



TECHNICAL SPECIFICATIONS

Water Well Rehabilitation and Solar-Powered Water Supply Projects

Al-Merdami Area Water Project – Al-Qabbaytah, Lahj, Yemen
Al-Kheer Village Water Project – Al-Musaymir District, Lahj, Yemen

1. DOCUMENT CONTROL AND BASIS

Item	Description
Document	Technical Specifications – Al-Merdami and Al-Kheer Village Water Projects
Organization	Action for Humanity (AFH)
Project locations	Al-Merdami Area, Al-Qabbaytah, Lahj; Al-Kheer Village, Al-Musaymir District, Lahj
Primary reference	The attached Bills of Quantities (BOQs) for the two projects

Note: Project-specific dimensions, capacities, quantities, pipe diameters, and performance requirements below have been retained from the attached BOQs. Where a BOQ contains an apparent wording inconsistency, the contractor shall verify the requirement with the AFH Engineer before execution.

2. GENERAL TECHNICAL AND CONTRACT REQUIREMENTS

1. The Contractor shall visit and fully assess the site and existing facilities before submitting its price and before commencing works.
2. No work item shall be considered complete or accepted unless it is fully executed, tested, commissioned and operational.
3. No material or equipment shall be incorporated into the works without prior approval of samples, technical data and/or manufacturer information by the AFH Engineer.
4. The Contractor shall comply at all times with occupational health, safety and site-security requirements applicable to the works.
5. All waste, debris, vegetation, unsuitable materials and construction obstructions shall be removed and disposed of at approved locations. The site shall be handed over clean and organized.
6. All materials shall be new, of good quality, suitable for the specified service conditions, and from reputable approved manufacturers unless otherwise approved by AFH.
7. The Contractor shall carry out all tests required by the BOQ and this specification and shall submit test results to the AFH Engineer.
8. A detailed work method statement and implementation programme shall be submitted and approved before starting the relevant activities.
9. All works shall comply with approved drawings, BOQ requirements, this technical specification and written instructions issued by the supervising Engineer.
10. Before installation of the pumping system, the Contractor shall verify the existing well condition, including static and dynamic water levels, well productivity and water quality. Any discrepancy affecting the design shall be reported for Engineer review before proceeding.
11. The Contractor shall provide all labour, supervision, tools, equipment, transportation, temporary works, lifting equipment, consumables, testing equipment and incidental materials necessary for complete execution.
12. The Contractor shall protect existing structures, pipes, equipment and public areas during construction and shall repair any damage caused by its operations at no additional cost.
13. All dimensions shown in drawings or BOQ shall be verified on site before fabrication or construction. No dimensional discrepancy shall be used as a basis for proceeding without Engineer approval.

3. MATERIAL APPROVAL, INSPECTION AND QUALITY CONTROL

- Submit manufacturer datasheets, certificates, samples and proposed makes/models for Engineer approval before procurement where requested.
- Materials shall be inspected on delivery. Damaged, defective, contaminated or non-conforming materials shall be removed from site.

- Concrete, masonry, plastering, paving, pipe installation, welding/heat fusion, electrical installation and solar equipment shall be inspected at appropriate hold points identified by the Engineer.
- All buried services shall be inspected and approved before backfilling.
- The Contractor shall maintain records of tests, commissioning activities, equipment serial numbers and warranties and shall hand them over at completion.

4. PROJECT-SPECIFIC DESIGN PARAMETERS

Parameter	Al-Merdami Area	Al-Kheer Village
Location	Al-Qabbaytah, Lahj, Yemen	Al-Musaymir District, Lahj, Yemen
Solar pump TDH	≥ 50 m	≥ 80 m
Minimum pump discharge	≥ 2.7 L/s	≥ 2.0 L/s
Minimum motor rating stated	≥ 3 kW and ≥1.3× required pump power	≥ 2.5 kW and ≥1.3× required pump power
Minimum PV array capacity	≥ 1.7× motor power	≥ 1.7× motor power
PV module requirement	N-type TOPCon, ≥23% efficiency	N-type TOPCon, ≥23% efficiency
Pumping line inside well	3 in UPVC, PN35; BOQ English states 24 m installation depth	2 in UPVC, PN35; BOQ English states 24 m installation depth
Main distribution pipe	3 in PE100, 16 bar, SDR11; 350 m	2 in PE100, 16 bar, SDR11; 300 m
Water point tank	Existing 10 m³ concrete tank	New 5,000 L polyethylene tank
Identification board	Marble, 60×40 cm	Marble, 40×40 cm

The above table is a concise project summary; the detailed clauses that follow govern each work item.

