

Technical Specifications for Photovoltaic Power Systems U.S. Virgin Island Energy Office

Request for Quotation

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1. PART I – Photovoltaic Back-up Power Systems

1.1 Introduction

This request for quotation covers the turnkey installation of photovoltaic power systems and equipment to be installed at residential, commercial and government facilities in the U.S. Virgin Islands. The intent of this specification is to detail project requirements, and to give the bidder a clear understanding of customer expectations and overall requirements for these projects. Forms and instructions for submitting bids and required information are also included in this document, and must be provided with any bids.

1.1.1 General Project Requirements

The following outlines general requirements of bidders for these projects. Additional details are provided throughout this document.

- Provide and install complete photovoltaic (PV, solar electric) power systems
- Specify layout and location of the systems at each site
- Deliver, assemble and install the equipment at each site
- Conduct acceptance testing on each system and a minimum of one-hour training for each site on the operation and maintenance of the system
- Provide required documentation and System Manual (System Design Review and Approval required – see below).
- Minimize the risk of vandalism, theft and personal injury in the installation and operation of the systems
- Systems should require no regular maintenance except for battery maintenance (as required) and scheduled replacement of batteries, as required (3-year minimum)

1.1.2 Schedule

- Installation and operation of these systems shall be completed within 90 days after contract award. Variances to this timeline may be granted due to availability of equipment, or customer or site constraints identified and agreed to by the VI Energy Office.
- Contractor must coordinate installation schedule with the U.S. Virgin Islands Energy Office and those individuals responsible for each site.

1.1.3 Proposal Requirements and Award Criteria

The following outlines requirements for responsive proposals. Sufficient detail on these items must be provided for consideration in this quotation. At a minimum, each proposal must include:

- Completed Contractor Information Form – include experience and qualifications, field experience, references and applicable licenses
- Completed Photovoltaic Power Systems Request for Quotation Form - include price for equipment and installation, and total price
- Proposed schedule for completing installations

Any or all of the individual applications (projects) may be bid. However, if only bidding for some projects, the bidder must clearly state which projects are being bid, and which are not. Although the site conditions are somewhat varied, the basic requirements for the equipment and installations are essentially the same. Therefore, it is requested that a single bid price be offered for each size system requested, applicable to any of the sites.

Evaluation criteria for proposals shall be weighted according to:

- Quality of the design in meeting the performance requirements and in reducing the risk of vandalism, theft, storm damage and personal injury (20%)
- Total price (50%)
- Capability of the bidder to satisfactorily implement the project (20%)
- Aesthetics (10%).

Payment for this contract will be in two parts. Because equipment is expected to be a high percentage of overall project costs, sixty (60) percent of payment will be made upon contract award and completion of the System Design Review and Approval. The final forty (40) percent will be paid upon satisfactory completion of the installation, acceptance testing, training and submittal of required System Manual.

Proposals must be delivered no later than eight weeks after the effective date of this bid document to:

VI Dept. of Planning and Natural Resources
Virgin Island Energy Office
#45 Mars Hill
Frederiksted, St. Croix 00840
Attn: Mr. Bevan Smith, Program Administrator (340) 773-1082 xt. 2254

1.1.4 Site and Application Descriptions

This request for quotation calls for the turnkey installation of photovoltaic power systems at residences and facilities on the islands of St. Croix, St. Thomas and St. John in the U.S. Virgin Islands. Prevailing conditions at these sites should be considered in any bids, including environmental conditions, system and equipment locations, shading, accessibility, and potential for vandalism or theft of components. Each site has acceptable solar access and suitable locations for installing PV arrays and equipment. The contact individual responsible for each site will work with the contractor to determine specific locations for the PV array and power processing equipment. The Appendix provides details and information about the sites.

Site visits by bidder and interviews with designated site managers are highly recommended and strongly encouraged.

1.2 System Configurations and Operational Requirements

Each photovoltaic power system covered in this RFP shall include an array of PV modules and support structures, a battery bank and enclosure, an inverter/charger and battery charge controllers, and associated balance-of-system (BOS) components including wiring, conduit, disconnects, overcurrent devices, surge suppression and grounding equipment, load sub panels and metering equipment.

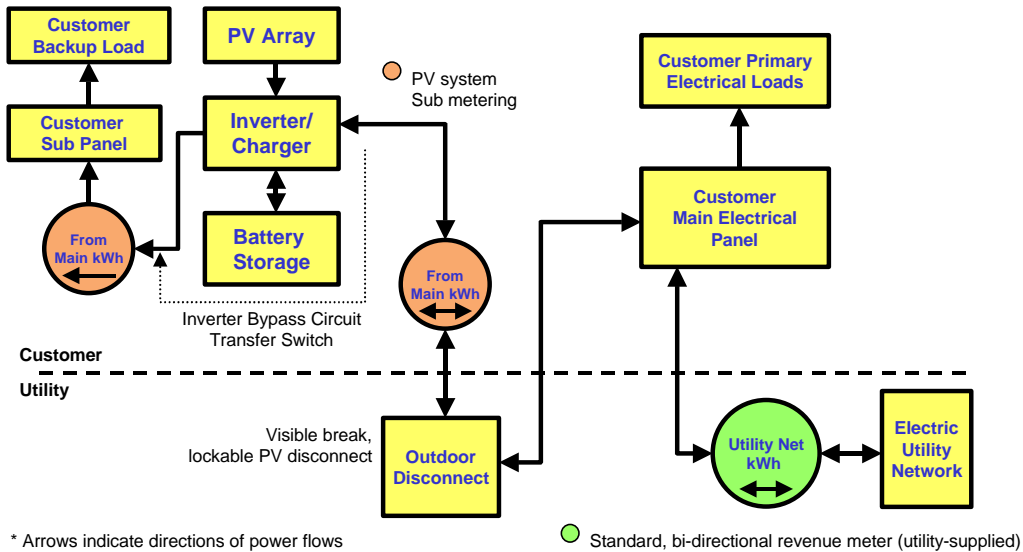
The PV power systems shall be installed as such, and must be capable of operation in either stand-alone mode, or interconnected in parallel with the utility supplied electrical service to the facility. The inverter/charger shall be designed specifically for operation with battery subsystems. Pending approval by the utility, systems may be interconnected with the utility grid at a later date.

To reduce costs, and to improve the prospects for long-term reliable operation of these systems, and to facilitate later interconnection of these systems to the utility grid, the systems and equipment bid for these projects should be similar for each site. Although site conditions and customer preferences will dictate the specific locations and configurations of the systems and equipment at each site, the specifications outlined in this document seek to standardize these configurations as much as possible.

As configured initially, the inverter/charger and battery system will be connected to the grid for battery charging purposes and load consumption only, and will not feed excess energy back into the utility network. Under normal circumstances, the inverter sub panel loads will be powered directly from the battery subsystem and inverter, which is recharged from either the PV array or utility grid. In the event the battery becomes discharged below the specified DOD limit, the inverter will transfer the loads connected to the inverter sub panel to utility power, and the batteries will start being recharged. Once the battery has been recharged to a pre-determined limit, the system will again power the sub panel loads from the inverter/battery system.

At a later date, and after approval from the utility, the system programming may be reconfigured to operate the system in parallel with the utility grid, allowing excess PV array energy not required for battery charging to power on site loads directly from the inverter, and send any excess energy back to the utility grid. This configuration is ultimately more desirable and efficient than the stand-alone mode of operation, and always maintains the batteries at full state of charge, extending their service life. In this mode of operation, in the event the grid becomes de-energized, control circuitry in the inverter opens the connection with the utility through a bus transfer mechanism, and operates the inverter from the battery to supply power to the dedicated critical load circuits only. This mode is similar to typical uninterruptible power supply (UPS) operation used for computers, communications and other critical equipment, and these loads are supplied from the dedicated inverter load sub panel. Under this back up scenario, a fully charged battery system is always available at the time of power outages, and the PV array is available to charge the batteries and sustain some level of critical loads for the customer during extended outages.

The equipment required in this bid, the desired system configuration, and the interfaces with other components and the customer's electrical service are identified in the diagram below.



1.3 Equipment Requirements

All PV power system designs supplied for these projects must have a design review and approval from the Florida Solar Energy Center (FSEC). For systems and equipment not already approved at the time of the bid, the bidder shall submit the required documentation for design review and approval prior to installation. There are no fees associated with this design review and approval.

For information on FSEC-approved PV systems, including design review and approval requirements, the process, and procedures for submitting designs for review, please see:

<http://www.fsec.ucf.edu/PVT/BuyInstallPV/pvapprovals/index.htm>

Criteria for system approvals are based on applicable codes and standards, and consistency with industry accepted design practices. Evidence to support these criteria must be contained in the supplier's *System Manual*, which shall include all applicable information concerning the equipment and installation. All systems installed under this project shall have a complete System Manual at the time of acceptance tests and end-user training. Systems already having FSEC-approval are supplied with a complete System Manual as part of approval requirements, and address many of the project requirements outlined below.

1.3.1 Photovoltaic Modules and Array

Two sizes of photovoltaic arrays must be bid for each installation, one with an output of at least 1 kWp DC at STC, and the other at least 2 kWp DC at STC. Decisions on which size array to be installed at each site will be based on overall budget availability, site considerations and customer needs at the time of a contract award. Some customer's may elect to add some of their own funds to increase the size of the PV array they will receive, and this will be negotiated with the bidder and customer at the time of contract award.

The PV modules used in these systems must meet industry-accepted standards for performance, reliability, safety and other considerations as outlined below:

- All PV modules shall meet or exceed the requirements of IEEE Standard 1262-1995 Recommended Practice for Qualification of Photovoltaic (PV) Modules and Underwriters Laboratories (UL) Standard 1703 Standard for Safety for Flat-Plate Photovoltaic Module, or equivalent standards.
- Either crystalline or polycrystalline silicon flat-plate PV modules are preferred; although thin-film PV modules will be considered if their performance, size and warranties are consistent with the site conditions and further requirements outlined in this document.
- Unless otherwise specified or dictated by site conditions and customer preferences, all PV arrays should be oriented facing from southeast to southwest, at tilt angles between 10 and 30 degrees from horizontal for maximum solar energy exposure. Wherever possible, arrays should be located to prevent shading from trees, poles or other structures at anytime between 9am and 3pm solar time, any day of the year.
- Due to expected high wind loads, and subsequent potential for damage from flying debris, all PV arrays must be securely installed to the facility roof or ground-mount structure as dictated by site conditions.
- To promote cooling and to maximize air circulation around PV arrays, rooftop mounted arrays should have a minimum of 3 inches between the top surface of the module and roof surface, with no obstructions preventing air flow between (beneath) the array and roof surface.

1.3.2 Batteries and Charge Control

The batteries used for these applications must be capable of sustained operation in a warm, tropical climate, and must deliver at least three (3) years of service while maintaining at least 50 percent of their initial rated capacity. Two sizes of battery systems shall be provided in any bid and specified for each system offered, including one option for at least 4 kWh of storage, and another option for at least 8 kWh of storage.

