

Statement of Work : Restoring Water Access for Vulnerable families in Lahj

Annex (A): Technical Specifications for Solar Pumping System

PART A (Mechanical)

1. Submersible Pump and Motor:

1.1 Vertical Pump

- Submersible pump different flow multi -stage separate type, AC - 3PH motor type, the motor pump Sets should be used for the solar PV, starting compatible with AC VFD operation, bidders shall indicate manufacture, country of origin, model. And temp. It shall follow below features as minimum:
- Pump Efficiency at Duty Point: 75 -80%,
- Casing (Pump Bowl), Impeller, Wear Rings, Pump delivery and Housing, Check valve (None Return Valve), Inlet strainer should be comply with: (AISI 304 or equivalent) or higher specification materials.
- Shaft and coupling, Shaft sleeve, Bearing bush, Guide bearing, Screw, stud, nut, washer. etc. should be comply with: (AISI 304 or equivalent) or higher specification materials.

1.2 Horizontal Submersible Motor

- The motors shall be Rewindable, insulation rating is compatible with AC VFD operation
- Rated Voltage:220/240 VAC
- Insulation Material and Class, PE2+PA, F or H
- IP: not less than 68
- Motor Efficiency: Not less than 80%
- Motor Speed:1850rpm – 2850rpm
- Shaft, Motor Sleeve, Motor Housing, Diaphragm cover, bolts, Nuts, Studs, screws Washers etc. Should be comply with: (AISI 304 or equivalent) or higher specification materials.
- Product warranty should be at least 1 year.

2. Solar Pumping Inverter Controller

The solar pumping drive is required to have a long lifetime, low maintenance cost and inbuilt MPPT + VFD (Variable Frequency drive). The drive rating should be 1.5 X total solar capacity follow below features:

- Three phase output, voltage range 380-415V (-15%~+10%);
- Efficiency: Not less than 95%;
- Output Frequency: 0~400Hz.
- Enclosure class should be not less than IP65.
- Maximum input voltage Voc: not less than 800 VDC.
- The system should be designed to run near its MPPT range.
- Operating temperature: up to 70 °C.
- Such device should have built in data loggers.
- The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source.
- Soft start, V/F stable speed control during solar radiation changes, adjustable auto/ manual starts in early morning, auto wakeup after adjustable hibernation time in cloudy days, 0 inputs for pressure switch and water level sensor to protect the pump against dry running and tank full water or closed pipeline (high pressure).
- Display: LCD Screen display with Cover + LED status indicator.
- Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency.
- Product warranty should be at least 1 year.

3- PV Combiner Box

The PV combiner box shall be used to combine the multiple DC input to one output, and it shall comply with the following specifications as minimum.

- Enclosure materials: Coated metal with lockable door.
- Enclosure protection: IP65.
- Number of input circuit: total number of strings in addition to 2 spare inputs.

- DC fuse rating for each string:1000V, 30 A.
- DC output circuit: In accordance with the maximum current X 1.5, 1000 VDC breaker.
- Anti-backflow diodes.
- The DC main breaker is not less than 200A and the sub breakers are not less than . 30A
- Operational Environment Temperature: -30 °C ~+70 °C;
- Product warranty shall be at least 1 year.

4. Earthing and Lightning Systems

4.1 AC and DC Earthing.

- All PV modules shall be grounded in accordance to the manufacturer instruction
- Each array structure of the PV modules should be grounded properly.
- All metal casing/shielding of the system and its components should be thoroughly grounded.
- Earthing System shall comply with IEC/BS EN 62305-3.
- Earthing clamps shall be used.
- Grounding and lightening protection equipment shall include SPD, earth pits and rods.
- Lightning arrestor must be higher than the solar panels system and have a dependent pit.
- Grounding resistance should be not more than 5 ohms.