5. SOLAR-POWERED SUBMERSIBLE PUMPING SYSTEM – COMMON SPECIFICATION

5.1 Scope of Supply

Supply, install, test and commission a complete solar-powered submersible pumping system, including pump and motor, controller/inverter, PV array, mounting structures, DC cabling, pump power cable, protections, earthing/lightning protection, valves, pumping pipework, mechanical installation, testing, commissioning and operator training.

The complete system shall be suitable for operation under harsh environmental conditions and ambient temperatures up to 50°C. Components exposed to the environment shall be corrosion-resistant.

5.2 Hydraulic Performance

- Al-Merdami: design TDH not less than 50 m and pump discharge not less than 2.7 L/s.
- Al-Kheer: design TDH not less than 80 m and pump discharge not less than 2.0 L/s.
- The pump selection shall be based on the required duty point and shall be compatible with the well conditions verified on site.

5.3 Submersible Pump and Motor

- Provide a submersible pump coupled to a suitable motor.
- Motor power shall be not less than 1.3 times the required pump power and shall be at least 3 kW for Al-Merdami and 2.5 kW for Al-Kheer.
- Pump shall include a strainer suitable for preventing ingress of sand and impurities.
- Pump, motor, seals and wetted components shall be suitable for continuous submersible service and the verified water quality.

5.4 Solar Pump Inverter / Controller

- Inverter/controller capacity shall be at least 1.5 times the motor power.
- Minimum enclosure protection: IP65 for outdoor installation.
- The controller shall support hybrid operation with solar and grid/diesel source where applicable.
- Provide combiner/protection box with appropriate circuit breakers and protection devices.
- Provide a weatherproof enclosure for the inverter/controller where required by the installation arrangement.
- Provide automatic dry-run protection to stop the pump when the water level falls below the safe operating limit.

5.5 Solar PV Array

- Total installed PV capacity shall be not less than 1.7 times the motor power.
- Modules shall be high-efficiency monocrystalline N-type TOPCon with minimum efficiency of 23%.
- PV array shall be installed at a location agreed with the community and AFH Engineer and at least 10 m from the well.
- PV mounting structures shall be hot-dip galvanized steel or approved equivalent, complete with all fasteners and accessories.
- Provide reinforced concrete foundations based on the BOQ requirement: nominal 50×50×80 cm foundations, minimum excavation depth 50 cm, with protection/insulation of buried steel portions and proper finishing.

5.6 DC Electrical Cabling

- PV array-to-combiner cables: minimum 10 mm².
- Combiner-to-inverter cables: minimum 10 mm².
- The BOQs state 50 mm for the junction-box-to-inverter DC wiring; the Contractor shall confirm the intended conductor cross-section with the Engineer before procurement where necessary.
- Cables shall be suitable for outdoor PV service, correctly terminated, protected from mechanical damage and routed neatly.

5.7 Pump Power Cable

- Provide pump power cables of minimum 3×6 mm², or larger where required by the approved equipment manufacturer and final installation conditions.
- Protect cables using plastic conduit of minimum 1.5-inch diameter where specified.
- Cables inside and outside the well shall be waterproof and securely supported.
- External buried cable sections shall be installed at a minimum depth of 50 cm.

