TECHNICAL SPECIFICATIONS

AL-SHAWAR WATER PROJECT

Tur Al-Baha District, Lahj Governorate, Yemen

Project	Al-Shawar Water Project
Location	Tur Al-Baha District, Lahj Governorate, Yemen
Implementing / Supervising Organization	Action for Humanity (AFH)
Document	Technical Specifications for BOQ Items

1. General Requirements

1. The Bill of Quantities (BOQ), these technical specifications, approved drawings, site instructions and written directions of the AFH Engineer shall be read together. Where a discrepancy occurs, the Contractor shall seek written clarification before proceeding.
2. The Contractor shall visit and inspect the site before pricing and commencement, verify dimensions and existing conditions, identify access and utility constraints, and allow for all work necessary to deliver complete, safe and operational facilities.
3. All materials shall be new, unused, of good quality, suitable for the hot, dusty and potentially corrosive local environment, and submitted for approval before procurement or installation. Samples, catalogues, technical data sheets and certificates shall be provided when requested.
4. Workmanship shall comply with applicable recognized standards and manufacturers' written recommendations. Dimensions and levels shall be verified on site. No deviation or substitution is permitted without prior written approval from AFH.
5. The Contractor shall provide all labor, supervision, materials, transport, tools, equipment, temporary works, excavation, backfilling, protection, testing, commissioning, cleaning and incidental items necessary for completion, whether specifically listed or reasonably required by the BOQ item.
6. Excavated material unsuitable for reuse shall be removed to an approved disposal location. Backfill shall be placed in layers and compacted adequately without damaging pipes, cables, foundations or existing structures.
7. Concrete and masonry shall be protected and properly cured. Unless a longer period is specified, cement-based works shall be kept moist for at least seven (7) days. Sulphate-resistant cement (SRC) shall be used where specified or where directed due to soil/water conditions.
8. Electrical equipment shall be installed by qualified personnel. All electrical circuits shall have correctly rated protection, safe isolation, earthing and cable protection. Outdoor equipment shall have suitable ingress protection and UV/heat resistance.
9. The Contractor shall maintain site safety, protect the public and existing facilities, and reinstate surfaces disturbed by the works. All work areas shall be left clean and safe.
10. Measurements and payments shall be based on the BOQ units and quantities, subject to inspection and approval. No item shall be accepted until completed, tested where applicable, and approved by the AFH Engineer.
11. Before handover, the Contractor shall submit equipment manuals, warranties, as-built information where applicable, test results, and provide operation and maintenance training for the solar pumping system and related equipment.

2. Item-Specific Technical Specifications

1.1 – Complete Solar Submersible Water Pumping System

Scope and performance

- Supply, install, test and commission a complete solar-powered submersible pumping system, including all equipment, accessories, transportation, installation, operator training and documentation.
- Equipment shall be of reputable European origin where specified, corrosion-resistant and suitable for continuous outdoor service at ambient temperatures up to 50°C.
- The pump shall deliver not less than 2.7 L/s at a total dynamic head (TDH) of at least 125 m. The Contractor shall submit certified pump curves demonstrating the required duty point before approval.
- The pump and motor shall be compatible with the required flow, head, borehole conditions and available power. The motor rating shall be appropriately selected for the pump duty; oversizing shall not be accepted as a substitute for hydraulic verification.
- The pump shall include a suitable inlet strainer and protection against dry running, overload, over/under-voltage and other faults recommended by the manufacturer.

Solar array and controller

- Provide high-efficiency monocrystalline N-type TOPCon PV modules with module efficiency of at least 23%. Total installed PV capacity shall be not less than 1.7 times the motor rated power, subject to verification of the complete system design.
- The solar pump inverter/controller shall be sized for the selected motor and PV array, with a rated capacity not less than 1.5 times motor power where technically compatible with the manufacturer's requirements. It shall support solar operation and hybrid grid/generator input if required and available.
- Provide a complete combiner/protection arrangement, including correctly rated DC isolators, circuit breakers/fuses, surge protection devices, connectors and a weatherproof inverter enclosure. Components shall be compatible with the system voltage and current.
- Locate the PV array at an approved location near the well, with a minimum horizontal separation of 10 m from the well. Orient and tilt modules to minimize shading and maximize energy yield.

