

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System– Al Bulk Hospital
Project: Omdurman
Date: 9th August 2025



Project Title: Drilling and Installation of Water Borehole with Solar-Hybrid System– Al Bulk Hospital

Technical Referents: Ibrar Khawaja (WatSan Team Leader); Abjad Al Sarraj (WatSan Manager)

Purpose:

The purpose of this project is to provide a sustainable and reliable water supply to Al Bulk Hospital, Omdurman, Sudan, through the installation of a hybrid solar-powered pumping system. The project includes drilling a 160-meter deep water borehole and integrating a solar-powered pump system to meet the hospital's daily water demand. By utilizing renewable solar energy, the system aims to reduce reliance on the grid, ensuring consistent operation and long-term cost savings for the hospital.

MSF Engineer

MSF designates 'Abjad Al Sarraj' as supervising engineer responsible for inspection and approval of works. Any changes to the agreed design must be approved in writing by the supervising engineer.

Objective:

The objective of this project is to drill a 160-meter deep borehole and install a 10 kW hybrid solar-powered pumping system at Al Bulk Hospital, Omdurman, Sudan, to ensure a sustainable and reliable water supply, meeting the hospital's daily demand while reducing dependence on grid electricity.

TECHNICAL SPECIFICATIONS & INSTALLATION GUIDE

Project: Solar-Powered Water Borehole System

Location: Al Bulk Hospital, Omdurman, Sudan

System Type: Deep Borehole with Solar Pumping System (Hybrid System)

Depth: 160 meters approximately

Pump Power: 10 kW

Water Demand: 30,000–50,000 L/day

PART 1 – GENERAL DESCRIPTION

1.1 Scope of Work

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
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The contractor shall:

- Geophysical survey
- Drill a 160-meter water borehole.
- Construct and develop the borehole with uPVC casing and screens.
- Install a solar-powered submersible pump system (10 kW)- Adjustable subject to the result of water pumping test
- Complete the electrical and solar array installation.
- Perform testing, commissioning, and training.

1.2 Applicable Standards

- WHO Guidelines for Drinking-Water Quality
- ISO 1452 / ASTM D1785 – uPVC casing 10-16 bar
- IEC 61730 / IEC 61215 – Solar Panels
- Manufacturer guidelines for pump and controller

PART 2 – TECHNICAL WORK SECTIONS

SECTION A – Geophysical Survey

The geophysical survey will be performed by the contractor to assess subsurface conditions in the proposed area, with results delivered in a siting report, including GPS coordinates and a lithology profile.

SECTION B – Borehole Drilling and Construction

2.1 Drilling

- Target Depth: 160 meters approximately

Borehole Diameter

- 10"
- 8" for uPVC casing

Drilling Fluids

Fresh, clean water and approved additives only. Drilling mud must be properly mixed and monitored (viscosity, density). Toxic substances are prohibited. Specific Marsh funnel viscosity and up-hole velocity values must be followed.

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
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Logging of Drilling Operations

Contractor and Client will log lithology, water strikes, drilling rates, and drilling fluids. Samples every 2m must be collected. The CONTRACTOR must fully cooperate.

2.2 Borehole Completion

Casing and Screen

Depth (m)	Component	Diameter	Material
0–6	Surface casing (grouted)	10"	Mild Steel
10–140	Plain casing	8"	uPVC Class D (10 bar)
140–160	Slotted screen (0.5–1 mm)	8"	uPVC Class D (10 bar)

- The casing/screen design will follow field lithology data. Screens must provide a **10% open area**, properly matched to gravel size. Centralizers are recommended for uniform gravel placement.
- **Gravel Pack:** 5–10 mm graded silica gravel placed from 140 m to 160 m + 2 m depend on the different lyres depths
- **Sealing:**
 - Cement grout: 0–10 m
 - Bentonite plug: Just above screen

2.3 Borehole Development

- Method: Air-lift and surging
- Duration: Until water is clear
- Air-lift development is mandatory before grouting. Purpose: clean well, settle gravel pack, assess yield. CONTRACTOR must record turbidity, sand content, water levels. Acceptable sand: max 15g/m³ over five samples.

2.4 Borehole Alignment and Verticality

- Alignment check using a 12m steel pipe; verticality via plumb-bob method at 3m intervals. Deviation > 2/3 casing diameter is unacceptable and must be corrected by CONTRACTOR.

2.5 Borehole Camera Inspection

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
Project: Omdurman
Date: 9th August 2025



- CLIENT will inspect the borehole via camera. CONTRACTOR must correct defects (bent casing, poor joints, sediment, etc.) at own cost. “Preferable” but the contractor can propose the inspection method.

2.6 Pumping Tests

- Step drawdown: 30 minutes per step (3–4 steps)
- Constant discharge test: 2 hours
- Recovery monitoring: 2 hours

2.7 Disinfection of the Well

Well must be sterilized with chlorine solution (50 mg/L) for at least 4 hours. Chlorine volume based on borehole volume and static water level.

