

Annex C

Scope of the Work

1. Scope of Work:

Design, Supply, and Installation of two On-Grid System with a capacity of 12 kWac and 3 kWac as an Extension for The Existing Solar Photovoltaic System at UNICEF Regional Office “RO” and Jordan Country office “JCO” Respectively.

2. Preamble:

- 2.1 The Contractor shall be deemed to have inspected the site prior to the submission of his tender and to have satisfied himself, the access to the site and all other factors affecting the execution and completion of the works and to have allowed for all these factors in preparing his tender.
- 2.2 During the execution period, access to the site will only be permitted during the weekend from 8 AM to 8 PM (Friday and Saturday only). And from 4 PM to 8 PM during the weekdays (Sunday to Thursday)
- 2.3 The contractor undertakes to keep noise and disturbance down to the minimum, keep the site tidy and clean all the time.
- 2.4 The contractor shall be deemed to have studied the drawings thoroughly, any uncertainties or queries must be raised prior to submitting the bid.
- 2.5 The contractor shall submit all materials and needed shop drawings for approval.
- 2.6 The Contractor will be responsible to Submit the Electrical Utility testing and commissioning application for the system after completion of the installation work, as UNICEF will provide the electrical approvals issued by JEPCO to the awarded bidder.
- 2.7 It is the responsibility of the contractor to make sure that all the requirements which are stated at the JEPCO approval are applied before submitting the testing and commissioning application.
- 2.8 It is the responsibility of the contractor to submit and follow up with GAM (Greater Amman Municipality) in order to achieve all related requirements and permits for the system installation.
- 2.9 Measurements of quantities of cables must be taken up or down the nearest meter.
- 2.10 The prices quoted are to be fixed prices and the Agency will not reimburse any cost increases due to instability of the prices in the market, this paragraph means no claims will be considered for any compensation due to high or low rises in the local market prices.
- 2.11 The bill of quantities shall be read in conjunction with the drawings.
- 2.12 It is the responsibility of the contractor to visit the site prior to submitting his tender and verify quantities of the materials and equipment required to execute the works in accordance with the contract drawings.
- 2.13 The contractor's price shall include for the following:
 - a) Including any auxiliary work that may be required for the proper execution of the works.
 - b) Supply materials and equipment to the site.
 - c) Installation of materials and equipment.

- d) All civil, mechanical & electric works required for the installation, such as: supports, chasing through walls and slabs for passage of cables, sleeves, fixing of cables, excavation and backfilling and return the site as before situation, water proofing, cleaning, protection, painting, removing & transportation to out of project site the old excavation outputs and any materials exceeded after the finishing of the works.
- e) All testing, balancing, adjusting, commissioning and handling to client complete operational systems.
- f) Allowance for cleaning and for proper protection of all equipment plants, electrical installation and structures during installation and paintings.
- g) All laborer's, materials, tools, instruments required for installation, testing, balancing, adjusting, operation and commissioning.
- h) Submittal of workshop drawings, prior to execution, showing all Details and coordination between Services.
- i) Submittal of original catalogues instruction and operation manuals, trouble shooting and Maintenance for all Equipment.
- j) Establish and submit Electrical Diagram and Circuits for power Supply and for control Circuits, for every equipment's separately, then for the complete system as connected, this does not include Factory made Circuits.
- k) As Built drawings with all exact details for all executed works.
- l) Ability to dismantle and reinstall the system in other locations in the future with the minimal move cost.
- m) All wires, cables & junction boxes used should be plastic insulated with the capacity of 240V and cross-section area that suits the load and distance, each couple of wires grouped together by twining if not cased. All wires for all purposes should be encased in UPVC plastic electrical conduit of 25mm or 20mm as required by the number of wires including all necessary fittings. The corrugated flexible type of conduits is prohibited in all cases and shall not be used.
- n) The snow and wind load effects should be considered in the submitted analysis & design
- o) All necessary cables, switches and accessories to ensure the system is connected properly, and functionally working as intended. Capable of exchange current with the National Grid without hindering the steady supply of electrical current to the offices.
- p) Provision of an online monitoring system, with a meter to read the monthly produced power & another meter reading the conveyed Kw power to the National Electrical Distribution Company
- q) Safety requirements and insurance for the site and contractor team members is the sole responsibility of the contractor
- r) Contractor to be responsible for all security of his assets, personnel and site during the construction phase.
- s) The contractor shall be responsible for the safety of its personnel while working at UNICEF premises. UNICEF is not responsible in case of any type of accidents occurring to the contractor's personnel in UNICEF premises.