5- Well Raiser

5.1 High pressure G.I pipes PN 35.

- Materials: Carbon Steel.
- Thickness / Schedule: High pressure, not less than 5.49 mm thick.
- Joint Type: Flanged.
- Single Piece Length: 6 m, diameter: 3".
- Pipes package shall include all required adaptors and accessories.
- Pipes allowable working pressure comply with the razing pipes installed with submersible pumps.

5.2Horizontal Raiser Non-return Valve (Check Valve not less than 40 bar).

- Nominal Diameter (DN): Shall be selected according to raiser line diameter.
- Connection Type: Flanged According to the raiser pipes.
- Complete with all required accessories.

6- PV Modules:

- The capacity of the solar modules should be at least 1.7 times greater than AC motor pump.
- Module capacity should not be less than 710 W @STC.
- The solar modules should be designed to run near the MPPT.
- Type of cell: Poly or Mono Crystalline N-Type.
- The PV manufacturer should be approved as tier-1.
- Module efficiency: should not be less than 22%.
- Tolerance of maximum power rating: 0-5 W.
- The PV modules junction box must be IP65.
- Module Voltage: Not less than 1000 VDC.
- Operating temperature: -40°C to 85°C.
- Temperature Characteristics: Pmax: -0.42% /C° or less.
- VOC: -0.31% /C° or less.
- Nominal operating cell temperature (NOCT) : - 40 to 80°C.
- Weather proof DC rated MC4 connector. Fully Secured, not allowing for any loose connections.
- High transmittance tempered glass: Minimum thickness of 4.0 mm.
- Must conform to IEC 61215, 61730, 61701, and UL 1703.TUV, UL certificates or equivalent.
- Certificates and Data sheet of PV module that contains the P-V & I-V Curves, all electrical and mechanical Data, Dimensions, Module area should provide by bidder.
- Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years.
- Product warranty shall be at least 25 years. It must be accompanied by an approved examination certificate from the University of Science and Technology Laboratory.

7- System Cables:

Cables should be sized in accordance with IEC 60364-5-52 standard, bidders should submit cable sizing, and voltage drop calculations considering that the maximum voltage drop should be no more than 3% for each side (AC and DC);

7.1 3phase, AC Submersible Pump Cable.

- Voltage rating:380/415VAC, Type of Conductor: pure copper, flexible, finely multi stranded, Insulation: black poly chloroprene, HO7RN -F or equivalent material, Thickness not less than 3 * 50 mm².

7.2 DC Cable (From array to Combiner Box).

- Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colors: black, red, Thickness not less than 2* 16mm² Type of Conductor: tinned copper, flexible, finely multi stranded.

7.3 DC Cable (From Combiner Box to inverter) Thickness not less than 2* 25mm².

- Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colors: black, red, type of Conductor: tinned copper, flexible, finely multi stranded.

7.4 Water level Cable with Sensor.

- Submersible cable, 1 ×1.5 mm², double sheath.

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7.3 DC Cable (From Combiner Box to inverter) Thickness not less than 2* 50mm²

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7.4 Water level Cable with Sensor

- Submersible cable, 1 ×1.5 mm², double sheath.
- Dry running electrodes.

8- Cable Laying

- All above ground cables shall be installed in polyethylene pipes.
- Under-ground cables shall be installed in cable trench 100 cm depth with PVC medium pressure

pipes as per drawings.

- 50% spare for future expansion.
- Over-head cable laying Columns of medium pressure galvanized iron pipes of not less than 6 meters in diameter and 3 inches in diameter must be installed. They must be excavated and concrete bases of 40 x 40x60 cm must be made with a depth of one meter and a tensile grommets installed.

9- MOUNTING STRUCTURES

Installation and implementation of fixed iron bases to carry solar panels to be against rust and withstand moisture and exposure to water and the sun , including the concrete bases with the work of a column of concrete reinforced, with the work of the excavations, leveling and backfilling. The distance between the tiles and the adjacent stile shall not be less than 5 cm. The distance between the slab and the adjacent slab in the same stack shall not be less than 10 cm. The number of panels in the base shall be 16. What is necessary to finish the item to the fullest according to the specifications and the instructions of the WASH Engineer.