5.8 Earthing and Lightning Protection

- Provide a complete earthing and lightning protection system.
- Copper earthing conductor: minimum 10 mm² as stated in the BOQs.
- Bond PV modules and mounting structures using a copper busbar and connect to the grounding system.
- Provide a dedicated grounding chamber for the lightning arrester, separate from the main grounding chamber.
- Lightning arrester conductor: minimum 10 mm²; copper rod approximately 1 m high and mast at least 3 m high, as stated in the BOQ.
- Earth pit shall include grounding rod/electrode, inspection chamber, copper strip, clamps and all accessories.

- Ground resistance shall be tested in the presence of the Engineer's representative using a calibrated earth tester and shall not exceed 5 ohms.

5.9 Pumping Line and Valves

- Al-Merdami: UPVC pumping line, 3-inch diameter, PN35, with the BOQ English description stating 24 m installation depth inside the well.
- Al-Kheer: UPVC pumping line, 2-inch diameter, PN35, with the BOQ English description stating 24 m installation depth inside the well.
- Provide ductile-iron double-flanged non-return valve at the pump discharge: 3-inch for Al-Merdami and 2-inch for Al-Kheer, compliant with the referenced British Standards requirement in the BOQ.
- Al-Merdami shall also include a pressure gauge/manometer with all required fittings and connections.
- All pipework shall be properly supported, aligned and protected against damage during installation.

5.10 Mechanical Installation, Testing and Training

- Secure the pump using a durable double-secured stainless-steel/nylon suspension rope or approved equivalent.
- The Contractor shall verify the pump setting depth and well conditions before final installation.
- The complete system shall be operated continuously for not less than 48 hours for testing and commissioning.
- Final acceptance shall be subject to satisfactory hydraulic/electrical performance, compliance with the BOQ/specification and Engineer approval.
- Provide on-site operation and routine maintenance training to designated operators/beneficiaries.

6. SOLAR PANEL PROTECTIVE FENCING

- Provide and install a complete protective fence around the PV array, including all posts, foundations, mesh, reinforcement, gate, locks, painting and finishing.
- Fence mesh: plastic-coated galvanized chain-link, maximum opening 70 mm.
- Fence height: 2.0 m above ground.
- Posts: galvanized iron pipe, 2-inch diameter, 2.5 m total length, with 0.5 m embedded in concrete and 2.0 m above ground.
- Maximum post spacing: 2.0 m.
- Fence shall be located sufficiently away from PV modules to avoid shading.
- Posts shall receive three anti-rust primer coats and two finishing coats in an Engineer-approved colour.
- Post foundations: plain concrete 1:2:4; continuous concrete curb/strip footing minimum 20×20 cm beneath the mesh.
- Where required, provide additional 40×40×50 cm concrete blocks, particularly at corners, as directed by the Engineer.
- Provide Ø8 mm horizontal steel reinforcement at the top and bottom of the mesh and securely fix all connections.
- Provide one lockable gate, 1.0 m wide × 2.0 m high, with 1.5-inch diameter, 3 mm thick galvanized frame, 3-inch galvanized gate posts, heavy-duty hinges and secure lock.
- Level the enclosed area and provide a compacted gravel/sub-base layer not less than 6 cm thick.
- Paint the donor/organization logo on the gate as directed.

7. CIVIL WORKS – COMMON SPECIFICATIONS

7.1 Site Clearance, Excavation and Leveling

- Clear the work area of obstacles, debris, vegetation and unsuitable material.
- Excavate to the lines, levels and dimensions required by the approved drawings and Engineer.
- Dispose of surplus and unsuitable material at approved locations.
- Backfill with approved material in layers and compact to the required stable condition.