3. System Design:

The suggested PV system has a state-of-the-art parts and components for a small scale On Grid PV System. It consists of a strings PV generator with inverter units. The PV modules are connected in such a way, so that the power generated is in accordance to the desirable inverter operation point.

All the cable connections will be fastened to the metal frame using tie wrap. This is based on a PV generator strings with an inverter unit.

4. Determine the Effect of Shadows:

The Contractor should evaluate the site in terms of shading that could be occurred on the module's surface, where a detailed simulation using Pvsyst software should be provided, as the outcomes of the simulation will be considered as a reference for Energy production Guaranty.

5. SYSTEM COMPONENTS Specification:

Following are the minimum requirements of the proposed PV system component:

5.1 PV Modules:

The PV Panel is a packaged, connected assembly of photovoltaic cells, with the following specification:

- a) The Photovoltaic should be from a well-known Tier 1 Modules Manufacturer.
- b) The Photovoltaic modules should be grade A.
- c) Cell Type: mono-crystalline or poly-crystalline modules are acceptable
- d) The output power of the modules should not be less than 450 Wp at (STC) using higher output modules and thus less Area use for the project will be appreciated, Conversion efficiency (not less than to 19.5%).
- e) ***72 cell photovoltaic modules must be used in RO Building and its Preferred to use 60 cell photovoltaic modules for the JCO Building (a Higher power modules will be counted in the evaluation)***
- f) Operating PV temperature should be between -10 deg.C and + 85 deg.C.
- g) Modules temperature sensitivity at peak power should not exceed -0.40%/°C.
- h) PV module frame should be Anodized Aluminium.
- i) The PV modules maximum system voltage should not be less than 1,000 V.
- j) The PV modules should be PID resistant.
- k) The PV modules should have a positive power tolerance only +3%.
- l) The modules shall have individual serial numbers behind each front glass.
- m) Electrical connection shall be on a robust terminal block in an IP65 junction box or higher.
- n) The warranty for module defects after installation should be at least 10 years.
- o) The awarded Bidder shall provide a manufacture power guarantee for all PV modules that will be installed with their serial numbers that guarantees that the loss of the output is not more than 10% during the first 10 years and up to 20% in total after 25 years. The warranty must state that the malfunctioning solar photovoltaic module must be exchanged by the manufacturer. The replacement

solar module must be identical to, or an improvement upon, the original design of the malfunctioning solar module.

- p) Mechanical stability – IEC 61215: Design qualification and type approval for crystalline silicon terrestrial photovoltaic (PV) modules.
- q) PV module safety qualification standard: IEC/EN 61730 for safety class II test.
- r) Along with TUV, CE compliant and UL certification, salt mist/ammonia resistance should be provided.
- s) Mechanical load tests up to 5400 Pa, Damp Heat, Thermo Cycle and Humidity and Freeze tests. Flash reports of PV modules (SN, Voc, I_{pmax} etc) shall be provided.

5.2 Inverter:

Three Phase Inverters which converts the variable direct current (DC) output of solar PV modules into utility frequency alternating current (AC) that can be fed into an electrical grid with the following Specification:

- a) Three phase power inverters.
- b) The inverters must comply with the British standard ENA, G99 Code. Preferably brand SMA
- c) The inverters shall comply with the EMRC and Electrical Company regulations and standards.
- d) The Inverter should be equipped with 2 or more MPPT.
- e) Efficiency should not be less than 97%.
- f) The Inverter shall be provided with LED Indicators to provide an instantaneous information about the system status.
- g) The Inverter shall have the following protections: reverse current, input over voltage & over current via fuses.
- h) Temperature operating range: -20 °C to 60 °C
- i) Total harmonic distortion (THD) should not exceed 3%.
- j) Protection degree is IP65 or higher (outdoor).
- k) TUV and CE compliant.
- l) Warranty after installation should be for 5 years at least. The warranty must state that the malfunctioning inverter must be exchanged by the manufacturer. The replacement inverter must be identical to, or an improvement upon, the original design of the malfunctioning inverter.
- m) All Outdoor installed inverters should be covered with Metal shades including the existing inverters if needed.

5.3 Mounting System:

The mounting structures will constitute of the main supporting structure of a suitable height in addition to the module-holding sub-structure with the necessary inclination in relation to the horizontal plane so as to gain the maximum of solar radiation and energy production.

