

REHABILITATION OF AGRICULTURAL WELLS- NABLUS AND QALQILYAH DISTRICTS

LOCATION OF WORK

The work of this Contract is located within the West Bank Districts (Qalqilyah and Nablus)

SPECIFICATIONS

A. SPECIFICATIONS FOR VERTICAL TURBINE PUMPS

PART 1: GENERAL

1. SCOPE OF WORK

SUMMARY:

- This section covers all works related to rehabilitation of irrigation wells requiring the installation /replacement of vertical turbine pumps shown in the bill of quantities. The work includes furnishing, delivering and installation of vertical turbine pumps, discharge heads, column well pipes, shaft column, gears if listed in the bill of quantities and appurtenance for the replacement of existing pumps with new vertical pump units/stations.
- Furnish all labor, materials, equipment and incidentals required, install, complete and ready for operation and field test, vertical turbine pumps including their respective motors, including all details as shown on the bill of quantities and as specified herein.
- All necessary and desirable accessory equipment and auxiliaries, whether specifically mentioned in this specification or not, shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
- Power factor correction capacitors conforming to the requirements of bill of quantities shall be furnished under this Section.

2. RELATED WORK

- Electric motors for Vertical Turbine Pumps are included in bill of quantities
- Instrumentation and control work provided in this section shall adhere to Instrumentation and Control Specifications in bill of quantities.
- Valves, mechanical piping and appurtenances, except as hereinafter specified, are included in bill of quantities.
- Electrical work, except as hereinafter specified, is included in bill of quantities.

3. SUBMITTALS

- Submit to the Engineer, shop drawings and product data. Submittals shall include at least the following:
 1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 2. Certified foundation, pump support and anchor bolt plans and details.
 3. Schematic electrical wiring diagrams and other data as required for complete pump installations.
 4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the specifications.
 5. Total weight of pumping units, as well as weights of individual components.

- Design Data : Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

- Test Reports and Confirmatory Reports
 1. Certified motor test data.
 2. Copies of all test data as described herein.
 3. Tabulated data for the drive motors including rated HP, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is operated at the design points specified. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings when the pump is operated at any of the design points specified.
 4. A schedule of the date of shop testing and delivery of the equipment to the job site.
 5. Description of pump factory test procedures and equipment.
 6. Submit a certified statement from the pump manufacturer installation instructions.
 7. A statement that the pump will function properly as installed with respect to the suction piping layout.

- Operation and Maintenance Data : Complete operating and maintenance instructions shall be furnished for all equipment included under this Section. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

- Bill of Quantities: A Bill of Quantities shall be prepared and submitted that identifies the items to be installed under this Section. Such Bill of Quantities shall include those items that would be installed under this section but specified in other sections with a reference made to indicate in which section they were specified. Items to be furnished but not installed under this section include spare parts.

4. REFERENCE STANDARDS

- Design, manufacturing and assembly of elements of the equipment specified herein shall be in accordance with, the following:
 1. Anti-Friction Bearing Manufacturers Association (AFBMA)
 2. American Gear Manufacturers Association (AGMA)
 3. American Institute of Steel Construction (AISC)
 4. American Iron and Steel Institute (AISI)
 5. American National Standards Institute (ANSI)
 6. American Society of Mechanical Engineers (ASME)
 7. American Society for Testing Materials (ASTM)
 8. American Welding Society (AWS)
 9. American Water Works Association (AWWA)
 10. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps; Hydraulic Institute, Vertical Pump Standards and Hydraulic Institute Test Standards, Vertical Pumps - 2.6.
 11. Institute of Electrical and Electronics Engineers (IEEE)
 12. National Electrical Code (NEC)
 13. National Electrical Manufacturers Association (NEMA)
 14. Occupational Safety and Health Administration (OSHA)
 15. The Society for Protective Coatings (SSPC)
 16. Underwriters Laboratories (UL)

- Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

5. QUALITY ASSURANCE

- To assure unity of responsibility, the pump, motor, and controls shall be furnished and coordinated by the pump manufacturer. The Contractor and the pump manufacturer shall assume full responsibility for the satisfactory installation and operation of the entire pumping system including pump, motor and controls, as specified herein.
- The equipment specified herein is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment similar to the applications stated in Paragraphs 1.01 and 1.06. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed.
- The pump manufacturer shall be fully responsible for the design, arrangement and operation of all connected rotating components of the assembled pumping unit mounted on a fabricated steel base plate, to ensure that neither harmful nor damaging vibrations occur and operation meets all specified conditions.
- The Contractor shall be fully responsible for all elements of the pump installation so that the installation meets the requirements as specified herein including depth of setting, discharge column pipe, and surface discharge head assembly.
- Vibration levels of the individual pump and the pump and motor assembly, when measured in the direction of maximum amplitude at the top motor bearing shall not

exceed 0.127 mm (5 mils) peak to peak displacement at a maximum peak velocity of 2.5 mm per second at the motor run speed.

6. DELIVERY, STORAGE AND HANDLING

- All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- All equipment and parts must be properly protected against any damage during shipment. The contractor shall store equipment in accordance with manufacturer's recommendations.
- Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer and/or the Construction Manager.
- The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
- Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- No shipment shall be made until all required submittals have been approved by the Engineer and/or the Construction Manager and shipment approved by the Engineer and/or the Construction Manager in writing.
- For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of Exxon, Rust-Ban No. 392 or equal treatment.