7.2 Control Room – 2.0 m × 2.0 m × 2.5 m

- Construct the control room adjacent to the well at a location selected by the Engineer and community committee.
- External dimensions: 2.0 m × 2.0 m; height: 2.5 m.
- Excavate and backfill to required dimensions and levels using approved compacted material.
- Provide 20 cm soling layer, properly compacted.
- Provide plain concrete floor, minimum 10 cm thick, mix 1:2:4.
- Construct walls from solid concrete blocks in 1:3 cement mortar; use sulphate-resistant cement (SRC).
- Internal and external plaster: cement mortar 1:3, approximately 2 cm thick, properly aligned and finished.
- External surfaces: weather-resistant coating and roughcast/splatter using sulphate-resistant cement as specified.
- Roof slab: 15 cm concrete slab reinforced with Ø12 mm bars at the BOQ stated 5/m grid spacing, including required electrical provisions and rainwater outlets.
- Provide two courses of concrete blocks where shown/required and finish internal and external faces.
- Door: steel, minimum 3 mm thick, with 4×4 cm steel frame, 2.0 m high × 0.9 m wide; provide anti-rust primer and two finishing coats.
- Provide 0.5×0.5 m ventilation opening/window with 3 mm protective grille, securely fixed and painted.
- Apply two coats water-based primer and two finishing coats to exposed surfaces.
- Paint organization logo according to approved design.
- Rehabilitate the existing well head by plastering/leveling with sulphate-resistant mortar and painting, including incidental works required for integration.

7.3 Inspection Chamber – 1.0 m × 1.0 m × 1.0 m

- Construct inspection chamber with external dimensions 1.0×1.0 m and height 1.0 m.
- Excavate and backfill as required; provide 20 cm soling layer.
- Provide 10 cm plain concrete floor, mix 1:2:4, using sulphate-resistant cement.
- Provide approximately 2-inch drainage pipe/outlet where required by site condition and Engineer.
- Build solid concrete block walls using 1:3 mortar with sulphate-resistant cement.
- Apply 2 cm internal and external plaster using 1:3 cement mortar; provide proper curing and external roughcast where specified.
- Provide 3 mm steel cover with 4×4 cm steel frame, hinges and lock, protected with two anti-rust coats and two finishing coats.
- Apply two coats water-based primer and two finishing coats to the chamber and provide organization/donor logo as directed.

7.4 Concrete Curb and Interlocking Paving Around Well/Control Room

- Construct continuous concrete curb/edge beam around the well/control room area as approved by the Engineer.

- Minimum concrete compressive strength: 300 kg/cm².
- Cement mortar for finishing: 1:3.
- Provide appropriate excavation and stone/plain-concrete foundation layer.
- Use sulphate-resistant cement where applicable.
- Cure concrete by watering at least twice daily for a minimum of 7 days.
- Finish and paint curb on three sides in approved colours.
- Provide coloured interlocking concrete paving blocks, preferably honeycomb type or approved equivalent, with minimum compressive strength 300 kg/cm².
- Prepare, level, backfill and compact subgrade; install paving to approved pattern, align joints and compact the finished surface.
- Cure by water spraying at least twice daily for the minimum period stated in the BOQ.

PART A – AL-MERDAMI AREA WATER PROJECT

Al-Qabbaytah, Lahj, Yemen. Project coordinate shown in the BOQ: 13°14'06.6"N, 44°36'25.4"E.

8. AL-MERDAMI – WATER POINT AND DISTRIBUTION WORKS

8.1 Existing 10 m³ Concrete Tank – Moisture-Resistant Granular Plastic Finish

- Prepare all external tank surfaces, access steps where applicable, and filling basin by cleaning, removing loose materials, repairing cracks and treating peeling areas.
- Apply two coats of moisture-resistant emulsion primer, including suitable sanding between coats.
- Apply spray-applied moisture-resistant granular plastic finish, American type or approved equivalent, in not less than three coats.
- Finish shall be uniform, dense, homogeneous, weather-resistant and properly bonded to the substrate.
- All paint materials and colours require prior Engineer approval; submit mock-up where requested.
- Include all labour, equipment, surface preparation and incidental works and apply AFH logo as directed.

8.2 Filling Basins – Concrete Block Walls

- Construct walls for two filling basins using solid concrete blocks with minimum compressive strength 35 kg/cm².
- Overall basin dimensions stated in BOQ: 2.6×2.6×1.6 m; wall thickness 20 cm.
- Use 1:3 cement:sand mortar with sulphate-resistant cement.
- Construct in staggered/stepped bonding with full interlocking and proper alignment.
- Provide four taps per basin with all required accessories.
- Cure masonry by continuous watering for at least 7 days.
- Provide two internal solid-stone partition walls, each 2.0 m long, as shown on approved drawings.
- Backfill the base with layers of medium-grade gravel mixed with cohesive soil, watered and well compacted.

