UNDP MALAWI

STATEMENT OF WORKS

SUSTAINABLE DEVELOPMENT GOALS HOTSPOT ACCELERATION INITIATIVE (SHAI) PROJECT

CONSTRUCTION OF SOLAR-PUMPED IRRIGATION SCHEME IN PHALOMBE DISTRICT

Luckson Ngalu, UNDP Engineer

July 2021

Table of Contents

Luckson Ngalu, UNDP Engineer

1. INTRODUCTION

In a quest to accelerate achievement of the Sustainable Development Goals (SDGs), there is an advocacy to adopt hotspots approach to local development. Malawi is one of the first countries in Africa to adapt this approach to local development planning and prioritization of service delivery. The country selected Phalombe and Nsanje Districts as the first phase of roll out. Implementation of the initiative (formerly as a project) began in January 2020 with Irish Aid as the donor. The project is implementing the first service response in GVH Gunda, Phalombe District where a solar powered irrigation scheme and boreholes will be constructed and drilled respectively.

2. OBJECTIVES

2.1 Broader Objective

The broader objective is to accelerate achievement of Sustainable Development Goals (SDGs) through hotspot approach to local development.

2.2 Specific Objectives

- The works in Phalombe will help to provide resilience and early recovery from hydrological disasters that negatively impact on food security for the affected communities
- Achievement of food security will further boost nutritional status among the beneficiary communities

3. SCOPE OF WORK

The works in Phalombe will involve construction of solar pumped irrigation scheme. Specific works will include steel frames and solar panels, pump control house and security fence, uPVC pipe works, storage reservoir and solar pumps. The UNDP Malawi expects that the works will be complete within a period of Three (3) months.

Luckson Ngalu, UNDP Engineer

4. LOCATION

Solar powered irrigation scheme in Phalombe will be constructed Sigoti Village under Group Village Head (GVH) Gunda in the area of Traditional Authority Jenala Phalombe District. The gross area for the scheme is about 30 hectares located about 8 km north of Chitekesa Rural Growth Centre in Phalombe District. The scheme will be irrigated using groundwater pumping.

Below are the GPS coordinates for the project site

District	Village	Latitude	Longitude
Phalombe	Sigoti	S 15^0 33' 44.04	E 35^0 36' 32.03

5. TASKS

Successful execution of the works will involve performing the following tasks:

- Topographic survey to establish profiles
- Setting out of the works (scheme layout, pump house, pipelines)
- Excavation in hard and soft material
- Dam embankment formation and compaction
- Borehole drilling, uPVC pipelines trench excavation, laying and backfilling
- Structural frames and solar panels installation
- Solar pumps and security fence
- Pump control house

6. MILESTONES

The UNDP Malawi expects that the tasks will be complete within a timeframe of 3 months and will have the following milestones:

i. Dam embankment rehabilitation
ii. Pump house construction
iii. Solar panels and mounting structure
iv. Borehole drilling & pump installation
v. Pipeline excavations and installation

Luckson Ngalu, UNDP Engir

For ease of management, the UNDP Malawi will tie payments to the milestones as indicated above.

7. DELIVERABLES Luckson Ngalu, UNDP Engineer

The deliverables under the project will include the following:

- Complete construction of solar-pumped irrigation scheme in Phalombe District
- Complete rehabilitation of existing dam

8. SCHEDULE

The above deliverables are due at the expiry of 3 months implementation period and UNDP Malawi will very much appreciate delivery of completed works within the scheduled time. UNDP Malawi expects successful bidders to make maximum use of the dry period to ensure completion of works on schedule and avoid risking damage of the works due to rains.

Activity	August				September				October				Nov
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1
Procurement of Contractor(s)													
Contract Signing													
Site Handovers													
Execution of Works													
Handover Completed Works													

9. STANDARDS AND TESTING

The construction of the hydraulic structures will be in accordance with the industry standards listed in the table below:

British Code or **equivalent/equal**	**Description**
BS 8110-Part 1: 1997 or equivalent/equal	Structural use of concrete – Code of Practice for design and construction
PD IEC TS 63157: 2019 or equivalent/equal	Photovoltaic (PV) systems – Guidelines for effective assurance of power conversion equipment
BS EN ISO 1452: 2009 – Parts 1 to 5 or equivalent/equal	Plastics piping systems for water supply, and for buried and aboveground drainage and sewage under pressure. unplasticised polyvinyl chloride (PVC-U)

BS ISO 16422: 2014 or equivalent/equal	Pipes and joints made of oriented unplasticised polyvinyl chloride (PVC-O) for the conveyance of water under pressure – Specifications

The UNDP Malawi may ask the Contractor to have any material tested in the laboratory or onsite as may be deemed fit and it will be the responsibility of the Contractor to do so at own cost.

