

**SUMMARY OF WORK**

**(SCOPE OF WORK)**

**Supply and Installation of Solar Power Systems for Registration Centers in Kharaz Camp, Lahj and Basateen Neighborhood, Aden - Yemen**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The WORK to be performed under this Contract shall consist of furnishing materials, tools, equipment, supplies, and manufactured articles, and furnishing all labor, transportation, and services, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.
- B. **The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the EMPLOYER.**
- C. If there are contradictions between the Contracts Documents, the CONTRACTOR will ask to the EMPLOYER to choose between the possibilities and the CONTRACTOR shall provide all work, materials and services which may be necessary for the complete and proper construction, supply and installation of the WORK in good faith according to the choice of the EMPLOYER.
- D. The estimated work duration and completion is 2 (Two) Months.

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of this Contract is to do procurement and installation of solar power components as per bill of quantities and specification attached in this ITB, the contract includes delivery of the materials to Kharaz camp in Lahj governorate, and Basateen Neighborhood in Dar Sa'ad district in Aden, Yemen, and installation in the designated places as below:

- Registration Center in Kharaz Refugee Camp in Luhj Governorate.
- Registration Center in Basateen neighborhood, Dar Sa'ad district in Aden Governorate.

The project includes preparation of the work in the sites and supply a good quality of solar system components according to the bill of quantities and specification, works covered by this contract will include but not limited to the below activities and any other works necessary to implement these activities per location:

**a. Registration Center in Kharaz Refugee Camp in Luhj Governorate:**

The planned activities covered in the contract will be complementary works to previous project of the Solar Power System for Kharaz Registration center implemented in the last year (2023), in the old solar power project the following solar power items were procured and installed in the registration center buildings:

- 1- 8 Solar Power panels 400 Watt with steel frame.
- 2- MPPT of 5 Kw
- 3-DC Combiner Box
- 4- DC Breaker Box.
- 5- AC Breaker Box

## 6- Wire, cables and other electrical accessories.

This year, UNHCR has intended to upgrade the existing solar power system to enhance the registration process in the camp, aiming in the same time to reduce the cost incurred due to consumption of fuel used in running of the diesel generator in the registration center in the camp.

The scope of work of the solar power elements proposed in this project will be incorporated with the existed solar power items, in which the old solar system installed in the registration center must be re-assessed to be aligned with the demand of the electrical loads required by the registration center in Kharaz camp and all available solar system will be harmonized with the new items of the solar system procured in this contract without ignoring of any electrical works existed earlier in the previous project.

Thus, all bidders must do site visit to the camp to take note of the existing solar power system in the registration center to be familiar with the context of the project to understand properly the way to incorporate the existing solar power with the new system in a good shape, including re-arrange, modify and change the old electrical map of the registration center buildings in line with the new upgrade of solar power system will be procured in this contract, works covered in this contract will include procurement of solar panels will be installed on the roof of the registration center buildings and other electrical equipment of the solar power components which will be installed in one room designated in the registration center buildings, including the cabling, earthing, lightning, protection and other accessories and electrical components, all items of works will be listed in the below points:

1. Supply, install, test, and commissioning of 22 solar panels not less than 550 W, the solar panels will be installed on the roof of the registration center buildings, any other re-arrangements of the existing solar panels to be harmonized with the new solar power plan of the registration building will be done with no additional cost, all rates of any re-arrangements must be charged on items of the new solar panels. Any additional space required to cover whole solar panels more than the available space on the roof of the registration center buildings adopted by the contractor either in the external yard, on the roof of the existing shade or elsewhere space will be done without additional cost, areas of installation of the solar panels must be approved by UNHCR engineer prior the installation.
2. Supply, install, test, and commissioning of single Phase, Pure Sine wave, 240 V, 50 Hz, hybrid inverter/charger 8 Kw, including all accessories required for parallel operation as per technical specifications. Installation of the inverter in one room in the registration center buildings designated by UNHCR or where the old solar power system was installed.
3. Supply, install, test, and commissioning of lithium Iron Phosphate Battery LIFE PO4 bank voltage 48 volts, Battery Capacity is 200 Ah;10kwh, 1 unit, including steel rack to carry the battery.
4. Supply, install, test, and commissioning of DC Combiner Box.
5. Supply, install, test, and commissioning of DC Cabling.
6. Supply, install, test, and commissioning of AC Cabling.
7. Supply, install, test and commissioning of Battery DC Breakers Box.
8. Supply, install, test and commissioning of Earthing System.
9. Supply, install, test and commissioning of Lighting Protection System.
10. Supply, install, test, and commissioning of protection board.
11. Supply, install, test and commissioning of 4 balls Extinguisher.
12. Supply, install, test and commissioning of 1.5 RT(18000 Btu) Split Air Condition inverter type, 2units.
13. Supply and installation of 2 ceiling fans fixed to ceilings with low power consumption 40 w, 220V 1400 mm, 3 blades.
14. Supply and installation of Steel Iron frame including RC bases to carry solar planes as a group according to the needed arrays.

