GP 600409-1 ITB to develop multiple Long Term Agreements for Lithium Ion based Energy Storage Systems and PV Lighting Kits

ITB/UNDP/PSU CASE ref. GP600409-1

ADDENDUM 2

To all Bidders;

Dear Sir/ Madam,

Please note that **amendments have been made in Section 3**: **ToRs of ITB GP 600409**, mainly pertaining to Lot 3 (no of cycles and DoD), please refer to below ToRs and Section 7 (Price Schedule) and carefully note the changes highlighted in yellow.

Thank you,
PSU UNDP Copenhagen

[insert: address and email address]

Section 3: Schedule of Requirements and Technical Specifications

3.a. Background Information, Objective and Scope

3.a.1. Background:

Over the past ten years there has been a rapid increase in both the scale and the number of PV power plants worldwide. This increase has been driven by a combination of rising conventional electricity costs, technology advancement, environmental concern and strong government incentives to encourage investment in grid-connected applications that resulted in significant lower costs of PV modules. Grid connected applications represent roughly 80% of the present global market, while the 20% of applications are mainly considered off-grid. The combination of high costs of expanding the public electrical grid to increase the access to rural and low energy density areas and the lower prices for PV generation have resulted in high interest in autonomous electrification schemes. Off-grid PV micro power plants and PV back-up micro power plants are often the least cost options. This is particularly the case in remote sites and in developing countries where the public grid infrastructure is limited or the service is unreliable.

Because of the intermittency of solar generation in these plants, electricity storage is needed to deliver an uninterrupted service to the loads. Additionally, when the DC voltage of the storage is not the same of that of the loads, a converter is needed to adapt it to the required conditions. In this specification, the term Energy Storage Solution (ESS) is used to include a battery, the Battery Management System (BMS), the converter if needed and protections. The selection of the type of storage, sizing its capacity and engineering the ESS to the specific requirements of the demand profile are key to long term performance of autonomous and hybrid PV plants.

UNDP operates in over 170 countries globally including additional remote missions in support of national projects. UNDP premises are usually reliant of main power supply from the national energy supplier (grid) but the organization also has off-grid locations where it is dependent on generators for power supply. Electricity from the main grid usually comes from fossil fuel powered stations (thermal power stations) with little or no alternative power supply mix. The quality and reliability of the main utility power is in some cases low, which impact operations.

During the last 3 – 5 years, UNDP has been commissioning photovoltaic (PV) off-grid stations or PV-hybrid (hybridized with the main grid or diesel generators) plants in many locations and aims at expanding PV installation globally at a fast rate.

3.a.2 Objective:

UNDP therefore aims to establish long-term agreements (LTAs) with different Energy Storage Systems (ESS) suppliers for the supply (and in some cases also training, installation, commissioning and after-sales) of lithium-ion batteries (LIBs) and components for PV plants to be installed globally. UNDP also envisages the possibility refurbish operating plants and replace storage components that which have reached their End of Life.

Once the LTAs are established, a secondary bidding process (secondary competition) for a specific project, between all qualified LTA suppliers will be conducted in order to identify the lowest priced technically compliant offer (see 3.a.5 below).

The ITB has been divided into 3 Lots. Bidders may submit proposals for one or more lots, or one or more sub-lots. **Therefore, partial bids and partial lots are accepted.**

3.a.3. Scope:

The ITB will be focused on requesting the full ESS consisting of **Lithium-Ion Battery (LIB) Systems including the battery management systems (BMS) and a compatible inverter** to avoid problems in the compatibility between the electronics in the BMS and the electronics in the inverter.

For actual orders following establishment of the LTAs, installation, commissioning, handing-over in good operating conditions and after-sales services will be required. The services will be requested and evaluated during the secondary bidding process.

Lots

There are many end-uses for PV technology, with a broad catalogue of design size and complexity. Depending on the application, more sophisticated control may be required and compatibility of ESS with the full PV plant may be a critical factor. Therefore, the ITB is distributed into 3 different lots depending on the application.

Another differentiating factor and requirement is the capacity (i.e. size) of the ESS. Therefore, the Lots are distributed into Sub Lots depending on the *capacity requirements*.

A. Lot 1 - PV lighting kits:

The PV lighting kits offered shall be a set of components matched and tested as a package by a manufacturer that consist at least of a photovoltaic module/s, LIB, BMS, wiring and switches and lighting equipment that can autonomously supply several illumination points for a given number of hours per day. The supply voltage to the loads shall be DC.

B. Lot 2 - Autonomous AC plants:

Supply of ESS to be integrated in autonomous AC PV plants to ensure the electricity supply consisting of LIBs, BMS, autonomous inverters and protections for the selected sites and, based on the project requirements, the provision of services such as (but not limited to) installation, commissioning, training as well as documentation on the operation and maintenance of the supplied solution. The supply voltage to the loads shall be AC.

Four categories/sub Lots will be considered within this Lot:

- Sub Lot 2.1 ESS PV-1: From 1 up to 25 kWh
- Sub Lot 2.2 ESS PV-2: From 25 to 200kWh
- Sub Lot 2.3 ESS PV-3: From 200 to 500 kWh
- Sub Lot 2.4 ESS PV-4: From 500 kWh to 1MWh

C. Lot 3 - For multiple source (MS) PV plants:

Supply of ESS to be integrated in PV hybrid plants where PV is used in combination with one or more auxiliary sources of power. The ESS shall consist of LIBs, BMS, dual-mode inverters and protections for selected sites and, based on the project requirements, the provision of services such as (but not limited to) installation, commissioning, training as well as documentation on the operation and maintenance of the installed solution. Four categories/Sub Lots will be considered within this Lot:

- Sub Lot 3.1 ESS MS-1: From 1 up to 25 kWh
- Sub Lot 3.2 ESS MS-2: From 25 to 200kWh
- Sub Lot 3.3 ESS MS-3: From 200 to 500 kWh
- Sub Lot 3.4 ESS MS-4: From 500 kWh to 1MWh

3.a.4. Award criteria / selection criteria
For the purpose of this ITB, the criteria will be based on the selection of the lowest priced technically qualified Bidder:

For Lot 1: lowest priced technically qualified

For Lot 2 and Lot 3: lowest priced technically qualified where the price (USD/kWh) will be calculated based on:

- Acquisition and Warranty Price (AWP) (in USD): EXW price of the battery system (USD) including warranty extension (if required to reach the 5 years' performance warranty):
    - AWP (USD) = EXW price + warranty extension

    - ENERGY THROUGHPUT (ETP) (in kWh): Energy throughput during life ownership, which is equivalent to the practical capacity (PC) x usable cycles in 10 years in the following conditions:
        - Lot 2: Practical capacity* x 1,500 full cycles in 10 years (assuming that the battery will work at temperature 25ºC, daily cycles of 40% DoD in 12 hours):
            - ETP (kWh) = PC x 1,500 cycles
        - Lot 3: Practical capacity* x 10,000 full cycles in 10 years (assuming that the battery will work at temperature 25ºC, 1 daily cycle of 80% DoD in 12 hours):
            - ETP (kWh) = PC x 10,000 cycles

** For this project, the practical capacity refers to the duty cycle, which is equivalent to the nominal capacity multiplied by the DoD.*

Final price to be included in the price schedule: AWP/ETP (USD/kWh)

Categories/Sub Lots per lot 2:

- Sub Lot 2.1 ESS PV-1: From 1 up to 25 kWh
- Sub Lot 2.2 ESS PV-2: From 25 to 200kWh
- Sub Lot 2.3 ESS PV-3: From 200 to 500 kWh
- Sub Lot 2.4 ESS PV-4: From 500 kWh to 1MWh

Categories/Sub Lots per lot 3:

- Sub Lot 3.1 ESS MS-1: From 1 up to 25 kWh
- Sub Lot 3.2 ESS MS-2: From 25 to 200kWh
- Sub Lot 3.3 ESS MS-3: From 200 to 500 kWh
- Sub Lot 3.4 ESS MS-4: From 500 kWh to 1MWh

3.a.5. Secondary competition will be applied for all call-offs:

LTAs will be subject to call-off at any point during the validity period through case-by-case secondary competition.

