Technical Specifications for the Water Pumping Systems of the Wells in Jordan Valley

PART 1 GENERAL

1.01 SUMMRY

This section covers all work related to the supply, installation, construction and erection of the water pumping systems on the water wells with numbers given in the Bill of Quantities (BoQ) in the proposed locations in Nassarya, Jeftlik and Bardala. The work shall include supplying and installing the water pumping systems with all accessories needed to have working systems including: the pumps, their electrical motors, the electric control panels, all needed pipes to connect the pumps with well heads, all needed pipes to connect the output of each well head with the discharge pipe line which is connected to the irrigation pipes or to the pipes delivering the pumped water to storage tanks and irrigation systems. A water flow meter, strainer, gate valves, pressure relief valves, dresser, flow switches, washout, other water controls and electric sensors have to be delivered and installed on each well (as requested in the BoQ) to form a complete working unit. Work shall include all materials and labor, in addition to tests required to complete the job as described in these specifications, contract drawings and bill of quantities.

1.02 QUALITY ASSURANCE

A. The contractor shall offer new pumps and electric motors suitable for running the pumps from manufacturers specializing in the design and manufacturing of water pumps and electric motors in accordance with international standards for more than 10 years. These pumps and electric motors should have been successfully used at least three other locations in the West Bank.

B. All materials and components supplied to this project including pumps, motors, controls, sensors, switches, valves, meters, strainers, fittings, shafts and pipes should pass the quality assurance tests at the factories producing these materials and components in accordance with accepted international standards. The contractor shall supply certificates indicating that the materials supplied have passed such tests.

B. The Contractor shall prove that he has successfully implemented similar works specified in this section in at least 3 other projects.

1.02 SUBMITTALS

A. Pump Submittals: Provide shop drawings, pump test results, performance curves, warranty and certificate approving installation for the pump.

B. Pump motor submittal: Provide shop drawing, performance characteristics, warranty and certificate approving the installation and suitability of the electric motor for the continuous successful operation of the system.

B. Operation and Maintenance Manuals: Provide 4 copies of the Operation and Maintenance manual; containing complete parts list, recommended maintenance schedules and procedures, and guide for operation.

C. Contractors shall provide complete submittals for the pumping station and all installations that will be implemented at the well site, including the pipes, valves, fittings and electric control unit, for approval.

1.04 WARRANTY

A. The contractor shall warrant the system installed and its durability against defects in workmanship and materials for at least 3 years.

B. The pump manufacturer shall warrant each pump and electric motor being supplied against defects in workmanship and materials for 3 years or 9,000 hours of operation, whichever comes first.

1.05 REFERENCE STANDARDS

In these reference standards, the Palestinian Standards when appropriate to the use shall prevail. However, when the Palestinian Standards do not cover a certain part or activity, the appropriate international standard will be used. Preference will be given to ISO otherwise the US (AWWA, ANSI, ASTM, API, ACI) or English standards will be used. The following is a list of standards related to the work proposed in this project:

American Water Works Association AWWA C200: Steel water pipe_6 IN. (150 mm) and larger

American Water Works Association AWWA C207: Steel pipe flanges for waterworks services – sizes 4 in. through 144 in. (100 mm through 3600 mm)

American Water Works Association AWWA C508: Swing-check valves for water works service, 2-in through 24 in. (50-mm through 600-mm)

American Water Works Association AWWA C509: Resilient-Seated Gate valves for water supply services

American Water Works Association AWWA C512: Air release, air/ vaccum, and combination air valves for waterworks service

American Water Works Association AWWA C701: Cold-water meters-turbine type, for customer service

ACIS 301-Standard Specification for Structural Concrete

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AC1 318-Building Code Requirements for Structural Concrete.

ANSI/ASTM A36-Standard Specification for Carbon Structural Steel

ANSI/ASTM A53-Standard Specification for Pipe, Steel, Black and Hot -Dipped, Zinc-Coated, Welded and Seamless

ASTM D 751 Hydrostatic Burst Test, Section 33, Procedure A

ISO 6002-1992: Bolted bonnet steel gate valves

ISO 5781 Hydraulic fluid power - Pressure-reducing valves, sequence valves, unloading valves, throttle valves and check valves -- Mounting surfaces

ISO 5752 Metal valves for use in flanged pipe systems -- Face-to-face and centre-to-face dimensions

ISO 5171 Gas welding equipment. Pressure gauges used in welding, cutting and allied processes

ISO 4126 Safety devices for protection against excessive pressure

EN 1074-4 Valves for water supply - Fitness for purpose requirements and appropriate verification tests - Part 4: Air valves

PSI 186-97: Steel pipes for general use.