Under no circumstances shall flooded lead-acid batteries be installed in any conditioned space or living/working areas of homes or facilities. Where batteries must be located in these areas, sealed, valve-regulated lead-acid VRLA types must be used. For this reason, it is expected that most bids will offer sealed lead-acid (VRLA) batteries, however, flooded lead-acid types will be considered if the bidder can clearly demonstrate that these batteries will not require maintenance or water additions more than once a year. To meet this requirement for flooded batteries, the batteries must be purpose-built photovoltaic batteries and have adequate reserve electrolyte volume, and incorporate special battery caps to prevent excessive water loss from the batteries.

All systems must include battery charge control to protect the battery from overcharge and overdischarge, with appropriate control set points for the type of battery used. Specifications and sources of batteries and controls needed for replacement must be clearly identified, set appropriately, and documented in the System Manual.

Following are additional requirements for the batteries and charge control:

- Nominal battery and system operating voltage shall be either 24 or 48 volts DC.
- Maximum allowable depth of discharge (DOD) should be no more than 75 percent of the nominal battery capacity for the given discharge rates. The specification of the inverter low battery transfer voltage should be consistent with this maximum allowable DOD for the battery.
- Battery enclosures should be designed to minimize large temperature variations of the battery, and to protect the batteries from creating a hazardous condition. When located outdoors, shading from direct sunlight, and surface coating of battery enclosure should be used to minimize direct solar gain and heating of the battery subsystem. Battery subsystem design and location should minimize the risk of electrolyte spills, corrosion, fire, vandalism, theft and personal injury, and be accessible to maintenance and service personnel.
- Battery charge control must be used between the PV array and batter bank. All charge controllers must have appropriate listing from UL or other recognized laboratory. Any type of charge algorithms are acceptable, however constant voltage or (pulse-width-modulated) PWM type controls are preferred. Either series or shunt type switching is acceptable, and the regulation switching elements must be solid-state (not electro-mechanical relays). The charge regulation set points must be specified, and be consistent with the type and size of battery used.
- Battery charge voltage temperature compensation must be provided as part of the charge controller and inverter/charger circuits, either on board or via an external probe, and the temperature compensation coefficients must be appropriate for the type of battery used.

1.3.3 Inverter and Battery Charger

Each system shall include an inverter/battery charger with a peak rated AC output of at least 4 kW, with a nominal AC output voltage of 120V single-phase or 120/240V split-phase, at 60 Hz. The inverter/charger shall be designed specifically for operation with battery subsystems, and be capable of automatic and continuous operation either in stand-alone mode, or interconnected in parallel with the electric utility service to the site. Initially, the inverters and systems shall be configured to operate in stand-alone mode. Pending approval by the utility, systems may be interconnected with the utility grid at a later date.

As configured initially, the inverter/charger and battery system will be connected to the grid for battery charging purposes and load consumption only, and will not feed excess energy back into the utility network. Under normal circumstances, the inverter sub panel loads will be powered directly from the battery subsystem and inverter, which is recharged from either the PV array or utility grid. In the event the battery become discharged below the specified DOD limit, the inverter will transfer the loads connected to the inverter sub panel to utility power, and the batteries will start being recharged. Once the battery has been recharged to a pre-determined limit, the system will again power the sub panel loads from the inverter/battery system.

Following are other specific requirements for the inverter/ battery charger subsystem and components:

- Each inverter/charger shall be compliant with IEEE Std. 929-2000 (Recommended Practice for Utility Interface of Photovoltaic Systems) and be listed to UL Standard 1741 (Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems) by a recognized conformity assessment laboratory. Any ancillary equipment or modifications of inverter hardware required to install the inverter in parallel with the utility grid to meet the above standards must be provided with the inverter.
- A bypass circuit shall be provided as part of the inverter/charger power-processing package. These bypass breakers shall allow isolation of the inverter, battery and PV array components from the rest of the customer's electrical system, and allow electrical loads connected to the load sub panel to be directly powered from the customer's primary electrical service.
- For inverters that only produce 120V single-phase output, the inverter AC input shall be connected to a dedicated single-pole overcurrent device (circuit breaker) at the customer's main electrical panel. For inverters that produce 120/240-volt split-phase, the inverter AC input shall be connected to a double-pole overcurrent device with appropriate ratings. These circuit breakers shall be fastened into the panel such that they cannot be removed by simply pulling on the breaker, and clearly labeled as the inverter AC input connection to the customer's electrical service.
- Special attention should be paid to voltage drop between the inverter and battery system. Oversize cables are strongly recommended to minimize voltage drop and to achieve maximum inverter efficiency. Maximum distance between the inverter/charger and battery shall be no more than eight (8) feet.
- Battery charge voltage temperature compensation must be provided as part of the inverter/charger circuit, using an external temperature probe, and the temperature compensation coefficients must be appropriate for the type of battery used.

1.3.4 Electrical Loads

A standard main-breaker 60-amp 120/240-volt AC electrical load sub panel shall be provided on the AC output circuit of the inverter for each system. This sub panel shall be installed on the customer's premises, in a location adjacent to the existing electrical panel. It is the responsibility of the installer and end-user to identify which existing load circuits are to be connected to this sub panel, based on the requirements outlined below.

For inverters that only produce 120V single-phase output, the inverter AC output shall be connected to a single-pole 60-amp overcurrent device (circuit breaker) in the inverter sub panel, and the panel shall be wired such that both halves of the panel are supplied by the single 120-volt output of the inverter (L1 and L2 are connected). Inverters with only 120-volt output must not be connected to any multi-wire branch circuits. For inverters that produce 120/240-volt split-phase, the inverter AC output shall be connected to a double-pole 60-amp overcurrent device in the sub panel, which feeds 120-volts to both halves of the panel, and provides 240-volts between L1 and L2.

The electrical load panel should be clearly labeled to identify it as the critical load sub panel connected to the inverter output, and which is served directly from the customer's main electrical panel when the inverter/battery subsystem is in bypass mode. All critical loads connected to branch circuits on the inverter sub panel must be clearly identified and labeled on the panel.

Following is additional information concerning the installation of the load sub panel and the connected electrical circuits:

- At the customer's preference, certain critical loads currently operating from existing utility-supplied electrical panels may be added to the inverter sub panel. New branch circuits may also be added to this sub panel, and is an added responsibility of the customer. To facilitate these circuit changes and additions, existing branch circuit conductors in electrical panels shall remain in place and removed from the existing breakers. Additional conductors shall be spliced/connected to these existing branch circuit conductors, and routed through conduit to the new inverter sub panel as required. In the event the PV system and equipment is ever removed, the existing load circuits can be restored to the original electrical panels as needed.
- It is paramount that the cumulative connected peak load to the inverter sub panel does not exceed 4 kW (or the maximum inverter output rating), when all loads are operating simultaneously. Failure to adhere to this provision may result in the inverter shutting down frequently from over temperature or overcurrent conditions.
- When the system is initially operating in stand-alone mode, the average daily energy use (kWh) of the load connected to the inverter sub panel should be consistent with the expected average daily energy production from the PV array. As a rule of thumb, the load should be limited to no more than 4 kWh/day for each kWp of installed PV array capacity at STC. Daily loads in excess of this amount will severely discharge and cycle the batteries, and require excessive battery charging backup power supplied from the utility grid, which is a much less efficient process than powering these loads directly from the grid. Later, when the system can be operated in grid-connected mode, the average daily energy use of the sub panel loads is less important, but must still be limited to no more than 4 kW peak, or the maximum rated inverter output, especially when the system operates in stand-alone mode.
- All loads connected to the inverter sub panel shall be 120 volts AC. Use of any electric resistive loads, such as electric stoves, heaters, dryers, toaster ovens and the like is strongly discouraged. 240-volt AC loads shall not be served from this load sub panel. It is the installer's responsibility to properly educate the end-user on the efficient use of electrical loads and the operation of the system.
- Due to the low efficiency, safety issues and problematic occurrences with many un-listed low voltage DC loads, these systems will not have provisions to serve DC loads/appliances at 12-volts or any other voltage.
- A standard utility watt-hour meter socket and enclosure shall be provided between the inverter AC output and the critical load sub panel, and must include a simple bi-directional mechanical utility watt-hour meter, wired for operation at 120 V or 120/240 V, as applicable. The display for this watt-hour meter shall read in digits, as opposed to dial readings. This meter must be installed within the customer's premises, and should be labeled as "Energy to Critical Load Sub Panel".

1.3.5 Replacement and Spare Parts

All system components must be clearly specified as to the type, manufacturer, and model number for later needs for replacement and service as required, and documented in the System Manual. Sources for this equipment should also be identified. It is highly recommended that the supplier/installer either maintain or have a ready source for replacement components for each system as needed for required warranties or service.

Following are spare parts must be supplied with each system:

- Complete set of replacements fuses of the same type and rating for all fuses used in the system.

1.4 System Documentation and Installation Requirements

1.4.1 System Documentation Requirements

It is paramount that the installer and system supplier provides a complete documentation package and a System Manual to the end-user and operator of each system at the completion of these projects. An additional copy of this System Manual is required for the VI Energy Office for each type of system supplied, and must be delivered and completed prior to installation.

For systems already having FSEC approval, a complete System Manual is available from the suppliers/manufacturers, and meets the requirements for documentation listed below. For systems or designs not already having approvals, the following materials must be submitted for review and approval prior to commencing installation of the systems.

At a minimum, the following items must be supplied as part of this System Manual:

- Overview of major system components, principles of operation and safety considerations
- Complete parts lists and specifications for the overall system and individual components, including all electrical components, mechanical hardware and other equipment required for installing the systems
- Diagram indicating overall layout of entire system, including PV array, and location of BOS hardware and inverter and battery subsystems with respect to the array and building facilities.
- Electrical schematics and diagrams showing all major components and devices, including conductor types and sizes, connections of individual modules and array source circuits, inverters, batteries, terminations at junction boxes, and connections to the customer's electric service and utility grid.
- Mechanical drawings showing details of module/array mechanical support structure and instructions for assembling/disassembling and installing arrays on rooftops or the ground as required
- Complete assembly and installation instructions for mounting array, junction boxes and enclosures, routing conduit, wiring arrays, and terminating conductors at array, combiner boxes and inverter/battery system
- Procedures for operating, disconnecting, servicing and maintaining complete system and individual components
- Warranty information on individual components as required in this bid document
- All equipment manufacturers' specifications and operations manuals, including those for PV modules, inverterchargers, charge controllers and BOS equipment.

1.4.2 **Electrical Design and Installation Requirements**

The electrical design and installation of all PV systems shall conform to the 2002 National Electric Code (NEC, NFPA 70). Article 690 of the NEC applies specifically to photovoltaic system safety, protection, control and interface with other sources. Other articles of the NEC also apply. The PV system electrical design shall also comply with the IEEE Std. 1374-1998 (Guide for Terrestrial Photovoltaic Power System Safety).