**b. Registration Center in Basateen Neighborhood, in Dar Sa'ad district, Aden Governorate:**

The bidders must do site visit to the registration center building in Basateen neighborhood in Dar Sa'ad to take note of the existing electrical cabling, electrical facilities, premises and available space for installation of the solar panels and proper area for storing solar components in the registration center building and also to be familiar with the context of the project to understand properly the way to incorporate the new solar system in the registration building in a good shape, including re-arrange, modify and change the old electrical map of the registration center buildings in line with the installation of new solar power system will be procured in this contract, works covered in this contract (will include procurement of solar panels will be installed on the roof of the registration center building and other electrical equipment of the solar power components which will be installed in one room designated in the registration center building, including the cabling, earthing, lightening, protection and other accessories and electrical components, all items of works) will be listed in the below points:

1. Supply, install, test, and commissioning of 96 solar panels not less than 680 W, the solar panels will be installed on the roof of the registration center buildings. Any additional space required to cover whole solar panels more than the available space on the roof of the registration center buildings adopted by the contractor either in the external yard, on the roof of the existing shade or elsewhere space will be done without additional cost, areas of installation of the solar panels must be approved by UNHCR engineer prior the installation.
2. Supply, install, test, and commissioning of single Phase, Pure Sine wave, 240 V, 50 Hz, 6 hybrid inverter/charger 8 Kw, including all accessories required for parallel operation as per technical specifications. Installation of the inverter in one room in the registration center building designated by UNHCR or where the old solar power system was installed.
3. Supply, install, test, and commissioning of lithium Iron Phosphate Battery LIFE PO4 bank voltage 48 volts, Battery Capacity is 200 Ah;10kwh, 6 units, including steel racks to carry the batteries.
4. Supply, install, test, and commissioning of DC Combiner Box.
5. Supply, install, test, and commissioning of DC Cabling.
6. Supply, install, test, and commissioning of AC Cabling.
7. Supply, install, test and commissioning of Battery DC Breakers Box.
8. Supply, install, test and commissioning of Earthing System.
9. Supply, install, test and commissioning of Lighting Protection System.
10. Supply, install, test, and commissioning of protection board.
11. Supply, install, test and commissioning of 6 balls Extinguisher.
12. Supply, install, test and commissioning of 1.5 RT(18000 Btu) Spilt Air Condition inverter type, 2 units.
13. Supply, install, test and commissioning of 1 RT(12000 Btu) Spilt Air Condition inverter type, 6 units.
14. Supply, install, test and commissioning of 0.75 RT(9000 Btu) Spilt Air Condition inverter type, 9 units.
15. Supply and installation of 10 ceiling fans fixed to ceilings with low power consumption 40 w, 220V 1400 mm, 3 blades.
16. Supply and installation of Steel Iron frame including RC bases to carry solar planes as a group according to the needed arrays.

The contractor is committed during his implementation stage to act to do complementary works in addition to the above works, which includes the following works:

1. **Site Works:** The contractor shall prepare the works at the designated sites, including installation of solar panel and the suitable locations as per available space within the registration centers, including the electrical wiring, cabling, earthing, lightening protection and other activities listed in the Bill of quantities of the project. The project activities are

including but not limited to the Manpower, materials, Equipment and all necessary to complete the works as instructed by the Employer's Engineer.

2. **Materials:** The contractor must give samples of the solar system and electrical components to get the approval of the EMPLOYER before supplying and install any equipments. If the contractors cannot offer materials with very good quality that satisfy the EMPLOYER, then The Employer can choose the vendor or brands of materials that meet the requirements.