9.1 Solar System Specifications

Submersible pump

Pumping equipment should conform to standard ISO-9906 or equivalent/equal specifications (See below for details). The supplier shall mention pump type and material and provide characteristic curves showing the efficiency and performance of the pump.

Submersible motor

The supplier shall mention the origin, make and material of the motor in the technical proposal. The winding material should be 99.99% copper with PE+PA Insulation. The motor should have wet type; water-cooled rewind-able/repairable stator. The motor should have non-disposable / non-hermetically sealed winding and mention the insulation class of the winding material. The technical proposal shall provide for each model quoted, all the technical parameters such as rated voltage, power factor, efficiency, full load ampere, speed and other similar parameters. The testing report with all basic parameters should also be provided in the technical proposal (for more detail specifications see Annex A).

Solar panels

The solar panel offered should be of Mono-crystalline type, duly tested and certified by TUV or equivalent/equal under following international standards or equivalent/equal:

- IEC 61730-1:2004 Luckson Ngalu, UNDP Engineer
- IEC 61730-2:2004
- EN 61730-1:2007
- EN 61730-2:2007
- IEC 61215:2005
- EN 61215:2005

The supplier shall mention the type, number and total output power of the solar panels including all technical parameters for each panel supplied. The output power should be 50% more than the maximum input power requirement of the motor.

Inverter/controller

The inverter/controller should have built-in overload protection; soft start/soft stop feature and variable frequency drive with Integrated Gate Bipolar Transistors (IGBTs) and the supplier shall mention the origin. The inverter/controller should have the provision for both 220V AC and DC input. The supplier shall mention all the electrical parameters like input and output voltage ranges, IP class and efficiency in the technical proposal. In case of inverter, the output should be sine wave.

Cable

The cable should be made of 99.99% copper and double insulated. The cable must be tested and certified as per British Standard Specification or equivalent/equal with the following reports provided in the technical proposal:

- Conductor Resistance test Report
- Insulation Resistance test Report
- Pressure Test Report
- Spark Test Report

Panel mounting

The panel mounting should be made of steel and should have the provision for manual seasonal adjustment.

System design

The supply shall apply adequate factor of safeties while designing the system in order to have compensations for variations in irradiations. The motor output power should be at least 20% more than the pump required input power (Shaft power). The panel output power should be 50% more than the maximum required input power of the motor (motor consumption).

Luckson Ngalu, UNDP Engineer 

9.1.1 Specifications for pumping machinery as per ISO 9906 or equivalent/equal Standard

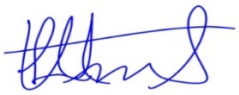
Pump

Pumps coupled with electric motors shall be Submersible for designed for installation and operation in tube wells/dug wells/open well with clear water discharge. Pump shall comprise of bowl assembly coupled to an Electric Motor of suitable rating, riser column pipes of suitable thickness and diameter, discharge bend, non-return valve as integral part of pumps part, single or double cable depending upon the starting method (DOL or Star Delta or equivalent/equal) including all parts and appurtenances to provide a complete working assembly. Pump and motor shall have a rigid coupling through a coupling of NEMA standard or equivalent/equal.

The stage casings of pumps will be connected as per NEMA /ANSI/AWWA/ASTM/BSS standard or equivalent/equal. Each stage casing must have replaceable wear ring with impellers secured to the pump shaft with tapered conical sleeves pressed into the taper bore of impeller or impeller secured through chrome plated. Stainless Steel hexagonal sleeves, suction casing must be between pump and motor with suction strainer as protection of pump against coarse impurities of the liquid handled. Pump shall have integral non-return valve with double.

Pump inlet body, intermediate bowl assembly and discharge bearing body shall be of grey cast iron/G-25. As the pumped liquid is fresh water and for irrigation purpose, therefore the pump impeller should be in cast iron/ bronze/ stainless steel as well as shaft sleeves and bearing in bowl assembly shall be of stainless steel/Bronze. Pump shaft shall be stainless steel AISI 420 or equivalent/equal; Fasteners shall be of stainless steel conforming to A2 grade.

Luckson Ngalu, UNDP

Engineer 

9.1.2 Specification for main components of the pumps

S/N	Components	Specification
1	Casing / Diffuser	The Casing / Diffuser should be in metal casted invariably cast iron/bronze / stainless steel Sheet Fabricated
2	Impellers	Cast iron/Bronze/Stainless steel**,** Noryle (composite material) or equivalent/equal
3	Driving Shaft	Stainless Steel 420
4	Sleeves	Bronze / Stainless Steel 304 for impellers sleeves
5	Gaskets	Rubber Gaskets
6	Bearings	AISI 316 or equivalent/equal Stainless Steel with Hard-Chrome Cover for Top and Bottom Bushes
7	Coupling & Screen + Cable Guard	Stainless Steel AISI 430 or equivalent/equal Stainless Steel 304 or equivalent/equal
8	Non Return Valve	As per British Standard Specification (BSS) or equivalent/equal, minimum 16 Bar Pressure Sustaining Design
9	Sluice Valve	As per British Standard Specification (BSS) or equivalent/equal, minimum 16 Bar Pressure Sustaining Design
10	Pressure Gauge	As per British Standard Specification (BSS) or equivalent/equal, having PSI and Bar scale
11	Clamps	Steel - Pressed
12	Column/Bowl Assembly	Column /Bowl Assembly of ASTM53 standard material or equivalent/equal with stainless steel nut bolts/double