Following are specific electrical requirements for these systems and installations:

- All equipment and electrical hardware used in these systems, including overcurrent protection, disconnects, surge suppression devices, conduit, wiring and terminals, must be approved, recognized, or listed for the intended application by UL or other recognized laboratory, and have appropriate voltage, current and temperature ratings for the application.
- Inverters, controllers and PV modules must have specific listings as noted elsewhere in this document. All circuit breakers, fuses and disconnects must be listed or recognized for use in DC circuits where applicable. Equipment only rated for use in AC circuits will not be permitted for use in DC circuits.
- All wiring (conductors) must be properly sized and rated for the application, including ampacity (including temperature and other deratings), location/application (exposure to elements, enclosure) and voltage drop. Conductor ampacities for all PV array source circuits must be based on both NEC and UL derating factors (156%). All other system conductors must be derated 125% according per the NEC. Voltage drop in array DC source circuits should be limited to no more than 5 percent, including losses in conductors, and through all fuses, blocking diodes and termination points as applicable. All wiring shall be listed for a minimum operation up to 600 volts and temperature rating of 90° C in wet locations. With exception of the PV module interconnect wiring, the use of any exposed conductors or cabling (excluding grounds) is not acceptable. All conductors must either be installed in conduit or directly buried in the earth, as applicable.
- PV module interconnect wiring must be sunlight-resistant USE-2 or equivalent rated conductor, and must be attached to module junction boxes using weather tight strain relief. The module wiring interconnections shall use a connector device that allows quick assembly and disassembly of the arrays under no load conditions. These connectors must be UL-listed, and be weather-sealed, guarded and polarity protected.
- With the exception of module interconnect wiring, all terminations must use listed box terminal or compression type connections, and must be made within an appropriate junction box or enclosure. Exposed, field splices between conductors will not be permitted. Twist on wire splices, crimped, soldered or taped connections are not permitted for the required field installed wiring of and DC circuits. However, wire splices in the customer's electrical panel will be allowed for connections to existing branch circuits for extension to the inverter sub panel. Proper torque specifications should be provided for all of the required field connections, and all termination points should be liberally coated with an anti-corrosion spray to preserve the quality of all connections over time.
- All system conductors must have appropriate means for disconnecting and overcurrent protection, and require the use of switches, fuses and circuit breakers as applicable. In all cases, means of isolating the battery subsystem must be provided. All overcurrent devices shall have trip ratings no greater than the derated ampacity of the conductors that it protects.

- All series connected strings of modules (source circuits) must include a series fuse as required by UL and NEC to prevent excessive reverse current flow through modules in source circuits under fault conditions, and the diodes must be contained in a listed junction/combiner box. Parallel connections of modules in individual source circuits are discouraged, and are only allowed as long as the module listing allows for a series fuse with high enough capacity required for this configuration. All series source circuit fuses shall be rated for at least 1.56 times the source circuit short-circuit current rating, and no greater than that specified on the module listing. Blocking diodes for array source circuits are optional. If used, these diodes must have voltage and current ratings (at temperature) at least twice the open-circuit voltage and short-circuit ratings of the source circuits.
- All metallic module frames, panel/array support structures, metal enclosures, panel boards and the inverter/battery cabinets must be properly bonded to a common grounding conductor and terminate at a ground rod installed at the utility service entrance point. If a ground rod or system is not already present, a grounding rod or network must be installed at each system with a preferred maximum earth resistance of 25 ohms. All grounding connections and terminations should be made accessible for routine inspections and maintenance as required. The neutral conductor of the inverter output shall be grounded at the customer's electrical service panel. No other AC connections to the grounding system are required.
- Surge suppression on the DC and AC side of the inverter must be provided. Silicon oxide varistors (SOVs) commonly used to protect electrical panels and equipment may be used for this purpose, and may be provided and/or required by the inverter manufacturer.
- An array ground-fault protection device must be included for all systems, and is an NEC requirement for any arrays mounted on the rooftops of dwellings. This device protects the array from creating a fire hazard under fault conditions, and it must be capable of detecting array ground faults, shunting the fault current to ground, and disabling the array until the fault has been cleared.
- A weather-tight, vented, locking, pad mountable enclosure shall be supplied by the bidder, suitable for housing the batteries, inverter/charger, controllers, AC/DC disconnect devices, and source circuit combiner boxes (as required), in an outdoor or indoor environment as required for the specific application. Provisions to separate the battery subsystem from the inverter/charger and from other power processing components will be required for some applications, but in no circumstance is this separation distance to be greater than eight (8) feet due to constraints on battery to inverter cabling sizes and voltage drop. The enclosure shall be rated as NEMA 4, 3R or better and have superior strength and corrosion resistance properties for the humid, salt-air marine environment. Aluminum or durable plastic construction is preferred for all battery enclosures to be mounted outdoors.
- An outdoor rated disconnect device must be installed in all systems at the interface between the PV system inverter/charger and the customer's primary electrical system served by the utility grid. This disconnect device shall be a visible break, lockable device, and shall be installed at a convenient location on the outside of the premises near the utility service entrance and meter.
- A standard utility watt-hour meter socket and enclosure shall be provided on the PV system side of this disconnect, and shall include a simple bi-directional mechanical utility watt-hour meter, wired for operation at 120 V or 120/240 V as applicable. The display for these watt-hour meters shall read in digits, as opposed to dial readings, and will record net energy supplied to or from the inverter/battery system.
- All electrical equipment, enclosures, disconnects and overcurrent devices must be clearly marked and identified.

1.4.3 Mechanical Design and Installation Requirements

All hardware required for installing PV arrays and other system equipment must be provided for the installations. Following are requirements for mounting the PV arrays, equipment and other materials and mechanical design considerations associated with these projects:

- Two types of universal mounting systems are required for the PV arrays for these sites - one for mounting arrays to rooftops, and the other for mounting the array on the ground. Roof mounting systems must be adaptable to the various types of roofing designs and materials at each site, must be corrosion resistant and have adequate structural support for the arrays and attachment to the structure, and any attachment points and penetrations to the building must be properly weather sealed using accepted roofing practice. Ground-mounted arrays must have an appropriate footer of sufficient weight to resist uplifting from wind forces. In all cases, the array mounting and orientation should be selected to maximize solar gain, and avoid any excessive shading of the array.
- The array mounting systems and overall installation must meet all applicable local building codes, and be capable of withstanding hurricane force winds of Category 3 or greater (130 miles per hour), for all attachment points, which are consistent with the module manufacturer's installation instructions, and the requirements of ANSI/ASCE 7-98. Calculations or certifications from a licensed professional engineer or test lab verifying that the system can withstand these wind forces, as installed on the ground or a building structure, is desirable. In all cases, any applicable local building codes must be followed.
- For those end-users who wish to further protect PV arrays from flying debris during wind storms, because the installations are not insured or otherwise, a means for quickly disassembling and removing the PV modules from the arrays should be provided. Although the need for this is not anticipated for all systems and no more often than once every few years, some customers have requested this feature and instructions to do so.
- The system installation and equipment layout should be considered with respect to the need for access, maintenance and future expansion of the system as needed by the customer.
- Array mounting hardware supplied for this installation should be compatible with the site considerations and environment. Special attention should be paid to minimizing the risk from exposed fasteners, sharp edges, and potential damage to the modules or support structure. Corrosion resistance and durability of the mechanical hardware is emphasized. All materials should be selected to avoid corrosion and degradation. The use of ferrous metals, contact of dissimilar metals and the use of any wood or plastic components are strongly discouraged. Aluminum and stainless steel components and hardware are preferred.
- These are high profile, publicly visible installations, and the aesthetics of the overall installations are extremely important. To create a uniform appearance of the array, spacing between individual modules and panels should be kept to a minimum, and the overall layout keeping in consistency with the overall architectural features of the buildings and properties. As much as possible, all mechanical hardware, conduit, junction boxes and other equipment should be concealed beneath and/or behind the array, and all other electrical work performed neatly and as inconspicuously as possible.
- The array layout should be consistent with the electrical ordering (and labeling) of source circuits in the array combiner boxes. Ease of access for array troubleshooting and maintenance is desired by allowing access to the back of the array for module junction box servicing, and removal/replacement of individual source circuits (panels) and modules if necessary.

1.5 System Commissioning and Warranties

1.5.1 Inspections, Acceptance Testing and User Training

All system installations must be properly permitted and inspected by local authorities as required. Evidence of these permits and inspections shall be provided at the time of acceptance testing and before final payment will be authorized.

A third-party agent will work closely with the project sponsor and the installer/contractor to conduct acceptance testing and ensure that all project specifications have been met. The system installer shall be available and present for the acceptance tests based on a pre-determined schedule. Acceptance testing will verify that the system and equipment specified in the bid was installed in a safe and code-compliant manner, and is operating properly under all conditions. Final contract payment will be tied to successfully completing acceptance testing, and delivery of the complete System Manual.

The installer/contractor will also be required to provide a minimum of one hour of training to the end-user and operator of each system. Topics to be covered in this training include theory of operation, operating requirements, component descriptions and specifications, maintenance requirements and schedule, safety precautions, overview of System Manual and record keeping.

1.5.2 Performance Monitoring

Performance monitoring will be verified by the metering installed on the system, recorded by the customer on a monthly basis. This information will be provided to the VI Energy Office, and based on these data and the size of systems installed, determinations can be made as to whether the systems are functioning properly, or whether any problems exist that require attention by the owner or service visit by the installer at a later date.

1.5.3 System Warranties and Maintenance

The supplier/installer must provide warranties on both the complete system and individual components. The methods for implementing a warranty provision must be clearly established, and handled by the system supplier/installer as the single point-of-contact for warranty service with the end-user. At the customer's discretion, additional service contracts may be required and will be negotiated in the final contract for purchase, or as an add-on parts and labor agreement.

At a minimum, the following warranties are required:

- Two-year, complete system-level warranty for the no-cost replacement of any defective component required for safe and as-specified system operation.
- PV modules must have a minimum ten-year limited manufacturer's warranty to maintain at least 80 percent of their initial rated output.
- Inverter/chargers and charge controllers must have a minimum 2-year warranty
- Batteries must be warranted for a minimum of three (3) years to deliver at least 50 percent of initial rated capacity.
- Supplier/installer may provide extended warranty or service contract beyond baseline warranties as requested.

End-users shall be trained by the installer to perform routine maintenance, as required.

2. PART II – Photovoltaic Water Pumping Systems

2.1 Introduction

This section covers the requirements for two (2) portable, trailer-mounted photovoltaic (PV) powered water-pumping systems, to be used primarily for agricultural purposes. One site is on the western end of St. Croix and the water source is a pre-existing shallow well. The other site is an agricultural cooperative on the west end of St. Thomas, and the water sources at this site are shallow water earthen dams.

For purposes of simplicity and reliability, these systems will be configured as direct-coupled dc systems, with the PV array directly connected to a dc motor and pump. They will not use water storage tanks or batteries for electrical energy storage, and will only pump water during sunlight hours. Users may optionally add water storage at a later date.

In general, the systems will require a direct-current (dc) pump-motor, a photovoltaic (PV) array, wiring and controls, trailer and support structure, and other required balance of system components. The Contractor will have responsibility for procurement and/or fabrication of hardware, system installations, system checkouts, and training of system operators.