- B. The supplier will do installation of the solar power systems as per the bill of quantity of the project including all solar and electrical components in the designated areas identified by UNHCR in both locations; Registration Center in Kharaz Refugee Camp in Luhj Governorate, GPS coordinate; [12°46'13.7"N 44°01'55.4"E](#). and Registration Center in Basateen neighborhood, Dar Sa'ad district in Aden Governorate, GPS coordinate; [12°53'13.8"N 44°58'15.2"E](#). The supplier will do supply and installation of the steel bases of the solar panels and look into fixing the panels in the available spaces within the designated places in the registration centers in both Basateen and Kharaz camp. The supplier will transport and deliver all required materials, equipment of the solar systems with sufficient quantity to the designated areas, the supplier will take the necessary measures to maintain safety to the solar system items during the transportation and will take responsibility in the delivery of the solar items. The supplier must do site visit organized by UNHCR to both locations to assess the ground works required to install the solar power systems according to the specification and instructions of the engineer including all requirements per location.

### 1.3 CONTRACT METHOD

**The WORKs hereunder will be implemented under a unit price contract comprised of both unit price items and lump sum items.**

### 1.4 WORK BY OTHERS

**Interference with Work on Utilities:** The CONTRACTOR shall cooperate fully with all utility forces of the EMPLOYER, forces of other public or private agencies or other contractors or companies.

### 1.5 PROJECT MEETINGS

#### **Progress Meetings:**

1. The CONTRACTOR shall schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by EMPLOYER or as required by progress of the WORK and will give a weekly report compared to the plan schedule. The CONTRACTOR, EMPLOYER, and all Contractors, Companies and Subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its Suppliers, Manufacturers, and other Subcontractors.
2. The EMPLOYER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems that may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

# Supply and Installation of Solar Power Systems for Registration Centers in Kharaz Camp, Lahj and Basateen Neighborhood, Aden - Yemen

## 1. Solar PV Module

Solar panels not less than 550 W AND 144 CELLS, N Type and should be comprising of either mono-crystalline or polycrystalline, including:

- a) The module type must conform with CE and IEC 61215, IEC 61730, IEC 61701 or equivalent standards.
- b) Module conversion efficiency should be equal to or greater than 20.6 % under STC.
- c) The PV manufacturer should be approved as tier-1
- d) The module shall be provided with a junction box with IP67.
- e) The PV module shall perform satisfactorily in temperature between – 40 oC to +85 oC;
- f) The rated output power of any supplied module shall have tolerance of 0-5 W;
- g) The supplied module DC voltage should be not less than 1000 VDC;
- h) The product warranty should be at least 15 years.
- i) The item and the cable must be hidden, covered with PVC pipes, and fixed on the roof.
- j) All the works must be done according to the specifications and instructions of supervised engineer.

## 2. Solar Inverter

Single Phase, Pure Sine wave, 240 V, 50 Hz, hybrid inverter/charger 8 Kw, including all accessories required for parallel operation as per technical specifications:

- a) The inverter shall produce pure sine wave form with provision for battery charger, and it can be configured individually or in parallel.
- b) Output frequency shall be 50 Hz.
- c) power factor 1.
- d) Maximum operating Temperature 0-55C.
- e) PV input voltage 100-500V.
- f) MPPT Rang voltage 125-425 V;
- g) DC input :48VDC and 190A.
- h) Total Harmonic Distortion shall be less than 3%.
- i) Designed for indoor enclosure IP 20;
- j) Maximum efficiency should be not less than 90 % at full load.
- k) To be certified to meet at least CE and UL marking and complaint with IEC 62109.
- l) The device should be integrated with LED indicators and LCD display.
- m) It shall allow adjustment of battery voltage and charging current.
- n) The device shall allow connection to grid and/or backup generator(s).
- o) Battery Type laid acid or lithium.
- p) PV input lightning, output over current, output over voltage, surge, output shorted protection are integrated.
- q) The charging function of the inverter/charger shall include battery charging functionality; and the inverter shall be wired in ways that make use of the inverter's battery charging functionality if the installation includes either mains power or a diesel generator.
- r) Protections required: AC overload and load short circuit, overvoltage, overheating and battery reverse polarity.
- s) The inverter with MPPT type (Maximum Power Point Tracking (MPPT) type), efficiency not less than 92 %.
- t) The inverter shall allow internet connection for remote monitoring.
- u) Product warranty shall be 5 years.