8.3 Ceramic Finishing

- Supply and install suitable-size ceramic tiles using 1:3 cement mortar.
- Spray/cure as required and fill joints with white cement.
- Pattern, colour, size and final finish shall be approved by the AFH Engineer.

8.4 Sidewalk Around Water Point – 1.20 m Width

- Provide a continuous concrete curb/edge restraint around the designated water point area, minimum height 30 cm and concrete compressive strength not less than 300 kg/cm².
- Use 1:3 cement:sand mortar for finishing and provide appropriate excavation and foundation.
- Use stone masonry or 1:2:4 plain concrete as the curb foundation.
- Cure by watering at least twice daily for a minimum of 7 days.
- Provide coloured interlocking concrete paving blocks, minimum compressive strength 300 kg/cm², with suitable subgrade preparation, compaction, alignment and joint filling.
- Cure paving by water spraying in accordance with the BOQ and Engineer instructions.

8.5 Connection from Existing Tank to Filling Basins

- Carry out all plumbing works required to connect the tank outlet to the two filling basins.
- Provide 1.5-inch polyethylene pipework to each basin and a maintenance valve on each branch.

- Include all fittings, connections, supports, excavation/backfilling and incidental work required for a complete functioning installation.

8.6 Corrugated Zinc Sunshades

- Provide two corrugated zinc sunshades, each 1.5 m wide × 2.5 m long.
- Provide two supporting columns, base 0.25×0.25 m with 0.2 m height, and 2×4 cm tubular frame, as directed by the WASH Engineer.
- Provide corrosion protection, secure fixing and proper drainage of the roof sheet.

9. AL-MERDAMI – PIPEWORK, MANHOLE AND IDENTIFICATION

9.1 Main PE Distribution Pipeline

- Supply and install PE100 high-density polyethylene pipe, 16 bar pressure rating, DIN 8074 / ISO 4427, black colour, SDR11.
- Nominal diameter: 3.0 inches; stated quantity: 350 linear metres.
- Pipe supplied in coils of approximately 100 m as stated in the BOQ.
- Provide all required tees, valves, fittings and connections at locations designated by the Engineer.
- Excavate manually to approximately 60 cm depth and 40 cm width where specified; in rocky areas provide suitable concrete supports as directed.
- Join PE pipes by approved heated/butt-fusion welding process using suitable equipment and trained personnel.
- Inspect joints before burial and pressure/test the completed line as required by the Engineer.
- Backfill only after inspection and approval; protect the pipe from sharp stones and construction damage.

9.2 Distribution Manhole – 60 × 60 × 50 cm

- Construct manhole of dimensions 60×60×50 cm.
- Provide 10 cm plain concrete floor, mix 1:2:4, using sulphate-resistant cement.
- Construct solid block walls in 1:3 mortar using sulphate-resistant cement and apply internal/external plaster.
- Provide 3 mm steel cover with hinges and lock, protected by two anti-rust coats and two finishing coats.

9.3 Project Identification Board

- Provide and install a marble project identification board, 60×40 cm.
- Include organization logo and project name, funding body, supervising body, supplying company and type of work supplied/installed.
- Fix securely at the location designated by the AFH Engineer.

10. SOLAR STREET LIGHTING UNITS – BOTH PROJECTS

- Supply, install, test and commission solar-powered lighting units for illumination of the solar panel courtyard, complete with accessories and civil works.
- Solar panel: minimum 60 W rated capacity, nominal voltage 18 V, high-efficiency outdoor module suitable for high temperatures.
- Battery: lithium, nominal voltage 12.6 V.
- Controls: integrated light sensor for dusk-to-dawn operation and motion sensor.