2.1.1 Schedule

- Installation of these systems shall be completed within 90 days after contract award. Variances to this timeline may be granted due to availability of equipment, or customer or site constraints identified and agreed to by the VI Energy Office.
- Contractor must coordinate installation schedule with the U.S. Virgin Islands Energy Office and those individuals responsible for each site.

2.1.2 Proposal Requirements and Award Criteria

Forms and instructions for submitting bids and required information are also included in this document, and must be provided with any bid. The following outlines requirements for responsive proposals. Sufficient detail on these items must be provided for consideration in this quotation. At a minimum, each proposal must include:

- Completed Contractor Information Form - include experience and qualifications, field experience, references and applicable licenses
- Completed Photovoltaic Power Systems Request for Quotation Form – include price for equipment and installation, and total price
- Provide required documentation and System Manual (System Design Review and Approval required – see below).
- Proposed schedule for completing installations

Any or all of the individual applications (projects) may be bid. However, if only bidding for some projects, the bidder must clearly state which projects are being bid, and which are not. Although the site conditions are somewhat varied, the basic requirements for the equipment and installations are essentially the same.

Evaluation criteria for proposals shall be weighted according to:

- Quality of the design in meeting the performance requirements and in reducing the risk of vandalism, theft, storm damage and personal injury (20%)
- Total price (50%)
- Capability of the bidder to satisfactorily implement the project (20%)
- Aesthetics (10%).

Payment for this contract will be in two parts. Because equipment is expected to be a high percentage of overall project costs, sixty (60) percent of payment will be after contract award and completion of the system design and approval by the VI Energy Office and their designated technical representative. The final forty (40) percent will be paid after the installation and upon satisfactory completion of acceptance testing and user training.

Proposals must be delivered no later than eight (8) weeks after the effective date of this bid document to:

VI Dept. of Planning and Natural Resources
Virgin Island Energy Office
#45 Mars Hill
Frederiksted, St. Croix 00840
Attn: Mr. Bevan Smith, Program Administrator (340) 773-1082 xt. 2254

2.1.3 Site and Application Descriptions

Prevailing conditions at these sites should be considered in any bids, including environmental conditions, system and equipment locations, shading, accessibility, and potential for vandalism or theft of components. Each site has acceptable solar access and suitable locations for PV arrays and equipment. The contact individual responsible for each site will work with the contractor to determine specific locations for the systems and equipment. Details and information about the sites are provided in the Appendix.

Site visits and interviews of end-users by bidder are highly recommended and strongly encouraged.

2.2 Equipment Specifications

Bidders must show that the components bid for this project have demonstrated reliable operational performance in the field with minimal maintenance. All equipment and components supplied for this project must be new and be currently manufactured and readily available.

All PV power system designs supplied for these projects must have a design review and approval from the Florida Solar Energy Center (FSEC). For systems and equipment not already approved at the time of the bid, the bidder shall submit the required documentation for design review and approval prior to installation. There are no fees associated with this design review and approval.

For information on FSEC-approved PV systems, including design review and approval requirements, the process, and procedures for submitting designs for review, please see:

<http://www.fsec.ucf.edu/PVT/BuyInstallPV/pvapprovals/index.htm>

Criteria for system approvals are based on applicable codes and standards, and consistency with industry accepted design practices. Evidence to support these criteria must be contained in the supplier's *System Manual*, which shall include all applicable information concerning the equipment and installation. All systems installed under this project shall have a complete System Manual at the time of acceptance tests and end-user training. Systems already having FSEC-approval are supplied with a complete System Manual as part of approval requirements, and address many of the project requirements outlined below.

2.2.1 Photovoltaic Modules and Array

The PV arrays must be sized to produce the energy that is required for the systems to supply the daily water requirements under a design insolation of 4 kWh/m²/day.

The PV modules used in these systems must meet industry-accepted standards for performance, reliability, safety and other considerations as outlined below:

- All PV modules shall meet or exceed the requirements of IEEE Standard 1262-2000 Recommended Practice for Qualification of Photovoltaic (PV) Modules and Underwriters Laboratories (UL) Standard 1703 Standard for Safety for Flat-Plate Photovoltaic Module, or equivalent standards.
- Either crystalline or polycrystalline silicon flat-plate PV modules are preferred; although thin-film PV modules will be considered if their performance, size and warranties are consistent with the project constraints and further requirements outlined in this document.

2.2.2 Water Pumps and Motors

Since the water sources for the two pumping systems requested are a shallow well and earthen dams, a self-priming centrifugal pump is preferred. Other types of pumps will be considered if the bidder can show that they can satisfy the water requirements.

Both systems must be capable of supplying a peak flow rate of at least 15 gpm (gallons per minute) under full sunlight, and be capable of discharging water 100 feet above the pump, with a total dynamic head of at least 150 feet.

Flexible hose, rated for continuous use and exposed, direct-sunlight application must be supplied with each pumping system. Both suction and discharge line hose must not be smaller than the inlet/outlet sizes of the pump, and no smaller than 1-inch diameter. Length of the suction and discharge lines shall be at least 50 feet each, or longer lengths as site conditions dictate. Both suction and discharge lines must be contained on hose reels to allow for easy transport, storage and deployment at each site.

Due to the poor water quality and debris contained in the dams, pre-filtration should be used at the pump if it is not capable of handling the expected debris. A high-quality spring-loaded foot valve or check valve must also be installed at the end of the suction line if applicable, at a level below the minimum water level expected. The valve must have appropriate screening to prevent admitting debris into the pump and to minimize silting of the screen. Due to the reliability problems associated with foot valves, a disconnect switch or relay should be installed on the pump motor to disconnect the power source in the event the pump loses its prime to prevent the pump from running dry. Provisions to re-prime the pump suction line must also be provided.

It is expected that most pumps bid for this project will be driven by dc motors, either permanent magnet or electronically commutated. However, ac motors will be acceptable if the associated power-conditioning hardware required between the PV array and/or battery bank can be shown to achieve the desired reliability at competitive cost. All motors must be designed for application in an outdoor, humid, salt-air environment.

All internal pump components must be constructed with corrosion resistant materials, preferably with stainless steel, composite and/or bronze alloys. Simple cast iron or steel pumps will not be acceptable. The pump, motor and associated controls must be covered or otherwise shielded from the elements.

2.2.3 Water Storage Tanks and Distribution Equipment

Water storage tanks are not required under this bid, but may be added as a later option by the end users. End users will also supply the necessary distribution piping, valves and other controls required to supply water from these systems to end uses beyond the distribution piping required under this bid.

The Contractor is responsible for providing connection to the suction line plumbing from the well or dam to the pump, including foot valves and filters.

2.2.4 Trailer

A highway-approved trailer must be provided to support the entire self-contained PV water pumping system and components. The trailer must be no wider than eight (8) feet and fabricated from galvanized steel and/or aluminum to resist corrosion. The entire trailer mounted assembly must be no higher than six (6) feet from the ground during transport and must have provisions to secure the system at the site to prevent tipping during high winds and to prevent theft. Dissimilar metals in connections of hardware should be avoided. Equipment must be securely attached to the trailer to permit travel on rough terrain without damage to the system. Shock absorbing mounting pads and hardware are required for the pump motors, PV arrays, and other components that may be damaged when trailering over rough terrain. A stowed system configuration for transport and/or storage is highly desirable. Tracking arrays will not be acceptable for these systems.

Special attention must be paid to the load on the trailer due to the weight of the equipment. The weight should be evenly distributed, with a low center of gravity to prevent tipping when towing around turns. Maximum tongue weight should be no more than 10 to 15 percent of the trailer load. Only one axle is required, but the axle(s) and tires must be rated substantially above the intended load. The trailer must have at a minimum 12-inch-diameter wheels. The trailer tongue must fit a standard 1-7/8" or 2" ball hitch. A heavy-duty lock and a 3/8-inch hot-dipped galvanized steel chain must be supplied with the trailer systems to secure the system and prevent theft.

The trailer must also be supplied with an approved roadway lighting system and standard 4-pin M/F connection harness. The system user will be responsible for connecting the trailer lighting system to a vehicle and obtaining registration for the trailer.

2.2.5 Instrumentation and Control Systems

All pumping systems must be supplied with an integrating flow meter to record the total gallons of water pumped over time, with a minimum resolution of at least ten gallons per minute. In addition, an elapsed time meter may be installed on the pump motor to record total operation time.

All systems should be provided with some means of preventing the pumps from running dry when power is applied and the pump is not primed. No other controls are required for the direct coupled pumping systems. However, additional components may be required for certain types of pump motors.

2.2.6 Replacement and Spare Parts

All system components must be clearly specified as to the type, manufacturer, and model number for later needs for replacement and service as required, and documented in the System Manual. Sources for this equipment should also be identified. It is highly recommended that the supplier/installer either maintain or have a ready source for replacement components for each system as needed for required warranties or service, especially parts for motors including replacement brushes as applicable.

2.3 System Documentation and Installation Requirements

2.3.1 System Documentation Requirements

The installer and system supplier must provide a complete documentation package and a System Manual for each system for the design review process, prior to the installations. All PV power system designs supplied for these projects must have a design review and approval from the Florida Solar Energy Center (FSEC). For systems and equipment not already approved at the time of the bid, the bidder shall submit the required documentation for design review and approval prior to installation. There are no fees associated with this design review and approval.

For information on FSEC-approved PV systems, including design review and approval requirements, the process, and procedures for submitting designs for review, please see:

<http://www.fsec.ucf.edu/PVT/BuyInstallPV/pvapprovals/index.htm>

Criteria for system approvals are based on applicable codes and standards, and consistency with industry accepted design practices. Evidence to support these criteria must be contained in the supplier's *System Manual*, which shall include all applicable information concerning the equipment and installation. All systems installed under this project shall have a complete System Manual at the time of acceptance tests and end-user training. Systems already having FSEC-approval are supplied with a complete System Manual as part of approval requirements, and address many of the project requirements outlined below at the completion of these projects. An additional copy of this System Manual is required for the VI Energy Office for each type of system supplied, and must be delivered and completed along with the acceptance tests for final contract payment.

At a minimum, the following items must be supplied as part of this System Manual:

- Overview of major system components, principles of operation and safety considerations
- Complete parts lists and specifications for the overall system and individual components, including all electrical components, mechanical hardware and other equipment required for installing the systems
- Diagram indicating overall layout of entire system, including PV array, and location of BOS hardware
- Electrical schematics and diagrams showing all major components and devices, including conductor types and sizes, connections of individual modules and array source circuits, and to the pump motor and controls.
- Mechanical drawings showing details of module/array mechanical support structure and instructions for assembling/disassembling arrays, pump motors and water distribution equipment.
- Procedures for operating, disconnecting, servicing and maintaining complete system and individual components
- Warranty information on individual components as required in this bid document

- All equipment manufacturers' specifications and operations manuals, including those for PV modules and pump motors.

2.3.2 Electrical Design and Installation Requirements

The electrical design and installation of these PV systems shall conform to the 2002 National Electric Code (NEC, NFPA 70).

