements.
* Electrical plans – including single line diagram and utility interconnection.
* Electrical details.
* Roof plan and/or carport plan – showing the full layout of the system and detailing any obstacles that must be permanently or temporarily removed or relocated.
* Array support and mounting details.
* Any drawings that may be required to install a complete project.
* Waterproofing details
  + 1. The contract documents shall sufficiently define the statement of work and shall stand on their own.
    2. Specifically address the means to keep the existing building accessible and operational by means of relocation and/or phasing.
  1. **Calculations:** The contractor will provide the following calculations.
     1. **System electrical calculations**: Provide with design development and again with 100% check set.
* PV Watts calculation or any other simulation software calculations
* System energy production calculation showing estimated monthly and yearly energy output for each array
* Energy value and project cash flow
  + 1. [**OPTIONAL**]. Energy performance is calculated by a detailed PV analysis program such as a PV system using proposed specific PV modules and inverters.
    2. If rooftop PV arrays are proposed, include roof structural loading calculations. These calculations shall specifically address roof loading from the PV array and confirmation that the loading does not exceed existing roof framing/loading capacity as determined by your analysis. The documents included in this contract include a preliminary *Roof Structural Analysis.* This document provides some preliminary indications on the existing roof's capability to carry additional loading and is intended to assist during the proposal process in developing your concept design. It is not intended to alleviate the need to do array-specific structural calculations during the subsequent design phases.
    3. If carport PV arrays are proposed, include carport structural loading calculations. If existing carports are to be used, these calculations shall specifically address existing carport loading from the PV array and confirm that the loading does not exceed existing carport capacity as determined by your analysis. The documents included in this contract include a preliminary *Carport Structural Analysis.* This document provides some preliminary indications on the capability of the existing roof to carry additional loading and is intended to assist during the proposal process in developing your concept design. It is not intended to alleviate the need to do array-specific structural calculations during the subsequent design phases. If new carports are proposed, include structural calculations for the proposed design.
  1. **Registration seals:** Each final working drawing and each submitted specification and calculation document shall be signed by, bear the seal of, and show the state certificate number of the architect and/or engineer who prepared the document and/or is responsible for its preparation.

## DESIGN SUBMISSIONS

The awarded contractor will secure from governing agencies and the utility company all required rights, permits, approvals, and interconnection agreements at no additional cost to ***[Developer/Entity name]****.* The awarded Contractor will complete and submit in a timely manner all documentation required to qualify for available rebates and incentives.

* 1. **Design reviews:** For each design/drawing submission, **[*Developer name*]** reserves the right to make comments and request changes after the receipt of the submission. Reviews will be made by **[*Developer/Entity name*]** staff. As part of its review, **[*Developer/Entity name*]** may offer submission reviews to local code officials. **[*Developer/Entity name*]** shall provide review comments within **[*Number of days*]** calendar days of receipt of the 75% design development submission and the 100% check set submission.
  2. **Purpose: [*Developer/Entity name*]** will review the contractor design submissions to verify adherence to contract requirements. Design reviews by **[*Developer/Entity name*]** are not to be interpreted as resulting in approval of the contractor's apparent progress toward meeting contract requirements but are intended to discover any information that can be brought to the contractor's attention that might prevent errors, misdirection, or rework later in the project. The contractor shall remain completely responsible for designing, constructing, operating, and maintaining the project per the requirements of this statement of work.
  3. **Resolution of comments:** The contractor shall respond to all design review comments in writing, indicating one of the following: (1) adoption and action taken, (2) adoption with modifications and action taken, (3) alternative resolution and action taken, or (4) rejection. In cases other than unqualified adoption, the contractor shall provide a statement as to why the reviewer's comment is inappropriate. If the contractor believes that any **[*Developer/Entity name*]** design comments or requested changes will result in a change in the contract cost, they shall notify **[*Developer/Entity name*]** within seven calendar days of receiving the comment(s) and provide a detailed cost estimate of anticipated contract modifications. Rejection items shall not go forward to the construction phase until adequate resolution to the rejected item has been approved by **[*Developer/Entity name*]**. Design review comments shall not relieve the contractor from compliance with the terms and conditions of this contract. The contractor's comment resolution shall be transmitted to **[*Developer name*]** within seven (7) calendar days of comment receipt and incorporate discussions from the scheduled design comment review meetings.