The above selection of lowest priced technically qualified bidder (3.a.4) will also apply to secondary bidding processes. However, investment costs will include further components such as freight, required services, etc. i.e. DAP pricing will be considered.

As UNDP has requests for ESS the organisation will solicit the LTA holders for specific offerings in a secondary round of competition on details such as certain technical features, system design, installation, maintenance & performance warranty agreements.

3.a.6. Terms of Execution:

Replacement and Spare Parts: All components that maybe replaced during the life time of the product need to have spare parts available. Equivalent parts replacing the installed item can be proposed with the UNDP/beneficiary/client approval.

Warranties:
The supplied goods shall be tested, commissioned and handed over complete and in perfect operating condition and shall be covered under a defects liability (parts and labour) for a minimum period of 24 months from the date of commissioning. This warranty covers all manufacturer / workmanship defects only.

- The expected duration of PV lighting kits (Lot 1) should be more than 5 years of normal use.
- The expected duration of the ESS in Lot 2 and Lot 3 should be more than 10 years of normal use.

The main components shall also have a manufacturer's warranty of defects in materials and workmanship for a minimum period as specified below:

- **For Lot 1:**
  - The expected duration of PV lighting kits should be more than 5 years of normal use and the warranty period should be of at least 2 years
  - LED lamps: the expected duration of the lamps should be more than 20,000 hours and L95 of at least 2,000 hours (i.e. the lamps should provide 2,000 hours of the expected illumination before the illumination drops below 95% of the rated value).
  - PV Modules: Overall 10 years of power output warranty and 2 years on material and manufacturing faults.
- **For Lot 2 and 3:**
  - The expected duration of the ESS should be more than 10 years of normal use and the warranty period (for the complete solution and/or for the different elements integrated in the ESS) should be of at least 5 years (included extensions if required)

- The Contractor has a maximum of one month to replace any defective component.
- It is understood that any alteration made to the product without the prior written approval of the Contractor will automatically cancel the remaining warranty period on the affected part.

3.a.7. General requirements

Scope

The works shall consist of supplying the complete ESS (consisting of the LIB, BMS and a compatible inverter) detailed in this ITB.

The project consists of the supply of the following equipment for Lot 1:

- PV lighting kit and operating guidelines
- Operation and Maintenance Manual

The project consists of the supply of the following equipment for Lot 2 and Lot 3:

- ESS per site specifications
- Testing and Handing Over in good operation conditions (if the case may be)
- Training Manual and Training sessions to the beneficiaries' staff maintenance crews (if the case may be)
- Operation and Maintenance Manual

The Supplier shall provide all necessary components except otherwise specified, and accessories, at the Supplier's own expense so that UNDP will be able to install complete operational units at the final sites.

The equipment furnished to these specifications must meet or exceed all requirements herein. Modifications of or additions to basic standard equipment of less size or capability to meet these requirements will not be acceptable.

The technical specifications presented herein are not to be interpreted as necessarily defining a particular manufacturer's product, model or features. The equipment shall conform in capability, strength, quality and workmanship to the accepted industry standards and relevant international quality standards.

Environmental and climatic conditions

All equipment shall be fully operational in the following conditions:

- Relative humidity up to 95%
- Ambient temperature from -5ºC to 45ºC
- Rural environment with high presence of dust, insects, etc.

External equipment shall additionally withstand the following conditions[1]:

[1] Safety against marine corrosion may be required for some requests during secondary bidding processes.

- High ultra violet radiation
- Wind speeds up to 120 km/h

Section 3b – Technical Specifications for Lots 1 – 3

Please note that the technical specifications outlined in this document should be considered the minimum threshold for passing technical evaluation and will be considered as minimum technical specifications for the subsequent LTAs.

Glossary of Terms:

Components	
Photovoltaic module or panel	The smallest complete environmentally protected assembly of interconnected cells. Colloquially referred to as a "solar module".
DC converter	An electronic component that changes the generator output voltage into a useable d.c. voltage.
Battery Management System	DC converter that also controls the state of charge of the battery, temperature and other safety conditions
Maximum power point tracking	A control strategy for dc converters whereby the PV generator operation is always near the point of current-voltage characteristic where the product of current and voltage yields the maximum electrical power under the operating conditions. Abbreviation: MPPT.
Inverter	A system component that converts d.c. electricity into a.c. electricity. One of the family of components that is included in "power conditioner".
Grid-connected inverter	An inverter that is able to operate in grid-parallel with a utility supply authority.
Grid-dependent inverter	An inverter that can only to operate in grid-parallel with an AC electric grid. Also known as a grid-tied inverter.
Dual mode inverter	A type of inverter that is able to operate in both autonomous and grid-parallel modes according to the availability of the utility supply authority. This type of inverter initiates autonomous operation.
Autonomous inverter	An inverter that supplies a load not connected to an electric utility. Also, known as a "battery-powered inverter" or "stand-alone inverter"
Storage	Accumulation of electricity in a non-electric form and which can be reconverted to electricity.
Lead-acid battery	An electrochemical electricity storage device commonly used in UPS and autonomous PV plants.
Lithium-ion Battery	An electrochemical electricity storage device which has a positive electrode made of lithiated metal oxides. Referred as LIB.
Energy Storage Solution	A set of component that store electrical energy to supply loads and consists of battery, BMS, and inverter (converter) for the proper operation of the loads (ESS)
Energy and Management System	Component with the objective of ensuring the proper management of the power plant (EMS)
Genset	A colloquial term meaning “engine-generator set” consisting of an engine coupled to a rotating electric generator. Also referred to as thermal generator.
Individual electrification plant	A small electric generating system that supplies electricity to one consumption point usually from a single energy source.
Interconnection	the result of the process of electrically connecting a distributed generation plant to a distribution system in order to enable the two systems to operate in parallel with each other.
Autonomous operation	The operating mode in which loads are electrified solely by the PV plant and not in parallel with the utility. Also known as stand-alone or off-grid.
Grid-connected operation	The operating mode in which a PV plant is operating in parallel with an electric grid. Site loads will be electrified by either or both the utility or the plant. Electricity will be able to flow into the grid if the utility permits back feed operation.
Photovoltaic plant	A photovoltaic generator and other components that generate and supply electricity suitable for the intended application. The component list and system configuration varies according to the application, and could also include: power conditioning, storage, system monitoring and control and utility grid interface. Also known as a photovoltaic system. Some such plants are grid-connected and large and others can also be small (micro plants). The following terms describe common system configurations.
Hybrid photovoltaic plant	See multi-source photovoltaic plant.
Multi-source photovoltaic plant	A power plants with photovoltaic generation operating in parallel with other electricity generators. Also called a "hybrid" system.