Following are specific electrical requirements for these systems and installations:

- All equipment and electrical hardware used in these systems, including overcurrent protection, disconnects, surge suppression devices, conduit, wiring and terminals, must be approved, recognized, or listed for the intended application by UL or other recognized laboratory, and have appropriate voltage, current and temperature ratings for the application.
- PV modules must have specific listings as noted elsewhere in this document. All circuit breakers, fuses and disconnects must be listed or recognized for use in DC circuits where applicable. Equipment only rated for use in AC circuits is not permitted for use in DC circuits.
- All wiring (conductors) must be properly sized and rated for the application, including ampacity (including temperature and other deratings), location/application (exposure to elements, enclosure) and voltage drop. Conductor ampacities for all PV array source circuits must be based on both NEC and UL derating factors (156%). All other system conductors must be derated 125% according per the NEC. Voltage drop in array DC source circuits should be limited to no more than 5 percent, including losses in conductors, and through all fuses, blocking diodes and termination points as applicable. All wiring shall be listed for a minimum operation up to 600 volts and temperature rating of 90° C in wet locations. With exception of the PV module interconnect wiring, the use of any exposed conductors or cabling (excluding grounds) is not acceptable. All other conductors must be installed in conduit.
- PV module interconnect wiring must be sunlight-resistant USE-2 or equivalent rated conductor, and must be attached to module junction boxes using weather tight strain relief. The module wiring interconnections shall use a connector device that allows quick assembly and disassembly of the arrays under no load conditions. These connectors must be UL-listed, and be weather-sealed, guarded and polarity protected.
- With the exception of module interconnect wiring, all terminations must use listed box terminal or compression type connections, and must be made within an appropriate junction box or enclosure. Exposed, field splices between conductors will not be permitted. Twist on wire splices, crimped, soldered or taped connections are not permitted for the required field installed wiring of and DC circuits. However, wire splices in the customer's electrical panel will be allowed for connections to existing branch circuits for extension to the inverter sub panel. Proper torque specifications should be provided for all of the required field connections, and all termination points should be liberally coated with an anti-corrosion spray to preserve the quality of all connections over time.
- All system conductors must have appropriate means for disconnecting (and overcurrent protection as required), and use of switches, fuses and circuit breakers as applicable. All overcurrent devices shall have trip ratings no greater than the derated ampacity of the conductors that it protects.

- All series connected strings of modules (source circuits) must include a series fuse as required by UL and NEC to prevent excessive reverse current flow through modules in source circuits under fault conditions, and contained in a listed junction/combiner box. Parallel connections of modules in individual source circuits are discouraged, and are only allowed as long as the module listing allows for a series fuse with high enough capacity required for this configuration. All series source circuit fuses shall be rated for at least 1.56 times the source circuit short-circuit current rating, and no greater than that specified on the module listing. Blocking diodes for array source circuits are optional. If used, these diodes must have voltage and current ratings (at temperature) at least twice the open-circuit voltage and short-circuit ratings of the source circuits.
- All metallic module frames, panel/array support structures, metal enclosures, panel boards and the inverter/battery cabinets must be properly bonded to a common grounding conductor and terminate at a ground rod installed near the trailer use locations. If a ground rod or system is not already present, a grounding rod or network must be installed at each system with a preferred maximum earth resistance of 25 ohms. All grounding connections and terminations should be made accessible for routine inspections and maintenance as required.
- Surge suppression on electrical supply to the pump motors must be provided. Silicon oxide varistors (SOVs) commonly used to protect electrical panels and equipment may be used for this purpose.
- A Dc-rated disconnect device must be installed in all systems at the interface between the PV array and pump motor.
- All electrical equipment, enclosures, disconnects and overcurrent devices must be clearly marked and identified.

2.3.3 Mechanical Design and Installation Requirements

All hardware required for installing PV arrays and other system equipment must be provided for these installations. Following are requirements for mounting the PV arrays, equipment and other materials and mechanical design considerations associated with these projects:

- All trailer and array mounting hardware supplied for these installations should be compatible with the site considerations and environment. Special attention should be paid to minimizing the risk from exposed fasteners, sharp edges, and potential damage to the modules or support structure. Corrosion resistance and durability of the mechanical hardware is emphasized. All materials should be selected to avoid corrosion and degradation. The use of ferrous metals, contact of dissimilar metals and the use of any wood or plastic components are strongly discouraged. Aluminum and stainless steel components and hardware are preferred.
- These are high profile, publicly visible installations, and the aesthetics of the overall installations are extremely important. As much as possible, all mechanical hardware, conduit, junction boxes and other equipment should be concealed beneath and/or behind the array, and all other electrical work performed neatly and as inconspicuously as possible.

2.3.4 Inspections, Acceptance Testing and User Training

All system installation must be properly permitted and inspected by local authorities as required.

A third-party agent will work closely with the project sponsor and the installer/contractor to conduct acceptance testing and ensure that all project specifications have been met. The system installer shall be available and present for the acceptance tests based on a pre-determined schedule. Acceptance testing will verify that the system and equipment specified in the bid was installed in a safe and code-compliant manner, and is operating properly under all conditions. Final contract payment will be tied to successfully completing installation, acceptance testing, user training, and delivery of the complete System Manual.

The installer/contractor will also be required to provide a minimum of one hour of training to the end-user and operator of each system. Topics to be covered in this training include theory of operation, operating requirements, component descriptions and specifications, maintenance requirements and schedule, safety precautions, overview of System Manual and record keeping.

2.3.5 Performance Monitoring

Performance monitoring will be verified by the metering installed on the systems, recorded by the customer on a monthly basis. This information will be provided to the VI Energy Office, and based on these data and the size of systems installed, determinations can be made as to whether the systems are functioning properly, or whether any problems exist that require attention by the owner or service visit by the installer at a later date.

2.3.6 System Warranties and Maintenance

The supplier/installer must provide warranties on both the complete system and individual components. The methods for implementing a warranty provision must be clearly established, and handled by the system supplier/installer as the single point-of-contact for warranty service with the end-user. At the customer's discretion, additional service contracts may be required and will be negotiated in the final contract for purchase, or as an add-on parts and labor agreement.

At a minimum, the following warranties are required:

- Two-year, complete system-level warranty for the no-cost replacement of any defective component required for safe and as-specified system operation.
- PV modules must have a minimum ten-year limited manufacturer's warranty to maintain at least 80 percent of their initial rated output.
- Pumps, motors and controllers must have a minimum 2-year warranty
- Supplier/installer may provide extended warranty or service contract beyond baseline warranties as requested.
- End-users shall be trained by the installer to perform routine maintenance, as required.

3. PART III – Photovoltaic Back-up Power System for DPNR Building

3.1 Introduction

This request for quotation covers the turnkey installation of a photovoltaic power system to be installed at the Virgin Islands Dept. of Planning and Natural Resources facilities in Frederiksted, St. Croix. The intent of this specification is to detail project requirements, and to give the bidder a clear understanding of customer expectations and overall requirements of this RFQ. Forms and instructions for submitting bids and required information are also included in this document, and must be provided with any bids.

3.1.1 General Project Requirements

The following outlines general requirements of bidders for these projects. Additional details are provided throughout this document.

- Provide and install photovoltaic (PV, solar electric) power systems. PV modules and support structures will be provided by the VI Energy Office. All other required equipment must be provided by the vendor.
- Specify layout and location of the system at the site
- Deliver, assemble and install the equipment at the site
- Conduct acceptance testing and a minimum of one-hour on-site training on the operation and maintenance of the system
- Provide required documentation and System Manual (System Design Review and Approval required – see below).
- Minimize the risk of vandalism, theft and personal injury in the installation and operation of the systems
- System should require no regular maintenance except for battery maintenance (as required) and scheduled replacement of batteries, as required (3-year minimum).

3.1.2 Schedule

- Installation and operation of these systems shall be completed within 90 days after contract award. Variances to this timeline may be granted due to availability of equipment, or customer or site constraints identified and agreed to by the VI Energy Office.
- Contractor must coordinate installation schedule with the U.S. Virgin Islands Energy Office and those individuals responsible for each site.

3.1.3 Proposal Requirements and Award Criteria

The following outlines requirements for responsive proposals. Sufficient detail on these items must be provided for consideration in this quotation. At a minimum, each proposal must include:

- Completed Contractor Information Form – include experience and qualifications, field experience, references and applicable licenses
- Completed Photovoltaic Power Systems Request for Quotation Form - include price for equipment and installation, and total price
- Proposed schedule for completing installations

Any or all of the individual applications (projects) may be bid. However, if only bidding for some projects, the bidder must clearly state which projects are being bid, and which are not. Although the site conditions are somewhat varied, the basic requirements for the equipment and installations are essentially the same. Therefore, it is requested that a single bid price be offered for each size system requested, applicable to any of the sites.

Evaluation criteria for proposals shall be weighted according to:

- Quality of the design in meeting the performance requirements and in reducing the risk of vandalism, theft, storm damage and personal injury (20%)
- Total price (50%)
- Capability of the bidder to satisfactorily implement the project (20%)
- Aesthetics (10%).

Payment for this contract will be in two parts. Because equipment is expected to be a high percentage of overall project costs, sixty (60) percent of payment will be made upon contract award and completion of the System Design Review and Approval. The final forty (40) percent will be paid upon satisfactory completion of the installation, acceptance testing, training and submittal of required System Manual.

Proposals must be delivered no later than eight weeks after the effective date of this bid document to:

VI Dept. of Planning and Natural Resources
Virgin Island Energy Office
#45 Mars Hill
Frederiksted, St. Croix 00840
Attn: Mr. Bevan Smith, Program Administrator (340) 773-1082 xt. 2254

3.1.4 Site and Application Descriptions

This request calls for the turnkey installation of a photovoltaic power system at the VI DPNR facilities on St. Croix. Prevailing conditions at this site should be considered in any bid, including environmental conditions, system and equipment locations, shading, accessibility, and potential for vandalism or theft of components. The site has acceptable solar access and suitable locations for installing PV arrays and equipment. The contact individual responsible for the building will work with the contractor to determine specific locations for the PV array, batteries, inverters and power processing equipment. The Appendix provides additional details and information about this site.

Site visits by bidder and interviews with designated site managers are highly recommended and strongly encouraged.

3.2 System Configurations and Operational Requirements

The photovoltaic power system covered in this RFP shall include an array of PV modules and support structures (provided by the VI Energy Office), a battery bank and enclosure, an inverter/charger and battery charge controllers, and associated balance-of-system (BOS) components including wiring, conduit, disconnects, overcurrent devices, surge suppression and grounding equipment, load sub panels and metering equipment as required.