The PV modules will be kept below 2.7 m height from the back (for easy cleaning). In detail, the minimum specifications of the mounting structure and sub-structure are:

- a) Hot –Dip Galvanized steel structure / G90, minimum 2 mm thickness.
- b) Manufacturer's warranty should be at least 10 years.
- c) Durable design which is capable to withstand high-speed wind of at least 140 km/h, the contractor should provide a detailed design analysis and get approval on them prior the implementation.
- d) The steel structure shall be anti-corrosion, anti-rust and can withstand high humidity.
- e) The mounting structure shall be all fitted / Pre-fabricated and should be assembled at the site (no welding)
- f) The Mounting structure should be fixed on Concrete bases (the Weight and Dimensions should be determined based on the Load Structure Load analysis), so that no drilling will be carried out on the roof.
- g) All bolts, nuts, and washers for the PV modules' mounting structure must be made of stainless steel. Stainless steel must not contact the PV modules' aluminum frames.
- h) All clamps in contact with the PV modules' aluminum frames must be made of aluminum.
- i) All exposed sharp edges in the mounting structure must be covered with an appropriate material.

5.4 Data logging & Monitoring System:

- a) System monitoring, remote diagnosis, data storage and visualization.
- b) Collects data from the inverters on the system side, keeping you informed of the system 's status at any given time (Compatible with the inverter).
- c) Shows the Instantaneous Values on Both DC and AC Side, which includes but not limited (Voltage, Current, Power, etc....)
- d) Connection inverters with Data points.
- e) The inverter must be equipped with Ethernet connection that enables real time data logging with all related hardware and software required.
- f) CAT6 data cable should be included in the installation with separated labelled conduit to the nearest approved internet point.
- g) Warranty after installation should be for 3 year at least.

5.5 Earthing protection:

- a) A complete system for grounding the PV modules one by one and the mounting structure for safety.
- b) Each array structure of the PV system should be grounded properly.
- c) All metal casing/shielding of the plant are to be thoroughly grounded.
- d) To check the existing earthing system resistance and modify if need, the earth resistance should be 3-5 Ω .

5.6 Cables:

The minimum specifications of the PV and AC cables are:

- a) PV cables shall comply with TUV standards.

- b) Operation temperature for PV cables should be up to +80 C
- c) PV cables shall be UV resistant, flame retardant, double insulated and with low smoke characteristics.
- d) PV and AC cables shall comply with local and international standards and Electrical Company requirement.
- e) All external cables must be installed inside a cable basket PVC Flexible pipes with glands shall be used between the modules and the cable basket tray or hot dipped galvanized cable tray.
- f) PVC Flexible pipes with glands shall be used between the modules and the cable tray.
- g) The cable ties shall be black color and UV resistance.
- h) All cables shall be marked properly by means of good quality labels or by other means so that cable can be easily identified.
- i) All cables shall be marked in compliance with IEC 60446-3 category C Basic and safety principles for man-machine interface, marking and identification.
- j) Factory warranty shall be not less than 5 years.
- k) Cabling losses: the cable losses are 1-3%; from string to inverter (DC side), and from inverter unit to the load (AC side).

5.7 Labelling

- a) Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place.
- b) Tags for each power cable or wire located in manholes, hand holes, and vaults shall be provided.
- c) Warning labels shall be provided and affixed in a conspicuous place.
- d) Warning Signs shall be provided and affixed in a conspicuous place in Arabic & English Sign
- e) All labelling material shall be weather-resistant.

6. Warranty

- a) Supplier is responsible for providing an Operation and Maintenance Bank warranty (5% of the value of the actual executed works) with a one year Free warranty (periodic operational & maintenance) inclusive of support visits plan, routine visits and the preventive maintenance visits with an online monitoring of the system's efficiency and productivity.
 - PV solar panels: 10 years on materials and work man work ship and 25-year linear power output warranty.
 - Inverters: 5 Years from Final taking over the project.
 - Mounting system: 10 Years from Final taking over the project.
 - Monitoring system: 3 Years from Final taking over the project.
 - Cables: 5 Years from Final taking over the project.