## UTILITY INTERCONNECTION AGREEMENT

* 1. The contractor shall coordinate with UTILITY to ensure that the project satisfies all UTILITY criteria for interconnection of the project to the UTILITY electric distribution system. This includes coordinating all negotiations, meeting with UTILITY, design reviews, and participating in any needed interaction between UTILITY and ***[Developer/Entity name]***.
  2. The contractor is responsible for preparing the required submissions for obtaining the net energy metering (NEM) and interconnection agreement from the utility. ***[Developer/Entity name]*** will sign the NEM and interconnection agreements, not the contractor.
  3. The contractor shall manage the interconnection and start-up of the project in coordination with the site and UTILITY. The contractor shall at its own expense pay any interconnection, processing, and other fees and expenses as may be required by UTILITY for interconnection and operation of the project.

## QUALITY CONTROL PLAN

* 1. **Content:** For each performance and installation requirement, the QCP shall identify the item/system to be tested, the exact test(s) to be performed, measured parameters, inspection/testing organization, and the stage of construction development when tests are to be performed. Each inspection/test shall be included in the overall construction schedule. The contractor is not relieved from required performance tests should these not be included in the plan.

The QCP is intended to document those inspections and tests necessary to assure **[*Developer/Entity name*]** that product delivery, quality, and performance are as required. It also serves as an inspection coordination tool between the contractor and **[*Developer/Entity name*]**. An example of these inspections/tests is the final test/inspection for overall performance compliance of the system. Results from tests and inspections shall be submitted within 24 hours of performing the tests and inspections.

At a minimum, the QCP should conform to “IEC 62446 Grid Connected Photovoltaic Systems-Minimum Requirements for System Documentation, Commissioning Tests, and Inspections (2009)”.

Performance tests will be conducted at the final commissioning/acceptance testing and one year after the acceptance date. Performance tests will include I-V curve traces for all PV strings. For project acceptance, measured performance at maximum power point must be at least 90% of expected performance, which will be adjusted for concurrently measured cell temperature and plane of array (POA) irradiance. This can be accomplished using a current industry standard I-V curve tracer with the capability to compare measured PV string I-V curves with nameplate performance of PV string compensated for concurrent cell temperature and POA irradiance measurements. If performance is less than 90% at the one-year performance tests (measured using the same method as for project acceptance), the contractor shall promptly troubleshoot and correct any malfunction or issues as necessary to return the project to 90% measured performance or better. The contractor shall supply ***[Develop/Entity name]*** with detailed documentation of malfunction or errors and all corrective actions taken.

* 1. **Submissions:** The QCP shall be prepared and submitted within 21 calendar days of the post-award conference meeting and prior to any construction on-site. The QCP may be rejected as incomplete and returned for resubmission if there is any performance, condition, or operating test that is not covered therein.
  2. **Updating:** During construction, the contractor shall update QCP if any changes are necessary due to any changes or schedule constraints. ***[Developer/Entity name]*** shall be notified immediately of any schedule and/or procedural changes.

