

**Ministry of Water and Environment**

***Urban Water Supply and Sanitation Project***

**Supply and Installation of Solar Power Systems for a Water Well and Pumping Station in MATNAH City**

Bid No.: EHC-AF-WS-SAN-008

Under: Emergency Human Capital Project

**Funded by World Bank**

**Through UNOPS**

**Technical Specifications – Electrical Works**

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# Electrical Works

## PART A (PV and Electrical Systems)

### PV Module

* The capacity of the solar modules should be **at least 40 %** greater than AC motor pump.
* Module capacity should not be less than **650 W** @STC.
* Type of cell: Poly or Mono Crystalline.
* The PV manufacturer should be approved as tier-1.
* Module efficiency: should not be less than 20.0%
* The PV modules junction box not less than IP67
* Module Voltage: Not less than 1500 VDC;
* Operating temperature: -40°C to 85°C
* Temperature Characteristics: P max: -0.38% /C° or less
* VOC: -0.30% /C° or less;
* Nominal operating cell temperature (NOCT) : 45 ±2°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 12 years.

### Solar Pumping Inverter Controller

The solar pumping drive is required, the drive should have a long lifetime, low maintenance cost, inbuild MPPT + VFD (Variable Frequency drive). The drive rating should be not less than 1.25 X AC pump rating and it shall follow below features:

* Three phase output, voltage range 380-420 V;
* Efficiency: Not less than 95%;
* Output Frequency: 50H±3%;
* Enclosure class should be not less than IP55.
* Maximum input voltage Voc): not less than 850 VDC;
* The system should be designed to run near its MPPT range;
* Operating temperature: up to 45 °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 start in early morning, auto wakeup after adjustable hibernation time in cloudy days, o 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
* Protection: Over-Voltage, pump Over-Current, pump Over-Load, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Anti-reverse, AC output unbalance (3Phase);
* 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 2 years.

### 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:1500V, 30 A.
* DC output circuit: In accordance with the maximum current X 1.25, 1500 VDC breaker;
* Built in surge protection device;
* Anti-backflow diodes.
* Operational Environment Temperature: -30 °C ~+70 °C;
* Product warranty shall be at least 2 years.

### System Cables:

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

#### 3phase, AC Submersible Pump Cable

Voltage rating:450/750VAC, Type of Conductor: copper, flexible, finely multi stranded, Insulation: **AD8 rated** black poly chloroprene, HO7RN -F or equivalent material.

#### DC Cable (From array to Combiner Box)

Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colours: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded

#### DC Cable (From Combiner Box to inverter)

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

#### Water level Cable with Sensor

• Submersible cable, 1 ×1.5 mm2 mm, double sheath.

• Dry running electrodes

### Cable Laying

* All above ground cables shall be installed in perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mountings structure.
* Under-ground cables shall be installed in cable trench 60 cm depth with PVC Sch#40 pipes as per drawings.
* 50% spare for future expansion.

### Earthing and Lightning Systems

#### 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 be comply with IEC/BS EN 62305-3.
* Earthing installation in accordance with the IEE Wirin1g regulations BS 7671.
* Earthing clamps shall be used.
* Grounding and lightening protection equipment shall include SPD, earth pits and rods
* Grounding resistance should be not more than 5 ohm.

#### Lightning System

* Lighting arrester should be provided.
* Lightning arrester shall be installed with height to protect all PV arrays.
* Lightning System shall be comply with IEC/BS EN 62305-3.
* Minimum height of lightning arrester is 1.5 m.
* System resistance should be not more than 1 ohm.

### Moulded Case Circuit Breaker (MCCB)

* 400V, 3P & 25KA
* NEMA 3R enclosure and powder-coated steel construction
* Lockable front door, wall mounted type, Direct handles, Locking devices, Auxiliary contacts and Protective plates.
* 3 ways at least, shock and vibration proof contacts.
* Conform to BS EN 60947-3 and UL 1008 Listed.

## PART B (Safety and Security)

### Solar Outdoor Lighting

* Minimum capacity 60 Wp lamp compact type ( All in one ) or separated module ( battery shall be built-in with the lamp)
* Lamp luminous efficacy: not less than 100 Im/w.
* Working life time: not less than 30,000.
* The colour temperature range: 3000K – 5000K.
* The LED lamps outdoor deigned with IP 65 protection.
* Operating Temperature range: up to 60°C.
* Certification: All related certificates shall be provided such CE, RoHS.
* PV module and Battery capacities shall cover all energy consumption by lamp for 12 Hr at least.
* Provided with mounting support and all required accessories.
* Fence supports cannot be facilitated for the installation of lighting
* Shall be distributed to light all area of PV modules and well-head room.

### Fire Extinguishers

* A portable fire extinguisher shall be provided, 2 extinguishers for each facility should be supplied near the solar inverter unit.
* Powder / CO2 extinguishers.
* Approved to EN1866.
* 5- 6 kg capacity.
* Made of high strength steel cylinders with a red epoxy polyester paint finish.
* Warranty: at least two years.