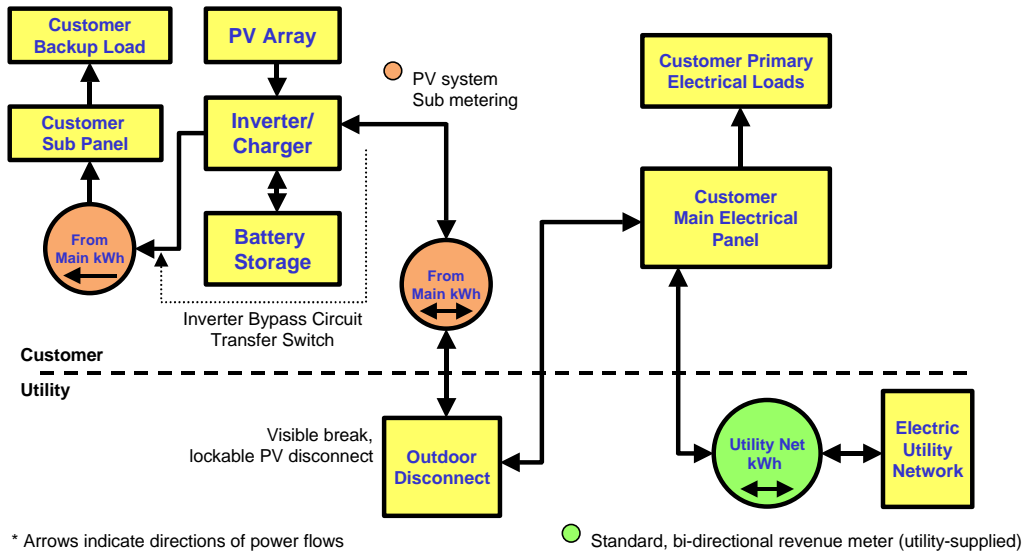
The PV power systems shall be installed as such, and must be capable of operation in either stand-alone mode, or interconnected in parallel with the utility supplied electrical service to the facility. The inverter/chargers shall be designed specifically for operation with battery subsystems. Pending approval by the local utility, systems may be interconnected with the utility grid at a later date.

To reduce costs, and to improve the prospects for long-term reliable operation of these systems, and to facilitate later interconnection of these systems to the utility grid, the systems and equipment bid for these projects should be similar for each site. Although site conditions and customer preferences will dictate the specific locations and configurations of the systems and equipment at each site, the specifications outlined in this document seek to standardize these configurations as much as possible.

As configured initially, the inverter/charger and battery system shall be connected to the grid for battery charging purposes and load consumption only, and will not feed excess energy back into the utility network. Under normal circumstances, the inverter sub panel loads will be powered directly from the battery subsystem and inverter, which is recharged from either the PV array or utility grid. In the event the battery becomes discharged below the specified DOD limit, the inverter will transfer the loads connected to the inverter sub panel to utility power, and the batteries will start being recharged. Once the battery has been recharged to a pre-determined limit, the system will again power the sub panel loads from the inverter/battery system.

At a later date, and after approval from the utility, the system programming may be reconfigured to operate the systems in parallel with the utility grid, allowing excess PV array energy not required for battery charging to power on site loads directly from the inverter, and send any excess energy back to the utility grid. This configuration is ultimately more desirable and efficient than the stand-alone mode of operation, and always maintains the batteries at full state of charge, extending their service life. In this mode of operation, in the event the grid becomes de-energized, control circuitry in the inverter opens the connection with the utility through a bus transfer mechanism, and operates the inverter from the battery to supply power to the dedicated critical load circuits only. This mode is similar to typical uninterruptible power supply (UPS) operation used for computers, communications and other critical equipment, and these loads are supplied from the dedicated inverter load sub panel. Under this back up scenario, a fully charged battery system is always available at the time of power outages, and the PV array is available to charge the batteries and sustain some level of critical loads for the customer during extended outages.

The equipment required in this bid, the desired system configuration, and the interfaces with other components and the customer's electrical service are identified in the diagram below.



3.3 Equipment Requirements

The PV power system designs supplied for this projects must have a design review and approval from the Florida Solar Energy Center (FSEC). For systems and equipment not already approved at the time of the bid, the bidder shall submit the required documentation for design review and approval prior to installation. There are no fees associated with this design review and approval.

For information on FSEC-approved PV systems, including design review and approval requirements, the process, and procedures for submitting designs for review, please see:

<http://www.fsec.ucf.edu/PVT/BuyInstallPV/pvapprovals/index.htm>

Criteria for system approvals are based on applicable codes and standards, and consistency with industry accepted design practices. Evidence to support these criteria must be contained in the supplier's *System Manual*, which shall include all applicable information concerning the equipment and installation. All systems installed under this project shall have a complete System Manual at the time of acceptance tests and end-user training. Systems already having FSEC-approval are supplied with a complete System Manual as part of approval requirements, and address many of the project requirements outlined below.

3.3.1 Photovoltaic Modules and Array

The VI Energy Office will provide existing photovoltaic modules and array support structures for this project. All other PV array-related equipment including fasteners, grounding provisions, and interconnect wiring shall be provided by the contractor. The PV modules are BP/Solarex MSX60 modules, and there are over 500 modules with a total capacity of over 30 kW. The available support structures are galvanized steel racks with mounting feet, and can support six individual PV modules per support. This equipment is on-site at the DPNR facilities, and bidders are encouraged to review this inventory prior to submitting a bid.

The PV array is to be located on the roof of the DPNR facilities in a location agreed upon by the building managers. The array shall be oriented in a continuous fashion, minimizing dead spaces between the subarray sections. The array shall be configured with an appropriate number of source circuits for the size and ratings of battery charge controllers, and the entire array will be connected to one central battery bank. The array shall be designed so as there are at least six (6) independent array source circuits that operate independently (with separate charge controllers) and in parallel to charge the battery subsystem.

The PV modules used in these systems meet all industry-accepted standards for performance, reliability, and safety. The contractor shall install the modules and array in accordance with manufacturer's instructions, and other considerations as outlined below:

- All PV modules meet or exceed the requirements of IEEE Standard 1262-1995 Recommended Practice for Qualification of Photovoltaic (PV) Modules and Underwriters Laboratories (UL) Standard 1703 Standard for Safety for Flat-Plate Photovoltaic Module, or equivalent standards.
- Unless otherwise specified or dictated by site conditions and customer preferences, all PV arrays should be oriented facing from southeast to southwest, at tilt angles between 10 and 30 degrees from horizontal for maximum solar energy exposure. Wherever possible, arrays should be located to prevent shading from trees, poles or other structures at anytime between 9am and 3pm solar time, any day of the year. Identified locations on the DPNR building meet these criteria.
- Due to expected high wind loads, and subsequent potential for damage from flying debris, all PV arrays must be securely installed to the facility roof by weather sealed attachments to building structural members.
- To promote cooling and to maximize air circulation around PV arrays, the array should have a minimum of 3 inches and maximum of 5 inches between the top surface of the module and roof surface, with no obstructions preventing air flow between (beneath) the array and roof surface.

3.3.2 Batteries and Charge Control

The contractor shall supply and install a central battery bank for this system that is capable of sustained operation in the warm, tropical climate, and must deliver at least three (3) years of service while maintaining at least 50 percent of their initial rated capacity.

Two sizes of battery systems shall be provided and specified in any bid, including one option for at least 250 kWh of storage, and another option for at least 500 kWh of storage.

Due to the costs, size and weight, flooded lead-acid, traction-type deep cycle antimony batteries, especially designed for application in PV systems are required for this project. These batteries must be purpose-built photovoltaic batteries and have adequate reserve electrolyte volume, and incorporate special battery caps to prevent excessive water loss from the batteries. The contractor is required to identify suitable installation locations in cooperation with building manager. In the event that an existing, suitable enclosure is not available, the contractor shall provide/construct an outdoor battery enclosure adjacent to and as close as possible to the inverter and building power panel locations. Due to the large size of this battery bank, special considerations should be made to use large capacity cells that minimize the number of parallel-connected battery strings.

All systems must include multiple battery charge controllers to protect the battery from overcharge and overdischarge from the PV array, with appropriate control set points for the type of battery used. Specifications and sources of batteries and controls needed for replacement must be clearly identified, set appropriately, and documented in the System Manual.

Following are additional requirements for the batteries and charge control for the PV array and inverter charging circuits:

- Nominal battery and system operating shall be 48 volts DC.
- Maximum allowable depth of discharge (DOD) should be no more than 75 percent of the nominal battery capacity for the given discharge rates. The specification of the inverter low battery transfer voltage should be consistent with this maximum allowable DOD for the battery.
- Battery enclosures should be designed to minimize large temperature variations of the battery, and to protect the batteries from creating hazardous conditions. If located outdoors, shading from direct sunlight, and surface coating of battery enclosure should be used to minimize direct solar gain and heating of the battery subsystem. Battery subsystem design and location should minimize the risk of electrolyte spills, corrosion, fire, vandalism, theft and personal injury, and be readily accessible to maintenance and service personnel.
- Battery charge control must be used between the PV array and batter bank. All charge controllers must have appropriate listing from UL or other recognized laboratory. Any type of charge algorithms are acceptable, however constant voltage or (pulse-width-modulated) PWM type controls are preferred. Either series or shunt type switching is acceptable, and the regulation switching elements must be solid-state (not electro-mechanical relays). The charge regulation set points must be specified, and be consistent with the type and size of battery used.
- Battery charge voltage temperature compensation must be provided as part of the charge controller and inverter/charger circuits, either on board or via an external probe, and the temperature compensation coefficients must be appropriate for the type of battery used.

3.3.3 Inverter and Battery Charger

A total of eight (8) separate inverters/battery chargers with a peak rated AC output of at least 4 kW each (32 kW total) shall be supplied and installed for this system, each with its DC input connected in parallel from the central battery bank. Each inverter must supply a nominal AC output voltage of 120V single-phase or 120/240V split-phase, at 60 Hz. The inverters/chargers shall be designed specifically for operation with battery subsystems, and be capable of automatic and continuous operation either in stand-alone mode, or interconnected in parallel with the electric utility service to the site. Initially, the inverters and overall system shall be configured to operate in stand-alone mode. Pending approval by the utility, the inverters may be interconnected with the utility grid at a later date.

The AC input of the inverters shall be connected directly to the existing subpanel overcurrent device that currently supplies each panel. The AC output of each inverter shall be connected to specific load subpanels that power lighting and office equipment in the DPNR facilities. The specific subpanels to be powered by the inverter will be made in the contractor's consultations with building managers. As configured initially, the inverter/charger and battery system will be connected to the grid for battery charging purposes and load consumption only, and will not feed excess PV energy back into the utility network. Under normal circumstances, the inverter sub panel loads will be powered directly from the battery subsystem and inverter, which is recharged from either the PV array or utility grid. In the event the battery become discharged below the specified DOD limit, the inverter will transfer the loads connected to the inverter sub panel to utility power, and the batteries will start being recharged. Once the battery has been recharged to a pre-determined limit, the system will again power the sub panel loads from the inverter/battery system. Under loss of utility power, the inverters will power the subpanel loads independent of the grid, and will sustain these loads as long as sufficient battery capacity and PV charging are available.