## SOLAR ELECTRIC MODULE ARRAY

* 1. **Photovoltaic modules**
     1. PV modules shall be a commercial off-the-shelf product and shall be as per NEPQA latest standard.
     2. The PV modules shall be installed such that the maximum amount of sunlight available year-round on a daily basis should not be obstructed. At a minimum, all PV arrays shall be shade-free from 9 a.m. until 3 p.m. (solar time). All projects must include documentation of the impact from any obstruction on the seasonal or annual performance of the solar electric array.
     3. The solar electric system shall produce the minimum annual AC energy output. If the system is proposed to produce more than the minimum required energy output to reduce the cost per delivered kWh then the system shall produce the “proposed” energy. The output will be adjusted if the actual yearly solar insolation received is less than that indicated by [simulation software] or any other simulation software. A normalizing calculation will be made to correct the output, so a contractor is not penalized for an extremely cloudy year.
     4. System wiring shall be installed in accordance with the provisions of the NEC or IS standard or national building code.
     5. All modules installed in a series string shall be installed in the same plane/orientation.
     6. PV modules shall have a 25-year limited warranty that modules will generate no less than 80% of rated output under STC. PV modules that do not satisfy this warranty condition shall be replaced.
     7. Panel installation design shall allow for the best ventilation possible of panels to avoid adverse performance impacts.
     8. Provide **[*Developer/Entity name*]** with 1% extra PV panels.
     9. Warranty. Provide a panel manufacturer’s warranty as a minimum: No module will generate less than 90% of its specified minimum power when purchased. PV modules shall have a 25-year limited warranty guaranteeing a minimum performance of at least 80% of the original power for at least twenty-five (25) years. Measurement made under actual installation and temperature will be normalized to standard test conditions using the temperature and coefficients published in the module specifications.
  2. **Inverter and controls**
     1. Each inverter and associated controls shall be properly installed according to manufacturer’s instructions.
     2. Inverters shall be commercial off-the-shelf product, compliance to IEC certifications and IEEE 1547.

The inverter shall have at a minimum the following features:

* IEC Certifications
* Peak efficiency of 96% or higher
* The inverter shall have operational indicators of performance and have built-in data acquisition and remote monitoring.
* The inverter shall be capable of parallel operation with the existing AC power. Each inverter shall automatically synchronize its output waveform with that of the utility upon restoration of utility power. Also, the anti-islanding function shall be present.
  + 1. Warning labels shall be posted on the control panels and junction boxes indicating that the circuits are energized by an alternate power source independent of utility-provided power.
    2. Operating instructions shall be posted on or near the system, and on file with facilities operation and maintenance documents.
    3. Provide detailed lock-out/tag-out instructions for all equipment.
    4. Power provided shall be compatible with onsite electric distribution systems.
    5. Install inverters and control panels in the most optimum locations with appropriate environmental protection. Roofs may be used if structurally sufficient. If inverters are mounted outside, they shall be shaded from direct sun from 10 a.m. to 6 p.m. and be able to be secured.
    6. The inverter and system shall utilize an astronomical timer or other means to shut down the inverter during nighttime to avoid energy usage at night.
    7. Warranty: A 10-year manufacturer’s warranty shall be provided.
  1. **Control panel to solar electric array wire runs**
     1. Areas where wiring passes through ceilings, walls, or other areas of the building shall be properly restored, booted, sealed, and returned to their original condition.
     2. All wiring between carports and the point of interconnection shall be underground and meet applicable codes.
     3. Thermal insulation in areas where wiring is installed shall be replaced to “as found or better condition.” Access doors to these areas shall be properly sealed and gasketed.
     4. All field electrical devices shall have the capability to be locked as appropriate.
  2. **PV monitoring**
     1. The PV systems installed shall provide for monitoring by ***[Developer/Entity name]*** as well as by the general public on a vendor-provided website. The public site is intended for education and outreach regarding renewable energy production and information on avoided greenhouse gas production. The public site shall be maintained for ten years.
     2. Monitor by an IP addressable device and displayed graphically in a user-friendly manner the following parameters:
* AC energy
* Solar irradiance
* Show the status of all equipment
* Provide electrical one line showing operation and performance of all equipment
* Temperature (ambient and cell), humidity

Data shall be available both in real-time and archived in 15-minute averages. All monitoring hardware and monitoring equipment shall be provided by the contractor.

The system shall also include metering for remote data collection and display on the vendor-provided website of system performance. System performance shall allow display during different monitoring periods from one hour to one year.