- Battery and PV capacity shall provide not less than 12 hours continuous operation.
- LED luminaire: minimum luminous efficacy 100 lumens/W; colour temperature 3000–5000 K; minimum life 30,000 operating hours; IP65 or higher.
- Operating temperature capability: ambient conditions up to 60°C.
- Recognized international standards/certifications shall be provided, including CE, RoHS or equivalent as stated in the BOQ.
- Pole: galvanized iron pipe, 3-inch diameter, minimum 4 mm thickness, 3.0 m above ground.
- Pole shall receive anti-rust primer and approved finishing coats.
- Foundation: 30×30×30 cm concrete, mix 1:2:4; ensure verticality and correct alignment.
- Test operation after installation and rectify any lighting, control, battery charging or structural defects before final acceptance.

PART B – AL-KHEER VILLAGE WATER PROJECT

Al-Musaymir District, Lahj, Yemen. Project coordinate shown in the BOQ: 13°26'05.3"N 44°37'14.2"E

11. AL-KHEER – WELL HEAD, WATER POINT AND DISTRIBUTION WORKS

11.1 Heavy-Duty Circular Steel Well Cover – Ø4.00 m

- Supply, fabricate, deliver and install a heavy-duty circular steel cover for the existing water well, approximately 4.00 m internal diameter.
- Minimum steel plate thickness: 5 mm.
- Provide a continuous supporting perimeter frame and structural stiffening ribs to prevent excessive deflection.
- Perimeter structural angle: 75×75×6 mm or approved equivalent.
- Internal radial stiffeners: minimum 50×50×5 mm angle.
- Radial ribs to be arranged at approximately 500–600 mm spacing.
- Provide four removable quarter-circle steel panels supported by a continuous perimeter frame and radial structural beams.
- Provide hinges/handles as required for safe removal and maintenance access, together with a secure locking arrangement.
- All steel shall receive suitable corrosion protection and finishing suitable for the site environment.
- All dimensions and fabrication details shall be checked against the existing well before fabrication; the Contractor shall submit shop/fabrication details for Engineer approval.

11.2 Filling/Base Tank and Basin – Excavation and Foundation

- Excavate base tank and basin area to approximately 2.6×2.6×0.4 m as directed by the AFH Engineer.
- Supply and place a selected stone layer 20 cm thick over the 2.6×2.6 m area.
- Water, level and mechanically compact the stone layer to achieve a stable foundation.
- Provide plain concrete floor 10 cm thick over 2.6×2.6 m area, total stated volume 0.676 m³, using sulphate-resistant cement.
- Concrete mix shall use the BOQ-stated quantities of coarse aggregate, sand and cement and achieve minimum compressive strength of 200 kg/cm².
- Provide proper surface preparation, formwork where required, placement, leveling, vibration/compaction and curing.

11.3 Concrete Block Walls for Base Tank and Filling Basin

- Construct solid concrete block walls with minimum block compressive strength 35 kg/cm².
- Overall filling basin dimensions: 2.6×2.6×1.6 m; wall thickness 20 cm.
- Use 1:3 cement:sand mortar with sulphate-resistant cement.
- Use staggered/stepped bonding, full interlocking and proper alignment.
- Provide four taps and all associated fittings.
- Cure masonry continuously by watering for not less than 7 days.
- Provide two internal solid-stone partition walls, each 2.0 m long, in accordance with approved drawings.
- Backfill inside the base with medium-grade gravel mixed with cohesive soil, watered and compacted.

11.4 Cement Plastering and External Painting

- Plaster all internal and external surfaces of tank base walls, tank floor, access steps where applicable, and filling basin.

- Plaster mortar cement content: not less than 300 kg/m³.
- Provide two coats (scratch and base/finish) using 1:2 cement:sand mortar, with screeds/guides to achieve correct thickness and straightness.
- Install plaster mesh where necessary to control cracking.
- Cure by water spraying at least three times daily for not less than 5 days.
- Apply two coats of high-quality external water-based plastic paint, white colour, to exposed external surfaces.
- Provide a 20 cm wide red border around base edges on all sides as specified.
- Provide organization logo according to approved format.