7. MAINTENANCE

- Furnish all special tools and test equipment required for the proper servicing of all equipment. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

8. WARRANTY

- The equipment shall be warranted for a period of 1 year from date of substantial completion to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced in the unit and the unit(s) restored to service at no expense to the owner.

PART 2: PRODUCTS

1. GENERAL

- The pumping unit shall all be supplied by one manufacturer and shall be complete including pump, motors, drive, controls and appurtenances such as, but not limited to, couplings, guards and gauges.
- The pump, motor, drive and controls shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially constructed to meet the specifications. Ample room and facilities shall be provided for inspection, repairs, and adjustment.
- All necessary foundation bolts, nuts and washers shall be furnished and shall be Type 316 stainless steel.
- Pump support and surface discharge is to be as described herein.
- Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pump shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed and all other pertinent data. As a minimum, nameplates for the motor shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.

2. CONDITIONS OF OPERATION

- The pump shall be designed for the conditions of service described herein and shall operate within the system head curves as appended. The pump shall have a rising head system curve for stable pump operation from the minimum head operating point to the shut-off head. Note: These conditions must be confirmed by the Engineer prior to construction.
- Each pump shall be designed for the conditions of service described as follows:
 1. Service: Water
 2. Number of pumps: Duty: 1
 3. Number of standby pumps: 0
 4. Maximum temperature (degree C): 45
 5. Primary design capacity: Refer to the bill of quantities
 6. Total head at primary design capacity: Refer to the bill of quantities
 7. Minimum efficiency at primary design capacity: 70 percent
 8. Maximum speed: 1500 RPM, Gear box will be used (if it is necessary to fulfill the discharge requirements) to increase the speed to 1800 rpm.
 9. Motor Horsepower: Refer to the bill of quantities
 10. Motor supply voltage and frequency: 400 volts, 50 cycles.

- Pump Setting: Setting depth shall be selected in accordance with the bill of quantities and to be verified by the contractor on site in coordination with the responsible engineer.
- The pumps shall operate throughout the entire operating range, within the vibration limitations specified in Paragraph 1.05E above.
- Motors shall have space heaters and winding temperature detectors.

3. PUMP CONSTRUCTION

- Vertical turbine pump shall be water-lubricated, completely equipped with motor support and head shaft steady bushing and shall conform to AWWA E101, Vertical Turbine Pumps or equivalent standards, where not in conflict with the specific requirements specified herein.
- Materials of construction shall conform to nomenclature and materials as listed in AWWA E101 and be of a material grade as standard with the manufacturer except as may be modified to conform to the following requirements.
- Pump bowls including suction bell, shall be ASTM A48, Class 30 cast iron, flanged and bolted construction. Internally porcelainized, externally coated with backed epoxy,
- Impellers shall be of the enclosed type Tin bronze B584 C903, machined to a smooth, hard finish and shall be dynamically balanced and designed, particularly for the service described herein. (Certified analysis of the impeller metal pour required).
- Impeller shafts and couplings shall be Type 416 stainless steel. Collets and lock nuts shall be Type 316 stainless steel.
- All parts shall be backed epoxy painted.
- Pump Discharge Head:
 1. Cast Iron, A48 Cl.30, 6"-6" unless indicated differently in bill of quantities, discharge flange dimensions according to ASA 150, internally and externally coated with backed epoxy, including stuffing box and SS 17-4PH head shaft.
 2. The discharge head shall include a stuffing box and have extra large openings for pump adjustment and seal maintenance. It shall also include a suitable sized drain connection, a continuous bypass to maintain low stuffing box pressure and to assure positive stuffing box bushing lubrication, a 6 mm (1/4 in) tap for the suction and discharge pressure gauges, each with brass pipe nipples and T-handle cock and bolts and nuts. A 25 mm (1 in) for an air valve shall be provided.
 3. Provide a minimum of five die-formed, interlaced, braided packing rings treated with a high temperature lubricant and complete with a combination pressure reducing and guide bushing.
 4. The base of the discharge head shall be machined to match the drilling of the top suction as selected by the pump manufacturer.
 5. The top of the discharge head shall have a registered fit for mounting driving motor.
 6. The discharge head shall have two one inch openings for PVC pipes used for water level sensor and water level measurement.
- The pump shall be equipped with a suction and discharge pressure gauge. Pressure gauges shall be bronze bourdon tube with Type 316 stainless steel rack and pinion movement or equal. The gauges shall be glycerin filled. Gauges shall be 115 mm (4-1/2 in) diameter furnished with 6 mm (1/4 in) inlet. All fittings and cocks shall be red brass. The

gauges shall be connected to the pump nozzles. Pressure gauges shall be furnished with isolating pulsation dampeners. All gauges shall be furnished by the pump manufacturer.

- The natural frequency of the assembled pump and its supporting structure shall be at least 25 percent higher than the maximum pump speed.
- The pump shall be capable of temporary operation at near shut off head during 1 minute, maximum, opening and closing of the pump discharge control valve as the pump starts and stops.
- The gear drive if specified in bill of quantities shall be Spiral Bevel Right Angle, Hollow shaft, with heavy thrust capacity, 1480 RPM, 1:1.2 ratio, service factor of 1.5, including non-reverse ratchet, drive shaft, nut and key.