Site	The geographical location of a plant and the load is supplied.
Sub-system	An assembly of components. The following terms describe common subsystems.
Photovoltaic generator sub-system	The components that convert light energy into electricity using the photovoltaic effect.
Power conditioning sub-system	The component(s) that convert(s) electricity from one form into another form that is suitable for the intended application. Such a sub-system could include the charge controller that converts d.c. to d.c., the inverter that converts d.c. to a.c., or the charger or rectifier that converts a.c. to d.c..
Storage sub-system	The component(s) that store(s) energy.
Monitor and control sub-system	The logic and control component(s) that supervise(s) the overall operation of the plant by controlling the interaction between all sub-systems.
Safety disconnect sub-system	The component(s) that monitor(s) utility grid conditions and open(s) a safety disconnects for out-of-bound conditions.
Data logging and evaluation sub-system	The measurement and logic component(s) that register and process all relevant operational parameters and data of the plant to establish the daily, monthly and annual final yields, losses and performance of the subsystems.
Performance parameters	
Standard test conditions (STC)	Reference values of in-plane irradiance (GI,ref = 1 000 W.m-2), air temperature (25°C), and air mass (AM = 1,5) to be used during the testing of any photovoltaic device. Abbreviation: STC.
Load	An electrical component that converts electricity into a form of useful energy and only operates when voltage is applied.
Performance ratio	The overall effect of losses on an array's rated output due to array temperature, incomplete utilization of the irradiation, and system component inefficiencies or failures. Commonly found by the quotient of the final system yield over the reference yield. Symbol: PR
Losses	The electrical power or energy that does not result in the service that is intended for the electricity.
Normalized losses	The amount of time that a device or system would need to operate at its rated capacity in order to provide for system energy losses. These are commonly calculated from a difference in yields.
Plant rated power	Pertaining to PV autonomous and back-up plants: The rated power capacity to supply a load.
Efficiency	The ratio of output quantity over input quantity. The quantity specified is normally the power, energy, or electric charge produced by and delivered to a component. Symbol: η is commonly used. Units: dimensionless, usually expressed as a percentage (%).
Rated efficiency	Pertaining to a device: The efficiency of a device at specified operating conditions, usually standard test conditions (STC). Pertaining to an inverter: The efficiency of an inverter when it is operating at its rated output.
Power efficiency	The ratio of active output power to active input power.
Partial load efficiency	The ratio of the effective inverter output power to its input power at a specified load.
Weighted average conversion efficiency	A method of estimating the effective energy efficiency. It is calculated as the sum of products of each power level efficiency and related weighting coefficients depend on a regional irradiance duration curve. When the plant is an autonomous type with a storage subsystem, the weighting coefficients depend on the load duration curve.
Storage rated capacity	The energy (or charge) that can be withdrawn from the storage device under specified discharge rate (time) and temperature conditions.
Practical capacity (or useful capacity)	The fraction of the rated capacity that can be extracted from a full charge condition without exceeding the threshold recommended by the manufacturer. For the same required practical capacity, a battery with a lower allowed SoC will require a smaller rated capacity. For this ITB, the practical capacity will be calculated considering the SoC (SoC = 100% - DoD) indicated for each lot.
Residual capacity	The charge or energy capacity remaining in an electrical storage device following a partial discharge.
State of charge	The ratio between the residual capacity and the rated capacity of a storage device. Abbreviation: SOC. Units: dimensionless, usually expressed as a percentage (%).
Partial state of charge	A state indicating that an electrical storage device has not reached a full charge. Abbreviation: PSOC. Units: dimensionless, usually expressed as a percentage (%).
Depth of discharge	A value to express the discharge of an electrical storage device. The ratio of the discharge amount to the rated capacity is generally used. Abbreviation: DOD. Units: dimensionless, usually expressed as a percentage (%).
Charging efficiency	A generic term to express ampere-hour efficiency (or less commonly, watt-hour efficiency.
Ampere-hour efficiency	The ratio of the amount of electrical charge removed during discharge conditions to the amount of electrical charge added during charge conditions in an electrical storage device.
Watt-hour efficiency	The ratio of the amount of electrical energy removed during discharge conditions to the amount of electrical energy added during charge conditions in an electrical storage device.

Storage Service/Calendar lifetime	The operational calendar time of a battery under given operating conditions and temperature.
Storage Cycle lifetime	Total number of discharge and recharge cycles that a battery is expected to withstand
Inverter rated power	The power that can be supplied by the inverter at 25 ºC. In grid-connected mode it refers to a continuous operating condition, in autonomous mode it usually refers to a 30’ surge.
Inverter efficiency	The ratio of the useful inverter output to its input.
Environmental parameters	
Ambient temperature	The temperature of the air surrounding a PV generator as measured in a vented enclosure and shielded from solar. Symbol: Tamb. Unit: °C.
Tilt angle	The angle between the horizontal plane and the plane of the module surface.
Irradiance	Electromagnetic radiated power incident upon a surface, most commonly from the sun or a solar simulator. Symbol: G. Unit: W·m-2.
Global irradiance	Irradiance on a horizontal surface. This equals horizontal direct irradiance plus horizontal diffuse irradiance.
In-plane irradiance	Total irradiance on the plane of a device. Symbol: GI.
Solar energy	Common term meaning irradiation.
Irradiation	Irradiance integrated over a specified time interval. Symbol: H. Unit: J·m-2.]
Testing and certification	
Inspection	Evaluation for conformity by measuring, observing, testing, or gauging the relevant characteristics as required by the technical specifications.
Tests	Technical operations to establish of one or more characteristics of a given product or service according to a specified procedure.
Acceptance testing	Site-specific testing to assure acceptable performance as required by the technical specifications.
Verification	Confirmation by examination and recording of physical evidence that specified requirements have been met.
Verification testing	Site-specific, periodic testing to assure continued acceptable performance.
Certificate of conformity	A label, nameplate, or document of specified form and content, directly associated with a product or service on delivery to the purchaser, attesting that the product or service is in conformity with the requirements of the certification program (e.g., with the referenced standards and specifications).
Miscellaneous	
Total harmonic distortion	The ratio of effective signal of total harmonic to effective signal of basic frequency. Units: dimensionless, usually expressed as a percentage (%).
Safe extra low voltage (SELV)	An extra-low voltage system which is electrically separated from earth and from other systems in such a way that a single fault cannot give rise to the risk of electric shock.
Extra-low voltage (ELV)	Voltage not exceeding not exceeding 50 V a.c. and 120 V ripple free d.c (a ripple content not exceeding 10% r.m.s). Some national standards consider 75 V dc as a maximum. In consideration of ELV status, VOC of the PV generator must be used
Low voltage.(LV)	Voltage exceeding extra-low voltage, but not exceeding 1 000 V a.c. or 1 500 V d.c.
High voltage (HV)	Voltage exceeding low voltage.
Class II equipment	Equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions
Class III equipment	Equipment in which protection against electric shock relies on supply at SELV and in which voltages higher than those of SELV are not generated.
Double insulation	Insulation comprising both basic insulation and supplementary insulation.
Earthing	A protection against electric shocks.

3.b.1. LOT 1

3.b.1.1. Technical requirements

Functional configuration:

The loads offered to the selected sites requiring the autonomous fixed PV lighting kits will have the main consumption spread along the evening and night (lighting). This means that under typical average conditions the coincidence factor between the load profile and the PV generation is very low (< 10%).

A compact rugged solution is sought with very long service life and low maintenance. The kit has to operate at a rated service voltage of 12 V_{DC} for the lamps and at 5 V for the USB outlet.

The requirements of the specifications in this document are derived from the final lighting output requirements. Illumination has to be provided to 3 separate rooms from a PV lighting kit that includes the cabling and switches for the lights. Typically, operation will be at night time. Each room requires at least 700 lumens and this can be accomplished with one lamp or, optionally, 2 smaller lamp units. An additional courtesy lamp yielding at least 150 lumens with an independent cable and switch is required that will be used in any of the rooms. The total illumination requirement is therefore a minimum magnitude of lumens during certain number of hours per day. The energy output of the USB outlet is not part of this average condition energy requirement because it will be used only on favourable conditions. The battery shall have autonomy for at least 1.5 average illumination daily requirements.