PWA, 2000: Planning and design guidelines " pumping stations for water"

PWA, 2003. Construction and installation of pipes in water supply and sewerage trenches.

PART 2 MATERIALS

1) Motor- pump unit: This unit shall include the following components:-

(a)- Vertical Multi Stage Centrifugal Pump and all the accessories it needs to get a working system with design discharge (Q) at a total pumping (dynamic) head (H_T) as specified in the BoQ for each well . Efficiency of this pump should not be less than 70% at the design point. **Pump Assembly:** Bowls-Cast Iron A48 Class 30, free from blowholes, sand holes and other faults, internally porcelain coated, externally coated with backed epoxy. Impellers are of enclosed type and of Zinc Free Bronze unless specified otherwise in the Bill of Quantities. Bowl Bearings- High-lead Tin bronze B584 C937. Turbine Shaft Stainless steel- A582 type 416, with diameter as given in BoQ, Bowl Bolts-SS A276 Type 316. Suction Strainer-SS A276 type 316. The recommended maximum outside diameters are defined in the BoQ, the Outside and internal pump diameters and all materials of pump elements and the diameter of the SS- shaft should be clearly identified in the catalogues presented and also in the offer. Out Diameter of pump should be appropriate to the diameter of the well casing, shut off head should be also clearly identified through the H-Q performance curves that should be submitted with the (Efficiency- Q) curves of all pumps.

The pump should be supplied with a pump nameplate easy to read and corrosion resistance containing complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, total dynamic head and discharge in m^3/hr or liters per second the middle design point, year manufactured, etc.

*For the wells : No. 19-16/005 and No. 19-17/20 , considering that water is brackish with high TDS, the specifications of the impellers have to take the brackish nature of the pumping water. The impellers to be made of special cast stainless steel resistant to corrosion and salt brackish water. The contractor will have to identify clearly in his offer the impellers material of the offered brackish water pumps. All other elements of the pump have to be with the same above mentioned specifications.

(b)- Electric Motor: Shall be a vertical hollow shaft 3 phase induction motor with enclosed fan cooling (squirrel cage) with maximum speed n= 1500 r.p.m. rated at an output power for each well according to the BoQ, Supply voltage =380Vrms, 50Hz, Efficiency>90%, P.F>0.87. Thrust Load=1.5xRated Load, water proof with high protection degree IP55 and insulation class F, including none –reverse ratchet with all protections needed, suitable to drive the above mentioned pump without over loading, with thermestors, space heater (max temp. at well site 46°C), drive shaft, couplings, flanges, nuts, bolts,...etc, and all necessary fittings and cables for installation of the pumping unit. The column shaft (connecting the pump) shall be directly connected to driver motor by means of an adjustable flanged spacer coupling, suitably sized to transmit the required driving torque and be easily accessible for adjustment, packing or mechanical seal replacement.

2) Electric Power Control, Switch and Distribution Board

The main power control switch and distribution board should be built in a dust tight, water proof IP65 steel sheet cabinet (2mm thick) rust free, factory made with front door and lock (gray thermally painted). The top of this cabinet should be 180cm from finished floor and its base is protected by min 20cm cement block. All wiring, bus bars and marking terminal unit and electric company kWh meter are to be in this power cabinet. On/Off push button, emergency button, warning lamps, alarm, digital multi-meter for measuring Current, Voltages and Power. Cabinet dimensions have to be not less than 160 X 120 X 40 cm. The cabinet should include a soft starter (appropriate for the rated motor power) with all protection relays timers, fuses, circuit breakers, bypass contactors and any other components necessary for protection of the 3 phase motor and the pump according to the attached technical drawings and the engineer's instructions. All circuit breakers must be secured through thermal and magnetic combination action while over load release should be of thermal type with calibration adjustable between 0.8 and 1.5 of the motor full current. Relays, circuit breakers, contactors, timers and any other protection components should be of best quality as Merlin Gerlin, Moeller, ABB , Schneider or other approved equivalent type. Transformer 220/ 2x12Vrms should be included in the control cabinet.