## 3. Solar Battery with Racks

Lithium Iron Phosphate Battery LIFE PO4 bank voltage shall be 48 volts as per below specification:

- a) Batteries shall be 48V cell, rated voltage 51.2 V, discharge current 100 A, Peak Discharge Current 200 A, Cut Off Discharge voltage 44.8 V, Charge Current not less than 60 A, Charge Voltage 58.4 V Weight not less than 125kg;
- b) - Battery cyclic life shall be at least 6000 cycles at 80% depth of discharge (DOD)and 8000 cycle at 50% depth of discharge (DOD);
- c) - Reliable performance at high operating temperatures of up to 50° C;

- d) - Wires connected to batteries shall utilize appropriately sized and rated lugs or terminals and proper hardware; battery shall be installed in a secured, well-ventilated powerhouse, or in an outdoor rated enclosure.
- e) Optional for LCD display or communication.
- f) Product warranty shall be 5 years; warranty certificates shall be provided by the manufacturer.

#### 4. DC Combiner Box (DCCB):

DC Combiner Box (DCCB) as per below specification:

- a) 5 input, 2 output DC Combiner Box;
- b) The DCCB to be provided for termination of connecting cables. The DCJB shall be made of metal or UV resistant material and suitable for outdoor installation, IP65,
- c) All wires/cables must be terminated through cable lugs;
- d) DC output circuit: In accordance with the maximum current X 1.25, 1000 VDC breaker.
- e) DC fuse rating for each string: 1000V, 15 A;
- f) Built in surge protection device;
- g) Product warranty shall be 2 years.

#### 5. DC Cabling

DC Cabling as per below specification:

- a) 1kV, Flexible stranded copper per EN 60228 , TUV certified. Insulation: Halogen-free, thermoset polyolefin. Jacket: low smoke non-halogenated, flame retardant, oil, abrasion, chemical and sunlight resistant meeting UL 44, UL 854.
- b) All cables shall be marked properly according to approved design so that cable can be easily traced & identified and hidden;
- c) PV array to battery circuit(s) to be sized for maximum 3% voltage drop at rated array power (Imp);
- d) Cable ends connections are to be made through suitable lugs or terminals, crimped properly & with use of cable glands; this item is including the cables and cable trays.
- e) Perforated type Galvanized steel cable trays, cable tray covers, clamping bolts and other cable tray accessories such as coupler plates, bends, tees, reducers, vertical elbows in manufactured accordance with ASTM A653 SS, Grade 33, coating designation G90.

Size of DC cables:

1. (1C\*16 sq.mm) (Red)
2. (1C\*16 sq.mm) (Black)
3. (1\*50 mm<sup>2</sup>) red 1000v flex to connect from inverters to DC breaker and to batteries installed inside trench and end are connected via proper terminals.
4. (1\*50 mm<sup>2</sup>) black 1000v flex to connect from inverters to DC breaker and to batteries installed inside trench and end are connected via proper terminals.

#### 6. AC Cabling

AC Cabling DC Cabling as per below specification:

- a) Stranded type, TUV certified, double insulation material 1kV XLPE/PVC/CU
- b) All cables shall be marked properly according to approved design so that cable can be easily traced and identified and hidden.
- c) All outdoor exposed wiring to be protected from UV radiation and physical damage, all cabling above ground should be suitably mounted inside cable trays with proper covers.
- d) XLPE insulated and PVC sheathed single or multi core flexible copper cables meeting IEC 60227 and IEC 60502.
- e) Cable ends connections are to be made through suitable lugs or terminals, crimped properly & with use of cable glands.
- f) include remove tiles and excavation trench as per site condition.

Size of AC cables:

1. 4C\*10 sq.mm include remove tiles and excavation trench as per site condition.

## 7. Battery DC Breakers Box:

Battery DC Breakers Box has the below specification:

- a) 2\* 250A 2P DC breakers (in and out);
- b) DC 1000V,10KA.
- c) The box including all the required accessories.