The capacity of the PV generator and the rated capacity of the battery should be calculated and defined by the manufacturer to provide the required illumination service. It will be influenced by the energy efficiency of the lamps; the electrical match between the PV module and the battery voltage (i.e., MPPT, voltage match, etc); the efficiency of the battery duty cycle; the maximum depth of discharge admitted by the battery; and the idle self-consumption of the battery and BMS. Bidders shall present a detailed technical brief that, based on the certified efficiency of the components proof that the capacities of the PV generator and the battery/ies meet the requirements of this specification. The reference solar radiation to be used is 4.0 kWh/m^2 for typical winter conditions, however, this factor will have to be adapted depending on the location of the site. The PR used shall consider the match between components and the type of BMS.

During the daytime, the PV generation recharges the battery and supplies the loads (if any). If there are lamps connected during this period, they will be also supplied from this current. The battery's BMS measures the battery's voltage and the current from the PV module/s. When the battery is charged, the BMS curtails the PV generation and shall indicate this status to the user. This is the best condition, for example, to charge the cell phone, digital camera or MP3 through the USB plug.

During the evening, the charged battery supplies the lighting DC loads as needed. A user interface shows the user the status and the remaining capacity. When the battery is too low it shuts down. Service is resumed when the battery has been recharged to a certain set point defined by the manufacturer.

The functional description of the kit can be summarized as follows:

- PV charging the battery while occasionally feeding some loads
- PV generation curtailed with charged battery
- Loads supplied from battery only
- Low battery and loads disconnected

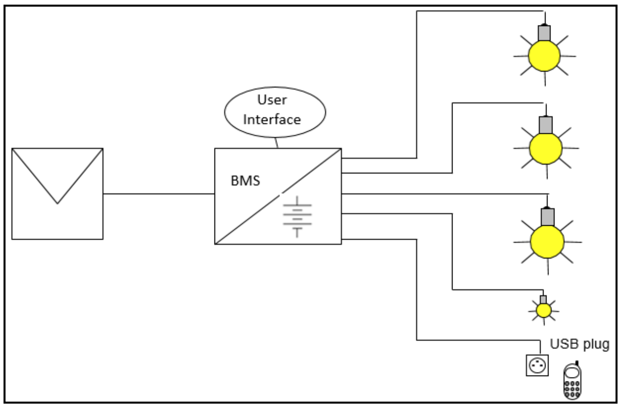
The modes of operation are managed by the user based on common sense and the status indicators provided by the unit.

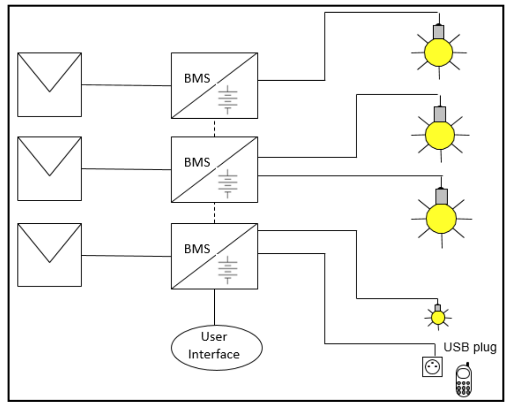
For safe operation, the kit shall include all the necessary safety protections against short circuit of the wiring and inverted polarity. Electrical shock protection is intrinsic because of the specified safe extra low voltage (SELV).

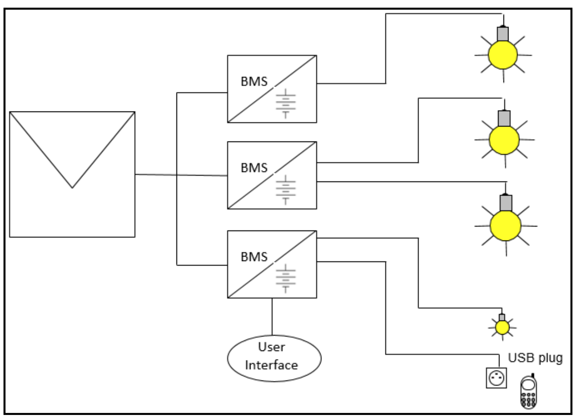
General layout:

To achieve modularity, robustness and economies of scale, the general design described in this specification is considered a single manufactured package with a performance rating for the complete kit.

The PV lighting kit has one general design and its application can be very universal. It consists of a small photovoltaic generator, a LIB, an integrated BMS with user interface and protections, four high efficiency lamps and switches and plug in cabling. The rating capacity of the main components can be fulfilled by the capacity of each unit or by a modular arrangement of several compatible components in parallel as illustrated in the figures below:







Mechanical design and exposure to environmental conditions:

Although installation is not included in this ITB, the components should ensure that the outdoor support structures and mounting arrangements comply with the environmental conditions and regulations and standards. Attention should be given to wind loads on the outdoor PV generators, their structures and their fasteners so that they withstand up to 120 km/h.

All structures shall be made of corrosion resistant materials. The same applies to all bolts, nuts, and fasteners (when required/included).

Outdoor PV generator cabling and associated components are exposed to UV, wind, water and other environmental conditions and shall be fit for this purpose and built in such a way as to minimize exposure to detrimental environmental effects.

Safety issues:

Protection against electric shock

Protection against electric shock is achieved intrinsically by the use of extra-low voltage (SELV) together with components classified as Class III or better.

Protection against fire

Direct current (DC) systems and photovoltaic generators pose various hazards, for example the ability to produce and sustain electrical arcs with currents that are not much greater than normal operating currents. In this case, this risk is reduced intrinsically by the voltage rating. All the plug-in sockets must be rated for DC current at the maximum design current.

Protection against over current

Battery over current protection: The battery BMS shall be integrated with the battery and include over current and short circuit protection of the input and output cabling connected to it. Risk of reverse polarity connection has to be also mechanically avoided by the choice of plug technology and size.

3.b.1.2. Equipment specifications

Photovoltaic Lighting kits:

The main specification of the kits is the minimum final output requirement. The PV kits shall provide the lighting level from the battery for the required number of hours and be able to recharge the battery with the PV generator exclusively. The total minimum illuminance is of 2250 lumens provided by at least 3 lamps of 700 lm each, one small courtesy lamp of 150 lm and the USB mobile Phone charging connection. The daily average required illumination period is of 7 hours and the reference PR (performance Ratio) is 0.7 to size the PV generator.

EC compliance is mandatory.

GENERAL SPECIFICATIONS		
Lights and loads	Lamp type	LED indoor
	Operating voltage range	10 to 15 V_{DC}
	Illuminance, each room lamp/s	≥ 700 lumens
	Illuminance, small courtesy lamp	≥ 150 lumens
	Number of room's lamps	≥ 3 units
	Number of small courtesy lamps	1 unit
	Lamp efficiency	≥ 75 Lm/W
	Lamp lifespan	≥ 20,000 hours
	Lamp illumination efficiency (L95)	≥ 2,000
	Lamp use	≥ 7 h/day
	Total minimum lighting requirements	≥ 15,750 lm-h/day
	USB mobile phone charging	
User interface in battery enclosure	Information	-Charging status -Load-disconnect state (or over discharge protection status) -Indicative state of charge or remaining available capacity or time
	Alarms	-Low battery state of charge / Low battery voltage / Low available capacity -Load disconnect -Battery fully charged
Photovoltaic generator	Type of module/s	Crystalline Silicon
	Tilt	latitude +5º (when possible)

	Reference Solar in plane average radiation (for calculations)	4.0 kWh/m^2
Battery and charge controller	Type	Lithium based
	Rated Voltage	12 V
	Autonomy at the rated daily load.	≥ 1.5 days
	Battery PV charge controller	integrated
	Discharge/recharge full cycles	≥ 1.800
	Modular multi battery solution allowed	yes
Cables and switches	Distance between the PV generator and the battery	≥ 6m
	Distance between the battery and each lamp	≥ 5m
	Additional extension cable for lamp or PV module. 1 unit	≥ 5m
	Cable connection plugs	included
	Switches	In the cables or in the lamps

3.b.1.3. Components

Data Sheets:

Although the kits are considered one functional unit that has to provide the final service requirements they consist of several interconnected components. Bidders are requested to provide details and data sheets that clearly show the specifications of the components to be supplied.