11.5 Ceramic Finishing

- Supply and install suitable-size ceramic tiles using 1:3 cement mortar.
- Spray/cure as required and fill joints with white cement.
- All tile selection and finish shall be approved by the AFH Engineer.

11.6 Moisture-Resistant Granular Plastic Finish

- Prepare all external surfaces of the base, tank structure, access steps where applicable and filling basin.
- Clean surfaces, remove loose material, repair cracks and treat peeling areas.
- Apply two coats of moisture-resistant emulsion primer with suitable sanding between coats.
- Apply not less than three coats of spray-applied moisture-resistant granular plastic finish, American type or approved equivalent.
- Provide uniform, dense and homogeneous texture with good adhesion and weather resistance.
- Submit paint samples/mock-ups for approval where requested.

11.7 Sidewalk Around Water Point – 1.20 m Width

- Provide continuous concrete curb/edge restraint, minimum 30 cm high, minimum compressive strength 300 kg/cm².
- Use 1:3 cement:sand mortar for finishing and appropriate foundation preparation.
- Provide stone masonry or 1:2:4 plain concrete foundation and cure by watering at least twice daily for 7 days.
- Finish and paint curbs on three sides in approved colours.
- Provide coloured interlocking paving blocks, minimum compressive strength 300 kg/cm², with proper subgrade preparation, compaction, alignment, joint filling and curing.

11.8 Corrugated Zinc Sunshades

- Provide two corrugated zinc sunshades, each 1.5 m wide × 2.5 m long.
- Provide two columns, 0.25×0.25 m bases with 0.2 m height and 2×4 cm tubular frame.
- Complete all fixing, corrosion protection and finishing in accordance with Engineer instructions.

11.9 5,000-Litre Polyethylene Water Tank

- Supply and install a high-quality high-pressure polyethylene tank, nominal capacity 5,000 litres, with minimum 10-year warranty.
- Tank shall be complete with float valves, control valves, triple-layer construction as stated in the BOQ, fittings and special connections.
- Inlet/rising pipe: PVC PN10, 1.5-inch diameter.
- Outlet/distribution pipe: PVC PN10, 1.5-inch diameter.
- Auxiliary pipework: PVC PN10, 0.75-inch diameter.

- Provide 1.5-inch high-quality brass gate valves at inlet and outlet.
- Provide eight 0.75-inch plastic taps, four on each side, evenly arranged.
- Overflow: 3-inch pipe safely discharging excess water.
- Rainwater drainage: 2-inch PVC pipe with suitable slope and connection to surface drainage.
- Prepare and finish tank base with 1:3 cement mortar to provide a smooth, level and stable surface.
- Secure tank using galvanized steel tie wires or approved equivalent anchoring system from bottom to top in both directions, with anti-corrosion coating.
- Install organization and donor logos as directed.
- Include all materials, labour, tools, transportation and incidental requirements for complete installation.

12. AL-KHEER – PIPEWORK, AIR RELEASE, MANHOLE AND IDENTIFICATION

12.1 Main PE Distribution Pipeline

- Supply and install PE100 HDPE pipe, 16 bar pressure rating, DIN 8074 / ISO 4427, black colour, SDR11.
- Nominal diameter: 2.0 inches; stated quantity: 300 linear metres.
- Provide all tees, valves, special fittings and connections at Engineer-designated locations.
- Excavate manually to approximately 60 cm depth and 40 cm width where specified; provide concrete supports in difficult rocky areas where directed.
- Join pipe by approved heated/butt-fusion welding process using suitable equipment and competent operators.
- Inspect, test and approve joints before backfilling.

12.2 Air Release Valve

- Supply and install one air release valve at the location identified by the Engineer.
- Valve shall be suitable for the operating pressure and pipe diameter/service arrangement and shall be installed complete with all required fittings and isolation arrangements where shown/required.