4. PUMP DRIVE SYSTEM

a. VERTICAL MOTOR:

- The pump shall be driven by a vertical hollow shaft squirrel cage induction electric motor with maximum horsepower and speed as specified and with severe duty enclosure, winding temperature detectors and shall include a thrust bearing capable of handling both the mechanical and hydraulic thrust of the pump.
- The pump motor shall be suitable for driving the pumps continuously over the entire pumping range. The pump motors shall be furnished by the pump manufacturer.
- The pump shall be directly connected to its driver by means of an adjustable flanged spacer coupling, suitably sized to transmit the required driving torque and be easily accessible for impeller adjustment, packing or mechanical seal replacement.
- All materials, design, construction and nomenclature for the motor, shall be in accordance with the NEMA standards.
- The pump manufacturer shall maintain an authorized representative within the country or in an adjacent country.

b. HORIZONTAL MOTOR:

- The motor shall be hollow shaft, premium high efficiency, foot mounted(B3), solid shaft horizontal motor, 1480 RPM, 400 volt, 50HZ, 3 phases, IP66, including class H insulation, heater, thermistors, drive shaft

c. ELECTRICAL CONTROL UNIT:

- Control panel box shall be made of 2 mm thick steel sheets with lock. It shall be dust tight and protected against water jets in accordance with IP65 (Ingress protection 65). It shall be gray, thermally painted (RAL 7302). It shall consist of two parts, one for electrical devices and components, and the other for the electric company meters. The control board shall be equipped with at least the following devices and components:
 1. Complete 4Px20 kA surge arrestors of replaceable type.

2. Complete soft starter unit suitable for the pumping station unit horsepower or more with all protections rated at suitable power that matches the pump motor with (0.8-1.2) overload range. This includes no-voltage, phase sequence and phase failure relay of best quality such as Cyrillic or equal.
3. The unit shall be supplied with a suitable by-pass contactor and any other accessories the unit needs.
4. Suitable capacitor banks with discharge resistors, compensating reactor dry type 400 V, 50 Hz to reach 0.95 lagging power factors such as Ducati or equal.
5. Digital multi-meter [V, A, Hz, kW, P.F].
6. Analog volt and ampere meters to show continuously one Line Voltage of the motor and its three Phase Currents via selector switch.
7. On-Off push button set, and emergency off bottom.
8. Reset push buttons, red color, and 22 mm.
9. Over load, relay unit rated at (1-1.15) of motor full load.
10. Working hours meter, (20x20) mm.
11. Suitable automatic circuit breaker with adjustable thermal and magnetic protection (Isc \geq 35kA). as NZM or equal.
12. Three phase fuse holder set, 10 x 38 mm, with appropriate Ampere Value- Fuses for each motor.
13. Suitable earth leakage relay class A (AC&DC trip)
14. Relays and timers, (24 VDC) for no flow switch and high pressure sensors.
15. 3-phase, 50 Hz, 380 V, (kW-hr) meter,
16. 24 V, 50 Hz indication lamps.
17. 3-position selector switch (auto, off, man.).
18. Cables to be used for control purposes shall have the following cross sectional areas:
19. (3*50 mm²+35 mm²) for the internal connections, 1.5 mm² for the driving wheel circuits, 2.5 mm² for the circuits of tension measurements, 4.0 mm² for the circuits of intensity measurements.
20. All terminals shall be carefully protected to assure electrical insulation.
21. Switches, measuring instruments, and warning lights shall be installed on the front side of the panel. A warning light for water level sensor shall be included to warn the operator if water level drops to a low level close to the pump setting.
22. All timers (Psk), relays and contactors shall be of best quality as Ormen, breakers as Merlin Gerin.
23. The contractor shall supply any other materials and devices that might be missed here and considered to be essential to complete the work, without claiming any changes in unit prices. The control panel must be equipped with earthing unit: earth equalizer comprising c14 box, copper B.B. 70 mm², foundations line, earth electrodes, D>19 mm, L=1.5 m and any other missing materials to earth the pumping station.

d. PRESSURE SWITCHES

- Pressure switches 1-30 bars, adaptors and cables required to connect switches with the control panel.

e. FLOW SWITCHES:

- Flow switches shall have no moving parts; include 316L Stainless Steel Sensor, suitable for temperatures up to 125F, and Pressures to 500. PSIG, Exotic Alloys for Corrosion Resistance. Electrical flow switch, powered by a 24V-DC power source.

5. SHOP TESTS

- The Engineer and/or the Construction Manager shall have the right to inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
- The pump shall be factory tested with a Standard Performance Test as described in Hydraulic Institute Test Standards, Vertical Pumps - 2.6 for vertical turbine pumps and all test data submitted for approval by the Engineer and/or the Construction Manager prior to shipment. Certified copies of the calculated pump performance curves shall be submitted including anticipated head, capacity, bowl efficiency, total brake horsepower. NPSH and required submergence. Such testing shall be performed in a manner that will insure that each assembled pump and motor shall be tested at the specified design operating conditions to make certain that the unit conforms to the specified requirements. Certified copies of test results shall be submitted to the Engineer and/or the Construction Manager for approval.
- The discharge head and bowl for each pump shall be hydrostatically tested in full compliance with the Hydraulic Institute Test Standards, Vertical Pumps - 2.6.
- Pump motor tests as specified and shall be submitted for approval to the Engineer and/or the Construction Manager prior to shipment.