Each component is meeting the following specifications as minimum

1-MOUNTING STRUCTURES

1.1 Dimensions and Access:

-The tilt angle must be South orientation with a fixed tilt angle 15 degrees if its fixed.

1.2 MATERIAL SPECIFICATION:

9- MOUNTING STRUCTURES

Installation and implementation of fixed iron bases to carry solar panels to be against rust and withstand moisture and exposure to water and the sun , including the concrete bases with the work of a column of concrete reinforced, with the work of the excavations, leveling and backfilling. The distance between the tiles and the adjacent stile shall not be less than 5 cm. The distance between the slab and the adjacent slab in the same stack shall not be less than 10 cm. The number of panels in the base shall be 16. What is necessary to finish the item to the fullest according to the specifications and the instructions of the supervising engineer.

Each component is meeting the following specifications as minimum

1-MOUNTING STRUCTURES

1.1 Dimensions and Access:

-The tilt angle must be South orientation with a fixed tilt angle 15 degrees if its fixed.

1.2 MATERIAL SPECIFICATION:

- The frames, post, cap plate, assembly of the structures, etc. shall conform to European standards as detailed in shop drawings of structural members. All elements sections shall be A40 steel with minimum yield stress 275MPa.
- The flash plates on the purlins shall be galvanized steel 02mm thick with 150x120mm for internals and 120x100 for edges and fixed by stainless steel self-drilling fasteners as detailed in the shop drawings.

1.3 Foundation of ground level mounting structures:

- For columns with a section of IPE120, their foundations are (0.40x0.40x1) m isolated footings reinforced concrete type C25 with reinforcement bars as shown in the shop drawings with installation of 4 anchor bolts $\Phi 16$ mm 400mm long inside each footing and all necessary related work as detailed in the shop drawings. This work includes all excavations work and all necessary related work according to the shop drawings and the instructions of the WASH Engineer.
- The reinforced concrete with proportion cement/ sand/ gravel 1: 1.5: 3 respectively.
- The reinforcement bars shall be with minimum yield stress 280MPa.

1.4 The drillings of anchor concrete Bolts shall be on the reinforced concrete slab with (10 cm) depth and (16mm) diameter.

1.5 CONNECTIONS:

- Welding of galvanized elements is not allowed.
- All fasteners (nuts, bolts and washers) shall be of Stainless Steel or galvanized steel.
- All fasteners shall be tightening with designed torque mechanically.
- Connection of columns and rafters shall be of Flange Haunch as indicated in the shop drawings.

1.6 COATING FOR STRUCTURAL STEEL WORKS:

- The first coat shall be from approved zinc chromite primer which applied by using mechanical spaying as well as final two coats of synthetic enamel paint over mounting elements except the galvanized elements as directed.
- Weld and steel elements surfaces shall be clean and flush before application of the protective coating.
- Steel shall not be welded after coating unless permitted by the Engineer and if permitted, the

welded areas shall be free of scale and slag and shall be treated with an alternative galvanizing or zinc coating system approved by the Engineer.

-Steel frames should be filled with fine aggregate, mortar concrete, for fixation all according to specifications and instructions of WASH Engineer.

10. Well Head Piping Equipment:

Piping equipment shall include any required fittings and materials for proper installation or existing system modification such as elbows, tees, sockets, flanges, piece of pipes, ..etc. with high quality and high rating, piping equipment shall be installed inside valve chamber.

11. Horizontal Pumping line Non-return Valve.

- Nominal Diameter (DN): Shall be selected according to pumping line diameter.
- Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line.
- Connection Type: Flanged.
- Type: Swing.
- Standard: BS5153 or Equivalent.
- Body Material: Cast Iron (Gg25).
- Spindle: Stainless steel.
- Complete with flanges, gaskets, bolts and nuts.