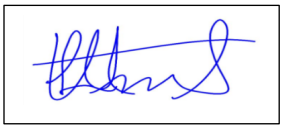
		galvanized and flanges thickness 20mm. The outer surface of pumping unit along with column assembly must be epoxy coated.
13	Pump Efficiency	Minimum efficiency of the pump should be 70% at duty point

Motor

The Motor shall be manufactured in compliance with National Electrical Manufacturer Association (NEMA) standards or equivalent/equal required three-phase motor shall be capable of operating at rated voltage of 380 Volts at 50 Hz. The motor should be capable of handling 10% variance in voltage. Winding of the motor shall be of rewind-able type with class-IC40 insulation and IP68 protection or equivalent/equal. The synchronous speed for 2-poles 2850 – 2950 RPM. Motor shall be capable of operation in well water with temperature normally start from 35° C. Motor should be designed for continuous operation.

The motor shall be without any chemical additives hazards to health for cooling but water filled only. The motor shall have proper protection against the entry of well water sand, etc. by double mechanical seal one, rotating and other stationery to be made of silicon carbide with sand protection guards. The motor shall have copper wire coated winding done with polyvinyl chloride or PE+PA. All supports shall be of high-grade cast iron and stator outer side jacket body should be in stainless steel AISI 304 or equivalent/equal. The motor shall pressure equalizing rubber diaphragm in its lower part to compensate for the excessive pressure due to heating up of the filled water. The oscillating sliding block type thrust bearing shall help to counter axial thrust of the pump. The thrust bearing of the motor should be able to bear a download thrust force from the water pump and the upward thrust force produced while starting the water pump. Motor shall be capable of maximum of 20 starts in an hour. Motor efficiency must not be less than 80%.

9.1.3 Specs of rewind-able wet stators, 3-phase squirrel cage water filled submersible motor



S/N	Components	Specification

1	Winding	Made of pure electrolytic copper a non-hygroscopic poly vinyl chloride for normal temperature and must full fill resistant tests range
2	Stator	Energy efficient low-losses electrical magnetic sheet fixed in stainless steel casing. M800 or M600 or equivalent/equal magnetic sheet are preferable to use
3	Rotor	Energy efficient low-losses electrical magnetic sheet fixed with high-grade copper bars. M800 or M600 or equivalent/equal magnetic sheet are preferable to use
4	Spline Shaft	AISI 420 or equivalent/equal stainless steel, flange dimension according to NEMA standard or equivalent/equal, over size design to ensure stiffness in severs condition
5	Shaft Bearing	Water lubricated guide/general bearings fixed in upper and lower brackets should be made of metal impregnated carbon
6	Lower Thrust Bearing	Thrust sliding block bearings, self-aligning Mitchell type, should be able to withstand **15500N / 20000N** axial load
7	Mechanical Seal (Stationary & Rotary)	Silicon carbide or tungsten carbide Mechanical Seal
8	Pressure Equalizing System and two way pressure relief valve	Consisted of Rubber Diaphragm Safety valves with filters rubber diaphragm located at lower and working together with safety valves to balance the internal motor and external well pressure two way safety valve fitted in the upper part of motor ensure perfect balance of external and internal pressure built by heating up during running. Moreover, fixed filters in safety valves allow only filtered water inside the motor.
9	Cooling Filling Fluid	Water mixed with non-toxic anti-freeze provide cooling and lubrication, and protect and prevent inside parts from corrosion.
10	Connection	Connected through rubber sheathed cable H07RN-F available in Delta and WYE (star) configuration (up to 30 HP DOL and above in Star Delta Configuration) or equivalent/equal.
11	Degree of Protection	IP68.
12	Insulation Class	With winding wire poly vinyl chloride up to 70^0 C with winding wire polyethylene up to 95^0 C.

13	Voltage Tolerance	+6% to -10%
14	Mounting Position	Vertical Horizontal
15	Class	IC 40 or equivalent/equal
16	Maximum Immersion Depth in Water	150 Meters
17	Stating per Hour	20

Luckson Ngalu, UNDP

Engineer

Submersible flate electric cable

The submersible cable should be made of 99.9% copper, coated with double PVC, should be adequately flexible, and environment friendly. The cable must have undergone quality tests as per British Standard Specifications or equivalent/equal. The following lab tests are mandatory:

- Conductor Resistance Test
- Insulation Resistance Test
- Pressure Test
- Spark Test

Note: The supplier should provide the quality test certificates.