The Cabinet shall be manufactured in approved Factory with at least five similar jobs of the same level

In addition to the above, the cabinet should include at least the followings:

a) Over load protection adjustable 0.8 – 1.5 Nominal motor current, short circuit capacity 4PX20 kA surge arrestors of replicable type.

b) Protection relays for: phase failure, phase sequence, short circuit and earth leakage.

c) Digital multimeter : Digital screens to be installed on the front door of the cabinet for presentation of the measuring variables : V, A, kW, Hz, PF , Water level above the pump in (m) and pressure in bar at the well ground surface level .

d) **Analogue Multimeters :** Analogue multimeters for measuring the three phase supply voltages and three phase supply currents of the induction motors are to be installed on the front panel of the control cabinet as specified in the BoQ.

e) Warning lamps for soft start fault, over load, No flow, High pressure, Low pressure and Low water level in the well .

f) Capacitor bank with discharge resistors, reactors and contactor operating at 3phase 400 V, 50 Hz to improve the power factor of the motor to achieve 0.95 lagging as specified in the BoQ and according to drawings and engineers directions. **The capacitors have to be connected in DELTA-connection, the capacity of each capacitor have to be based on the supply voltage of 400V(rms-Value).**

g) **Earthing unit**: Earth equalizer, Comprising C14 box, Copper B.B. 70 mm^2 foundation line 3 earth electrodes (D> 19 mm, L = 1.5m) and any other necessary material or components to achieve an earthing resistance of R_{Earth} <1.5 Ohm for the whole pumping station. Earthing unit should be properly connected to the power/control cabinet of the booster pump and to other components according to the technical drawings.

3) Accessories:

3.1 Water Level Sensor : (Out Diam.<19mm to fit in the 25 mm PVC sleeve pipe), 4-20 mA with all necessary components for proper operation and the cable(with enough length>150m) which includes the wires and thin pipe. The sensor will be connected via its cable with the electric board to measure continuously the water level above the pump. The measured value in m should be shown digitally on the front panel of the control cabinet in accordance with technical specifications and/or engineer's directions. This water level sensor have to be used also for protection of the motor against dry running by switching the motor OFF if the water level above the pump sinks to a definite adjustable limit.

3.2 Pressure Switches: A set of low and high pressure switches 0-30 bar to be connected with the control panel unit including all required cables and accessories in accordance with drawings and/or engineer's directions.

3.3 Flow Switch: Electric flow switch (at least 16bar) suitable for the pipe to be installed in (6" or 4" steel pipes) powered by a 24 V source. Flow switches shall have no moving parts, include 316 Stainless Steel Sensor, suitable for water temperatures up to 40^{o}C, and Pressures of 40 bars or more, Exotic Alloys for Corrosion Resistance including all cables and accessories to connect it to the control unit in accordance drawings and/or engineer's directions.

3.4 Water Flow Meter: Turbine water flow meter (6" or 4" as specified in BoQ, cast iron body, at least 16 bars) complete with flanges, gaskets, bolts and nuts all according to AWWA C207, AWWA C701, or appropriate ISO standards. The meter shall have an accuracy of ±1.5% or better, maximum pressure drop at maximum discharge 0.3 bar. Materials: meter housing (cast iron epoxy coated or cast bronze), rotor (thermoplastic or stainless steel), rotor bearing pivots (stainless steel type 316). The standard register is a straight-reading, permanently sealed magnetic drive register. The meter to include an automatic reading through 100 mA @ 24 V ac/dc reed switch, cable length 5 meters and an LCD to display meters reading in SI units.

3.5 Strainers (cast iron, at least 16bars). Strainers body will be made of cast iron. Strainer body will be coated with an epoxy powder minimum thickness 120 microns. Screen shall be made of stainless steel. For maintenance purposes, covers shall be provided to allow ample access to inspection, cleaning and servicing. A drain bend at the bottom of the body, fitted with a stopcock shall be incorporated. Head loss shall not

be more than 0.1 bars, when clean, at the nominal flow rate of the control valve or water meter protected by the strainer box.

3.6 One Way (check) Valves, cast iron, swing type: Check valves shall be swing type and shall meet the material requirements of ISO 5781 or EN 1074-3. The valves shall be iron body, bronze mounted, single disc, 16 bars (350 psi) working water pressure, nonshock, and hydrostatically tested at a minimum of 36 bars (525 psi). The check valve shall:

A. When there is no flow through the line the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.

B. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.

C. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and spring. Springs with various tensions shall be provided and springs approved by the Engineer shall be installed.

3.7 Gate Valves: (Resilient seated Rising Stem Gate Valves, metal seal, at least 16 bars) complete with flanges, gaskets, bolts and nuts according to AWWA C509, AWWA C207 standards and drawings. The Gate valve shall be of iron body, have flanged ends, and shall be bronze, solid wedge, rising-stem-type gate valve. The valve shall be rated for 16-bar pressure and a minimum of 36 bars test pressure. The valve should have the following characteristics:

A. Valves shall be outside screw and yoke type with rising stem.

B. Face to face metal valves dimension shall conform to ISO 5752 or EN 558-1,2.

C. Bronze gate rings shall be fitted into grooves of dovetail or similar shape in the gates. For grooves or other shapes, the rings shall be firmly attached to the gates with bronze rivets.

D. Hand wheels shall turn counterclockwise to open the valves. Hand wheels shall be of ample size and shall have an arrow and the word OPEN cast thereon to indicate the direction of opening.

E. Stuffing box follower bolts shall be of steel and the nuts shall be of bronze.

F. The design of the valves shall permit packing the valves without undue leakage while they are wide open and in service.

G. O-ring stuffing boxes may be used.

3.8 (a) Analog Pressure Gages (range: 0- 20 bar): Pressure gauges (with Analog Scale) shall be manufactured in accordance with ISO 5171 or EN 837-1,2,3 and shall

be furnished and installed in each pump suction and discharge nozzle and in accordance with the drawings and bill of quantities. Where gauge taps are not available in the pump's suction or discharge nozzle, the necessary taps in the adjacent piping shall be made for installation of gauge connections. Each pressure gauge should be equipped with a stop valve of the same pressure rating.

(b) Digital Pressure Measuring Sensor (range 0-20bar) to measure digitally the pressure in the discharge pipe near the well opening. The digital measurement in bar should be indicated at the front panel of the control cabinet. All work should in accordance with these technical specifications, drawings and engineers directions.

3.9 Air Release/ Relief Valves: Air relief valves shall be of the double orifice pattern with cast iron bodies, the inlet flange shall be fitted and drilled in accordance with EN 1074-4. The valves shall be adequately sized for the release of air from the pipeline without restriction of rate of filling or flow due to backpressure. Air shall be allowed to enter at a rate sufficient to prevent excessive reduction of pressure in the pipe during pipeline emptying. The "aerokenetic" type shall be provided, air valves with internal operating linkages shall be avoided. Valves shall be designed to prevent the operating elements being in contact with the pipeline liquid by approved means such as the provision of an auxiliary float and chamber sufficiently large to isolate the orifice valves and seats throughout the rated operational range.

Air valves shall be fitted with a separate isolating sluice or gate valve and gearing shall be provided, where necessary, to facilitate operation. EN 1074-4. All air relief valves and associated isolating valves shall be works tested and capable of withstanding the same test pressure as the pipeline or vessel on which they operate. All materials used in the manufacture of the valve shall conform to EN 1074-4.

3.10 Pressure Relief Valves with adjustable setting to allow pressure relief when pressure exceeds an adjustable setting in accordance with ISO 4126. The pressure/surge relief valve shall be heavily constructed cast iron valve body, with integral end flanges and full unobstructed flow through area. The disc shall be cast iron having a replaceable resilient seat for tight shut-off. The Pivot shaft shall be stainless steel and be a single unit (not stubs), extending through the valve body with a weight and lever mounted on one or both ends.

The pressure/surge relief valve shall be adjusted at the factory to hold closed against the normal operating system pressure. When the system pressure exceeds this setting, the surge relief Valve shall open immediately to relieve the pressure rise, but closes slowly at an adjustable rate as the system pressure returns to normal.

A heavy-duty oil dashpot system and stainless steel oil reservoir shall be externally mounted on the valve to control the rate of closure, in such a manner, to positively prevent any slam. The closing rate shall be externally and infinitely adjustable thru a

color-coded flow control valve having a locking device to prevent tampering, once the close rate is set.