## PART C (Mechanical)

**Submersible Pump and Motor:**

**Pump**

Submersible pump Mixed 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 and model. It shall follow below features as minimum:

Pump Efficiency at Duty Point: Not less than 65%, For wells that has TDH more than 300 m and Flow rate less than 10 m3/hr Efficiency at Duty Point: Not less than 60%

Clearance (well dia-pump max dia with cable) = not less than 40 mm;

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.

Maximum allowable sand: 100 gr/m3.

Coupling: according to NEMA.

**Motor**

The motors shall be Rewindable, insulation rating is compatible with AC VFD operation

Rated Voltage:380/400VAC

Insulation Material and Class, **PE2+PA**

Ambient water temp:45 C°

IP: not less than 68

Motor Efficiency: Not less than 80%

Motor Speed:1850rpm – 2850rpm

Cooling sleeve suitable for well internal diameter

Shaft, Motor Sleeve, bolts and Motor Housing, should be comply with: (AISI 304 or equivalent) or higher specification materials.

Shaft Seal (Mechanical Seal) Tungsten carbide/ceramic- Diaphragm Nitrile Rubber Radial Bearing (Guide Bearing) Graphite or superior Axial Bearing (Thrust Bearing) Graphite/ S.S Pads superior, Rubber Parts NBR or equivalent

Product warranty should be at least 2 years.

**Well Raiser**

**GI Carbon Steel Raiser Pipes**

Materials: Hot dip galvanized Carbon Steel according to BS 1387 or equivalent

Joint Type: Threaded or Flanged

Thickness / Schedule: Heavy as per BS 1387 standard or equivalent.

Single Piece Length: 6 m, 3m length is acceptable.

Pipes package shall include all required adaptors and accessories

Pipes allowable working pressure not less than 80 bar

**Vertical Raiser Non-return Valve (Check Valve).**

Nominal Diameter (DN): Shall be selected according to raiser line diameter.

Nominal Pressure (PN): Shall be more than TDH of the system.

Body Material**: Stainless steel 304** or higher grade

Connection Type: According to the raiser pipes.

Standard: BS5153 or Equivalent

Complete with all required accessories

**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.

**Mechanical Water Flow Meter**

Inline, Flanged, Magnetic type, Dray dial, turbine flow meter with all needed accessories such as threaded flanges, gaskets and bolts.

Nominal Diameter (DN): Shall be selected according to output pumping line diameter.

Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line.

Body: Cast Iron

Standard: EN14154, ISO4064

Transient Flow Qt : Shall be less than 50% of Pump flow rate.

Accuracy: ±2% of Nominal flow

Maximum dial indication: 999999

Measuring Units: cubic meter m3

**Surface Pump and Motor:  
 Pump**Pump Efficiency at Duty Point: Not less than 60%,  
Horizontal or Vertical multi-stage centrifugal pump  
Impeller and Diffuser Material: SS 304 or higher  
Stainless steel Shaft  
Tungsten carbide bearing or equivalent  
Mechanical Seal: Carbon/Sci  
Motor Speed:1850rpm – 2950rpm  
Product warranty should be at least 2 years.  
 **Motor**The motors shall be Rewindable, insulation rating is compatible with AC VFD operation  
Rated Voltage:380/400VAC  
 Insulation Material and Class: F  
Motor: IP54 or equivalent  
 Ambient water temp: not less than 40 C°  
 Motor Efficiency: Not less than 80%  
Motor Speed:1850rpm – 2950rpm  
 Product warranty should be at least 2 years.

**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

**Gate 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.

Standard: BS BS6163 or Equivalent.

Operator: Hand Wheel

Resilient Seated.

Body Material: Cast Iron(Gg25)

Stem: Stainless Steel

Complete with flanges, gaskets, bolts and nuts

**Pressure Switch**

Hi pressure Low pressure function

Regulating range: Shall be selected according to output pressure on the beginning of the pumping line

NO/NC electric connection

NPT thread connection to pipe

Manual trip function

IP44 to EN 60529 / IEC 60529

Shall be equipped with isolation Stainless steel 1/2 inch Ball valve of the same pressure rating.

**Analogue Pressure Gauge.**

Reading range: Shall be specified according to the pressure on the installation point.

Process connection: NPT connection 1/2" or 1/4".

Pressure gauge should be equipped with isolation Stainless steel 1/2 inch Ball valve of the same pressure rating.

Casing: Stainless steel, 4 inch

**Well Cap / Cover**

Material: made from A36 or equivalent CS plate

Min. thickness: 18 mm for borehole wells caps

Painted by Anti-corrosion Paint

Diameter: Shall be more than well diameter

Fabricated with stiffeners and holes for pump and sensor cables

Stiffeners shall be holed for lifting purposes