6. SURFACE PREPARATION AND SHOP PRIME PAINTING

- The pump and associated equipment shall be shop-primed and finished-coated in accordance with the manufacturer's standard practice prior to shipment. Color shall be selected by the Engineer and/or the Construction Manager and an adequate supply of touch-up paint shall be supplied by the manufacturer.
- All interior and exterior wetted surfaces of pump columns and discharge elbows and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale and supplied with an NSF 61 approved, polyamidoamine epoxy coating in accordance with manufacturer's instructions.
- All coatings on wetted surfaces shall meet NSF 61 Certification for use with drinking water systems. Surface preparation shall conform to the coating manufacturer's recommendations.

7. DISCHARGE COLUMN PIPE

- The discharge pipe shall be steel pipe conforming to ASTM A120, ASTM A53 grade B or equivalent and the weight shall be not less than Schedule 40 and painted with epoxy from inside and outside in accordance with AWWA C210-97 and in 3 meters length segments

and connected by threaded sleeve type steel coupling. The ends of the pipes shall have ANSI B1.20.1 standard tapered pipe threads. Diameter of the pipe shall be as shown in the bill of quantities for each well. The contractor to verify the suitability and the ability to connect new pipes with the older ones prior to starting any works in the well.

- Threaded column sections shall be connected with threaded, sleeve-type couplings. Column joints are to be butted to insure perfect column alignment after assembly.

8. COLUMN SHAFT

- The contractor shall take care in disjoining the existing old shaft and shall try to use the existing column pipe as feasible as possible. For these damaged sections or the deteriorated ones, the contractor to supply new line shafts with the following specifications:
 1. The new shafts shall be made of 416 stainless steel with diameters equal to 35 mm diameter. The shafts shall be coupled with extra-strong threaded coupling to allow joining them with each other and with the old shaft sections.
 2. Line shafts shall be fitted with stainless steel replaceable sleeves at each bearing and shall conform to AISI 304 material.
 3. Line shaft bearings/dresses shall be of bronze or neoprene material construction.
 4. Line shaft bearings shall be retained in bronze guides that are fitted into the column coupling and secured in place by the butted column pipe ends.
 5. Joint rubber: joint rubbers should be inspected and their suitability for use should be verified before reusing them.

PART 3: EXECUTION

1. PREPARATION

- Coordinate with other trades, equipment and systems to the fullest extent possible.
- Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.

2. INSTALLATION

- Installation shall be in accordance with the manufacturer's instructions and recommendations in the locations shown in the bill of quantities. Anchor bolts shall be set in accordance with the pump manufacturer's recommendations and setting plans.
- The installation of the pumping unit shall comply with AWWA E101, Vertical Turbine Pumps, Line Shafts and Submersible Types using installation equipment to insure a proper installation without damaging the pump or any accessory items. Pumping unit installation shall comply with any applicable health requirements.
- The pump manufacturer shall supply the services of a factory representative to check over the completed pump installation to the satisfaction of the Engineer and/or the Construction Manager. If the Contractor does not have a qualified engineer and/or service person on the job during the installation, the Engineer and/or the Construction Manager

- may direct the Contractor to provide the services of a factory representative to give the necessary instructions to insure a proper installation.
- Connection of piping to pumps shall be done in the presence of the Engineer and/or the Construction Manager. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections. The minimum straight run of pipe without disturbances on the suction side shall be done according to the pump manufacturer's recommendations.
- All labor and equipment necessary to complete the pump and surface discharge assembly, including all components specified in this Section and components involved with the pump setting as may be specified in other Sections shall be furnished to set and install the pumping unit as specified herein.
- Painting of the pump surface discharge shall be satisfactorily performed with an approved paint, furnished in unopened manufacturer containers.
- A certificate from the equipment manufacturer shall be submitted stating that their installation of their equipment is satisfactory, that the equipment is ready for operation and that the Owner's operating personnel have been suitably instructed in the operation, lubrication, and care of each pumping unit.

3. FIELD TESTS

- In the presence of the Engineer such tests as necessary to indicate that the pumps, motors conform to the efficiencies and operating conditions specified shall be performed. A 7-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the specified requirements, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. All test procedures shall be in accordance with factory test procedures specified above and certified results of tests shall be submitted. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 10 days prior to testing.
- After installation and as soon as conditions permit full speed operation, retain the services of a qualified independent mechanical testing firm to perform a detailed vibration signature analysis of each unit, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a sketch of the unit indicating on where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak displacement, in mils, (b) frequency and (c) peak velocity level, in inches per second. The report shall contain a complete analysis of their findings, describing any problems encountered, if any, probable cause and specific recommendations for any required corrective action.
- If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.
- The vibration analysis indicated above shall be repeated 6 months after signature testing. A report shall be prepared comparing the results of the 6 month tests with the results of

- the signature tests. Significant worsening of the vibration, to be determined by the Engineer, during the 6 month tests shall require corrective action and retesting.
- After the pump has been completely installed, a test of the equipment shall be conducted by the Contractor with a factory representative of the pump manufacturer under the direction of the Engineer and/or the Construction Manager to prove compliance with the requirements set forth for the pump design. An efficiency test of the pump shall also be conducted and the Contractor shall furnish all instruments, meters, gauges and incidentals that may be required for the test.
 - Pump performance shall be computed from field pump test data. After accounting for field test accuracy, the pump shall be expected to operate within 5 percent of the approved head-capacity curve and not more than 2 percent from the approved efficiency curve. Correct any condition to obtain performance equal to these field operating conditions.
 - Pump supplier shall provide a non-witnessed rotor balance performance test in accordance with AWWA E101. The results of the performance test shall be documented in a report delivered to the Engineer and/or the Construction Manager.
 - If compliance with the above requirements are not met and corrections not effected within 30 days of a mutually agreed date, then the pump unit shall be replaced with one that will meet the head-capacity and efficiency requirements. Such replacement shall be in full accordance with all requirements as specified herein. Rejection of the pumping unit may not preclude its use after rejection if removal of the pumping unit, prior to furnishing a replacement unit, will adversely affect the Owner.
 - The Contractor shall provide a 12-hour onsite pump operation and maintenance (O&M) workshop to be conducted for the owner and/or owner representative by manufacturers' representatives.