Column pipe

The column pipe shall be flanged ERW steel pipes confirming to ASTM designation A-53 or equivalent/equal with a minimum thickness of 3.5mm and painted with corrosion resistance paint of suitable thickness. Flanges thickness of 20 mm may have grooves for cable passage. Each column pipe shall be complete with gaskets, bolts/studs, washers and nuts. All nuts, bolts and washers shall be made of minimum A2 grade stainless steel or double galvanized. The supplier shall supply column pipe in interchangeable section having an approximate length of 10 feet,

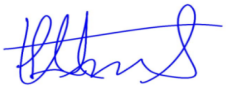
column pipes shall be flanged perpendicular to the axis of pipe. The supplier shall provide sole plate and clamps for the support of pumps.

Features

- Manufacturer's pipes should meet international standards like BSEN 10255 & ASTMA53 or equivalent/equal
- The supply shall observe the dimensional accuracy, circularity and plan end cut
- The supplier shall ensure adequate weld strength of pipe & mechanical properties of raw materials
- Pipes should be NDT tested (Nondestructive testing – Eddy Current)
- Pipes should be hydrostatically pressure tested as per manufacturing standard
- Pipes should be gone through straightening process to remove bendiness

Top set

Bore Cover Plate, (Covering Borehole completely and securely), sluice valve, Reflex valve, Connector and cable jointing material (Cable connection form motor to switching device shall be joint free) pressure gauge and cable ties.

Luckson Ngalu, UNDP Engineer 

10. MEASUREMENT AND VALUATION

This contract will be Fixed Sum or Lump Sum Contract such that payments will based on agreed milestones. Measurement and valuation process will involve checking and verifying that the milestone against which payment claim is made, is indeed complete and in accordance with the requirements of the specifications.

11. TESTS ON COMPLETION

All solar pumping equipment will be tested and commissioned upon completion to ascertain that the installed system is performing as expected.

12. TAKING OVER

Upon completion of the works, the contractor will request for a joint final inspection of the completed works. The Engineer will prepare a punch list where necessary upon conducting the final inspection for the contractor to rectify. Once the punch list has been attended to, and works are certified complete then the contractor will hand-over the works to the communities through the district council.

13. DEFECTS AND DEFECT NOTIFICATION PERIOD

A defect in this context is defined as any observance of a physical problem that may cause structural weakness or failure hence less effective for the intended purpose. The defects can either be patent (obvious, easy to fix and often merely aesthetic) or latent (not easy to find and tend to be somehow problematic). Construction defects may arise from the materials used or workmanship during construction.

The works will have a defects liability period of 12 months within which any defects arising will be documented and the contractor will be instructed to make good of the same unless the defect is due to a force majeure. Failure to attend to the defects without giving any proper reason will result in forfeiture of the retention money withheld by the UNDP Malawi.

14. CLOSURE

Project closure will be upon completion and certification of the works by the UNDP Malawi's representative who will review and sign off on the deliverables. The completed works will be subject to defects liability period as may be determined in the contract document.

15. INSURANCE

The contractor shall have a "Contractor's All Risks (CAR)" insurance during the execution period for the contract to cover the works, equipment, personnel, other people's lives and property.

16. LIABILITY

The Contractor shall not be liable for the defects arising from the design or specifications. However, the Contractor shall be liable for the defects arising from the materials and workmanship. Luckson Ngalu, UNDP Engineer

17. PROJECT SUCCESS

Success of the project as expected by the sponsor, beneficiaries and other stakeholders is dependent on the capacity of the completed structure in resisting failure and protecting target communities from flood damage risk. Success, therefore, requires adherence to standards, quality workmanship and use of quality materials during construction.

18. REQUIREMENTS

UNDP Malawi through their representative will require certifying any completed works in accordance with the milestones before processing any payment for the completed milestone.

19. CONTRACT PRICE AND PAYMENT

The Contract Price will be fixed in Malawi Kwacha (MWK) and the currency of payment is Malawi Kwacha. The UNDP Malawi will pay the Contractor upon completing a milestone as outlined in paragraph 6 above. The amounts payable for each completed milestone will be determined at the time of drafting a contract. However, the UNDP Malawi may pay the Contractor an Advance (20% of the Contract Sum) upon satisfying the requirements in form of Advance Payment Guarantee.

20. OTHER

Complying with Covid-19 protection measures on site is mandatory and the Contractor will have to their work in such a way that workflow is not disrupted in the process of adhering to the

measures. The Contractor will observe and follow safety guidelines on the construction site as instructed by the engineer or any party designated by UNDP Malawi.

Luckson Ngalu, UNDP Engineer