PV Generator:

PV module(s)

They shall be crystalline silicon PV modules that comply with the norm IEC 61215 edition 2 and shall be qualified to and be classified by Class according to IEC 61730.

The voltage rating shall be compatible with the battery voltage. Mismatch losses to be considered.

Amorphous silicon and other thin film type cells are not acceptable under this tender.

PV capacity

PV capacity is dependent on the efficiency of the lamps, battery and self-consumption of the components included in the kits. Lower efficiency can be offset by larger PV capacity and vice-versa.

It is up to the Bidder to offer what he considers the most cost effective design as long as the minimum light service requirements are met.

As an indication and for the minimum lighting requirements of 15,750 lm·h/day, some examples for the PV capacity are presented:

Lamp efficiency	Considerations	PV capacity
75 lm/W	PR= 0.7 (without MPPT) or 0.75 (with MPPT) Gdy= 4.0 kWh/m^2	75 Wp/ 70 Wp
90 lm/W		63 Wp/58 Wp
100 lm/W		56 Wp/53 Wp

Cables

For the purpose of this ITB the typical distance between the PV generator and the battery is 6 m.

Cables used for the PV generator shall be Cu and have a temperature rating higher than 40°C above ambient temperature; be UV-resistant and be flexible (multithreaded).

Cable ties or appropriate fastening means have to be compatible with outdoor use.

Disconnecting means

Disconnecting means shall be provided for the PV generator to isolate it from the battery safely.

Support Structure

The PV modules' supports frames shall be anchored outdoor of the selected sites with great attention to the tild, orientation and shades.

The support frame shall be of either lightweight aluminum or galvanized steel and it shall be easy for installation and maintenance.

Electrical Storage – LIB:

LIB:

Application

The battery feeds the loads (i.e. lamps and auxiliary USB mobile phone charger) on a daily basis. Reliability of service is very important and preference shall be for batteries which have a proven capability under high duty cycle and deep discharge conditions.

Type

The battery should be LIB, deep discharge type with a permissible repeated deep discharge without damage. The type of LIB shall be specified.

Lead acid batteries are not acceptable under this ITB. The batteries should have RoHS certification (for environmental aspects).

Rating

The battery shall have a 12 V_{DC} nominal operating voltage (typically around 12.7 V).

Battery capacity is dependent on the efficiency of the lamps included in the kits, the battery duty cycle efficiency and the allowable depth of discharge. Lower efficiencies can be offset by larger battery capacity and vice-versa. It is up to the Bidder to offer what he considers the most cost effective design as long as the minimum requirements are met (i.e. the battery shall be capable of feeding the lamps during 7 hours/day and have at least an autonomy of 1.5 days without being recharged).

As an indication and for the minimum lighting requirements of 15,750 lm·h/day, some examples for the battery capacity are presented:

Lamp efficiency	Considerations	Battery capacity at 12 V
75 lm/W	Autonomy of 1.5 days Battery efficiency 0.90 DoD of 100% allowable	29.2 Ah
90 lm/W		24.3 Ah
100 lm/W		21.9 Ah

Battery performance

The battery shall have a self-discharge at room temperature of less than 3% per month (at 23±5°C and fully charged) of its rated capacity.

The battery shall have a Coulombic efficiency of at least 90% on a typical duty cycle.

Lifetime

The design lifetime of the batteries shall be of at least 8 years or 1800 full cycles without losing more than 10% of the rated capacity.

Warranty

Bidders must include a statement of warranties in effect including what specifically is covered under warranty and requirements for obtaining compensation for the kits and (and their components) which have failed under warranty.

Battery Replaceability

The battery should be easily replaced at its end of life.

Labelling

On each battery, the following information has to be provided:

- Manufacturer
- Serial number
- Rated capacity
- Manufacturing date
- Clear indication of the connecting inlets and outlets
- Safety warning

Data sheets

Full technical data sheets shall be provided by the Bidder. These must include:

- Curves showing rated Ah capacity at several discharge rates
- Cycle life versus depth of discharge
- Self-discharge characteristics
- Physical size and weight
- Details of the materials used in construction.

Enclosure and modularity

The battery, its BMS and the user interface shall be integrated in one enclosure. Nevertheless, the ESS of the kit can be made of several independent enclosures/batteries in parallel to achieve the required autonomy rating.

Fuses (short circuit and overcurrent protection)

Automatic protection means shall be rated for DC use and can be solid state and integrated into the battery enclosure. For the PV inlet it shall have a voltage rating equal or greater than 1,2xV_{OCpvg}, be rated to interrupt fault currents from the battery to the PV generator wiring.

For the loads outlets it shall be rated to interrupt overloads and fault currents from the battery to the lamps cabling.

PV battery charge controller/BMS

The PV battery BMS shall be included in the battery enclosure and shall control the following features:

- photovoltaic generator charging of the battery,
- efficiency
- load control,
- protection functions,
- user interface functions,

User Interface

The user interface shall include any of the following types; LCD screen, LED indicators and, audible alarms.

Required operation information

- An indication of charging status (i.e. charging or not charging).
- An indication of load-disconnect state (or over discharge protection status).
- An indication of the charge remaining in the battery (in time left or state-of-charge indication).

Other additional operational information displayed by the unit may include but is not limited to:

- Battery voltage.
- Charging current.
- Energy input/output.

Compliance shall be determined by inspection of the unit and accompanying user/installation manual.

Alarms

The following conditions should be signaled by the user interface:

- Low battery state of charge / Low battery voltage / Low availability.
- Load disconnect
- Battery management trip (e.g. by over temperature).

Visible alarms, clearly identifiable by the user, shall be triggered within the unit in case of any of the above conditions occurring. If there are audible alarms they shall be time limited and revert to a visible alarm.

Loads:

Lamps

The lifespan of the LED lamps shall be above the 20,000 hours.

The lamps efficiencies shall be higher than 75 Lm/Watt and L95 of minimum 2,000 hours (i.e. the lamps should provide 2,000 hours of Illumination before Illumination dropped to 95% of the Initial Illumination value. Lower efficiency is not acceptable. The colour rating shall be warm white.

USB Mobile phone charger

At least one USB connection from the battery enclosure shall be included. Adaptors for different mobile phone brands shall also be provided.

Cabling

The cabling for the lamps shall be Cu and flexible (multithreaded). The required length is 5 m for each lamp and the cross section must meet the requirement of a maximum voltage drop of 1.5%. However, if during siting and installation, longer distances are detected and the extension cable is required, the cable cross section shall take into account any voltage drop requirements.

Cable ties or appropriate fastening have to be adequate for indoor use in households.

Disconnecting means

Disconnecting means shall be provided for the lamp cables to isolate it from the battery safely.

Switches

The switches can be integrated either to the cables or in the lamps.

Documentation and Training:

The Contractor shall provide data sheets and technical documentation and manuals in **English or French**.