PART 4: 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.
- The contractor shall understand that payments for column shaft, column pipe and bearings will be made for the new parts only according to their corresponding unit prices.
- The installation cost of reused ones from the existing pipes, shafts, bearings and sleeves is considered as part of the total installation/disassembling cost item of the bid schedule.
- Any extra items needed for connecting these parts supplied by well owner or reused from older ones will be considered incidental to the project.

B. SPECIFICATIONS FOR VALVES AND ACCESSORIES

GENERAL

- All valves and accessories are recommended to be furnished by a single manufacturer and should be subjected to the Engineers approval before ordering the valves. Valves shall be compatible with pipes and fittings specified in the contract and these Specifications. Compatibility should be the Contractor's responsibility at his own expense, and should be approved by a third party accredited by PSI certified Testing Laboratory.
- Two copies of manufacturing and installation manuals shall be provided at time of materials delivering.
- All valves shall be supplied according to the latest editions of standards and references specified in these Specifications. Valves shall be fabricated according to Standards and References specified in these specifications or shall be equivalent and compatible to these standards and references subjected to third party accredited testing laboratory.
- The type and size of valve to be used at any location shall be as indicated in the bill of quantities or specified herein and shall be rated to at least the same pressure as the pipeline in which they are to be installed. All valves shall be designed to avoid cavitations and vibration in all positions, to minimize head loss in the open positions and to seal the water passage when completely shut.
- All operating spindles and gears shall be provided with adequate points for lubrication. Unless otherwise specified, all valves shall be closed in a clockwise direction. Head loss curves through the valves for throttled flow conditions shall be provided for all valve sizes.
- Bolts, nuts, rubber seals (joint rings), gaskets, and flanges shall be in accordance with standards specified in these specifications.
- Valves of different types in general can be listed as follows:
 1. Gate valves
 2. Check valves (None Return Valve).
 3. Butterfly valve.
 4. Surge relief valves.
 5. Pressure gauges.
 6. Expansion joints and dressers.
 7. Air release and vacuum valves.
 8. Flow meters.
 9. Strainers.

SUBMITTALS

- The contractor shall submit the following:
 1. Assembly drawings.
 2. Manufacturer Valid quality certifications ISO or equivalent.
 3. Certified copies of Manufacturer quality control Test results and reports.
 4. Assembly shop drawings.
 5. Instruction manuals.

6. Catalogues.

- With every consignment of valves, accessories and specials delivered under this Contract, the Contractor shall furnish a certificate worded as follows:
- "This is to certify that the valves, accessories and specials delivered in this consignment comply with the required specifications and Standards".

MARKING OF VALVES AND WATER METERS

- The valves and water meters shall be clearly labeled and marked with the following information:

1. Valves:

- a. Class or Pressure rating.
- b. Nominal Diameter
- c. Arrow showing the flow directions (for valves designed for one way flow only).
- d. Name or trade mark of the manufacturer.
- e. Date of manufacturing.

2. Water Meter:

- a. Pressure rating.
- b. Nominal diameter.
- c. Meter class.
- d. Arrow showing the flow direction.
- e. Serial number.
- f. Name or trade mark of the manufacturer.

VALVE COATINGS

- Unless otherwise indicated in the Tender Documents for an alternative coating system, the internal and external surfaces of valves shall be prepared and coated with epoxy paint. The final coat shall be applied to external surfaces after installing the valves.

WORKS TESTS

- All valves shall be hydrostatically tested at the place of manufacture. The Contractor shall supply a certificate stating that the valves supplied have satisfactorily passed the specified tests and comply in all respects with these Specifications or BOQ.
- All valves shall be subjected to pressure test in accordance with ISO 5208 and shall be drop tight.

PACKING

- All valves shall be securely packed in crates or boxes for protection against damage during transit, and shall be accompanied by the materials necessary to secure all flanges to adjacent pipe work. These materials shall also be suitably packed and shall be stored away from sunlight at all times.

GATE VALVES AND APPURTENANCES

- Gate valves, shall have flanged, screwed, or solder ends as required; and shall be bronze, solid wedge, rising-stem-type gate valves or none rising-stem type as specified in the Tender Documents.
- Gate valves, shall be iron body, steel or as specified in the Tender Documents, bronze mounted, solid wedge gate valves with flanged ends.
- Valves shall be rated for 16-bar pressure and a minimum of 24 bars test pressure or as specified in the BOQ.
 1. Valves shall be outside screw and yoke type with rising stem.
 2. Face to face metal valves dimension shall conform to ISO 5752 or EN 558-1, 2.
 3. 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.
 4. 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.
 5. Stuffing box follower bolts shall be of steel and the nuts shall be of bronze.
 6. The design of the valves shall permit packing the valves without undue leakage while they are wide open and in service.
 7. O-ring stuffing boxes may be used.