Mounting, cabling and earthing

- Provide hot-dip galvanized steel mounting structure, including foundations, excavation and all fixing hardware. Concrete foundations shall use a 1:2:4 mix unless approved design requires otherwise; the stated typical foundation size is 50 × 50 × 80 cm with excavation depth of at least 50 cm, subject to site verification and structural adequacy.
- PV strings to the combiner box shall use UV-resistant solar DC cable of at least 10 mm². The cable from the combiner/junction box to the inverter is stated in the BOQ as 50 mm; this shall be clarified in writing before procurement and shall be specified as conductor cross-sectional area in mm², selected by calculation for current, voltage drop, installation method and manufacturer limits.
- Provide a complete earthing and lightning/surge protection system, including copper conductor of at least 10 mm², earth electrode(s), clamps, connectors and accessories. Earth resistance shall be measured and recorded; the system shall meet applicable electrical safety requirements and the equipment manufacturer's recommendations.
- Provide pump power cable of at least 3 × 6 mm², subject to verification against motor current, cable length, voltage drop and starting conditions. Cable shall be suitable for permanent submersible use and protected in conduit of at least 1.5-inch nominal diameter where specified. External buried cables shall be laid at least 50 cm below finished ground level and suitably marked/protected.

Rising main, valves and installation

- Supply and install a 3-inch diameter PN16 HDPE rising main to the specified installation depth of 28 m inside the well, with compatible fittings and joints. Confirm actual well depth, pump setting depth and required pipe length on site before ordering.
- Provide a 3-inch PN16 ductile-iron double-flanged non-return valve complying with an applicable recognized standard, together with compatible flanges, gaskets, bolts and supports.
- Secure the pump using a durable, corrosion-resistant double-secured suspension system such as stainless-steel/approved nylon safety rope. Do not rely on the electrical cable to support the pump.
- Install all equipment in accordance with approved drawings and manufacturers' instructions. Protect all exposed metalwork against corrosion and all cables against mechanical damage, heat and UV exposure.

Testing, commissioning and training

- Inspect and test the complete installation, including polarity, insulation, protective devices, earthing, controller settings, pump operation, flow rate and discharge pressure/head as applicable.
- Operate the system continuously for at least 48 hours, subject to adequate solar conditions and safe borehole yield. Record operating conditions, flow rate, controller readings and any alarms. If solar conditions prevent a meaningful test, agree a documented supplementary test with AFH.
- Provide on-site operation and maintenance training to designated operators and hand over manuals, warranties, wiring diagrams, equipment datasheets and test records.

2.1 – Protection Fence for New and Existing Solar Panels

Supply and install a complete fence enclosing the full solar-panel area, including both new and existing panels, with a total length of approximately 95 linear metres or as verified on site.

Fence mesh shall be plastic-coated galvanized chain-link mesh with openings not exceeding 70 mm and a finished height of 2.0 m above ground.

Posts shall be galvanized iron pipes, 2-inch diameter and 2.5 m long, with approximately 0.5 m embedded in concrete and 2.0 m exposed. Post spacing shall not exceed 2.0 m. Provide additional corner/end bracing and concrete support blocks at corners and other locations directed by the Engineer.

Provide plain concrete post foundations using a 1:2:4 mix and a continuous concrete strip/curb beneath the mesh, minimum 20 × 20 cm. Additional concrete blocks of approximately 40 × 40 × 50 cm shall be installed where required by the Engineer. Finish exposed concrete neatly and paint as approved.

Provide Ø8 mm horizontal steel bars at the top and bottom of the mesh, securely fixed to posts to prevent sagging or displacement. All connections, tensioning wires, clamps and fasteners shall be corrosion-resistant.

Provide one lockable access gate, 1.0 m wide × 2.0 m high, made of matching mesh and a galvanized frame using 1.5-inch diameter pipe, 3 mm thick. Gate posts shall be 3-inch diameter galvanized pipes. Include heavy-duty hinges, latch/lock, smooth operation and the donor's logo on the gate.