The Contractor shall provide user-easy to use guides for the beneficiaries in English and French with possibility of requirements in other EU language. The guides must be shared and accepted by the UNDP project. It is expected that the guidelines be written on a maximum of 1 A4 paper bounded by a thin film and tapped near the batteries and controller of the PV kit.

3.b.2. LOT 2 and LOT 3

3.b.2.2. Technical requirements – Lot 2

Functional configuration:

In autonomous alternating (AC) plants, the electricity from the PV generator is converted to feed the loads that operate at standard AC electricity. The inverter acts as a voltage source to supply stable AC to the loads from the LIB that allows the match between the intermittent PV energy source and the intermittent or variable consumption requirements.

In Lot 2 the ESS to be supplied and installed consists of LIBs, BMS, autonomous inverters and auxiliary equipment to be integrated in autonomous PV plants to ensure the electricity supply at selected sites.

The PV generator is not included in this ITB. The ESS may integrate an input to connect directly the PV generator or the ESS can be connected in an AC coupling configuration to the rest of the plant components.

The ESS in an autonomous PV plant is sized so that its *practical* capacity endures 1.5 days of autonomy to supply the average daily energy requirements. Typically, A high lifetime (at least 150 cycles per year or 1,500 equivalent full cycles in at least 10 years) is required in combination with a relatively low self-discharge.

The ESS in Lot 2 should ensure the lifetime energy throughput of: 1,500 cycles in 10 years with the following conditions: Temperature 25ºC, daily cycles at 40% DoD in 12 hours

During the daytime, the PV generation recharges the LIB and supplies the loads. At night or when the solar generation is limited, the loads are covered by the ESS. The functional description of the ESS can be summarized as follows:

- LIB is charged by the PV generator while PV is also feeding the daily loads
- During daytime and when the LIB is charged, PV generation is curtailed if the loads are fed
- ESS feeds all loads
- Low LIB and loads disconnected

The modes of operation are managed by the user based on common sense and the status indicators provided by the ESS.

For this type of applications, the size may vary from small up to very large capacity. Four categories/Sub Lots are considered within this Lot (nominal capacity):

- Sub Lot 2.1 ESS PV-1: From 1 up to 25 kWh
- Sub Lot 2.2 ESS PV-2: From 25 to 200kWh
- Sub Lot 2.3 ESS PV-3: From 200 to 500 kWh
- Sub Lot 2.4 ESS PV-4: From 500 kWh to 1MWh

For safe operation, the ESS shall include all the necessary safety protections against short circuit of the wiring and inverted polarity.

General layout:

To achieve modularity, robustness and economies of scale, the general design described in this specification is considered a package with a performance rating for the ESS.

The ESS consists of the LIB, an integrated BMS, the autonomous inverter, user interface and protections and plug in cabling. The rating capacity of the main components can be fulfilled by the capacity of each unit or by a modular arrangement of several compatible components in parallel.

Bidders should note that a containerized solution for the battery systems may be requested during the secondary bidding process.

Safety issues:

Protection against electric shock

Protection against electric shock in the DC side shall be achieved by best practices and international standards together with components and systems classified as Class II or better.

Protection against fire

DC systems pose various hazards, for example the ability to produce and sustain electrical arcs with currents that are not much greater than normal operating currents. In this case this risk is reduced intrinsically by the voltage rating. All the plug-in sockets must be rated for DC current at the maximum design current.

Protection against over current

The inverter's cable over current protection shall be installed between the battery and the inverter as close as possible to the battery.

Protection against effects of lightning and surge over-voltage

Damage caused by over-voltage is ultimately due to the failure of insulation between live parts or between live parts and earth. The intention of over-voltage protection is to equalize all exposed metallic sections of an installation to a common potential during the event of an over-voltage. Equipotential bonding is therefore required as an important over-voltage protection measure and shall be done in accordance with recognized standards or acceptable state of the art procedures.

3.b.2.3. Technical requirements – Lot 3

Functional configuration:

Multi-source plants, called hybrid plants, are terms used where PV is used in combination with one or more auxiliary sources of power. This means a second power source such as wind or hydroelectric turbines, or also auxiliary dispatch able sources such as fossil-fuelled gensets or even the utility grid. The term dual mode is used to describe the special case of a PV multi-source plant that operates either in parallel with an external AC grid (grid-dependent) or as an autonomous AC source (off-grid) when the forming source is off.

Multi-source plants are usually designed to provide continuous grid equivalent electrical service during the night or during unfavorable weather conditions and with a high fraction of the energy being delivered by the solar facility. During sunny weather, the consumer's demand is met by the PV generator and surplus generation is stored in the battery. If needed, a back-up genset can simultaneously supply both the loads and charge the battery. If adequately sized, this set up has high reliability and avoids the need for an oversized PV generator.

- **Uninterruptible Power Supply (UPS) /back-up:**
  The battery is used for the provision of electricity to all (or only critical) loads during blackouts which can be produced by the low quality of the main utility grid or when the diesel genset is off. In this case, the battery should be able to cover the loads but for a shorter period of time than off-grid autonomous PV plants (the ESS should be sized to cover the loads at least during the blackout/off-grid period). In this type of application, the ESS can be considered Uninterruptible Power Supply (UPS).

- **Time-shift:**
  ESS can also, in some applications, create economic value through energy trading via "storing-selling-consumption": Storage of electrical energy in off-peak periods when the price of energy is low followed by discharge of this energy in on-peak periods when energy prices are high. Typical duration is 1 to 6 hours, daily cycle.

- **Peak-shaving:**

In multisource plants, ESS can also be used to reduce the peak load demand from the grid or the genset (this type of application is named Peak shaving). In applications where the genset capacity or the contracted power from the gird is lower than the peak demand, the difference can be covered by the ESS. In this case, the ESS is sized to be able to satisfy the energy demand and off-set the power difference. The discharged duration is between 1 to 5 hours per day.

For this ITB, the ESS to be supplied and installed consists of LIBs, BMS, dual-mode inverters and auxiliary equipment to be integrated in PV hybrid plants ensuring the continuity of electricity supply at selected sites.

The PV generator is not included in this ITB. The ESS may integrate an input to connect directly the PV generator or the ESS can be connected in an AC coupling configuration to the rest of the plant components.

For this ITB, the ESS will be sized to cover the demand needs considering that the diesel generators at the sites are turned off at night. Therefore, the ESS in the multisource PV plant is sized so that its *practical* capacity endures 12 hours of autonomy to supply (all or critical) loads.. In this case, the battery will cycle up to 1 time a day, thus at least 365 cycles per year or 3,000 equivalent full cycles in at least 10 years is required in combination with a relatively low self-discharge.

The ESS in Lot 3 should ensure the lifetime energy throughput of: 3,000 cycles in 10 years with the following conditions: Temperature 25ºC, 1daily cycles at 80% DoD in 12 hours)

The functional description of the ESS can be summarized as follows:

- LIB is charged (preferably) by the PV while PV and/or the auxiliary sources are feeding the daily loads
- ESS feeds all or critical loads (as only energy source)
- ESS feeds partially the loads (in peak shaving or time shifting configuration)

Depending on the complexity of the system, the modes of operation are automatically triggered by an Energy and Management System, called EMS, based on conditions such as state of charge of the battery, PV generation and conditions of the day: switch off certain loads, charging exclusively from PV or not, etc. Therefore, the supply or installation of ESS in sites where a EMS is required will be treated separately.

For this type of applications, the size may vary from small up to very large capacity. Four categories/ Sub Lots are considered within this Lot (nominal capacity):

- Sub Lot 3.1 ESS MS-1: From 1 up to 25 kWh
- Sub Lot 3.2 ESS MS-2: From 25 to 200kWh
- Sub Lot 3.3 ESS MS-3: From 200 to 500 kWh
- Sub Lot 3.4 ESS MS-4: From 500 kWh to 1MWh

For safe operation, the ESS shall include all the necessary safety protections against short circuit of any external wiring and inverted polarity.