CHECK VALVES

- Check valves shall be swing type and shall meet the material requirements of ISO 5781 or EN 1074-3. Steel check valves should comply with EN 13709. The valves shall be iron body, bronze mounted, single disc, 16 bars (250 psi) working water pressure, non shock, and hydrostatically tested at 24 bars (375 psi) or as specified in the BOQ.
 1. 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.
 2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.
 3. 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.

BUTTERFLY VALVES

- Metallic butterfly valves shall be manufactured in strict accordance with ISO 10631 or EN 593. Valves shall be bubbles tight at rated pressures specified in the BOQ. Valve discs shall rotate 90 degrees from full closed to open. The valve manufacturer shall assemble operators to the valve. The valve manufacturer shall test the valve/operator as a complete assembly.
- Valves bodies shall be constructed of cast iron according to ISO 10631, ISO 5752 or EN 593, EN 1503. Valves in vaults shall be flanged. Laying length shall be short body as listed in ISO 10631, ISO 5752 or EN 593, EN 1503.
- Valve discs shall be constructed of cast iron according to ISO 10631, ISO 5752 or EN 593, EN 1503. Disc edge shall be either ni-chrome or stainless steel.
- The seat shall be located in the valve body. If seat retaining hardware such as screws and segments are used they shall be monel. If screws are used, monel plugs shall be affixed in the valve body and tapped to receive these screws. Shaft seals shall be provided where the shaft projects through the valve body. Shaft seals shall be standard split-V type packing.
- Valves shall be fitted with sleeve type bearings contained in the trunnions of the valve body. Bearing material shall be nylon for valve through 500mm (20in) and fiberglass with Teflon lining for valve 600mm (24in) and larger.
- All valves shall be hydrostatically and leak tested.

SURGE RELIEF VALVES

- Surge relief valves shall be in accordance with ISO 6264 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.
- 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.
- Valves shall be rated 40 bars (600 psi) working pressure or as specified in the Contract Tender Documents.

MECHANICAL TYPE SEALS

- Mechanical rubber seals (joint rings) shall be in accordance with ISO 4633, ISO 2230, ISO 10221 or EN 681 and shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The seal shall be rated by the manufacturer for the specified head, or as otherwise provided.
- Mechanical seals shall be specifically designed for Standard service (insulating type): EPDM rubber.
- Selection of mechanical seals to be installed at each location shall be as Manufacturer instructions and as directed by the Engineer.

PRESSURE GAUGES

- Pressure gauges shall be manufactured in accordance with ISO 5171 or EN 837-1, 2, 3 and shall be furnished and installed in accordance with BOQ and Engineers directions. Where gauge taps are not available, the necessary taps in the piping shall be made for installation of gauge connections. Pressure range up to 20 bars. Each pressure gauge should be equipped with a stop valve of the same pressure rating.

AIR RELIEF VALVES

- Air relief valves shall be of the double orifice pattern with ductile 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 (or other container) 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 "aerokinetic" 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 valve and gearing shall be provided, where necessary, to facilitate operation.
- In applications where the pipeline characteristics may lead to liquid column separation with consequent possibility of surge conditions, a vented non-return valve shall be provided which allows air to enter freely on separation but controls expulsion of air as the liquid column rejoins.
- 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.

STRAINERS

- Strainers will be made of ductile iron or 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.
- Due to particularly hard conditions of service – high speed, high-pressure, presence of solid elements in the network – bidders are requested to pay particular attention to the quality of the protection provided by the strainers to the regulation valves and meters placed downstream.
- 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.

WATER METERS

1. General

- Water meters shall be manufactured in accordance with PS 402, PS 447 with a copper, bronze main case and shall register flow in cubic meters. Each meter shall be supplied with a cast-iron meter box, which shall be constructed with a slotted, open-bottom base section of length to fit over the service piping. The meter box shall have the words "WATER METER" in Arabic cast into the lid.
 - a. Shop Drawings and Samples:**
 - The contractor shall submit the following:
 1. Manufacturer's product data including catalogue cuts.
 2. Shop drawings showing details and dimensions.
 3. List of special tools.
 4. Schedule of meter identifications and locations.
 - b. Product Manual:**
 - The following shall be included in the product manual:
 1. Certified performance data including curves showing flow and pressure drop.
 2. Manufacturer's installation instructions.
 3. Manufacturer's maintenance and operating instructions including step-by-step troubleshooting procedures with necessary test equipment.
 4. Manufacturer's certification that meters comply with published accuracy's for the flow ranges indicated.
 5. Certification that meters have been field-calibrated, under flow conditions.
 - c. Inspection, Testing and Accuracy:**
 - Inspection and Testing: The manufacturer shall provide an experienced factory service representative to inspect and test meters for proper performance and installation and field calibrate meters under flow conditions.
 - Accuracy: Except as otherwise indicated, flow meters shall be designed and fabricated for an accuracy of plus or minus 2 percent of actual flow throughout the range indicated.

2. Products

a. Special Tools:

- The product shall include special tools recommended by the manufacturer and one extra steel spool for each size of meter. Spools shall be labeled and shall show meter identification, size and service.