2.8 Water Quality Testing

- Parameters: pH, TDS, Iron, Nitrate, Coliforms, Fluoride
- Laboratory: Accredited (public or private)

SECTION C – Solar Pumping System (10 kW) – Approximate calculations will be adjust after performing the pumping test

3.1 Submersible Pump (hybrid system)

- Flow Rate: 30– 60 m³/hr at H depends on the pump setting depth and height of 10 m above the ground level.
- Total Dynamic Head (TDH): 150–160 m
- Power: 10 kW
- Type: Brushless, stainless steel solar pump (DC or AC with inverter)
- Brand: Grundfos or Lorentz (or equivalent)

3.2 Pump Controller (MPPT - Maximum Power Point Tracking)

- MPPT-based
- Auto start/stop based on sunlight & tank level
- Dry-run, overload, over-temp protection
- Remote monitoring capable (GSM optional)

3.3 Solar Array

- Capacity: 10 kWp
- Type: Monocrystalline

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
Project: Omdurman
Date: 9th August 2025



- Power per panel: 550–600 Wp
- Quantity: 18–20 panels
- Efficiency: $\geq 20\%$
- Mounting: Fixed-tilt, galvanized steel, south-facing @ 20–25°
- Cable: UV-resistant, minimum 6 mm²

3.4 Electrical Protection

- Components:
 - Circuit breakers (DC rated)
 - Lightning arrestor
 - Grounding rod (2 m copper)
 - Surge protector

3.5 Hybrid System Integration (Solar + Grid)

- The system will be **hybrid**, capable of operating on both **solar power** and **grid electricity**.
 - **Solar Priority:** The system will use **solar energy** as the primary power source when available.
 - **Grid Power Backup:** When solar power is insufficient (e.g., cloudy days or at night), the system will automatically switch to **electricity from the grid** to ensure continuous operation.
- **Key Components:**
 - **Hybrid Inverter:** Manages the seamless transition between solar and grid power.
 - **Automatic Transfer Switch (ATS):** Detects insufficient solar power and switches to grid power.
- **Operation:**
 - **Daytime:** Solar power operates the pump.
 - **Nighttime / Low Solar Availability:** Switches to grid electricity when solar power is insufficient.

Part : 3 - Step-by-Step Contractor Instructions

Step 1: Geophysical survey

Step 2: Mobilization & Site Preparation

- Clear and level drilling and solar area.

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
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Step 3: Drilling and Borehole Construction

- Drill to 160 m.
- Logging
- Drilling Fluids
- Install casing and screen.
- Place gravel pack and grouting.
- Develop borehole.
- Conduct pumping test and water analysis (chemical and bacteriological).

Step 4: Pump Installation

- Install pump at ~135 m depth.
- Connect riser pipes and secure cables.
- Surface controller and control panel mounted in a ventilated weatherproof box.

Step 5: Solar Panel Mounting

- Install ground-mounted steel structure (tilted south).
- Install and wire panels (series-parallel config).
- Connect to MPPT controller and pump.

Step 6: Electrical Protection

- Install breakers, surge protector, and grounding system, changeover.

Step 7: Piping Installation

- Connect the pumping system to the existing water storages (20m pipeline 3 inch GL with their necessary fittings).

Step 8: Commissioning and Testing

- Verify pump operation, flow rate, and solar input.
- Fill tank and inspect system for leaks.
- Provide operational training to hospital staff.

PART 4 – DELIVERABLES & DOCUMENTATION

The contractor must submit:

Annex C – Technical Specifications

Subject: Drilling and Installation of Water Borehole with Solar-Hybrid System – Al Bulk Hospital
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Item	Description
Geophysical	Geophysical survey report
Drilling Log	Depth, formation, yield
Borehole Construction Diagram	Casing and screen placement
Pumping Test Report	Step, constant rate, recovery
Water Quality Test Results	From certified lab
Solar Array Wiring Diagram	Panel and controller connections
System Operation Manual	For hospital technical staff
Warranty Documents	Minimum 1-year equipment warranty

PART 5 – QUALITY ASSURANCE

- All materials must be new, original, and compliant with international standards.
- Site must be cleaned and restored post-construction.
- Training to be conducted in Arabic or English.
- The system should be designed to operate **independently off-grid**, 6–8 hours/day under average sunlight

9. Equipment:

1. Drilling Rig
2. Drill Pipes & Rods
3. Drill Bits
4. Mud Pump
5. Mud Tanks
6. Dewatering Pump
7. Casing Pipes
8. Slotted Screens
9. Casing Driving Tools
10. Backhoe/Excavator
11. Safety Gear (Helmets, Gloves, Boots)

6. Schedule: 15 Working days