* + 1. Provide networking equipment, engineering, programming, wiring, and software to allow remote connection by ***[Developer/Entity name]*** to the local area network.
    2. Meters shall be installed in the main distribution panel (MDP) when possible. Meters shall not be mounted to the transformer housing without prior approval when there is no other reasonable place to mount it.
  1. **Structural requirements** 
     1. All structures, including array structures, shall be designed in accordance with all applicable state and local codes and standards.
     2. The contractor shall provide structural calculations, stamped by a licensed professional structural engineer in the appropriate state.
     3. All structural components shall be non-corrosive (galvanized steel, stainless steel, or aluminium). All hardware shall be stainless steel or aluminium. All components shall be designed to obtain a minimum 40-year design life.
     4. ***[Include for roof mounted systems]*** All roof penetrations shall be designed and constructed in collaboration with the roofing professional or manufacturer responsible for the roof and roofing material warranty for the specific site. The number and size of the penetrations necessary to extend the power and control cable into the building must be kept to a minimum and grouped in a single location when practicable. All roof installations and weatherproofing of penetrations shall not compromise the roof warranty, or if the roof has no warranty, accepted best practice. The roof penetrations and roof connections shall be warranted for weather tightness for ten (10) years from the installer including parts and labour.
     5. [Include for roof mounted system] Rooftop installations where there is no parapet or the parapet is very less, a safety zone from the roof edge to the PV system shall be maintained. A clear path of travel shall be maintained to and around all rooftop equipment. The design shall address access for maintenance and replacement of the equipment. Appropriate fall protection or temporary platforms shall be incorporated into the design to allow for this maintenance and replacement work. If the inverters are mounted on the roof this equipment shall have permanent access walkways installed to facilitate monitoring and maintenance.
  2. ***[Include for roof mounted system]*** **Attachment to roof**
     1. [Include for roof mounted system] The system shall be mounted using the best means practicable, such as direct attachment or a fully ballasted system. All penetrations and structural connections associated with supports and conduit shall be kept to a minimum and shall be water-proof.
  3. Lightning Protection: Provide surge protection on all electrical systems.
  4. **PV system installation warranty:** The PV systems shall carry a ten (10) year workmanship warranty by both the manufacturer and the installer including parts and labour.

## SHOP DRAWINGS/PRODUCT DATA

* 1. **Submissions:** The Contractor shall submit shop drawings and product data/submittals, catalogue cuts, etc. as stipulated herein. Shop drawing/product data submissions to ***[Developer/Entity name]*** shall be made after review and approval by the contractor. All approved product data and shop drawings shall be delivered to ***[Developer/Entity name]*** in one submission electronically.

The contractor shall combine all product data submission material into hard-copy manuals for reference during all phases of construction. Shop drawings shall be bound with product data.

See also electronic project management requirements in Section 1, General requirements.

* 1. **Reviews:** Reviews of shop drawings and product data by ***[Developer/Entity name]*** are not to be interpreted as an approval of the contractor's product selections. The contractor shall remain completely responsible for constructing the PV system in accordance with all contract performance requirements.
  2. **Products for submission:** The contractor shall provide shop drawings and product data for all systems, equipment and materials

## INSPECTIONS AND TESTS

* 1. **General:** The contractor shall perform inspections and tests throughout the construction process including existing conditions/needs assessments, construction installation placement/qualification measurements, and final inspections/tests performance certification. Periodic “quality” inspections shall also be conducted to support progress payments as identified in the contractor’s QCP.
  2. ***[Developer/Entity name]* Witness:** All inspections and tests, to verify documented contract assumptions, to establish work accomplishment, or to certify performance attainment shall be witnessed by ***[Developer/Entity name]*** and/or construction management (CM) and coordinated through the QCP.
  3. **Final inspections and tests:** In order to ensure compliance with provisions of the NEC, an inspection by a licensed electrical inspector is mandatory after construction is complete. Unless otherwise identified, manufacturer recommendations shall be followed for all inspection and test procedures. The NEC inspection shall be conducted by an independent third-party electrical inspector familiar with PV systems. Provide qualifications of the proposed third-party inspector for review and approval prior to conducting the NEC inspections.