7. Electrical PV System Design:

- a) The technical offer shall include an Electrical PV System Design Description, including at minimum:
- A simulation model for forecasting the energy output of the proposed design with a detailed simulation report.
 - A detailed Single Line Diagram for the PV system
 - Voltage drops calculations for all circuits and cables.
 - An earthing design plans.
- b) The Bidder shall consider in their electrical design the Industry Standards, the National Electric Code, and other applicable codes and standards.
- c) All proposed AC- electrical designs must comply with IEC standards and electricity Company requirements.
- d) The Bidder shall select the suitable inclination and orientation angles of the PV system at each area in the site of installation, so as to achieve the ultimate electricity production.
- e) The simulation software design and results shall take into account all shading patterns and shall include shading analysis for the design.
- f) The simulation software used shall be PV system.
- g) The Bidder must take into consideration the following input parameters in the simulation software, and all values must be realistic and close to the field norms and standards:
- Thermal loss factor
 - DC wiring losses
 - AC wiring losses
 - Transformer losses
 - LID losses
 - Mismatch losses
 - Soiling losses (according to the prosper cleaning plan)
 - Auxiliaries consumption
 - Albedo values
 - Design conditions
 - Shading factor table
 - Shading limit angle
 - Power factor (must be 0.9 over excited)
- h) The simulation report shall contain the expected annual energy output in kWh and performance ratio for 3 years, which will be the guaranteed values.
- i) The simulation report shall contain the expected annual energy output in kWh and performance ratio for 20 years.

- j) The simulation design and results shall be submitted as a software copy.
- k) The electrical design provided in the offer documents shall include the appropriate sizing of all cabling works and all protection equipment (above and below ground) that will connect the modules, strings, arrays, inverters, and to the point of interconnection.
- l) All protection equipment throughout the system shall be sized and specified to reduce damage on all components and the interconnection point in case of an electrical failure (e.g., over voltage, under voltage, over current and intermittency protections).
- m) The Bidder shall include in the offer all the required sizing, cross-sectional areas and lengths of the DC and AC cables along with required sizes of conduits and trenches (if available).
- n) The Bidder shall provide voltage drop calculations for all PV and AC circuits to meet the allowed voltage drop percentages from the nominal voltages as follows:
 - o) For PV/DC circuits: 2% voltage drop from the nominal voltages for all DC circuits.
 - p) For AC circuits: 3% voltage drop from the nominal voltages for all AC circuits.
- q) Earthing system shall be provided for the earthing of the entire project including distribution boards, panel boards, electrical circuits, PV modules, mounting structure, inverters, and building structure...etc. and associated equipment.
- r) The DC, AC, earthing systems must be separated according to Electricity Company regulation and requirements.
- s) The earthing system shall achieve a maximum total resistance of 3-5 Ω .

8. PV SYSTEM LAYOUT:

- a) The technical offer shall include PV System Layout Drawings, including 2D and 3D Layouts of the system.
- b) The 2D and 3D layouts of the system shall:
 - i. Consider service passages to enable the ease of maintenance and system cleaning.
 - ii. Include the location of the PV modules, inverters and cable routes.

9. POINT-OF-INTERCONNECTION DESIGN:

- a) The Bidder shall propose the electrical design for the Point of Interconnection
- b) The coupling point shall be through separate electrical enclosure from the existing system, and should include proper CB AC/DC systems and all necessary protection relays including G59 relay, and metering.
- c) Circuits Protection Devices should be from a well-known brand.

10. DESCRIPTION OF WORKS & PROJECT TIME PLAN:

- a) The Bidder shall include a Description of the Works which will be provided throughout the project in details including all procurement, installation and operation tasks in compliance with the works.
- b) The Bidder shall include a time plan of the project implementation phases excluding the time needed for Electricity Company / Third Party GIS study. The time plan shall be a maximum (6) weeks.

11. TESTING AND COMMISSIONING PLAN

- a) The Bidder shall include in the technical offer a Testing and Commissioning Plan in compliance with the testing and commissioning technical requirements provided.
- b) If there is a need of any additional tests or testing equipment asked by UNICEF, the project consultant or Electricity Company, the Contractor must accept and provide it on his own expenses.
- c) The final commissioning will be performed by the Contractor on his own expenses and will be witnessed and approved by UNICEF project consultant and Electricity Company.

12. MAINTENANCE AND CLEANING PLAN

The Bidder shall include in the technical offer for a Three (3) years maintenance for the new system and cleaning for exciting and extension systems, with the following details:

- a) A detailed maintenance plan including a maintenance checklist and technical support as per the requirements
- b) Detailed cleaning mechanism for the PV system including the devices used for cleaning.
- c) The cleaning frequency should be 6 times per year at least.
- d) The Cleaning activities should include the existing PV system, where the price of each system cleaning costs should be indicated separately.
- e) The awarded contractor should submit a monthly report about performance the system till the end of 3rd year.
- f) The contractor must make any corrective action when production isn't as design proposal.
- g) An operation-monitoring plan for UNICEF to follow up on the energy production including periodic reporting.