Prepare and level the enclosed ground and place a compacted gravel sub-base at least 6 cm thick over the entire enclosed area. Apply three coats of anti-rust primer and two finishing coats to painted metalwork, using the approved color. Protect galvanized surfaces with a compatible coating system.

3.1 – Site Clearance, Excavation and Leveling

Clear the designated work area of vegetation, debris, rubbish, loose material and obstructions. Excavate, level and grade the site to the lines and levels directed by the AFH Engineer.

Dispose of unsuitable material at an approved location. Reusable material may be used for backfilling only with the Engineer's approval. Protect existing structures, services, the well and adjacent property throughout the works.

The lump-sum rate shall include labor, equipment, transport, disposal, temporary protection and reinstatement of disturbed areas.

3.2 – Circular Well Inspection / Protection Chamber

Construct a circular protective wall around the well with an external diameter of approximately 3.0 m and a height of 2.5 m, with dimensions and opening locations verified and approved before construction.

Excavate to the required dimensions and levels. Backfill with approved material in compacted layers. Provide a 20 cm thick compacted stone-soling layer and a plain concrete floor at least 10 cm thick, using a 1:2:4 mix. Provide a 2-inch PVC drainage pipe embedded in the slab, positioned to drain safely without undermining the foundation.

Build the circular wall from solid concrete blocks laid in 1:3 cement:sand mortar using sulphate-resistant cement. Ensure proper bonding, alignment and plumbness. Apply internal and external 20 mm thick cement plaster in 1:3 mortar and finish external surfaces with approved weather-resistant coating/roughcast.

Provide a steel access cover at least 3 mm thick with a 40 × 40 mm steel frame, hinges and secure locking arrangement. Apply two coats of anti-rust primer and two finishing coats in the approved color.

Provide a steel door measuring approximately 0.9 m wide × 2.0 m high, made from at least 3 mm thick steel plate with a 40 × 40 mm frame, hinges and secure lock. Provide a 0.5 × 0.5 m ventilation/opening panel with a securely fixed 3 mm protective grille, where approved by the Engineer.

Apply two coats of water-based primer and two coats of approved exterior paint to exposed surfaces. Add the organization's logo in the approved format. Repair and plaster the existing wellhead with sulphate-resistant cement mortar and integrate it neatly with the new works.

All dimensions, steel details, ventilation openings and drainage arrangements shall be approved before construction. Keep the chamber secure and prevent debris or surface runoff from entering the well.

3.3 – Inspection Chamber – 1.0 m × 1.0 m × 1.0 m

Construct one inspection chamber with external dimensions of approximately 1.0 × 1.0 m and height of 1.0 m, including excavation, backfilling, base preparation, masonry, plastering, cover and finishing.

Provide 20 cm thick stone soling and a 10 cm thick plain concrete floor in 1:2:4 mix using sulphate-resistant cement. Install a 2-inch PVC drainage pipe through the floor where shown and approved.

Construct walls from solid concrete blocks using 1:3 cement:sand mortar and sulphate-resistant cement. Apply 20 mm thick internal and external plaster in 1:3 mortar. Cure cement works by watering at least three times daily for no less than seven days.

Provide a 3 mm thick steel cover with a 40 × 40 mm steel frame, hinges and lock. Apply two coats of anti-rust paint and two finishing coats. Apply two coats of water-based primer and two coats of approved paint to the chamber and display the organization/donor logos as instructed.

3.4 – Concrete Curb and Interlocking Pavement Around Well

Prepare and level the area, excavate as required, and construct a continuous concrete curb/edge beam around the well area to dimensions approved by the Engineer. Concrete compressive strength shall be at least 300 kg/cm² (approximately 29.4 MPa) where specified.

Provide a properly compacted stone-soling/base layer and plain concrete bedding using a 1:2:4 mix. Use sulphate-resistant cement where specified or directed. Finish mortar shall be 1:3 cement:sand.

Supply and lay colored interlocking concrete paving blocks, preferably honeycomb type or approved equivalent, with compressive strength not less than 300 kg/cm². Prepare and compact the subgrade, provide the approved bedding layer, lay blocks in a uniform pattern, fill joints and compact the finished surface.

Cure concrete works by watering at least twice daily for a minimum of seven days. Finish and paint exposed curb faces in the approved color. Finished paving shall be even, stable, free of rocking blocks and graded to avoid ponding.