3. Execution

a. Installation:

- Meters shall be installed in accordance with the manufacturer's installation instructions. Meters shall be installed in easily accessible locations and oriented for ease of reading and maintenance, and, where shown, for balancing of flow. Wherever possible, meters shall be installed in such a way to comply with the manufacturer's recommendations.
- Meters, shut-off and balancing valves shall be properly supported. In-line meters shall be installed to ensure full-line flow and not less than the manufacturer's recommended head at all times.

b. Testing:

- Equipment shall be prepared for operational use in accordance with manufacturer's instructions after field calibration. The Engineer reserves the right to observe field calibration.
- Meters shall be field tested at no less than 3 flow conditions over the total range of capability of the equipment. Where applicable, tests shall be conducted in accordance with the relevant Palestinian Standards.

VALVES INSTALLATION

- All valves shall be installed in accordance with the Specifications and shall be installed on the pipelines in the positions approved by the Engineer.
- Flanged gate valves installed on black steel lines with welded joints shall be provided on one side with the appropriate Viking Johnson flange adapter or dresser with tie rods.

C. PIPES MATERIALS

WORK INCLUDED

- This Division governs the Fabrication of Steel and PVC pipes in the diameters and pressure classes required under the Tender Documents requirements. Pipes, fittings, accessories, and specials including protective coatings and joints materials shall be according to the latest editions of Standards and References specified in this Specifications or shall be equivalent and compatible to these Standards and References subjected to third party accredited (by the PSI) testing laboratory.

SUBMITTALS

- The Contractor shall submit:
 1. Manufacture valid quality certificates ISO or equivalent.
 2. Detailed manufacturer's proposals for pipe and fitting manufacture, coating and catalogs.
 3. Certified copies of manufacturers' quality control test results and reports.
 4. Certified copies of compliance for steel plate, coating and other components of finished pipes and fittings.
 5. Instruction manual. With every consignment of pipes, fittings, accessories, and specials delivered under this Contract, the Contractor shall furnish a certificate worded as follows:

"This is to certify that the pipes, fittings, accessories, and specials delivered in this consignment comply with the required specifications and Standards".
- No payment shall be made in respect of any consignment of pipes and specials, which is not accompanied by such certificate.

QUALITY OF PIPES, FITTINGS, ACCESSORIES AND SPECIALS

- The Contractor shall have a Quality Assurance System including:
 1. Records of tests performed by manufacturers on materials brought in.
 2. Sequential numbering of pipes and fittings.
 3. All goods or materials supplied by the Contractor shall be new of first class quality and of the best workmanship and design. The quality assurance system records shall be open to inspection by the Engineer, and shall be maintained in such a way that any pipe or fittings is identified by a unique sequential production number and can be uniquely related to each stage of its manufacture including material origin and quality, date and time of each operation, operator(s) involved and results of relevant quality tests. Testing of materials should be according to the Relevant Standards. The Contractor shall pass a complete set of the quality assurance records to the Engineer.
 4. Pipes, fittings, accessories, and specials including their protective coating and joints materials, that will or may come into contact with potable water shall not constitute a toxic hazards, shall not support microbial growth, shall not cause taste or odor, cloudiness or discoloration of water, and shall be approved by a recognized certifying authorities as being suitable for use in portable water supply systems.

5. Pipes, fittings, accessories and specials are recommended to be furnished by a single Manufacturer.

MARKING OF PIPES AND SPECIALS

- All pipes and specials supplied shall be bearing the following markings in triplicate on the outside of the pipe or special according to the Relevant Standards, that includes:
 1. Name or Trade Mark of the manufacturer.
 2. Date of manufacturing.
 3. Class or pressure rating.
 4. Nominal Diameter.
 5. Wall thickness.
- The letters of the length of the pipe shall be painted on only after the pipes or specials have found to satisfy the tests and all other requirements of the Specifications and Standards. The sequential manufacturing number shall not only be painted on the pipe, but shall also be stamped indelibly onto the inside of the socket, or other approved location. Approved, clearly identifiable colored bands shall be used to differentiate between sized and unsized pipes.

STEEL PIPES

- Pipes shall be manufactured according to PS 107, PS 141, PS 186, high tensile, welded, with normal working pressure for pipes and fittings etc, of pressures according to Tender Documents requirements. Coating shall be according to PS 325, PS 325 Part 1- Part 6 or any other equivalent compatible standard.
- The Contractor shall be responsible for ensuring that the pipe ends are suitably prepared in the works or in the field for each joint, according to the jointing method to be used in each case. The manufacturer as required by the Palestinian Standards or any other equivalent and compatible standard shall supply a product data.

a) Joints

- Joints shall be made at plant either by forging or by another process provided that the pipe and joint shall meet all radiography, x-ray, thickness dimension, mechanical stresses, chemical and other requirements of the Palestinian Standards. The thickness of the slop joint, which must be part of the pipe, shall be greater than or equal to the pipe thickness.
- The joint shall be welded externally in the field and shall be completed internally by a rubber ring built into socket. The length of the socket shall be such that the rubber ring cannot undergo any damage during the field welding operation.
- The gaskets shall comply with ISO 7483 or any equivalent compatible approved standard. The jointing ring shall be of Ethylene Propylene Rubber (EPDM) or Styrene Butadiene Rubber (SBR) an approved shape and shall be securely fitted. The joint rings and rubber seals shall be according to ISO 4633.