Following are other specific requirements for the inverter/ battery charger subsystem and components:

- Each inverter/charger shall be compliant with IEEE Std. 929-2000 (Recommended Practice for Utility Interface of Photovoltaic Systems) and be listed to UL Standard 1741 (Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems) by a recognized conformity assessment laboratory. Any ancillary equipment or modifications of inverter hardware required to install the inverters in parallel with the utility grid to meet the above standards must be provided with the inverters.
- A bypass circuit shall be provided as part of the inverter/charger power-processing packages. These bypass breakers shall allow isolation of the inverters, battery and PV array components from the rest of the customer's electrical system, and allow electrical loads connected to the load sub panels to be directly powered from the primary electrical service.
- For inverters than only produce 120V single-phase output, the inverter AC input shall be connected to a dedicated single-pole overcurrent device (circuit breaker) at the main electrical panel supplying power to the office subpanels. For inverters that produce 120/240-volt split-phase, the inverter AC input shall be connected to a double-pole overcurrent device with appropriate ratings. These circuit breakers shall be fastened into the panel such that they cannot be removed by simply pulling on the breaker, and clearly labeled as the inverter AC input connection to the electrical service.
- Special attention should be paid to voltage drop between the inverter and battery system. Oversize cables are strongly recommended to minimize voltage drop and to achieve maximum inverter efficiency. Maximum distance between the inverter/charger and battery shall be no more than ten (10) feet, or as reasonably permitted with the site constraints.
- Battery charge voltage temperature compensation must be provided as part of the inverter/charger circuit, using an external temperature probe, and the temperature compensation coefficients must be appropriate for the type of battery used.

3.3.4 Electrical Loads

The AC output of each inverter shall be connected to one of several existing office subpanels used to power lighting and office equipment. It is the responsibility of the contractor and building managers to identify which load subpanels are to be powered by the inverters, based on the requirements outlined below.

The electrical load panel should be clearly labeled to identify it as the panel connected to the inverter output, and which is served directly from the customer's main electrical panel when the inverter/battery subsystem is in bypass mode. All loads connected to branch circuits on the office sub panels must be clearly identified and labeled on the panel.

Following is additional information concerning the installation of the load sub panel and the connected electrical circuits:

- It is paramount that the cumulative peak load connected to the office load subpanels does not exceed 4 kW (or the maximum output rating of each inverter), when all loads are operating simultaneously. Failure to adhere to this provision may result in the inverters shutting down frequently from over temperature or overcurrent conditions.
- When the system is initially operating in stand-alone mode, the average daily energy use (kWh) of the loads connected to all the inverter sub panels should be consistent with the expected average daily energy production from the PV array. As a rule of thumb, the load should be limited to no more than 4 kWh/day for each kWp of installed PV array capacity at STC. Daily loads in excess of this amount will severely discharge and cycle the batteries, and require excessive battery charging backup power supplied from the utility grid, which is a much less efficient process than powering these loads directly from the grid. Later, when the system can be operated in grid-connected mode, the average daily energy use of the sub panel loads is less important, but must still be limited to no more than 4 kW peak, or the maximum rated inverter output, especially when the system operates in stand-alone mode.
- All loads connected to the inverter sub panel shall be 120 volts AC. Use of any electric resistive loads, such as electric stoves, heaters, dryers, toaster ovens and the like is strongly discouraged. 240-volt AC loads shall not be served from this load sub panel, nor shall 120-volt multiwire branch circuits be connected to these panels. It is the installer's responsibility to properly educate the end-user on the efficient use of electrical loads and the operation of the system.
- Due to the low efficiency, safety issues and problematic occurrences with many un-listed low voltage DC loads, these systems will not have provisions to serve DC loads/appliances at 12-volts or any other voltage.
- Standard utility watt-hour meters and enclosures shall be provided between the inverter AC output circuits and the office load sub panels, and must include a simple bi-directional mechanical utility watt-hour meter, wired for operation at 120 V or 120/240 V, as applicable. The display for this watt-hour meter shall read in digits, as opposed to dial readings. This meter must be installed within the customer's premises, and should be labeled as "Energy to Critical Load Sub Panel", and identify which subpanel it powers.

3.3.5 Replacement and Spare Parts

All system components must be clearly specified as to the type, manufacturer, and model number for later needs for replacement and service as required, and documented in the System Manual. Sources for this equipment should also be identified. It is highly recommended that the supplier/installer either maintain or have a ready source for replacement components for each system as needed for required warranties or service.

Following are spare parts must be supplied with each system:

- Complete set of replacement fuses of the same type and rating for all fuses used in the system.

3.4 System Documentation and Installation Requirements

3.4.1 System Documentation Requirements

It is paramount that the installer and system supplier provides a complete documentation package and a System Manual to the end-user and operator of this system at the completion of the project. An additional copy of this System Manual is required for the VI Energy Office for each type of system supplied, and must be delivered and completed prior to installation.

For systems already having FSEC approval, a complete System Manual is available from the suppliers/manufacturers, and meets the requirements for documentation listed below. For systems or designs not already having approvals, the following materials must be submitted for review and approval prior to commencing installation of the systems.

At a minimum, the following items must be supplied as part of this System Manual:

- Overview of major system components, principles of operation and safety considerations
- Complete parts lists and specifications for the overall system and individual components, including all electrical components, mechanical hardware and other equipment required for installing the systems
- Diagram indicating overall layout of entire system, including PV array, and location of BOS hardware and inverter and battery subsystems with respect to the array and building facilities.
- Electrical schematics and diagrams showing all major components and devices, including conductor types and sizes, connections of individual modules and array source circuits, inverters, batteries, terminations at junction boxes, and connections to the customer's electric service and utility grid.
- Mechanical drawings showing details of module/array mechanical support structure and instructions for assembling/disassembling and installing arrays on rooftops or the ground as required
- Complete assembly and installation instructions for mounting array, junction boxes and enclosures, routing conduit, wiring arrays, and terminating conductors at array, combiner boxes and inverter/battery system
- Procedures for operating, disconnecting, servicing and maintaining complete system and individual components
- Warranty information on individual components as required in this bid document
- All equipment manufacturers' specifications and operations manuals, including those for PV modules, inverterchargers, charge controllers and BOS equipment.

3.4.2 Electrical Design and Installation Requirements

The electrical design and installation of the PV systems shall conform to the 2002 National Electric Code (NEC, NFPA 70). Article 690 of the NEC applies specifically to photovoltaic system safety, protection, control and interface with other sources. Other articles of the NEC also apply. The PV system electrical design shall also comply with the IEEE Std. 1374-1998 (Guide for Terrestrial Photovoltaic Power System Safety).

Following are specific electrical requirements for these systems and installations:

- All equipment and electrical hardware used in the system, including overcurrent protection, disconnects, surge suppression devices, conduit, wiring and terminals, must be approved, recognized, or listed for the intended application by UL or other recognized laboratory, and have appropriate voltage, current and temperature ratings for the application.
- Inverters, controllers and PV modules must have specific listings as noted elsewhere in this document. All circuit breakers, fuses and disconnects must be listed or recognized for use in DC circuits where applicable. Equipment only rated for use in AC circuits will not be permitted for use in DC circuits.
- All wiring (conductors) must be properly sized and rated for the application, including ampacity (including temperature and other deratings), location/application (exposure to elements, enclosure) and voltage drop. Conductor ampacities for all PV array source circuits must be based on both NEC and UL derating factors (156%). All other system conductors must be derated 125% according per the NEC. Voltage drop in array DC source circuits should be limited to no more than 5 percent, including losses in conductors, and through all fuses, blocking diodes and termination points as applicable. All wiring shall be listed for a minimum operation up to 600 volts and temperature rating of 90° C in wet locations. With exception of the PV module interconnect wiring, the use of any exposed conductors or cabling (excluding grounds) is not acceptable. All conductors must either be installed in conduit or directly buried in the earth, as applicable.
- PV module interconnect wiring must be sunlight-resistant USE-2 or equivalent rated conductor, and must be attached to module junction boxes using weather tight strain relief. The module wiring interconnections shall use a connector device that allows quick assembly and disassembly of the arrays under no load conditions. These connectors must be UL-listed, and be weather-sealed, have strain-reliefs, are guarded and polarity protected.
- With the exception of module interconnect wiring, all terminations must use listed box terminal or compression type connections, and must be made within an appropriate junction box or enclosure. Exposed, field splices between conductors will not be permitted. Twist on wire splices, crimped, soldered or taped connections are not permitted for the required field installed wiring of and DC circuits. However, wire splices in the customer's electrical panel will be allowed for connections to existing branch circuits for extension to the inverter sub panel. Proper torque specifications should be provided for all of the required field connections, and all termination points should be liberally coated with an anti-corrosion spray to preserve the quality of all connections over time.
- All system conductors must have appropriate means for disconnecting and overcurrent protection, and require the use of switches, fuses and circuit breakers as applicable. In all cases, means of isolating the battery subsystem must be provided. All overcurrent devices shall have trip ratings no greater than the derated ampacity of the conductors that it protects.

- All series connected strings of modules (source circuits) must include a series fuse as required by UL and NEC to prevent excessive reverse current flow through modules in source circuits under fault conditions, and the diodes must be contained in a listed junction/combiner box. Parallel connections of modules in individual source circuits are discouraged, and are only allowed as long as the module listing allows for a series fuse with high enough capacity required for this configuration. All series source circuit fuses shall be rated for at least 1.56 times the source circuit short-circuit current rating, and no greater than that specified on the module listing. Blocking diodes for array source circuits are optional. If used, these diodes must have voltage and current ratings (at temperature) at least twice the open-circuit voltage and short-circuit ratings of the source circuits.
- All metallic module frames, panel/array support structures, metal enclosures, panel boards and the inverter/battery cabinets must be properly bonded to a common grounding conductor and terminate at a ground rod installed at the utility service entrance point. If a ground rod or system is not already present, a grounding rod or network must be installed at each system with a preferred maximum earth resistance of 25 ohms. All grounding connections and terminations should be made accessible for routine inspections and maintenance as required. The neutral conductor of the inverter output shall be grounded at the customer's electrical service panel. No other AC connections to the grounding system are required.
- Surge suppression on the DC and AC side of the inverters must be provided. Silicon oxide varistors (SOVs) commonly used to protect electrical panels and equipment may be used for this purpose, and may be provided and/or required by the inverter manufacturer.
- An array ground-fault protection device shall be included for the PV array, and is an NEC requirement for any arrays mounted on the rooftops of dwellings. This device protects the array from creating a fire hazard under fault conditions, and it must be capable of detecting array ground faults, shunting the fault current to ground, and disabling the array until the fault has been cleared.
- A weather-tight, vented, locking, pad mountable enclosure shall be supplied by the bidder, suitable for housing the batteries, inverters/chargers, controllers, AC/DC disconnect devices, and source circuit combiner boxes (as required), in an outdoor or indoor environment as required for the specific application. Provisions to separate the battery subsystem from the inverter/charger and from other power processing components will be required for some applications, but in no circumstance is this separation distance to be greater than ten (10) feet due to constraints on battery to inverter cabling sizes and voltage drop. The enclosure shall be rated as NEMA 4, 3R or better and have superior strength and corrosion resistance properties for the humid, salt-air marine environment. Aluminum or durable plastic construction is preferred for all battery enclosures to be mounted outdoors.
- An outdoor rated disconnect device must be installed in all systems at the interface between the PV system inverter/charger and the customer's primary electrical system served by the utility grid. This disconnect device shall be a visible break, lockable device, and shall be installed at a convenient location on the outside of the premises near the utility service entrance and meter, and close to the metering required below.
- A standard utility watt-hour meter socket and enclosure shall be provided on the PV system side of this disconnect, and shall include a simple bi-directional mechanical utility watt-hour meter, wired for operation at 120 V or 120/240 V as applicable. The display for these watt-hour meters shall read in digits, as opposed to dial readings, and will record net energy supplied to or from the inverter/battery system.
- All electrical equipment, enclosures, disconnects and overcurrent devices must be clearly marked and identified.