## 8. Earthing System:

Earthing System as per technical specifications including cabling, cable lugs, earthing rods and all required accessories:

- a) Each array structure of the PV modules should be grounded properly;
- b) All metal casing/shielding of the system and its components should be thoroughly grounded;
- c) Earthing pit
- d) Earth resistance should be tested in presence of site engineering representative by calibrated earth tester, the earth resistance should not be more than 5 Ohm.
- e) Earthing installation in accordance with the IEE Wiring regulations, BS 7671
- f) All conductive materials shall be copper.
- g) The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54.
- h) All should be according to the specifications and instructions engineer

## 9. Lighting Protection System:

Lighting Protection System as per technical specifications and drawings including cables, mast and all required accessories:

- i) Lighting arrester shall be copper.
- j) All metal casing/shielding of the system and its components should be thoroughly grounded;
- k) Earthing pit
- l) Earth resistance should be tested in presence of site engineering representative by calibrated earth tester, the earth resistance should not be more than 5 Ohm.
- m) Earthing installation in accordance with the IEE Wiring regulations, BS 7671
- n) All conductive materials shall be copper.
- o) The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54.

## 10. protection board:

Protection board includes:

- p) Under and over voltage protection device both of them input and output.
- q) Under and over current protection device both of them input and output.
- r) AC circuit breaker MCB 100A single phase for input and out put main gride electricity.

## 11. Ball Extinguisher:

Extinguisher balls with warranty at least 2 years.

## 12. Split AC Unit Dual Inverter Type:

Split AC units inverter type of variety of capacities; 15, 000 BTU, 12,000 BTU and 9,000 BTU, specification as below specification:

- a) Alternate operation and temperature control unit with all wiring requirements;
- b) Adjustable fan speed.
- c) Voltage: 220-240.
- d) Frequency: 50 Hz;
- e) Single phase.
- f) Noise level shall not exceed 45 dB.

- g) Star rating 3 star or above;
- h) Suitable for wall mounting;
- i) Outdoor unit shall be housed inside painted metal gage made of mild steel.
- j) The product warranty should be at least 1 years and 5 year for providing spare part

13. Ceiling fan AC/DC:

Solar powered motorized ceiling fan of 40 Watt, with below specification:

- a) Ceiling fans fixed to ceilings with low power consumption 40 w, 220V, 1400 mm, 3 blades ; with remote controlling speed and all supplies and connections inside black plastic pipes (PVC) and bent - in the bending areas - using springs, copper wires and boxes with fixing with screws, up to the assembly point with all necessary components to complete the work as required and approved by the supervise engineer.

14. Steel Iron frame of the Solar Panels:

Supply and installation of Steel frame including RC bases to carry the solar panels as a group according to the needed arrays, as the below specification:

- a) The solar panels in each array should be with an angle of 15 degree with vertical supports, Installing of Galvanized Iron frame consists of a main holder with two circular columns of galvanized iron Tube 4 inches Dia. (thickness not less than 4mm) fixed and anchored in concrete bases (50cmx50cmx50cm) cm. The iron column is carrying iron frame made of Galvanized Iron angle section (50mmx50mm), 5mm thickness. The work includes of supplying and installation of steel box (35x60x50) cm to cover the wires combiner box, install of hinges and closed with a lock laid and under the metal structure, Maximum height of the steel frame of the panels should be not less 2 m. All steel works must be approved in prior the installation by UNHCR engineer.
- b) All steel frames will be painted with high quality anti-corrosion paints 2 coats and one coat of desirable color paint.
- c) The mounted structures and the foundations must be designed structurally to be suitable to withstand all static loads (weight of modules, wind loads etc) that might occur according to the Site conditions. The mounting structure components are bonded together to guaranty potential equalization, The work includes transportation to the project site, and everything needed to complete the work according to drawing, specifications, and instructions of the engineer.
- d) In areas when the roof is not able to carry the solar panels with the RC bases, contractor has mange to compensate installation of the solar panels in space suitable for the panels subjected to UNHCR engineer.
- e) In areas when the space for solar panels are not enough to install all solar panels, contractor will requested to install the panels in the nearest free space subjected to UMHCR engineer.

15. Steel Racks for Batteries:

Supply and installation of Steel Racks for Batteries, include the below specification:

- a) Steel Racks made of galvanized Iron angle section 5cmx5cm and not less than 3mm thickness, the dimension of the frame should be compatible with the size of one battery or array of batteries in a god shape.
- b) All steel frames will be painted with high quality anti-corrosion paints 2 coats and one coat of desirable color paint.