General layout:

To achieve modularity, robustness and economies of scale, the general design described in this specification is considered a package with a performance rating for the ESS.

The ESS consists of the LIB, an integrated BMS, the dual-mode inverter, user interface and protections and plug in cabling. The rating capacity of the main components can be fulfilled by the capacity of each unit or by a modular arrangement of several compatible components in parallel.

For actual requests during secondary bidding, a containerized solution may be requested for the battery systems during the secondary bidding process.

Safety issues:

Protection against electric shock

Protection against electric shock in the DC side shall be achieved by best practices and international standards together with components and systems classified as Class II or better.

Protection against fire

DC systems pose various hazards, for example the ability to produce and sustain electrical arcs with currents that are not much greater than normal operating currents. In this case, this risk is reduced intrinsically by the voltage rating. All the plug-in sockets must be rated for DC current at the maximum design current (if the solution is note in a closed enclosure).

Protection against over current

The inverter's cable over current protection shall be installed between the battery and the inverter as close as possible to the battery.

Protection against effects of lightning and surge over-voltage

Damage caused by over-voltage is ultimately due to the failure of insulation between live parts or between live parts and earth. The intention of over-voltage protection is to equalize all exposed metallic sections of an installation to a common potential during the event of an over-voltage. Equipotential bonding is therefore required as an important over-voltage protection measure and shall be done in accordance with recognized standards or acceptable state of the art procedures.

3.b.2.4. Equipment Specifications (Lot 2 and Lot 3)

General Specifications:

Lithium-ion battery	**Rated storage capacity (kWh)**	**ESS PV-1**	1 - 25
		ESS PV-2	25 – 200
		ESS PV-3	200 – 500
		ESS PV-4	500 – 1,000
		ESS MS-1	1 - 25
		ESS MS-2	25 – 200
		ESS MS-3	200 – 500
		ESS MS-4	500 – 1,000
	Type	Lithium based	
	Rated full cycles (at 100% DoD) (lifetime)	**Lot 2**	> 1,500 cycles
		Lot 3	> 3,000 cycles
	Equivalent operation	**Lot 2**	365 cycles/year at 40% of DoD
		Lot 3	365 cycles/year at 80DoD
	Discharge current	**Lot 2**	0.02C – 0.1C (of the battery)
		Lot 3	0.07C – 0.2C (of the battery)
	Charge current	**Lot 2**	0.05C – 0.2C (of the battery)
		Lot 3	0.13C – 0.5C (of the battery)
	Rated service life time	≥ 10 years	
	Control	Integrated BMS for safety and operation	
	Self-discharge	< 5% per month	
	Max efficiency (charge & discharge)	> 90%	
	Standards and certificates	CE; EN 61000-6; Transport: UN38.3 or equivalent	

		IEC 62619:2017 (if the case may be)	
	Rated capacity (kW)	**ESS PV-1**	P1 (capable of discharging the 40% battery in 12 hours)
		ESS PV-2	P2 (capable of discharging the 40% battery in 12 hours)
		ESS PV-3	P3 (capable of discharging the 40% battery in 12 hours)
		ESS PV-4	P4 (capable of discharging the 40% battery in 12 hours)
		ESS MS-1	P1 (capable of discharging the 90% battery in 4 hours)
		ESS MS-2	P2 (capable of discharging the 90% battery in 4 hours)
		ESS MS-3	P3 (capable of discharging the 90% battery in 4 hours)
		ESS MS-4	P4 (capable of discharging the 90% battery in 4 hours)
	Power 5 sec (kW)	**ESS PV-1**	2 x P1
		ESS PV-2	2 x P2
		ESS PV-3	2 x P3
		ESS PV-4	2 x P4
		ESS MS-1	2 x P1
		ESS MS-2	2 x P2
		ESS MS-3	2 x P3
		ESS MS-4	2 x P4
Dual Mode Inverter	Designed for an electrical grid of	230 V and 50Hz or 110 and 60Hz (Based on the selected sites)	
	Minimum Discharge current at normal operating conditions	**Lot 2**	0.03C (of the battery)
		Lot 3	0.07C (of the battery)
	Minimum Charge current at normal operating conditions	**Lot 2**	0.05C (of the battery)
		Lot 3	0.1C (of the battery)
	Inverter function	Yes	
	Charger function	Yes	
	Assistance to the grid	Yes	
	Anti -islanding protection	Yes/ VDE 0126-1-1 or similar	
	Additional requirements	Dynamic compensation of reactive power, inverter automatic reconnection conditions, utility-interactive photovoltaic inverter system.	
	Standards	EMC 2004/108/EC; EN 61000-1; EN 6100-2; EN 61000-3; EN 61000-6; EN 62040-2 (when applicable) Low voltage directive: 2006/95/EC (where applicable); EN 621091; EN 621092 EN 500178	
ESS	Monitoring	The ESS should avail monitoring data to a third monitoring facility that will perform the remote monitoring of the PV plant	
	Communication	MODBUS or CAN (with communication bridge if required), allowing the option to be read by a third monitoring device/datalogger	

3.b.2.5. Components

Battery:

Type

The use of lithium based batteries is mandatory. The type of battery used shall be described in the offer.

Rating

The LIB nominal operation voltage is to be described in the offer. The LIB may be made up by one battery module or by several, but the price quoted shall be for a complete battery of the required capacity.

The total capacity shall be detailed in the tender.

LIB performance

The ESS operational temperature range shall be at least from – 10ºC to +50ºC.

The ESS shall have a self-discharge, when new, of less than 5% per month (at 25ºC and fully charged) of its nominal capacity. The battery shall have charging and discharging efficiency of at least 90%.

For Lot 2: The LIB cycle life for regular cycles down to 40% DoD shall be more than 4,000 cycles; equivalent to 1,500 full cycles in 10 years.

For Lot 3: The LIB cycle life for regular cycles down to 80% DoD shall be more than 3,000 full cycles in 10 years.

Tenders must include details or the results of any tests carried out on the batteries by independent laboratories particularly regarding performance in conditions equivalent to solar equipment located in moist, equatorial coastal locations shall be included.

Lifetime

The design lifetime of the batteries shall be of at least 10 years without losing more than 20% of the rated capacity.

Battery management system

Embedded control with at least the following features:

- Recharge algorithm with battery temperature compensation
- Voltage and current supervision and voltage settings adjustable
- Calculation of battery SoC: Based on energy balance and operating conditions of the battery
- Safety (disconnect when required)
- Thermal monitoring and management
- Provide warning and alarms

Labelling

On each ESS the following information has to be provided:

- Manufacturer
- Serial number
- Rated capacity
- Manufacturing date

- Clear indication of the positive and negative terminal
- Safety warning as needed

Data sheets and technical documentation

Full technical data sheets and technical documentation shall be provided. These must include:

- Cycle life versus depth of discharge
- Physical size and weight
- Self-discharge characteristics
- Total and practical Capacity
- Charging and discharging rates
- Interface details
- Details of the type of technology
- Warranties
- Compliant standards
- Safety warning and advice how to handle batteries
- Maintenance and replacement procedure
- Range of operating temperature and storage temperature

Warranty

Bidders must include a statement of warranties in effect including what specifically is covered under warranty and requirements for obtaining compensation for batteries which have failed under warranty.

Autonomous Inverter (Lot 2):

The provided inverter will be multi functions, bidirectional, and sine-wave inverter.