b) Fittings

- All fittings, bends, tees and tapers shall be manufactured of seamless or butt-welded steel pipes and shall comply with the relevant parts of ISO 3419 or EN 10224 (Draft), and EN 10253-1,2. The wall thickness of fittings shall be the same as that of pipes as a minimum. All fittings shall be externally coated with polyethylene. The flanges shall be according to ISO 7005-1 or EN 1092-1. The working pressure shall be PN 10, PN 16, or according to Tender Documents requirements.
- Each set of flange jointing materials shall be complete with nuts, bolts and washers. Joint rings and rubber seals shall be Ethylene Propylene Rubber (EPDM) comply with ISO 4097 or Styrene Butadiene Rubber (SBR) reinforced with two-ply flex fabric and complying with ISO 2322. Bolts shall be hexagonal and shall be in accordance with ISO EN 4014, ISO EN 4016 or EN 1515. Nuts shall comply with ISO EN 4032, and ISO EN 4034.

c) External Coating

- Pipes and fittings that are not buried shall be externally coated with epoxy to suit site weather condition. Repairing the joints of pipes should be done by heated shrinkable sheets

d) Size Pipes

- Where required sized pipes shall be supplied truly circular throughout their length for cutting to provide closing lengths and to accept flexible couplings. The tolerances on the outside diameters of such pipes shall be as set out in PS 107, PS 141, and PS 186.

e) Flexible Couplings and Flange Adapters

- Flexible couplings and flange adaptors shall be of mild steel and shall be Viking-Johnson couplings or other similar approved type suitable for making a watertight flexible connection between plain-ended pipes or between a plain-ended and a flanged fitting.
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- Flexible mechanical couplings shall be without the center register. Unless otherwise specified, the external surfaces of couplings and adaptors shall be cleaned down to metallic finish and primed and painted with two coats of red lead oxide paint. The internal surfaces shall be similarly treated and protected with two coats of non-toxic approved epoxy bituminous paint.
- All mechanical coupling shall be of appropriate internal diameter and shall be capable of withstanding the maximum works test pressure specified for the pipes they are to connect, at a joint deflection of up to 3 degrees in any direction.

- All mechanical couplings and flange adaptors shall be supplied complete with all necessary coupling rings, nuts, bolts, washers and rubber rings. Joint rings and rubber seals shall comply with ISO 4633, and shall be made of Ethylene Propylene Rubber (EPDM) or Styrene Butadiene Rubber (SBR). The gaskets shall comply with ISO 7483. Bolts shall be hexagonal with dimensions in accordance with ISO EN 4014, ISO EN 4016 or EN 1515; nuts shall comply with ISO EN 4032 and ISO EN 4034. Where a harnessed steel flange adapter is required, the bolts connecting the flange of the flexible flange adapter to the flange of the adjacent fitting shall be replaced by the bars threaded at both ends. One threaded end of each tie bar shall pass through holes in the abutting flanges and be anchored by two nuts to make the flanged joint in the normal way. The other threaded end shall be anchored by two further nuts in a corresponding bolt hole on the flanges soundly welded integrally onto the fitting which it is intended to harness to the adaptor. All nuts fully tightened, the integrally-cast flange is about 400mm axially from the abutting flanges.
- The bolt circles on all the flanges shall comply with ISO 7005-1 or EN 1092-1.
- The threaded tie bars shall be machined from steel at least equal to that specified for flange bolts of corresponding duty and treaded in the same way. The threaded lengths shall allow the nuts to be run forward sufficiently to permit complete withdrawal of the tie bars from the flange of the abutting fitting without requiring any other joint to be dismantled. The strength of the threaded tie-bars in both tension and compression shall be appropriate to the pressure rating of the flanged joints.

PVC PIPES

- PVC pipes shall comply with ISO 4422-1,2,5 or EN 1452-1,2,5. PVC fittings shall comply with ISO 4422-1,3,5, ISO 264, ISO 727-1 or EN 1452-1,3,5.
- The joint rings and rubber seals shall comply with ISO 4633. Flanges shall comply with ISO 2536 and the adapters shall comply with ISO 3460.

PVC Joints

- The joining of one pipe to another may be performed using various methods. Gasketed joints and solvent cement joints are covered in the following paragraphs.
- Gasketed Joints: The assembly of the gasketed joint should be performed as recommended by the pipe manufacturer. The elastomeric gaskets may be supplied separately in packages or propositioned in the bell joint or coupling at the factory. Note that some joint designs provide permanent factory-installed gaskets. When gaskets are color coded, it is important that the pipe manufacturer or the manufacturer's literature be consulted for the significance. Lubricant should be applied as specified by the pipe manufacturer. Damage to the gaskets or the pipe may result from the use of unapproved lubricants. Use only lubricant supplied by the pipe manufacturer for use with gasketed PVC pipe in potable water systems.
- Solvent Cement Joints: In special applications, solvent cemented joints may be required. Solvent cemented joints should be made in accordance with manufacturer's recommendations. Proper training of installation crews in the technique of solvent cementing is advised to ensure reliable Joints. Techniques must be modified to

accommodate significant changes in the environment. (For example, wind, moisture, dust, and temperature require proper consideration).

FITTINGS AND APPURTENANCES

- Piping systems include pipe and various appurtenances required in the control, operation, and maintenance of the systems. Proper design, installation, and operation of PVC must relate to appurtenances as well as pipe.

Service clamps or saddles used with PVC pipes should: Provide full support around the circumference of the pipe.

MEASUREMENTS AND PAYMENTS

- The payment will be on actual quantities
- All pipes shall be measured by linear meter, and the bends and other fittings should be measured by number (piece) or as specified in the BOQ..