12.3 Distribution Manhole – 60 × 60 × 50 cm

- Construct manhole with dimensions 60×60×50 cm.
- Provide 10 cm plain concrete floor, mix 1:2:4, using sulphate-resistant cement.
- Construct solid block walls in 1:3 mortar using sulphate-resistant cement and provide internal/external plastering.
- Provide 3 mm steel cover with hinges and lock, protected with two anti-rust coats and two finishing coats.

12.4 Project Identification Board

- Provide and install a marble project identification board, 40×40 cm.
- Include organization logo, project name, funding body, supervising body, supplying company and description of supplied/installed work.
- Fix securely at the location designated by the AFH Engineer.

13. TESTING, COMMISSIONING AND HANDOVER

14. Submit inspection and test plans for major activities before execution.

15. Carry out all required material, concrete, pipework, electrical, earthing, pump and functional tests specified in the BOQ.
16. For PE pipelines, inspect fusion joints, verify route/depth, perform appropriate pressure/leakage testing before final backfilling, and rectify defects.
17. For the solar pumping system, verify PV array installation, polarity, cable termination, protection devices, controller settings, dry-run protection, earthing and lightning protection.
18. Measure and record earth resistance with a calibrated earth tester; maximum permitted value is 5 ohms as stated in the BOQs.
19. Operate the complete pumping system continuously for at least 48 hours and demonstrate stable operation and the required hydraulic performance.
20. Verify tank filling, valves, taps, overflow, drainage and water-point operation.
21. Verify lighting units, sensors, battery charging and night operation.
22. Correct all defects and non-conformities identified during commissioning before final acceptance.
23. Provide operator training and basic operation/maintenance instructions.
24. Submit final handover documentation including test certificates/results, warranties, equipment datasheets, serial numbers, approved drawings/shop drawings where applicable, and operation/maintenance information.

14. WORKMANSHIP AND FINAL ACCEPTANCE

- Workmanship shall be neat, durable, properly aligned and suitable for the environmental conditions of the project.
- Exposed steel shall be protected against corrosion; buried metal components shall receive appropriate protection before backfilling.
- Concrete and masonry shall be properly mixed, placed, compacted and cured. Cracked, honeycombed, weak or poorly finished work shall be repaired or replaced as directed.
- Pipes shall be properly supported, protected and installed to the approved route and levels.
- Solar modules shall be clean, undamaged, securely fixed and arranged to avoid shading.
- All access covers, doors, gates, valves and taps shall operate smoothly and safely.
- The final site shall be clean, free from construction debris and handed over in an orderly condition.
- Final acceptance shall be subject to completion of all BOQ items, satisfactory testing and commissioning, compliance with approved technical requirements, and written approval by the AFH Engineer.

15. CONTRACTOR'S RESPONSIBILITY FOR COMPLETE WORKS

Unless expressly excluded from the BOQ, the Contractor's rates shall be deemed to include all materials, labour, equipment, transportation, fabrication, excavation, backfilling, supports, fittings, fasteners, protective coatings, testing, commissioning, training and incidental works necessary to provide a complete, safe and operational system in accordance with the approved drawings, BOQ and instructions of the AFH Engineer.

APPENDIX A – BOQ-TO-SPECIFICATION CHECKLIST

Work Package	Al-Merdami	Al-Kheer
Solar submersible pump system	Included	Included
PV protective fence	Included	Included
Control room	Included	Included
1×1×1 m inspection chamber	Included	Included
Heavy-duty Ø4 m steel well cover	—	Included
Concrete curb/interlocking around well/control room	Included	Included
Water point tank	Existing 10 m ³ concrete tank – coating/finish	New 5,000 L polyethylene tank
Filling basin works	Included – two basins	Included – base tank/filling basin
Ceramic works	Included	Included
Water point sidewalk	Included	Included
Tank-to-basin plumbing	Included	Included through tank/fittings arrangement
Sunshades	2 units	2 units
Main PE pipeline	3 in, 16 bar, SDR11, 350 m	2 in, 16 bar, SDR11, 300 m
Manhole	60×60×50 cm	60×60×50 cm
Air release valve	—	1 No.
Project identification board	60×40 cm	40×40 cm
Solar courtyard lighting	Included	Included