3.4.3 Mechanical Design and Installation Requirements

With the exception of the PV modules and support structures, all hardware required for installing PV arrays and other system equipment must be provided for this installation. Following are requirements for mounting the PV arrays, equipment and other materials and mechanical design considerations associated with this project:

- The PV array shall be mounted to the building rooftop. The mounting system and hardware must be adaptable to the specific roof type (metal), must be corrosion resistant, have adequate structural support for the arrays and attachment to the structure, and any attachment points and penetrations to the building must be properly weather sealed using accepted roofing practice. The array mounting and orientation should be selected to maximize solar gain, and avoid any excessive shading of the array.
- The array mounting system and overall installation must meet all applicable local building codes, and be capable of withstanding hurricane force winds of Category 3 or greater (130 miles per hour), for all attachment points, which are consistent with the module manufacturer's installation instructions, and the requirements of ANSI/ASCE 7-98. Calculations or certifications from a licensed professional engineer or test lab verifying that the system can withstand these wind forces, is desirable. In all cases, any applicable local building codes must be followed.
- The system installation and equipment layout should be considered with respect to the need for access, maintenance and future expansion of the system as required.
- Array mounting hardware supplied for this installation should be compatible with the site considerations and environment. Special attention should be paid to minimizing the risk from exposed fasteners, sharp edges, and potential damage to the modules or support structure. Corrosion resistance and durability of the mechanical hardware is emphasized. All materials should be selected to avoid corrosion and degradation. The use of ferrous metals, contact of dissimilar metals and the use of any wood or plastic components are strongly discouraged. Aluminum and stainless steel components and hardware are preferred.
- This is a high profile, publicly visible installation, and the aesthetics of the overall installation are extremely important. To create a uniform appearance of the array, spacing between individual modules and panels should be kept to a minimum, and the overall layout keeping in consistency with the overall architectural features of the buildings and properties. As much as possible, all mechanical hardware, conduit, junction boxes and other equipment should be concealed beneath and/or behind the array, and all other electrical work performed neatly and as inconspicuously as possible.
- The array layout should be consistent with the electrical ordering (and labeling) of source circuits in the array combiner boxes. Ease of access for array troubleshooting and maintenance is desired by allowing access to the back of the array for module junction box servicing, and removal/replacement of individual source circuits (panels) and modules if necessary.

3.5 System Commissioning and Warranties

3.5.1 Inspections, Acceptance Testing and User Training

The system installation must be properly permitted and inspected by local authorities as required. Evidence of these permits and inspections shall be provided at the time of acceptance testing and before final payment will be authorized.

A third-party agent will work closely with the project sponsor and the installer/contractor to conduct acceptance testing and ensure that all project specifications have been met. The system installer/contractor shall be available and present for the acceptance tests based on a pre-determined schedule. Acceptance testing will verify that the system and equipment specified in the bid was installed in a safe and code-compliant manner, and is operating properly under all conditions. Final contract payment will be tied to successfully completing acceptance testing, and delivery of the complete System Manual.

The installer/contractor will also be required to provide a minimum of one hour of training to the end-user and operators of the system. Topics to be covered in this training include theory of operation, operating requirements, component descriptions and specifications, maintenance requirements and schedule, safety precautions, overview of System Manual and record keeping.

3.5.2 Performance Monitoring

Performance monitoring will be verified by the metering installed on the system, recorded by the customer on a monthly basis. This information will be provided compiled by the VI Energy Office, and based on these data and the size of system installed, determinations can be made as to whether the system is functioning properly, or whether any problems exist that require attention by the owner or service visit by the installer at a later date.

3.5.3 System Warranties and Maintenance

The supplier/installer must provide warranties on both the complete system and individual components. The methods for implementing and terms of the warranty provisions must be clearly established, and handled by the system supplier/installer as the single point-of-contact for warranty service with the end-user. At the customer's discretion, additional service contracts may be required and will be negotiated in the final contract for purchase, or as an add-on parts and labor agreement.

At a minimum, the following warranties are required:

- Two-year, complete system-level warranty for the no-cost replacement of any defective component required for safe and as-specified system operation.
- PV modules must have a minimum ten-year limited manufacturer's warranty to maintain at least 80 percent of their initial rated output (VIEO responsibility)
- Inverter/chargers and charge controllers must have a minimum 2-year warranty
- Batteries must be warranted for a minimum of three (3) years to deliver at least 50 percent of initial rated capacity.
- Supplier/installer may provide extended warranty or service contract beyond baseline warranties as requested.
- End-users shall be trained by the installer to perform routine maintenance, as required.

4. Appendix

4.1 Site and Application Information

Additional site details and contact information not listed in the table below can be obtained by contacting the VIEO Program Manager.

Site/ Location Contract Individual	Site/Application Information	Links to Images and Photographs of Installation Site
St. Croix		
Bamboula Haven Barbara Knight #133 Clifton Hill 778-6164	Rooftop mounted array. Inverter and sub panel to be located in ground-floor storage room, near existing electrical panel. Batteries may be located in storage room or on pad outside building at customer's preference.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STCROIX/PV/BARAKNIGHT_BAMBOULA_PV
Bruce Wilson Mt. Victory Camp PO Box 696 Creque Dam Road Frederiksted 00841 772-1651 brucewilson@islands.vi	Ground mounted array. Electrical panels and utility service located behind residence.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STCROIX/PV_DHW/MT_VICTORY_BRUCE_DHW_PV
VIEO/DPNR Offices #45 Mars Hill Federiksted	Rooftop mounted array. 30 kW PV modules and support structures supplied by VIEO. Multiple inverter/battery chargers required, equipment locations determined b DPNR facility managers. Only certain electrical services in the building will be served by this equipment.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STCROIX/PV/NEW_ENERGY_OFFICE_PV/
Valerie Hendrickson #4 Estate Oxford Fredericksted	Direct-coupled, portable water pumping system, no water or electrical storage.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STCROIX/PV/VALERIE_HENDRICKSON_PV/index.htm
St. Thomas		
Brian Emerich 6672 Estate Harmony 775-7077 brian@emerich.com	Rooftop mounted array, batteries and inverters to be located in storage rooms.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STTHOMAS/PV/EMERICH_PV/
Edwin Hatchette 37-25 Estate Pearl Southside Quarter #2 774-8211	Ground mounted array. Inverter and batteries to be located near customer's main electrical service.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STTHOMAS/PV/DHW/HATCHETTE_PV_DHW/
Werner Wernicke 4-2-6 Estate Fortuna 776-0440 wwernicke@vitelcom.net	Ground mounted array. Equipment locations TBD with customer.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STTHOMAS/PV/WERNICKE_PV/
Lloyd Williams #2 Estate Raphune 2B New Quarters 775-5401 lisamw@viaaccess.net	Ground mounted array. Inverter and batteries to be located in ground floor storage room. Customer has multiple load sub panels.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STTHOMAS/PV/DHW/LLOYD_WILLIAMS_DHW_PV/
Bordeaux Farmers Gerald Hodge 776-2922	Direct-coupled, portable water pumping system, no water or electrical storage.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STTHOMAS/PV/BORDEAUX_FARMS_PV/index.htm

St. John		
John Folly's Institute Alvis Christian 13 B Hard Labor Coral Bay 776-6444	Rooftop mounted array. Inverter and batteries to be located in room with main electrical panel.	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STJOHN/PV_DHW/JOHN_FARLEY_INSTITUTE_PV_DHW/
Curtis Johnson 693-5534 Coral Bay	Portable, trailer mounted system – 1kW PV array, 4 kWh battery	http://www.fsec.ucf.edu/pvt/vieo/VIEOPICS/STJOHN/PV/CURTIS_JOHNSON_PV/

4.2 Request for Quotation Form

Vendor Name _____

Date _____

4.2.1 Part I: Photovoltaic Power Systems

Each bid must provide optional quotes for the turnkey installation of four systems, with various sizes of PV arrays and battery subsystems.

Nominal System Size	Manufacturer, Model and No. of PV Modules	Manufacturer, Model and No. of Batteries	Manufacturer and Model of Inverter/Charger	Manufacturer and Model of Controllers	Equipment and Hardware Cost (\$)	Installation Labor Costs (\$)	Total Installed System Cost (per system, \$)
1 kW PV array 4 kWh battery							
1 kW PV array 8 kWh battery							
2 kW PV array 4 kWh battery							
2 kW PV array 8 kWh battery							

4.2.2 Part II: Photovoltaic Water Pumping Systems

Water Pumping Systems	Manufacturer, Model and No. of PV Modules	Manufacturer and Model of Pump and Motor	Manufacturer and Model of Controllers	Equipment and Hardware Cost (\$)	Installation Labor Costs (\$)	Total Installed System Cost (per system, \$)
Bordeaux Farmers						
Valerie Hendrickson						

4.2.3 Part III: Photovoltaic Power System for DPNR Building

Each bid must provide optional quotes for the turnkey installation of four systems, with various sizes of PV arrays and battery subsystems.

Nominal System Size	Manufacturer, Model and No. of PV Modules	Manufacturer, Model and No. of Batteries	Manufacturer and Model of Inverter/Charger	Manufacturer and Model of Controllers	Equipment and Hardware Cost (\$)	Installation Labor Costs (\$)	Total Installed System Cost (per system, \$)
30 kW PV array 250 kWh battery	Solarex MSX60						
30 kW PV array 500 kWh battery	Solarex MSX60						

Applicant Check List

The following information is requested of the bidder:

- _____ Request for Quotation Form
- _____ Contractor Information Form
- _____ Copy of U.S. Virgin Islands “Contractors License” or “Installation of Equipment” License as applicable
- _____ Copy of Workmen’s Compensation Certificate of Insurance, as applicable

4.3 Contractor Information Form

Contractor Identification

Company Name	
Address, Street	
City, Zip, Island	
Telephone Numbers	
Fax Number	
E-Mail	
Contact Individual	

Contractor License Information

All contractors must possess a current U.S. Virgin Islands "Contractor's License", or "Installation of Equipment" license qualifying them to install PV lighting systems in the Territory. Contractors shall provide the information requested below and submit a copy of their current license(s).

License Number	Licensing Authority	Expiration Date

Service Area: _____ St. Croix _____ St. Thomas _____ St. John

References

Please provide four (4) references for prior work with solar or photovoltaic systems:

Name	Address	Telephone Number	Types of Systems Installed	Installation Date

Submitted by _____ Signature _____ Date _____