4.1 – Rehabilitation of Existing Water Point and Water Tank

Inspect the existing tank and water point and confirm all connection sizes and conditions before work. Renovate the installation, including float valve, control valves, fittings, supports and all special connections required for a complete leak-free system.

Supply and install PN10 PVC inlet/rising pipe, 1.5-inch diameter; PN10 PVC outlet/distribution pipe, 1.5-inch diameter; and auxiliary PN10 PVC pipe, 0.75-inch diameter, with compatible fittings and solvent-welded joints in accordance with the manufacturer’s instructions.

Supply and install brass gate valves of approved Italian type, 1.5-inch diameter, on both tank inlet and outlet. Provide four durable plastic taps, 0.75-inch diameter, evenly arranged and securely fixed.

Provide 3-inch overflow piping discharging safely away from the tank foundation and 2-inch PVC rainwater drainage piping with adequate slope and an approved discharge point.

Prepare and level the tank base/platform with 1:3 cement mortar and apply two coats of paint in the approved color. Secure the tank using galvanized steel tie wires or an approved equivalent anchoring system in both directions from bottom to top. Apply compatible anti-corrosion coating, white, to exposed fixing components.

Apply the organization’s and donor’s logos as directed. Test all pipework, valves, taps and connections for leakage and proper operation. The price includes all materials, labor, transport, tools and incidental work.

4.2 – Excavation for Collection Basin Base

Excavate the basin base to nominal dimensions of 2.6 × 2.6 × 0.4 m, or to the dimensions and levels confirmed by the AFH Engineer. Remove unsuitable material and dispose of it at an approved location.

Trim and level the excavation bottom, remove loose material and prevent water accumulation. Do not place stone or concrete until the formation has been inspected and approved.

4.3 – Stone Foundation Layer for Collection Basin

Supply and place a 20 cm thick layer of selected durable stone over the prepared basin formation. Stones shall be clean, sound and appropriately graded, free from organic matter and excessive fines.

Spread, water, level and compact the stone layer to provide a firm and uniform base. Obtain Engineer approval before placing concrete.

4.4 – Plain Concrete Floor for Water Collection Basin

Provide and cast a 10 cm thick plain concrete floor over the approved base. Use sulphate-resistant cement. The BOQ mix design specifies, per cubic metre, approximately 250 kg cement, 0.4 m^3 sand and 0.8 m^3 coarse aggregate; the Contractor shall submit the proposed mix and demonstrate that it achieves the specified minimum compressive strength of 200 kg/cm^2 (approximately 19.6 MPa).

Prepare the base, provide formwork where needed, mix and place concrete uniformly, compact without segregation, finish to the required levels and provide adequate curing. No concrete shall be placed on loose, muddy or unapproved formation.

4.5 – Solid Concrete Block Walls for Filling Basin

Construct basin/enclosure walls from solid concrete blocks with minimum compressive strength of 35 kg/cm^2, laid in 1:3 cement:sand mortar using sulphate-resistant cement. Bond blocks in a staggered pattern with full mortar joints and accurate alignment.

Construct two internal solid-stone partition walls, each approximately 2.0 m long, in locations shown on approved drawings. Backfill the base in layers using approved medium-grade gravel mixed with suitable cohesive soil, wet and compact each layer to the Engineer’s satisfaction.

Cure masonry by keeping it moist for at least seven days. Dimensions, wall thickness, reinforcement (if required) and any water-retaining details shall be confirmed on approved drawings before construction.

4.6 – Cement Plastering and Painting to Existing Tank Base and Filling Basin

Prepare and plaster the internal and external surfaces of the tank-base walls, floor, access steps where applicable, and filling basin. Remove loose material, clean surfaces and repair defects before plastering.

Apply two coats of cement plaster using 1:2 cement:sand mortar with cement content not less than 300 kg/m^3. Use screeds/guides to achieve consistent thickness, straight edges and smooth, level surfaces. Install plaster mesh at dissimilar-material junctions or wherever required to control cracking.

Cure plaster by water spraying at least three times daily for at least five days. Apply two coats of high-quality white, water-based exterior paint to exposed surfaces. Paint a 20 cm wide red border around all edges of the base and apply the organization’s logo in the approved format.