Prior to shipment of the valves the manufacturer shall factory test the valves under the pressure and flow conditions specified above. The manufacturer shall submit to the Engineer with certified copies of the factory test results. Surge relief valves shall be in accordance with ISO 4126 and shall be installed on the plant water lines as shown on the Drawings.

The surge relief valve shall be heavily constructed cast iron valve body, with integral end flanges and full unobstructed flow through area. The disc shall be cast iron having a replaceable resilient seat for tight shut-off. The Pivot shaft shall be stainless steel and be a single unit (not stubs), extending through the valve body with a weight and lever mounted on one or both ends.

The surge relief valve shall be adjusted at the factory to hold closed against the normal operating system pressure. When the system pressure exceeds this setting, the surge relief Valve shall open immediately to relieve the pressure rise, but closes slowly at an adjustable rate as the system pressure returns to normal.

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Prior to shipment of the valves the manufacturer shall factory test the valves under the pressure and flow conditions specified above. The manufacturer shall submit to the Engineer with certified copies of the factory test results.

Surge relief valves shall be installed where indicated on the Drawings. Valves shall be rated 40 bars (600 psi) working pressure.

3.11 Black Steel Pipes at least 3.96mm Thick externally coated with backed epoxy manufactured in accordance with PSI 186-97 and AWWA C-200 for connecting the riser column pipe through the well discharge head with the valves, switches, meters, strainer , gages and dressers in accordance with BoQ and drawings and engineer's directions. Price includes all jacks, accessories, material, welding, cutting and supports needed to connect and support the pipe in place and its connections. Black steel pipe should have been tested at a pressure of 55 bars or above.

3.12 **Flanged Dresser: 6" and 4"** complete for (16 bars) with two tie rods 60 cm long diameter of 5"/8 and 4 ears for each dresser in accordance with drawings and engineers. Material of dresser shall be high strength steel

3.13 Wash Out: the main wash out end is shown in drawings. The work shall be completed according to the contract condition and the engineer approval. The material needed including a heavy duty 3" flanged cast iron gate valve (16 bars, all piping and all accessories, fittings, piping and joints needed as shown in the drawings

PART 3
EXECUTION:

1) The contractor to dismantle existing pumping system and move dismantled parts to storage area specified by the engineer.
2) The contractor has to prepare a well head plate as specified in the BoQ with epoxy coating and the two holes for installing of two PVC pipes (each 1") used for monitoring the water level in the well .
3) The contractor to deliver and install the vertical turbine pump, column pipes, shaft, PVC sleeves and accessories, the driving induction motor. All to be installed in accordance with manufacturer recommendations, the BoQ and according to engineers directions.
4) The contractor to install the piping and fittings shown in the drawings in accordance with manufacturer recommendations for the various items of valves, strainer, water meter and other fittings and engineer's directions.
5) The contractor to install the electric control board and install the various mechanical and electric controls for the system as shown in the drawings, manufacturer recommendations and engineer's direction.
6) The contractor to flush the system to clean the pipes and fittings from any strange objects.
7) An initial pump test run to be performed to insure the workability of the system.
8) The contractor to perform field hydrostatic testing to insure no leakages in the system. This could be done through adjusting the pressure head utilizing the gate valve available. The contractor shall correct any leaks disclosed by this test. The owner shall furnish water required for testing at the time of pumping station erection completion, and at no charge to the contractor. Labor and equipment necessary for the testing and fixing the leaks shall be the full responsibility of the contractor at no additional costs for the owner or UNDP.
9) The contractor to perform a field test for the pumping station to insure and show that the installed pump shall perform in accordance to the specifications and the manufacturer performance curves of the pump including discharge-head and discharge efficiency relationships.
10) The contractor shall perform all adjustments needed for the valves, controls and sensors to submit a fully operating system with all necessary safety measures.

11) During the process of adjustments and testing, the contractor is responsible in training the pumping station operator assigned by the owner on the safe operation and regular maintenance of the system.
12) The contractor to provide full technical support on the regular maintenance and operation of the system during the warranty period.

PART FOUR

MEASUREMENT AND PAYMENT

The payment for this section will be in accordance of the unit prices shown in the bill of quantities. Only items mentioned clearly in the bill of quantities and implemented under this specification and approved by the supervising engineer will be measured and paid for. Any extra items used to complete the connections of the system or used in the electrical connections to get the water and electrical system operational will be considered incidental to the project and will not be covered or paid for as separate items.

END OF SECTION