**Technical Specification for the installation of solar pumping systems**

Adapted from IOM & OXFAM – Global solar and water initiative

1. **Project Information**

Bidders should consider and design a solar power water pumping system which delivers the water needs as specified in this document.

It is envisaged that the system is made up of the following components.

* Solar generator to provide power
* Pump and pump motor to pump the required water
* Electrical control equipment

Metric measurements – Cubic meters, Kilowatts and Meters should be used as standard in responses.

1. **System Design**

* All components of the solar system shall be robust, neatly assembled, firmly fixed supports in ground and designed to allow easy access using adequate tools.
* System designs should eliminate the use of components with a short life. Typical component lives should be: 20 years solar generator; 7 years pump motors; 10 years pump ends; 7 years control equipment; 30 years Structures; 30 years mechanical and electrical fittings. All components should be subject to minimal servicing and without expensive parts.
* All components and accessories shall be made from corrosion resistant material and made good to be rust-free by galvanizing and or painting of all surfaces that are exposed to the ambient conditions. All materials shall be resistant to effects of excessive moisture, water, and ambient temperature. Resistance to corrosion shall be according to DIN 8985 standards.
* All equipment, parts and accessories shall be well designed and fastened against theft, with considerable difficulty to unscrew the solar modules or metal parts from the entire assembly.
* The system should be of high quality and designed for use in remote locations. The bidder should outline the key design elements that make the solution suitable for the environment it will be installed in

1. **Bidder Qualification**

* The bidder must have a minimum of 10 years’ experience of designing, installing and maintaining solar pumping solutions of a similar size, scope and application. As evidence of experience and success is able to demonstrate they have similar pumps in operation for the last 10 years
* The bidder must make available a minimum of 2 reference projects in which they have worked. The reference projects must be of a similar scope, size and implemented within Sudan. References will be followed up.
* The bidder should be able to provide positive references from international organisations within the country. There should be an overall positive reputation for good business practise, professionalism and financial stability.
* The bidder must operate a quality management system that is ISO 9001 or equivalent and have recognised third party verification. Have UL / MET listed products for supply. Solar modules, pumps, motors, and control equipment must meet the necessary CE / international standards for safety and where applicable functionality.
* The bidder must have qualified and trained staff that is certifiable with the equipment manufacturer. Training must be of a level to successfully implement the project.
* The bidder must have access to spare parts supply with backing from the equipment manufacturer. Spare parts should typically be available within 5 days of payment.
* The bidder must have access to the manufacturers design support team.
* The bidder must be able to demonstrate that they have a safety management system in place and have a good history of employee health and safety. They must demonstrate good employment practices at all locations which include employment diversity (sex and race), fair wages and appropriate employee representation through workers council / unions. Bidders should take reasonable steps to ensure their supply chain also takes employee responsibility seriously.

1. **Equipment Specification**

The following forms a guide on the equipment specifications required for this project. Any equipment that does not meet these basic requirements will not be considered. The bidder MUST attach equipment datasheets detailing equipment characteristics and features.

**Solar Generator**

The solar generator must be designed to provide adequate power to the system in real world conditions. Pure theoretical models must be avoided and bidders should show what assumptions have been made in calculating the solar generator size and include it in the design

* Only certified Mono-crystalline silicon modules are generally acceptable. The modules should be certified for compliance with IEC/EN 61215 and 61730 or UL 1703 certified and listed
* All modules must be of a robust design and bidders should provide evidence of successful prior off grid use
* Modules shall be guaranteed for 25 years with 10% derating for the first 10 years, and 20% derating within 20 years. The efficiency of solar-PV cells shall be minimum 16% and solar modules total efficiency of minimum 14%
* The PV Modules shall be clearly labelled and permanently marked with a data plate containing the following information: manufacturer’s name and physical address, type/model number, the watt-peak power rating at STC, open circuit voltage and short circuit current, voltage and current at maximum power point, tolerance and temperature coefficient, country of manufacture, certification, e.g: UL listing, IEC 61215,ISO certification, with fool-proof +ve/-ve connectors

**Control Equipment**

A power inverter shall be used to convert DC power from solar PV modules to AC power that can be used to power an AC motor based water pump. The inverter shall act as a pump drive or controller manufactured and supplied to work well with induction motors; suitable for solar water pumping applications. The inverter shall be designed to provide convenient information about voltages, switch and sensor status, and overload conditions; and provide maximum power [maximum power point tracking (MPPT) and current boosting] under varying conditions. It should provide direct solar connection as standard and have the ability to add on an optional power back up if required in the future. The control equipment must meet EN 61800-1, EN 61800-3, EN 60204-1 or internationally recognised equivalent standards

Other desired features include:

* Controlling of the pump system and monitoring of the status of system operation
* Has two control inputs for well probe (dry running protection), float or pressure switches for remote control, with automatic reset after well probe turns pump off
* Protections for over current, under voltage, over speed, over temperature, reverse polarity and dry running.
* Data logging of operating parameters including running time, starting/stopping time, max power/voltage of day and total energy generated in the day. The data can be recalled for reference
* Selectable display of operating including input/output amperage, power and voltage, pump speed and temperature.
* Control equipment must have simple system health indicators that are user visible for trouble shooting purposes: typically of pump status, pump speed, well dry, tank full, low source power information
* Settable minimum and maximum speed to provide continuous water delivery and overload avoidance.
* Integrated MPPT (Maximum Power Point Tracking)
* Maximum Voc 850 VDC, Operating Voltage range Vmpp 500-650 VDC for 3-phase systems
* Output power : 380-400-415 VAC 3-phase, 50 Hz
* Maximum efficiency 97 %
* Inverter enclosure: IP 54 or higher (sealed, weatherproof, insect proof, lizards proof)
* Ambient temperature: -10 to +45°C
* Inbuilt fan which efficiently cools the controller

**Module Support Structure**

* The structural steel for the support of the PV module shall be consist of 4'' Pipe Class A poles, drilled plates 160\*160\*8mm, 50x50x3mm rafters, 50x50x3mm SHS struts and ties, 40x40x4mm angle iron to support the quantity of panels. All joints to be bolt and nuts with spot welding.
* Angle iron shall be used only to support the PV modules and not anywhere else. All steel surfaces shall have a red oxide prime coat and two coats of aluminium paint upon erection
* All welding will be continuous and of full penetration on both sides.
* In case the steelwork is prefabricated away from site, a final coat of paint shall be applied upon erection of the structure on site.
* The structure will be joined and fastened using bolts and nut with spot welding for vandal proofing
* For this location, the solar array should be installed with a tilt angle of 200, facing due south in order to capture maximum irradiation from the sun

**Cabling**

* The cabling will be as follows: From the PV generator to the controller and switch gear, from the generator to the switch gear, from the switching gear to the pump control panel, earthing cable.
* Cable distances should be kept as short as possible to minimize wire size [voltage drop precautions] and installation cost. The appropriate cable size should be selected for use with respect to the distance, voltage and current values involved.
* All the structural components and electrical enclosures shall be bonded together to a common earth connection.
* The ground wire of the pump shall be connected to one of the ground connections in the controller, or to the controller enclosure. Grounding helps to prevent shock hazard if there is a fault in the motor
* An effective discharge path for the surge should be created for earth. One or more 8-foot copper-plated ground rods, preferably in moist earth, should be installed
* A lightening arrestor must be erected such that it will remain the tallest structure on site and grounded with a copper strips of not less than 25mmx4mm
* Proper termination of cables must be used using well crimped cable lugs and cable glands
* All underground cables shall be armoured.

1. **Scope of work**

The scope will include but not limited to the following:

* Transport and delivery of all the equipment and structural parts to the sites
* Erection of the solar panel support structure, positioning of the solar modules on the structure, securing with bolts and nuts with vandal proofing such as spot welding.
* Installation of all the protective and control equipment including solar controller, cable connections between pump, controller, solar modules and generator, grounding, earthing and lightning protection
* The controller and all controls shall be housed in a lockable powder coated steel enclosure complete with rodent proof cable access to the enclosure and provision for enough air circulation.
* Upon completion of the installation the contractor shall conduct a short term pumping and equipment test lasting for the duration of 24hrs to monitor the system.
* On completion of all works, the contractor shall submit to MSF-H a hard and soft copy of the test certificate comprising a test sheet of parameters including insulation resistance, tested peak flow in m3/hr and peak frequency in Hz and others

The contractor shall submit to MSF-H Water and Sanitation department in Port Sudan, a delivery, installation and commissioning report (both soft and hard copies) of all the works done including an operation manual detailing in an easy to follow manner, the operation and maintenance regime to be employed in managing the newly installed solar pumping facilities

* 1 day training of pump attendants and at least 2 MSF-H staff on the operation and maintenance of the solar system by a qualified manufacturer-approved trainer

Note the bidder must submit a realistic work plan together with their bid and commit to abide by the work plan.

1. **Warranty, Defects Liability, Service and Maintenance**

Bidders shall provide a one year warranty and defects liability period (DLP) from the date of commissioning. During this period the bidder will be responsible for making good at their cost repair and replacement of faulty parts and shall promptly attend to faults on demand.

The bidder should also detail as part of the technical proposal their availability and capacity to provide backup support from within the country.

1. **Deliverables**

* The contractor, in consultation with MSF-H Dojdore office, will be responsible for logistical issues required to facilitate delivery, installation, testing and commissioning of a complete, suitable Solar PV pumping system
* On completion of all works, the contractor shall submit to MSF-H a hard and soft copy of the test certificate comprising a test sheet of parameters including insulation resistance, tested peak flow in m3/hr and peak frequency in Hz and others
* Upon completion of the installation the contractor shall conduct a short term pumping and equipment test lasting for the duration of 24hrs to monitor both solar and generator.
* The contractor shall submit to MSF-H Watsan department in Dojdore, a delivery, installation and commissioning report (both soft and hard copies) of all the works done including an operation manual detailing in an easy to follow manner, the operation and maintenance regime to be employed in managing the newly installed solar pumping facilities **(must be provided before final payment is made)**
* The contractor shall conduct 1 day training of pump attendants and at least 2 MSF-H staff on the operation and maintenance of the solar system by a qualified manufacturer-approved trainer **(must be done before final payment is made)**

**Support Structure**

Example support structure

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