4.7 – Ceramic Tiling

Supply and install good-quality ceramic tiles of a size approved by the AFH Engineer. Tiles shall be sound, uniform in size and color, suitable for the intended wet-area use, and free from cracks or defects.

Prepare the substrate to be firm, clean, level and properly cured. Lay tiles using 1:3 cement:sand mortar or another approved bedding method, maintaining consistent joints and falls where drainage is required. Fill joints neatly with white cement or approved grout, clean the finished surface and replace damaged or hollow-sounding tiles.

4.8 – Moisture-Resistant Granular Plastic Exterior Finish

Apply a high-quality, moisture-resistant, spray-applied granular plastic finish (American type or approved equivalent) to the designated external surfaces of the base, tank structure, access steps and filling basin.

Prepare surfaces by cleaning, removing loose or peeling materials, repairing cracks and ensuring the substrate is dry and sound. Apply two coats of compatible moisture-resistant emulsion primer, sanding between coats as recommended by the manufacturer.

Apply at least three coats of the approved granular finish using suitable spray equipment to achieve a consistent texture, color and coverage. Submit product data and a sample/mock-up for approval before full application. The completed finish shall adhere firmly and be free from runs, pinholes, peeling and uneven patches.

4.9 – Sidewalk Around Water Point – 1.20 m Wide

Construct a sidewalk 1.20 m wide around the designated water point, including subgrade preparation, approved fill, compaction, curbs and interlocking pavement.

Provide a continuous curb at least 30 cm high, with concrete compressive strength of at least 300 kg/cm². Excavate and prepare the foundation, provide stone masonry or 1:2:4 plain-concrete base, align and level the curb, and use 1:3 cement:sand mortar for finishing where required.

Supply and lay colored interlocking concrete paving blocks, preferably honeycomb type or approved equivalent, with minimum compressive strength of 300 kg/cm². Fill joints, compact the blocks and finish to provide a uniform, stable surface with suitable drainage falls.

Cure concrete by watering at least twice daily for seven days. Water the paved area at least twice daily for five days where required by the Engineer and block manufacturer. Paint three exposed curb faces in approved colors.

4.11 – Corrugated Metal Sunshade

Supply and install one sunshade measuring approximately 1.5 m wide × 2.5 m long, made from corrugated galvanized steel/zinc sheets fixed to a steel-tube frame of 20 × 40 mm section.

Support the shade on two columns securely fixed to concrete bases nominally 250 × 250 mm in plan and 200 mm high, or as approved by the Engineer. Verify column height, footing depth, anchorage and wind stability on site before fabrication.

All steel members shall be straight, securely welded/bolted and protected against corrosion. Sheet overlaps and fixings shall prevent leakage and uplift. Finish and paint exposed steelwork in an approved color, and remove sharp edges and welding spatter.

5.1 – HDPE Pressure Pipe – 3-inch, PN16

Supply and install black PE100 high-density polyethylene pressure pipe, nominal diameter 3 inches, PN16, SDR11, compliant with ISO 4427 and/or the applicable DIN 8074/8075 standards. Pipes shall be from an approved manufacturer, clearly marked with manufacturer, material grade, diameter, pressure class and standard.

Provide all fittings and accessories required for a complete installation. Excavate trenches nominally 40 cm wide and 60 cm deep, unless site conditions or the Engineer require otherwise. Prepare a suitable bedding, lay pipes without point loads, and provide approved protection or concrete supports at rocky sections.

Join pipes by approved butt-fusion or electrofusion methods using calibrated equipment and trained operators. Fusion faces shall be clean and aligned; joints shall cool naturally and be inspected before installation. Do not use open-flame heating or unapproved adhesive joints.

Backfill with selected fine material around and above the pipe, compact carefully in layers, and complete remaining backfill to the required level. Pressure-test and flush the pipeline before commissioning. Protect the pipe from stones, sharp objects and damage during backfilling.

5.2 – Ductile-Iron Gate Valves – PN16

Supply and install two ductile-iron gate valves, nominal size DN63 / approximately 2.5 inches as stated in the BOQ, pressure rating PN16, with compatible flanged ends and all required gaskets, bolts, nuts, adaptors and supports.