Type of Inverter

The inverter may be an inverter of the same brand/manufacturer than the battery or from an independent manufacturer. When battery and inverter are from different manufacturers, compatibility shall be ensured and the operation of the proposed system is to be demonstrated with references from previous projects.

The inverter shall comply with the following features:

- Multi-mode sinewave inverter
- Rated voltage equivalent to the battery voltage
- Rated power shall be included in the Offer (as Pinv) capable of discharging the 40% battery in 12 hours
- Power for 5 seconds 2xPnom
- Maximum efficiency above 96% at rated power
- Rated output voltage 230V±2% or 110V±2%
- Frequency 50Hz±0.1% or 60Hz±0.1%Battery nominal charger current: 0.05C (of the battery)
- Battery nominal discharge current: 0.04C (of the battery)

The Bidder shall also supply all ancillary necessary equipment for the configuration of the autonomous inverters.

Standards

Inverter must in all respects comply with the following standards:

- EMC 2004/108/EC CE compatibility
- IEC 61000-1;
- IEC 61000-3 (depending on inverter’s capacity)
- IEC 61000-6
- EN 62040-2 (when applicable)

Low voltage directive:

- 2006/95/EC (where applicable)
- EN 62109-1
- EN 62109-2
- EN 50178

Labelling

On each inverter, the following information has to be provided:

- Manufacturer's name, if the Bidder is not the manufacturer the address of the Bidder must be indicated
- Serial nº
- Type of Inverter
- Nominal Power
- Date of manufacture

Lifetime and warranties

The Bidder has to provide a replacement warranty of at least 5 years and the expected lifetime should be of at least 10 years.

Bidders must include a statement of warranties in effect including what specifically is covered under warranty and requirements for obtaining compensation for Inverter which have failed under warranty.

Information required from Bidders:

Full technical specifications shall be provided by the Bidder and additional documentation

These must include:

- Efficiency curve
- Data-sheet with principal characteristics
- Physical size and weight
- Details of the materials used in construction.
- Safety warning and advice how to install equipment
- Maintenance and replacement procedure

Dual-mode Inverter (Lot 3):

The multi-mode inverter shall be a bidirectional sinusoidal inverter. It can operate in autonomous mode as well as grid-tied mode through a transfer switch. It also requires some additional special functions:

- The operating parameters of the unit shall be configurable as to adjust the power ratings of each functionality (voltage control inverter, current control inverter, charger and boost). A lower threshold of battery voltage for the boost function shall be established to ensure an energy reserve for the blackout situation.
- A boost function which can add power from the DC side to the AC source from the grid according to the input limit current that shall be configured.
- A RE priority function which adjusts the instantaneous power consumed from the source according to the battery voltage. The operation of the solar priority function shall be done with an automatic adjustment algorithm of the input limit current. The input limit current is decreased, if there is enough energy available at the DC side, from the initial value (that will be established by the UNDP's representative). The lower the input current, more power to the load is provided from the DC side by the boost function.

The Bidder shall have the possibility to supply one inverter remote control unit that shall be used for the configuration of all the inverters.

The inverter shall comply with the following features:

- Multi-mode sinewave inverter
- Rated voltage equivalent to the battery voltage
- Rated power shall be included in the Offer (as Pinv) capable of discharging the 90% battery in 4 hours
- Power for 5 seconds 2xPnom
- Maximum efficiency above 96% at rated power
- Rated output voltage 230V±2% or 110V±2% (to be detailed in the offer)
- Frequency 50Hz±0.1% or 60Hz±0.1% (to be detailed in the offer)
- Battery nominal charger current: 0.1C (of the battery)
- Battery nominal discharge current: 0.07C (of the battery)
- Power Frequency Shift function
- Grid Assistance Function
- Output power control from a third device (read and write capabilities)

The Bidder shall also supply all ancillary necessary equipment for the configuration of the dual-mode inverters.

Standards:

Inverter must in all respects comply with the following standards:

- EMC 2004/108/EC CE compatibility
- IEC 61000-1;
- IEC 61000-3 (depending on inverter's capacity)
- EN 61000-6
- EN 62040-2 (when applicable)

Low voltage directive:

- 2006/95/EC (where applicable)
- EN 62109-1
- EN 62109-2
- EN 50178

Labelling

On each inverter, the following information has to be provided:

- Manufacturer's name, if the Bidder is not the manufacturer the address of the Bidder must be indicated
- Serial nº
- Type of Inverter
- Nominal Power
- Date of manufacture

Lifetime and warranties

The Bidder has to provide a replacement warranty of at least 5 years and the expected lifetime should be of at least 10 years.

Bidders must include a statement of warranties in effect including what specifically is covered under warranty and requirements for obtaining compensation for Inverter which have failed under warranty.

Information required from Bidders:

Full technical specifications shall be provided by the Bidder and additional documentation

These must include:

- Efficiency curve
- Data-sheet with principal characteristics
- Physical size and weight
- Details of the materials used in construction
- Safety warning and advice how to install equipment
- Maintenance and replacement procedure

Section 7: Price Schedule Form[2]

The Bidder is required to prepare the Price Schedule as indicated in the Instruction to Bidders.

As detailed in Section 3.a.4 above:

Lot 1: Price will be EXW unit price in USD
Lots 2 and 3: The price (USD/kWh) will be calculated based on:

- Acquisition and WARRANTY PRICE (AWP) (in USD): EXW price of the battery system (USD) including warranty extension (if required to reach the 5 years' performance warranty):
    - AWP (USD) = EXW price + warranty extension

- ENERGY THROUGHPUT (ETP) (in kWh): Energy through put during life ownership, equivalent to the practical capacity x usable cycles in 10 years:
    - Lot 2: Practical capacity x 1,500 cycles
    - Lot 3: Practical capacity x 3,000 cycles

Cost Breakdown by Lots and Sub-lots:

[2] *To the extent possible UNDP would like your offer to follow the format provided. Some modifications might be necessary for the purpose of the tender.*

Lot 1: Solar PV Lighting Kits			USD FCA cost per unit			Volume Discount unit price (FCA) for > 100 units	Volume Discount unit price (FCA) for > 1,000 units	Volume Discount unit price (FCA) for > 10,000 units
Lot 2: Autonomous AC Plants			**Practical Capacity in kWh***	**Acquisition Cost (FCA)**	**Warranty Extension Cost****	**AWP (acquisition cost plus warranty cost)**	**ETP (kWhx1,500)**	**USD/kWh**
	Sub-Lot 1	ESS PV-1: 25 kWh						
	Sub-Lot 2	ESS PV-1: 200 kWh						
	Sub-Lot 3	ESS PV-1: 500 kWh						
	Sub-Lot 4	ESS PV-1: 1 MWh						
Lot 3: Multisource (MS) PV Plants			**Practical Capacity in kWh***	**Acquisition Cost (FCA)**	**Warranty Extension Cost****	**AWP (acquisition cost plus warranty cost)**	**ETP (kWhx3,000)**	**USD/kWh**
	Sub-Lot 1	ESS MS-1: 25 kWh						
	Sub-Lot 2	ESS MS-1: 200 kWh						
	Sub-Lot 3	ESS MS-1: 500 kWh						
	Sub-Lot 4	ESS MS-1: 1 MWh						

* Practical Capacity conditions for Lot 2: if the battery works at temperature 25ºC, daily cycles at 40% DoD in 12 hours;
for Lot 3: if the battery works at temperature 25ºC, 1 daily cycle at 80% DoD in 12 hours
The practical capacity refers to the duty cycle, which is equivalent to the nominal capacity multiplied by the DoD
** Only if not already included in the acquisition cost (at least 5 yrs warranty required)