Tests shall include a commissioning of the array. Commissioning tests shall conform with the requirements in Section 7 (QCP). Commissioning shall be performed for the entire PV system. This data shall be used to confirm the proper performance of the PV system.

* 1. **Documentation:** Inspections/tests required in the QCP shall result in a written record of data/observations. The Contractor shall provide two (2) copies of documents containing all test reports/findings. Test results shall typically include the item/system tested, location, date of the test, test parameters/measured data, state of construction completion, operating mode, contractor inspector/ ***[Developer/Entity name]*** witness, test equipment description, and measurement technique.

## PROJECT CLOSEOUT

* 1. **Preparation for final inspection and tests:** The following steps shall be taken to ensure the project is in a condition to receive inspections and tests.

Finalize record drawings and manuals, indicating all “as-built” conditions.

* 1. **Record drawings:** The contractor shall maintain on-site the working record drawings of all changes/deviations from the original design. Notations on record drawings shall be made in erasable red pencil or other colour to correspond to different changes or categories of work. Marked-up drawings shall always be maintained at the contractor's on-site construction office, available for ***[Developer/Entity name]*** to review. Record drawings shall note related change order designations on impacted work. When shop drawings indicate significant variations over design drawings, shop drawings may be incorporated as part of record drawings. A review of record drawings may be required before monthly payments can be processed.
  2. **As-built drawings and specifications:** The contractor shall provide "as-built drawings" and documents based upon actual site installation. Should ***[Developer/Entity name]*** determine that variations exist between the finished construction and the as-built drawings, the contractor shall correct the drawings to the satisfaction of ***[Developer/Entity name]***.

The contractor shall submit six (6) hard copies and two (2) CDs containing the “as-built” drawings and specifications as CAD and PDF files.

* 1. **Warranties and guarantees:** Submit specific warranties and guarantees, final certifications, and similar documents to ***[Developer/Entity name]*** upon substantial completion and prior to final payment. Include copies of the operations and maintenance manual. All warranties shall be signed by a principal of the contractor’s firm and sealed if a corporation.
  2. **Maintenance manual:** Provide a detailed operation and maintenance manual including a diagram of system components, description of normal operation; description of operational indicators and normal status of each, table of modes of operation, safety considerations, preventative maintenance requirements, troubleshooting and corrective actions; sources of spare parts and cut-sheets for all components. The contractor shall prepare six (6) hardcopies and two (2) CDs containing the detailed maintenance manual. Submit to ***[Developer/Entity name]***.
  3. **Spare parts:** The contractor shall provide a recommended list of spare parts. At the minimum, a set of combiner box fuses for each array shall be provided along with the required spare panels noted in Section 8.
  4. **Demonstration and training:** Provide ***[Developer/Entity name]*** approved training for designated personnel in the operation of the entire photovoltaic energy system, including operation and maintenance of inverter(s), transfer switches, panel board, disconnects, and other features as requested by ***[Developer/Entity name]***. Instruct the designated ***[Developer/Entity name]*** personnel in the removal and installation of panels, including wiring and all connections. Provide ***[Developer/Entity name]*** with written instructions and procedures for shut-down and start-up activities for all components of the system. ***[Developer/Entity name]*** shall be permitted to video tape this training for official use.

## OPERATIONS AND MAINTENANCE SERVICE

* 1. Provide operation and maintenance of the solar array systems for one year. Work shall include all manufacturer-recommended maintenance as well as a 12-month performance commissioning as outlined in in section 7.1 (QCP). ***[Developer/Entity name]*** shall be invited to witness all performance commissioning. A maintenance log shall be maintained to note dates, equipment and issues being resolved. Contractor should be available within 48 hours to respond to natural disasters (extreme storms, hail, wind events) to inspect the array for damage.