Valves shall be suitable for potable/raw water service, corrosion-protected internally and externally, and supplied with manufacturer's name, size, pressure rating and flow-direction/operating markings as applicable. Provide a handwheel or operating mechanism and ensure accessible installation.

Excavate and backfill connections in trenches nominally 40 cm wide and 60 cm deep or as directed. Provide concrete supports at rocky locations where required. Test valve operation and check all joints for leakage.

5.3 – 3-inch PN16 HDPE Tee/Y Fitting and Flanged Adapter

Supply and install one 3-inch PN16 HDPE tee or single-Y fitting, as approved by the Engineer, for pump-line distribution. The fitting shall be compatible with PE100 SDR11 pipe and rated for the system operating pressure.

Provide a suitable flange adapter/stub end and backing flange for transition between HDPE and ductile-iron/metal pipework, complete with compatible gasket, bolts, nuts and all necessary accessories.

Fusion joints shall be made using approved equipment and procedures. Align pipework without imposing undue stress on the fitting. Pressure-test the completed connection and rectify leakage before acceptance.

5.4 – Project Identification Signboard

Supply and install one marble identification board, nominal size 600 × 600 mm, at a location approved by the AFH Engineer. The board shall be durable, neatly finished, legible and securely fixed using corrosion-resistant anchors or an approved support system.

Include the project name, funding body, supervising organization, supplying/contracting company and description of the supplied/installed works, together with the organization's logo and donor logo where provided. All text, logos, language, layout and colors shall be approved before fabrication.

6.1 – Solar Street Lighting Units

Supply, install, test and commission three complete solar street-lighting units to illuminate the solar-panel courtyard, including PV module, LED luminaire, lithium battery, controller/sensors, pole, foundation, wiring and accessories.

Solar module and battery/control

- PV module rated at least 60 W, nominal voltage 18 V, high-efficiency and suitable for outdoor operation at high ambient temperatures.
- Lithium battery with nominal voltage 12.6 V, integrated charge/control system, dusk-to-dawn light sensor and motion sensor. The complete unit shall operate for at least 12 continuous hours after a full charge under the specified operating mode. The Contractor shall submit battery capacity in Ah/Wh and autonomy calculations for approval.

LED luminaire

- LED efficacy shall be at least 100 lumens/W, color temperature between 3000 K and 5000 K, rated service life at least 30,000 hours, and ingress protection IP65 or higher.
- Equipment shall be suitable for ambient temperatures up to 60°C and supplied with recognized compliance documentation such as CE, RoHS or equivalent.

Pole and foundation

- Provide a galvanized iron pole 3.0 m above finished ground level, nominal diameter 3 inches and wall thickness at least 4 mm. Apply compatible anti-corrosion primer and finishing paint in the color approved by the Engineer.
- Fix each pole in a concrete foundation nominally 30 × 30 × 30 cm using 1:2:4 concrete, with suitable embedded anchors/holding-down arrangement. Confirm foundation adequacy for soil and wind conditions. Set poles plumb and secure before curing.

Route and secure all cables, seal outdoor connections against water ingress, and verify charging, automatic dusk-to-dawn operation, motion-sensor response and lighting performance. Provide manufacturer's instructions and warranty.

3. Inspection, Testing and Handover

- Submit shop drawings, equipment schedules, solar system sizing calculations, pump curves, PV module/controller datasheets, cable sizing calculations and product samples for approval before installation.
- Give AFH reasonable notice for inspection of excavations, foundations, reinforcement where applicable, pipe bedding, concealed cables, fusion joints and other work that will be covered. Do not cover work before inspection where inspection has been requested.
- Conduct and document pipeline pressure/leak tests, pump flow/head and 48-hour operational test, electrical safety and earthing tests, lighting functional tests, and inspection of civil finishes as applicable.
- Rectify at the Contractor's cost any defective, damaged, non-compliant or poorly finished work. Rejected materials shall be removed from site and replaced with approved materials.
- At handover, provide a completion checklist, test reports, equipment manuals, warranties, as-built sketches where applicable, and operator training records. The works shall be accepted only after the AFH Engineer confirms satisfactory completion.